MEASURING FACTOR PRODUCTIVITY OF THE BANKING SECTOR IN KENYA

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Abstract: This study examines changes in the productivity of commercial banks in Kenya in the context of liberalization using Data Envelopment Analysis (DEA). We measure the productivity growth and its components from a time series dataset obtained from Central Bank of Kenya publications and National Banking Surveys. DEA method is used to measure Malmquist index of total factor productivity for a sample of 34 banks for the period 1999-2008. A decomposition of Total Factor Productivity (TFP) measure is done to establish the source of changes in factor productivity. The results suggest that TFP deteriorated over the period while Efficiency change (EFFCH) increased as Technical Change (TECH) declined implying that deterioration of TFP was due to either technological innovations or shocks. Given that technology is the main driver of productivity, we recommend that the monetary authorities design practicable protocol as a technological standards requirement.

Keywords: Productivity, Data Envelopment Analysis, Kenya, Malmquist Index, Competitiveness

INTRODUCTION

Banks play a pivotal role in the process of financial intermediation by mobilizing the transfer of funds from surplus units to the deficit ones. As prime movers of economic life, banks occupy a significant place in the economy of every nation and it is therefore not surprising that their operations are perhaps the most heavily regulated and supervised of all businesses. Policy makers, economists and monetary authorities recognize that the ability of banks to achieve the desired results and to continue to play the role earmarked for them depends on the existence of an enabling environment and the number of operating banks and their performance from one financial year to another.

In 1980s and early 1990s, Kenya introduced an extensive economic reform and structural adjustment program to transform the economy from an inward and centrally planned one dominated by the public sector to an outward looking economy led by the private sector, (Were et al, 2005). Liberalization of the financial sector in general, and the banking system in particular, were crucial to the intended transformation of the economy. Kenya's move towards this transformational process of the economy was in response to the general globalization process. The major objective was to enhance productivity and efficiency since productivity growth is key to sustainable economic growth and development in any society.

These reforms appear to have borne fruits. Over the years, the sector has continued to record relatively strong performance. In the period 2006-2007 for instance, total deposits held by financial institutions grew by 25.2 percent, total assets recorded a growth rate of 33.8 percent, while non-performing loans declined by 20.4 percent. The sector also recorded impressive growth in pre-tax profits which rose by 34.3 percent during the period under review. The improvement could be explained by increased competition in the banking sector, adoption of new technology and introduction of innovative products targeting different market segments.

Within the context of globalization, liberalization of financial markets worldwide has led to deeper

integration of financial institutions. As a result, financial institutions today face a fast-paced, dynamic, and competitive environment on a global scale. Given such a competitive environment, financial sector supervisors, as well as financial institutions, are today required to examine their performance as their survival is likely to depend on their productive efficiencies. Earlier studies (Berger and Humphrey, 1991 and Berger, Hunter and Timme, 1993) had demonstrated that in the banking sector in particular, inefficiencies are more important than scale and scope issues.

In Kenya such endeavors have resulted into advancements in Information and Communications Technology (ICT) in the banking industry which has enhanced efficiency and improved customer service. This is reflected particularly in the increased use of Automated Teller Machine (ATMs) resulting from broadening of ATM networks, including additional ATMs and a wider network of merchants that accept payment through credit/debit cards (CBK, 2006).

Several institutions continue to utilize ICT as a tool to enhance operational efficiency, support newly developed products and improve the quality of customer service. For example, some banks are focusing on branch interconnectivity to facilitate branchless banking and are increasingly embracing E-banking to reduce long queues in banking halls. The mobile phone banking services for instance provides several account enquiry tools (CBK, 2007).

Other notable efficiency related changes include automation of a large number of services and a move towards emphasis on the complex customer needs rather than traditional 'off-the-shelf' banking products. The recent development of mobile banking has the potential to offer low cost, thereby providing easily accessible financial services to poor people in Kenya who do not have bank accounts. Besides, many banks have come up with new strategies of offering diverse services to their customers, including investment and corporate finance advisory services and lately, agency banking.

Structure of the Banking Sector in Kenya

CBK (2007) classifies the banking sector in Kenya as comprising of a total of 45 institutions, 42 of which are commercial banks, 2 mortgage finance companies and 1 non-bank financial institution. Out of 45 institutions, 35 were locally owned and 10 were foreign owned. The locally owned financial institutions comprised of 3 banks with significant shareholding by the Government and State Corporations (public owned), 29 privately owned commercial banks, 2 mortgage finance institutions and 1 non-bank financial institution.

Local private institutions constituted 71.1 percent of total institutions while local public institutions constituted 6.7 percent and foreign institutions 22.2 percent. The total net assets for local private institutions constituted 54.7 percent while the local public institutions and foreign institutions constituted 5.3 percent and 40.0 percent of the total net assets respectively.

Eight (8) out of the forty-five (45) banks control 69% and 70% of the market share in terms of net assets and deposits respectively (CBK, 2007). Small and medium-sized banks that are the majority in terms of numbers are not able to compete favourably with the few big banks in terms of the range of products and services. This apparent lack of an effective competitive environment has led to inefficiencies that translate into high interest rates.

Employment in the banking industry has been on a downward trend for a while now. Total staff complement decreased by 8.2 percent from 13,962 in December 1999 to 12,822 in December 2000. Reduction in employment in the banking industry has generally been experienced in all categories except management. This trend continued with a low of 11, 331 employees being registered in 2003. As employment declined the branches expanded implying that banks were trying to increase efficiency and productivity by squeezing employees to get the best out of them.

Productivity and the Banking Sector

In the liberalized and dynamic markets with constantly changing consumer preferences, new structures of production and work among others, it is imperative to rethink the concept of productivity. Traditionally productivity was viewed mainly as an efficiency concept; that is the amount of outputs in relation to inputs. Today productivity is increasingly being viewed more as an efficiency and effectiveness concept, effectiveness being how well sectors and organizations meet dynamic needs and expectations of their markets or how organizations or sectors create and offer customer value.

Since banks offer comparable products and services, they continually search for a competitive advantage to attract new customers and help them retain existing ones. This is a clear indication that the banking sector, by endeavoring to develop innovative programs and initiatives to maintain superior customer service levels, has embraced and is streamlining into their operations, the concept of productivity.

A critical objective of any developing country like Kenya is to enhance sustainable economic growth and development. The contribution of the banking industry towards the attainment of this objective

cannot be gainsaid. Banks play a pivotal role in the process of financial intermediation by mobilizing the transfer of funds between the surplus units and the deficit ones and they are prime movers of economic life. An efficient, competitive and productive financial system is critical in fostering investment and economic growth by facilitating optimal collection and allocation of resources thereby curbing wastage in the sector. A banking system that efficiently channels available resources to productive uses is therefore a powerful mechanism for sustainable economic growth and development. To the best of our knowledge, no study has been carried out to measure the productivity levels of commercial banks in Kenya. Consequently it is not possible to ascertain the contribution of the banking sector to the critical process of economic growth and development. This is the gap that the present study seeks to fill.

ECONOMETRIC TECHNIQUE

There are many different ways of measuring productivity change. They include growth accounting, stochastic frontier analysis (SFA) and data envelopment analysis (DEA) among others. The choice between them depends on the purpose of productivity measurement and, in many instances, on the availability of data. Growth accounting is the most widely used method for measuring productivity. However, the drawback for this approach is that the parameters are average values and if the features of the firms are heterogeneous then this approach becomes an inappropriate tool.

To circumvent the averaging problem SFA can be used. This approach constructs a frontier of efficient observations which envelops the relatively inefficient observations. An important advantage of the method is the ability to handle outliers and to allow for hypothesis to be tested. However, there are major drawbacks to this approach too. The production function is assumed valid for all observations and technological change is the same for all observations. Besides, the distributional form of the error term as well as the functional form of the production function has to be specified.

By contrast, DEA does not require any assumption about the functional form of the production function or economic agent's behaviour. Furthermore, there is no need to assume any specific distributional form of the error term, neither is there need to assume perfect capital markets or optimal allocation of resources.

DEA can either be input or output oriented depending on the objectives. The input-oriented method, defines the frontier by seeking the maximum possible proportional reduction in input usage when the output is held constant for each sector. The output-oriented method seeks the maximum proportional increase in output production with input level held fixed. These two methods provide the same technical efficiency score when a constant return to scale (CRS) technology applies but are unequal when variable returns to scale (VRS) is assumed (Coelli et al, 2005). In this study, the output-oriented method is used by assuming that in banking, output maximization is obtained from a given set of inputs.

There are different methods for estimating the total factor productivity (TFP) for instance Malmquist and Tornquist indexes. The former has gained popularity in recent years since Fare et al., (1994) applied the linear programming approach to calculate the distance functions that make up the Malmquist index. According to Shih et al, (2003), since Data Envelopment Analysis (DEA) can be directly applied to calculate the index, the Malmquist index has the advantage of computational ease. Besides it does not require information on cost or revenue shares to aggregate inputs or outputs, and consequently it is less data demanding besides allowing decomposition into changes in efficiency and technology. This method does not attract any of the stochastic assumptions restriction. However, it is susceptible to the effects of data noise, and can suffer from the problem of 'unusual' shadow prices, when degrees of freedom are limited (Coelli et al, 2005).

This study uses Malmquist index to measure the productivity growth of the banking sector using a sample of 34 commercial banks in Kenya for the period 1999–2008. We proceed by constructing the best – practice frontier in banking production for the sampled banks. Malmquist productivity indices as well as efficiency change and technological change components for each bank in the sample are then calculated. Since this index is based on discrete time, each bank is given an index for every pair of years.

Assuming Constant Returns to Scale (CRS) technology we estimate total factor productivity (TFP) scores using DEA. DEA is a popular technique for performance analysis in general and in the banking sector in particular. The banking sector has a series of characteristics that make it particularly amenable to DEA. DEA technique defines productivity measure of a production unit by its position relative to the frontier of the best performance (distance) established mathematically by the ratio of weighted sum of outputs to weighted sum of inputs. The estimated frontier of the best performance is also referred to as the efficient frontier or envelopment surface.

Malmquist index is constructed using the DEA based Malmquist approach which allows for calculation of technical progress and technical efficiency. This type of decomposition is important in facilitating a comparison that may help explain and characterize

the differences and similarities in growth patterns of different banks.

Using a framework developed by Färe et al. (1992, 1994), Malmquist productivity index is computed and total factor productivity is decomposed into change in technical efficiency and technological change, the Malmquist index is then used to measure the productivity of the commercial banking sector in Kenya.

Estimating Distance Functions Using DEA

Following Grosskopf (1994) and Rao and Coelli (1998), Suppose there are K banks (indexed by k) using N inputs (indexed by n) to produce M products (indexed by m). x_n^{ki} and y_m^{ki} denote the n^{th} input and m^{th} output in the k^{th} bank at time period i (i=s, t). We can solve a linear programming problem to evaluate each of the distance functions in the following equation. Assuming a constant returns-to-scale technology, then;

$$\left[D^i(x^{k'i'}, y^{k'i'})\right]^{-1} = \max_{z,\theta} \theta^{k'}$$

$$\theta^{k'i'} y_m^{k'i'} \le \sum_{k=1}^{K} z^{ki} y_m^{ki}$$

s.t , m = 1,…,M,

$$\sum_{k=1}^{K} z^{ki} x_n^{ki} \le x_n^{k'i'}$$

, n = 1,…,N,

$$z^{ki} \ge 0$$

, k = 1,…,K,

where z^{ki} is a variable indicating the intensity at which a particular activity is employed in constructing the frontier of the production set. Note that when i=i'=s (correspondingly, i=i'=t), solving the linear programming yields technical efficiency in period s (t).

Measuring Productivity Changes

In order to examine changes in productivity in the banking sector, the study employs Malmquist Total Factor Productivity (TFP) index on annual data for commercial banks in Kenya for the period 1999-2008. Introduced by Caves, Christensen and Divert (1982), Malmquist firm-specific productivity indices assume an output possibility set of the following type:

P(x) = {y: x can produce y}. (1)

The output distance function with technology at time s, the initial period, can then be defined as:

$$d^s(x, y) = \min\{\theta : \frac{y}{\theta} \in P(x)\} \quad (2)$$

Note that when θ is minimized, y/θ is maximized. This distance function measures the maximum possible output that a given amount of inputs can produce. Similarly, we can define a distance function in relation to technology in time t, the final period, as $d^t(x, y)$. Productivity change can then be measured by the part of output growth that is not contributed by input growth.

The Malmquist Productivity Index defined by Caves, Christensen and Diewert (1982a and 1982b; hereinafter CCD), with reference to the technology of the initial period can then be expressed as;

$$m^{s}_{CCD} = \frac{d^s(x^t, y^t)}{d^s(x^s, y^s)} \quad (3)$$

However, we can also choose technology in period t as the reference in defining a productivity index in which case the Malmquist Productivity Index in relation to the technology of the final period is then defined as:

$$m^{t}_{CCD} = \frac{d^t(x^t, y^t)}{d^t(x^s, y^s)} \quad (4)$$

The two indexes appear to be identical. However, they may or may not be the same in the case of multiple inputs and varying returns to scale (VRS) technology. To avoid the arbitrariness in choosing the benchmark, we follow Färe et al. (1992, 1994) in specifying the Malmquist Productivity Index as the geometric mean of the above two indexes such that;

$$m\ (x^t, y^t, x^s, y^s) = \left[\frac{d^s(x^t, y^t)}{d^s(x^s, y^s)} \times \frac{d^t(x^t, y^t)}{d^t(x^s, y^s)}\right]^{1/2} \quad (5)$$

Färe et al. (1992) shows that this index is equivalent to:

$$m\,(x^t, y^t, x^s, y^s) = \frac{d^t(x^t, y^t)}{d^s(x^s, y^s)} \times \left[\frac{d^s(x^t, y^t)}{d^t(x^t, y^t)} \times \frac{d^t(x^s, y^s)}{d^t(x^s, y^s)}\right]^{1/2}$$

And that the two components of the Malmquist Index as in Equation (6) are represented by:

$$\text{Efficiency change} = \frac{y^{t} / y^{c}}{y^{s} / y^{a}} \quad (7);$$

and

$$\text{Technical change} = \left[\frac{y^{t} / y^{b}}{y^{t} / y^{c}} \times \frac{y^{s} / y^{a}}{y^{s} / y^{b}} \right]^{1/2} \quad (8).$$

Equation 6 is our estimable equation where the ratio outside the brackets measures the change in technical efficiency (EFFCH) between the years s and t. The geometric mean of the two ratios inside the square brackets captures the shift in technology (TECH) between the two periods evaluated at x^s and x^t.

To estimate equation 6 we model commercial banks as multi-product firms, producing 3 outputs and using 3 inputs. The input vector includes; labour, capital, and loanable funds, which is the sum of deposit (demand and time) and non-deposit funds (value of total liabilities). Hence, the total cost includes both interest expense and operating costs and are proxied by the sum of labour, capital and loanable funds expenditures. The output vector includes, customer loans net of provisions, other earning assets, (loans to special sectors, interbank funds sold) and investment securities (treasury bills, government bonds and other securities). The time series data is entered in the Data Envelopment Analysis Programme version 2.1 to generate Total Factor Productivity scores. The results are reported in Table 1 and 2 in appendix.

ESTIMATION RESULTS

The results are reported in Tables 1, 2 and 3 in appendix. Table 1 reports Malmquist indices by annual means while Table 2 shows Malmquist indices means by firm for the period of study. Table 2 shows that 26 percent of the sample recorded productivity growth while the rest (74 percent) experienced a decline in productivity. In the sample the highest productivity growth experienced is 7.3 percent while the highest decline is 13.2 percent.

The average annual values of Total Factor Productivity Index (TFPCH), Technological Change (TECH), Technical Efficiency Change (EFFCH), Pure Technical Efficiency Change (PECH) and Scale Efficiency Change (SECH) for the years 1999 to 2008 are reported in Table 1, while Table 2 shows the same but for average values across firms. Table 1 shows that there was total factor productivity growth in the first four years after which there was a decline in the subsequent six years; the highest TFP growth was experienced in the 5th year at 3.2 percent. On average there was decline of 2.7 percent in TFPCH which can be explained by the decline in TECH of 3.3 percent which is greater than the slight growth in EFFCH of 0.6 percent. TFPCH is a combination of TECH and EFFCH. The Malmquist Index cannot be constructed without a reference technology, which could be the technology for any year in a multi-period setting. In this study, we report the results relative to the technology fixed at the initial year 1999. A value of the index greater than unity implies a positive growth of total productivity. An index equal to unity indicates no change in productivity level and a value less than one shows decline in productivity from period t to period t+1.

The mean values of TFP ranged from 1.073 and 0.868 for all the firms and the average TFP decline is 2.7 percent. 26 percent of the firms experienced TFP growth while 74 percent experienced TFP decline. 65 percent of the firms experienced EFF growth while 35 percent experienced a decline. On the other hand only 18 percent had a TE growth while 82 percent experienced a decline in TE growth. 12 percent had both EFF and TE growth. Thus the low number of firms that experienced growth in TE might have eroded the average gains for the high number of firms that had growth in EFF leading to a decline in TFP.

The level of TFP of the banking sector can be improved either by changing the technical efficiency or by shifting the production frontier (technological change). Table 3 reports the comparison between technical efficiency change and technological change for various sub-sections of the banks considered in this study. Among the 34 commercial banks, 9 foreign-owned and 4 public-owned banks recorded a decline in productivity on average. The 4 listed banks had a decline in productivity while 30 non-listed banks recorded growth in productivity. For all the sub-sections only small banks had a decline in EFF while foreign-owned, publicly-owned and listed banks had a decline in TE. The sub-sections that experienced a decline in TE also recorded decline in TFP although they all recorded growth in EFF.

year	EFFCH	TECH	PECH	SECH	TFPCH
1	0.000	0.000	0.000	0.000	0.000
2	1.042	0.981	1.022	1.019	1.022
3	0.982	0.951	0.990	0.992	0.935
4	0.978	1.045	1.010	0.969	1.023
5	1.039	0.994	1.001	1.037	1.032
6	0.940	1.005	0.975	0.964	0.944
7	0.967	0.957	1.020	0.948	0.926
8	0.984	0.992	0.985	0.999	0.977
9	1.086	0.853	1.010	1.075	0.926
10	1.044	0.941	1.037	1.006	0.982
mean	1.006	0.967	1.037	1.006	0.973

Table 1: Malmquist Index Summary of Annual Means
Source: Author's

CONCLUSION AND RECOMMENDATIONS

This study was motivated by the fact that even though the banking sector is the largest component of the financial system in Kenya accounting for more than 80 percent of the financial sector assets, there is not much quantitative literature on its general performance and productivity. Productivity has been measured by the Malmquist index and was found to be equal to 0.973, which means that total productivity decreased by 2.7 percent. Its two components, the technological change index was found to equal 0.967 and the technical efficiency change index was found to be 1.006.

The results reveal that the TFP decline was observed for all the banks except for 9 banks whose growth ranged from 0.3 percent to 7.3 percent. The sources of growth were found to be efficiency changes rather than technological progress. In terms of sub-sections small banks had the highest productivity growth of 5.8 percent; large banks had a growth in TFP of 1.3 percent while medium banks experienced a 0.6 percent growth. Locally-owned banks experienced a 3.9 percent productivity growth while foreign-owned and publicly owned banks had a decline in productivity of 1.9 percent and 6.5 percent respectively. Its only medium banks, large banks, locally owned banks and banks not listed in NSE that experienced both efficiency and technological growth.

The findings of this study suggest that large banks are more productive than medium banks. With the Central Bank of Kenya's proposal to increase core-capital for all except large banks, the medium sized banks are bound to move to the category of large banks thereby making them more productive. These results suggest that as the banks capitalize, they can lend more and still be well insulated in the event of failure. It is also evident from the results that Kenyan banks have not been as productive as they should be, with low productivity emanating mainly from technology change (innovations/shocks). Given that technology is the main driver of productivity in the banking sector, we suggest that Central bank's supervision department design a practicable protocol as a technological standards requirement for the sector.

Firm	EFFCH	TECH	PECH	SECH	TFPCH
1	1.021	0.977	1.024	0.997	0.998
2	1.004	0.936	1.013	0.992	0.939
3	1.000	1.016	1.000	1.000	1.016
4	0.998	1.000	1.000	0.998	0.988
5	0.972	1.015	1.000	0.972	0.987
6	1.035	0.993	1.006	1.029	1.028
7	0.980	0.958	0.986	0.994	0.938
8	0.996	0.973	1.000	0.996	0.969
9	1.010	0.978	1.002	1.008	0.988
10	1.066	1.006	1.066	1.001	1.073
11	1.026	0.994	1.009	1.017	1.020
12	1.000	0.958	0.993	1.008	0.958
13	0.987	0.913	0.988	0.999	0.901
14	0.979	0.978	1.000	0.979	0.958
15	0.993	0.979	0.997	0.996	0.972
16	1.044	0.955	1.043	1.001	0.988
17	1.004	1.031	1.000	1.004	1.035
18	0.979	0.968	1.000	0.979	0.948
19	0.998	1.001	0.993	1.005	0.999
20	1.000	0.905	1.000	1.000	0.905
21	1.000	0.976	1.000	1.000	0.976
22	1.000	0.994	1.000	1.000	0.994
23	1.029	0.975	1.021	1.008	1.003
24	1.019	0.989	1.000	1.019	1.008
25	1.000	0.985	1.000	1.000	0.985
26	1.000	0.824	1.000	1.000	0.824
27	0.985	0.991	1.000	0.985	0.977
28	1.041	0.920	1.010	1.030	0.958
29	0.998	0.870	1.000	0.998	0.868
30	1.039	0.970	1.034	1.004	1.007
31	1.000	0.918	1.000	1.000	0.918
32	0.999	0.994	1.000	0.999	0.993
33	1.000	0.953	1.000	1.000	0.953
34	1.007	1.037	1.006	1.001	1.044
Mean	1.006	0.967	1.005	1.001	0.973

Table 2: Malmquist Index Summary of Firm Means
Source: Author's

Sub- section of banks	Number of firms, Number of periods in brackets	EFFCH	TECH	PECH	SECH	TFPCH
Whole sample	34(10)	1.006	0.967	1.005	1.001	0.973
Small	09(10)	0.999	1.059	0.999	1.000	1.058
Medium	14(10)	1.002	1.004	1.001	1.001	1.006
Large	11(10)	1.002	1.011	1.001	1.001	1.013
Foreign owned	09(10)	1.003	0.978	1.002	1.001	0.981
Local owned	21(10)	1.008	1.030	1.001	1.000	1.039
Public owned	04(4)	1.000	0.935	1.000	1.000	0.935
Listed in NSE	04(4)	1.018	0.919	1.008	1.010	0.936
Not listed in NSE	30(10)	1.002	1.095	1.002	1.000	1.097

Table 3: Summary of Malmquist Means by Sub-Sections
Source : Author's

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