



## **Productivity Change of the Egyptian Banking Sector: A Two Stage Non-Parametric Approach**

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### **Abstract**

This study aims to evaluate of the productivity change of the Egyptian Banking sector by using a data set which cover 14 banks operating in the Egyptian market from 1997 to 2013. We use a non-parametric approach Data Envelopment Analysis based analysis to investigate the productivity change in the Egyptian banking sector. Input-oriented Malmquist indices of productivity change are estimated to measure total factor productivity (TFP) change. The TFP changes are decomposed into the product of technological change and technical efficiency change (catch-up). In the second stage, potential determinants of productivity change are studied using a regression model. We find that Egyptian banking sector experienced a decline in TFP growth at the rate of 2.55% in the whole sample period 1997-03. The estimated regression model identifies some variables which significantly influence the productivity of banks in Egypt. The banks with higher loans to deposit ratio and higher returns on equity have higher productivity growth reflecting on their strong strategic and managerial skills. The size of bank seems to be associated with an increase in productivity. The maturity of a bank (measured by age) is associated with higher productivity. The NIM, NIETA and the financial crisis variables do not seem to be affecting the productivity of the Egyptian banks.

**JEL Classification: D22, D24 and G21.**

**Key Words: Data Envelopment Analysis, Egyptian Banks, Malmquist Productivity Indices, Total Factor Productivity**

## **1. Introduction**

The productivity of banks can be measured simply as a scalar ratio of outputs to inputs that the bank uses. Bank's productivity may vary based on differences in the quality of inputs used. However, efficiency can be measured by associating the observed and optimal values of the bank's outputs and inputs. The question of whether banks outperform or underperform other banks has received considerable attention in the literature. There is a large body of literature dealing with the measurement of banking efficiency and productivity growth in the developed economies, but studies on banking efficiency and productivity growth relating to Middle Eastern economies are few. To the best of our knowledge, there are only a handful of research articles related directly to the efficiency and productivity growth of banks in Egypt. One of the reasons for the lack of this research is that most Middle Eastern countries including Egypt did not introduce financial and banking sector reforms until the 1990s. Until then, financial system in these countries tended to be heavily regulated and dominated by the public sector (United Nations, 2005). However, over the past two decades, the majority of Middle East countries have gradually moved towards more liberalised financial systems. Moreover, this has created interest among policy makers, managers and economists to study the efficiency performance and productivity of banks in Middle Eastern countries over time.

The purpose of this paper is to investigate whether the Egyptian banks have experienced any improvement in their productivity during the financial liberalisation period, 1997-2013. The aim is to investigate whether there has been an increase and convergence of efficiency levels following the process of liberalization. The paper uses data envelopment analysis (DEA) to calculate input-oriented Malmquist productivity indices to measure total factor productivity (TFP) change in 14 banks during the period 1997-2013. The TFP changes are decomposed into the product of technological change and technical efficiency change (catch-up). We then also evaluate the main determinates of Egyptian banks' efficiency in order to analyse the influence of various factors on bank efficiency.

The rest of the paper is organised as follows. Section 2 presents a brief overview of existing literature on productivity changes in the banking industry. The results of productivity change and the estimates of productivity change regressed against a vector of explanatory variables presents in Section 3. Sections 4 summarises and brings together the main findings.

## **2. A Review of Literature on the Egyptian Banking Efficiency and Productivity Change**

The literature on efficiency and productivity change of banks and how productivity influenced by changes in regulations, innovation and technological processes and differences of productivity across countries is vast. Various studies conducted in the US, Europe, Asia and a few in Africa have measured efficiency and productivity change in banking sector.

The literature on assessing the efficiency of US banks are numerous (Ferrier and Lovell, 1990; Elyasiani and Mehdiian, 1995; Mukherjee et al., 2001; Grabowski et al., 1994; Whelock and Wilson, 1999; and Seiford and Zhu, 1999) have all studied efficiency and productivity of US banks in recent years. Elyasiani and Mehdiian (1995) investigated productivity, concentrating on trends in technical efficiency and technological change for small and large US commercial banks for the period of 1979–1986. They used DEA to measure the efficiency of US banks pre and post deregulation periods and found that the technical efficiency of large banks declined by 3% over an eight-year period. They asserted the absence of any significant difference in the technical efficiency of US banks following bank deregulation. Mukherjee et al. (2001) studied productivity growth in 201 large US commercial banks, covering the initial post-deregulation period of 1984–1990, and found that productivity grew by 4.5% per year on average, with a significant decline in the initial years. Banks with large asset size experienced higher productivity growth overall. This study shows that larger banks and a higher specialization of products in general have higher productivity.

Reda and Isik (2006) examine the efficiency and productivity of commercial banks in Egypt from 1995 to 2003 using the DEA and Malmquist productivity index. They find commercial banks are technically inefficient and productivity deteriorating annually over the period of study. Badreldin and Kaloefer (2009) examine the effect of mergers and acquisitions on Egyptian banks' performance by employing the Return on Equity (ROE) scheme during the period 2002-2007. They find that there is insignificant positive relationship between mergers and acquisitions and profitability of banks. They conclude that banking industry reforms had not have any effect on profitability.

None of these studies have covered the entire financial deregulation and revolution period. The present study overcomes this limitation by encompassing the entire financial liberalisation period and investigating the drivers of productivity change in Egyptian banks.

### **3. The Malmquist Total Factor Productivity Index: Decomposition and Measurement**

The Malmquist TFP index was first introduced in two very influential papers by Caves, Christensen and Diewert (1982a, 1982b). These authors define TFP index using Malmquist distance functions; hence the resulting index is known as Malmquist TFP index. One of the important features of these distance functions is that they allow description of a multi-input, multi-output production technology without the need to specifying a behavioural objective such as cost minimisation or profit maximisation. Distance functions are of two types: the input distance functions and the output distance functions. Input distance functions look for a minimal proportional contraction of an input vector, given an output vector; and output distance functions consider the maximum proportional expansion of output with a given set of inputs. Since the banks have better control over the inputs, we adopt an input-orientated approach for computing TFP.

### 3.1 Results of Malmquist TFP Change

The data used in this study cover 1997–2013 period and are taken from, auditing annual report of individual banks Central Bank of Egypt (CBE). The data were collected from 14 banks operating in Egypt, 11 domestic banks, and 3 foreign banks.

We have used non-parametric data envelope approach to compute the input oriented Malmquist indices of productivity change based on the panel data which cover 14 banks operating in the Egypt from 1997 to 2013. The computer software DEAP (Coelli, 1996) is used to calculate these indices. The value of the Malmquist productivity indices (MPI) greater than one indicates positive productivity growth or productivity progress while a value less than one productivity decline or productivity regress. Percentage change in productivity is given by  $(\text{productivity change} - 1) \times 100$ .

**Table 1: Assets of Domestic and Foreign Banks, 1997**

Bank Category	Bank Name	Short Name	Total Assets (JD millions)
Domestic			
Large	National Bank of Egypt	NBE	15905295
	Banque Misr	BM	14758047.9
	Bank du Caire	BDC	8446256.8
Medium	Commercial International Bank	CIB	4011017.1
	Suez Canal Bank	SCB	2180494
	Faisal Islamic Bank	FIB	1838888
	Housing & Development Bank	HDB	1590305
	Misr Iran Development Bank	MIDB	1160970
Small	Export Development Bank of Egypt	EDB	691101.18
	AlBaraka Bank Egypt	ABE	461254.73
	Societe Arabe Internationale de Banque	SAIB	401020
Foreign			
	National Societe Generale Bank	NSGB	1164457
	Arab African International Bank	AAIB	997995
	HSBC Egypt	HSBC	636343.2

Source: Annual report for each bank, 1997.

To check how productivity has changed over the sub-periods of financial reforms, we present in Table 1 the estimates of TFP for all banks for three sub-periods, 1997-03, 2003-08 and 2009-13 which represent respectively the early, middle and later phases of financial liberalisation in Egypt. And the estimates of TFP for all banks for the whole period are provided.

The results in Table 2 reveal that TFP growth in the banking sector experienced a decline in TFP growth at the rate of 2.55% in the early phase 1997-03, the reason may be due to several factors affecting the banking performance. Firstly, the Egyptian economy faced a serious currency liquidity crisis in 1999 prior to bank privatization. This crisis affected the performance of Egyptian banking sector due to the recessionary economic environment. Secondly, at the end of 2002, the CBE raised the minimum capital adequacy ratio from 8% to 10% which created a problem for undercapitalized banks that have to raise their capital or merge with another capitalized bank. Thirdly, in the early 2003, the Egyptian government decided to float the Egyptian pound against the US\$ which increased the banks' foreign exchange losses, particularly, those that have significant proportion of their investment portfolio in foreign currency. As a result, the CBE reacted quickly by increasing interest rates on T-bills so as to limit overshoot in the exchange rate (CBE, 2004). The average interest rate on T-bills rose up from around 8.10% in early 2003 to around 11.30% at the end of the same year. During this year, the Egyptian banks, especially state-owned banks, suffered from high non-performing loans ratios.

**Table 2: Average Annual Growth Rates of Productivity Growth by Sub-group, 1997–2013 (Percentage)**

Period	Growth of TFP	Growth of TEC	Growth of TC
All Banks			
1997-2003	-2.55	-3.27	0.72
2004-2008	4.04	5.68	-1.66
2009-2013	-1.54	-4.23	2.70
1997-2013	-0.18	-0.77	0.60

Note: TFP denotes total factor productivity, TEC is the technical efficiency change, and TC denotes technological change.

In the middle phase 2004-08, TFP growth increased at the rate of 4.04 % per annum, implying that banking sector has responded positively to the financial liberalisation policies initiated by the Egyptian government. In 2004, the Central Bank of Egypt started a new program to restructure the banking sector and deal with non-performing loans by encouraging a wave of mergers and acquisitions which enabled large and strong banks to acquire the small banks. As a result, the banking sector consolidated to some extent and the number of banks operating in Egypt plunged from 65 in 2003 to 40 in 2014 (CBE, 2014). Simultaneously, in 2005, the Egyptian minister of finance affirmed a revamp of Egypt's income tax structure, on the personal and corporate levels, with the later constituting a unification of the taxation rate at 20% down from a 42% levy on service entities.

In the later phase 2009-13, TFP growth declined at the rate of 1.54% per annum. There are several potential reasons for this decline; Firstly, the impact of the global financial crisis on the Egyptian banking sector. Before the global financial crisis, the Egyptian banks were more liquid, well capitalized, regulated and closely scrutinized (CBE, 2009). However, the banks' profitability was negatively affected by the global financial crisis and the collapse of the local stock market. While the portfolios of Egyptian banks do not include risky instruments like derivatives and securitized bonds, the Egyptian banks suffered losses on their portfolio investments as a result of the slowdown of economy (CBE, 2009). Secondly, the CBE prepared a new phase of the financial reform plan after the global financial crisis which included a deposit insurance plan to protect small investors and establishing the non-banking financial sector regulatory body to regulate insurance companies, capital market activities, and mortgage finance companies (CBE, 2010). Finally, the operating macroeconomic environment for Egyptian banks became more challenging, characterized by lower per capita GDP, high unemployment and soaring consumer price inflation.

### **3.2. Determinants of Total Factor Productivity Change**

The estimates of productivity change are regressed against a vector of explanatory variables (x). The explanatory variables are drawn from previous studies in banking



efficiency literature (see Cavallo and Rossi (2002), Hermes and Nhung (2010), Pasiouras et al. (2009), Casu and Girardone (2004) and Vu and Turnell (2011)).

Specifically the variables that are widely used in the banking productivity change literature are as follows: LTA: It is the logarithm of total assets. It is used as a proxy for the growth of banks. LTD: It is the ratio of loans to deposits. ROE: It is the return on equity. NIETA: It is the ratio of non-interest expense over total assets. NIM: Net;2 interest margin. Financial crises (FC): we use it as a dummy variable. We consider the following model which assumes the TFPC depends on LTA, LTD, ROE, NIM, NIETA and a dummy variable of financial crisis.

$$TFPC = f(LTA, LTD, ROE, NIM, NIETA, FC)$$

Given that our data set consists of balanced panel of banks, we use fixed effects estimator for estimating the model in linear form. The estimated model seems to give a reasonable fit to data in terms of  $R^2$ . Most of coefficients are statistically significant at conventional level of significance.\* The coefficients for LTA are positive and significant suggesting that, other things remaining the same, growth of the bank is accompanied by an increase in its productivity, this means that larger banks are on average more efficient. Positive and statistically significant coefficients on LTD suggest that banks with a higher ability to transform deposits into loans (i.e. that maintain a high ratio of loans to total deposits) would have more TFP gains than their counterparts. This finding is reasonable because a higher ratio of loans to deposits means that inputs are utilised more productively; ROE is positively and statistically significant coefficients related to TFP change. This finding is reasonable because the higher the ROE for a given set of inputs, the more productive the banks are. The coefficients for NIETA are positive and statistically insignificant indicating that this variable do not have any influence on the productivity growth of the Egyptian banks. Negative and statistically insignificant coefficients on NIM suggest there is no effect of this variable on the productivity of the banks in Egypt. The coefficients of financial crisis are negative but statistically insignificant, implying that these variable do not have any influence on the productivity growth of banks in Egypt.

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\* Detailed results can be obtained from the authors.

#### **4. Concluding Remarks**

This paper has used DEA model to estimate input-oriented Malmquist indices to examine TFP changes in the Egyptian banking sector during the entire deregulation period and the period of several crisis in Egypt, 1997-2013. The TFP changes were decomposed into the product of technological change and technical efficiency change (catch up). The technical efficiency change is further decomposed into product of pure technical efficiency change and scale efficiency change. To the best of our knowledge, this is the first attempt to examine TFP changes in the domestic and foreign banks in Egypt during the entire deregulation period, not encompassed in the earlier studies.

The results in Table 2 reveal that TFP growth in the banking sector experienced a decline in TFP growth at the rate of 2.55% in the whole sample period 1997-03. The estimated regression model identifies some variables which significantly influence the productivity of banks in Egypt. The banks with higher loans to deposit ratio and higher returns on equity have higher productivity growth reflecting on their strong strategic and managerial skills. The size of bank seems to be associated with an increase in productivity. The maturity of a bank (measured by age) is associated with higher productivity. The NIM and NIETA variables do not seem to be affecting the productivity of banks. Surprisingly, our results reveals that the financial crisis did not have significantly adverse impact on the productivity of Egyptian banks.

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