International Journal of Business, Economics and Management

2015 Vol. 2, No. 4, 100-119.
ISSN(e): 2312-0916
ISSN(p): 2312-5772

DOI: 10.18488/journal.62/2015.2.4/62.4.100.119

THE TOTAL FACTOR PRODUCTIVITY OF LIBYAN BANKS, 2004 – 2010

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ABSTRACT

This paper provides a comparative analysis regarding the performance of 17 Libyan banks over the period 2004 up to 2010. According to the relevant literature, there are few studies that measure both technical efficiency and Malmquist productivity index approach using non – parametric approach (DEA) for the banking sector in Libya. For this study, the DEA technique was used to estimate technical, pure technical, and scale efficiency of sampled banks by using DEAP software. . The results showed that the specialized banks have exhibited higher mean technical efficiency relative to commercial and private banks. This paper concludes with some policy implications of the results. The results for total factor productivity (TFP) showed 11 of 17 Libyan banks decline because TFP levels of banks drawn by negative technical efficiency change (less than 1) or by negative technological change, or both of them are negative.

Keywords: Technical efficiency, Malmquist productivity, Data envelopment analysis, Commercial banks, Specialized banks, Private banks.

Received: 8 December 2014/ **Revised:** 23 February 2015/ **Accepted:** 27 March 2015/ **Published:** 9 April 2015

Contribution/ Originality:

This study contributes in the existing literature and to provide practical contribution to practitioners who implement financial initiatives in Libya such as financial managers, policy makers, strategists and financial specialists and analysts. Also, this study is one of very few studies which have investigated in Arab Countries particularly in 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

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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 and 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 *et al*., 2009).

The banking sector in Libya encountered large and very important changes with the installation of a new national payments system, a program which was implemented in 2005 following consultation with the World Bank (Panorama Report, 2008). This shows that previously the banking sector in Libya was a local, heavily regulated, and restricted business, resulting in a closed and an 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 *et al.*, 2004). Therefore, it appears that there are no sufficient studies that have been conducted for Libyan banking.

For this reason, this paper provides a comparative analysis of the performance of banking sector in Libya over the period 2004 to 2010 by following a two stages approach: estimating efficiency scores in the first stage, and measuring Malmquist productivity 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 *et al.* (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.

Percin and Ayan (2006) attempted to measure and evaluate the efficiency of commercial banks in Turkey using a Data Envelopment Analysis (DEA) and Malmquist Productivity Index (MPI) methodologies. For this purpose, two outputs representing total loans and non-interest income, and four inputs representing the number of employees, physical capital, non-deposit funds and total deposits are selected for a two-year (2003-2004) period in the analysis. Using data for the year 2004, 11 of the 31 banks are found to be efficient under CRS, while 16 of them efficient under VRS assumption. Also, for the year 2003, 16 of the 31 banks have been calculated efficient under CRS while 23 of them efficient under VRS assumption. In addition to efficiencies of banks, it has been found that there is an increase of bank's efficiency changes over the time period of 2003- 2004.

Ausina *et al.* (2008) attempt to analyse the efficiency and productivity of Spanish savings banks over the 1992–1998 post-deregulation period, and to provide statistical precision in our results. They used two inputs loans (y_1), and saving, time, and transactions deposits (y_2), and they used three inputs labor (x_1), capital (x_2), and purchased funds (x_3). Their results showed that

productivity growth has occurred, mainly strap analysis yields further evidence, as for many firms productivity growth, or decline, is not statistically significant.

Matthews and Zhang (2010) examined the productivity growth of the nationwide banks of China and a sample of city commercial, banks for the ten years to 2007. Using a bootstrap method for the Malmquist index, estimates of the total factor productivity growth was constructed. This study employs an unbalanced panel of annual data (1997–2007) for the 5 state-owned or state-controlled commercial banks (SOCB), 9 joint-stock commercial banks (JSCB) and 47 city commercial banks (CCB). The total sample consisted of 314 bank year observations. The main source of the data was Fitch/Bank scope, and individual annual reports of banks. They used three outputs loans, other earning assets, and RFEE (net fee income), and three inputs deposits, overheads, and fixed assets. In general, average TFP growth has been neutral over the period for the SOCBs and JSCBs but positive for the CCBs in the second part of the period. Efficiency gains (catch-up) were obtained through cost reduction and technical innovation was associated with greater diversification of revenue away from interest earnings.

Deng *et al.* (2011) attempted to find out what happen to the bank productivity in Malaysia during 2001-2008, that is the period of internet technology waves. DEA is used to calculate and decompose the Malmquist index of total factor productivity (TFP) growth into technical change and change in scale efficiency. They used a panel data of 24 banks (9 local, and 15 foreign) in Malaysia during the period 2001-2008. The data were compiled from ABM Bankers Directory. This study used two outputs loans and advances, and profit, and three inputs branches, staff, and deposits. The study found that the average TFP change is 1.4%, which is mainly due to the efficiency change of 3.3%. In addition, foreign banks were found to have higher efficiency level, followed by the local banks. Finally, the study found that the TFP does not always keep increasing as the technology improved. Fujii *et al.* (2014) examined technical efficiency and productivity growth in the Indian banking sector over the period from 2004 to 2011. They use other earning assets, customer loans and bad loans as outputs, also they use three inputs: labor, deposits and premises. They find that the inefficiency levels are significantly different among the three ownership structure of banks in India. Foreign banks have strong market position in India and they pull the production frontier in a more efficient direction. SPBs and domestic private banks show considerably higher inefficiency. We conclude that the restructuring policy applied in the late 1990s and early 2000s by the Indian government has not had a long-lasting effect.

3. RESEARCH METHODOLOGY

DEA can be defined as a mathematical method using linear programming to measure the relative efficiency of a number of administrative units (decision-making units) through the identification of the optimal mix of inputs and outputs which are grouped based on their actual performance (Manadhar and Tang, 2002; Zhu, 2003). The most important models of DEA are

the CCR (Charnes, Cooper, and Rhodes) model and the BCC (Banker, Charnes, and Cooper) model. The CCR was developed by Charnes *et al.* (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 and Stoker, 1991). 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 *et al.*, 1998).

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

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

$$SE = \frac{\theta^*_{CCR}}{\theta^*_{BCC}} \qquad (5)$$

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 (5) shows a decomposition of efficiency as

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

$$\text{Technical eff. (TE)} = \text{Pure Technical eff. (PTE)} \times \text{Scale eff. (SE)} \qquad (6)$$

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 *et al.*, 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. Table I shows the types and the names of Libyan banks.

Table-1. Types of Libyan Banks

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

3.1. Input and Output Definition

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

The production approach views banks as primarily services producing for customers. The banks generate transactions and process documents for customers as an output, such as loan 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 labor 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 (y1) (Drake *et al.*, 2009), profit after tax (y2) (Mostafa, 2007), No. of employees (x1) (Wu *et al.*, 2006), total fixed assets (x2) (EL Moussawi and Obeid, 2011), and deposits (x3) (Sufian, 2007; Sufian, 2009; Sufian, 2011). Variables y1, y2, x2, and x3 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. Productivity

Productivity indices are measures of total factor productivity, when the efficiency score comes from economic production frontier models. TFP includes all categories of productivity

changes and can be decomposed further to provide a better understanding of the relative importance of various components, including Technical Change and Efficiency Change (Fare *et al*., 1994). Technical Change measures shifts in the production frontier, so-called frontier shift. Efficiency Change measures changes in the position of a production unit relative to the frontier, the so-called catching-up factor.

There are two main approaches to measuring bank productivity: the intermediation approach and the production function approach. The intermediation approach uses a combination of data envelopment analysis (DEA) and the Malmquist Productivity index (Canhoto and Dermine, 2003; Ataullah *et al*., 2004; Isik, 2007). These methods are based on a linear programming input–output technique and estimate the relative efficiency of an organization. The primary advantages of this method are its non-parametric approach and the use of multiple inputs and outputs. The major drawback is that "the frontier is defined on the outliers rather than on the whole sample and is thereby particularly susceptible to extreme observations and measurement error" (Colwell and Davis, 1992).

According to Fare *et al*. (1994), TEC (Technical Efficiency Change) 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 measure as follows:

$$MPI_0^{t+1}(x^{t+1}, y^{t+1}, x^t, y^t) = \left[\frac{D_0^t(x^{t+1}, y^{t+1}/CRS)}{D_0^t(x^t, y^t/CRS)} \times \frac{D_0^{t+1}(x^{t+1}, y^{t+1}/CRS)}{D_0^{t+1}(x^t, y^t/CRS)}\right]^{\frac{1}{2}} \quad (7)$$

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

$$\text{TC} = \left[\frac{D_0^t(x^{t+1}, y^{t+1}/CRS)}{D_0^{t+1}(x^{t+1}, y^{t+1}/CRS)} \times \frac{D_0^t(x^t, y^t/CRS)}{D_0^{t+1}(x^t, y^t/CRS)}\right]^{\frac{1}{2}} \quad (8)$$

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

$$\text{TEC} = \frac{D_0^{t+1}(x^{t+1},y^{t+1}/CRS)}{D_0^t(x^t,y^t/CRS)} \quad (9)$$

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 decomposited into PTEC and SEC, defined as below:

TEC = PTEC × SEC;

where

$$PTEC = \frac{D_0^{t+1}(x^{t+1},y^{t+1}/VRS)}{D_0^t(x^t,y^t/VRS)} \quad (10)$$

$$SEC = \frac{D_0^{t+1}(x^{t+1},y^{t+1}/CRS)/D_0^{t+1}(x^{t+1},y^{t+1}/VRS)}{D_0^t(x^t,y^t/CRS)/D_0^t(x^t,y^t/CRS)} \quad (11)$$

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 capture 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 $TC = PTEC \times SEC$

4. RESULTS

4.1. Efficiency Level of Libyan Banks Using DEA Approach

4.1.1. Descriptive Analysis – Bring from the Banks

Table (1) gives summary statistics. It includes descriptive statistics pertaining to the outputs (loan income (y1), profit after tax (y2)) and inputs (No. of employees (x1), total fixed assets (x2), and deposits (x3)) of the sample during the period of study. As is shown, the banking sector in Libya grew significantly from 2004 to 2010, mainly as high oil prices as the country heavily depend on oil export (95% from the total). The Libyan banks achieved a whopping 198% growth in average deposits for the period from 2004 to 2010. During those years, , the average amount of total fixed assets over the sample period reflected the high growth path of 89.6%.

Table (1) shows that the mean of Loan Income in 2010 is the highest (1.4 billion Libyan Dinar), followed by 2009 (1.3 billion Libyan Dinar). The mean of loan income increases from 2004 to 2006 then decrease in 2007 by 8% after that started increase again from 2008 to 2010 by19%.

The profit after tax is not stable during the period of the study increases in some years and decreases in other years. The highest profit in 2010 (45 million Libyan Dinar) and the lowest profit in 2006 (28 million Libyan Dinar).

Table-2. Descriptive Statistics of Outputs and Inputs of Libyan Banks from 2004 – 2010

year	Loan Income (y_1)	Profit After Tax (y_2)	No. of Employees (x_1)	Total Fixed Assets (x_2)	Deposits (x_3)
2004					
Mean	761.196	31.993	1189.308	29.900	1518.270
Std. Deviation	903.977	64.333	1057.672	44.855	2830.244
Minimum	0.458	0.177	44	0.630	11.858
Maximumum	3152.600	238.600	3073	163.800	10251.800
2005					
Mean	832.629	34.557	1172.923	40.086	1946.268
Std. Deviation	959.479	60.390	1030.956	87.824	3061.380
Minimum	0.853	0.450	53	0.881	17.325
Maximum	3262.300	225.100	3100	325.300	11085.300
2006					
Mean	1132.819	27.6128	1225.923	21.7821	2794.442
Std. Deviation	1309.70221	43.4189961	1049.59396	22.6653545	4807.51361
Minimum	4.984	0.653	60	0.837	22.790
Maximum	4074.600	160.100	3166	59.641	17853
2007					
Mean	1044.752	33.605	1001.235	28.3428	2855.266
Std. Deviation	1513.91029	55.8736911	1042.97256	27.9627492	5014.62061
Minimum	0.261	0.225	53	2.524	33
Maximum	4784.800	224	3206	104.858	18964.700
2008					
Mean	1166.468	31.389	1118.706	39.111	3752.261
Std. Deviation	1599.80	42.857	1248.486	32.445	5844.863
Minimum	3.730	0	54	2.389	30
Mximum	5898.700	142.500	4560	87.321	17552.400
2009					
Mean	1312.682	39.641	1183.706	50.917	3839.276
Std. Deviation	1876.582	55.489	1298.561	43.887	5664.993
Minimum	0.787	0	55	4.646	28.300
Maximum	6596.700	164.700	4894	163.452	19817.160
2010					
Mean	1392.158	45.435	1292.941	56.572	4524.999
Std. Deviation	2074.55158	56.8165115	1502.09848	47.9049603	6991.97827
Minimum	1.694	0.398	99	4.77	29.8
Maximum	7403.3	175.958	5936	161.121	25105.11

4.1.2. Technical Efficiency of the Libyan Banks

The technical efficiency measures address by how much can input quantities be proportionally reduce without changing the output quantities produced (Shih *et al.*, 2004). In this research we measure the technical efficiency with the assumption of variable return to scale input-

based (VRS) using DEAP 2.1 software as we mentioned in chapter 4 (methodology). 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.

4.1.2.1. Technical Efficiency of Libyan Commercial Banks from 2004 – 2010

Table (2) shows the relative position of each commercial bank in Libya. Using DEAP 2.1 software and under VRS assumptions the data indicate progress in the average efficiency scores for almost all samples during the period of study between 2004-2010. The TE efficiency score average of Wahda, Aljumhoria, National Commercial bank was the highest overall score (1.000) except for Sahara bank which shows 0.600 in 2004. Wahda bank is efficient in 2004 and 2006. Aljumhoria banks is efficient only in 2004, also Sahara bank is efficient only in 2005. And the National Commercial bank is the best one, it's efficient in 2004, 2005, and 2006. Table (5.2) shows that, there is no any commercial bank efficient during the period from 2007 to 2010. Furthermore, the average efficiency score in commercial banks shows better score in 2004, and the worst score in 2007.

Table-3. Technical Efficiency of Libyan Commercial Banks From 2004 – 2010

	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
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
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
National Commercial							
TE	1.000	1.000	1.000	0.184	0.204	0.266	0.581
PTE	1.000	1.000	1.000	0.193	0.218	0.269	0.740
SE	1.000	1.000	1.000	0.953	0.939	0.991	0.784
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

Figure (1) shows that the inefficiency in commercial banks' performance refers to pure technical inefficiency for years 2004, 2005, 2007, 2008, and 2009 (for example pure technical inefficiency 27.7% in 2005) also, the figure refers to scale inefficiency in 2006 and 2010 (scale inefficiency in 2010 was 25.1%). So, the main source of inefficiency was caused by inappropriate

pure technical and scale of operation. This implies that the commercial banks are not working in its' optimal level in operations. Also, the results show decreasing return to scale.

4.1.2.2. Technical Efficiency of Libyan Specialized Banks from 2004 – 2010

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. The TE score of the specialized banks appeared stable and had the highest overall score. From table 5.3 we can see that the Real State Investment bank and Development bank are efficient in all the period of study, Agriculture bank is efficient for all the years of study except 2006 it is 34.1%, also the Libyan Foreign bank is efficient for all the years of the study except 2004 it is 73%. Alrefi bank is efficient only in 2005, 2008, 2009, and 2010. Furthermore, the average efficiency score in specialized banks shows better score in 2005, 2008, 2009, and 2010. Overall, the results in table (5.3) show an improvement in the average efficiency scores for specialized banks.

Table-4. Technical Efficiency of Libyan Specialized Banks From 2004 – 2010

	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
Real State Investment							
TE							
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
	1.000	1.000	1.000	1.000	1.000	1.000	1.000
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
Libyan Foreign							
TE							
PTE	0.728	1.000	1.000	1.000	1.000	1.000	1.000
SE	0.846	1.000	1.000	1.000	1.000	1.000	1.000
	0.861	1.000	1.000	1.000	1.000	1.000	1.000
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
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

Figure (2) shows that the specialized banks' totally efficiency (100%) in 2005, 2008, 2009 and 2010. Also, figure (2) illustrates that the performance refers to scale inefficiency in 2004, 2006 and 2007. So, the main source of inefficiency was caused by inappropriate scale of operation. This

implies that the specialized banks are not working in its' optimal level in operations. Also, the results show decreasing return to scale.

4.1.2.3. Technical Efficiency of Libyan Private Banks from 2004 – 2010

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 is efficient only in 2010 . Furthermore, the average efficiency score in Private banks appears not efficient during the period of study. In table 5.4 the highest average efficiency scores in 2010, it is 51%.

Table-5. Technical Efficiency of Libyan Private Banks From 2004 – 2010

	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
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
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
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
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
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
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
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
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

Same the commercial banks in 2006 and 2010, figure (3) shows that the inefficiency in private banks' performance refers to scale inefficiency for all the years of the study, (for example scale inefficiency in 2004 for private banks equal 59.8%). So, the main source of inefficiency was caused by inappropriate scale of operation. This implies that the private banks are not working in its' optimal level in operations. Also, the results show decreasing return to scale.

4.1.2.4. Overall Technical Efficiency of Libyan Banks from 2004 – 2010

Table (5) shows the overall technical efficiency of Libyan banks during the period of study. According to the results shown in Table (5) and based on VRS, the study found that the results show that the most efficient banks to be specialized banks, followed by commercial banks and in the last private banks. Given the relatively well equipped nature of the specialized banks and the facilities given by government to commercial ones, this above result does not come as a surprise; it can be partly attributed to increased foreign participation and improved in banking regulation in banking sector in Libya.

Table-6. Overall Technical Efficiency of Libyan Banks From 2004 – 2010

Mean	2004	2005	2005	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	0.648	0.636	0.539	0.537	0.576	0.526	0.726	0.598
TE	0.847	0.816	0.871	0.700	0.715	0.706	0.864	0.788
PTE	0.758	0.749	0.602	0.814	0.800	0.775	0.838	0.762
SE								

Figure (4) shows that the overall inefficiency in Libyan banks' performance refers to pure technical inefficiency for years 2007, 2008, and 2009 (for example pure technical inefficiency 30% in 2007) also, the figure refers to scale inefficiency in other years of study (scale inefficiency in 2006 equal 39.8%). So, the main source of inefficiency was caused by inappropriate pure technical and scale of operation. This implies that the commercial banks are not working in its' optimal level in operations. Also, the results show decreasing return to scale.

4.2. Measuring Productivity of Libyan Banks

Following Fare *et al.* (1994), the Malmquist total factor productivity change index (TFP) has been measured of Libyan banks. Productivity change is decomposed into technological change (TC) and technical efficiency change (TEC), where TFP = TC × TEC. If the value of TFP greater than one indicates positive TFP growth while the value less than one indicates decline over the period of 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 decomposed 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-7. 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	1.188
2005/ 2006	0.726	1.129	1.007	0.721	0.820
2006/ 2007	0.909	0.906	0.978	0.929	0.823
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.

Table (7) and figure (5) 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) using DEAP 2.1 software developed by Coelli (1996). For the Libyan banks in the panel total factor productivity is decline for all the years of the study except 2005 it was growth by 18.8 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 by 1.6 per cent, pure technical efficiency change recorded a positive growth of 0.09 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-8. Individual Malmquist Indices of Libyan Banks 2007 – 2010

Bank	Technical Efficiency Change (TEC)	Technological Change (TC)	Pure technical efficiency change (PTEC)	Scale efficiency change (SEC)	Total factor productivity (TFP)
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
Agricultur	1.000	0.896	1.000	1.000	0.896
Real State 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
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

Based on Table (8) the results of individual banks unbalanced panel data are presented. Overall the results seem to indicate productivity growth for the following banks: Alrefi (24.3%), Alejmaa Alarabi (22.6%), Commercial and Development bank (19.6%), Al-Wafa (17%), Mediterranean (8.4%) and Alsary (5.3%). TFP of and the growth banks were calculated as the average of their values in tables 4.8. From an analysis of the decomposition of the Malmquist TFP, productivity growth in Alejmaa Alarabi, Commercial and Development bank, Al-Wafa, Mediterranean, and Alsary, seem to have been brought about mainly by a positive change in technical efficiency.

Alrefi, bank, the gains achieved from technological advances have benefited the bank's technical efficiency level where there in increase of its technical efficiency 3.2 % (PTEC = 1.032). Also, the bank display positive scale efficiency change indicating that its scale size is economical which can prevent wastage in expenditure. In addition, productivity changes of Alrefi bank (TEC = 1.140) has also resulted from improvements in bank efficiency.

The productivity of Al Wafa bank seems to have been brought about more by increases in technological change (+17%) (TC = 1.170) rather than by technical efficiency. The efficiency is constant (TEC = 1.000) due to pure technical efficiency equal scale efficiency (PTEC = SEC = 1.000).

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

5. CONCLUSION

We evaluated the technical, pure technical, and scale efficiency of banking sectors in the Libyan banking sector employing the two-stage method. In the first stage, the efficiency score of 17 banks was estimated by using the DEA approach to investigate whether the technical, pure technical, and scale efficiency of the banking system improved between 2004 and 2010. The 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 in the last private banks. In the second stage we measure the productivity of Libyan banks using Malamquist productivity index, and the results showed that there are 11 of 17 Libyan banks decline because TFP levels of banks drawn by negative technical efficiency change (less than 1) or by negative technological change, or both of them are negative. 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, 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.

6. ACKNOWLEDGEMENTS

This study was supported by Arshad Ayub Graduate Business School, Universiti Teknologi MARA, Malaysia

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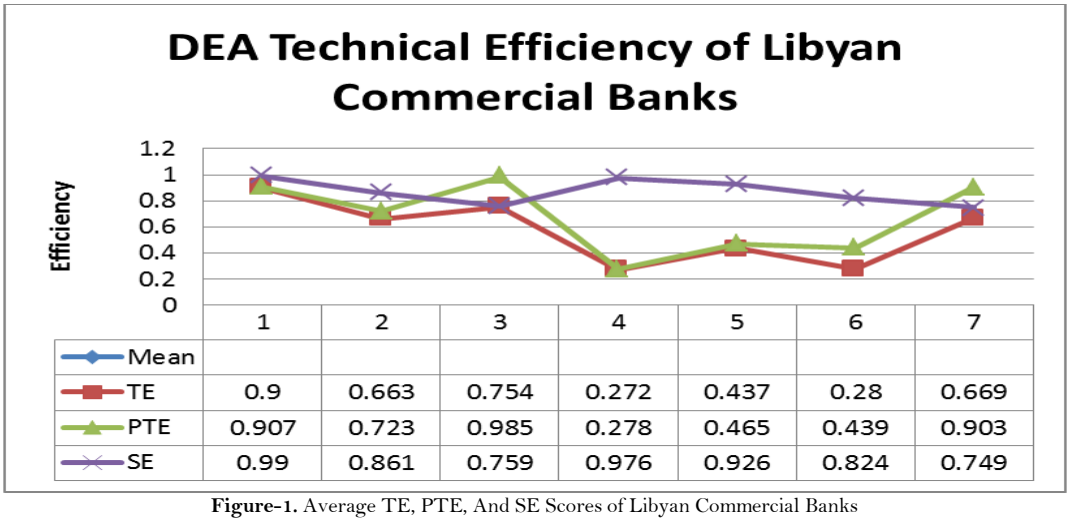
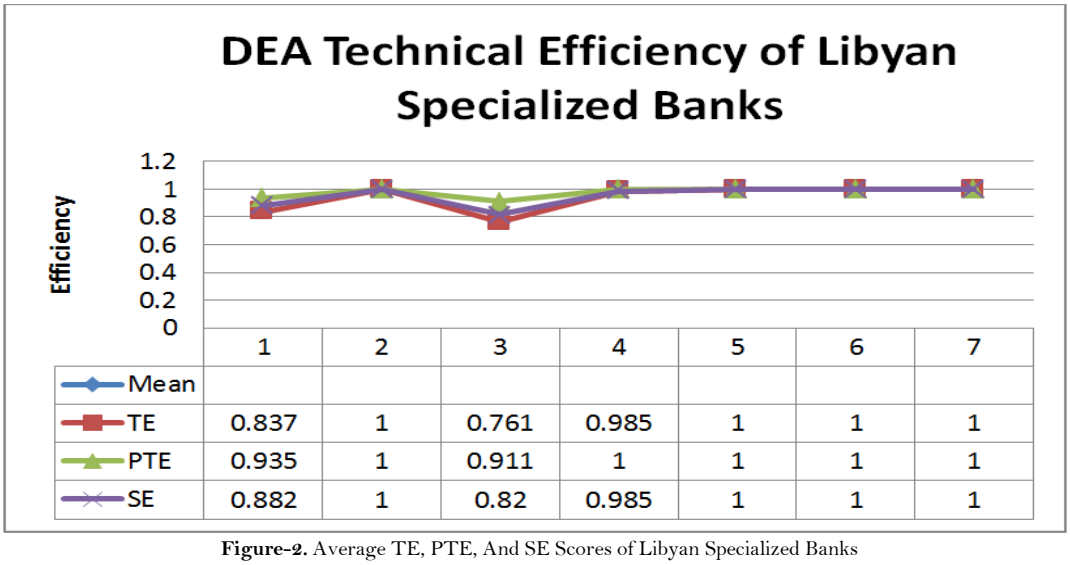


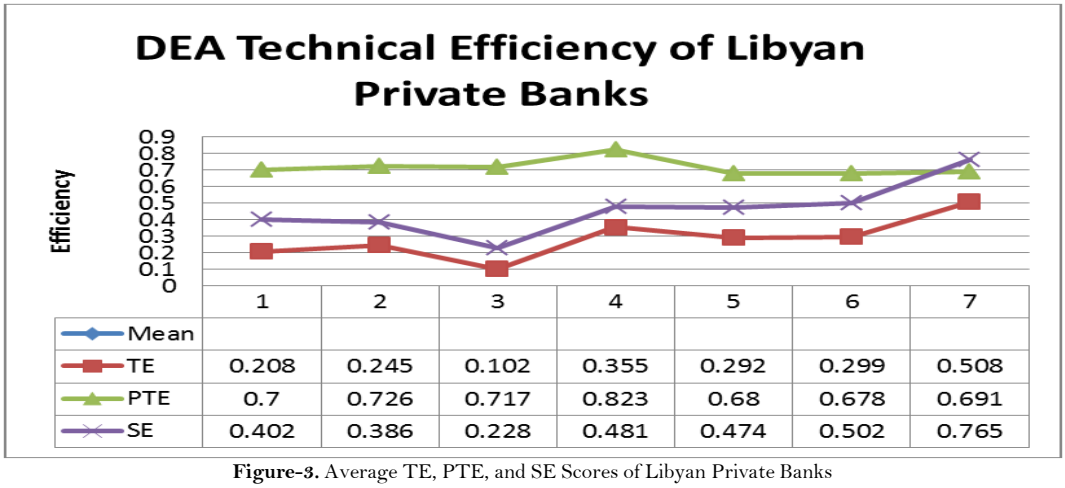
	1	2	3	4	5	6	7
Mean							
TE	0.9	0.663	0.754	0.272	0.437	0.28	0.669
PTE	0.907	0.723	0.985	0.278	0.465	0.439	0.903
SE	0.99	0.861	0.759	0.976	0.926	0.824	0.749

Figure-1. Average TE, PTE, And SE Scores of Libyan Commercial Banks



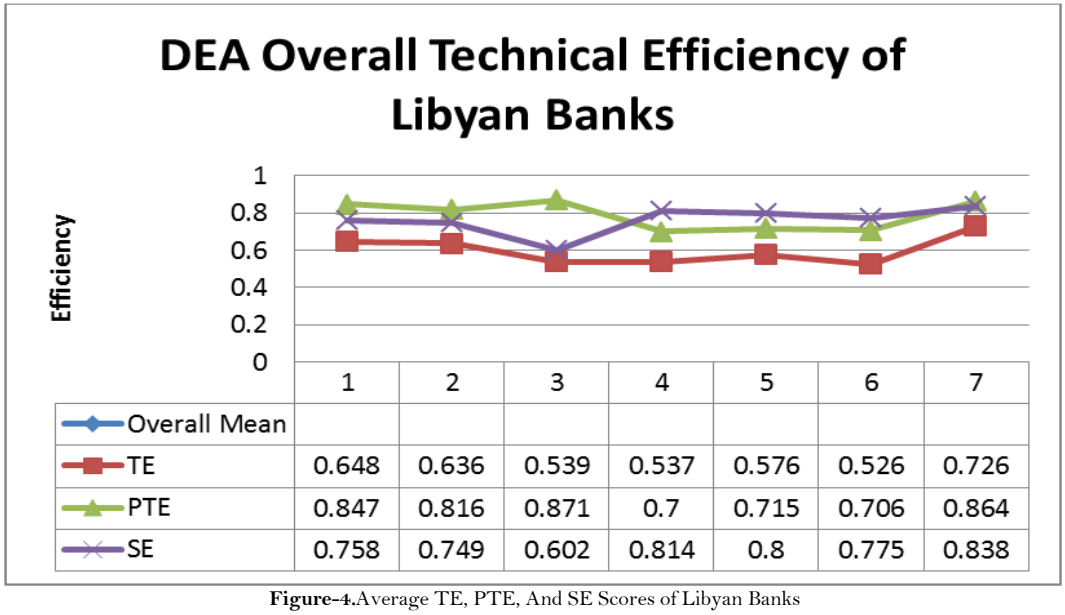
	1	2	3	4	5	6	7
Mean							
TE	0.837	1	0.761	0.985	1	1	1
PTE	0.935	1	0.911	1	1	1	1
SE	0.882	1	0.82	0.985	1	1	1

Figure-2. Average TE, PTE, And SE Scores of Libyan Specialized Banks



	1	2	3	4	5	6	7
Mean							
TE	0.208	0.245	0.102	0.355	0.292	0.299	0.508
PTE	0.7	0.726	0.717	0.823	0.68	0.678	0.691
SE	0.402	0.386	0.228	0.481	0.474	0.502	0.765

Figure-3. Average TE, PTE, and SE Scores of Libyan Private Banks



	1	2	3	4	5	6	7
Overall Mean							
TE	0.648	0.636	0.539	0.537	0.576	0.526	0.726
PTE	0.847	0.816	0.871	0.7	0.715	0.706	0.864
SE	0.758	0.749	0.602	0.814	0.8	0.775	0.838

Figure-4. Average TE, PTE, And SE Scores of Libyan Banks

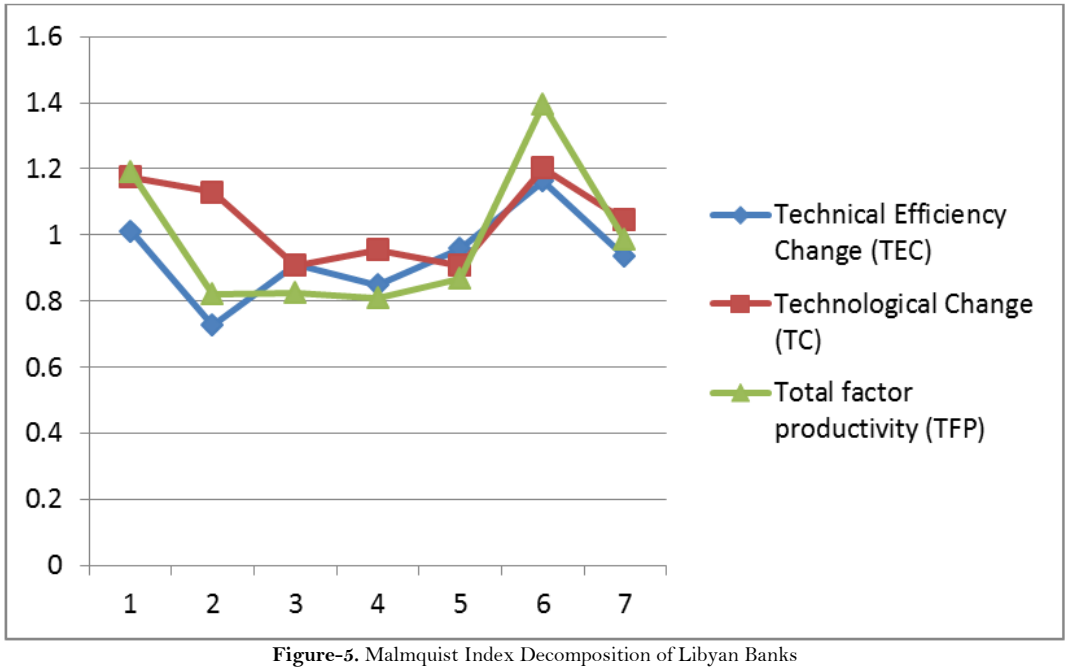


Figure-5. Malmquist Index Decomposition of Libyan Banks