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Determinants of Total Factor Productivity of Libyan Banks 2004 – 2010

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Abstract: *The paper examines the determinants of Total Factor Productivity (TFP) of Libyan banks by employing Data Envelopment Analysis (DEA) based Malmquist Productivity Index (MPI) and Ordinary Least Square (OLS) estimation regression model for the period 2004 – 2010. For estimate TFP and determinants in this study we used DEAP 2.1 software and we used Evies 7 software for estimating determinants. The results showed that our variables which used in this study are not significant related to TFP.*

Keywords: *Determinants; Total Factor Productivity; Data Envelopment Analysis; Ordinary Least Square and Libyan Banks*

1. INTRODUCTION

Measurement and analysis of bank's efficiency has received increasing attention in applied economics in recent years. This is due firstly, to the rapid globalization of the financial industry and secondly to increasing competitiveness in international financial markets. In economics, efficiency in general refers to how well a system performs in maximizing outputs for given inputs. There is enhanced efficiency when outputs increase without increasing inputs or when outputs remain but inputs are reduced. In the banking industry, efficiency is measured as the difference between the bank's position and its best production frontier that is used as a benchmark to determine the efficient and inefficient banks. The efficiency of the banking system is one of the most important issues in the financial market of a particular country because the efficiency of banks can affect the stability of the banking industry and thus the effectiveness of the whole monetary system of a country.

The banking system in Libya is a newly-developed independent system and plays a vital role in developing the economy. Thus, measuring the technical efficiency of the Libyan banking sector is essential for further improvement, especially under the dominance of the globalization of the banking system and the increasing competitiveness between domestic and foreign banks in Libya.

There are three types of banks in Libya. The banks can also be classified according to (i) those controlled heavily by Central Bank of Libya, (ii) controlled heavily by private sectors, and (iii) controlled by Central Bank of Libya and private sectors (Mireles et al., 2009)[47]. The types of banks are:

Commercial Banks: Libya's commercial banks (almost 90 per cent from banking industry) which are owned in full or in the majority by the Central Bank of Libya.

Specialized Banks: Banks that work in a special area such as agriculture, real estate, and foreign investments. These banks also controlled by the Libyan Central Bank.

Private Banks: Banks that are controlled by the Central Bank of Libya. These banks are owned by shareholders and they are the decision makers in these banks.

The controlling system of Libyan banks not only consists of financial control and technical system, but also includes managerial control system. Moreover, in the Central Bank there is a specialized supervision and monitoring department that is responsible for controlling banking system activities. These entire systems takeover the monetary of Libyan banks by Law 1 of 2005 about Libyan banks. Banking supervision focuses on follow up banking financial statements, credit granting processes, and risk analysis. Financial control and technical system have a role as external auditors of the balance sheet and income statements of banks and note the delay adoption of the budget. The most notes that come in the audit reports is a traditional and repeated observation (Quidara, 2010)[51].

The Libyan banking system is currently undergoing a substantial modernization program to upgrade available services and products, deal with large numbers of nonperforming loans, establish a functioning national payments system, facilitate use of non-cash payment instruments and institute new standards of accounting and training. While the 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 has taken hold (Mireles et al., 2009).

Controlling the system of Libyan banks consists of financial control and technical system, and managerial control system as a state-owned, and bank supervision and monitoring department in Central Bank of Libya. All these systems take over the monetary control of Libyan banks by Law 1 of 2005 about Libyan banks. Banking supervision focuses on follow up banking, financial statements, credit granting processes, and risk analysis. Financial control and technical system has a role as external auditor to check the financial statements of banks and note the delay adoption of these financial statements. The most notes that come in the audit's report are a traditional and repeated observation (Quidara, 2010). Quidara (2010) stated that Libyan banks were able to collect savings and deposits, for example at the end of 2008. They collected about 40 billion Libyan Dinar as savings and deposits. But the Libyan banks failed to provide adequate facilities to finance investments - especially small and medium enterprises by the traditional approach of funding. Also the financial statements showed that the volume of financing for the basic sectors such as agriculture and industry was very limited, the percentages of financing to the agriculture and industry sectors were one per cent and two per cent respectively, while the majority of funding for trade and special purposes was more than 90 per cent of the size of the facilities.

Also the financial statements in 2008 showed the distribution of banks' assets, which amounted to about 52 billion dinars which were found to be distributed as follows 33 billion assets in cash, 10 billion in loans and advances and facilities, thus indicating that more than 60 per cent was rigid assets without revenues, while 20 per cent of the banks' assets was employed depending on the interest in getting a return. This financing structure was a weakness of Libyan banks in the development of the economy. To be able to address these challenges, bank managers as well as the government need to determine the level and sources of technical efficiency in the banking industry as predictor of performance both of individual banks and of the industry as a whole.

Moreover, there have been few studies conducted on Libyan banking sector organizations and no previous studies have been known to examine the cost efficiency of Libyan banks using two stage approaches. In view of this, 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 cost efficiency scores in the first stage, and using OLS estimation 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 the U.S., Armah, Park and Lovell (1999) and Dias and Helmers (2001), evaluated agricultural bank management performance, focusing on the impacts of interstate banking laws on productivity change. The generalized Malmquist productivity index decomposes productivity change into technological change, technical efficiency change, and change in scale economies. While managerial productivity rose from 1982 to 1991. Also, Dias and Helmers determined productivity and efficiency of agricultural and nonagricultural banks categorized into six different asset size groups using nonparametric data envelopment analysis. An output- oriented Malmquist index is estimated and decomposed into its components to provide a comparison of performance over the 1981-1991 study periods.

Armah et al. (1999) found that the most liberal interstate banking laws experienced the greatest improvement in productivity. Large agricultural banks were more efficient in states that had more liberalized interstate banking laws while small agricultural banks fared better in states with more restrictive laws. In the same way, Dias and Helmers (2001)[19] found that the primary source of productivity improvements for larger banks of both types has been technical changes or innovations. Small banks of both types have derived competitive strength from increased efficiency gains or catching up with frontier banks. Competitive pressure brought in by restructuring of the agricultural credit market has caused increased volatility in productivity growth, showing negative Total Factor Productivity for the study period.

Other study is conducted in Australia, Sathye (2002)[56] aimed to analyse the change in the productivity of Australian banks during the period 1995 to 1999. Productivity has been measured by the Malmquist index, using a Data Envelopment Analysis technique. The data consists of a panel of 17 locally incorporated banks in Australia. The study found that the technical efficiency of banks in the panel has declined by 3.1 per cent and the Total Factor Productivity (TFP) index declined by 3.5 per cent during 1995-1999. Though the mean technical efficiency change and the mean TFP (both 1.013), remain positive the decline in productivity is a cause for concern. The decline could be traced to negative or near stagnant technical progress index. No association was found between size and productivity. Hence the argument for merger of banks so as to improve productivity by achieving a larger size is not tenable. Sathye (2002) recommended that the study could help banks in strategic planning and also the policy makers interested in knowing the effects of deregulation on productivity of Australian banks.

In addition, Fukuyama and Weber (2002) estimated output allocative efficiency and productivity changes in Japanese banks during 1992 – 1996. The data were

obtained from Nikkei's data tape of financial statements. During the period of the study Japanese banks experienced productivity decline averaging two percent per year and could have used only 78 – 93 per cent of actual inputs if they had chosen the revenue maximizing output mix.

In another study, Krishnasamy, Ridzwa and Perumal (2004) and Sufian and Ibrahim (2005) examined the changes in productivity of the merged ten commercial banks in Malaysia in the period of 2000 and 2001 using Data Envelopment Analysis and Malmquist Productivity Index. And attempted to investigate to what extent the inclusion of Off – Balance Sheet items in the output definition of banks affect the estimated Total Factor Productivity change indexes respectively. They used a non – parametric Malmquist Productivity Index and they selected all Post – Mergers Malaysian banks over period 2001 – 2003 respectively. The results of Krishnasamy et al. (2004) indicated that Total Factor Productivity increased in all eight banks except for EON, which remain the same while PBB, recorded a decrease in productivity. AFB recorded the highest growth in Total Factor Productivity. The growth in productivity is attributed to technological change rather than technical efficiency change. While, Sufian and Ibrahim (2005)[61] found that the inclusion of Off – Balance Sheet items results in an increase in estimated productivity levels for all banks under study. However, the impact seems to be the largest on technological change rather than efficiency change.

Also, other studies are conducted by Hassan and Hussein (2003)[30], Ramanathan (2007), Al- Muharrami (2007)[3] and Akhtar (2010)[1] Hassan and Hussein (2003) measured the relative efficiency and productivity of the banking industry in Sudan by employing a panel of 17 banks for the years 1992 and 2000. Ramanathan (2007)Assessed the performance of banks in countries of the Gulf Cooperation Council (GCC). Performances of 55 banks operating in countries of the GCC were examined in this study using DEA and Malmquist productivity index over the period 2000-2004. Also, Al- Muharrami (2007) aimed to examine historic rates of productivity change in Arab GCC banks. The paper planned to answer the following research questions: How did productivity develop during the period 1993-2002? What was the cause for this change? Using data of 52 banks over ten years, Total Factor Productivity (TFP) changes were calculated using the Malmquist DEA. Akhtar (2010) aimed to estimate the Data Envelopment Analysis efficiency scores and Malmquist productivity indices of banks in Saudi Arabia, an economy that is heavily dependent on the hydrocarbon sector. His study is based on a sample of nine out of 11 local commercial banks operating in Saudi Arabia during the period of 2000-2006. The results of Hassan and Hussein (2003) indicated that the productivity decline in Sudanese banks had been fuelled more by the decline in advances in technology, and by not operating at the right scale, rather than by a decline of technical efficiency. While, Ramanathan (2007) found that only 15 of the 55 banks were rated as efficient under constant returns to scale (CRS) assumption, and all the GCC countries had at least one efficient bank. The analysis using MPI showed that banks in four of the six GCC countries (Bahrain, Kuwait, Saudi Arabia and the UAE) registered productivity improvements during 2000-2004. The selected banks in Bahrain showed the highest productivity improvements during this period, while the selected banks in Qatar registered the highest reductions in productivity during this period. Interestingly, all the countries seem to have registered reductions in productivity in terms of technology change. Also, the results of Al-Muharrami, (2007) the Malmquist DEA slight downward shift in average efficiency of the banks in the sector during 1993 to 2002, stemming from change in the technical efficiency of banks (catching up effect), and technology equally decreasing during the period. Looking at the behaviour of total assets, deposits, and loans, the results revealed that there was a downward trend in total of assets, deposits, and loans. On other hand, Akhtar (2010) found that the Malmquist productivity index reflect an improvement in average productivity of banks. However, the major increase in productivity gains emerged through technological change relative to the efficiency change. The banks across the Kingdom appear to have succeeded in catching up with the best practices, even though the average scores on technical efficiency stood beyond optimal levels.

3. METHODOLOGY

Data Envelopment Analysis (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)[66] and Manadhar and Tang (2002))[43]

Also, Cullinane, Wang, Song, and Ji (2006)[17] define DEA as a non-parametric method of measuring the efficiency of a decision making unit with multiple inputs and outputs. And Jacobs (2001)[33] defines DEA as the ratio of the weighted sum of outputs of a trust to its weighted sum of inputs. Also efficiency is defined as the ratio of the actual quantity of output, relative to a maximal feasible quantity of output (Bryce, 1996)[12]

"The relative efficiency of any decision-making unit (j_0) for a group of decision-making units is calculated by solving the following fractional linear programming model" (Charnes, Cooper, Lewin, & Seiford, 1994):

$$Max\ u,v \qquad h_0 = \frac{\sum_{r=1}^{t} U_r Y_{rj_0}}{\sum_{i=1}^{m} V_i X_{ij_0}}$$

Subject to:

$\frac{\sum_{r=1}^{t} U_r Y_{rj}}{\sum_{j=1}^{m} V_i X_{ij}} \leq 1$ j = 1, 2, ……., n

Ur, Vi ≥ ∀ r and i

(r = 1,2,3, ……, t) , (i = 1,2,3, ……., m)

where:

Yrj = Quantity of the output of the unit

Ur = Weight allocated to the output

Xij = Quantity of input to the unit

Vi = Weight allocated to the input

t = Number of outputs

m = Number of inputs

3.1 First Stage: Determining Total Factor Productivity of Libyan Banks

According to Fare, Grosskopf, Norris and Zhang (1994) TEC is TE under the constant return to scale assumption. If the production possibility set is extended to the Variable return to Scale (VRS), then the change in TE under the VRS, namely, pure technical efficiency change (PTEC) and scale efficiency change (SEC), can be obtained and TFP can measured as follows:

$$MPI_0^{t+1}(x^{t+1}, y^{t+1}, x^t, y^t) = \left[\frac{D_0^t(x^{t+1}, y^{t+1}/CRS)}{D_0^t(x^t, y^t/CRS)} \times \frac{D_0^{t+1}(x^{t+1}, y^{t+1}/CRS)}{D_0^{t+1}(x^t, y^t/CRS)}\right]^{\frac{1}{2}} \quad (1)$$

Where:

$MPI_0^{t+1} > 1$ represents the progress trend of productivity;

$MPI_0^{t+1} = 1$ represents that the productivity remains unchanged; and

$MPI_0^{t+1} < 1$ represents the declining trend of productivity.

MPI can be disintegrated into the multiplication of TEC and TC under the VRS assumption. TEC, also known as the catch-up effect, refers to the degree of the progress or decline of the TE of a DMU. TC, also known as the efficiency frontier-shift effects or innovation effect, reflects the change in the efficiency frontier of two time periods. The two indicators can be defined as follows:

MPI = TEC × TC

Where:

$$TC = \left[\frac{D_0^t(x^{t+1}, y^{t+1}/CRS)}{D_0^{t+1}(x^{t+1}, y^{t+1}/CRS)} \times \frac{D_0^t(x^t, y^t/CRS)}{D_0^{t+1}(x^t, y^t/CRS)}\right]^{\frac{1}{2}} \quad (2)$$

In the above equation,

TC > 1 indicates progress in the TC;

TC = 1 indicates no change in the TC; and

TC < 1 indicates a decline in the TC.

In addition

$$TEC = \frac{D_0^{t+1}(x^{t+1}, y^{t+1}/CRS)}{D_0^t(x^t, y^t/CRS)} \quad (3)$$

Where:

TEC > 1 represents an increase in TE;

TEC = 1 represents no change in TE; and

TEC < 1 represents a decrease in TE.

Meanwhile, TEC can be decomposed into PTEC and SEC, defined as below:

TEC = PTEC × SEC

Where:

$$PTEC = \frac{D_0^{t+1}(x^{t+1}, y^{t+1}/VRS)}{D_0^t(x^t, y^t/VRS)} \quad (4)$$

$$SEC = \frac{D_0^{t+1}(x^{t+1}, y^{t+1}/CRS)/D_0^{t+1}(x^{t+1}, y^{t+1}/VRS)}{D_0^t(x^t, y^t/CRS)/D_0^t(x^t, y^t/CRS)} \quad (5)$$

When SEC > 1, is compared with period t, period t + 1 is closer to the constant return to scale that is the DMU is closer to the optimal production scale.

When SEC < 1, is compared with period t, period t + 1 is far from the constant return to scale, that is, the DMU is far from the optimal production scale.

According to Fare et al. (1994) it is possible to provide four efficiency indices for each firm and a measure of technical progress over time. These are TEC, TC, PTEC, SEC, and Malmquist productivity Index (MPI). MPI indicates the degree of productivity change; MPI > 1 means that period (t+1) productivity is greater than period t productivity, while MPI < 1 means productivity decline and MPI = 1 corresponds to stagnation.

An assessment can be made of the sources of productivity gains or losses by comparing the values of TEC and TC. If TEC > TC, then productivity gains are largely the results of improvements in efficiency. Whereas if TEC < TC, productivity gains are primarily the result of technological progress.

Fare et al. (1994) proposed an "enhanced decomposition" which takes the efficiency change component calculated relative to the CRS technology and further decomposes into a "pure technical efficiency change" component (calculated relative to the VRS technology) and a residual "scale efficiency" component, which captures changes in the deviation between the VRS and CRS technologies.

the decomposition becomes:

$$MPI_0^{t+1}(x^{t+1}, y^{t+1}, x^t, y^t) = TC \times PTEC \times SEC$$

Where TC represents technological change, $PTEC$ represents pure technical efficiency change and SEC represents scale efficiency change. The scale efficiency change and pure technical efficiency change components are the decomposition of the efficiency component

$$TEC = PTEC \times SEC$$

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 and Lindley, 1977)[57] The production approach views banks as primarily services producing for customers. The banks generate transactions and process documents for customers as an output, such as loans applications, credit reports, checks, or other payment instruments, while the input includes only the physical variables, such as the number of employees and the physical capital. The intermediation approach treats the work of banks as primarily intermediating funds between savers and investors (depositors and borrowers). The banks use operating and interest expenses to produce major assets. For instance, they use labour and capital as inputs to produce loans, investments, and other means of financing as outputs. Under the intermediation approach, a deposit is treated as an input.

To calculate TFP we are able to collect data on two outputs and three inputs namely: loan income (y1) (Drake, Hall, and Simper, 2009), profit after tax (y2) (Mostafa, 2007), No. of employees (x1) (Wu, Yang, Liang, 2006), total fixed assets (x2) (EL Moussawi and Obeid, 2011), and deposits (x3) (Sufian, 2007; Sufian, 2009; and Sufian, 2011). Variables y1, y2, x2, and x3 measured in millions of Libyan Dinar. And we are using DEAP 2.1 software to analyze the data that are obtained of inputs and outputs.

3.2 Second Stage: Factors Influencing the Total factor Productivity of Libyan Banks

To further investigate the determinants of Libyan bank efficiency we follow a two-step approach, as suggested by Coelli, Rao and Battese (1998). Using the efficiency measures derived from the DEA estimations as the dependent variable, we then estimate the following OLS estimation model using EViews 7 software:

$$TFP = \beta_1 ROA_{it} + \beta_2 Risk_{it} + \beta_3 SO_{it} + \beta_4 GL_{it} + \beta_5 Mergers_{it} + \beta_6 OWS_{it} + \varepsilon_{it}$$

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, 2009). Our hypothesis is suggested below:

H_0 : Profitability is not significantly related to TFP of Libyan banks, and

H_a : Profitability is significantly related to TFP of Libyan banks.

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)[36].

H_0 : Risky banks are decreased TFP, and

H_a : Risky banks are increased TFP.

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, 2009)[59] We develop the following hypothesis in relation to size of operation and bank efficiency:

H_0 : Large size operation is not significantly related to TFP of Libyan banks, and

H_a : Large size operation is significantly related to TFP of Libyan banks.

3.2.4 Government Link of Bank and Efficiency

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

H_0 : Government Link is not significantly related to TFP of Libyan banks, and

H_a : Government Link is significantly related to TFP of Libyan banks.

3.2.5 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 TFP of Libyan banks, and

H_a : Mergers are significantly related to TFP of Libyan banks.

3.2.6 Ownership Structure (OWS)

In this paper we consider two ownership structures: 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 TFP of Libyan banks, and

H_a : Ownership structure is significantly related to TFP of Libyan banks.

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
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 Determining Total Factor Productivity of Libyan Banks

This section presents the findings and discusses productivity (TFP) change analysis of the sampled banks. There is also a discussion of productivity change analysis of the technical model.

Following Fare et al. (1994), the Malmquist Total Factor Productivity change index has been used to measure Libyan banks. Productivity change is divided into technological change (TC) and technical efficiency change (TEC), where TFP = TC × TEC. The value of TFP greater than 1 indicates positive TFP growth while the value less than 1 indicates decline over the period of the study. An improvement in TC is considered as a shift in the best practice frontier, whereas an improvement in TEC is the "catch-up" term. The technical efficiency change is divided into the pure technical efficiency change (PTEC) and scale efficiency change (SEC) components TEC = PTEC × SEC. The importance of the decomposition is that it would provide information of the sources of overall productivity change in the Libyan banking industry. All indices are relative to the previous year; hence the output begins with the year 2004.

Table 2 show that the Total Factor Productivity (TFP) on technical efficiency for the Libyan banks decreased by an average of 1.6 per cent over the period of study (2004/2010: 0.984). For the Libyan banks in the panel Total Factor Productivity declined in all the years of this study except (2004/2005: 1.188) it showed growth by 18.8 per cent and (2009/ 2010: 1.396) it was growth by 39.6 per cent. The decrease is attributed by the decline in technical efficiency change. Another fact is that the efficiency decreases were mostly contributed by non-improved scales. In line with the TFP decline of 1.6 per cent, pure technical efficiency change recorded a positive growth of 0.9 per cent. Hence, the scale efficiency change result decline of 7.2 per cent. This change is attributed to decline of technical efficiency by 6.4 per cent.

Table: 2. Malmquist Index Decomposition (Summary of Annual Means)

Year	Technical Efficiency Change (TEC)	Technological Change (TC)	Pure technical efficiency change (PTEC)	Scale efficiency change (SEC)	Total Factor Productivity (TFP)
2004/ 2005	1.011	1.174	0.946	1.069	1.187
2005/ 2006	0.726	1.129	1.007	0.721	0.820
2006/ 2007	0.909	0.906	0.978	0.929	0.824
2007/ 2008	0.849	0.953	0.887	0.957	0.809
2008/ 2009	0.957	0.906	1.110	0.862	0.867
2009/2010	1.161	1.202	1.128	1.029	1.396
2004/ 2010	0.936	1.045	1.009	0.928	0.984

Note: A number < 1 indicates decline; a number > 1 indicates growth.

Based on Table 2 the results of individual banks unbalanced panel data are presented. The TFP of Wahda Bank is decreased by 27.2 per cent, the decrease is contributed by TEC and TC by 7.1 per cent and 21.7 per cent respectively, and the decline of TEC is contributed by SEC by 7.1 per cent. Also, for Aljumhoria Bank the TFP is decreased by 49.9 per cent and the percentage of decrease contributed by TEC and TC by six per cent and 46.7 per cent. The decrease of TEC is contributed by SEC by six per cent; in addition, TC has a higher percentage of contribution in decreasing of TFP. In Sahara Bank, the TFP is decreased also by 36.4 per cent, this percentage is contributed by TC only while TEC growth by 4.8 per cent. The growth of TEC is contributed by PTEC by 6.5 per cent, whereas SEC declined by 0.8 per cent. For the National Commercial Bank, the TFP is decreased also by 47.3 per cent and this percentage is contributed by TEC and TC by 8.5 per cent and 42.4 per cent respectively.

Table: 3. Individual Malmquist Indices of Libyan Banks

	Bank	Technical Efficiency Change (TEC)	Technological Change (TC)	Pure technical efficiency change (PTEC)	Scale efficiency change (SEC)	Total Factor Productivity (TFP)
Panel A: Commercial Banks	Wahda	0.929	0.783	1.000	0.929	0.728
	Aljumhoria	0.940	0.533	1.000	0.940	0.501
	Sahara	1.048	0.607	1.065	0.992	0.636
	National Commercial	0.915	0.576	0.951	0.962	0.527
Panel B : Specialized Banks	Agricultur	1.000	0.896	1.000	1.000	0.896
	Real Estate Investment	1.000	0.809	1.000	1.000	0.809
	Development	1.000	0.858	1.000	1.000	0.858
	Libyan foreign	1.054	0.645	1.028	1.025	0.680
	Alrefi	1.140	1.090	1.032	1.105	1.243
Panel C: Private Banks	Commercial and Development	1.233	0.970	1.217	1.013	1.196
	Mediterranean	1.122	0.966	1.000	1.122	1.084
	Alsary	1.188	0.887	1.020	1.164	1.053
	Alejmaa Alarbi	1.600	0.766	1.055	1.517	1.226
	United	0.839	0.952	1.000	0.839	0.799
	Amman	0.727	1.085	1.000	0.727	0.789
	Al Wafa	1.000	1.170	1.000	1.000	1.170
	Al- Waha	0.695	0.923	1.000	0.695	0.641
	Mean	1.025	0.854	1.022	1.002	0.873

In Agriculture, Real Estate Investment, Development, and Libyan Foreign Bank, The TFP is decreased for each bank by 10.4 per cent, 19.1 per cent, 14.2 per cent and 32 per cent respectively. The TFP is contributed for each bank by TEC (equal 1) for each bank except Libyan Foreign Bank (equal 1.045 rather than other banks by 4.5 per cent) and the decrease is contributed by TC by the same rating mentioned above except Libyan Foreign Bank the decrease is 35.5 per cent. The results of Alrefi Bank seem to indicate the TFP growth is by 24.3 per cent. For Alrefi Bank, the gains achieved from technological advances have benefited the bank's technical efficiency level where there is increase of its technical efficiency by 3.2 per cent (PTEC = 1.032). Also, the bank displays positive scale efficiency change indicating that its scale size is economical which can prevent wastage in expenditure. In addition, productivity gains of Alrefi Bank (TEC = 1.140) have also resulted from improvements in bank efficiency.

Also, the results seem to indicate productivity growth for Commercial and Development, Mediterranean, Alsary, Alejmaa Alarabi banks. TFP for these banks are 19.6 per cent, 8.4 per cent, 5.3 per cent and 22.6 per cent respectively. The TFP for each bank is contributed by TEC and achieved by SEC rather than PTEC for each bank except TEC of Mediterranean Bank, where it is the PTEC rather than SEC. The productivity of United and Amman Bank is decreased by 20.1 per cent and 21.1 per cent respectively because all of the TEC and TC are negative by 16.1 per cent and 4.8 per cent for United Bank. The TEC of United Bank is negative effect because the SEC is less than 1 while the PTEC equals 1 (100 per cent). On the other hand the decline growth of Amman Bank is because the TEC is decreased by 27.2 per cent, while the TC is increased by 8.5 per cent. And the results of Al – Waha Bank seem to indicate a decline of TFP by 35.9 per cent; the result shows that the rate of TEC decline is more than the rate of TC decline of 30.5 per cent and 7.7 per cent respectively. The last bank is Al-Wafa Bank, The productivity of Al-Wafa Bank seems to have been brought about more by increases in technological change (+1 per cent) (TC = 1.170) rather than by technical efficiency. The efficiency is constant (TEC = 1.000) due to pure technical efficiency being equal to scale efficiency (PTEC = SEC = 1.000).

As a summary, overall the results seem to indicate productivity growth for the following banks: Alrefi (24.3 per cent), Alejmaa Alarabi (22.6 per cent), Commercial and Development Bank (19.6 per cent), Al-Wafa (17 per cent), Mediterranean (8.4 per cent) and Alsary (5.3 per cent). TFP of the growth banks was calculated as the average of their values in Table 4.11. From an analysis of the decomposition of the Malmquist TFP, productivity growth in Alejmaa Alarabi, Commercial and Development banks, Alsary, Arefi, and Mediterranean,

seem to have been brought about mainly by a positive change in technical efficiency.

On the other hand, 11 out of 17 Libyan banks declined because TFP levels of banks are drawn by negative technical efficiency change (less than 1) or by negative technological change, or both of them are negative.

Dias and Helmers (2001) [19]found the agriculture banks in US are negative (decline) Total Factor Productivity during period 1981 – 1991. Also, Fukuyama and Weber (2002)[25] found that Japanese banks experienced productivity decline averaging two per cent during the period 1992 – 1996. This study consistent with Sathye (2002) found the Australian bank is negative Total Factor Productivity over period 1995 – 1999. Like Hassan and Hussein (2003) found that the productivity declined in Sudanese banks, fuelled more by the decline in advances in technology, and not by operating at the right scale, than by decline of technical efficiency. Also, Ramanathan (2007) found that two of six countries in the Gulf Cooperation Council (GCC) had reduction in productivity during the period of thr study from 2000 to 2004. Interestingly, all the countries seem to have registered reductions in productivity in terms of technology change. Like Ramanathan (2007), also Al-Muharrami, (2007)[3] found the Total Factor Productivity for Gulf Cooperation Council had delined from 1993 – 2002.

Similar to Rezitis (2008) [54]and Ausina, Grifell-Tatje, Armero and Conesa (2008), their results showed that the technical efficiency changes and Total Factor Productivity growth of Greek banks and Spanish savings banks respectively are negative. Like with this study, Gaganis, Liadaki, Doumpos and Zopounidis (2009)[26] found that some Greek commercial banks are negative Total Factor Productivity. Also, Pasiouras and Sifodaskalakis (2010) found that the Total Factor Productivity of small commercial banks in Greece are decline from 2000 to 2005. Tai Liu (2010) found that the TFP of 10 out of 25 Taiwanese banks declined while, 15 banks improved. Also, Matthews and Zhang (2010) found the TFP growth of the state-owned commercial banks and the join-stock banks had been neutral over the period of the study. Our results are also consistent with Arjomandi, Harvie and Valadkhani (2012). They found the Total Factor Productivity of Iranian banking industry is declined during the period from 2003 to 2008. In addition, Zhang and Wang (2013)[65] Found that in China, the commercial banks with foreign ownership are negative Total Factor Productivity over the period 2004 – 2011. Consistently Fujii, Managi and Matousek (2014) found that in the Indian banks the TFP growth had not improved significantly over the period from 2004 to 2011. All the previous mentioned studies support the results of the present study.

Hassan, Al-Sharkas and samad (2004) found that the TFP of banks in Bahrain had improved during the period 1998 – 2000 while, Hassan (2006) found that the TFP of Islamic banks in the world had grown by three per cent during the period from 1995 to 2001. The difference between the results of the present study and Hassan et al. (2004) and Hassan (2006) may be because the most important part of the financial services offered in the Libyan economy is performed either by owned banks, whole or a large proportion of the Central Bank of Libya, and this had a negative impact on the performance of these banks and led to low productivity and the presence of a significant proportion of surplus labor.

4.2 Factors Influencing The Total Factor Productivity 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 Ordinary Least Square (OLS) regression onto a vector of explanatory variables is to explain the variation in the efficiency scores obtained from stage one. Table 4.12 used OLS 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:

$$TFP = \beta_1 ROA_{it} + \beta_2 Risk_{it} + \beta_3 SO_{it} + \beta_4 GL_{it} + \beta_5 Mergers_{it} + \beta_6 OWS_{it} + \varepsilon_{it}$$

Table: 4. Results of the Panel Estimation: Technical, Pure Technical, Scale Efficiency and Total Factor Productivity

	TFP
C	0.925
Profitability	-2.021 (0.447)
Risk	-0.478 (0.785)
Size of Operation	0.145 (0.123)
Government Link	-0.129 (0.458)
Mergers	0.025 (0.847)
Ownership Structure	0.047 (0.664)
R-squared	0.067
Adjusted R-squared	-0.020
F – statistics	0.767
Prob. (F – statistics)	0.633
Durbin – Watson	2.423

Note: ***, ** and * denote significance level at the 1per cent, 5 per cent and 10 per cent respectively

4.2.1 Hypothesis 1: Profitability

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

H_a : Profitability is significantly related to bank efficiency and Productivity.

The results in Table 4 show ROA as peroxide by profitability (Net Income after Tax divided by Total Assets) has a negative sign. This factor indicates the profit of Libyan banks; these results indicate that the less profitable banks are less efficient. The profitability is negatively related to total factor productivity and not significant. Based on these results, reject the Null Hypothesis that stated Profitability is not significantly related to bank efficiency is accepted.

Results of this study are consistent with previous and current studies such as Miller and Noulas (1996)[46] Isik and Hassan (2002)[32], Yildirim (2002)[64], Casu and Molyneux (2003)[13] Hasan and Marton (2003)[27] Hassan et al. (2004), Sufian (2007a and 2009), Ariff and Can (2008), Hays, De Lurgio and Gilbert (2009), Avkiran (2011), and El Moussawi and Obeid (2011)[22]. 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.

4.2.2 Hypothesis 2: RISK

H_0 : Risky banks are less efficient and decreasing productivity, and

H_a : Risky banks are efficient and increasing productivity.

The results of this study showed that the risk is negatively related to total factor productivity 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 total factor productivity are not significant. So, based on these findings this study accepts the Null Hypothesis that stated risky banks are less efficient total factor productivity and the Alternate 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.

4.2.3 Hypothesis 3: Size of Operation

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

H_a : Large size operation is significantly related to efficiency and productivity

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 not significantly related to total factor productivity Therefore, this study accepts the Null Hypothesis that large a sized operation is not significantly related to 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, Drake and Howcroft (2002) found that a significant and positive relationship related to size of bank in UK. 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, Kamaruddin (2007), Kiyota (2009), and Sufian (2007, 2009 and 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.

4.2.4 Hypothesis 4: Government Link

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

H_a : Government Link is significantly related to bank efficiency and productivity.

Our results also showed that government link (i.e., relation between government ownership and efficiency) is negatively and not significant related to total factor productivity. So, the Null Hypothesis is accepted for total factor productivity.

However, a study by Sufian (2009) showed that coefficient in relation to government link has a negative

sign, meaning there is an inverse relationship between government link and bank productivity.

4.2.5 Hypothesis 5: Mergers

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

H_a : Mergers are significantly related to bank efficiency and productivity.

In addition, the results of this study showed that merger is positively and not significantly related to total factor productivity. This means that the banks that merge will 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 accepted.

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 U.S. 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, Liu and Tripe (2001), 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.

4.2.6 Hypothesis 6: Ownership Structure

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

H_a : Ownership structure is significantly related to bank efficiency.

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 positively and not significantly related to total factor productivity. 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 total factor productivity is accepted.

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 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.

In conclusion, these hypotheses suggest that there is no significant between variables which used in this study and total factor productivity.

5 CONCLUSION

This study investigated the TFP of Libyan banking industry during the period of 2004-2010. The results showed that the TFP on technical efficiency for the Libyan banks decreased by an average of 1.6 per cent over the period of study (2004/2010: 0.984). In addition, 11 out of 17 Libyan banks declined because TFP levels of banks are drawn by negative technical efficiency change (less than 1) or by negative technological change, or both of them are negative. The results also showed that among the six variables, there is no significant between variables which used in this study and total factor productivity. So, we suggest use other variables that may effect on TFP on Libyan banks.

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