European Journal of Business and Management
ISSN 2222-1905 (Paper) ISSN 2222-2839 (Online)
Vol.5, No.6, 2013

A DEA- Based Malmquist Productivity Index approach in assessing performance of commercial banks: Evidence from Tanzania

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Abstract

This study intends to measure Productivity change of Tanzanian commercial banks for the period of seven years. In this study the nature of efficiency and productivity change is investigated through the Malmquist Productivity Index (MPI).The Malmquist productivity index has the components which are used in performance measurement; such as changes in technical efficiency, change in technological change, change in pure technical efficiency, change in scale efficiency as well as change in Total factor productivity. Most commercial banks recorded improvement in efficiency change by 67 percent, a technical change improvement by 83 percent, pure technical change improvement by 67 and scale efficiency change by 50 percent.

Generally the mean efficiency change of LDB is higher compared to the rest of the groups; hence manage to push the frontier of possibility outwards with respect to other groups, followed by small banks with mean efficiency change of 10.3 percent while the LFB recorded efficiency change of 1.8 percent, similarly the mean total factor of productivity of small banks were higher compared with the rest of the groups, by recording productivity improvement of 57.9 percent exceeding LDB and LFB with 51.4 percent and 54 percent respectively. Generally both groups of commercial banks experienced, technological progress, however the efficiency gains during the period of the study was due to improvement in Technical efficiency rather than scale efficiency. With reference to bank groups, the result implies that small banks have invested in Technological innovation, so as to reduce related costs of production.

Key words: Malmquist productivity index; Technical efficiency; Scale efficiency,

1. Introduction

Commercial banks play a significant role in stabilization of national economy, by ensuring that productive sectors in need of funds receive funds from those with excess funds. The importance of commercial banks in developing countries including Tanzania is accelerated by underdevelopment of financial markets, unlike developed world where financial markets work hand in hand with financial sector. Therefore banks and financial institutions in most cases remain the only source to bridge the gap between savers and borrowers.

Due to ever-changing business environment, commercial banks are obliged, to use resources more efficiently, so as to survive in the current world of business competition. With no exception to Tanzanian commercial banks, much emphasis should be placed on effective utilization of resources so as to enhance productivity as well as achievement of planned activities. Measuring productivity change in commercial banks has increased recently in both developed countries and developing countries. Total factor productivity refers to all factors pertaining production process, which in one way or another provide total information in the production process. Therefore taking total factor productivity in holist view and try to measure its change over a period of time results into much more consistent results. The total factor productivity involves the two important aspects such as the change in Technical efficiency as well as Technological change. Therefore in commercial banks high economic performance and competitive ability is achieved when there is improved in both of the two components.

Despite the current development of the financial sector and its wider contribution to stability of the economy, only a hand full of studies have paid attention on measuring efficiency and productivity change in developing countries. In Tanzania in particular, one of the most comprehensive efficiency study was the study by Aikael, 2008. This study intends to provide more current evidence of productivity change of Tanzanian commercial banks, by covering most current years with the highly competitive banking environment. Through the application of Non Parametric Malmquist productivity index (MPI) Methodology, the study intends to cover the period of seven years. Through this approach we disentangle efforts to catch up to the frontier which is referred to efficiency change from shift of

frontier which is referred to technological change. We went further by examining, the main causes of efficiency change, and for example the efficiency change due managerial improvement (Pure Technical efficiency) or efficiency towards improvement towards required scale (scale efficiency change).

2. Literature Review

The measurement of productivity Change is another important aspect to consider when dealing with efficiency and performance of financial institution. Banks and financial institutions are expected to show the productivity change as the results of innovation of deregulation of the financial sector, therefore technical efficiency and technological efficiency should be measured correctly. The other aspect of DEA is a Malmquist Productivity Index (MPI) especially when focusing on inefficiency aspects of Non Parametric Method. Malmquist Total factor productivity is based on the assumption of competitive behavior of the producer with respect to inputs.

The Total Factor productivity (TFP) is the productivity measure which involves factors of production. Banks are said to operate efficiently when they a found to be positioned on the frontier on the other hand when they are found below the frontier they are referred to be technically inefficient. The shifting of this production frontier is what we refer as Technical Change. The background of Malmquist Total factor productivity began when Caves et al (1982) developed Malmquist from the notion of scaling, which was initiated earlier by Malmquist (1953) but Caves (1982) did not account for inefficiency. It was Fare (1992) when combined the ideas of Farrell (1957) on the measurement of efficiency and measurement of productivity, then caves et al (1982) develop Malmquist Index of productivity Change. Malmquist Productivity assesses the productivity Change of DMU, in this study we refer to Commercial banks between periods of time. One can define MPI as the process where the production frontier shifts and the DMU is subjected to recover the productivity change (Caves, et al (1982). The recovers can have two important aspects such as improvements or deterioration of both technical efficiency change and Technological efficiency change. Therefore the estimation of TFP should be obtained by decomposing the above two components i.e. technological change and efficiency change.

MPI based on DEA model is currently regarded as the most popular index due to the ability to handle a lot of information dealing with panel data as well as having favorable properties to many researchers. The Malmquist productivity index started to appear in the literatures in early 1980s by Nishizu, M&Page, J.M (1982)in their article total factor productivity growth, which was based on technological growth and technical change in Yugoslavia during the 1965-1978 study period. The authors were able to decompose productivity growth into two important elements by considering the time interval change. i.e. Technical change refers to the change of frontier level and efficiency change which refer to the individual productivity displacement with respect to the frontier. Moreover MI is based on the performance assumption that if the index is found to be less than 1 this will imply worsen or deterioration and greater than one 1 means improvement /progress in relevant (Fare at al 1994).

Several studies have worked with MPI to determine the change in production within a certain period of time. Malmquist productivity Index (MPI) in Europe was first applied by Berger et al (1992) in the Norwegian banking system aimed at evaluating the impact of deregulation in the banking sector, the empirical findings of their analysis showed productivity deterioration prior deregulation an another hand post deregulation the Norwegian banking system was found to have improvement in productivity. There are also other studies on productivity change in both developed , developing economies as well as developing countries, the following are selected studies from different countries.

Worthington, A.C (1999) using Non parametric frontier analysis, employed Malmquist indices (MALMQUIST –DEA) to investigate productivity growth in credit unions, the productivity growth is decomposed into technical efficiency change and technological efficiency change for 269 Australian credit unions. The results were found similar to that of Berger (1992) that most credit unions experienced technological progress after deregulation, more specifically they found that any efficiency improvement was largely the results of technical improvement in technical efficiency rather than scale efficiency.

Using similar method Sufian (2007) examined different indices namely productivity change, technological change and efficiency change as well as scale efficiency, under intermediation approach the other part of the study intended to examine whether the domestic banks and foreign banks were drawn from the same environment, the findings of their study indicated that Malaysian Islamic bank productivity exhibited an inverted U shaped behavior during the period under study on another case domestic banks exhibited higher productivity growth than foreign banks. In terms of size majority of Malaysian Islamic banks have shown productivity progress due to technological progress from

medium group, on the other hand the majority of Malaysian Islamic banks that experienced productivity regress due to technological regress came from the small bank group. From this perspective small banks were found lagging behind the other bank groups in terms of technological progress.

3. Data and Methodology.

The following inputs and output were used in this study; inputs were labor, physical capital, operating costs and deposit. While the outputs were Loan and Investment, therefore a panel data with 146 observations used in the analysis. The Panel data was used to arrive to MPI estimates, with a total of 21 Commercial banks. The following table depicts descriptive statistics of data and variables used in this study. The intermediation approach is adopted, considering labor, physical capital, operating costs and deposit as inputs, while loans and investments are considered as output

Table: 1

Variable	Obs	Mean	Std. Dev	Min	Max
Loan	146	1.64E+11	2.48E+11	2.20E+08	1.43E+12
Investment	146	7.71E+10	1.22E+11	0	6.31E+11
Labor	146	364.1096	539.2115	26	2615
Physical Capital	146	2.25E+10	6.32E+10	1.90E+08	4.63E+11
Operating cost	146	2.23E+10	3.23E+10	2.20E+07	1.52E+11
Deposit	146	2.79E+11	4.29E+11	5.00E+08	2.41E+12

Using a DEA approach a number of indices can be used as alternative for measuring the productivity changes, some researchers have used fisher index, Tomqvist index and Malmquist Index. In this study we use Malmquist index which is applied by a number of researchers in bank efficiency studies, this is due to the fact that it neither require the profit maximization nor cost minimization assumption, in addition since we have panel data, this approach enable decomposition of productivity change into technical efficient change or catch up and technical change. We adopt output oriented approach according to Fare et al (1994) as follows

$$\text{Mo (yt+1, xt+1, yt, xt)} = \left[\frac{d_0^t(x_{t+1}, y_{t+1})}{d_0^t(x_t, y_t)} * \frac{d_0^{t+1}(x_{t+1}, y_{t+1})}{d_0^{t+1}(x_t, y_t} \right]^{0.5}$$

The above equation represents the productivity of production points (xt+1, yt+1) relative to the production point (xt, yt), the value greater than 1 implies total productivity growth from period t to the next period t+1, however the index is the geometric mean of the two outputs based Malmquist indices .The index uses period t technology and the other period t+1 technology.

The above output based Malmquist productivity Index can be decomposed, according to Fare et al (1989, 1992) as follows

$$\text{Mo}\left(x^{t+1}, y^{t+1}, x^t, y^t\right) = \frac{d_0{}^t\left(x^{t+1}, y^{t+1}\right)}{d_0{}^t\left(x^t, y^t\right)} * \left[\frac{d_0^t\left(x^{t+1}, y^{t+1}\right)}{d_0^{t+1}\left(x^{t+1}, y^{t+1}\right)} * \frac{d_0^t\left(x^t, y^t\right)}{d_0^{t+1}\left(x^t y^t\right)} \right]^{0.5}$$

The above equation indicates some ratios outside the brackets, which implies the measurement change in relative efficiency in the output based technical efficiency between periods of time i.e. between (t) and (t+1). On the other hand the terms inside the brackets indicates the geometry of the two ratios in the equation, which indicates the shift in technology of two units, in our case we refer to the commercial banks. This is to say the efficiency change is obtained by calculating the ratio of efficiency in (t+1) period in proportion to efficiency in (t) period. Again to obtain efficiency change and technological change we split the equation above, as shown below.

$$\text{Change in efficiency} = \frac{d_0{}^t\left(x^{t+1}, y^{t+1}\right)}{d_0{}^t\left(x^t, y^t\right)}$$

Technological change= $\left[\frac{d_0^t\left(x^{t+1},y^{t+1}\right)}{d_0^{t+1}\left(x^{t+1},y^{t+1}\right)} * \frac{d_0^t\left(x^t,y^t\right)}{d_0^{t+1}\left(x^t y^t\right)}\right]^{0.5}$

In case of no significant change between periods of time, which can be illustrated by xt=xt+1, as well as yt= yt+1, then the MPI is equal to 1.
The Malmquist Total factor productivity can be obtained by solving a series of linear programming equations under a constant return to scale as shown below (Fare, 1998, Worthington, A 1999)

$$\left[D^t o(y_t,x_t\right]^{-1} = \max_{\theta,\lambda}\theta$$

Subject to

$$\begin{aligned} &-y_{it} + Y_t\lambda \geq 0 \\ &\theta x_{it} - X_t\lambda \geq 0 \\ &\lambda \geq 0 \end{aligned} \qquad (1)$$

$$\left[\ D^{t+1}o(y_{t+1},x_{t+1})\ \right]^{-1} = \max_{\theta,\lambda}\theta$$

Subject to

$$\begin{aligned} &-y_{i,t+1} + Y_{t+1}\lambda \geq 0 \\ &\theta x_{i,t+1} - X_{t+1}\lambda \geq 0 \\ &\lambda \geq 0 \end{aligned} \qquad (2)$$

$$\left[\ D^{t+1}o(y_{t,},x_t)\ \right]^{-1} = \max_{\theta,\lambda}\theta$$

Subject to

$$\begin{aligned} &-y_{it} + Y_{t+1}\lambda \geq 0 \\ &\theta x_{it} - X_{t+1}\lambda \geq 0 \\ &\lambda \geq 0 \end{aligned} \qquad (3)$$

$$\left[\ D^{t+1}o(y_{t+1},x_{t+1})\ \right]^{-1} = \max_{\theta,\lambda}\theta$$

Subject to

$$\begin{aligned} &-y_{i,t+1} + Y_t\lambda \geq 0 \\ &\theta x_{i,t+1} - X_t\lambda \geq 0 \\ &\lambda \geq 0 \end{aligned} \quad (4) \qquad (4)$$

4. Results

In this subsection we intend to measure the total factor productivity and its corresponding changes in its components between 2005 and 2011. We employed balanced panel data with about 147 observations that appears in 7 yrs of our study, therefore about 21commercial balanced panel were included in our study. The Malmquist productivity index has components which are used in performance measurement; these are changes in technical efficiency, change in technological change, change in pure technical efficiency, and change in scale efficiency as well as change in Total factor productivity.

Therefore the Malmquist productivity indexes provide us with the opportunity of comparing the productivity change within the banking industry as well as to compare the productivity change within groups, hence give the opportunity of poor performers to catch up. Total factor productivity as the word implies refer to all factors pertaining the production of commercial banks, more specifically the change in total factor productivity entails the changes in efficiency and changes in Technology. When interpreting the Malmquist total factor productivity we consider all of its components greater than one indicates improvement or progression on the other hand the values less than one refers to the deterioration of regression, whereas the values equal to one refers to as no improvement has been observed.
We used DEAP 2.1 program developed by Coelli (1996b) to measure the productivity indexes, we applied Constant Return to Scale input oriented.

Table: 2 Malmquist Index summary of annual means

Year	effch	techch	pech	sech	tfpch
2005/2006	1.081	1.242	1.057	1.023	1.342
2006/2007	1.042	1.036	1.048	0.995	1.08
2007/2008	0.559	1.766	0.73	0.766	0.988
2008/2009	1.765	0.529	1.386	1.274	0.934
2009/2010	1.074	0.91	1.004	1.07	0.978
2010/2011	0.863	1.199	0.924	0.934	1.035
Mean	**1.005**	**1.046**	**1.006**	**0.998**	**1.052**
	effch<1=02	techch<1=01	pech< 1=02	sech < 1=03	tfpch< 1=03
	effch >1=04	techch >1=05	pech> 1=04	sech > 1=03	tfpch> 1=03
	effch =1=0	techch =1=0	pech=1=0	sech=1=0	tfpch=1=0

Note: Technical efficiency change (Techch), Efficiency Change (effch), Pure Technical efficiency change (pech) and Total factor productivity change (tfpch).

The table 2 above indicates most banks have shown improvement in efficiency change by 67percent, technical change improvement by 83 percent, pure technical change improvement by 67 Percent and Scale efficiency change by 50%. However the trend shows the most changes deteriorates from 2005 to 2008. On the other hand Scale efficiency change (failure to catch up) deteriorates by 0.2 percent, other Malmquist indexes recorded an improvement in productivity change as follows, and efficiency change 0.5 percent, technological change 4.6 percent, pure efficiency change 0.6 percent and total factor productivity change 5.2 percent. The year 2008/2009 recorded higher regress in technical efficiency by recording 47.1 percent deterioration, which is mainly caused by managerial inefficiency in controlling cost rather than scale inefficiency, however total factor productivity change in the same year recorded deterioration of 1.2 percent which is due to deterioration in both technology and technical efficiency. Similarly the year 2005/2006 recorded higher improvement in technical efficiency change by 24.2 percent and efficiency change by 8.1 percent.

The results of efficiency change and technological change resulted in an improvement of commercial banks total productivity in the same year by 34.2 percent, therefore we support the argument, Deliktas, (2002) &Sufian, F (2007)

that bank`s total factor productivity depends on the improvement of both efficiency change and technological change and through these changes commercial banks can reach a high performance level and achieve competitive ability. With reference to the Malmquist summary of annual means, it is evident that most commercial banks experienced technological progress, however the efficiency gains during the period of study was due to improvement in Technical efficiency rather than scale efficiency. The individual Mean productivity change of individual banks is shown in the table below

Table:3 Malmquist index summary of firm means

DMU	effch	techch	pech	sech	tfpch
ABC	0.982	0.913	0.984	0.998	0.896
AKIBA	1.051	0.927	1.046	1.005	0.974
AZANIA	0.876	1.001	0.877	1	0.877
BOA	1.051	1.051	0.966	0.99	1.005
BARCLAYS	0.804	0.968	0.84	0.957	0.778
CITIBANK	1.162	1	1	1	1.162
CBA	1.083	1.005	0.991	1.093	1.088
CRDB	0.963	1.012	1	0.963	0.974
DTB	1.05	1.003	1.003	0.988	1.041
EXIM	0.978	1.015	1	0.978	0.992
FBME	1.047	1.454	1	1.047	1.522
HABIB	1.108	0.927	1.045	1.06	1.027
I&M	1	1.226	1	1	1.226
INT`NAL CB	0.849	1.023	0.849	0.849	0.869
KCB	1.126	1.061	1.126	1.001	1.195
NMB	0.93	1.081	1	0.93	1.006
NBC	1.304	1.083	1.229	1.062	1.412
NIC	1.111	1.021	1.111	1	1.134
PBZ	0.996	1.011	0.965	1.032	1.007
STANBIC	1.041	1.085	1.016	1.024	1.129
STDCHART	1.014	1.014	1	1.019	1.034
Mean	**1.046**	**1.046**	**1.006**	**0.998**	**1.052**
	effch<1=07	**techch<1=04**	**pech< 1=07**	**sech < 1=08**	**tfpch< 1=07**
	effch >1=13	**techch >1=16**	**pech> 1=07**	**sech > 1=09**	**tfpch> 1=14**
	effch =1=1	**techch =1=1**	**pech=1=7**	**sech=1=4**	**tfpch=1=0**

The table 3 above indicate most commercial banks recorded an improvement in productivity change in both categories, with exceptional to scale efficiency change where the score recorded deterioration in productivity change of about 0.2 percent. The productivity change in both categories is as follows, with efficiency change 33.3 percent of commercial banks indicated deterioration in efficiency change, while 61.9 percent recorded an improvement in efficiency change while 0.047 percent recorded no improvement in efficiency change.

The second category of our analyses is technological change, 19 percent of commercial banks under study, recorded deterioration in technological advance while 76.2 percentage indicated progress in technological advance and only

0.05 percent did not show any changes in technology advancement, therefore we see good number of commercial banks have achieved higher in technological change. With pure efficiency change the number of commercial banks recorded deterioration, progress and no change remained the same, 33.3 percent.

A good number of commercial banks indicated deterioration in scale efficiency; this indicates most commercial banks were operating in a wrong scale. About 38 percent of commercial banks recorded deterioration in scale efficiency, almost similar with those with improvement in scale efficiency change, 43 percent. Due to the fact that most banks have achieved higher percentage in both efficiency change and technological change, similarly most commercial banks recorded higher total factor productivity change about 67 percent recorded an improvement in productivity change and 33.3 percent recorded deterioration in total factor productivity.

4.1 Productivity change by group categories.

The main objective of this subsection is to compare the productivity change of commercial banks within their respective groups, this will provide a precise description as to what among groups of commercial banks has shown superior productivity change compared with the rest of the groups, similarly what among groups have shown deterioration in productivity change as well as indicating the percentage of catch up. The table 4 below indicates productivity change of commercial banks by peer groups

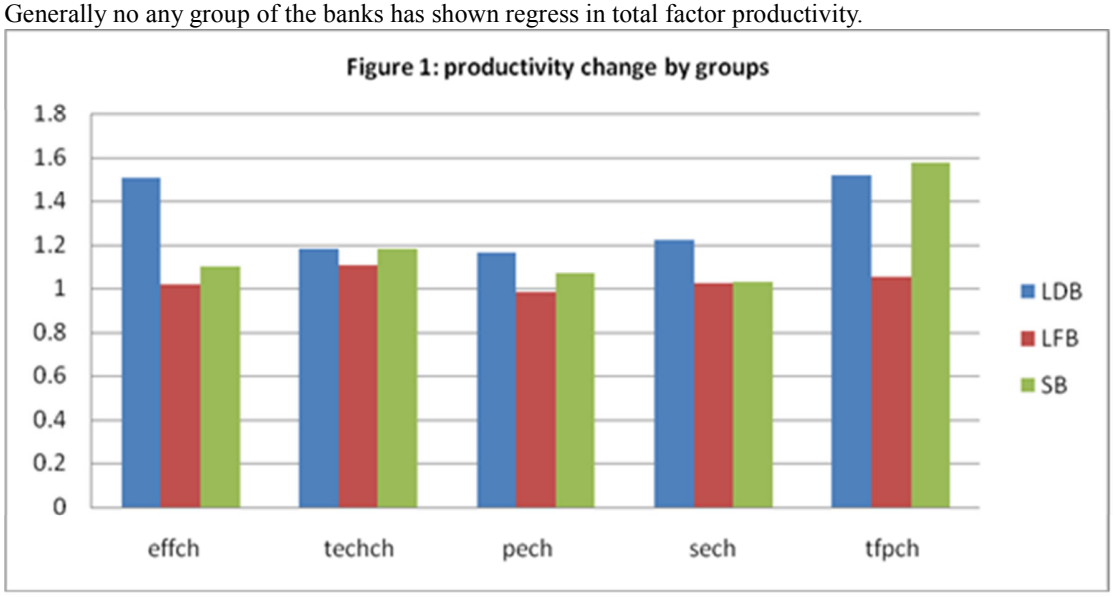
Table : 4 Malmquist index summary of banks groups

	Year	effch	techch	pech	sech	tfpch
LDB	2005	2.940	1.240	2.038	1.177	4.064
	2006	0.826	1.269	0.995	0.830	0.863
	2007	0.487	2.041	1.014	0.478	0.988
	2008	2.855	0.489	1.000	2.855	1.261
	2009	1.102	0.882	0.996	1.106	0.952
	2010	0.852	1.171	0.941	0.907	0.987
	mean	1.510	1.182	1.164	1.226	1.519
LFB	2005	0.968	1.369	0.938	1.030	1.320
	2006	0.938	1.035	1.025	0.923	0.984
	2007	0.791	1.479	0.903	0.859	1.079
	2008	1.411	0.684	1.117	1.228	0.883
	2009	1.139	1.078	1.040	1.090	1.198
	2010	0.865	1.023	0.861	0.995	0.858
	mean	1.018	1.111	0.981	1.021	1.054
SB	2005	1.041	1.284	1.042	1.011	1.373
	2006	1.245	1.135	1.150	1.099	1.480
	2007	0.722	1.904	0.813	0.868	1.438
	2008	1.557	0.516	1.373	1.136	2.737
	2009	1.105	0.898	1.015	1.091	0.994
	2010	0.946	1.374	1.007	0.955	1.453
	mean	1.103	1.185	1.067	1.027	1.579

The above table indicates both Large and Small banks recorded productivity change in all perspective. More specifically LDB recorded a 33.3 percent improvement in both components of total factor productivity. However SB

recorded higher improvement in efficiency change, technological change, scale efficiency change as well as total factor productivity change by 67 percent. This indicates during the period of our study most small banks managed to push their frontier possibility outwards relative to other groups, in some circumstances failure to catch up and experience productivity regress was only 33 percent.

The mean efficiency change of LDB is higher compared to the rest of the group; hence manage to push the frontier of the production possibility outwards with respect to other groups, followed by small banks with mean efficiency change of 10.3 percent while LFB recorded efficiency change of 1.8 percent. With the technological change improvement both small banks and Large Domestic banks indicated an average score of 18.5 percent, however during the period of study the total factor productivity small banks were higher compared with the rest of the group, the group recorded a productivity improvement of 57.9 percent exceeding LDB and LFB with 51.4 percent and 54 Percent respectively. The results indicate small banks have invested in technological innovation so as to reduce related costs of production. Generally no any group of the banks has shown regress in total factor productivity.



Note: LDB=Large Domestic Bank, LFB=Large Foreign Bank, SB=Small banks, effch=efficiency change, techch= technical change, pech=pure efficiency change, sech=scale efficiency change, tfpch=Total factor productivity change.

5 Conclusion

We used Malmquist Productivity Index (MPI) to measure productivity improvement productivity change within commercial banks. The Malmquist productivity index has the components which are used in performance measurement; these are changes in technical efficiency, change in technological change, change in pure technical efficiency, and change in scale efficiency as well as change in Total factor productivity. Most commercial banks recorded improvement in efficiency change by 67 percent, a technical change improvement by 83 percent, pure technical change improvement by 67 and scale efficiency change by 50 percent.

Generally the mean efficiency change of LDB is higher compared to the rest of the group; hence manage to push the frontier of possibility outwards with respect to other groups, followed by small banks with mean efficiency change of 10.3 percent while the LFB recorded efficiency change of 1.8 percent, similarly the mean total factor of productivity of small banks were higher compared with the rest of the groups, by recording productivity improvement of 57.9 percent exceeding LDB and LFB with 51.4 percent and 54 percent respectively. The result implies that small banks have invested in Technological innovation, so as to reduce related costs of production.

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ABBREVIATION

Effch= Efficiency change; Techch=Technical efficiency change; Pech=Pure Efficiency Change; Sech=Scale Efficiency Change; Tfpch=Total factor productivity change

APPENDIX 1A &1B respectively shows **Malmquist index summary** of individual commercial bank.

	2006					2007					2008				
firm	**effch**	**techch**	**pech**	**sech**	**tfpch**	**effch**	**techch**	**pech**	**sech**	**tfpch**	**effch**	**techch**	**pech**	**sech**	**tfpch**
ABC	1.000	0.525	1.000	1.000	0.525	1.000	0.718	1.000	1.000	0.718	1.000	2.160	1.000	1.000	2.160
AKIBA	0.630	1.438	0.643	0.981	0.906	1.537	0.643	1.507	1.020	0.989	0.687	1.641	0.800	0.859	1.128
AZANIA	0.923	1.007	0.944	0.978	0.930	1.062	0.905	1.040	1.022	0.961	0.467	2.311	0.688	0.678	1.078
BOA	0.816	0.998	0.861	0.947	0.814	0.747	1.207	0.719	1.040	0.902	0.445	2.152	0.601	0.740	0.957
B'CLAYS	1.000	1.370	1.000	1.000	1.370	0.825	0.671	0.895	0.922	0.554	0.363	1.982	0.792	0.458	0.720
CITI	1.000	1.487	1.000	1.000	1.487	1.000	1.375	1.000	1.000	1.375	1.000	1.167	1.000	1.000	1.167
CBA	1.324	1.261	1.000	1.324	1.669	1.314	0.759	1.000	1.314	0.997	0.501	2.143	0.511	0.979	1.073
CRDB	0.834	1.305	1.000	0.834	1.089	1.199	0.772	1.000	1.199	0.926	0.460	1.657	1.000	0.460	0.762
DTB	0.841	1.058	0.789	1.067	0.890	1.251	0.963	1.332	0.939	1.205	0.505	2.366	0.675	0.748	1.195
EXIM	1.000	1.253	1.000	1.000	1.253	1.000	0.678	1.000	1.000	0.678	0.471	2.091	0.865	0.545	0.986
FBME	1.317	2.704	1.000	1.317	3.561	1.000	1.961	1.000	1.000	1.961	0.023	0.720	0.026	0.878	0.017
HABIB	1.065	1.450	1.303	0.817	1.544	1.735	0.554	1.000	1.735	0.962	1.000	1.778	1.000	1.000	1.778
I&M	1.000	1.231	1.000	1.000	1.231	1.000	1.171	1.000	1.000	1.171	0.659	2.413	1.000	0.659	1.590
KCB	0.690	1.170	0.688	1.002	0.807	2.958	1.844	2.954	1.001	5.455	0.281	1.229	0.420	0.669	0.345
NMB	1.000	0.962	1.000	1.000	0.962	0.370	2.035	1.000	0.370	0.752	0.321	2.329	1.000	0.321	0.749
NBC	6.986	1.452	4.113	1.698	10.141	0.910	1.001	0.986	0.922	0.910	0.679	2.138	1.041	0.653	1.452
NIC	1.523	1.031	1.878	0.811	1.570	1.234	2.618	1.000	1.234	3.231	1.000	1.781	1.000	1.000	1.781
PBZ	1.627	1.465	1.489	1.093	2.384	0.632	0.952	0.588	1.074	0.601	1.411	1.479	1.755	0.804	2.086
STANBIC	0.751	1.391	0.753	0.997	1.044	0.925	1.189	1.204	0.768	1.099	0.802	1.699	0.819	0.978	1.362
STDCH	1.122	1.228	1.000	1.122	1.378	1.000	0.906	1.000	1.000	0.906	1.000	1.068	1.000	1.000	1.068
AVG	**1.081**	**1.242**	**1.057**	**1.023**	**1.342**	**1.042**	**1.036**	**1.048**	**0.995**	**1.080**	**0.559**	**1.766**	**0.730**	**0.766**	**0.988**

Appendix 1A(2006-2008) Year 2- Year 3; Malmquist index summary of individual commercial bank **continue……..**

	2009					2010					2011				
firm	**effch**	**techch**	**pech**	**sech**	**tfpch**	**effch**	**techch**	**pech**	**sech**	**tfpch**	**effch**	**techch**	**pech**	**sech**	**tfpch**
ABC	1.000	0.762	1.000	1.000	0.762	1.000	0.880	1.000	1.000	0.880	0.897	1.058	0.907	0.989	0.949
AKIBA	2.282	0.407	2.426	0.940	0.929	1.130	0.837	0.920	1.228	0.946	0.786	1.227	1.040	0.964	0.964
AZANIA	2.153	0.469	1.480	1.455	1.010	0.899	0.892	0.936	0.960	0.803	0.511	1.142	0.485	1.054	0.584
BOA	2.015	0.530	1.601	1.259	1.068	1.311	0.872	1.257	1.042	1.143	1.068	1.125	1.086	0.983	1.201
B'CLAYS	2.273	0.447	1.357	1.676	1.017	0.961	0.839	0.824	1.166	0.805	0.412	1.205	0.442	0.933	0.497
CITI	1.000	0.838	1.000	1.000	0.838	1.000	1.293	1.000	1.000	1.293	1.000	0.954	1.000	1.000	0.954
CBA	1.997	0.568	1.955	1.021	1.133	1.000	0.898	1.000	1.000	0.898	0.927	0.983	0.945	0.982	0.912
CRDB	1.696	0.587	1.000	1.696	0.997	0.977	1.048	1.000	0.977	1.024	1.043	1.044	1.000	1.043	1.089
DTB	1.988	0.521	1.491	1.333	1.035	0.946	0.959	1.003	0.944	0.907	0.948	1.113	0.961	0.987	1.055
EXIM	2.026	0.562	1.156	1.753	1.139	0.911	1.012	1.000	0.911	0.922	1.003	1.082	1.000	1.003	1.085
FBME	43.083	0.648	37.808	1.140	27.913	0.630	0.945	0.637	0.988	0.595	1.589	4.040	1.569	1.012	6.418
HABIB	0.679	0.476	0.685	0.991	0.323	1.398	0.913	1.460	0.957	1.277	1.054	1.024	1.000	1.054	1.079
I&M	1.518	0.577	1.000	1.518	0.875	1.000	1.291	1.000	1.000	1.291	1.000	1.314	1.000	1.000	1.314
KCB	2.830	0.419	1.986	1.425	1.187	0.889	0.819	0.894	0.994	0.728	1.417	1.568	1.342	1.056	2.222
NMB	5.339	0.378	1.000	5.339	2.019	1.342	0.719	1.000	1.342	0.965	0.756	1.291	1.000	0.760	0.982
NBC	1.529	0.502	1.000	1.529	0.767	0.987	0.879	0.988	0.998	0.867	0.756	1.177	0.824	0.918	0.890
NIC	1.000	0.388	1.000	0.388	0.388	1.000	0.462	1.000	1.000	0.462	1.000	1.314	1.000	1.000	1.314
PBZ	0.776	0.474	0.629	1.233	0.368	1.147	0.845	1.100	1.043	0.970	0.755	1.294	0.760	0.994	0.977
STANBIC	1.370	0.611	1.110	1.234	0.837	1.593	0.862	1.337	1.192	1.374	1.046	1.104	1.000	1.046	1.155
STDCH	1.000	0.841	1.000	1.000	0.841	1.000	1.318	1.000	1.000	1.318	1.000	0.827	1.000	1.000	0.827
AVG	**1.765**	**0.529**	**1.386**	**1.274**	**0.934**	**1.074**	**0.910**	**1.004**	**1.070**	**0.978**	**0.863**	**1.199**	**0.924**	**0.934**	**1.035**

Appendix 1B 2009-2011 Year 4-Year 6; Malmquist index summary of individual commercial bank

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