Relative Input and Output Efficiency and Productivity of Private Commercial Banks in Ethiopia: Wegagen Bank

Tamirat Shawoel

Abstract

The result of this paper shows the relative input and output efficiency and change in total factor productivity of private commercial banks in Ethiopia. The analysis conducted on the three-year data collected from the fourteen private commercial banks and is composed of eight variables. The study adopted "intermediation" approach that is the primary role of banks in business intermediating between savers and investors; in other words deposit collection and loan provision and investments. The selected eight variables are Salary and Benefit, Interest Expense, Office Rent, Promotion and Advertisement, Expense on Fixed Asset, Total Deposit, Loan and NBE Bill. The variables organized in to two different but appropriate input-output combinations of deposit collection and allocation of the collected deposit. The data analyzed using a statistical model called Data Envelopment Analysis (DEA), and generic model called Malmquist analysis, which is one of the up-to-date and most appropriate efficiency measurement tools for the banking sector. The two categories analyzed at three-year aggregate level; at yearly level and at Big Six banks level. The result has four parts; Efficiency; Proportional movement and Projection of inputs and/or outputs for inefficient banks; Sensitivity Test and measurement of Total Factor Productivity changes. The average efficiency result shows inefficiency of private commercial banks, however, few banks are efficient in deposit collection and allocation of resources. The Sensitivity tests identified no outlier(s), i.e. no super-efficient or super-inefficient bank. Change in productivity analysis, i.e. the year-to-year change in relative productivity of variables, found out that at aggregate level the main productivity contributing factors are smaller change technologies i.e. introduction of new way of doing. However, the result is mixed when looked at individual banks, which means for some banks technical efficiency is the driving force in change in productivity.

Key Words: Efficiency, Efficiency Frontier, Data Envelopment Analysis (DEA), Projections, Sensitivity, Total Factor Productivity Change

1. Background of the Study

1.1 Introduction

The financial system in Ethiopia has largely been dominated by the intermediation role of commercial banks. The banking business in turn is governed and regulated by stringent proclamation, directives, rules, regulations and procedures. However, all banks are successful enough to announce profit margins, increasing and building their deposit and asset every year facing the legislative headwinds. At the end of 2014/15 fiscal year over Birr 118.5 billion total deposits or deposits equivalent was at private commercial banks custody, which is about 50 percent of the giant government owned Commercial Bank of Ethiopia's (CBE) deposit collection and is about nine (9) percent of the Gross Domestic Product. As the most crucial source of credit, the private commercial banks together provided lending over Birr 75 billion in 2014/15 fiscal year, which is about 63.3 percent of collected deposit and approximately is 60 percent of CBE's provision.

The level of investment of the private commercial banks is in an increasing trend from year to year and the total capital of all 16 private commercial banks' reached more than Birr 22 billion in 2014/15 fiscal year, which is far larger (by 167%) than CBE's. The asset building endeavor of the private commercial banks as well resulted in increasing to Birr 157.5 billion in 2014/15 fiscal year.

Owing to the importance of commercial banks to the government, investors and households, the profitability of banks is one of the most concerns to be managed by efficient allocation of resources. The private banking sector in Ethiopia even after two decades of operation is at infancy, but has big potential that contributes substantially to the financing of national economy and generation of satisfactory profit to owners. To proceed successfully in the promising future, efficiency of commercial banks is one of the most interesting and important issues for both the government and private sector or owners. In a nutshell the Ethiopian private commercial banks are gaining people's or/and investors trust and are making higher profits and investments. Furthermore, several changes are going on in the banking sector; among which increasing competition for resources mainly for deposit, geographic position, technology and market share are major ones. The domestic banking environment, though fierce, is free from direct influence of foreign banking competition, which is an opportunity for gaining policy space to strengthen technological and legislative regime.

The existing domestic competitive environment, forces all commercial banks to improve their performance and stay in the market by raising their profitability. Moreover, people and investors have always been questioning the performance and efficiency of commercial banks. Efficiency of banking business is often linked to the level of performances that a process uses the lowest input amount to create the greatest output and benefits. The use of all input to produce a given amount of output, including personal time and energy is a form of approach to efficiency measurement (N.Berger and J.Mester, 1997). However, the concept of efficiency has commonality with slight differences among authors.

The slight differences in the concepts of efficiency developed often vary depending on the data sources, the type of data collected and the measurement method or tools adapted/utilized. Efficiency measurement among others can be conducted by taking inputs, cost, outputs, standard profit, environment variables, price efficiencies and operational efficiencies. The cost measurement often can take components like price of variable input with the corresponding quantity of variable output. The standard profit efficiency measures how close a bank is to producing the maximum possible profit given a particular level of inputs and outputs prices and other variables. Environmental or market variables as well can affect performances and other efficiency factors.

In view of that, this study is planned to examine the relative efficiency of Wegagen Bank compared to industry's (private commercial banking) best practices in Ethiopia with specific concern to measuring the level of efficiency and setting target called best practice for inefficiency to be observed based on the three years (2011/12 – 2014/15) data collected from 14 private commercial banks.

The paper is organized in seven sections. Section two presented the reviewed relevant theoretical and empirical literatures, written by different authors on bank efficiency and attempted to develop comprehensive conceptual framework. Section three and four respectively tell about data description and detailed analysis and interpretation utilizing appropriate data analysis tool called Data Envelopment Analysis (DEA).Conclusion and recommendations were presented in section five and six, which are the final part of the paper.

1.2. Statement of the Problem

The functional and operating environment in which banks play, directly or/and indirectly is influenced by the external and internal mechanisms that discipline bank managers' (P.Hughes and J.Mester, 2008). Organizational form, ownership (level of banks' freedom), capital structure, governing boards, and managerial compensations are the main internationally identified factors that could be induced or reduced by internal disciplines. External disciplines that could be induced or reduced by government actions include capital market discipline, managerial labor market competition, outside block holders (equity and debt) and product market competition. These are influential factors that impede or accelerate banks' efficiency and productivity.

Banks' ability to perform efficiently, i.e. to obtain accurate information concerning its customers' financial prospects and write effective contracts for enforcement and increase the level of debt or liability, depends in part on the legal, regulatory and contracting environment such as accounting practices, chartering rules (guidelines, rules and procedures) and market conditions or market powers.

The private commercial banks in Ethiopia as well operate in a relatively stringent domestic financial and economic policy and regulatory environment and anticipating potential threats of entry of highly efficient foreign banks. Moreover, the internal banking environment is getting momentum and competition becomes fiercer for resources and market position, getting upper returns from the allocated resources or investment remains not to be an easy task.

Private commercial banks since their commencement of operation have recorded commendable profit and growth rate, the impact of which is to be measured in terms of the size of asset, capital and level of deposits and credit. With the objective of insuring higher profit margin and service accessibility, the banks opened and are opening numbers of service outlets throughout the country; thereby the number of staff or employees as well the size of outstanding loan is in an increasing trend, while the industry average for Non-Performing Loan (NPL), is within the tolerable margin. In view of customers' in mentality and to catch up with the pace of expertise, the banks, setting aside ample resources, continuously attempt to adapt and update technology driven services; organizational change programs and are owning and building state of the art Headquarters. Private commercial banks are working with large number of money transferring agents, which are the main sources for foreign currency generation. Periodic assessment and review of interest rate is practical to check and keep the profit margin of the bank in healthy position. The organizational restructuring and change management endeavors in many of the banks is a great stride in bringing the banks forward by fighting myopia to ensure performance efficiency and secure better market position in the industry.

However, irrespective of the commitments and efforts made by the management and staff, the resource accumulation and profit fertility of the banks lack uniformity. On the other hand the people and investors are questioning the profitability, level of efficiency or cost consciousness of the management.

The Level of bank costs or expenses vary significantly pursuing the business strategy of the bank or/and economic conditions. It is a showy truth that a high level of spending on labor, material or on physical plant does not necessarily signal inefficiency; and reduced spending on these items is no guarantee that a bank is being run efficiently (De Young, 2012). Disproportionate reduction or

cutting of expenses/cost can affect or damage service quality, portfolio quality, and earnings. Case in point, high expenditures on branches and ATMs/PoS machines might provide greater convenience for customers, similarly high salary/wages might result in the production of more financial services per worker, and large employee rolls might make a bank healthier if the additional workers are put to work in focus and care. The other strategy driven expenses might be linked to banks that produce large amounts of fee-based services will incur large amounts of labor expenses; banks located in fast growing markets or economy will incur expansion-related expenses, and banks in economically depressed regions will incur large expenses related to administering problem or else.

The forgoing brief problem statement invites to raise a question of "Why does the research on efficiency on Banks need to be conducted? And what is/are the efficiency and productivity levels of private commercial banks in terms of input and output combination and utilization?"

1.3 Research Questions

➢ What are the relative Inputs and Outputs Efficiency levels and Productivity Change of private commercial banks in Ethiopia?
➢ What or where is/are the best efficiency frontier or point of inefficiency for private commercial banks in Ethiopia?
➢ What or where is/are the best target (input-output combination) for inefficient operation for the bank?

1.4 Objective of the Study

The general objective of the research is to measure the relative input and output efficiency levels and factors productivity changes to locate best practice efficiency frontier(s) of the Bank, for inefficient banks.

Specifically the study is:
➢ To test the robustness of the study via sensitivity analysis, that identifies outliers;
➢ To measure and find out the main contributing factors for the Change in Total Factor Productivity;
➢ To list out the key components for efficiency operation variables.

1.5 Significance of the Study

The study helps to identify/measure the level and depth of the relative efficiency/inefficiency and change in factor productivity of the private commercial bank by vitally listing out all relevant parameters/variables. The study adapts data analysis tools, statistical or econometric model to increase the reliability of the study results by avoiding misleading myopic ratio analysis. The result of the study is important for all stakeholders specifically to policy makers and top bank management for passing applicable decisions; for bank employees to get clear strategic idea and act accordingly to execute the decisions. The study can also serve as a reference material and stepping stone for those who have interest to conduct further studies to cover any seam.

1.6. Scope of the Study

The study primarily is based on data obtained from recorded sources of private commercial banks that covers three years, 2012/13 – 2014/15. The data was extracted from the financial statements of audited annual report of each bank. The reviewed literature covers both the global and national financial and banking environment, with more emphasis on empirical results. The study primarily designed to measure the relative input-output efficiency and factor productivity of each private commercial Banks in Ethiopia, benchmarking the industry average and/or industry members' best performances. The data analysis adapts powerful tool/model called Data Envelopment Analysis (DEA).

2. Methodology

The eight variable or data (described in chapter three, Table 3.1) organized and analyzed using one of the powerful efficiency measurement model/tool called Data Envelopment Analysis (DEA) to measure the Efficiency, Proportionate movement Projections, Sensitivity tests and Total Factor Productivity Change (TFPC).

2.1 Data Envelopment Analysis (DEA)

Data Envelopment Analysis (DEA) is a non-parametric linear programming technique that computes a comparative ratio of outputs to inputs for each unit, which is reported as the relative efficiency score. The DEA approach was pioneered by Charnes, Cooper, and Rhodes or CCR (1978) and later extended by Banker, Charnes, and Cooper or BCC (1984). Since the original study by Charnes et al. (1978) considerable amounts of researches published using DEA model. The DEA tool helps to escape the biases or myopic situations in which accounting-based expense ratios are misleading and show that statistics based "efficient cost frontier" approaches often measure cost efficiency more accurately.

The DEA efficiency score is usually expressed either as a number between zero and one $(0 – 1)$ or between zero and hundred (between $0 – 100$) in per cent. A Decision Making Unit (DMU) - any structured organization with clear vision, mission and objectives - with a score less than one (<1) or less than hundred (<100) is deemed inefficient relative to other units, equal to one $(=1)$ is efficient and greater than one (>1) called outlier. For decades, DEA has become a very popular linear programming technique used as an invaluable benchmarking tool in examining efficiency in banking industry. Leibenstein and Maital (1992), argue that DEA is the superior method for measuring overall technical inefficiency. It is a deterministic methodology for determining the relatively efficient production frontier based on the empirical data on chosen inputs and outputs of a number of entities called Decision Making Units (DMUs). The tool is more appropriate and practically applicable to measure a bank or banking industry efficiency. Besides to measuring the efficiency level of a DMU, DEA is a superior method for forwarding possible solutions or efficient targets. The tools need carefully selected variables and parameters to process and produce practicable and reliable outputs. The overall or simplified form of DEA can in general be represented as:

$$Efficiency = \frac{Weighted\ sum\ of\ outputs}{Weighted\ Sum of Input}$$

DEA as well measures the Total Factor Productivity Changes for all and each DMUs. The specific DEA analysis is called Malmquist (after the creator's name Professor Sten Malmquist) DEA method often called **Malmquist Productivity Index (MPI)** is often used to calculate Technical Efficiency changes, Technological change factor productivity, Scale Efficiency changes and Total Factor Productivity (TFP) changes. Malmquist index in general is the product of or can be decomposed into two important elements (Hung, 2007)

i) Change in technical efficiency or how close a bank can get to the efficient frontier (namely the catching up index)
ii) Technological change, namely the change in best practice index or how much the bench mark production frontier shifts at each bank observed input mix (innovation or shocks)

Malmquist Productivity Change index formulated (Worthington, 2000) as:

$$M_I^{t+1}\left(y^{t+1}, x^{t+1}, y^t, x^t\right) = \frac{D_I^{t+1}(y^{t+1}, x^{t+1})}{D_I^t(y^t, x^t)} \sqrt{\left(\frac{D_I^t(y^{t+1}, x^{t+1})}{D_I^{t+1}(y^{t+1}, x^{t+1})} \; X \; \frac{D_I^t(y^t, x^t)}{D_I^{t+1}(y^t, x^t)}\right)}$$

Where the subscript 1 indicate input orientation

M = Malmquist total factor productivity index is the product of a measure of technical progress and

Period t (averaged geometrically) and

D input distance functions

It is thus possible to provide four efficiency/productivity indices for each firm and a measure of technical progress over time. These are:

(i) Technical efficiency change (TE) (i.e. relative to a constant returns-to-scale technology);
(ii) Technological change (*P*);
(iii) Pure technical efficiency change (*PT*) (i.e. relative to a variable returns-to-scale technology);
(iv) Scale efficiency change (*S*); and
(v) Total Factor Productivity (TFP) change.

A value greater than one is an indicator for positive total factor productivity growth between two periods; and a value less than one is for decline or negative total factor productivity. In computation of Malmquist indices of productivity growth three crucial issues need to be noted. First productivity changes were measured over the review period. The changes in productivity further decomposed into what is called Efficiency Change which generally referred to as a 'Catching-up' Effect; and Technological Change (a Frontier Shift' Effect). Further, the 'Catching up' Effect is decomposed to identify the main source of improvement, through either enhancements in Technical Efficiency or increases in Scale Efficiency. Interpretation on the results of the model is conducted taking into account such arrangements.

The Malmquist Index measures of greater (less) than unity indicate that there has been Productivity gain (loss), Efficiency increase (decrease) or Technical progress (regress). Similarly, the Overall Technical Efficiency (OTE) change is the product of Pure Technical Efficiency and

Scale Efficiency changes. The post-DEA sensitivity analysis was put into operation as conducted by (Gulati, 2011).

3. Description of Data and Approaches

The data obtained from 14 private commercial banks of Ethiopia's official annual reports over three-year period 2012/13 - 2014/15, were to make the efficiency analysis. Data from two banks' (Enat and Debub Global Banks) were left uncollected due to report incompleteness in the years 2012/13.

The study adapted Intermediation approach for measuring the relative efficiency of 14 private commercial Banks in Ethiopia. Assuming that bank management has more concern and control over how and how much outputs to be generated employing scarcely available resources as inputs therefore, adopts an input-oriented approach, following Goddard et al. (2001) and Berger (2007) study outputs. And as well output oriented approaches adapted to measure the efficiency of banks towards output generation. The choice of inputs and outputs is essential for measuring the relative efficiency variation among banks.

Different banking literatures have found out those disagreements among researchers which are prevalent about what constitute inputs and outputs of banking business to conduct analysis and interpretation (Casu, 2002; Sathye, 2003), (Humphrey, 1985) and Sealey and Lindley, 1977.

As mentioned above this study has adapted intermediation approach and eight (8) variables were carefully selected to conduct the analysis. The eight variables used are Total Salary and Benefit of employees, Interest Expenses for deposit, Office Rent for head office and branches, Promotion and Advertisement, total expenses for Fixed Asset, Total Deposit collected, Total Loan and Total Investment in the form of NBE Bill.

The three-year data collected from the 14 private commercial banks in Ethiopia arranged in different combinations to conduct Efficiency; Proportional Movement and Projection; Sensitivity Test on Efficiency results and finally Measuring Total Factor Productivity Changes.

The formations of input-output combinations or equations are contextual to the objective of the analysis and the detail presented in Table 3.1.

Table 3.1: Input and Output Variables and Arrangements

Variables
1. **Salary and benefits**
2. **Interest Expense**
3. **Office Rent**
4. **Promotion and Advertisements**
5. **Expense on Fixed Asset/Capital**
6. **Deposits**
7. **Loans and**
8. **NBE Bill**
Input Output Combinations
Five Inputs and One Output

INPUTS	OUTPUTS
1. Salary and benefits	
2. Interest Expense	1. **Deposits**
3. Office Rent	
4. Promotion and Advertisements	
5. Expense on Fixed Asset	

One Input Two Output**s**

INPUTS	OUTPUTS
1. Total Deposit	1. **Loan**
	2. **NBE Bill**

DEA analysis has two fold purposes. The first purpose is to compute the relative efficiency scores for individual bank and identify those banks that define the efficient frontier. The second purpose is to quantify the potential for efficiency improvements for each inefficient bank. Moreover, DEA model as well used to measure the productivity of variable inputs over the three-year period. Therefore, the analysis on the data collected and interpretation on the results of the models (DEA) are organized into four (4) broader categories.

These are,

    i) Measuring Efficiency of banks at Three-year Aggregate level; at Individual Bank Yearly level and at Big Six banks level,

    ii) Identifying the potential for Proportionate input and output movement or change and Proportionate Projection of Input and Output variables and locate the most efficient point (efficiency frontier);

    iii) Conducting Sensitivity Tests of efficiency; and equally importantly

    iv) Conducting Overall Total Factor Productivity Change**.**

The Efficiency measurement results are represented as Overall Technical Efficiency (OTE) which is the combined result of Pure Technical Efficiency (PTE) and Scale Efficiency (SE); and Return to Scales (RTS) scores. Moreover, the projection (the proposed efficient point or frontier) for each inefficient bank were provided by first observing the efficiency gap and associated proposed Proportional (upward for outputs and downward for inputs) Movements. The results were obtained by executing the two most generic DEA models, namely, CCR and BCC models, but CCR model is the most appropriate for this paper. The DEA generic CCR is abbreviation after the name Charnes, Cooper and Rhodes, who all the three are DEA developers.

Finally, but yet importantly Total Factor Productivity Change represented by (**tfpch**) analysis were conducted by employing Malmquist or **Malmquist** Productivity Index (**MPI**) analysis. The MPI is based on the concept of the Production function. The Total Factor Productivity Change decomposed into Overall Technical Efficiency (**OTE**) or (**effch**) and technical or Technological Advancement or Change (**techch**).

Before proceeding to the analysis and interpretation it is again important to note that Overall Technical Efficiency (**OTE**) is composed of or decomposed into two mutually exclusive and non-additive components, called Pure Technical Efficiency (**PTE**) and Scale Efficiency (**SE**). It is also weighty to note that like OTE measure, the PTE measure also indicates the underutilization of inputs. However, in contrast to the OTE measure, the PTE measure doesn't consider or devoid of scale effects (scale efficiency) (Gulati, 2011).

4. Data Analysis and Interpretation

The study adapted intermediation approach to measure the intermediation role of private commercial banks by mobilizing deposit and utilizing or allocating the collected deposit into income generating investments. The data analysis and interpretation conducted using Data Envelopment Analysis (DEA) model on two equations of input and output combinations to measure efficiency and make projections for inefficient bank. The first equation formulated based on five input variables (Salary and Benefit; Office Rent; Interest Expense; Promotion and Advertisement and Expenses for Fixed Asset); and one output Deposit (TD = f (SB, Or, Ie, Pa, EFa)). The second equation designed to show how the collected deposit used or allocated in the form of Loan plus Treasury Bill and NBE Bill plus Renaissance Dam Bond (TD = f (Ln,NBE Bills)). Besides to the efficiency measurement and projections; Sensitivity test and Total Factor Productivity Analysis were carried out. The analysis and interpretations were done categorizing the data or variables into: 1) Three-year Aggregate, 2) Each bank at yearly base and at 3) Big Six banks level. The following subsections present the analysis and interpretations.

4.1 Measuring Efficiency and Projections

The five inputs and one output i.e. the equation to measure the deposit mobilization efficiency of private commercial banks are Salary and Benefits; Interest Expense; Office Rent; Promotion and Advertisement and Expenses on Fixed Asset; all input variables and Total Deposit as Output variable (Five Inputs and One Output). The efficiency measurement accompanied by movement (amount of proposed increment) and projections for inefficient banks.

4.1.1 Three Years Aggregate Deposit Collection Efficiency

Efficiency

The DEA results of the three years aggregate efficiency score – summarized in Table 4.1 shows that Eight banks (Abyssinia, Awash, Birhan, Cooperative Bank of Oromia, Dashen, Lion, Oromia International and Zemen Banks) are all successful enough to score the highest efficiency level and defined the efficiency frontiers of OTE, PTE and SE all at constant return to scale (CRS). All the eight banks have scale efficiency as well as pure technical efficiency at constant return to scale.

Table 4.1: Three-year Aggregate Deposit Collection Efficiency

NO	DMU	OTE (CRS)	PTE (VRS)	SE	RTS
1	Abyssinia	1	1	1	CRS
2	Awash	1	1	1	CRS
3	Birhan	1	1	1	CRS
4	Coop BO	1	1	1	CRS
5	Dashen	1	1	1	CRS
6	Lion	1	1	1	CRS
7	OroIB	1	1	1	CRS
8	Zemen	1	1	1	CRS
9	Buna	0.92	0.94	0.98	IRS
10	NIB	0.91	0.93	0.98	DRS
11	United	0.87	0.88	0.99	DRS
12	AddisIB	0.85	1	0.85	IRS
13	Wegagen	0.82	0.97	0.85	DRS
14	Abay	0.81	0.83	0.98	IRS

	Average	**0.94**	**0.97**	**0.97**	
	Max	1	1	1	
	Min	0.81	0.83	0.85	
	StdD	0.076	0.054	0.053	
	CofVar	8.03	5.60	5.44	

The mean/average value of OTE, PTE and SE scores were respectively observed to be 0.94, 0.97 and 0.97, which all the three are below the efficiency frontier. The three banks - Buna, Addis IB, and Abay though are inefficient and fall below the efficiency frontier have potential with increasing returns to scale to move towards the efficiency frontier. Wegagen bank left far behind of all banks remained inefficient in deposit mobilization with decreasing returns to scale, scoring the lowest OTE score of 0.82 (82 percent) and is as well below average. The lower value 0.82 for OTE was mainly the result of the lowest efficiency score of SE (Scale Efficiency). Wegagen was poor in scale efficiency, implying working at sub-optimal scale or underutilization of its size.

4.1.2 Yearly Deposit Collection Efficiency (Five Inputs one output, Deposit)
Efficiency
The Deposit collection efficiency of the private commercial banks over each three years period by utilizing five inputs - Salary and Benefits, Office Rent, Interest Expense, Promotion and Advertisements and Expense on Fixed Asset – summarized in Table 4.2.While observing the yearly efficiency scores, seven banks – Bank of Abyssinia, Awash, Birhan, Cooperative Bank of Oromia, Dashen, NIB and Zemen in 2013 and Birhan again in 2015 and CBO in 2014 found to be perfectly efficient and molded the efficiency frontier.

Table 4.2: Yearly All Banks Deposit Collection Efficiency (5 Inputs and 1 Output)

NO	DMU	OTE (CRS)	PTE (VRS)	SE	RTS	DMU	OTE (CRS)	PTE (VRS)	SE	RTS
1	Abyssinia 13	1	1	1	CRS	NIB14	0.84	0.91	0.92	DRS
2	Awash13	1	1	1	CRS	Wegagen 13	0.83	0.94	0.89	DRS
3	Birhan 13	1	1	1	CRS	Abyssinia 15	0.82	0.90	0.91	DRS
4	Birhan 15	1	1	1	CRS	Lion14	0.82	0.84	0.97	IRS
5	CoopBO13	1	1	1	CRS	Abay13	0.81	0.91	0.89	IRS
6	CoopBO14	1	1	1	CRS	Addis IB14	0.81	0.94	0.86	IRS
7	Dashen13	1	1	1	CRS	Awash15	0.80	1	0.80	DRS
8	NIB13	1	1	1	CRS	Birhan 14	0.79	0.87	0.91	IRS
9	Zemen13	1	1	1	CRS	Dashen15	0.79	1	0.79	DRS
10	Awash14	0.95	1	0.95	DRS	United14	0.78	0.85	0.93	DRS
11	Buna 13	0.95	1	0.95	IRS	Zemen14	0.78	0.83	0.93	DRS
12	OroIB15	0.94	1	0.94	DRS	Wegagen 14	0.76	0.88	0.85	DRS
13	Dashen14	0.93	1	0.93	DRS	Buna15	0.75	0.75	1	DRS
14	Lion15	0.93	0.98	0.94	DR	Zemen15	0.75	0.80	0.94	DR

					S					S
15	Abyssinia 14	0.92	0.98	0.93	DRS	NIB15	0.74	0.86	0.86	DRS
16	CoopBO15	0.92	1	0.92	DRS	Buna14	0.73	0.73	0.99	DRS
17	Lion13	0.91	1	0.91	IRS	United15	0.72	0.84	0.86	DRS
18	OroIB14	0.91	0.91	0.99	DRS	Wegagen 15	0.71	0.91	0.78	DRS
19	OroIB13	0.89	0.95	0.94	IRS	Abay14	0.70	0.71	0.99	DRS
20	Addis IB13	0.87	1	0.87	IRS	Abay15	0.67	0.68	0.99	DRS
21	United13	0.85	0.87	0.97	DRS	Addis IB15	0.57	0.57	1	IRS
						Average	**0.86**	**0.91**	**0.94**	
						Max	1	1	1	
						Min	0.57	0.57	0.78	
						StdD	0.11	0.11	0.06	
						CofVar	13.04	11.62	6.67	

All the rest banks' levels of efficiency were below the efficiency frontier. The average efficiency score for OTE is 0.86 and 10 banks' OTE score fall below the average.

Projections: Input Oriented

The result of Input Oriented Projections made on the five Input variables has shown that the largest amount of reduction was made on Office Rent. A 40 percent reduction in 2014 further goes up to 87 percent reduction in 2015 from the actual expenditure for Office rent, indicating that Wegagen was paying bigger rent out of proportion to the amount of deposit collected. Similarly DEA has made a 30 percent to 40 percent reduction on Salary and Benefit and on Expense on Fixed Asset. Wegagen is the third largest salary payer among the private commercial banks[7], which is an opportunity for attracting highly qualified workers. However, the amount of deposit collected during those three years period was not reward full, implying that the efficiency and productivity of employees was lesser. Annex 4.3 presents the summary.

Salary and Benefit

The analysis has found out that Abyssinia, Awash, Birhan, CBO, Dashen, NIB and Zemen in 2013 and CBO in 2014 and Birhan in 2015 are the only banks that are efficient in salary payment. The rest, all banks are inefficient and DEA has made reduction proposal. The largest eight salary payers, within the range of more than Birr 220 million to Birr 400 million, in the private banking industry are Dashen, Awash, and United and Wegagen banks. Within that range Wegagen bank is the least payer (Birr 220 million) and Dashen is the highest with more than Birr 393 million. However, the DEA relative efficiency analysis has made larger salary reduction proposition for six inefficient banks (Dashen, Wegagen, Awash, United, NIB and Oromia International Banks) respectively in 2015 and in 2014; among them the largest salary reduction proposal made for Dashen by Birr 141 million followed by Wegagen by Birr 108 million both for 2015 fiscal year.

---

[7] Author's Calculation from the collected data set

Interest Expense

Over the three year (2012/13 – 2014/15) period the private commercial banks have expended a total interest expense of Birr 7.1 billion which is 46 percent of the total main expenditures in the industry and is the largest of all expenses. In the 2014/15 fiscal year six banks (Dashen Birr 530 million, Awash Birr 508 million, Abyssinia 305 million, United Birr 277 million, NIB Birr 222 million and Wegagen Birr 208 million) respectively have paid larger interest expenses for interest bearing deposits they collected, which holds about 29 percent of the total interest expenses in the industry. All the six banks mentioned above however are among inefficient banks in 2014/15 fiscal year, therefore, proportionate reduction and projection of interest expenses were made comparable to the amount of deposit collected. Over the three years period proportionate interest payment reduction of a total of Birr 1.23 billion were made by DEA. For the top six banks a reduction of a total of Birr 604 million or 49 percent was made of the total reduction. The DEA tool has made significant proportionate reduction of interest expenses on actual expenses for Dashen Birr 137 million, Awash Birr 131 million, United Birr 109 million, Wegagen Birr 83.5 million, NIB Birr 78 million and from Abyssinia Birr 66 million. The proposed reduction is the result of the DEA analysis; however, reduction of interest expense often is difficult to do.

Office Rent

Office Rent held about nine percent of the total main expenses of private commercial banks. Banks are in fierce competition for premises to hold strategic location for mobilization of critical deposit resources. Almost all banks' (except Awash and OIB) Head Offices are located in rented offices. They set aside ample resources to pay it for premises for branch outlet. They are increasing the number of their branches throughout the country and often are willing to pay higher rent. In that regard the largest Office Rent payers in the fiscal year 2014/15 among the private commercial banking industry in Ethiopia were Dashen Birr 94 million, Awash Birr 93.4 million, Wegagen Birr 83 million, NIB Birr 78 million, Abyssinia Birr 73.6 million, United Bank Birr 70 million and at smaller margin Buna Birr 38 million. However, compared to the benefit (mobilized deposit), the rent expense was/is very high; therefore, DEA has indicated the optimum level of office rent comparable to the mobilized deposit. DEA has indicated that the actually mobilized deposit by the inefficient banks would have been much more efficient if the office rents were reduced by a total of Birr 171 million. In that respect each of the following eight banks would have been efficient if they were reducing their office rent by Birr 33 million for NIB, by 24 million for Wegagen, by Birr 22 million for Buna, by Birr 20 million for United, by Birr 19 million for Dashen, by Birr 19 million for Awash, by 18 million for Abyssinia and by Birr 16 million for Abay banks. The lonely efficient bank in 2014/15 was Birhan Bank, the efficiency of the remaining eight efficient banks were revealed in 2013, CBO in 2014.

Promotion and Advertisement

Promotion and Advertisement is one of the very powerful tools for attracting customers and mobilizing huge amount of resources. Over the three years review period the fourteen banks together expended a total of Birr 260 million, which is about two (2) percent of the main five types of expenses. Five banks (Dashen Birr 17.5 million, Awash Birr 14.5 million, NIB Birr 11 million, United Birr 10 million and Wegagen Birr 9.7 million) together have expensed more than Birr 63 million in 2014/15 fiscal year. Year on year the expense for promotion and advertisement is in an increasing trend and for almost all banks the largest expense was made in 2014/15 fiscal

year. Most of the banks' deposit return, over the three years period was not proportional to the amount of expenses made; hence, DEA has made proportional reductions in all the three years. A proposed reduction of a total of Birr 47 million was made by DEA to indicate the required amount of promotion and advertisement expenses against the actually collected deposit. At bank level a total of Birr 22 million proportionate reductions were made for 10 inefficient banks; and in 2014/15 the largest reduction was made for Dashen, Awash, NIB, United and Wegagen banks.

Expense of Fixed Asset

The capital and asset building endeavor of banks has a tendency of increasing the amount of expenditure on fixed asset. The annual depreciation, amortization and repair and maintenance are factors for building capital and were increasing over the last three review periods. Within the three years period a total of Birr 1.8 billion were expended for fixed asset. Nonetheless, for most banks the expenditure was not proportional to the amount of deposit collected. The DEA decreased the total expenses on fixed asset by Birr 467 million to bring the total expenditure to the level of Birr 1.34 billion. Among the inefficient banks for 2014/15 fiscal year, the largest reduction of expense on fixed asset was made for United Birr 49 million, Dashen Birr 46.5 million, NIB Birr 31.6 million, Awash Birr 23.4 million, Wegagen Birr 21 million and for Abyssinia Birr 15 million.

Output Oriented Projection of All Banks Yearly

The technical combination of the five inputs, valued over Birr 18 billion, over the three years period under review has helped the private commercial banks to mobilize a total deposit of over Birr 282 billion. Though, DEA has found out that all fourteen banks in 2013/14 and in 2014/15, except Cooperative Bank of Oromia in 2013/14, were not on the efficiency frontier or inefficient in deposit collection, i.e., the committed five resources were not efficiently allocated. Therefore, proportional (to the allocated inputs) increments of deposits were made by DEA to show the required amount of deposit that had to be collected. For the year 2014/15 a total of Birr 49 billion increment was made by the tool to show the efficient level of deposit to be collected by the allocated resources or five inputs. That brings the total deposit to Birr 331.4 billion from the actually collected amount of Birr 282 billion, which is a 17 percent increment. For the fiscal year 2014/15 for instance a total of more than Birr 26 billion increments was proposed by the model for seven banks (Dashen, Awash, United, Wegagen, Nib, Abyssinia and Abay) the largest increment was made for Dashen by Birr 5 billion, Awash by Birr 4.8 billion, United Birr 4.4 billion and Wegagen Birr 4 billion.

4.1.3 Big Six Deposit Collection Efficiency and Projections

a. Efficiency Big Six

Under the five inputs and one output arrangements, among the Big Six banks (Dashen, Awash, Wegagen, United, Abyssinia and NIB) and except United, all have one hundred percent deposit collection efficiency in 2013 at constant return to scale. In the fiscal years 2014 and 2015 all the six banks' deposit collection efficiency was below the efficiency frontier. The inefficiency level of each bank further deteriorated in 2014/15 fiscal year falling below the industry's average level of 91 percent. The return from expenses was worsening trending in decreasing return to scale. Table 4.3 shows the detail.

Table 4.3: Big Six Efficiency (Five Inputs and One Output)

NO	DMU	OTE (CRS)	PTE (VRS)	SE	RTS
1	Abyssinia13	1	1	1	CRS
2	Awash13	1	1	1	CRS
3	Dashen13	1	1	1	CRS
4	NIB13	1	1	1	CRS
5	Wegagen 13	**1**	**1**	**1**	**CRS**
6	Awash14	0.95	1	0.95	DRS
7	Dashen14	0.93	1	0.93	DRS
8	Abyssinia14	0.92	0.98	0.93	DRS
9	NIB14	0.91	0.95	0.96	DRS
10	Wegagen 14	0.91	0.95	0.96	DRS
11	United13	0.89	0.9	1	DRS
12	United14	0.87	0.88	0.98	DRS
13	Abyssinia15	0.86	0.9	0.95	DRS
14	NIB15	0.86	0.9	0.95	DRS
15	Wegagen 15	0.86	0.96	0.90	DRS
16	Dashen15	0.83	1	0.83	DRS
17	Awash15	0.82	1	0.82	DRS
18	United15	0.78	0.85	0.92	DRS
	Average	**0.91**	**0.96**	**0.95**	
	Max	1	1	1	
	Min	0.78	0.85	0.82	
	StdD	0.070	0.051	0.055	
	CofVar	7.70	5.32	5.80	

b) Projections: Big Six Inputs Oriented

Proportionate reduction and projection of input variables were made for inefficient banks in mobilization of deposit. The total proportionate input reductions that have been made by DEA on all the five input variables amounted to about Birr 1.8 billion. The largest reduction was made from Interest expense and Salary and Benefit at a rate of 38 percent 35 percent of the sum of all five expenses. A relatively smaller reduction of 8.8 percent and 1.1 percent were made from Office rent and from Promotion and Advertisement.

c) Salary and Benefits

A total proportional reduction of Birr 641 million (13.5%) was made from the actually paid (Birr 4.8 billion) amount of salary and benefits, to show the compatible amount of expenses for mobilizing the actually collected deposit. From the total reduction about 70 percent or Birr 449 million was made from the 2014/15 fiscal year, indicating the inefficient utilization of resource. No reduction was made by the model from the five big banks in 2011/13, but United, as all the five banks' salary and benefit expenses were made efficiently.

d) Interest Expenses

All the big six banks expended a total interest expenses of Birr 6.5 billion over the three years review period. The DEA found out that the amount of interest expenses in the fiscal year 2013/14 and in 2014/15 are not compatible to the actual deposit collection and indicated the optimum level

of interest expenses. All the six banks were not efficient in the fiscal year 2013/14 and 2014/15, thus DEA has made proportional reduction of Birr 686.5 million, which is about 11 percent of the actual interest expenditure, and brought the interest expenses to lower level of Birr 5.79 billion. While observing the individual bank level reductions relatively larger amount was decreased from Awash 116.5 million, Dashen Birr 112 million and from United Birr 86 million.

e) Office Rent

Over the three years period all the fourteen banks have expended a total office rent of Birr 1.68 billion, out of which the big six banks together held 67 percent (Birr 1.112 billion). All six banks' office rent expenses are not efficient specifically in the years 2013/14 and 2014/15. To show the balanced office rent expenses compatible to the actual deposit collection, DEA has made a total office rent reduction of Birr 160.4 million (14 % less of the actual collection), and projected the required amount to Birr 958.8 million. The largest reduction made on all six banks in 2014/15 fiscal year; Birr 26.5 million for NIB; Birr 21 million for Wegagen; Birr 17 million for Awash and Birr 16 million each for Dashen, United and Abyssinia.

f) Promotion and Advertisement

Banks to attract the attention and arose the interests of customers, make announcements via all forms of media and sacrificed a total Birr 259.7 million for promotion and advertisement. Big six banks together expended a total Birr 159 million or 61 percent of the total private banks' expenses. However, the DEA identified that the reward or the return in the form of deposit was not commendable and made proportional reduction of Birr 19.5 million. The proportional expenses for promotion and advertisement shrunk by 12 percent or to Birr 139.8 million. The largest reduction was made from Dashen, NIB, Awash, United and Wegagen from the 2014/15 fiscal year.

g) Expenses for Fixed Asset

In similar fashion the DEA proportionally reduced the total actual expenses made for fixed assets by Birr 316 million from the total actual expenditure of Birr 1.28 million to Birr963 million. The reduction is higher from United, Dashen, and NIB and Awash banks together by Birr 229 million.

h) Projections: Big Six Outputs Oriented

The output oriented deposit collection projection under Big Six banks category a total addition of more than Birr 23 million made on the actually collected deposit. The DEA identified that actually collected deposit was unproportional or lesser when compared to the amount of inputs allocated.

Table 4.4: Big 6 Output Oriented Deposit Projection   Birr in million

NO	DMU	Score	Movement (Total Deposit)	Projection (Total Deposit)	Actual Deposit Collection	Change
1	Awash15	0.82	4,132	22,653	18,520	22.31
2	Dashen15	0.83	4,003	23,818	19,814	20.20
3	United15	0.78	3,201	14,365	11,164	28.67
4	Abyssinia15	0.86	1,840	12,958	11,118	16.55
5	Wegagen 15	0.86	1,678	11,896	10,218	16.42
6	NIB15	0.86	1,655	11,429	9,774	16.93
7	United14	0.87	1,357	10,266	8,909	15.23
8	Dashen14	0.93	1,277	18,958	17,681	7.22
9	United13	0.89	922	8,621	7,699	11.97
10	Abyssinia14	0.92	843	9,940	9,096	9.27
11	Wegagen 14	0.91	811	9,196	8,385	9.67
12	Awash14	0.95	806	15,845	15,040	5.36
13	NIB14	0.91	773	8,697	7,923	9.76
14	Abyssinia13	1	-	8,496	8,496	-
15	Awash13	1	-	12,545	12,545	-
16	Dashen13	1	-	15,851	15,851	-
17	NIB13	1	-	6,655	6,655	-
18	Wegagen 13	1	-	7,551	7,551	-
	Total		**23,297**	**229,739**	**206,442**	**11.29**

The big six total deposit collected over the three years period projected and increased to Birr 229.7 billion, considered proportional to the input allocation. At bank level larger increment of Birr four billion each for Awash and Dashen banks and Birr 3.2 billion for United Bank.

3.1.4 One Input and Two Out puts

The second set of analysis involves by organizing one input Total Deposit and two outputs, Loan and NBE Bill. The total Loan includes the Treasury bill purchased in 2012/13 budget year and the NBE bill also includes the Bond purchased for the Great Renaissance Dam. This set of analysis helps to show the resource allocation efficiency of the management that has the power to set aside the collected total deposit into higher return or value generation investments. The aggregate, Yearly and Big six efficiency and projection measurement and results presented in the following sub section.

a) Efficiency (Aggregate)

The result of aggregate efficiency shows, Cooperative Bank of Oromia, Nib International and Wegagen Banks' efficiency has met the efficiency frontier at Constant Return to Scale.

Table4.5: Aggregate Deposit Allocation Efficiency

NO	DMU	OTE (CRS)	PTE (VRS)	SE	RTS
1	Coop BO	1	1	1	CRS
2	NIB	1	1	1	CRS
3	Wegagen	1	1	1	CRS
4	United	0.95	0.98	0.98	DRS
5	Buna	0.94	0.96	0.98	IRS
6	Addis IB	0.93	1	0.93	IRS
7	Awash	0.91	1	0.91	DRS
8	Lion	0.89	0.9	0.99	IRS
9	Abay	0.88	0.9	0.98	IRS
10	Birhan	0.86	0.88	0.98	IRS
11	Abyssinia	0.82	0.86	0.95	DRS
12	Dashen	0.82	1	0.82	DRS
13	Orion	0.78	0.79	1	IRS
14	Zemen	0.89	0.95	0.94	IRS
	Average	**0.91**	**0.94**	**0.96**	
	Max	1	1	1	
	Min	0.78	0.79	0.82	
	StdD	0.070	0.067	0.050	
	CofVar	7.762	7.143	5.190	

The rest eleven banks' efficiency falls below the efficiency frontier showing the inefficiency of the banks. Therefore, Wegagen is efficient in resource allocation when the data set analyzed at three years aggregate level so no DEA projections needed.

b) Efficiency (All Banks Yearly)

The year to year efficiency measures for all banks has identified that only three banks, Cooperative Bank of Oromia, Nib International Bank and Wegagen Bank in 2015, have molded the efficiency frontier scoring 100 percent efficiency at constant return to scale. The overall technical efficiency for all the rest banks falls below the efficiency frontier within the range of 53 percent to 93 percent.

Table4.6: Yearly All Banks Deposit Allocation Efficiency (1 input 2 Outputs)

NO	DMU	OTE (CRS)	PTE (VRS)	SE	RTS	DMU	OTE (CRS)	PTE (VRS)	SE	RTS
1	CoopBO15	1	1	1	CRS	Dashen15	0.80	1	0.80	DRS
2	NIB15	1	1	1	CRS	Zemen13	0.80	0.83	0.96	IRS
3	Wegagen15	1	1	1	CRS	Addis IB14	0.79	0.98	0.81	IRS
4	NIB14	0.93	0.94	1	IRS	Buna13	0.79	0.85	0.93	IRS
5	United15	0.92	0.96	0.96	DRS	Abyssinia14	0.78	0.78	1	IRS
6	Buna15	0.90	0.92	0.98	IRS	Abyssinia15	0.78	0.81	0.96	DRS
7	Addis IB15	0.89	1	0.89	IRS	Berhan14	0.78	0.82	0.95	IRS
8	NIB13	0.89	0.89	1	IRS	Abay14	0.77	0.80	0.96	IRS

9	United13	0.89	0.89	1	IRS	Lion14	0.77	0.79	0.96	IRS
10	Wegagen14	0.89	0.90	1	IRS	Zemen14	0.77	0.83	0.92	IRS
11	Zemen15	0.89	0.92	0.96	IRS	Abay13	0.76	0.82	0.92	IRS
12	Awash15	0.88	1	0.88	DRS	Abyssinia13	0.76	0.76	1	IRS
13	Wegagen13	0.88	0.88	1	IRS	Berhan13	0.75	0.80	0.93	IRS
14	Abay15	0.85	0.87	0.98	IRS	OroIB15	0.75	0.75	1	IRS
15	Buna14	0.83	0.87	0.95	IRS	CoopBO14	0.74	0.74	0.99	IRS
16	Lion15	0.83	0.84	0.98	IRS	Dashen13	0.71	0.87	0.82	DRS
17	Lion13	0.82	0.86	0.95	IRS	Dashen14	0.70	0.80	0.88	DRS
18	United14	0.82	0.82	1	IRS	Addis IB13	0.69	1	0.69	IRS
19	Awash13	0.80	0.86	0.92	DRS	OroIB13	0.69	0.71	0.97	IRS
20	Awash14	0.80	0.89	0.9	DRS	OroIB14	0.66	0.66	0.99	IRS
21	Berhan15	0.80	0.82	0.97	IRS	CoopBO13	0.53	0.54	0.99	IRS
						Average	**0.81**	**0.86**	**0.95**	
						Max	1	1	1	
						Min	0.53	0.54	0.69	
						StdD	0.09	0.10	0.07	
						CofVar	11.63	11.71	7.09	

The inefficiencies in both years mainly came out of poor decision of the management i.e. poor technical efficiency than scale efficiency. Table 4.10 presents the detail. The inefficiency scores for the two years however, were above average and accompanied by increasing returns to scale which were indicative of promising potential for improvement that finally enable the bank to meet the efficiency frontier in 2015.

c) Projections: One Input Two Outputs

Over the three years period the amount of Loan granted and NBE Bills plus Bonds purchased by the fourteen banks was Birr 170 billion and Birr 79.6 billion. The DEA has identified that the amount of Loan provided and NBE Bill and Bond purchased was lesser or not proportional to the amount of available deposit resources. To locate the comparative Loan and NBE Bill and Bonds against the value of the five input variables, DEA made proportional increment of Loan by Birr40 billion to increase it to the level of Birr 210.24 billion and NBE Bill plus Bond by Birr 17.5 billion to increase it to Birr 97 billion. At bank level the largest increment of Birr 15.6 billion is made for Dashen and Awash banks. The increment for NBE Bill and Bond as well is made for Awash and Dashen banks.

NOTE: the projection or increment made for NBE Bill and is often not welcomed by all private commercial banks as the net effect/return is negative.

4.2 Sensitivity Analysis

Post DEA or modified DEA analysis with the purpose of checking the robustness of the efficiency results and to cross examine the presence of outlier or extreme observation, sensitivity check or analysis is conducted here under. By means of modified DEA models, in which a specific DMU on the efficiency frontier under examination is excluded one by one from the reference set, to see the impact of the removal of that variable on the average or mean efficiency. If the removal of a specific efficient DMU from the analysis brings significant or drastic change on mean/average

value of OTE, then that observation or DMU is super-efficient or called outlier. Data are allowed to vary simultaneously for all DMUs across different subsets of inputs and outputs.

The sensitivity test conducted on the two categories of efficiency measures of 1) all banks with five inputs and one outputs; and 2) all banks with one input and two outputs. All the inputs and output variables used in the efficiency analysis are Salary and Benefits, Interest Expenses, Office Rent, Promotion and Advertisements and Expenses on Fixed Asset all inputs variables; and Total Deposit as output and as input variable and Loan and NBE Bill as output variables.

The results of the sensitivity test on all the two categories mentioned above, have indicated no drastic change have occurred on the mean/average values of each efficiency category. The efficiency calculation and analysis on each category is robust and no extreme outlier either above the output efficiency frontier or below the input efficiency frontier existed.

4.3 Total Factor Productivity Changes

Malmquist DEA method often called Malmquist Productivity Index (MPI) is frequently used to calculate Technical Efficiency changes, Technological change factor productivity, Scale Efficiency changes and Total Factor Productivity (TFP) changes. Malmquist index in general is the product of or can be decomposed into two important elements (Hung, 2007)

i) Change in technical efficiency or how close a bank can get to the efficient frontier (namely the catching up index)
ii) Technological change, namely the change in best practice index or how much the bench mark production frontier shifts at each banks observed input mix (innovation or shocks)

It is thus possible to provide four efficiency/productivity indices for each firm and a measure of technical progress over time. These are:
i) Technical efficiency change (tech) (i.e. relative to a constant returns-to-scale technology);
ii) Technological change (techch);
iii) Pure technical efficiency change (ptech) (i.e. relative to a variable returns-to-scale technology);
iv) Scale Efficiency Change (*sech*); and
v) Total Factor Productivity Change (tfpch).

A value greater than one indicates positive total factor productivity growth between two periods; and less than unity is for decline in total factor productivity. An assessment can also be made of the major sources of productivity gains/losses by comparing the values of ptech and *sech*. If ptech > *sech* then productivity gains are largely the result of improvements in efficiency, whereas if ptech<*sech,* productivity gains are primarily the result of technological progress. An indication of the major source of efficiency change can be obtained by recalling that overall technical efficiency is the product of pure technical efficiency and scale efficiency, such that otech = ptech *x sech*. If ptech > *sech* then the major source of efficiency change is improvement in pure technical efficiency, whereas if ptech < *sech* the major source of efficiency is an improvement in scale efficiency Charnes *et al*. (1993).

Given that the Malmquist index of productivity change of total factor productivity (tfpch) is a multiplicative composite of Technical efficiency change (otech) and technological Change (techch). The major cause of productivity improvements can be ascertained by comparing the values of the Efficiency

change and Technological change indexes. In other words, the productivity improvements described can be the result of efficiency gains, technological progress, or both.

The Malmquist Index measures of greater (less) than unity indicate that there has been Productivity gain (loss), Efficiency increase (decrease) or Technical progress (regress). Similarly, the Overall Technical Efficiency change is the product of Pure Technical Efficiency and Scale Efficiency changes.

4.3.1 All Banks Total Factor Productivity Changes (2013 – 2015)

The measurement on Total Factor Productivity Change (TFPC) is done for deposit collection for all fourteen banks and for Big Six banks. The Malmquist DEA analysis summary results presented in four tables (Table 4.7 to 4.10). All indices are relative to the previous year and year 2013 is the base year, so the output Total Factor Productivity Change (tfpch) gains or losses begin from the year 2014. The DEA analysis was done on output oriented five inputs (Salary and Benefits, Interest Expense, Office Rent, Promotion and Advertisement and Expense for Fixed Asset) and one output, Total Deposit. The results in Table 4.7 are based on the explanations and definitions given by (Timoty J.Coelli and et al, 1998) about productivity changes and reflected the product of changes in technical efficiency and technological progress.

Table 4.7: Malmquist Index Summary of Annual Means

Output Oriented					
Year	otech	techch	ptech	sech	tfpch
2014	1.011	1.007	0.985	1.026	1.018
2015	0.929	1.089	0.945	0.983	1.012
Mean	**0.969**	**1.048**	**0.965**	**1.004**	**1.016**

Source: **DEA Result of Authors Calculation**

Note:**effch = overall technical efficiency change; techch = technology change; pech = pure technical efficiency change; sech= scale efficiency change; tfpch= total factor productivity change**

The Malmquist Index summary of annual means or average of change in Total Factor Productivity (tfpch) has shown a two (2) percent increment or gain. The two percent gain in (tfpch) is the result of the net effect between Technology Change (techch) or gain of 4.8 percent and a 3.1 percent reduction/loss of Overall Technical Change (otech). The two percent gain in (tfpch) mainly came out of the change in Technology (techch). While observing the three-year trend of (tfpch), the change from 2013 (base year) to 2014 has resulted in a net gain of 2 (two) percent, which is the result of a 1.1 percent gain in overall technical efficiency (otech) and 0.7 percent gain in technological change (techch). However, the (tfpch) from 2014 to 2015 has remained the same at 2 (two) percent gain, which is the result of the net effect of the difference between increase in techch and decrease in otech.

In general, the overall productivity improvement over the study period mainly is the result of the change in technology. Therefore, the productivity loss of overall technical efficiency change (otech) in 2015, has affected the increment magnitude of total factor productivity. The three-year average has shown that the Total Factor Productivity Change was more attributable to the technological change (techch) than overall technical efficiency change (fetch).

The banks' smaller gain from Total Factor Productivity Change could be an indicator for Banks effort to adopt and multiply new service provision approaches. Facilitating technology supported services like ATMs, Point of Sale (Pops) machines, Mobile and Internet banking and card services contribute for the higher value of (techch). However, the total factor productivity change figure demonstrations that the private banking industry is at a very lower level of technology adaption and utilization.

The Malmquist index summary figures in Table5.2.1 above serve to obscure some variation in the productivity in each of the year for each Bank. For that reason all fourteen banks based details of Malmquist output-oriented productivity indices on five inputs (Salary and Benefits, Interest Expense, Office Rent, Promotion and Advertisement and expense for Fixed Asset; and one output Total Deposit) presented in Table 5.2.2 here under with due and special regard to Wegagen Bank.

A total of nine (9) banks have registered gains of Total Factor Productivity Change (tfpch) from year 2013 to 2014, scoring between 5 percent for Buna International Bank and 28 percent for Dashen Bank. Dashen, Birhan, Awash, Abay and Zemen banks were the first four banks with larger score of total factor productivity changes from 2013 to 2014.Wegagen was the least efficient by scoring a 22 percent loss of total factor productivity or scoring 0.78 percent (tfpch) gain, which was the relative poor performances in overall technical efficiency change (otech) of (0.8%) and technological efficiency change (techch) (0.97%); was scale inefficient but pure technically efficient.

Table 4.8: All Banks Malmquist Index Summary, year (2013 - 2015)

No.	Banks	otech	techch	ptech	sech	tfpch
	Mean 2014	**1.011**	**1.007**	**0.989**	**1.021**	**1.018**
1	**Dashen**	1.097	1.167	1.063	1.032	1.280
2	**Birhan**	1.124	1.082	1.116	1.008	1.217
3	**Awash**	1.164	1.006	1.063	1.095	1.171
4	**Abay**	1.098	1.023	1.067	1.029	1.123
5	**Zemen**	1.054	1.063	1.000	1.054	1.120
6	**Abyssinia**	1.096	0.990	0.914	1.199	1.085
7	**Cooperative Bank of Oromia**	1.028	1.043	1.028	1.000	1.072
8	**United**	1.069	1.001	1.000	1.069	1.070
9	**Buna**	1.044	1.005	0.857	1.219	1.049
10	**Addis International**	0.962	1.043	0.929	1.036	1.004
11	**Lion**	1.000	1.000	1.000	1.000	1.000
12	**Nib International**	0.870	0.907	1.000	0.870	0.789
13	**Wegagen**	0.803	0.971	1.000	0.803	0.780
14	**Oromia Inter. B**	0.827	0.842	0.857	0.964	0.696
	Mean 2015	**0.929**	**1.089**	**0.947**	**0.981**	**1.012**
1	**Birhan**	1.000	1.377	1.000	1.000	1.377
2	**Cooperative Bank of Oromia**	1.116	1.201	1.114	1.002	1.341
3	**Abyssinia**	1.097	1.201	1.094	1.003	1.317
4	Wegagen	1.173	1.035	0.943	1.244	1.213
5	**Lion**	1.000	1.164	1.000	1.000	1.164
6	**Buna**	1.024	1.119	1.167	0.877	1.146
7	**Addis International**	1.056	1.059	1.077	0.981	1.118
8	**Oromia Inter. B**	0.976	1.133	1.121	0.870	1.105
9	**Zemen**	0.918	1.001	1.000	0.918	0.919
10	**Awash**	0.809	1.055	0.928	0.872	0.853

11	**Dashen**	1.000	0.837	1.000	1.000	0.837
12	**Nib International**	0.809	1.005	0.709	1.141	0.813
13	**United**	0.693	1.050	0.710	0.976	0.727
14	**Abay**	0.568	1.105	0.616	0.923	0.627

Taking a single bank e.g. Wegagen, has made tremendous improvements from 2014 to 2015 on change in total factor productivity. The 22 percent loss of total factor productivity recorded in 2014 has got improved with a 21.3 percent gain in 2015.The change in 2015 has resulted from the 17.3 percent and a 3.5 percent gain in overall technical efficiency change and technological change respectively. The 17.3 percent gain of overall technical efficiency was the result net gain of a 24.4 percent gain in change in scale efficiency and 6.5 percent loss of a change in pure technical efficiency. Wegagen's change in scale efficiency was commendable that as well marginally by 3.5 percent increased the change in technology. *Overall Wegagen's change in total factor productivity mainly derived out of change in overall technical efficiency (otech)*.The change from 2014 to 2015 has decreased the number of gainers in total factor productivity (tfpch) to eight which the number was 12 in 2014.

4.3.2 Big Six Banks Total Factor Productivity Change

Output oriented Total Factor Productivity Change (tfpch) measures were done for deposit collection of all big six banks adapting the Malmquist DEA analysis, and output oriented summary results presented in Table 5.2.3. All indices are relative to the previous year and year 2013 is the base year, and the Total Factor Productivity Change gains or losses begin from year 2014. The DEA analysis were done on five inputs (Salary and Benefits, Interest Expense, Office Rent, Promotion and Advertisement and expense for fixed asset) and one output, Total Deposit.

Table 4.9: Big Six Malmquist Index Summary of Annual Means

Year	otech	techch	ptech	sech	tfpch
2014	0.973	1.113	0.991	0.982	1.082
2015	1.013	0.944	1.015	0.997	0.956
Mean	**0.992**	**1.025**	**1.003**	**0.990**	**1.017**

The mean for total factor productivity change for Big Six amounted to be a two percent increment, which the net result of the net effect between the overall technical efficiency change and technological change. Technology change has increased by 2.5 percent while overall technical changes declined by 0.8 percent. Therefore, innovation or technological change made practical among the banks at a very smaller rate of 2.5 percent.

The Big Six banks yearly summary of change in total factor productivity is presented in Table 5.2.4. Five banks, including Wegagen, found to be gainers from change in total factor productivity at different magnitude in deposit mobilization movement from 2013 to 2014. Nib International Bank's factor productivity was at the leading position at the rate of 31 percent, followed by Dashen at 8.5 percent, and United Bank at a rate of 7.2 percent. Wegagen again was the fourth largest gainer from productivity at 6.2 percent resulted from change in technology, indicating adoption of new way of doing. Awash was the only underdog among the Big Six in 2015.

Table 4.10: Big Six Malmquist Index Summary

Banks	otech	techch	ptech	sech	tfpch
Mean 2014	**0.973**	**1.113**	**0.991**	**0.982**	**1.082**
NIB	1.000	1.309	1.000	1.000	1.309
Dashen	0.949	1.143	1.000	0.949	1.085
United	0.973	1.101	0.973	1.000	1.072
Wegagen	1.000	1.062	1.000	1.000	1.062
Abyssinia	1.022	1.000	0.932	1.097	1.022
Awash	0.896	1.086	1.053	0.859	0.974
Mean 2015	**1.014**	**0.944**	**1.016**	**0.999**	**0.957**
United	1.044	0.980	1.028	1.016	1.023
Awash	1.058	0.925	1.000	1.058	0.979
Abyssinia	1.008	0.962	1.073	0.940	0.970
Dashen	1.025	0.941	0.994	1.031	0.964
NIB	1.000	0.947	1.000	1.000	0.947
Wegagen	**0.946**	**0.910**	**1.000**	**0.946**	**0.861**

In the year 2015 United Bank was the only productivity gainer at the rate of 2.3 percent. On the other hand the rest five banks including Wegagen were productivity losers. Wegagen remained loser in the productivity movement from 2014 to 2015 and the total factor productivity declined by 14 percent and the gap got wider by about 20 percentage point compared to the 6.2 percent gain in productivity movement from 2013 to 2014.Wegagen's rate of productivity has declined mainly due to a 5 percent and 9 percent productivity loses occurred on change of overall technical efficiency and technological change. Wegagen was a loser in all the total factor productivity measurement parameters in 2015. The summary on total factor productivity analysis illustrated in Table 4.2.5.

5. Conclusion

5.1 Efficiency
The researcher has found out that results of the analysis under all banks yearly and Big Six banks category are more appropriate for making generalization and conclusion. The deposit collection effort of the private commercial banks, over the three-year period, in general was inefficient as shown by the average efficiency score of 86 percent for all banks at yearly bases below the efficiency frontier. While observing the efficiency scores of individual banks, seven banks (Abyssinia, Awash, Birhan, Cooperative Bank of Oromia, Dashen, NIB and Zemen); together built the efficiency frontier i.e. the decision of the management in input utilization was competent.

Similarly, but with higher value, the average efficiency score for the big six banks over the three years period was as well below the efficiency frontier with value of 91 percent. The efficiency score below 100 percent indicate inefficiency of banks in input or resource utilization, in that the amount of deposit collected was not proportional to the use of input. Individual banks like Abyssinia, Awash, Dashen, NIB and Wegagen banks in the year 2012/13 were all efficient in

deposit collection, indicating the carful allocation and utilization decision of the management. However, their efficiency deteriorated in the following the consecutive two years.

Banks' largest expense, in both categories, goes to Interest expense about 45 percent; salary and Benefit Expenses 35 percent and Office Rent about nine percent. The amount of interest expenses and salary and benefit expenses varies from bank to bank; however, the banks were not getting the required amount of returns in the form of the amount of collected deposit. The larger proportional reduction of inputs were made on these expenses by Birr 1.23 billion from Interest Expenses, by Birr 1.12 billion from Salary and Benefits and by Birr 360 million from Office Rent.

The sensitivity analysis has identified that all the banks are operating either on or below the efficiency frontier. No extreme (super-efficient or super-inefficient or outlier) bank existed during the review period. Therefore, the analysis made on the data is perfect or correct and free from bias.

5.2 Total Factor Productivity Change

The analysis on aggregate total factor productivity change resulted about a two percent change of factor productivity. The change in total factor productivity was the result of marginal increment in technological change influenced by reduction in technical change. At private banking industry level, the introduction and operation of banks using new technological products like ATMs and PoS machines, internet and mobile banking, has contributed for the change; though all are at infancy level. The change in total factor productivity has variation from bank to bank and the contributing factors for the change in total factor productivity could either be technological or technical or scale efficiency.

Generally, with increasing competition in financial markets, rapid technological advances in banking operations and services, and industry- wide consolidation, efficiency and productivity are critical aspects in banking — one that seems destined to separate the banks that will survive and prosper from those that will have problems serving their customers and remaining competitive.

In terms of financial characteristics, the most efficient banks are those making a concerted effort to control all aspects of expenses/cost, including salary expenses, fixed costs like office rent and expense on fixed asset and other noninterest expenses. At the same time, these banks remain focused on generating income and serving customers, and they appear to be conducting activities that are more resource and service intensive than those undertaken at less efficient banks. As a result, bank managers and personnel, through their ability to utilize resources effectively, would appear to play the largest role in banking efficiency.

Within a bank's ownership and management structure, a number of factors characterize efficient banks. Perhaps the most important are active involvement by major stockholders and the presence of managers and policymakers that either have a strong financial stake in the bank or have the appropriate incentives and monitoring to ensure that stockholder interests are followed. Other notable characteristics of efficient banks are active involvement by directors and a commitment to controlling bank risk exposure and costs/expenses. These characteristics will all be important as banks continue to deal with financial competition, technological change, and consolidation. Banks under a number of different circumstances and organizational forms can be efficient, but in each case, quality and pro-active involvement of bank management stratum and active participation by ownership are the keys to success.

6. Recommendations

Inefficient banks need to work more towards improving deposit collection efficiency level so as to ensure equalization and excelling towards technical and scale efficiency and factor productivity. Increase competitiveness not only within domestic market but as well at international level to meet the long term vision of the bank, which will be helpful in times when foreign banks are allowed to operate in the country. Inefficient Banks, to survive from ever intensified competitions and remain in the business should:

1) **Sustainably increase the size of Deposit and Deposit collection efficiency:** by rationally increasing the number of branches at business contestant areas and located at customers' convenient.

2) **Deploy highly paid and benefited employees into more productive working environment:** Wegagen bank is the third high salary payer and benefit provider among the private commercial banking sector. However, the salary and benefit package provided was/is not proportional to the expected amount of deposit collected and loan provided. Therefore, imperative to work towards building employee capacity and change in attitude.

3) **Avoid Master Slave Relationship between Managers and Employees:** Narrowing the gap/distance between employee and managers by creating enabling environment for closer contact and interactions to understand the feelings, interests and potentials of employees, which all are critical strategic issues. Managers should play leadership and coaching role than staying behind the door. Moreover, open and transparent discussion need be there among managers as well, which enable them speak the same language.

4) **Cut Office Rent:** Many banks need to cut office rent by higher proportion compared to the amount of returns among which to the amount of deposit collected. Need to adapt office space efficiency optimization strategy by attempting to avoid the attitude of the demand for wider office space, rather focusing on the quality of services.

5) **Encourage for Innovation and Adaption of new way of doing:** Almost all big banks are not benefiting out of their size (scale efficiency); therefore, need to move forward for adaption of new technology and innovation, which is essential to reduce costs and satisfy customers' interest.

6) **Empower Branch Managers' to enable them Grant Loan with limited Discretion:** avoid the compliant of branch managers' and encourage and initiate them to attract savers for deposit and investors for loan by letting them allow granting loan within limited margin e.g. of Birr 5 to 20 million per period, depending up on the size of the bank.

7) **Enhance the Commitment of Senior and Middle level Managers:** The banks' efficiency and productivity largely determined by the critical role played by the banks managers. Need to avoid rush hour running and play marathon by distributing energy thought out the year and sustainably throughout the strategic plan years' (period). Besides to the branch managers Head Office management can have effective role and persuasive power to play by approaching bigger business people and prominent personalities.

8) **Gradual Shifting towards Alternative Source of Income:** Reduce higher dependency of income on loan and advances by diversifying sources of income towards stock or capital market, which directly is linked to liberalization of the financial sector. Non-Interest Income sources are alternative sources that the banking sector need to seek for it, which have larger part of the total income and is a tool for fighting economic slowdown.

Reference

Barros, C. P., and Wanke, P. (2014). Banking Efficiency in Brazil. *Journal of International FInancial Markets, Institutions and Money*.

Berger, A. N., and DeYoung, R. (1997). Problem Loans and Cost Efficiency in Commercial Banks. *Forthcoming, Journal of Banking and Finance, 21*.

BKP Development, R. (2007). *ASSESSMENT OF THE IMPACT OF THE GENERAL AGREEMENT ON TRADE IN SERVICES ON THE ETHIOPIAN FINANCIAL SERVICES SECTOR.* Addis Ababa: MINISTRY OF TRADE AND INDUSTRY.

Boru, T. (2014). Efficiency in the Ethiopian Banking System DEA. *European Journal of Business and Management*.

Brady,S.(2016).*PRISM Decision System*. Retrieved 02 25, 2016, from prismdecision. Com /tools/frontier-analysis: http://www.prismdecision.com/tools/frontier-analysis

Chansarn, S. (2008). The Relative Efficiency of Commercial Banks in Thailand: DEA Approach. *International Research Journal of Finance and Economics*.

Dash, M., and Charles, C. (2010). A STUDY OF TECHNICAL EFFICIENCY OF BANKS IN INDIA. Bangalore: Alliance Business Academy.

DeYoung, R. (1997). Measuring Bank Cost Efficiency:Don't Count on Accounting Ratios. *Academic Journal*.

Gulati, R. (2011). Evaluation of technical, pure technical and scale efficiencies of Indian Banks:An analysis from cross-sectional perspective. *The 13th Annual Conference on Money and Finance in the Indian Economy.* Mumbai: Indira Gandhi Institute of Development Research.

Hung, N. V. (2007). Measuring Efficiency of Vietnam Commercial Banks: An Application of Data Envelopment Analysis.

Ikhide, S. (2000). Efficiency of Commercial Banks in Namibia. Windhoek: BANK OF NAMIBIA.

K.Adjei-Frimpong, and et al. (2014). COST EFFICIENCY OF GHANA'S BANKING INDUSTRY: A PANEL DATA ANALYSIS. *The International Journal of Business and Finance Research*.

K.Kosmidou, and C.Zopounidis. (2008). MEASUREMENT OF BANK PERFORMANCE IN GREECE. *South-E 80 astern Europe Journal of Economics*.

K.Werner, and J.Moormann. (2009). Efficiency and Profitability of European Banks- How Important is perational Efficiency? Frankfurt: Frankfurt School of Finance and Management.

M.J.Farrell. (1957). The Measuremenr of Productive Efficiency. *Jornal of the Royal Statistical Society*.

N.Berger, A., and J.Mester, L. (1997). Inside the Black Box: What Explains Differences in the Efficiencies of Financial Institutions. *Forth Comming. Journal of Banking and Finance*.

P.Hughes, J., and J.Mester, L. (2008). Efficiency in Banking: Theory, Practice and Evidences. Philadelphia.

P.Hughes, J., and L.J.Mester. (2013, August 01). Measuring the Performance of Banks: Theory, Practice, Evidence, and Some Policy Implications. Federal Reserve Bank of Philadelphia.

P.Tecles, and M.Tabak, B. (2010). Determinants of Bank E±ciency: The Case of Brazil. Banco Central Do Brasil.

Spong, K., and J.SulivanandDeYoung. (1993). What makes a Bank Efficient. *Journal of Banking and FInance*.

Timoty J.Coelli, and et al. (1998). *An Interoduction to Efficiency and Productivity Analysis.* USA: Springer.

Vittas, B. (1991). *Measuring Commercial Bank Efficiency.*

Worthington, A. C. (2000). Technical Efficiency and Technological Change in Australia Building Society. Blackwell Publishing.