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Total Factor Productivity Change of the Ethiopian Banking Sector: a Malmquist Productivity Index Approach (MPI)

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ABSTRACT

This objective of this article is to assess the total factor productivity of the Ethiopian commercial banks using the MPI approach based on the audited secondary data obtained from the National Bank of Ethiopia.
The results of the analysis showed that the improvement in TFP is driven by technical progress not due to improvements in overall technical efficiency.

KEYWORDS productivity, Malmquist productivity index, total factor productivity

1.1 Introduction

The modern banking system in Ethiopia was first introduced in 1905 by the Emperor Minilik II during which bank of Abyssinia was inaugurated in 1906. Bank of Abyssinia was the first indigenous bank in Africa and established by an official decree on August 29, 1931 with capital of £750,000. Before the bank of Abyssinia is replaced by bank of Ethiopia in 1931, the bank managed to expand its branches in various parts of Ethiopia. In the earlier periods of the Ethiopian banking history, the sector was all open to foreign banks to operate and invest in Ethiopia. This resulted in the opening of Barclays bank which came with British troops in 1941. In the following years Banco Di Roma and Banco Di Napoli s.c have obtained the license to operate in Ethiopia.

According to World Bank report (2013) total bank assets constitute 25% of the total GDP in Ethiopia which clearly indicates how significant the sector is to the overall economy. The report also marks the 1.7% professionals per bank which is slightly better than the figure reported in neighboring countries like Kenya but below Uganda and Tanzania. Ethiopia is the country where one hundred thousand individuals share 0.02 banks and where 84% 0f the banking sector is dominated by five banks of which the government owned banks take 61% (World Bank 2013). It is there for the extent of effort required by the banks regarding resource mobilization and the role they can play in regional imbalance is immense and needs greater effort and efficient resource management.

1.2 Review of Related Literature

The performance of financial institutions can also be assessed by taking a look at the productivity change over time. Various studies on productivity used the Malmquist productivity index to measure the changes in productivity over time (Bauer et al. 1993. For example Sathye (2002) calculated the productivity change in Australia banking during the period 1995-1999. Based on the balanced panel data of 17 banks it was found that technical efficiency and total factor productivity declined 3.1% and 3.5% respectively during the study period. However, the mean score of technical efficiency and TFP were positive.

Isik and Hassan (2003) carried out productivity assessment on Turkish banks found higher productivity gain by Turkish commercial banks which was driven by improvements in technical efficiency rather than the technological progress.

Jeanneneyet al. (2006) decomposed the productivity change in to efficiency change and technological change to see the productivity growth in the republic of china. The result demonstrated an increase in total factor productivity which was mostly contributed by an increase in technical progress rather than improvement in technical efficiency. The result was a demonstration of china's advancement in technology. Opposed to China, Worthington (1999) found that productivity gains in Australian banks are due to improvement in technical efficiency rather than scale efficiency.

Most of the studies apply the variable returns to scale (VRS) which was suggested by Banker et al. (1984). The VRS decomposes the overall technical efficiency in to pure technical efficiency and scale efficiency. Pure technical efficiency assesses the management ability to utilize the firms given resources. And the scale efficiency refers to exploiting scale economies by the point where the firm operates at CRS.

Noulas (1997) showed that the assumption of CRS is used to compare the small banks with large banks. He states that, in the sample where large banks are available the use of VRS assumption provokes the possibility that these larger banks will seem to be efficient. Avkiran (1999) also noted that the VRS compares the banks with similar size instead of against all units. Therefore, the variable returns to scale is more appropriate for larger sample size.

Percin and Ayan (2006) used DEA and Malmquist productivity index to evaluate the efficiency of Turkish commercial banks under CRS and VRS for the period of 2003-2004. They found that eleven of the thirty one banks were efficient under CRS, while 16 of them were efficient under VRS assumption. This shows that the banking system was improving in terms of input management and scale efficiency. Also the MPI showed an increase in bank efficiency change for the period of 2003-2004.

1.3 Data and Methodology

This study is based on the secondary data obtained from the National Bank of Ethiopia and applied non-parametric DEA

approach and the respective MPI is estimated using DEAP version 2011. Since the MPI estimated based on CRS ignores the size of the DMUs, the study applies the CRS-based MPI which is estimated from individual year's data to estimate technical and technological change.

The assessment of productivity needs balanced data which requires the availability of all the banks in the sample in the study periods and their corresponding inputs (operating expenses, total deposit, interest expense and fixed asset) and outputs(loans and advances, interest income and non-interest income). Therefore, considering these facts, it is difficult to assess the productivity of all the banks in Ethiopia. This forced the study to focus on analyzing the productivity of only selected banks with balanced data. For the sake of productivity estimate, the study used older banks such as DB, AIB, UB, BOA, WB, CBE and NIB. The total of seven older banks with a balanced data for fourteen years from 2000-2013 are included in analyzing the productivity. Banks established and started operations before and after the year 2000 are not included in the productivity estimate because they lack some data which will create unbalanced panel data.

Fare et al. (1994) used the DEA-based MPI to measure the productivity improvements of Swedish hospitals using the concept of Farrell (1957) and Caves, Christensen and Diewert (1982). The Fare et al. (1994) input-oriented MPI using input distance function for two periods time 't' and 't+1' is

expressed as follows: Equation I

$$Mi(x_{t+1}, y_{t+1}, x_t, y_t) = \left[\frac{D_c^t(y_{t+1}, x_{t+1})}{D_c^t(y_t, x_t)} * \frac{D_c^{t+1}(y_{t+1}, x_{t+1})}{D_c^{t+1}(y_t, x_t)} \right]^{1/2}$$

Where: D is the input distance function, $\mathbf{M}(\mathbf{x}_{t+1}, \mathbf{y}_{t+1}, \mathbf{x}_t, \mathbf{y}$ is the MPI which shows the change in productivity of DMUs under constant returns to scale ('c') and $y_{t+1}, x_{t+1}, y_t, x_t$ represent output and input in period t+1 and t respectively. Fare et al. (1994) states the productivity change in two periods can be decomposed in to two parts technical efficiency and change in production technology. Equation II

$$M(x_{t+1}, y_{t+1}, x_t, y_t) = \left[\frac{D_c^t(x_{t+1}, y_{t+1})}{D_c^t(x_t, y_t)} \right] * \left[\frac{D_c^t(x_t, y_t)}{D_c^{t+1}(x_t, y_t)} * \frac{D_c^t(x_{t+1}, y_{t+1})}{D_c^{t+1}(x_{t+1}, y_{t+1})} \right]^{1/2}$$

TPC=Efficiency Change X Frontier Shift

Equation III

$$\text{Efficiency change} = \left[\frac{D_a^t(x_{t+1}, y_{t+1})}{D_c^t(x_t, y_t)} \right]$$

Equation IV

$$\text{Frontier shift} = \left[\frac{D_a^t(x_t, y_t)}{D_c^{t+1}(x_t, y_t)} * \frac{D_c^t(x_{t+1}, y_{t+1})}{D_c^{t+1}(x_{t+1}, y_{t+1})} \right]^{1/2}$$

The MPI of the value greater than one shows an improvement in productivity of two periods and the value less than one shows a decrease in productivity in the two periods.

1.4 Results and Discussions

The MPI provides the total factor productivity change (TFPCH) which can be decomposed in to technical efficiency change (EFCH) and technological change (TECH). An increase in productivity from one period to the other is either the result of improvement in technical efficiency or advancements in technology or both. As previous sections the technical efficiency change is divided in to pure technical efficiency change (PTEC) and scale efficiency change (SEC). This classification is important because it directs the sources of productivity changes in the banks.

If the results show TFPC of greater than one, we can say that there is productivity gain which could result from an increase in efficiency or progress in technology and if the index is less than one it means there is a productivity loss which could be the result of decrease in efficiency or technical regress.

Table 1: MPI Summary of the Bank Means 2000 – 2013

FIRMS	EFCH	TECH	PTECH	SECH	TFPCH
DB	1.001	0.981	1.001	1.001	0.982
AIB	1.000	0.987	1.000	1.000	0.987
BOA	0.996	0.967	1.000	0.996	0.963
WB	1.000	1.009	1.000	1.000	1.009
UB	0.993	0.976	0.996	0.997	0.969
NIB	1.000	1.121	1.000	1.000	1.121
CBE	1.000	1.016	1.000	1.000	1.016
Mean	0.999	1.007	1.000	0.999	1.006

Source: Own computation

As can be seen from the table above the increase in the highest average total factor productivity change is observed at Nib International bank with the value of 12.1 % (1.121-1.000) followed by 1.6% of commercial bank of Ethiopia and Wegagen bank at third place with the value of 0.9%. This increment in the productivity of NIB, WB and CBE is basically due to the progress in the technical change rather than overall efficiency change. Other banks which have reported increase in productivity change include Wegagen Bank and Commercial Bank of Ethiopia.

However, the remaining four banks such as Dashen Bank, Awash International Bank, Bank of Abyssinia and united Bank have all registered productivity loss for the period 2000-2013 which was mainly resulting from technological regress(downward shift in the frontier) during the period. The reason for technical regress could be the fact that these banks have not embarked on the use of new technologies such as the introduction of information communication technologies, ATM, internet banking and mobile banking which would have provided cost effective ways of delivering financial services (Avkiran, 2000).

This finding is quite interesting to the fact that Dashen bank is one of the leading private banks in the country mostly known for the introduction of the modern banking infrastructures yet it is shows technical regress during the study period. Regardless of optimal managerial efficiency (PTE), Bank of Abyssinia had reported TFP loss of 3.7% which was an overall efficiency decline of -0.4 percent caused by scale inefficiency and technical regress of -3.3% during the period. The 3.1 percent total productivity loss attributed to united bank is caused by 0.7 percent decline in overall technical efficiency as a result of pure technical and scale inefficiency and 2.4 percent technical regress in the period under assessment.

Overall, the Ethiopian commercial banks have shown an increase in the total factor productivity progress with mean score of 0.006 percent. This progress has been mainly contributed from positive increase in technical change with 0.007 and a regress in the overall efficiency score difference of 0.001.

The decomposition of overall technical efficiency in to pure technical efficiency and scale efficiency would direct the sources of regresses of overall efficiency. Based on the results of the above table, Awash International Bank, Commercial Bank of Ethiopia, Nib International bank and Wegagen bank did not show any progress towards improving the TFPCH because all the three banks had pure technical and scale efficiency of 1.000 during the study period. Contrary to these banks, Dashen bank had positive average increase in pure technical and scale efficiency for the period both scoring 1.001. The remaining two banks, Bank of Abyssinia and United bank reported

different results as can be seen from the table. BOA reported pure technical efficiency of 1.000 and scale efficiency of 0.996 this highlights that scale inefficiencies have contributed to the loss on total factor productivity change. On the other hand, united bank reported pure technical efficiency of 0.996 and scale efficiency of 0.997 which showed pure technical (managerial) inefficiencies have contributed more to the regress in total factor productivity than scale inefficiency.

Generally, based on the mean score observed we can say the older and bigger banks have shown scale inefficiency rather than managerial inefficiency problems. This could be supported by mean pure technical efficiency of 1.000 and scale efficiency of 0.999 during the period. The loss of productivity on four of the seven biggest banks in the country reflects that the bigger banks have shown weaker intermediation in the mobilization of financial resources.

The table below shows Malmquist index means (using geometric mean) for the entire period 2000-2013.

Table 2: Annual Means

Years	EFFCH	TECHCH	PECH	SECH	TFPCH
2001	0.916	1.102	0.965	0.949	1.009
2002	0.98	0.824	1.034	0.948	0.808
2003	1.037	1.069	0.957	1.083	1.109
2004	0.992	1.018	1.04	0.953	1.01
2005	1.039	1.021	0.982	1.058	1.061
2006	1.032	0.979	1.009	1.023	1.01
2007	1.021	0.954	1.019	1.002	0.974
2008	0.985	0.962	0.987	0.997	0.948
2009	0.986	0.913	1	0.986	0.9
2010	1.025	0.995	1.013	1.012	1.02
2011	1.005	0.981	1.001	1.004	0.986
2012	1	1.034	1	1	1.034
2013	0.973	1.309	0.991	0.982	1.273
MEAN	0.999	1.007	1	0.999	1.006

Source: Own computation

The results from the table 2 above show inconsistencies on the total factor productivity of the banks. The productivity improved in the year 2013 (1.273), which saw the highest technological progresses in the banking industry and it was the year that banks were introducing technologies like: internet banking, mobile banking and ATM expansions and other ICT technologies. The banks also showed average TFPCH of 1.006 which was driven by 0.7% improvements in technology and showed 0.1% regress in overall efficiency change which was caused by -0.1% scale inefficiency. The year 2002 has seen the lowest total factor productivity which counted to the total productivity loss (regress) of -19.2% most of which is associated the technological regress of 17.6% and 2% decline in overall efficiency. The decline (-2%) in the overall technical efficiency is the result of -5.2% loss in scale inefficiency. The only positive in this year is the improvement in managerial efficiency which contributed to 3.4% increase in pure technical efficiency change.

The banking sector as can be seen from MPI results is showing more of frontier shift than catching-up because the annual means show slightly higher values to technological progress than the technical efficiency change. Through the years, the change in technical progress has sheltered the improvements in technical efficiency occurring as a result of optimal pure technical efficiency of the banks.

1.5 Conclusions

Therefore, based on the overall assessment of the productivity of the Ethiopian banking the following important points can be extracted:

- The overall annual mean of the seven older banks included in the study showed gains in total factor productivity as a result of technical progress not in improvement in overall technical efficiency.
- The year 2002 has reported the worst loss in TFP as a result of excessive technical regress and loss in the overall technical efficiency.
- Among some of the biggest private banks included in the sample, NIB has reported the highest TFP gain (12.1%) as a result of massive technical progress followed by the biggest government bank CBE (1.6%) which is derived by improvements in technical change. And finally, WB at third level which has also reported technical progress of 0.9% during the study period.
- Overall the older banks included for the assessment of productivity has exhibited more of frontier shift as a result of improvements in technology than catching-up effect.

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