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Using Non-Parametric Approach to Measure Profit Efficiency in Libyan Commercial Banks

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ABSTRACT

In this study, the performance of eight Libyan commercial banks between 2004 and 2010 is compared. There aren't many studies that analyze the efficiency levels of the Libyan banking sector and then look at its determinants using both the Data Envelopment Analysis (DEA) and Tobit regression model, according to the pertinent literature. In this study, the DEA was used to determine the profit effectiveness of sampling banks. In the second stage, the Tobit regression model was also used to identify potential efficiency-related parameters. The results show that public commercial banks have shown to be more efficient at making profits than private commercial banks. The results of the efficiency determinants showed that there was a positive relationship between bank efficiency and size of operation (SO) and a negative relationship between bank performance and return on investment (ROA). The findings of this study's conclusion have some consequences for policy.

Keywords: efficiency, data envelopment analysis, Libyan commercial banks, public commercial banks, private commercial banks

INTRODUCTION

Usually, the financial industry makes a considerable contribution to the development and expansion of a country's economy. For the purpose of transforming deposits into financial assets, banks, acting as financial intermediaries, are essential (Mohammed, 2002). One of the most significant areas of modern economies is the banking sector, is now used to gauge how safe a nation's economy is on a global scale (Berger & De Young, 1997). However, the development of technology, the deregulation of the financial services industry, and international competition have had an impact on the functions played by banks. More significantly, these modifications have altered the productive efficiency of how banks operate.

The country's financial industry is dominated by four banks, Aljumhoria Bank, Wahda Bank, Sahara Bank, and National Commercial Bank, which are all wholly or primarily owned by the Libyan Central Bank. These organizations control around 90% of the assets in Libya's banking sector. All of these banks had capital of at least 100 million Libyan Dinars (about 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 shortlisted for the Wahda Bank privatization. Institutions from France, Italy, Jordan, Bahrain, and Morocco are among these affiliates. The Arab Bank of Jordan was selected. They made a proposal for a 19% stake in Wahda Bank with the intention of increasing 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 over operational management of the company. In accordance with the terms of the contract, BNP Paribas has the option to purchase additional shares, amounting to up to 51% of Sahara's capital, during the course of the following three to five years. The local market didn't have an abundance of financing options. In Libya, personal connections more often than economic techniques are used to make lending choices, and public bank management lacks clear incentives to diversify their holdings. It is clear that Libya's progress is being hampered

by a lack of money. In order to better the services and products provided, address the high percentage of nonperforming loans, set up a functional national payments system, make it easier to use non-cash payment instruments, and implement new standards of accounting and training, the Libyan banking system is undergoing a significant modernization program. Despite the fact that international banks are legally permitted to enter the Libyan market under the 2005 Banking Law, the Central Bank has worked to prevent this until the reform process is complete (Mireles et al., 2009).

The financial sector in Libya saw significant and significant changes with the development of a new national payments system, a program that was implemented in 2005 after consultation with the World Bank (Panorama Report, 2008). This illustrates how the Libyan banking sector was once small, extensively regulated, and constrained, resulting in a closed and uncompetitive banking sector. The industry undertook a series of economic changes after 2003 to establish a free market and make it more transparent and open. These changes allowed for the freedom of interest and foreign currency rates as well as the acceptance of new financial organizations and products. Additionally, the country's mixed economy, which fosters competition among banks of all sizes and specializations (commercial, private, and specialized), makes Libya's banking sector a compelling example for assessing the efficiency and performance levels of various bank types. These banks now confront significant challenges in the wake of liberalization. Due to the banking liberalization that resulted, any inefficient banks were forced off the market by the more efficient banks, which had an impact on the banking sector in Libya. A review of the literature indicates that there hasn't been much research on how effective banking is in developing countries (Hassan, Al-Sharkas, & Samad, 2004). As a result, it appears that not enough investigation has been done on Libyan banks.

This paper uses a two-stage approach to provide a comparative analysis of the performance of the Libyan banking sector from 2004 to 2010 by first estimating efficiency scores and then using the Tobit regression model to identify efficiency determinants. This is how the paper develops. The Libyan banking system is introduced in part 1, followed by a review of the literature in section 2, an introduction of the DEA and profit efficiency metrics in section 3, and the methodology, data, and variables in section 4. Section 5 discusses the findings, and Section 6 is the conclusion.

LITERATURE REVIEW

The efficiency with which banks transform their expensive inputs into a range of financial products and services in a rapidly evolving global financial market worries bank managers, investors, and regulators. According to Assaf et al. (1993), efficiency research has not kept pace with the financial services industry's rapid global change. Berger and Humphrey (1997) focused their excellent global survey research on the imbalance of the focus in the literature after analyzing 130 efficiency studies from 21 different nations. They found that the majority of research on banking efficiency focuses on banks in developed nations.

Portela and Thanassoulis (2007): In this paper, the groundbreaking geometric distance function (GDF) for calculating profit efficiency is proposed. The GDF efficiency indicator has the benefit of being straightforward to analyze, making it possible to establish whether profit inefficiency is caused by technical or allocative inefficiency. However, when utilizing the accounting notion of profit, it is feasible that profit efficiency is higher than 100% since maximum profit units are not required to be scale-efficient. It is impossible to interpret technological efficiency in terms of dual profit when the accounting idea of profit is used. This led to the creation of a profitability efficiency metric that was also based on the GDF. The maximum value of this indicator, which has a maximum value of 100%, allows for a

dual profitability interpretation of the GDF measure of technical efficiency. The scale efficiency can also be retrieved using the profitability efficiency metric, which enhances the information obtained from the performance of a for-profit unit.

Al-Farisi and Hendrawan (2010): They aimed to compare the profitability of conventional and Islamic banks. Both the intermediary strategy and the alternative profit efficiency model were used in this study. The sample for this study consists of the 102 conventional banks and 3 Islamic banks that functioned in Indonesia between 2002 and 2007. According to the study's findings, three Islamic banks were among Indonesia's 20% most effective banks at performing intermediation tasks.

Sufian and Kamarudin (2014): In this study, new empirical data are used to analyze the level of profit efficiency and returns to scale of the banking sector in Bangladesh. The Slack-Based Data Envelopment Analysis (SBM-DEA) method was used to evaluate the level of profit efficiency of particular institutions from 2004 to 2011. Empirical study indicates that Bangladesh's banking sector had the highest and lowest levels of profit efficiency in 2004 and 2011, respectively. Only eight banks were profitable over the investigation period, according to the findings. According to the empirical findings, the majority of Bangladeshi banks either experienced diseconomies of scale because they were larger than necessary or economies of scale because they were smaller than necessary. Therefore, changing the production scale may result in cost savings or improved efficiency.

Hadhek, Frifita and Lafi (2018): Using a stochastic frontier analysis approach, this study calculated the factors that affect how profitable Islamic banks are. 37 Islamic banks are used throughout fifteen nations between 2005 and 2014. The effectiveness of Islamic banks was contrasted. In addition, the internal (bank-specific) and external variables were examined to see if they could aid in the explanation of inefficient areas and those that could aid in lowering profit efficiency scores on a variety of different factors, such as GDP per capita, average annual inflation rate, population density, size, capital adequacy ratio, financial profitability ratio, credit risk, and operational costs. Therefore, the efficiency-profit of Islamic banks cannot be determined solely by credit risk.

Assaf et al. (2019): They examined how bank efficiency in normal times effects survival, risk, and profitability during successive financial crises using data from five U.S. financial crises and the prior normal periods. The results show that while cost efficiency has a minor effect on bank failure probability, risk, and profitability during successive financial crises, profit efficiency offers few advantages. The results indicated that cost efficiency more accurately measures management skill, whereas profit efficiency may partially represent transiently high returns from riskier investments undertaken during normal times. The findings have implications for policy and imply that improving bank performance may be accomplished by raising cost effectiveness of banks outside of financial crises.

Kadang and Surayya (2020): This study employs the trans log Alternative Profit Efficiency model to calculate profit efficiency using stochastic frontier analysis (SFA). The Bank Activity Approach is used in the equation of the model. The measurements' findings, which are based on an average of 8 commercial banks, are inefficient. The degree of profit efficiency is substantially influenced by bank size, capital, liquidity, and credit risk.

Arbelo, Pérez and Gómez (2021): This study employed balanced data from 49 Spanish companies across multiple industries from 2010 to 2016 (343 observations) to evaluate the impact of company reputation on profit efficiency. Then, to determine profit efficiency, a stochastic frontier model with random coefficients was applied. The results showed that the average effectiveness of the profit frontier using random coefficients is 75.94%. The results also support the notion that firms can improve performance—as seen by profit efficiency—by leveraging reputation as a strategic resource.

This study agrees with previous studies in measuring profit efficiency. Also, this study uses non-parametric approach (DEA) such as Sufian and Kamarudin (2014), while other previous studies use parametric approach (SFA) such as Kadang and Surayya (2020). But this study will be conducted in 2023, whereas other studies were carried out between 2007 and 2021. Finally, the profit efficiency framework in Libyan banks was not covered by earlier studies.

OVERVIEW OF PROFIT EFFICIENCY

According to Zhu (2003) and Manadhar and Tang (2002), DEA is a mathematical technique that uses linear programming to evaluate the relative efficacy of a number of administrative units (decision-making units) by identifying the ideal combination of inputs and outputs that are categorized based on their actual performance. The two most important DEA models 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 in 1978. This methodology assesses efficiency and determines the extent and cause of inefficiency. It is said that Banker, Charnes, and Cooper created the BCC model. This model, which is based on the CCR model, estimates technical efficiency in accordance with the scale of operation in the unit required to deliver services to beneficiaries at the time of measurement, i.e., efficiency is linked to a certain amount of operation (Norman & Stoker, 1991).

The computation of the greatest possible profit serves as the foundation for a profit analysis within the DEA framework. The model presented in (1) can be used to accomplish this (Fare et al., 1994, p. 213).

$$\max_{\lambda_j, y_r x_i} \left\{ \sum_{r=1}^{s} p_{ro} y_r - \sum_{i=1}^{m} w_{io} x_i \sum_{j=1}^{n} \lambda_j y_{rj} - y_r \geq 0, r = 1, \dots\dots, s; \right.$$

$$\sum_{j=1}^{n} \lambda_j x_{ij} - x_i \leq 0, i = 1, \dots\dots, m;$$

$$\left. \textstyle\sum_{j=1}^{n} \lambda_j = 1,\ \lambda_j \geq 0, j = 1, \dots\dots, n \right\} \qquad (1)$$

where the remaining notation is as previously described and p_{ro} and w_{io} are, respectively, the price of output r and input *i* unit o faces. Since no variables are regarded as fixed in Model (1), long-term profit maximization is guaranteed. Additionally, it just considers technological limitations (unlike Fare et al. (1990), who also included budgetary constraints to (1)). Model (1) assumes VRS because, according to Varian (1992); Fare et al. (1994), the maximum profit level for a technology with globally constant returns to scale (CRS) is either zero or the maximum profit model's solution is indeterminate. The results of assuming VRS in (1) are as follows: (i) We do not assume totally competitive markets, as this would result in all enterprises having zero long-term earnings, unlike in (1) where the highest profit may be positive. The calculation of overall profit efficiency does not take into consideration scale efficiency. (ii) To make this feasible under CRS, the maximum profit model (1) should be applied (Fare et al., 1994). (iii) Banker (1984) did not stipulate that the maximum profit units must also be the most productive scale size (MPSS) units. In other words, Kuosmanen (1999) argues that maximum profit units do not require scale efficiency.

RESEARCH METHODOLOGY

Sample and Data

Out of the 17 Libyan banks that make up the population studied for this study, eight were chosen prior to or at the start of 2004. These banks are owned by individuals, whether they be natural or legal persons, who assume responsibility for the management of the institution's affairs and will be held liable for all of the institution's business dealings. The study's time frame runs from 2004 to 2010. This period was chosen because, following the lifting of sanctions against Libya by the United States and the United Nations in 2003, the Libyan economy started to be privatized. 2011 was not included because the Libyan revolution had already started. In February 2011, the Libyan populace overthrew Muammar Gaddafi's regime, beginning a struggle that lasted until the end of October 2011. This conflict has had an effect on the Libyan economy. As a result, 2011 was excluded from this analysis because it was a unique year. The study's overall conclusions will be negatively impacted by the 2011 data, which could also give a false impression of how Libyan banks function. The most important institutions in Libya, including the Libyan Central Bank, were divided between the eastern and western zones after 2011, as well. Because of this, the study's coverage spans the years 2004 to 2010. The information was acquired from bank annual reports, the Libyan stock exchange, and the central bank of Libya's statistics bulletin. Table 1 lists the names and categories of Libyan banks.

Table 1: Types of Libyan banks

	Public Commercial Banks	Specialized Banks	Private Commercial Banks
1	Wahda Banks	Agriculture Bank	Commercial and Development Bank
2	Aljumhoria Bank	Real Estate Investment Bank	Mediterranean 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

Additionally, Table 2 lists the banks that made up the study's sample.

Table 2: Sample of study

	Public Commercial Banks	Private Commercial Banks
1	Wahda Banks	Commercial and Development Bank
2	Aljumhoria Bank	Mediterranean Bank
3	Sahara Bank	Alsary Bank
4	National Commercial Bank	Alejmaa Alarabi Bank

Input and Output Definition

The production and intermediation methods are the two that predominate in the literature on banking theory (Sealey & Lindley, 1977). According to the production method, banks primarily provide services to their clients. As an output, banks create transactions and handle paperwork for clients such loan applications, credit reports, or other payment options. The primary role of banks, according to the intermediation model, is to act as financial

mediators between savers and investors (depositors and borrowers). Bank operations and interest expense produce large assets. For instance, they might use capital and labor as inputs and loans, investments, and other types of financing as outputs. When using the intermediation strategy, a deposit is treated as an input.

To calculate the profit efficiency we are able to collect data on two outputs, three inputs namely: loan income (y_1) (Drake, Hall, and Simper, 2009), net interest income (y_2), profit after tax (x_1) (Mostafa, 2007), number of labours (x_2) (Wu, Yang, and Liang, 2006), total fixed assets (x_3) (EL Moussawi and Obeid, 2011), price of labor (w_1), price of fund (w_2) and price of physical capital (w_3). Variables y_1, y_2, $x_1$and x_3 measured in millions of Libyan Dinar.

Environmental Variables

To learn more about the variables influencing Libyan bank efficiency, we use a two-step procedure suggested by Coelli et al. (1998). The efficiency measurements produced from the DEA computations are then used as the dependent variable in the estimation of the following Tobit regression model using the Stata10 program:

$$PE = \beta_1 SO + \beta_2 EQASS + \beta_3 ROA + \beta_4 Risk + \varepsilon_0$$

The following is an explanation of the model's determinants:

1. Size of Operation (SO):

It is used to calculate the size of the bank in order to determine any potential cost benefits of size (Sufian, 2009). The following was developed as the hypothesis on the 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.

2. Capital Adequacy (EQASS):

To determine capital adequacy, one compares the total book value of shareholders' equity to all assets (Sufian, 2009). The following is the hypothesis:

H_0: Capital Adequacy is not positively related to efficiency, and

H_a: Capital Adequacy is positively related to efficiency.

3. Return on Assets (ROA):

ROA is a metric used to assess a bank's profitability. According to Sufian (2009), we anticipate a positive relationship with bank efficiency. We propose the following as our hypothesis:

H_0: Return on Assets is not positively related to efficiency, and

H_a: Return on Assets is positively related to efficiency.

4. Risk:

Risk related to capital structure was also taken into account in our analysis as a factor affecting banking efficiency. In particular, the bank's management effectiveness and risk preference are reflected in the capital level determined by the equity capital to total assets ratio (Kamaruddin, 2007).

H_0: Large capitalized banks are less efficient and riskier, and

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

Table 3 below contains information on the potential efficiency determinant variables.

Table 3: Explanatory variables and measurements

Variable	Measurement
Size of Operation (SO)	Natural Log of Total Assets
Capital Adequacy (EQASS)	Total book value of shareholders equity over total assets.
Return on Assets (ROA)	Net Income/ Total Assets
Risk	Equity Capital/ Total assets

EMPIRICAL RESULTS

Efficiency of Libyan Banks

The following are the descriptive statistics for the inputs and outputs used in this study, as shown in Table 4.

Table 4: Summary statistics of efficiency scores

Variable	Mean	Std. Deviation	Minimum	Maximum
Profit after tax (x_1)	25.832	20.268	0	175.958
Number of employees (x_2)	1507.625	368.282	44	5936
Net fixed assets (x_3)	44.471	17.487	0.63	163.121
Net loans (y_1)	850.234	490.756	0.261	5042.780
Net interest income (y_2)	69.468	54.459	0.175	443.784

Profit efficiency of the Libyan commercial banks: Evidence from specific year

Table 5 displays the mean profit efficiency level for each year from 2004 to 2011 for the commercial banks in Libya. The empirical results shown in Table 5 appear to show that the level of profit efficiency (or inefficiency) reached its highest (lowest) point in 2010 (54.7% (45.3%), while its lowest (highest) point was recorded in 2005 (30.8% (69.2%)). In other words, it is claimed that the Libyan commercial banks failed to completely maximize revenues and limit costs, which led to profit inefficiencies. In essence, the empirical findings from this study show that Libyan commercial banks lost the chance to make 45.3% and 69.2% more profit from the same level of inputs during the years 2010 and 2005, respectively. On average, Libyan commercial banks earned 54.7% during the year 2010, but only 30.8% during the year 2005. In general, all of the Libyan commercial banks' profit efficiency values for particular years are low.

Table 5: Summary on level of profit efficiency

Bank	2004	2005	2006	2007	2008	2009	2010	Mean Bank
Wahda bank	0.308	0.267	0.297	0.306	0.387	0.361	0.548	**0.354**
Aljumhoria bank	0.537	0.519	0.600	0.728	0.683	1.014	0.870	**0.707**
Sahara bank	0.554	0.686	0.815	0.852	1.328	1.235	1.089	**0.937**
Nat. Comm. bank	0.441	0.393	0.401	0.414	0.531	0.564	0.619	**0.480**
Com& Dev bank	0.164	0.137	0.168	0.476	0.522	0.479	0.463	**0.344**
Mediterran. bank	0.273	0.243	0.248	0.465	0.398	0.319	0.267	**0.316**
Alsary bank	0.178	0.188	0.271	0.428	0.369	0.383	0.394	**0.317**
Alejmaa Alarb. Bank	0.014	0.029	0.126	0.048	0.034	0.013	0.125	**0.056**
Mean Years	**0.309**	**0.308**	**0.366**	**0.465**	**0.532**	**0.546**	**0.547**	

Profit efficiency of the Libyan commercial banks: Evidence from specific bank

Table 5 provides the mean profit efficiency level for each bank from 2004 to 2010. The empirical results seem to indicate that only one bank, Sahara Bank, has demonstrated the highest level of profit efficiency, at 93.7% (6.3%), with Aljumhoria Bank coming in second at 70.7% (29.3%). The findings show that this bank has a minor intermediation function weakness but has been successful in maximizing revenues while reducing costs, which has resulted in the perfect profit efficiency.

Also, Table 5 shown that the lowest (highest) profit efficiency (profit inefficiency) was shown by Alejmaa Bank (5.4%; 94.6%), followed by Mediterranean Bank (31.6; 68.4%), Alsary Bank (31.7; 68.3%), Commercial and Developing Bank (34.4%; 65.6%), Wahda Bank (35.4%; 64.6%), and National Commercial Bank (48; 52). The findings show that, although using the same amount of inputs as their counterparts, these six banks have earned the least of what was possible, which has resulted in a bigger loss of chance to create higher profits.

Overall profit efficiency of the Libyan commercial banks: Evidence from type of bank:

Table 6 displays the outcomes for the public and private commercial banks in Libya. The overall profit efficiency of public commercial banks increased over the course of the study; it was 46% in 2004 and continued to rise until 2009, when it reached 79.3%; after that, it declined to 78.2% in 2010.

Table 6: General efficiency measurements results

Public Commercial Banks		**Private Commercial Banks**	
Efficiency measures		**Efficiency measures**	
Panel A: 2004		**Panel A: 2004**	
Overall profit efficiency	0.460	Overall profit efficiency	0.157
Allocative efficiency	0.511	Allocative efficiency	0.762
Technical efficiency	0.900	Technical efficiency	0.206
Panel B: 2005		**Panel B: 2005**	
Overall profit efficiency	0.466	Overall profit efficiency	0.149
Allocative efficiency	0.703	Allocative efficiency	0.608
Technical efficiency	0.663	Technical efficiency	0.245
Panel C: 2006		**Panel C: 2006**	
Overall profit efficiency	0.529	Overall profit efficiency	0.203
Allocative efficiency	0.703	Allocative efficiency	1.000
Technical efficiency	0.754	Technical efficiency	0.203
Panel D: 2007		**Panel D: 2007**	
Overall profit efficiency	0.575	Overall profit efficiency	0.345
Allocative efficiency	1.000	Allocative efficiency	0.997
Technical efficiency	0.575	Technical efficiency	0.355
Panel E: 2008		**Panel E: 2008**	
Overall profit efficiency	0.732	Overall profit efficiency	0.331
Allocative efficiency	1.000	Allocative efficiency	1.000
Technical efficiency	0.732	Technical efficiency	0.331
Panel F: 2009		**Panel F: 2009**	
Overall profit efficiency	0.793	Overall profit efficiency	0.299
Allocative efficiency	1.000	Allocative efficiency	1.000
Technical efficiency	0.793	Technical efficiency	0.299
Panel G: 2010		**Panel G: 2010**	
Overall profit efficiency	0.782	Overall profit efficiency	0.312

Allocative efficiency	1.000	Allocative efficiency	0.614
Technical efficiency	0.782	Technical efficiency	0.508
Panel H: For all years		**Panel H: For all years**	
Overall profit efficiency	0.620	Overall profit efficiency	0.257
Allocative efficiency	1.000	Allocative efficiency	0.816
Technical efficiency	0.620	Technical efficiency	0.315

Statistics show that public commercial banks had an average overall profit efficiency of 62 percent, which equals an average input waste of 38 percent. This implies that just 62% of the inputs used by the Libyan public commercial banks could have resulted in the same amount of outputs. It is also clear from Table 6 that technical inefficiency triumphs over allocative inefficiency when evaluating the total profit efficiency of the public commercial banks in Libya during the research period.

Table 6 also gives the impression that there has been volatility in Libya's private commercial banks during the duration of the investigation. Over the years, the average overall profit efficiency for private commercial banks in Libya was 25.7%, compared to 62% for public commercial banks. Table 6, in which technical inefficiency triumphs over allocative inefficiency, further demonstrates the overall profit inefficiency of the private commercial banks in Libya.

Determinants of Libyan Banks' Efficiency

We created an econometric regression model using the DEA efficiency scores as the dependent variable in addition to estimating the DEA efficiency scores in stage one to find the relationship between efficiency and some of the determinants. Tobit regression was used to estimate our model, and we used a vector of explanatory variables to explain the variation in the stage one efficiency scores. Tobit regression was utilized in Table 7 to provide the predicted results from 2004 to 2010. The estimated coefficients and standard errors from the Tobit regression for the regression profit efficiency change on the vector of explanatory variables were shown in the second column of this table. In the model below, we investigate the impact of several variables on profit efficiency scores:

$$PE = \beta_1 SO + \beta_2 EQASS + \beta_3 ROA + \beta_4 Risk + \varepsilon_0$$

Table 7: Determinants of profit efficiency

	PE
C	**-1.960**
SO	**0.113*** (0.000)**
EQASS	**0.279 (0.882)**
ROA	**-3.289* (0.101)**
RISK	**0.975 (0.594)**
R - Squared	**0.526**
Adjusted R-Squared	**0.489**

According to Asteriou and Hall (2007), Table 7 uses the fixed effects approach of regression because the adjusted R-squared is greater than 0.05. Table 7 shows that whereas

other parameters are not significant at the 5 percent confidence level, Size of Operation and ROA are positive significant at the 1 percent and 10 percent confidence levels, respectively. We therefore reject the null hypothesis and support the alternative hypothesis for Size of Operation and ROA in light of these data. The size of the operation has a coefficient estimate of 0.113, meaning that a change in the size of the operation of 0.113 percent will result in a 1% increase in profit efficiency. Additionally, ROA's coefficient estimates of -3.289 indicates that a 3.289 percent change in ROA will result in a 1% reduction in profit efficiency.

The profitability ratios (ROA) indicated that bank efficiency and the coefficient had a positive statistically significant relationship to the profit efficiency score at a 10% level, suggesting that the ROA was favorably related to bank efficiency. This outcome is in line with Casu and Molyneux's findings from 2003. Additionally, the results of the profitability study show that banks with higher profits typically have lower levels of inefficiency, which is consistent with findings from earlier studies (Isik & Hassan, 2002; Hasan & Marton, 2003; Miller & Noulas, 1996). Customers typically favor banks with higher profitability ratios, which draws the largest share of deposits and the greatest possible creditworthy borrowers. Such circumstances foster an environment where profitable banks may perform their intermediation functions more effectively.

The SO is a substantial component of the regression model and a positive coefficient associated to profit effectiveness. Sufian (2009) analyzed the SO structure in Malaysian banks, and he suggested that the value-added approach regression models have a regression model that is statistically significant and that predicts favorably. Most of his results indicated that banks with a majority foreign ownership are probably more effective than their domestically held equivalents.

CONCLUSION AND POLICY IMPLICATIONS

In this study, we looked at the efficiency of the Libyan commercial banks from 2004 to 2010. The non-parametric DEA technique was used to analyze each bank's efficiency estimations.

The empirical findings reveal that profit efficiency in Libyan commercial banks over the study period, meaning that private and some public commercial banks have been managerially inefficient in using their resources to the best of their ability. According to the empirical results, public commercial banks have demonstrated greater profit efficiency than private commercial banks. We discovered that Libyan commercial banks' profit efficiency has been poor over the course of the study's years.

The results imply that profit efficiency has a significant positive relationship with banks' size of operation (SO) and return on assets (ROA). Future extensions to this paper could go like this. First, this study's scope can be expanded to look into how relative and operational efficiencies have changed over time. Second, in comparison to the intermediation function, future studies might also look at the production function. The Malmquist Total Factor Productivity Index should be used in future studies to measure productivity changes through time as a result of technical development, technological advancement, or regression. Despite these restrictions, the results of this study are anticipated to add to the body of knowledge about the effectiveness of the Libyan banking industry. The policy ramifications concern the particular administration of banks. Respective banks should work to maximize the use of the resources and inputs at their disposal, as well as develop their managerial skills, particularly with regard to the effective distribution of limited resources. They can readily acquire economies of scale for their banks by carrying out these. Eventually, those initiatives might help Libya's private banks, specialized banks, and commercial banks maintain sustainable competitiveness.

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