

Performance of Private Commercial banks in Pakistan: A Data envelopment Analysis Approach

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Abstract

The study applied Data envelopment Analysis (DEA) technique to measure the performance of commercial banks in Pakistan for the period 2006 to 2010. DEA is a non parametric approach and takes into account multiple inputs and outputs to measure efficiency of business called Decision making Units. The study used input oriented CCR model by using intermediation approach, mostly used approach in Banking sector by taking Interest and Non Interest expenses as inputs while Interest and Non Interest Income as outputs. The results indicated that Muslim Commercial Bank (MCB) was the efficient bank throughout study and Samba bank the most inefficient one. The study also found that average efficiency of the private commercial banks declined during the study period.

Keywords: Data Envelopment analysis, commercial banks, Decision Making Units, efficiency.

1. Introduction

In today's competitive world, where the entire efforts of the business organizations are being directed to produce goods and services in order to satisfy customer needs. This requires transformation of resources of materials, Labor, Capital, techniques, technology etc., as inputs to produce output in the form finished goods and services. Managers of the business organizations are striving to allocate minimum resources (inputs) to produce maximum possible goods or services (outputs). For attaining organizational goals, the primary focus then is to reduce cost of inputs used and enhance outputs by eliminating inefficient processes and procedures. It can be done by evaluating the performance of businesses so that to shape it more productive and efficient. Therefore, performance evaluation is one of the main tools for benchmarking, in current situation where the business operations are surrounded by sophisticated and computerized based technologies / processes, communication, tough and growing competition etc. The businesses are forced to improve their efficiency in order to survive and prosper under global competition.

In the of course evaluating the performance, one can identify what the customer needs are, what the strengths and weaknesses of the business are and how to improve the business operations to create new goods and services. More often, performance evaluation and benchmarking is done by single input and output measure/analysis as a primary method. However, one of the serious concerns under this method is the recognition of the benchmark where multiple input- output measures are available and the complexity in determining whether the resources used were managed efficiently or not. . Therefore, single measures are not enough to assess financial performance. e.g., financial ratios of Return on Assets, Return on Equity, Net interest margin, etc. due to overlooking of interaction, tradeoff or substitution among different measures and also deficient in identifying and classifying the Best practice frontier.

A number of different techniques are available to approximate the best practice frontier which uses functional forms to show the relationships among different performance measures on the basis of prior information. Under these techniques, a business unit's operations in current situations are evaluated internally and then they are compared to similar business units externally to identify the best practice frontier over a period of time or for specific period.

Data Envelopment Analysis, which is based on optimization techniques, is one of mostly used method for performance evaluation and benchmarking. It measures the performance of business units in terms of multiple inputs employed and multiple outputs formed. DEA looks at the availability of resources (inputs) to each business unit and their conversion into desired products or services (outputs). DEA has been recognized by the researchers in the field as one of the excellent method for modeling business operations and processes in the absence of priori information. It has been found to be widely used in profit and nonprofit organization whether it is education sector, or banking, healthcare, transportation, manufacturing or market research etc.

1.2 Objectives of the study

The objectives of the study were:

1. To determine the performance of private commercial banks in terms of its efficiency.
2. To Rank the banks under study according to its efficiency scores.

1.3 Significance of the study

Managers of business firms are constantly under immense pressure to improve the performance. For this purpose, they set standards for performance standards against which actual performance will be measured. They direct

their efforts to achieve these performance standards and compare it with standard performance by using benchmarking techniques. These techniques are then used to define effective and efficient performance standard and the way out to enhance productivity. This process becomes more valuable at times when it is hard to set some objective performance standards for example in case of managing service operations, it becomes difficult to define these standards compared to manufacturing businesses. Therefore, benchmarking techniques become indispensable for setting the performance standards for business units in the services sector.

One of the benchmarking technique commonly known as Data Envelopment Analysis is used to identify best performing standard known as Best practice Frontier. This is one of the useful techniques for setting performance standards and then comparing the actual performance of the business unit under study. It uses mathematical programming models to evaluate the performance of business units taking into account multiple inputs used to produce multiple outputs. In other words, it also examines the resources available to each unit and conversion of these resources (inputs) into the desired outputs.

Researchers in a number of fields have quickly recognized that DEA is an excellent methodology for modeling operational processes. DEA's empirical orientation and absence of a priori assumptions have resulted in its use in a number of studies involving efficient frontier estimation in the profit and nonprofit sector, regulated and private sectors. DEA has wide range applications education, health care, banking, armed forces, auditing, market research, retail outlets, organization effectiveness, transportation, public housing, and manufacturing etc.

Keeping in view the above, this study used DEA approach for analyzing the performance of private commercial banks in Pakistan in terms of its efficiency

2. Literature Review

Banking sector plays a significant role in the economic development of any country and is considered as a backbone of the country's economy. Therefore, it is crucial to examine and measure the progress and development of the banking system regularly and to get a thorough insight into it. In the course of evaluating performance of banking sector, one needs to review some past studies and efforts in the field of banking during different periods and by different researchers. Following are some of previous studies under taken to evaluate the performance of banks using Data Envelopment Analysis.

Gupta & Garg, (2011) used DEA to measure the efficiency of public and private sector banks in India. The study used 49 banks to measure their competitiveness and for this purpose an intermediation approach was applied for inputs and outputs choice. The results showed that 19 banks were found to be efficient technically and the scale at which they operated during period under study. The inefficient banks had to improve their scale of operations and technology in order to compete globally and locally as the main reason for inefficiency was attributed to scale inefficiency.

O & T (2010) applied Multi –stage DEA to analyze three different types of efficiency of 13 commercial banks in Nigeria. In their study, 25 % of the banks were identified as efficient and identified that efficiency of the banks was positively affected by intermediation ratio and market power as environmental variables.

Ahmed et al (2009) used Dataenvelopment analysis and Malmquist Productivity index to examine the dynamics of efficiency in banking together with impact of financial sector reforms. For this purpose, 20 domestic banks of Pakistan were chosen and period under study was from 1990-2005. To estimate efficiency of the banks, the study composed of 3inputs of labor, deposits and capital and 3 outputs of loan advances and investment. The study period was decomposed into pre-reform, 1st reform phase and 2nd reform phase from 1991-1997, 1998-2001 and 2002-2005 respectively. They found from the results of Malmquist productivity index that technological change (Te-Ch) and Total factor productivity (TFP) both decreased by 14.3% and 12.2% in first period of reforms while 2.1% increase in technical efficiency change (Te-Eff) was noticed. The increase of 17.4%, 14.6% and 2.4 % was recorded in the 2nd phase of reforms respectively in TFP, Te-Ch, and Te-Eff. The results sustained the hypothesis that efficiency of Pakistani banking sector improved with financial reforms.

Ariff and Can (2008) investigated the cost and profit efficiency of 28 banks in China by using DEA approach. The study also attempted to measure impact of ownership, profitability, and other main environmental changes on the efficiency during 1995 to 2004. For this purpose, Tobit regression model was employed. The results indicated that banks with higher profitability were more efficient and there was a statistical significant between Non Interest income to total income.

Sufian (2006) studied the efficiency of 29 banks in Singapore from 1993 to 2003 using DEA window Analysis. The inputs of the study were Total deposits, fixed assets and total loans while Non Interest income and other income were used as outputs. The results indicated decline in average efficiency of the banking sector early period and dramatic increase in the later period.

X.Chen et al., (2005) applied DEA to find technical, cost and allocative efficiency of banks in china. The sample included 43 banks and the period under study was from 1993 to 2000. The inputs were Interest

expenses, non-interest expense, price of deposits and price of capital while outputs used were deposits, loan and Non-interest income. The study found that medium-size banks in china were less efficient as compared to large and small size banks and technical efficiency was the major cause of inefficiency in Chinese banking sector.

Chen (2004) examined the impact of financial crisis on the efficiency of banking sector of Taiwan. For this purpose, the study collected data of 44 banks from 1994 to 2004 to find out cost, allocative and technical efficiency. The DEA approach was applied and sensitivity analysis was performed to choose proper inputs and output of the study. The inputs and outputs were decided on the basis of mostly used intermediation approach in banking sector. The study found that efficiency of banks in Taiwan deteriorated in the phase of financial crisis. The technical, cost and allocative efficiency showed decline during financial crisis. The main reasons for decline in efficiency score was suggested to be Rate of return and bed debts(loan).

Mercan et al. (2003) studied the performance of banking sector in turkey. The performance was measured in terms of Ownership and size of assets during 1989 to 1999. They found that Government owned banks had poor performance as compared to private and foreign banks. Burki and Niazi found similar results while examining the impact of financial reforms on the efficiency of Pakistani banks during 1991 to 2000.

Mercan and Yolalan (2003) implemented DEA with Camel approach for performance of banks during the period from 1989 to 1999 and found that average efficiency score of the banks was from 25 % to 40 %. They concluded that private and foreign banks were more efficient as compared to govt owned banks and that large banks exhibited increase in their performance than small and medium size banks. while Bassett and brady (2002) found that small banks were at high level in terms of profitability and growth than large banks from 1985 to 2001. The interest costs were at high level which was counterbalanced by higher returns on assets.

Isik and Hassan (2002) used DEA models to estimate technical, cost and allocative efficiency of the banking industry of turkey from 1988 to 1996. In their study, they used intermediation approach for measuring banking efficiency. They identified that efficiency of the Turkish sector in the period from 1988 to 1996 was poor for domestic banks as compared to foreign and state owned banks. The study also found that ratio of loans to total assets had positive impact on efficiency. They suggested in their study that in order to enhance or improve the efficiency, the government should encourage competition in the banking sector.

Yildirim (1999) evaluated the banking sector efficiency in turkey through DEA. The efficiency evaluation was performed from 1988 to 1996 by taking Time deposits, demand deposits, interest expenses and non-interest expenses as inputs and interest income, Non-interest income and total credits as outputs. He came with the finding that banks which are profitable were also found to be efficient and there was no significant difference between efficiency and quality of assets.

Bhattacharyya et.al (1997) examined the productive efficiency of commercial banks in India using DEA. They analyzed 70 commercial banks from 1986 to 1991 and found that though there was consistent decline in efficiency of public sector banks but still they are more efficient than foreign banks and private banks.

Miller and Noulas (1996) examined the overall technical, pure technical and scale efficiencies of 201 banks in US under CCR and BCC models with increasing and decreasing return to scale assumptions for the period from 1984 to 1990. For this purpose, they used 4 inputs of Total Transaction deposits, total non-transaction Deposits, interest and Non-Interest expenses and 6 outputs (Total interest income, total non-interest income, investments, commercial loans, consumer loans, and real estate loans). The results of the study indicated that inefficiency of the banks under study was more due to pure technical efficiency rather than scale effect. By running regression in the second stage analysis, they found that significant contributors to inefficiency in the form Technical, pure technical or scale efficiency were size and profitability of the banks.

3. Research Methodology

3.1 Approach

To analyze and evaluate the performance of banks, a number of approaches are used like parametric and non-parametric. This study used one of mostly used non-parametric approach known as Data Envelopment Analysis (DEA).

DEA in its mathematical formulation was first offered by Farrell (1957) and DeBrau (1951) who worked out how Linear programming (LP) could be utilized to examine the economic aspects of production tendency. Farrell studied the inclusion of multiple inputs to produce single output by formulating LP to estimate relative efficiency of Decision making units (DMU).

Charnes, cooper and Rhodes in early 1970's started working on a project to develop programs for deprived children in the public schools. The project was sponsored and funded by US office of Education. They used econometric approaches for assessing the performance of these programs but the results were not worthwhile. Cooper was unsatisfied from the results obtained through econometric approaches and therefore, cooper's attention was diverted by Rhodes to a paper of Farrel who was working on non parametric approaches to evaluation and assessing the performance of organizations. Based on farrel work, Cooper, charnes and Rhodes developed the first DEA model known as CCR ratio (Cooper, Seiford, and Tone, 2000). They examined

how to use linear programming to maximize the ratio of the outputs to inputs.

Data envelopment analysis is used to find out the efficiency of business units. Efficiency can be defined based Extended Pareto-Koopmans Definition (Definition 1.1) as “ A decision making unit (DMU) can attain 100% or full efficiency if and only if none of its inputs or outputs can be improved without worsening some of its other inputs or outputs”. This definition is valid in situations when input and output targets of DMUs are known. these targets are difficult to establish or may not be applicable in most of management fields. Therefore, in situation where it is difficult or not possible to establish inputs and outputs targets then efficiency of the DMUs may be judged by Relative efficiency of the DMU under consideration to other DMUs in the same business. The Relative efficiency (definition 1.2) can be defined as “ A DMU is to be rated as fully (100%)efficient on the basis of available evidence if and only if the performances of other DMUs does not show that some of its inputs or outputs can be improved without worsening some of its other inputs or outputs. Relative efficiency definition was used in this study to compare the DMUs under study.

3.2 Model Specification:

DEA Models are mostly used to determine the efficiency of Business units known as Decision Making Unit (DMU). Basically, A DMU is considered as a business unit that uses its resources (inputs) independently and converts these inputs into outputs in the shape of final product or service. The performance of each DMU is then evaluated by comparing the ability of producing maximum output at given level of inputs or resources or the ability to use minimum resources to get given level of output. The DMU under study may be a bank or hospital, school, department Store or supermarket etc,

There are two basic models of Data Envelopment Analysis known as CCR and BCC models. These models seek to minimize inputs at the given level of output under input oriented approach and maximize the outputs at the experimental level of inputs under output oriented approach.

The study applied one of the basic envelopment model known as Charnes, Cooper and Rhodes model(CCR) in its input orientation. The mathematical formulation of this model is provided below:

$$\begin{aligned} \theta^* &= \min \theta \\ \sum_{j=1}^n \lambda_j x_{ij} &\leq \theta x_{i_0} \quad i = 1, 2, \dots, m; \\ \sum_{j=1}^n \lambda_j y_{rj} &\geq y_{r_0} \quad r = 1, 2, \dots, s; \\ \lambda_j &\geq 0 \end{aligned} \quad 1.1$$

Where DMU_o represents one of the n DMUs under evaluation, and x_{i_0} and y_{r_0} are the ith input and rth output for DMU_s respectively and λ represents a non negative vector of all variables (j= 1 to n). θ^* is called optimal θ and shows the efficiency value or score under input-oriented model for the DMU_o .

If (optimal theta) $\theta^* = 1$, then the current input levels cannot be reduced (proportionally), indicating that DMU_o is on the frontier. Otherwise, if optimal θ is less than 1, then DMU_o is dominated by the frontier. θ^* Represents the (input-oriented) efficiency score of DMU_o . Optimal θ should be more than 0 and less than or equal to 1.

If optimal θ^* is less than 1 then it indicates that there exists input excesses and (or) output shortfalls. It means that the DMU_o utilized more inputs to attain the given level of output in case of input oriented model or outputs attained are less than for the given level of inputs in case of output oriented model. The θ^* is called CCR efficiency and also known as Farrel efficiency.

3.3. Selection of Variables as Inputs and Outputs

As DEA models are based on inputs and outputs for examining the efficiency, therefore, it is necessary to select appropriate inputs and outputs variables. Two well-known approaches are used for the section of variables as inputs and outputs of the banking industry. One such approach, known as production approach, treats the banking unit as the producer of outputs and the second approach, known as intermediation, takes banking unit as an agent between the depositors and borrowers of funds.

This study has made use of intermediation approach by taking interest expenses (the amount paid on deposited funds) and non interest expenses (operating expenses) as inputs while interest income (interest received on Advances and non-interest income (income received from investments) as outputs. The intermediation approach is found to be more suitable measure for evaluating the performance of banks (Berger& Humphrey, 1997) as the main objective of the banks or any financial institution is to maximize profits and minimize the costs to become efficient. The study used this intermediation approach for efficiency measurement and the inputs output combination is given in the table: A below.

Table 3.1: Input-outputs of the study

Inputs	Outputs
Interest Expenses	Interest Income
Non Interest Expenses	Non Interest Income

3.4 Population and sample

The objective of the study was to compute and analyze the efficiency of private commercial banks in Pakistan. There were 22 private commercial banks operating in Pakistan and hence form the population of the study. It includes Islamic, conventional and foreign banks. The study used all private commercial banks except Islamic and foreign banks.

3.5 Collection of Data

In order to calculate efficiency under DEA Models, secondary sources for data collection methods were used. The data for this purpose was composed from financial statement Analysis-2006-2010 published by State bank of Pakistan (www.sbp.org.pk).

4. Findings

The efficiency scores of 16 private banks to be called as Decision making Units (DMU) under input oriented CCR model from year 2006 to 2010. The DMUs have been ranked as per the relative efficiency scores that range from 0 to 1 and have been converted to percentages for easy interpretation. The score of 100% or 1 indicates that the bank is operating on the best practice frontier or it is the best performing unit among the DMUs under consideration and a DMU with a score of less than 100% shows that it is operating below the best practice frontier.

The DMU having a score of 100% also shows that it has used their input resources at the optimum capacity to produce the given level of output and a score less than 100% will indicate that it has to enhance its input utilization for the given level of output. The banks have been ranked in the table 4.1 according to efficiency scores of each bank under evaluation. MCB has been ranked first and Samba as last on the basis of their efficiency scores. The second, third and fourth top performing banks were HMP, UBL, and Summit respectively.

The year wise efficiency scores of private commercial banks from 2006 to 2010 have been provided in the table 4.1. The industry average shows the average efficiency score of Banks in each year. The average efficiency scores (industry Average) were 74%, 72%, 72%, 73%, and 59% in 2006, 2007, 2008, and 2009 and 2010 respectively indicating that there is a decline in efficiency of banking sector.

The analysis of these average efficiency scores revealed that 3 banks were 100% efficient in 2006, 3 banks in 2007; 2 banks in 2008; 4 banks in 2009 and 2 banks in 2010. further it was found that 6 banks were above average in 2006, 6 in 2007 while 8 banks in 2008, 2009 and 2010 each. The number of banks remained below average were 8 in 2006, 2009 and 2010 each where as 10 banks were found to be found operating the average efficiency score in 2007.

The average efficiency score of the banks indicated that MCB (100%) was most efficient bank followed by HMP in the period from 2006 to 2010. HMP was observed to be efficient in all years except 2010 where its efficiency score was 68%. Summit bank achieved 100% efficiency in 2006, 2007 and 2009 while 66% and 37% in 2008 and 2010 respectively. Samba bank was observed to be the least efficient bank in the period under study followed by JS Bank and Silk Bank.

5. Conclusion

The study focused on the performance of private commercial banks in Pakistan from year 2006 to 2010. The objectives of the study were to compute efficiency of banks and to rank these according to efficiency scores obtained. The efficiency scores were obtained by using input oriented CCR model of Data Envelopment analysis. The two inputs (Interest Expense and Non-Interest Expense) and two outputs (Interest Income and Non-Interest income) for these models were chosen on the basis of intermediation approach mostly used in the performance of banking sector evaluation.

The analysis of period from year 2006 to 2010 indicated that 3 banks (Habib Metropolitan, MCB, and summit bank) were top performing banks in year 2006, and 2007, 2 banks (Habib Metro and MCB) in 2008, 4 banks (HMP, MCB, Summit and UBL) in 2009 and 2 banks (BAF and MCB) in 2010. The most efficient bank in the whole study period was MCB with average efficiency score of 100%.

It is concluded from the analysis that average overall efficiency decreased from 2006 to 2010 period. This decline may be attributed to in efficient use of their inputs or inefficient management or both. On the basis of the study findings, it is recommended that banks should improve their efficiency by using inputs at their optimum capacity.

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Table 4.1: Efficiency Analysis from 2006 To 2010

RANK	DMU	2006	2007	2008	2009	2010	Average
1	MCB	100%	100%	100%	100%	100%	100%
2	HMP	100%	100%	100%	100%	68%	94%
3	UBL	74%	63%	92%	100%	96%	85%
4	Summit	100%	100%	66%	100%	37%	81%
5	Soneri	99%	85%	83%	82%	52%	80%
6	HBL	64%	66%	81%	78%	91%	76%
7	ABL	74%	58%	71%	86%	78%	73%
8	BAF	72%	62%	65%	66%	100%	73%
9	AKL	81%	84%	65%	65%	64%	72%
10	BAL	72%	59%	69%	82%	71%	71%
11	MYB	82%	95%	90%	59%	20%	69%
12	NIB	61%	61%	45%	67%	45%	56%
13	KASB	72%	60%	56%	41%	30%	52%
14	Silk	63%	63%	49%	44%	36%	51%
15	JSB	46%	55%	72%	49%	28%	50%
16	Samba	17%	35%	47%	48%	24%	34%
	Industry Average	74%	72%	72%	73%	59%	70%

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