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Measuring Bank Efficiency and Its Determinants in Developing Countries Using Data Envelopment Analysis: The Case of Libya 2004-2010

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Abstract

This paper offers to measure the technical efficiency and its determinants factors of Libyan Banks from 2004 to 2010. For this objective we use Data Envelopment Analysis for assessing technical efficiency in the first stage, and in the second stage we use the Tobit regression model to identify potential determinants of efficiency by using E-Views 7 software. The results showed that the specialized banks have exhibited higher mean technical efficiency relative to commercial and private banks. The results of efficiency determinants showed positive relationship between bank efficiency, and ROA; size of operation; capital adequacy; and government linked banks (government ownership). This paper concludes with some policy implications of the results.

Keywords: efficiency, determinants, bank, developing countries, data envelopment analysis, Libya

1. 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 (Jamahiriya Bank, Wahda Bank, Sahara Bank, Umma Bank and the National Commercial Bank). These banks constitute almost ninety per cent 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.

The 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, Ogilvie, & Shedid, 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. This paper provides a comparative analysis of the performance of banking sector in Libya over the period 2004 to 2010 by following two stages approach: estimating technical 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 2 provides a review of the literature, followed by section 3 on the methodology, data, and variables. Section 4 provides discussion on the results while section 5 is the conclusion.

2. 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 Berg, 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 the focus 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.

Mostafa (2007a) measured the relative efficiency of the top 100 Arab banks over the period 2005-2006. The results indicated that the performance of several banks is sub-optimal, suggesting the potential for significant improvements. Separate benchmarks were derived for possible reductions in resources used, and significant savings are possible on this account.

In the same way, Mostafa (2007b) investigated the efficiency levels of the GCC countries' banks in Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates using 2005 operation data. He used DEA and specified three outputs (net profit, rate on assets (ROA), and rate on equity (ROE)) and two inputs (assets and equity) by using the intermediation approach. The evidence indicated that the efficiency levels ranged between 13 and 100 % with an average of 55% and a 22.1 standard deviation when using CRS. Although the efficiency levels when using VRS ranged from 20% to 100%, with an average of 73 % and a standard deviation of 21.8, Mostafa suggested that efficiency could be better evaluated through the analysis of average efficiencies across time rather than just for one year.

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.

Lin, Lee, and Chiu (2009) evaluated the operating performance of business units of a certain bank in Taiwan. Their sample for this study was chosen from 117 branches of a certain bank in Taiwan in 2006. Their results indicated that the overall technical efficiency of the case bank had many inefficient branches distinctly: the average overall technical efficiency of branches was 54.8% and the average pure technical efficiency of branches was 67%. The average scale efficiency was 82%. Resource wastage due to technical inefficiency was 45.2% while 55.3% was due to pure technical inefficiency.

Sufian (2009a) was a pioneer in investigating the efficiency of the banking sector in Malaysia around the time of the Asian financial crisis in 1997. His inputs came from annual bank level and macroeconomic data of

Malaysia's commercial banks from 1995 to 1999. Results indicated that the lowered technical efficiency level was more sudden under the intermediation approach relative to the value added and operating approaches. The regression results that focused on bank efficiency and other bank specific traits indicate that there is a negative relationship between efficiency and expense preference behaviour and economic conditions, while a positive relationship exists between bank efficiency loans intensity.

Also, Sufian (2009b) provided a comparative analysis on the performance of the Islamic banking sector in 16 MENA (Middle East and North Africa) and Asian countries during the period 2001-2006. Tobit regression model was used to determine the impact of internal and external factors on Islamic banks' efficiency. Positive relationship was found between bank efficiency and loans intensity, size, capitalization and profitability. The empirical results show that technically the more efficient banks are those that have smaller market share and low non-performing loans ratio.

Kumar and Gulati (2010) wanted to appraise the efficiency, effectiveness, and performance of 27 public sector banks (PSBs) operating in India by using a two-stage performance evaluation model. The public banks' sector in India over the period 2006-2007 was chosen for this study. The overall technical inefficiency stemmed primarily from managerial inefficiency rather than scale inefficiency.

El Moussawi and Obeid (2011) aimed to propose a method of evaluating the productive performance of Islamic banks operating in the GCC. They chose the Islamic banks operating in the GCC region over the period 2005-2008. The technical inefficiency and allocation inefficiency increased bank costs, on average, by about 14% and 29%, respectively.

Sufian and Habibullah (2012) provided a new empirical evidence on the efficiency of the Malaysian banking sector around the Asian financial crisis of 1997. Data of banks operating in Malaysia during the period 1995-2008 were used in this study. The results indicated that the foreign banks exhibited higher technical efficiency compared to their domestic bank counterparts.

From the above previous studies in developing countries the gap in the literature has been determined as follows: Very few studies were conducted in the context of banking industry in Arab countries. To the best of this researcher's knowledge none have examined the efficiency of the banking industry in Libya using two-stage DEA and Tobit regression model.

3. 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 & Tang, 2002). The most important models of DEA are the CCR (Charnes, Cooper, & Rhodes) model and the BCC (Banker, Charnes, & Cooper) model. The CCR was developed by Charnes, Cooper & 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).

3.1 First Stage: Determining Technical Efficiency of Libyan Banks

In this study, we use non-parametric DEA technique to estimate the technical efficiency of Libyan banks with the assumption of a Variable Return to Scale (VRS).

Technical efficiency concentrates on the physical relationship of levels of inputs relative to levels of outputs, so it requires only the input and output data without the prices (Bauer, Berger, Ferrier, & Humphrey, 1998).

Based on the CCR and BCC scores, scale efficiency can be defined as follows:

Let the CCR and BCC scores of a DMU be θ^*_{CCR} and θ^*_{BCC} respectively. The scale efficiency (SE) is defined by:

$$SE = \frac{\theta^*_{CCR}}{\theta^*_{BCC}} \quad (1)$$

SE is not more than one. For a BCC-efficient DMU with CRS characteristics, i.e., in the most productive scale size, its scale efficiency is one. The CCR scores is called the technical efficiency (TE), since it takes no account of scale effect as featured from pure technical efficiency (PTE). On contrast BCC expresses the PTE under variable return to scale conditions. Using this information, relationship (1) shows a decomposition of efficiency as:

$$\theta^*_{CCR} = \theta^*_{BCC} \times SE, \text{ or}$$

$$\textit{Technical eff. (TE)} = \textit{Pure Technical eff. (PTE)} \times \textit{Scale eff. (SE)} \quad (2)$$

This decomposition, describes the sources of inefficiency, i.e., whether it is caused by inefficient operations (PTE) or by disadvantage conditions displayed by SE or by both (Cooper, Seiford, & Tone, 2007).

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 effect 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.

3.1.1 Inputs and Outputs

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 & Lindley, 1977). In this paper we use the intermediation approach. 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 and three inputs namely: loan income (y_1), profit after tax (y_2), No. of employees (x_1), total fixed assets (x_2) and deposits (x_3). 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.

3.2 Second Stage: Factors Influencing the Efficiency Level of Libyan Banks

To investigate the determinants of Libyan banks efficiency we follow a two-step approach, as suggested by Coelli, Rao, and Batesse (1998). Using the efficiency measures derived from the DEA estimations as the dependent variable, we then estimate the following Tobit regression model using E-Views 7 software:

$$TE = \beta_1 ROA_{it} + \beta_2 Risk_{it} + \beta_3 SO_{it} + \beta_4 LNDEPO_{it} + \beta_5 EQASS_{it} + \beta_6 GL_{it} + \beta_7 Mergers_{it} + \beta_8 OWS_{it} + \varepsilon_{it}$$

$$PTE = \beta_1 ROA_{it} + \beta_2 Risk_{it} + \beta_3 SO_{it} + \beta_4 LNDEPO_{it} + \beta_5 EQASS_{it} + \beta_6 GL_{it} + \beta_7 Mergers_{it} + \beta_8 OWS_{it} + \varepsilon_{it}$$

$$SE = \beta_1 ROA_{it} + \beta_2 Risk_{it} + \beta_3 SO_{it} + \beta_4 LNDEPO_{it} + \beta_5 EQASS_{it} + \beta_6 GL_{it} + \beta_7 Mergers_{it} + \beta_8 OWS_{it} + \varepsilon_{it}$$

The determinants of the above model are elaborated below.

3.2.1 Return on Assets (ROA)

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

H_0 : Profitability is not significantly related to bank efficiency, and

H_a : Profitability is significantly related to bank efficiency.

3.2.2 Risk

Our study also considered risk associated with capital structure as one of the factors that effect 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 : Risky banks are less efficient, and

H_a : Risky banks are efficient.

3.2.3 Size of Operations (SO)

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

H_0 : Large size operation is not significantly related to efficiency, and

H_a : Large size operation is significantly related to efficiency.

3.2.4 Market Share

It is used as a proxy of market share" (Sufian, 2009a). The hypothesis of market share is as follows:

H_0 : Market share is not significantly related to bank efficiency, and

H_a : Market share is significantly related to bank efficiency.

3.2.5 Capital Adequacy

It is the total book value of shareholders equity over total assets, and it's used to measure a capital adequacy (Sufian, 2009a). Our hypothesis as follows:

H_0 : Capital adequacy is not significantly related to bank efficiency, and

H_a : Capital adequacy is significantly related to bank efficiency.

3.2.6 Government Link of Bank and Efficiency

It is used to investigate the relationship between government ownership and efficiency (Sufian, 2009a). We develop the following hypothesis in relation to Government Link of bank and efficiency:

H_0 : Government Link is not significantly related to bank efficiency, and

H_a : Government Link is significantly related to bank efficiency.

3.2.7 Merger

Ownership is expanded through mergers and acquisition. A merger can happen when to banks decide to combine into one or when one company buys another (Al-Khasawneh & Essaddam, 2012). The hypothesis of mergers is as follows:

H_0 : Mergers are not significantly related to bank efficiency, and

H_a : Mergers are significantly related to bank efficiency.

3.2.8 Ownership Structure (OWS)

In this paper we consider two ownership structure: domestic structure and mixed structure ownership (domestic and foreign ownerships) in Libyan banks. This variable is used to measure the relationship between ownership of banks with efficiency (Sathye, 2001; Isak & Hassan, 2002). Our hypothesis is suggested below:

H_0 : Ownership structure is not significantly related to bank efficiency, and

H_a : Ownership structure is significantly related to bank efficiency.

Table 1 below contains information on the potential efficiency determinant variables.

Table 1. Explanatory variables and measurements

Variable	Measurement
Return on Assets (ROA)	Net Income/ Total Assets
Risk	Equity Capital/ Total assets
Size of Operation (SO)	Natural Log of Total Assets
Market Share (LNDEPO)	Natural Log of Total Deposits
Capital Adequacy (EQASS)	Total book value of shareholders equity over total assets.
Government Link of bank and efficiency (GL)	Dummy variable that takes a value of 1 for government links banks, 0 otherwise.
Mergers	Dummy variable that takes a value of 1 for any banks mergers together, 0 otherwise.
Ownership Structure (OWS)	Dummy variable that takes a value of 1 for foreign ownership ≥ 30%, 0 otherwise.

4. Empirical Results

4.1 Efficiency Level of Libyan Banks Using DEA Approach

The technical efficiency measures examine by how much input quantities can be proportionally reduced without affecting the output quantities produced (Shih, Harrington, Pizer & Gillingham, 2004). In this research the technical efficiency is measured with the assumption of variable return to scale input-based (VRS). The analysis of this study is based on the assumption of VRS because the input quantities appear to be the primary decision variables and because most studies choose the VRS assumption.

4.1.1 Technical Efficiency of Libyan Commercial Banks

Table 2 shows the relative position of each commercial bank in Libya. The data indicate progress in the average efficiency scores for almost all samples during the period of study between 2004 and 2010.

Table 2. Technical efficiency of Libyan commercial banks

	2004	2005	2006	2007	2008	2009	2010
Wahda							
TE	1.000	0.388	1.000	0.194	0.209	0.177	0.628
PTE	1.000	0.500	1.000	0.201	0.217	0.182	1.000
SE	1.000	0.776	1.000	0.967	0.963	0.976	0.628
RTS	–	IRS	–	IRS	IRS	IRS	DRS
Aljumhoria							
TE	1.000	0.262	0.718	0.301	0.347	0.390	0.683
PTE	1.000	0.391	1.000	0.301	0.425	1.000	1.000
SE	1.000	0.669	0.718	0.999	0.816	0.390	0.683
RTS	–	IRS	DRS	–	DRS	DRS	DRS
Sahara							
TE	0.600	1.000	0.298	0.408	0.987	0.288	0.784
PTE	0.626	1.000	0.941	0.415	1.000	0.306	0.870
SE	0.960	1.000	0.317	0.983	0.987	0.940	0.901
RTS	IRS	–	IRS	IRS	IRS	IRS	DRS
National Commercial							
TE							
PTE	1.000	1.000	1.000	0.184	0.204	0.266	0.581
SE	1.000	1.000	1.000	0.193	0.218	0.269	0.740
RTS	1.000	1.000	1.000	0.953	0.939	0.991	0.784
	–	–	–	IRS	IRS	IRS	DRS
Mean							
TE	0.900	0.663	0.754	0.272	0.437	0.280	0.669
PTE	0.907	0.723	0.985	0.278	0.465	0.439	0.903
SE	0.990	0.861	0.759	0.976	0.926	0.824	0.749

The TE efficiency score average of Wahda, Aljumhoria, National Commercial bank are the highest overall score (1.000) except for Sahara Bank which shows 0.600 in 2004. This means that the Sahara Bank wasted 40 % of inputs, and this waste of inputs could have been saved to produce the same level of outputs. Wahda Bank is efficient in 2004 and 2006 but not efficient in other years of this study. The value of TE is not stable over the period of the study for this bank, and the scale efficiency scores are more than the pure technical efficiency for all years except 2004 and 2010. In the case of the Wahda Bank, waste of 61.2, 80.6, 79.1, 82.3 and 37.2 % of inputs are evident in 2005, 2007, 2008, 2009 and 2010. The sources of wasted inputs could have been saved to produce the same level of outputs. Aljumhoria Banks is efficient only in 2004 and inefficient in the other years; the TE is decreased in 2005 then increased in 2006 and after that decreased again in 2007 before starting to increase gradually to reach 0.683 in 2010, and the pure technical efficiency scores equal 1 in 2004, 2006, 2009 and 2010 and less than scale efficiency in other years. According to the results the Aljumhoria Bank wasted 73.8, 28.2, 69.9, 65.3, 61 and 31.7 % of inputs from 2005 to 2010, and it could have saved the wasted sources of inputs to produce the same level of outputs. Also, Sahara Bank is efficient only in 2005 and inefficient in the other years 2004 and 2006 to 2010 and the value of TE is changeable from year to year. Also, it can noted that the pure technical

efficiency scores are larger than scale efficiency in 2006 and 2008 and smaller than scale efficiency in 2004, 2007, 2009, and 2010. The results of Sahara Bank show that the Sahara Bank wasted 40, 70.2, 59.2, 1.3, 71.2 and 21.6 % of inputs in 2004, 2006, 2007, 2008, 2009 and 2010 respectively. These sources of inputs could have been saved to produce the same level of outputs. The National Commercial Bank is the best one of the lot; it is efficient in 2004, 2005, and 2006 then reaches the least value of TE in 2007 after which the value of TE starts to increase again to reach 58.1 % in 2010, and the scores of pure technical efficiency of the non-efficient years are smaller than the scale efficiency. Also, the National Commercial Bank wasted 81.6, 79.6, 73.4, and 41.9 % of inputs during the period from 2007 to 2010. These waste sources could have been saved to produce the same level of inputs. Also Table 2 shows that there is no commercial bank that was efficient during the period from 2007 to 2010. Furthermore, the average efficiency score in the commercial banks shows better score in 2004, and the worst score in 2007.

4.1.2 Technical Efficiency of Libyan Specialized Banks

Table 3 shows the relative position of each specialized bank in Libya. Under VRS the data indicate progress in the average efficiency scores for almost all samples during the period of study from 2004 to 2010.

Table 3. Technical efficiency of Libyan specialized banks

	2004	2005	2006	2007	2008	2009	2010
Agriculture							
TE	1.000	1.000	0.341	1.000	1.000	1.000	1.000
PTE	1.000	1.000	0.923	1.000	1.000	1.000	1.000
SE	1.000	1.000	0.370	1.000	1.000	1.000	1.000
RTS	–	–	IRS	–	–	–	–
Real Estate Investment							
TE	1.000	1.000	1.000	1.000	1.000	1.000	1.000
PTE	1.000	1.000	1.000	1.000	1.000	1.000	1.000
SE	1.000	1.000	1.000	1.000	1.000	1.000	1.000
RTS	–	–	–	–	–	–	–
Development							
TE	1.000	1.000	1.000	1.000	1.000	1.000	1.000
PTE	1.000	1.000	1.000	1.000	1.000	1.000	1.000
SE	1.000	1.000	1.000	1.000	1.000	1.000	1.000
RTS	–	–	–	–	–	–	–
Libyan Foreign							
TE	0.728	1.000	1.000	1.000	1.000	1.000	1.000
PTE	0.846	1.000	1.000	1.000	1.000	1.000	1.000
SE	0.861	1.000	1.000	1.000	1.000	1.000	1.000
RTS	DRS	–	–	–	–	–	–
Alrefi							
TE	0.456	1.000	0.463	0.924	1.000	1.000	1.000
PTE	0.829	1.000	0.632	1.000	1.000	1.000	1.000
SE	0.550	1.000	0.732	0.924	1.000	1.000	1.000
RTS	IRS	–	IRS	IRS	–	–	–
Mean							
TE	0.837	1.000	0.761	0.985	1.000	1.000	1.000
PTE	0.935	1.000	0.911	1.000	1.000	1.000	1.000
SE	0.882	1.000	0.820	0.985	1.000	1.000	1.000

The TE scores of the specialized banks appeared stable and had the highest overall score. From Table 3 we can see that the Real Estate Investment Bank and Development Bank are efficient throughout the period of study, Agriculture Bank is efficient for all the years of the study except 2006, when it is 34.1 %, and the pure technical efficiency score is more than the scale efficiency score. Also, the Libyan Foreign Bank is efficient for all the years of the study except 2004, when it was 73 %. Also, in Libyan Foreign Bank the pure technical efficiency score is close to scale efficiency score. Alrefi Bank is efficient only in 2005, 2008, 2009, and 2010, and the pure technical efficiency scores in other years are larger than the scale efficiency scores except in 2006. Furthermore, the

average efficiency score in specialized banks shows better score in 2005, 2008, 2009, and 2010 but not efficient in 2004, 2006, and 2007. Overall, the results in Table 4.2 show an improvement in the average efficiency scores for specialized banks. From Table 4.2 it can be conclude that the Agriculture Bank wasted 65.9 % of inputs in 2006, Libyan Foreign Bank wasted 27.2 % of inputs in 2004 and also Alrefi Bank wasted 54.4, 53.7, and 7.6 % of inputs in 2004, 2006, and 2007 respectively. These wasted sources could have been saved to produce the same level of outputs.

4.1.3 Technical Efficiency of Libyan Private Banks

Table 4 shows the relative position of private banks in Libya. The private banks are not efficient during the period of study except Al Wafa Bank which is efficient only in 2010.

Table 4. Technical efficiency of Libyan private banks

	2004	2005	2006	2007	2008	2009	2010
Commercial and Development							
TE	0.170	0.164	0.034	0.259	0.347	0.228	0.594
PTE	0.188	0.182	0.064	0.313	0.379	0.277	0.596
SE	0.906	0.899	0.529	0.828	0.918	0.824	0.997
RTS	IRS	IRS	IRS	IRS	IRS	IRS	DRS
Mediterranean							
TE	0.387	0.482	0.084	0.367	0.322	0.323	0.745
PTE	1.000	1.000	1.000	1.000	0.770	1.000	1.000
SE	0.387	0.482	0.084	0.367	0.418	0.323	0.745
RTS	IRS	IRS	IRS	IRS	IRS	IRS	IRS
Alsary							
TE	0.259	0.310	0.250	0.292	0.279	0.264	0.723
PTE	0.887	1.000	1.000	1.000	1.000	1.000	1.000
SE	0.292	0.130	0.250	0.292	0.279	0.264	0.723
RTS	IRS	IRS	IRS	IRS	IRS	IRS	IRS
Alejmaa Alarabi							
TE	0.015	0.024	0.039	0.117	0.016	0.274	0.256
PTE	0.726	0.722	0.802	0.768	0.418	1.000	1.000
SE	0.021	0.033	0.048	0.153	0.039	0.274	0.256
RTS	IRS	IRS	IRS	IRS	IRS	IRS	IRS
United							
TE	-	-	-	0.164	0.204	0.072	0.300
PTE	-	-	-	1.000	1.000	0.419	0.389
SE	-	-	-	0.164	0.204	0.173	0.769
RTS				IRS	IRS	IRS	IRS
Amman							
TE	-	-	-	0.556	0.459	0.277	0.161
PTE	-	-	-	0.619	0.541	0.359	0.246
SE	-	-	-	0.899	0.848	0.773	0.657
RTS				IRS	IRS	IRS	IRS
Al-Wafa							
TE	-	-	-	0.651	0.523	0.702	1.000
PTE	-	-	-	1.000	1.000	1.000	1.000
SE	-	-	-	0.651	0.523	0.702	1.000
RTS				IRS	IRS	IRS	–
Al-Waha							
TE	-	-	-	0.436	0.184	0.250	0.287
PTE	-	-	-	0.880	0.328	0.366	0.295
SE	-	-	-	0.495	0.561	0.682	0.972
RTS				IRS	IRS	IRS	IRS
Mean							
TE	0.208	0.245	0.102	0.355	0.292	0.299	0.508
PTE	0.700	0.726	0.717	0.823	0.680	0.678	0.691
SE	0.402	0.386	0.228	0.481	0.474	0.502	0.765

Furthermore, the average efficiency score in Private Banks appears to be not efficient during the period of study. In Commercial and Development banks the scores of TE during the period of study are not stable and sometimes decrease and at other times increase and the scores of pure technical efficiency are larger than the scores of scale efficiency for all years of the study. In Mediterranean Bank the scores of TE also are changeable during the period of the study and it can be seen in the results of this bank. The scores of PTE equal 1 for all years except 2008, which

is 77%. For the Alsary Bank the scores of TE are at the largest value in 2010. It is 72.3% and the least score in 2006 is 25 %, and we can also see the scores of PTE equal 1 for all years except 2004, when the value of PTE is 88.7%. In Alejmaa Alarabi Bank the scores of TE are very small and the bank is not efficient for all the years of the study with the largest score of TE at 27.4% in 2009, the PTE equals 100% in 2009 and 2010 and the scores of pure technical efficiency are larger than scores of scale efficiency for all years of the study.

The other specialized banks were established in 2007, such as United, Amman, Al-Wafa and Al-Waha banks. The score of TE for United Bank is increased from 2007 to 2008 then decreased in 2009 and after that starts to increase again to reach 30% in 2010. The pure technical efficiency scores of United bank are equal to 100 % in 2007 and 2008, also the scores of pure technical efficiency are larger than scores of scale efficiency for all years except 2010. The results also show that the TE of Amman Bank is decreased from 2007 to 2010, starting from 55.6% in 2007 and reaching 16.1% in 2010. In addition the scores of pure technical efficiency for all years are smaller than scores of scale efficiency. Al-Wafa Bank is efficient only in 2010, and for the other years the scores of TE are not stable from year to year, and the scores of pure technical efficiency for all years equal 100%. The last bank is Al -Waha Bank and the scores of TE are decreased from 2007 to 2008 and after that starts to increase again to reach 28.7 % in 2010. Also the scores of pure technical efficiency are smaller than the scores of scale efficiency except in 2007.

In addition, from Table 4 it can be summarized that all the private banks waste part of their inputs. These wasted sources of inputs could have been saved to produce the same level of outputs except in the case of Al-Wafa Bank in 2010. Also, it can be noted that the highest average efficiency score in 2010 is 51 %, and the lowest average efficiency score in 2006 is 10 %. In addition, the average of pure technical efficiency is larger than the average of scale efficiency for all years except 2010.

4.1.4 Overall Technical Efficiency of All Libyan Banks

Table 5 shows the overall technical efficiency of Libyan banks during the period of study.

Table 5. Overall technical efficiency of Libyan banks

Mean	2004	2005	2006	2007	2008	2009	2010	Mean
Commercial Banks								
TE	0.900	0.663	0.754	0.272	0.437	0.280	0.669	0.568
PTE	0.907	0.723	0.985	0.278	0.465	0.439	0.903	0.671
SE	0.990	0.861	0.759	0.976	0.926	0.824	0.749	0.869
Specialized Banks								
TE	0.837	1.000	0.761	0.985	1.000	1.000	1.000	0.940
PTE	0.935	1.000	0.911	1.000	1.000	1.000	1.000	0.978
SE	0.882	1.000	0.820	0.985	1.000	1.000	1.000	0.955
Private Banks								
TE	0.208	0.245	0.102	0.355	0.292	0.299	0.508	0.287
PTE	0.700	0.726	0.717	0.823	0.680	0.678	0.691	0.716
SE	0.402	0.386	0.228	0.481	0.474	0.502	0.765	0.463
Overall Mean								
TE	0.648	0.636	0.539	0.537	0.576	0.526	0.726	0.598
PTE	0.847	0.816	0.871	0.700	0.715	0.706	0.864	0.788
SE	0.758	0.749	0.602	0.814	0.800	0.775	0.838	0.762

According to the results shown in Table 5 and based on VRS, the study found that the results show that the most efficient banks are the specialized banks, followed by commercial banks and then the private banks. Given the relatively well-equipped nature of the specialized banks and the facilities given by the government to commercial banks, the above results are not unexpected. It could also be partly attributed to increased foreign participation and improvements in banking regulations in the banking sector in Libya.

The mean of technical efficiency of commercial banks in Libya is between 90% in 2004 and 27.2% in 2007, which clearly suggests that the commercial banks could have wasted annually about 10%, 33.7%, 24.6%, 72.8%, 56.3%, 72%, and 33.1% of inputs in 2004, 2005, 2006, 2007, 2008, 2009, and 2010 respectively. These wasted sources of inputs could have produced the same level of outputs, had they been fully technically efficient.

In the same way, the mean of technical efficiency of specialized banks in Libya is between 100% in 2005, 2008, 2009, and 2010 and 76.1% in 2006, which clearly suggests that the specialized banks could have wasted annually about 16.3%, 23.9%, and 1.5% of inputs in 2004, 2006 and 2007 respectively. These wasted sources of inputs could have produced the same level of outputs, had they been fully technically efficient.

In addition, the mean of technical efficiency of private banks in Libya is between 50.8% in 2010 and 10.2% in 2006, which clearly suggests that the private banks could have wasted annually about 79.2%, 75.5%, 89.8%, 64.5%, 70.8%, 70.1%, and 49.2% of inputs in 2004, 2005, 2006, 2007, 2008, 2009 and 2010 respectively. These wasted sources of inputs could have produced the same level of outputs, had they been fully technically efficient.

Finally, the mean of technical efficiency of Libyan banks is between 72.6% in 2010 and 52.6% in 2009, which clearly suggests that the Libyan banks could have wasted annually about 35.2%, 36.4%, 46.1 %, 46.3%, 42.4%, 47.4%, and 27.4% of inputs in 2004, 2005, 2006, 2007, 2008, 2009, and 2010 respectively. These wasted sources of inputs could have produced the same level of outputs, had they been fully technically efficient.

So, the primary reason for inefficiency was inappropriate pure technical and scale of operations. This means that the commercial banks are not working at the optimal level in their operations.

In general, the study shows that the overall technical efficiency, pure technical efficiency, and scale efficiency of commercial banks are 56.8%, 67.1%, and 86.9% respectively while for specialized banks estimates of technical, pure technical, and scale efficiencies are 94%, 97.8%, and 95.5% respectively. Also private banks show technical, pure technical, and scale efficiencies of 28.7%, 71.6%, and 46.3%. This suggests that these banks wasted around 43.2% for commercial banks, six percent for specialized banks, and 71.3% for private banks of their inputs relative to the theoretical best practice (TE = 1.000, (full efficiency)). Consequently, technical efficiency shows that the three types of banks were considered inefficient in their operations with the above mentioned percentages.

These results of first stage suggest that the specialized banks have exhibited higher technical efficiency compared to commercial banks and private banks. During the period of study we found that pure technical inefficiency has greater influence in determining the total technical inefficiency of commercial banks, while scale inefficiency has greater influence in determining the technical inefficiency of private and specialized banks.

In line with Berger and Humphrey (1997), although this technical efficiency score is within the range but when compared to developed countries it shows a lower satisfactory degree. In this study the overall technical efficiency shows that specialized banks estimate of 94% is higher than the other banks in the sample namely, commercial and private banks with estimates of 56.8% and 28.7% respectively. Sathye (2003) found that the public banking sector is more efficient than private banking sector in India during the period 1997-1998. Also, Sathye (2001) observed that the domestic banks are more efficient than foreign-owned banks in Australia. Chen, Skully, and Brown (2005) found that the large state-owned banks and smaller banks are more efficient than medium sized Chinese banks. In addition, Li (2006) found that the Chinese commercial banks are not efficient compared with other banks in China during the period of his study Similarly with our study, Mokhtar, Abdullah, and Al-Habashi (2006) found that the efficiency level of Islamic banking in Malaysia is lower than that of conventional banks, also their study reveals that full-fledged Islamic banks are more efficient than Islamic windows, while Islamic windows of foreign banks tend to be more efficient than those of domestic banks.

Our study is consistent with Floros and Giordani (2008) who found that the large banks in Greece (the large banks in Libya are commercial and specialized banks) are more efficient than small banks (small banks in Libya are private banks). Also, Tahir, and Haron (2008) found the domestic banks in Malaysia to be more efficient relative to foreign banks during the period 2000-2006. Our study also is consistent with Sufian & Habibullah (2012) who found that the foreign banks have exhibited higher technical efficiency compared to their domestic bank counterparts in Malaysia. Aydin, Yalama, and Sayim (2009) also agree with the results of this study and they found that the most efficient banks in Turkey are state-owned, foreign-owned, development-investment and private-owned banks respectively. Also, Staub, Souza, and Tabak (2010) found that the state-owned banks in Brazil are more efficient than private and domestic banks over the period 2000-2007. In the same way, Akhtar (2010) measured the technical efficiency and found that the public banking sector is more efficient than the private banking sector in Pakistan for the years from 2001 to 2006. Also, Wozniewska (2008) found all the commercial banks in Poland are not efficient, which agrees with the results of this study for Libyan commercial banks. The earlier mentioned previous studies support the results of this study.

4.2 Factors Influencing the Efficiency Level of Libyan Banks

In addition to estimating the DEA efficiency scores in stage one. The study constructed an econometric regression model based on the efficiency scores as a dependent variable to detect the relationship between efficiency and some of the determinants. Due to the limited nature of the efficiency measure of this study, which ranged from 0 to 1, it was estimated the current research models using Tobit-regression onto a vector of explanatory variables is to explain the variation in the efficiency scores obtained from stage one. Table 6 used Tobit regression to give the estimated results for each year. This research examined the effect factors on technical efficiency scores as seen in the following model:

$$TE = \beta_1 ROA_{it} + \beta_2 Risk_{it} + \beta_3 SO_{it} + \beta_4 LNDEPO_{it} + \beta_5 EQASS_{it} + \beta_6 GL_{it} + \beta_7 Mergers_{it} + \beta_8 OWS_{it} + \varepsilon_{it}$$

$$PTE = \beta_1 ROA_{it} + \beta_2 Risk_{it} + \beta_3 SO_{it} + \beta_4 LNDEPO_{it} + \beta_5 EQASS_{it} + \beta_6 GL_{it} + \beta_7 Mergers_{it} + \beta_8 OWS_{it} + \varepsilon_{it}$$

$$SE = \beta_1 ROA_{it} + \beta_2 Risk_{it} + \beta_3 SO_{it} + \beta_4 LNDEPO_{it} + \beta_5 EQASS_{it} + \beta_6 GL_{it} + \beta_7 Mergers_{it} + \beta_8 OWS_{it} + \varepsilon_{it}$$

Table 6. Results of the panel estimation: technical, pure technical and scale efficiency

	TE	PTE	SE
C	-1.135	2.328	-2.029
Profitability	5.285	0.636	7.252
	(0.049)**	(0.881)	(0.000)***
Risk	-0.308	-0.179	-1.321
	(0.841)	(0.947)	(0.242)
Size of Operation	0.125	0.042	0.120
	(0.121)	(0.733)	(0.054)**
Market Share	-0.056	-0.119	0.005
	(0.412)	(0.227)	(0.930)
Capital Adequacy	0.673	0.449	1.500
	(0.662)	(0.867)	(0.192)
Government Link	0.459	0.472	0.287
	(0.001)***	(0.029)**	(0.013)***
Mergers	-0.442	-0.117	-0.431
	(0.008)***	(0.666)	(0.001)***
Ownership Structure	-0.400	-0.452	-0.171
	(0.001)***	(0.004)***	(0.072)*
R-squared	0.555	0.327	0.597
Adjusted R-squared	0.552	0.322	0.594
F - statistics	15.448	5.960	18.169
Prob. (F – statistics)	0.000	0.000	0.000

Note. ***, ** and * denote significance level at the 1%, 5% and 10% respectively.

According to Asteriou and Hall (2007) it is possible to used use the fixed effects method if R-squared and adjusted R-squared are more than or equal to 0.05. In contrast if R-squared and adjusted R-squared are less than 0.05 the random effects method will be used. In this study R-squared equals 0.555, 0.327, and 0.597 and adjusted R-squared equals 0.552, 0.322, and 0.594 for technical efficiency, pure technical efficiency and scale efficiency respectively. So, according to values of R-squared and adjusted R-squared this study will use the fixed effects method. And F–statistics values are 15.448, 5.960, and 18.169 for technical efficiency, pure technical efficiency and scale efficiency respectively.

The results in Table 6 show ROA as peroxide by profitability (Net Income after Tax divided by Total Assets) has a positive sign. This factor indicates the profit of Libyan banks. These results indicate that the more profitable banks are more efficient. Also the results showed that the ROA is significantly related to technical efficiency at 95% confidence level. Apart from that the results also reveal a positive, significant relationship between profitability and scale efficiency at 99% confidence level. In contrast the profitability is positively related to pure technical efficiency but not significant. Based on these results, reject the Null Hypothesis that stated Profitability is not significantly related to bank efficiency is rejected for technical efficiency and scale efficiency and the Alternative Hypothesis is accepted.

ROA has a coefficient estimate of 5.29 and 7.25 for technical efficiency and scale efficiency respectively which suggests a one % increase in TE and SE will magnify Profitability (or ROA) by approximately 5.3% and 7.3% respectively. In other words, when banks are productive, this implies that they have efficient employees. In addition, the results of this study are consistent with previous and current studies such as Miller and Noulas (1996), Isik and Hassan (2002), Yildirim (2002), Casu and Molyneux (2003), Hasan and Marton (2003), Hassan et al. (2004), Sufian (2007a & 2009a), Ariff and Can (2008), Hays, De Lurgio, and Gilbert (2009), Avkiran (2011), and El Moussawi and Obeid (2011). However, a study conducted by Limam (2001) showed there was a positive-non-significant relationship: Hence weak relationship between technical efficiency and profitability (or ROA) for Gulf Council Countries' (GCC) banks for the year 1999. This weak relationship may be due to monetary policy and banking sector policy of the GCC. This includes reduction in the deposit rates in order to achieve monetary stability in GCC. The implications would be controlled inflationary pressures and creating conditions that are conducive to strengthening the sound financial position of local banking and the financial system in GCC.

Like Havrylchyk (2006) and Sufian (2007b, 2009a), the results of this study showed that the risk is negatively related to technical efficiency, pure technical efficiency, and scale efficiency and less efficient. This means that the less efficient banks are more risky. In contrast, the more efficient banks are less risky. The results also showed that the coefficients of risk related to technical efficiency, pure technical efficiency and scale efficiency are not significant. So, based on these findings this study accepts the Null Hypothesis that stated risky banks are less efficient for technical efficiency, pure technical efficiency and scale efficiency and the Alternative Hypothesis is rejected. Risk management is inevitable in the banking business. Poor asset quality and low levels of liquidity are the two major causes of bank failures. Most of the studies have found that well-capitalized banks are more efficient, i.e., consistent with the moral hazard theory, which suggests that managers of institutions closer to bankruptcy might be inclined to pursue their own interests. However, causation could run the other way-less efficient institutions have lower profits, leading to lower capital ratios (Kalluru & Bhat, 2009). Kwan and Eisenbeis (1995) found that the less efficient financial institutions take on more risk to offset this inefficiency. Also Kwan and Eisenbeis (1996) have found that the less efficient banks tend to be with higher risk. Resti (1997) agrees with the result of this study and he found that the large capitalized banks are more risky in Italy. Also, El Moussawi and Obeid (2011) found that there is negative significance between risk and efficiency.

In addition, this study finds that size of operation is positive, meaning that the large sized operation banks are more efficient than the small sized operation banks. The size of operation is significantly related to scale efficiency at 95% and positively related to technical efficiency and pure technical efficiency but not significant. Therefore, this study rejects the Null Hypothesis that large a sized operation is not significantly related to efficiency, this study rejects it for scale efficiency and accepts the Alternative Hypothesis. Size of operation has a coefficient estimate of 0.120 for scale efficiency, which suggests size of operation could be magnified by 1.2% following a one % increase in scale efficiency. The results of this study are consistent with Berger and Humphrey (1992) who concluded that bank efficiency is positively related to the size of large American banks. The results of this study are also consistent with Berger, Hancock, and Humphrey (1993). A study by Mester (1996) and Altunbas, Liu, Molyneux, and Seth (2000) also revealed this positive relationship. In addition, Yildirim (2002) reported that the size of a bank is positively related to technical efficiency and scale efficiency. Meanwhile, Jemric and Vujcic (2002) found that large banks appeared to be locally efficient, while smaller banks are globally efficient. This result also concurred in a study by Hassan et al. (2004) with respect to Bahranian banks. Additionally, Kabir (2006), Kamaruddin (2007), Kivota (2009), and Sufian (2007a, 2009b, & 2011) also found a positive relationship between size and bank efficiency in their study. Specifically, Delis and Papanikolaou (2009) reported that the bank size of 10 EU countries during the period 1994-2005 had a positive impact on bank efficiency. On the contrary, El Moussawi and Obeid (2011) found a negative and significant relation between size and technical efficiency. El Moussawi and Obeid's (2011) results of the study imply that an increase in the size of banks is a source of additional costs. Therefore this condition tends to reduce the efficiency of large banks. In other words, the negative relationship identified between efficiency and size shows that economies of scale affect the production performance of small banks in a positive way, while economies of scale have impacted negatively on the efficiency of large banks.

This study discovers that market share is negative, meaning the more efficient banks are associated with the bank with reduced market share, thus weakening the market leadership argument. The results of this study imply that banks with small market share such as private banks can be at least as efficient as market dominant banks in their intermediation function because to maintain or expand market share might incur extra costs and inputs and thus worsen inefficiency. In this study market share is negatively and not significantly related to technical and pure

technical efficiency. But the market share is positively and not significantly related to scale efficiency. So, based on these findings this study accepts the null hypothesis that market share is not significantly related to bank efficiency, and reject the alternative hypothesis. This finding agrees with Sufian (2009a, 2009b and 2011) who found that there is a negative relationship between banking efficiency and market share. Similarly, the result is consistent with previous findings by Randhawa and Lim (2005) among others. Also, Sathye (2001), Hassan et al. (2004) and Fries and Taci (2005) have found the negative significance between market share and bank efficiency.

This study finds that Capital Adequacy is positively related to technical, pure technical and scale efficiency, but not significant. The High Capital Adequacy of banks is assumed to be more efficient. So, based on these findings we accept the null hypothesis that capital adequacy is not significantly related to bank efficiency, we accept it for technical efficiency, pure technical efficiency and scale efficiency, and we reject the alternative hypothesis. This result is consistent with Kaparkis, Miller, and Noulas (1994), among them, who found a positive relationship between inefficiencies and non-performing loans to total loans and equity capital to total assets. Berger (1995), Goddard, Molyneux, and Wilson (2004), also, agree with Hassan et al. (2004), who discovered that the capital adequacy of banks in Bahrain is positive. Also like with Pasiouras and Kosmidou (2007). In the same way, Ariff and Can (2008) reported that capital adequacy is positive significant related to bank efficiency. Kiyota (2009) also supported the result of this or this hypothesis and he found a positive relationship between capital adequacy and bank efficiency. Brack and Jimborean (2009), Hays, De Lurgio, and Gilbert (2009), Avkiran (2011), and Sufian (2009b, 2011) and Sufian and Habibullah (2012) while Sufian (2009a) found that capital adequacy is negatively and related to technical efficiency of Malaysian banking. The findings suggest that the more efficient banks use more leverage compared to their peers. The results seem to suggest that the less efficient banks could have been involved in riskier operations and in the process tend to hold more equity, voluntarily or involuntarily, i.e., the reason might be banks' deliberate efforts to increase safety cushions and in turn reduce the cost of funds, or perhaps regulatory pressures that mandate riskier banks to carry more equity.

Our results also showed that government link (i.e., relation between government ownership and efficiency) is positively and significantly related to technical efficiency at 99% confidence level. Apart from that the results also revealed a positive and significant relationship between government link and pure technical efficiency at 95% and scale efficiency at 99% confidence level. It means that the banks with government ownership are more efficient than others, as these banks are controlled by the Central Bank of Libya so, they supported by the Central Bank to be efficient. Based on these results, all the Null Hypothesis that government link is not significantly related to bank efficiency for technical efficiency, pure technical efficiency and scale efficiency is rejected and the Alternative Hypothesis is accepted. Additionally, government link has coefficient estimates of 0.459, 0.472, and 0.287 for technical efficiency, pure technical efficiency and scale efficiency respectively, which suggests that a five percent, five percent and three percent respectively in strength of government link will be able to increase technical efficiency, pure technical efficiency and scale efficiency respectively by one percent. However, a study by Sufian (2009a) showed that coefficient in relation to government link has a negative sign, meaning there is an inverse relationship between government link and bank efficiency.

In addition, the results of this study showed that merger is negatively and significantly related to technical efficiency at 99% confidence level. Apart from that, the results also revealed a negative, significant relationship between mergers and scale efficiency at 99% confidence level and negatively and not significantly related to pure technical efficiency. This means that the banks that merge twill be less efficient, which is related to the policy of the Central bank of Libya restricting banks' freedom to perform at optimal levels. Based on these results, the Null Hypothesis that merger is not significantly related to bank efficiency for technical efficiency and scale efficiency is rejected and accepts it for pure technical efficiency. Based on these results, we can conclude that a reduction in the strength of merger of 4.42% and 4.31% will be able to increase technical efficiency and scale efficiency by one percent. This implies that merger and acquisition is not practical for banks to be efficient in performance. Peristiani (1997) employed the Distribution-Free Approach (or DFA) (i.e., another technique of production efficiency frontier) to a study involving 4,900 commercial and saving banks in the USA for the period 1980-1990. The results revealed that bank mergers did not result in a significant X-efficiency (i.e., allocative and technical efficiency). Similarly, Sathye (2001) and Rezitis (2008) found that merger is negatively and significantly related to technical efficiency. On the contrary, Lin (2002) found a positive relationship with bank efficiency. The difference in the results of this study compared to Lin (2002) can be explained by the following financial services offered in the Libyan economy which are either wholly (for large banks) or partially (for some small banks) controlled by the Central Bank of Libya. This explains the inverse relationship between merger and bank efficiency for Libyan banks because of the intervention by the Central Bank that restricts their freedom to perform at optimal levels.

Also, this study finds that ownership structure (i.e. domestic and foreign ownerships and some are partially while some others are wholly controlled by the Central Bank). Ownership structure of banks is negatively and significantly related to technical efficiency at 99% confidence level. Apart from that, the results also revealed a negative, significant relationship between ownership structure and pure technical efficiency and scale efficiency at 99% and 90% confidence level respectively. This is due to the fact that the financial services offered in the Libyan economy, which are banks wholly or in large proportion owned by the Central Bank of Libya, may cause a negative impact on the performance of the respective banks. Based on these findings, the Null Hypothesis that Ownership structure is not significantly related to bank efficiency is rejected and accept the Alternative Hypothesis for technical efficiency, pure technical efficiency and scale efficiency. This implies that a four percent, 4.52% and 1.71% respectively in strength with regard to mixed ownership structure will reduce technical efficiency, pure technical efficiency and scale efficiency by one percent respectively. In comparison with the empirical efficiency analysis involving public and private firms, Broadman and Vining (1991) in Canada; Chen and Yeh (2000) in Taiwan, Kumbhakar and Sarkar (2003) in India. These studies found that ownership plays an important role in improving the efficiency of banking firms. These studies showed that privately-owned financial institutions enjoyed higher technical efficiency than those owned publicly. Similarly, Delis and Papanikolaou (2009) found that public ownership had a negative effect on efficiency. On the contrary, Chen (2002) found that the ownership was positively related to bank technical efficiency in Taiwan. The variation between this study's results and Chen (2002) is due to the fact that the financial services offered in the Libyan economy, which are either owned banks wholly or in large proportion by the Central Bank of Libya, may cause a negative impact on the performance of the respective banks. However, the regulatory and administrative constraints imposed by this ownership control, has been reviewed by the accounting system of financial control in Libya. This has resulted in a liberalization policy for some banks by the then Gadhafi regime in 2005. This enables banks to have access to development programs by the Central Bank, which subsequently is able to improve the production efficiency of the respective banks.

5. Conclusion

In this paper, we examined the efficiency of Libyan banks over period 2004-2014. The efficiency measures of individual banks were evaluated by using DEA. Results showed an improvement in the average efficiency scores for the banking sector. The study also found that the most efficient banks to be specialized banks followed by commercial banks and the private banks. In the second stage we investigated the determinants of Libyan banks efficiency using the efficiency measures derived from the DEA estimations as the dependent variable and using Tobit regression model to measure the effecting of determinants. The result of the second stage showed that among eight hypotheses, five hypotheses were supported by data namely, Profitability, size of operation, government link, mergers and ownership structure. In future, this paper can be extended as follows. First, the scope of this study can be extended to investigate changes in cost, allocative, and technical 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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