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Technical Efficiency Evaluation of Kenyan Sample Banking Sector

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Abstract

The Kenyan financial institutions structure has changed for the last two decades. The commercial banks have undergone incredible development. The study attempts to investigate technical efficiency of Kenyan commercial banks during 2004-2013 by using a Data Envelopment Analysis (DEA). The results suggests that the degree of technical efficiency was found to be lower which indicates that the inefficiency is due to producing at an inefficient scale level rather than producing below the production frontier.

Keywords: Banking; Technical; Efficiency and Evaluation

Jel Classification: C52, H21, H43, D04, E5, G24.

Introduction

The Kenyan financial institutions structure has changed for the last two decades. In addition, global trend towards liberalization in banking has led to blurring segregation of lines separating activities of the different groups of financial institutions and the removal of artificial barrier competition. At the same time, deposit taking, credit granting, investment, insurance and financial advisory services are being bundled into one financial corporation of financial supermarkets. As the financial integration of financial markets within and across borders as well as the mergers among banks, reflect an attempt to increase financial industry efficiency.

Efficiency Measurement in Banking

Efficiency is the maximum output that can be produced from any given total of inputs. It refers to the efficiency of a firm, which allocates resources to produce maximum quantity of output. The allocation efficiency of resource, Sparks, Guthrie and Shepherd [1]. This pinpointed two categories i.e. internal efficiency which referred to effective management within the firm itself like how the ways the management inspires the staff, control costs and keep the operation lean. However, when a company is increased in size, profit flows also show an increase. Hence, the management becomes less effective. Such shortcomings are known as inefficiency in management. Early research in banking industry was mainly concerned with estimating the average productivity using some sort of indices and with comparison by Farrell [2]. Researchers tended to substitute efficiency by market share. They assumed that banks with medium market shares are expected to earn higher profits because of the lower unit costs [3,4]. In other words, banks with lower cost structures could maximize profits by either maintaining the current level of prices and size or reducing the price levels and expanding a positive relationship between firms' profits and market structures being attributed to the gains made by firms that are more efficient.

Statement of the Problem

An attempt to study the efficiency in respect of return on assets of sample Kenya banks is important for benchmarking and strategic planning in the financial services sector. In Kenya, the dominance of the public sector has declined due to the use of technology and introduction of professional management by private and foreign sector banks that gained remarkable position in the Banking Industry. Private sector banks play an important role in the development of the Kenyan Economy. Many firms in the service industry, including the banks, face the problem of not producing better results in terms of return on assets efficiency. In particular, the last decade witnessed continuous changes in regulation, technology upgradation and competition in the global financial services industry and the Kenyan Commercial Banks are no exception to this. The efficiency of banks in general and technical efficiency in respect of return on assets in particular, has become an important issue in Kenya. It is therefore crucial to benchmark the efficiency of banks operating in Kenya, based on efficiency and hence this study on investigation of the efficiency (return on assets) of Kenyan Large, Medium and Small Bank groups (Table 1).

Objectives of the Study

The main objective of this study was to analyze the Total Assets of Kenyan Sample Banks

Hypothesis of the Study

The following null hypothesis was framed and tested in this study

NH01: There is no significant difference in the efficiency of Total Assets among the Kenyan Sample Banks.

Methodology of the Study

(A) Sample Selection

For the purpose of the study, the sample selection was made systematically. In Kenya, there are 41 banks, including public and private sector, as on 31 December 2013. It was found that the required data for analysis were available only for 35 banks. Finally, only six banks were selected by adopting the following criteria.

1. Sample banks were classified as medium, medium and small size for this study as used by Kenya Central Bank. The Kenya Central Bank used weighted composite index, covering assets, Total Assets, capital, and number of deposit accounts and loan accounts to classify the banks.

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Year Author/authors	Title of Study	Methodology	Findings in Brief
Keshari PK and Paul MK (1994)	Relative efficiency of foreign and domestic banks	Stochastic frontier production function	Foreign banks and domestic banks are not significantly different in terms of their efficiency
Bhattacharya A, Lovell CAK and Sahay P (1997)	The impact of liberalization on the productive efficiency of Indian commercial banks	1. DEA for calculating radial technical efficiency 2. Stochastic frontier analysis	Publicly owned Indian banks were the most efficient followed by foreign owned banks and privately owned banks
Milind Sathye (2003)	Efficiency of banks in a developing economy: The case of India	Data Envelopment Analysis	Mean efficiency score of Indian banks compares well with the world mean efficiency score and the efficiency of private sector commercial banks as a group is, paradoxically lower than that of public sector banks and foreign banks in India
Mukherjee A, Nath P and Pal MN (2002)	Performance benchmarking and strategic homogeneity of Indian banks	1. DEA 2. Multiple correlation clustering	Public sector banks are more efficient than private or foreign banks although this could be due to the fact that public sector banks have a larger number of customers and are more widespread than foreign banks, the latter generally catering for small niche markets
Ram Mohan TT and Subhash C Ray (2004)	Productivity growth and efficiency in Indian banking: A comparison of public, private and foreign banks	Data Envelopment Analysis	PSBs performed significantly better than private sector banks but not differently from foreign banks. Superior performance of PSBs is to be ascribed to higher technical efficiency
Abhiman Das, Ashok Nag and Subhash C Ray(2004)	Liberalization, ownership, and efficiency in Indian banking: A nonparametric approach	Data Envelopment Analysis	Indian banks are not much differentiated in terms for input or output oriented technical efficiency and cost efficiency. However, they differ sharply in respect of revenue and profit efficiencies
Sathya Swaroop Debasish (2006)	Efficiency performance in Indian banking: Use of data envelopment analysis	Data Envelopment Analysis	Foreign owned banks were on average most efficient and that new banks are more efficient that old ones, which are often burdened with old debts
Saha A and Ravishankar TS (2000)	Rating of Indian commercial banks: A DEA approach	Data Envelopment Analysis	Public sector banks have in general, improved their efficiency scores over the period 1991/92 to 1994/95
Sunil Kumar and Rachita Gulati (2008)	Technical, pure technical, and scale efficiencies in Indian public sector (1992–2005)	1. DEA 2. Logistic regression analysis 3. Slacks and targets setting 3. input-	Public sector banks operate at 88.5 per cent level of overall technical efficiency. Exposure of the banks to off-balance sheet activities has a strong and positive impact on the overall technical efficiency of banks.
Subroto Chowdhury (2011)	Effect of financial Crisis in efficiency and strategic homogeneity of Indian commercial banks: An empirical investigation	1. DEA 2. Cluster analysis	The global financial crisis failed to have any impact on the technical efficiency of the Indian banking sector.
Mukesh Kumar and Vincent Charles (2012)	Evaluating the performance of Indian banking sector using data envelopment analysis during post reform and global financial crisis	1. DEA 2. Malmquist productivity index 3. Jackknifing analysis	The performance of public sector banks is at par with private sector banks in terms of efficiency.
Isaiah Onsarigo Miencha and Murugesan Selvam (2013)	Financial Performance in the Banking Sector: A Study With Special Reference to Kenyan Commercial Banks Using Data Envelopment Analysis (DEA)	Data Envelopment Analysis	The extent of TE and SE varied across the commercial Kenyan banks over the study period.
Miencha et al (2013)	Relative Efficiency of Kenyan Commercial Banks	Data Envelopment Analysis	There was a small number of efficient banks and there was scope for these sample banks to improve their production efficiency.
Miencha et al (2015)	Efficiency Measurement of Kenyan Commercial Banks	Data Envelopment Analysis	The extent of TE and SE varied across the commercial Kenyan banks over the study period.

Table 1: Summary of Recent Studies on Evaluation of Banks' Efficiency.

2. Fifty percent of the total banks for which the required data were available, were selected as sample (i.e 50% of 35=18 banks). In these 18 banks, only six banks were selected from medium size.

3. According to the top index value, 6 banks from medium size (i.e. top 3 and lowest 3. The details of sample banks are given in Table 2.

(B) Sources of Data

The present study was mainly based upon Secondary Data. The required secondary data were collected from Annual Report published by Central Bank of Kenya, various reputed journals and respective bank websites. The other relevant information for this study was collected from Books, News Papers, Magazines, Articles and various websites.

(C) Feedback

The experts in the field of banking, including officials of the banking, were contacted by the Researcher. Their views and valuable information helped the Researcher to validate the findings. Consultations with the experts helped the Researcher to fine tune the research study. Some of the suggestions offered were based on the interaction with the experts.

(D) Period of Study

The study period covered a period of ten years from January 2004 to December 2013.

(E) Tools Used

For the purpose of the analysis, the following tools were used.

i) Descriptive Statistics

a) Mean

The arithmetic mean is the sum of the entire list divided by the number of items in the list. It is often simply to as the average. The following formula was used to calculate the mean.

Mean $\bar{X} = \frac{\sum X_i}{n}$

Where,

$\bar{x}$ =represents the mean,

Σ=Symbol of Summation

x_i=Value of the i^{th} item x, i=1, 2, 3 ….n, and

n=total number of items

b) Standard Deviation

Standard Deviation is the square root of the mean of the squared deviation from the arithmetic mean. It measures the absolute dispersion. Greater the standard deviation, greater will be the magnitude of the deviation of the values from their mean. A small standard deviation means a high degree of uniformity of the observation as well as homogeneity of a series. The standard deviation of a random variable X is defined as below (Table 2).

$$\sqrt{E(X-E(X)^2} = \sqrt{E(X)^2-(E(X)^2}$$

$$=\sqrt{Var(X)}$$

Where,

E(X) is the expected variable of X, and

$\sqrt{Var(X)}$ =is the variance of X.

ii) Correlation

Correlation Analysis refers to the techniques used in measuring the relationship between the variables. Correlation Co-efficient indicates the direction and degree of correlation. Correlation may be positive or negative, depending upon the direction of changes of the variables. If both the variables are varying in the same direction it is called positive correlation and if the variables are varying in the opposite direction, it is called negative correlation. Coefficient of Correlation always lies between +1 and -1. +1 is perfect positive correlation, -1 is perfect negative correlation and 0 is no relationship between variables.

ρX, Y=cov (X, Y)/σx σy=E[(X-λx) (Y-λy)]/σxσy

Where,

ρX, Y=random variables of x and y

λx=expected value of x

λy=expected value of y

σx=standard deviation of x, and

σy=standard deviation of y

iii) Data Envelopment Analysis (DEA)

This is a non-parametric method for the measurement of the efficiency relative to various Decision Making Units (DMUs). DMUs are the homogeneous units and in the present study, DMUs are the sample commercial banks. Technical Efficiency Score is the total weighted sum of outputs divided by total weighted sum of inputs. In this model, the efficiency was measured by the ratio of weighted outputs to weighted inputs. The efficiency of bank was measured in terms of how efficiently a bank utilized its inputs by using the following formula (Charnes, Cooper and Rodhes, 1978). In the model, the condition of efficiency is $\Theta^*=1$ and all the slack variables are assumed to be zero (O). Under such conditions, DMU_O's many outputs maximized values against many inputs, which are the subject to evaluation is assumed h_0 is as follows:

$$\text{Efficiency} = \frac{\text{weighted sum of Outputs}}{\text{weighted sum of Inputs}}$$

CCR Model

Charnes et al. [5] coined the term Data Envelopment Analysis (DEA). They extended Farrell [2] piecewise-linear convex hull approach to frontier estimation by expanding multiple inputs and single output to multiple inputs and and multiple outputs and utilized linear combination to convert it to single virtual input and output. Their model assumed Constant Returns to Scale (CRS) to measure the relative efficiency of each DMU which is between 0 and 1 and can determine whether a DMU is constant, increasing or decreasing returns to scale. Following Emrouznejad and Anouze the linear programming formulation is as follows.

Minimum Θ

Subject to:

$\Sigma_s \lambda_s$I sx-0Ikx≤0 Ṽ inputs x

$\Sigma_s \lambda_s$ 0sx-0kx ≥0 Ṽ outputs y

$\lambda_s \geq 0$ Ṽ s

The value of Θ obtained will be the efficiency score of the i^{th} DMU.

BCC Model

Banker et al. (1984) widened the CCR model to account for Variable Returns to Scale (VRS). The CRS linear programming problem can be easily modified to account for VRS by adding the following constraints to the above model [6-9].

$$\Sigma_s \lambda_{s=} 1$$

This approach forms a convex hull of intersecting planes which envelope the data points more tightly than the CRS conical hull and thus provides technical efficiency scores which are greater than or equal to those using CRS model. For the purpose of calculating data for this study, Data Envelopment Analysis Online Software (D.E.A.O.S) was used by [10,11].

Bank groups	Categories of Banks	SR. No.	Names of the Banks	Market Index Value as on 31 December 2013
Medium size Banks	Top size Banks	1	Commercial Bank of Africa Ltd	4.40%
		2	Bank of India Ltd	4.35%
		3	Bank of Baroda Ltd	4.23%
	Lower size Banks	4	National Industrial Development Bank of Kenya Ltd	4.21%
		5	I&M Bank Ltd	4.19%
		6	Diamond Trust Bank (K) Ltd	4.16%
Note: Market Index Value was calculated by the Central Bank of Kenya as on 31st December 2013				

Table 2: Details of Sample Banks (Selected based on Market Value as on 31st December 2013).

Limitations of the study

The present study suffers from the following major limitations.

- The study investigated the relative efficiency and inefficiency of Kenyan Commercial Banks and not their absolute efficiency.
- The three sample categories of banks (medium, medium and small) were selected from public and private banks.
- The study was based on only secondary data.

Analysis Efficiency of Kenyan Sample Selected Banks

8.1 Descriptive Statistics of Total Assets for Medium (Top and Lower) size Kenyan Commercial Banks

8.2 Technical Efficiency of Kenyan Commercial Banks (Top and Lower in the MEDIUM group) in respect of TOTAL ASSETS

Descriptive Statistics of TOTAL ASSETS for Medium Size (Top and Lower) Kenyan Commercial Banks

The results of descriptive statistics, for medium size Kenyan sample banks (top and lower size), during the study period from 2004 to 2013, are given in Table 3. The efficiency of sample banks was measured in terms of Total Assets as an indicator. The mean values (for total assets) of three top sample banks (Bank of India, Bank of Baroda (K) Ltd and Commercial Bank of Africa Ltd) in the medium size group, were Ksh. 15845.50, Ksh. 25159.70 and Ksh. 60677.50 respectively, during the study period. Besides, one top sample bank, namely, Commercial Bank of Africa Ltd earned a maximum total assets value of Ksh. 124882.00 which was considered by [12-15] the highest value (top rank) among the top sample banks in the medium size group. This was followed by Bank of Baroda (K) Ltd, with a total assets value of Ksh. 52022.00 and Bank of India, with a maximum total assets value of Ksh. 30721.00, during the study period. The Commercial Bank of Africa Ltd earned a high risk for total assets value of Ksh. 33220.20, with an average total assets value of Ksh. 60677.50, which was considered as a high degree of variation among top sample banks in the medium size group banks, selected for this study. The top sample bank (Bank of Baroda (K) Ltd) in the medium size group was considered for the second position, with a dispersion value of Ksh. 15728.01 for total assets and the average assets value of Ksh. 25159.70, during the study period. Another sample bank, namely, Bank of India earned a value of Ksh. 8423.64 (lowest variation) and an average total assets value of Ksh. 15845.50, with a P-value of 0.000, in the medium top group of banks during the study period [16,17]. The average assets value of sample Banks (lower size), namely, National industrial Development Bank of Kenya Ltd, I & M Bank Ltd and Diamond Trust Bank (K) Ltd in the medium size group, were to the tune of Ksh. 52517.50, Ksh. 50667.80 and Ksh. 51259.40 respectively during the study period. But the maximum of total assets values earned by Diamond Trust Bank (K) Ltd, I & M Bank Ltd and National industrial Development Bank of Kenya Ltd were Ksh. 114136.00, Ksh. 110316.00 and Ksh. 112917.00 respectively during the study period (Table 3). It is clear from Table 2 that one sample bank namely, Diamond Trust Bank (K) Ltd under lower- medium size, earned high amount (Ksh. 34704.93) for total assets variation and an average assets value of Ksh. 51259.40 during the study period. But the National Industrial Development Bank of Kenya Ltd got second rank by earning a dispersion value of Ksh [18,19]. 33547.44, along with an average assets value of Ksh. 52517.40 during the study period. The I & M Bank Ltd, with a dispersion of Ksh.33155.19 for total assets, earned an average asset value of Ksh. 50667.80 which was considered as low dispersion and low assets value, with a P-value of 0.000, which was less than 0.01 level during the study period. The overall analysis of the Table shows that the Diamond Trust Bank (K) Ltd in the lower- medium size group performed better than other two sample banks, namely, I &M Bank Ltd and National Industrial Development Bank of Kenya Ltd in the same sample group. On the other hand, one sample bank, namely, Commercial Bank of Africa Ltd in the top-medium size group, had accounted for high dispersion in the total assets, with a low mean asset value. Another sample bank, namely, Bank of Baroda (K) Ltd also earned high amount of variation in the total assets (15728.01), with a better average asset (25159.70). The Bank of India had also assumed high degree of variation, with a low mean asset value, during the study period. The total assets always act like saviours of the bank all the time. Hence it is suggested that the two sample banks, Bank of India and Bank of Baroda (K) Ltd, should encourage more total assets, without affecting the profitability [20,21].

Technical Efficiency of Kenyan Commercial Banks (Top and Lower in the MEDIUM group) in respect of TOTAL ASSETS

The results of technical efficiency for sample banks (i.e top and lower size banks in the medium group) in Kenya, in respect of their total assets, under CCR, BCC and Technical Efficiency models, during the study period from 2004 to 2013, are displayed in Table 4. The mean efficiency scores for total assets, under CCR model, were 0.651 by top medium sample bank group, 0.952 by lower medium bank group and 0.802 by all banks during the study period from 2004 to 2013. The Table reveals that the use of total assets, under the CCR model was not uniform throughout the study period. Two sample banks, namely, Commercial bank of Africa Ltd and Diamond Trust bank (K) Ltd earned an efficiency score of 1.000 in respect of total assets during the study period. This indicates that these two sample banks utilized their total assets (inputs) effectively to be at the efficient frontier level during the study period. The performance of some other sample banks, namely, Bank of Baroda (K) Ltd (0.663), National Industrial Development Bank of Kenya Ltd (0.936), and I & M Bank Ltd (0.921) was considered to be near and moderately efficient during the study period. In order to

Sr. No.	Name of the Banks	Min	Max	Mean	Std Deviation	P-value
	I. Medium –Top Banks					
1.	Bank of India	6138.00	30721.00	15845.50	8423.64	0.000
2.	Bank of Baroda (K) Ltd	8355.00	52022.00	25159.70	15728.01	
3.	Commercial Bank of Africa Ltd	20176.00	124882.00	60677.50	33220.20	
	II. Medium – Lower Banks					
4.	National Industrial Development Bank of Kenya Ltd	16636.00	112917.00	52517.50	33547.44	0.000
5.	I&M Bank Ltd	14912.00	110316.00	50667.80	33155.19	
6.	Diamond Trust Bank (K) Ltd	11037.00	114136.00	51259.40	34704.93	
Note: Raw data in Kenyan Shillings (Ksh.) were used for the statistical calculation						

Table 3: Results of Descriptive Statistics of Total Assets of (Top and Lower in the Medium group) Kenyan Commercial Sample Banksfrom 2004 to 2013.

Sr. No.	I. Medium – (top) banks in the medium group	CCR	BCC	T.E
1.	Bank of India	0.290	0.542	0.411
2.	Bank of Baroda (K) Ltd	0.663	0.705	0.584
3	Commercial Bank of Africa Ltd	1.000	1.000	1.00
	Average Score (among three top banks)	0.651	0.749	0.665
	II. Medium – (lower) banks			
4.	National Industrial Development Bank of Kenya Ltd	0.936	0.958	0.947
5.	I&M Bank Ltd	0.921	0.983	0.952
6.	Diamond Trust Bank (K) Ltd	1.000	1.000	1.00
	Average Score(among three lower banks)	0.952	0.980	0.966
	Average Score (overall among six sample banks)	0.802	0.865	0.816
Note: I) CCR: Charnes, Coopers and Rodhes Model, BCC: Bankers, Charnes and Rodhes, T.E: Technical Efficiency Models. II) Scale value of 1.000 indicates efficiency III) Scale value of 0.500 to 0.999 indicates near or moderately efficiency IV) Scale value of less than 0.499 indicates inefficiency of banks.				

Table 4: Results of Technical Efficiency Total Assets (using CCR, BCC and T.E Models) for Kenyan Commercial Banks (three Top and three Lower banks in the Medium group) during the study period 2004-2013.

improve and be at the efficient level, these two banks, (namely, Bank of Baroda (K) Ltd and National Industrial Development Bank of Kenya Ltd) are required to earn a score of 0.337 and 0.064 respectively, by using their inputs perfectly. But Bank of India (an Indian origin bank) underperformed, with an efficiency score of 0.290 and it needs to earn a score of 0.710 in respect of total assets to be at the efficient frontier. The technical efficiency, under the BCC model, in respect to total assets is also represented in Table 4. The average efficiency scores were 0.749 earned by top sample banks, 0.980 by lower sample banks and 0.865 by all sample banks (overall average) during the study period. It is significant to note that all the sample banks selected for this study performed well all through, without any inefficiency score in respect of total assets, during the study period. From the analysis, it is to be noted that Commercial Bank of Africa Ltd and Diamond Trust Bank (K) Ltd gained an efficient level of 1.000 in respect of total assets during the study period (Table 4).

But banks, namely, Bank of India, Bank of Baroda (K) Ltd, National Industrial Development Bank of Kenya (Ltd) and I & M Bank Ltd earned efficiency score values of 0.542, 0.705, 0.958 and 0.983 respectively, in respect of total assets, during the study period. These sample banks, namely, (Bank of India, Bank of Baroda (K) Ltd, National Industrial Development Bank of Kenya Ltd and I & M Bank Ltd) are required to earn scores of 0.458, 0.295, 0.042 and 0.017 by using total assets efficiently, to become efficient. The analysis of efficiency score, under the Technical Efficiency model, is displayed in the Table 4. It is clear from the above analysis that the performance of Commercial Bank of Africa Ltd and Diamond Trust Bank (K) Ltd was efficient, with a score value of 1.000 for total assets during the study period. This indicates that these banks utilized their inputs in respect of total assets properly to find a place at the efficient level. Other banks like Bank of Baroda (K) Ltd, National Industrial Development Bank of Kenya Ltd and I & M Bank Ltd earned efficiency scores of 0.584, 0.947 and 0.952 respectively, regarding total assets. Hence these banks need to earn score values of 0.416, 0.053 and 0.048, by using total assets of these banks intelligently, to be at the efficient level [22-24].

Conclusion

The Commercial Bank of Africa Ltd and Diamond Trust Bank (K) Ltd maintained efficiency, in respect of its total assets satisfactorily, under CCR, BCC and Technical Efficiency models, indicating their growth. Other sample banks, namely, Bank of India, Bank of Baroda (K) Ltd, Commercial bank of Africa Ltd, National Development Bank of Kenya Ltd and I & M Bank Ltd experienced fluctuating efficiency scores all through the study period. Hence it is suggested that sample banks like Bank of India, Bank of Baroda (K) Ltd, Commercial bank of Africa Ltd, National Development Bank of Kenya Ltd and I & M Bank Ltd have to adopt the latest technology and innovations in their products and create awareness among the public to attract more customers and to earn high profits.

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