

## Empirical Analysis Of Total Factor Productivity Changes in Nigerian Commercial Banks

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### Abstract

*The main objective of this study is to examine whether there were changes in the total factor productivity of commercial banks in Nigeria in the post 2004 banking sector reforms era as well as whether commercial bank total factor productivity is positively related to bank size by total assets. Relying on the Data Envelopment Analysis (DEA) and the Malmquist Productivity Index (MPI) research models, the study reveals that the major driving factor in commercial bank productivity growth in Nigeria is technological innovation. The study also revealed that there was no direct positive relationship between bank size by total assets and productivity changes during the period covered by the study. The study therefore recommends that commercial banks in Nigeria should be technologically innovative while emphasis should not be placed on bank size as a the driving factor in productivity of commercial banks in Nigeria, rather banks should identify optimal economies of scale to enhance their efficiency and productivity.*

**Key Words:** Total Factor Productivity Changes, Bank Size, Nigerian Commercial Banks

### 1.0 Introduction

Banks are engaged in the process of financial intermediation using multiple inputs such as capital, labour and customers' deposits to produce multiple outputs such as loans, advances and investments. The study of commercial banks' performance has posed several problems because of its multidimensional complexity based on the multiple inputs and outputs parameters for assessing bank performance as well as the several interested parties on the performance of commercial banks. While some interested parties evaluate performance based on profitability, growth, efficiency and risk, others especially financial economists have focused their studies on the ability of banks to mobilize savings, the ratio of private sector credit to GDP and the ratio of money supply to GDP. Existing findings in the literature suggest in most cases that medium sized banks are more scale efficient and more productive than large banks (Berger & Timme 1993; Mester 1987; Humphrey 1990,). Studies in other countries show evidence that larger sized banks are more able to identify and develop cutting- edge technology and management system (Batchelor, Kuppusamy & Allen 2005) but have not necessarily enhanced their efficiency and productivity. Studies specifically investigating the productivity of banks in Nigeria are scanty in the literature. The banking sector consolidation reform of 2004 in Nigeria resulted in higher capitalized banks by shareholders funds as well as bigger sized banks by total assets some of which resulted from mergers and acquisitions. However, it is not certain whether there has been a direct positive relationship between bank size by total assets and the efficiency and productivity of the larger banks that were the outcome of the consolidation exercise in Nigeria.

### 1.1 Statement of the Research Problem

Over the years, the Central Bank of Nigeria has continued to embark on reforms in the areas of regulations, deregulations, structuring and restructuring of the financial system, yet the problems of unsatisfactory performance of commercial banks in Nigeria seem to have persisted. Evidence of such less than expected performance are indicated by banking sector instability, distress, huge portfolios of non- performing loans and advances, high operating costs, wide margins between lending and deposit rates. These and related negative performance indicators led to the withdrawal of banking licenses of some banks and the controversial bail out of some weak banks in year 2009 with over N620 billion from public funds by the Central bank of Nigeria (CBN). It would appear that there are some internal operational factors that have not been fully identified by bank management such as low efficiency and factor productivity resulting in unabated danger of instability, high level of non- performing risk assets, high operational costs, and weak internal control systems that that have continued to afflict commercial banks in Nigeria. The Nigerian banking system also witnessed lots of structural changes during the period 2005 to 2011, in terms of labor turn over, staff and managerial movements and board changes. As an information technology based industry, Nigerian commercial banks during the period invested heavily on IT infrastructure to boost efficiency and productivity. The question has remained whether the commercial banks have become more productive and to what extent have there been improvements in efficiency and productivity during the period following the reforms. This situation raises several research questions on bank efficiency and productivity in Nigeria such as :

- i. Have there been changes in the productivity of commercial banks in the post 2004 reforms era in Nigeria?
- ii. Is there a direct positive relationship between total factor productivity of commercial banks in Nigeria and bank size by total assets?

## 1.2 Objectives Of The Study

The main objective of this study is to access the relative technical efficiency and productivity changes in commercial banks in Nigeria. The specific objectives are to:

- i) Investigate whether there have been changes in the total factor productivity of commercial banks in Nigeria in the post 2004 banking sector reforms era;
- ii) Examine whether commercial bank total factor productivity is positively related to bank size by total assets.

## 1.1 Research Hypothesis

Based on the research questions and objectives stated above, this study examines the following null hypothesis:

H0<sub>1</sub>: That there have been no changes in the total factor productivity of commercial banks in Nigeria immediately following the post 2004 banking sector reforms era.

H0<sub>2</sub>: That the total factor productivity changes of commercial banks in Nigeria are not related to bank size by total assets.

## 1.4 Scope of the Study

The study examines the productivity changes in commercial banks in Nigeria using a sample size of 15 commercial banks quoted in the Nigerian Stock Exchange for the period 2005 to 2011.

## 1.5 Significance of the Study

The banking sector in any country is the live wire of the economy as their activities impact greatly on the government, public and private organizations, investors, apex regulatory authorities, boards and management of banks and other non-bank financial institutions who are all interested in the performance of banks.

## 2.0 Literature Review

The words efficiency and productivity have most often been taken to mean the same or one taken in place of the other. The concept of productivity, according to Saari (2006: 1) is closely related to those of "profitability, economic growth, surplus value, quality and performance" Productivity is a ratio of total output to total input within a given period of time hence it may be better considered as total factor productivity. Therefore, an increase in productivity brings about a shift of production function with a resultant increase in the prevailing output/input ratio. Thus total factor productivity is a composite measure of technical efficiency, allocation and cost efficiency using a given technology in converting available but usually limited resources into final outputs. Several authors have used the non-parametric Malmquist distance function DEA productivity models to examine the relative productivity of banks using a variety of inputs and outputs Berg, Forsund, Jansen (1992) used the combination of labour and operating expenses as inputs while loans, advances and deposits as output to examine productivity changes in Norwegian banks during the deregulation period of 1980-89. The findings revealed that productivity increased during the period of deregulation. (LY Kirikal: 2005). Studies by Mlima (1999) on productivity change in Swedish banks from 1984 to 1995 using the Malmquist productivity distance functions showed that there was productivity improvement following the deregulation in the banking sector.

In Nigeria, Abraham and Ogunniyi (2010) investigated the efficiency of 13 commercial banks using the multi-stage DEA model. The results indicated that 25% of the banks were inefficient. They observed that the inefficiency could be attributed to scale inefficiency or inappropriate uses of inputs. In Nigeria also, Mautin (2011), examined bank consolidation and scale economies in a developing country. By using the DEA model to compute scale economies for 15 banks that had consistent data from 2001 to 2008, he finds that six banks were scale efficient while the remaining banks experienced scale diseconomies. However, the changes in scale and efficiency fluctuated inconsistently during the period of study. In Croatia and Jemric (2002) examined the efficiency and productivity of banks. Their findings revealed that foreign banks were more efficient and on the average, new banks operating in the Croatia banking industry were more efficient than the old generation banks, while studies by Wu (2005) in Australia covering the period 1983 to 2001 indicated that the deregulation of the banking industry in that country increased the efficiency and productivity of commercial banks

In India, Singh (1990) investigated productivity changes from 1969 – 1985 using several indicators such as labour productivity, branch productivity, and financial ratios that measure productivity. The study indicated mixed results for various banks showing that bank performance depends to a great extent on their levels of efficiency and productivity.

## 3.0 Research Design

The research design chosen for the study is an ex-post facto comparative analysis of productivity changes in commercial banks in Nigeria. By decomposing the total factor productivity into its components of pure technical, technological and scale efficiencies, the study identified the components that contributed more to performance in terms of efficiency and productivity improvement in the Nigeria commercial banking industry.

## 3.1 The Population and Sampling

The sample size is made up of the 15 commercial banks that were publicly quoted in the Nigerian Stock Exchange during the period from 2005 to 2011 out of the total population of 23 commercial banks in Nigeria during the period covered by the study.

### 3.2 Sources Of Data

The data for this study were obtained from secondary sources such as the Central Bank of Nigeria (CBN) Statistical Bulletin, commercial banks' annual financial statements, the Nigeria Stock Exchange Fact Book and the NDIC annual reports

### 3.3 The Research Instrument

The research instruments are the Data Envelopment Analysis (DEA) and the Malmquist Productivity Index (MPI). Malmquist (1953) proposed distance function ratios and were introduced by Caves, Christen and Divert (1982) for measuring firm specific productivity changes. The MPI indices rely on the DEA linear programming methods proposed by Fare et al (1994) using the DEAP computer software (Coelli:1996) to estimate in the first stage the relative technical efficiency of the respective banks on comparative basis.

### 3.4 Model Specifications and Data Analysis Plan

In this study, the total factor productivity changes for commercial banks in Nigeria for adjacent periods  $t, t+1, \dots, t+n$  is calculated by using four different distance functions

Where  $d^t$  = distance function at time  $t$   
 $x^t$  = set of inputs at time  $t$   
 $y^t$  = set of outputs at time  $t$

The four distant functions are:

- i.  $d^t(y^t, x^t)$
- ii.  $d^t(y^{t+1}, x^{t+1})$
- iii.  $d^{t+1}(y^t, x^t)$
- iv.  $d^{t+1}(y^{t+1}, x^{t+1})$

Following Shephard (1970), the total factor productivity change in this model is expressed as:

$$M^t(x^t, y^t, x^{t+1}, y^{t+1}) = \left( \frac{d_o^{t+1}(x^{t+1}, y^{t+1})}{d_o^t(x^t, y^t)} \right) \times \left( \frac{d_o^t(x^{t+1}, y^{t+1})}{d_o^{t+1}(x^{t+1}, y^{t+1})} \right) \times \left( \frac{d_o^t(x^t, y^{t+1})}{d_o^t(x^{t+1}, y^{t+1})} \right)$$

This is re-started as

$$M^t(x^o, y^t, x^{tu}, y^{t+1}) = \left( \frac{TEC_o(x^t, y^t, x^{t+1}, y^{t+1})}{TEO_1(x^t, x^t, x^{t+1}, y^{t+1})} \right) \times \left( \frac{TC_o(x^{t+1}, y^{t+1})}{TC_1(x^{t+1}, y^{t+1})} \right) \times \left( \frac{d_o^t(x^t, y^{t+1})/d_o^t(x^{t+1}, y^{t+1})}{d_1^t(y^t, x^{t+1})/d_1^t(y^{t+1}, x^{t+1})} \right)$$

Following Fare et al, we further decompose the total factor productivity (TFP) into changes in technical efficiency (catch up) and changes in frontier technology shift (innovation).

$$M^t = \left\{ \frac{d^{t+1}(y^t, x^{t+1})}{d^t(y^t, x^t)} \times \frac{d^t(y^{t+1}, x^{t+1})}{d^{t+1}(y^{t+1}, x^{t+1})} \times \frac{d^t(y^t, x^t)}{d^{t+1}(y^t, x^t)} \right\}^{1/2}$$

Thus  $M^{t, t+1} = TE^{t+1} \times TC^{t+1}$

Where;

$Mt^{t, t+1}$  = Malquist Productivity change index for period  $t$  and period  $t+1$

$TE^{t, t+1}$  = Change in technical efficiency from period  $t$  to  $t+1$

$TC^{t, t+1}$  = Technological change from period  $t$  to  $t+1$

When  $M > 1$ , it implies total factor productivity TFP change between period  $t$  and  $t+1$ .

When  $M < 1$ , it indicates a negative total factor productivity change

When  $M = 1$ , then there has been no change.

### 3.5 Operationalization and Measurement Of Variables

#### i. Output Variables

The four independent output variables used in this study are Loans and Advances less non-performing portions, Investment (interest income bearing), Net earnings (EAT) and Value- Added (VAD). Non-performing loans are excluded because they are considered to be undesirable outputs. Net interest earnings represent the margins between

the interest charged on loans and those paid on deposits and non-deposit borrowings. Value added is the final output added to the bank in a given period.

#### ii. *Inputs Variables*

Inputs are independent variables, the resources or a combination of resources used by banks to generate outputs in the intermediation process. They are usually deployed at a cost to the bank hence banks try to minimize inputs while maximizing outputs. The four types of inputs used in this study are inputs are Customers' Deposits, Physical capital (tangible assets), Operating expenses and Number of employees. The number of and calibre of employees determine the expenses on salaries/wages and benefits while maintenance of premises, vehicles, equipment and other fixed assets, marketing expenses, administrative and general expenses constitute the operating expenses.

### 3.6 Methods of Data Analysis

The study relied on the DEAP Version 2.1 computer programme (Coelli 1996) to analyse data that were generated specifying inputs and outputs distance functions to estimate the efficiency of each bank in the sample. The Malmquist Productivity Index (MPI) is used to determine the total factor productivity changes in commercial banks in Nigeria during the period covered by the study. The total factor productivity changes are calculated using the Malmquist Productivity Index (MPI) simply represented by M in our analysis. The hypothesis that there was no change in TFP will be rejected if  $M > 1$  and accepted if  $M < 1$ . Bank size is represented by total assets. If there was a direct relationship between bank size and total factor productivity, the MPI should grow as bank size increased during the period covered by the study. Thus the change in productivity should march the change in total assets for the respective banks.

### 4.0 Findings

The year by year analysis of the Malmquist Total Factor Productivity changes (Table 1 in the Appendix) shows that annual mean total factor productivity changes between the first (2005) and the second year (2006) declined by 16.1%.. In the third year (2007), there was productivity growth of 6.3% and a further growth of 24.7% in fourth year (2008), while there was a decline of 12.9% in the fifth year (2009). The sixth year (2010) showed a sharp rise of 54.7% but again declined sharply during the seventh year (2011) by 24.8%. The annual geometric mean changes for all the banks were respectively 7.8% for technical efficiency, -5.4% for technological change, 2.7% for pure efficiency, 5% for scale efficiency. On the whole, there was a total factor productivity mean growth of 2% for all the banks in the sample during the period covered by the study. The hypothesis that there was no growth in TFP is therefore rejected.

However, on bank specific basis, the result showed that there was total factor productivity growth in 10 banks consisting of Access Bank(16%), Sterling Bank(14.1%), GTB (8.6), UBA (8.9%), Skye Bank (7.8%), Zenith Bank (5.9%), Unity Bank (3.3%), FCMB (2.8%), and Wema Bank (0.5%). For the remaining 5 banks in the sample, there was total factor productivity regress consisting of Diamond Bank (-5.9%), Fidelity Bank (-4.5%), First Bank (5%), Stanbic IBTC Bank (-19.6%), Union Bank (-1.2%). On the relationship between Bank Size and total Factor Productivity Changes, the results of our analysis revealed that there was no direct positive relationship between bank size by total assets and total factor productivity of commercial banks in Nigeria. The result shows that Access bank that ranked the 6<sup>th</sup> position by bank size had the highest TFP change followed by the GTB that ranked 4<sup>th</sup> position before that of Zenith Bank and First Bank that ranked first and second position respectively by bank size.(Figures 3-5 in Appendix). Since the largest banks by total assets did not reflect higher total factor productivity, the hypothesis that the total factor productivity changes in commercial banks in Nigeria are not directly positively related to bank size by total assets is therefore accepted.

### 5.0 Conclusions and Recommendations

The study reveals that the major driving factor in commercial bank productivity growth in Nigeria is technical efficiency and that there was no direct positive relationship between bank size by total assets and productivity growth during the period covered by the study. The study therefore recommends that commercial banks in Nigeria should be technically proactive and innovative while emphasis should not be placed on bank size as a the driving factor in productivity of commercial banks, rather banks should identify optimal economies of scale to enhance their technical efficiency and productivity.

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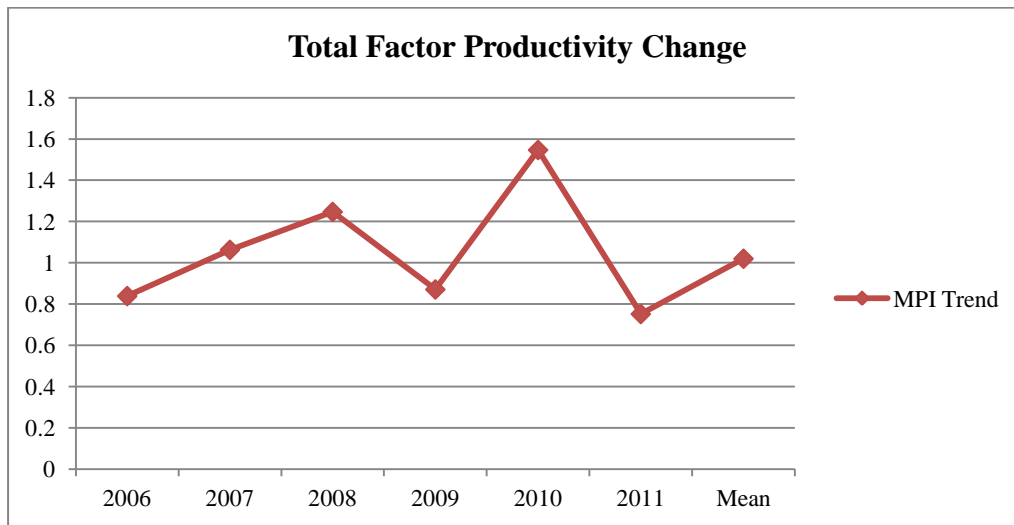
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## APPENDIX

**Table 1 Total Factor Productivity Change**

Year	Total Factor Productivity Change
2	0.839
3	1.063
4	1.247
5	0.871
6	1.547
7	0.752
<b>Mean</b>	<b>1.020</b>

**Source:** Author's Computation



**Figure 1: TFPch**

Source: Author's computation

**Table 3. Malmquist Index Summary**

S/N	DMU (BANKS)	Efficiency Change	Technical Change	Pure Efficiency Change	Scale Efficiency Change	Total Factor Productivity Change
1	Access Bank	1.161	0.999	1.085	1.070	1.160
2	Diamond Bank	1.023	0.920	1.000	1.023	0.941
3	Eco Bank	1.115	0.902	1.033	1.079	1.006
4	FCB Bank	1.154	0.891	1.077	1.071	1.028
5	Fidelity Bank	1.060	0.901	1.040	1.020	0.955
6	First Bank	1.044	0.943	1.000	1.044	0.985
7	GTB	1.073	1.012	1.000	1.073	1.086
8	Skye Bank	1.121	0.962	1.086	1.032	1.078

9	Stanbic IBTC Bank	1.000	0.804	1.000	1.000	0.804
10	Sterling Bank	1.000	1.141	1.000	1.000	1.141
11	UBA	1.042	1.046	1.000	1.042	1.089
12	Union Bank	1.164	0.849	1.000	1.164	0.988
13	Unity Bank	1.050	0.983	1.086	0.967	1.033
14	Wema Bank	1.102	0.912	1.011	1.090	1.005
15	Zenith Bank	1.084	0.977	1.000	1.084	1.059
	<b>Mean</b>	<b>1.078</b>	<b>0.946</b>	<b>1.027</b>	<b>1.050</b>	<b>1.020</b>

Source: Author's Computation from DEAP Version 2.1

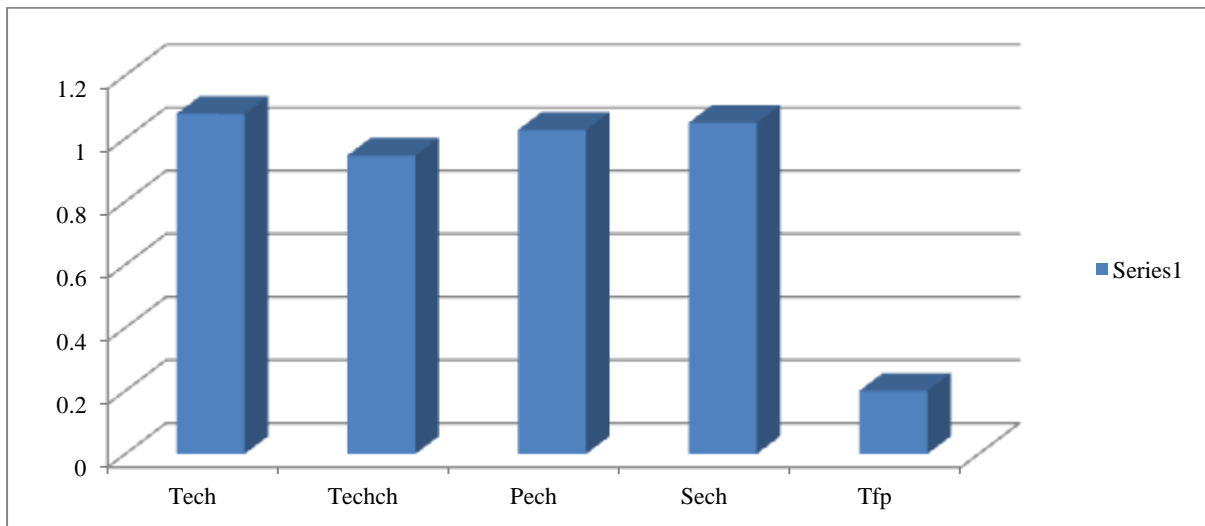


Figure 2: Decomposition of Malmquist Productivity Index into its Components

Source: Author's Computation

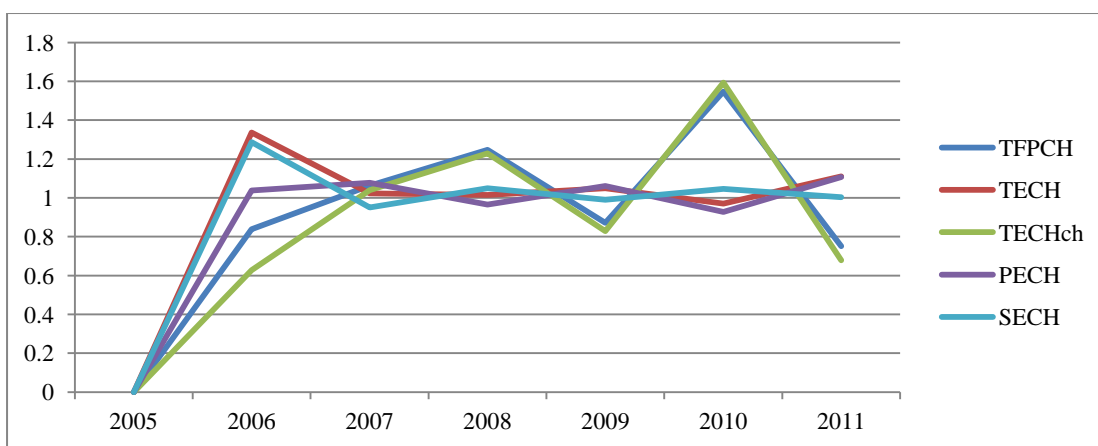
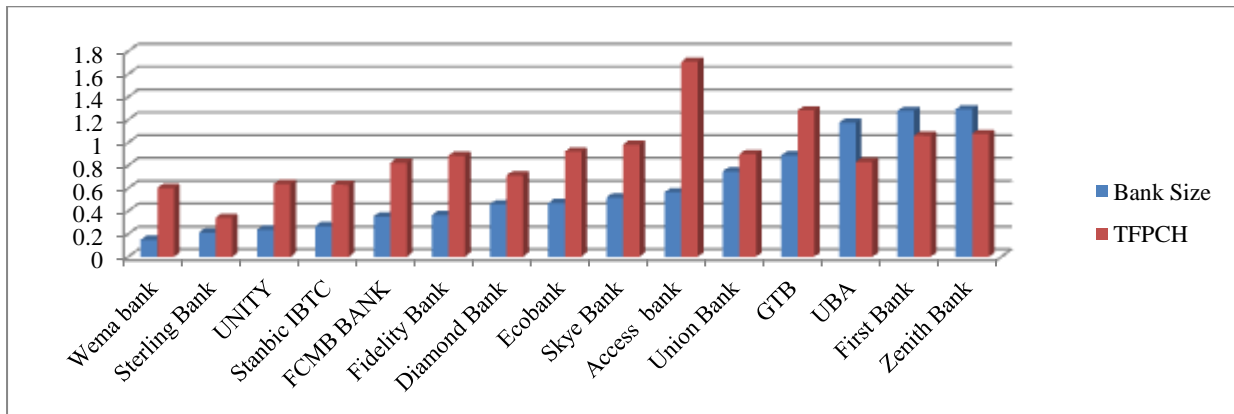


Figure 3: Trend of TFP Components.

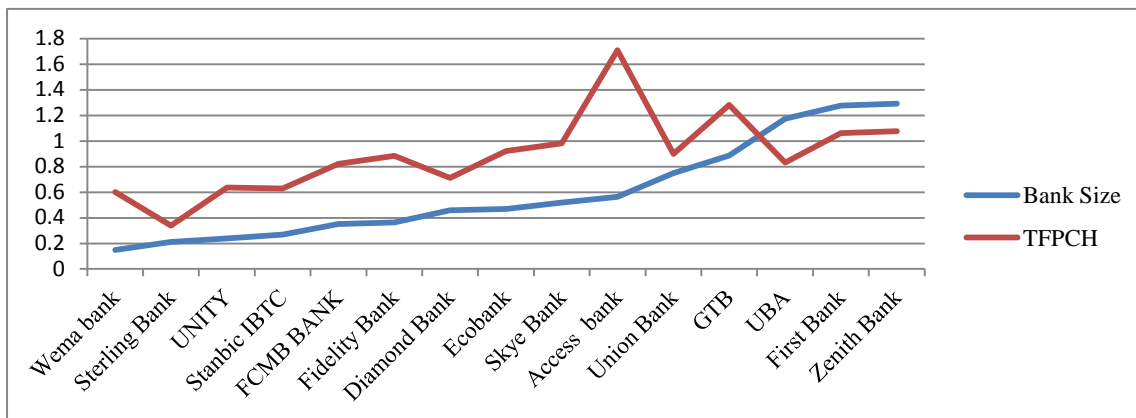
TFP = Total Factor Productivity change, TECH = Technical Change, TECHch = Technological Change, PEch = Pure Efficiency Change, SEch = Scale Efficiency Change





**Figure 4. Bank Size by Total Assets and Total Factor Productivity change**

Source: Computed by the author



**Figure 5. Bank Size by Total Assets and Total Factor Productivity Change**

Source: Computed by the author