AN EMPIRICAL INVESTIGATION OF COMMERCIAL BANKS' EFFICIENCY IN PAKISTAN: A NON PARAMETRIC DATA ENVELOPMENT APPROACH

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ABSTRACT

The objective of this study was to examine technical (TE), pure technical (PTE) and scale (SE) efficiencies of 32 commercial banks (CB) in Pakistan for the year 2009. The study applied a non-parametric Data Envelopment Analysis (DEA) to measure efficiencies. For the selection of inputs and outputs variables, an intermediation approach was adopted. These variables were Number of employees, Physical Capital and Borrowed funds, as inputs while net advances, investments and lending to financial institutions as outputs. Two basic models of DEA namely CCR and BCC were applied. The empirical results of these models disclosed that CB functioned at 93 percent level of TE which means that CB can achieve the same level of outputs by using 7% less than current inputs used. The technical inefficiency was mainly caused by scale size (4%) than managerial inefficiency (3%). The pre-dominate cause of scale inefficiency was observed to be decreasing return to scale. The most efficient (highly robust) banks were Bank of Punjab, Habib Metropolitan, Muslim Commercial bank, Burj Bank, and Faysal Bank while Bank Islami and HSBC Oman were indicated as most inefficient banks.

Keywords: *Efficiency, Commercial Banks, Data envelopment Analysis, CCR, BCC*

INTRODUCTION

Banking sector is considered as a nervous system of country's economy. If the nervous system fails to function, the whole body becomes useless. Similarly, failure of banking system will lead to catastrophe of whole economic system. Therefore, for the stability and growth of economy, banking sector has to function at its optimum level. This can be achieved only if the banking sector is able to allocate the resources efficiently or with minimum waste. In the last few decades, substantial changes have been witnessed in the banking sector like financial deregulation, globalization, competition, innovation and advances in technology. These changes drastically altered the financial scenario and led the banks to operate at high level of efficiency in order to survive.

Since, efficient banks are better able to compete in the market due to their low operational and transaction costs and can grab the business away from less efficient banks. Therefore, it is a matter of concern for the regulators, customers, stakeholders and managers to monitor continuously the efficiency of banks. From the regulators point of view, inefficient banks are more risky and therefore have more chances of its failure. Customers are of the view that only efficient banks can offer better services at reasonable prices. Stakeholders think that only efficient banks can ensure reasonable returns while managers consider that, in changing and completive market conditions, only efficient banks can survive and maintain their market share while inefficient ones will ultimately be eliminated.

Efficiency at basic level can be defined as “doing things right”. However, in a scientific context, it is defined as “maximizing the desired outputs with minimum waste of available resources” and is measured by the ratio of outputs to inputs. This ratio becomes meaningful only for a business when it is compared with same ratio of other businesses in the same industry (Avkiran, 2006).

Problem Statement

In developing countries like Pakistan, the banking systems have been influenced by relatively high levels of government control and intervention which caused inhibition of efficient resources utilization and healthy competition. In order to create an effective, competitive and stable banking sector, a number of reforms have been initiated and implemented in Pakistan. These reforms forced the banking sector to better utilize their resources which is a prerequisite for their ultimate survival. Therefore, it is important to measure the relative efficiency of individual commercial banks in Pakistan and to identify the possible improvement or deterioration in its performance specifically after financial and banking sector reforms. Moreover, it is also important to uncover whether banks are suffering inefficiency due to its managerial failure or due to choice of unsuitable scale size.

Research Objectives

The objectives of the study are:

- To explore the efficiency status of commercial banks in Pakistan.

- To find out causes of inefficiency prevalent in the banks under study sample.
- To classify and rank the banks on the basis of their efficiency score.

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 essential to examine and measure the progress and development of the banking system regularly and to get a thorough insight into it. Following are some of prominent studies relating to efficiency of banks using data envelopment analysis.

Kiani (2005) examined technical efficiency of domestic and foreign banks in Pakistan by using the panel data of 18 banks from 1976 to 1996. This study found that domestic banks were least efficient compare to foreign banks. Moreover, banks were ranked as per average efficiency scores and claimed that Deutsche bank was the most efficient whereas Provincial Bank for Co-operatives was the least efficient banks. National Bank of Pakistan (NBP) was the most efficient Pakistani banks, which was at No. 4 in the ranking list of all 18 banks. This study concluded that banking efficiency improved during banking deregulations period.

Rizvi (2001) studied technical, pure technical and scale efficiencies of banks of Pakistan. The study utilized data for a period of 1993- 1998 and used DEA method. Input and output variables were selected under intermediation approach where number of employees, interest and operational expenses were the inputs and deposits, investment along with loans were the outputs. This study established that though pure technical and scale efficiency of domestic banks slightly improved compare to foreign banks, however, technical efficiency could not improve significantly throughout the analysis period and concluded that efficiency of scheduled banks almost stagnated during post banking deregulation era.

Ataullah, Cockerill and Le (2004) estimated technical efficiency of commercial banks of Pakistan and India. They used data from 1988 to 1998 and applied output oriented DEA technique. This study found that technical efficiency of Pakistani and Indian's banks gradually improved particularly after 1995. However, scale efficiency of Pakistani public sector banks improved compare to

Indian banks. They also argued that assets earnings enhanced efficiency of banks than income generation process of banks. This study argued that there is room for further improvement in technical efficiency of both countries' banks.

Jaffry, Ghulam, Pascoe and Cox, (2005) investigated technical efficiency of banks existed in Indian subcontinent (Pakistan Indian and Bangladesh). This study used data from 1993 to 2001 and applied DEA approach. Two outputs – interest income and non-interest income and two inputs – interest and non-interest expenses were selected. They found that there was improvement in technical efficiency of Bangladeshi and Indian banks, however, technical efficiency of Pakistani banks decreased during the middle period. This study concluded that efficiency trend converged in banking sectors of all the three countries.

RESEARCH DESIGN

Approach

The study applied non parametric Data envelopment analysis (DEA) approach. This approach was initially developed by (Charnes, Cooper & Rhodes, 1978) to assess the relative efficiency of non-profit business units. But it gains popularity in profit oriented business organizations due to its wide use and applicability. The relative efficiency refers to comparative position of business under observation to the best performing businesses in that industry. The business unit under investigation in DEA is termed as decision making unit (DMU). The relative efficiency is the ratio of weighted outputs to weighted inputs and ranges from 0 to 1 for DMU under DEA. The DMU with relative efficiency score of" 1" or 100% is referred to efficient DMU and less than 1 to 0 as inefficient one relative to other DMUS under trial.

Alternative Analysis Options in DEA

The efficiency analysis in data envelopment analysis can be performed with two orientation i.e., input and output orientation. Input orientation option refers to achieving given level of outputs with minimum use of inputs (when management wants to pursue cost reduction strategies). While output orientation refers to getting maximum outputs at given level of inputs (where the objective is to increase productivity without decreasing its market share). The study used input oriented models to determine the efficiency of banks.

Mathematical formulation of DEA models

This study used input oriented CCR (Charnes et al., 1978) and BCC (Banker, Charnes, & Cooper, 1984) models to measure overall technical and pure technical (managerial efficiency) respectively. The scale efficiency is the ratio of overall technical efficiency to pure technical efficiency. The mathematical formulation of these models in envelopment form is provided below:

Table 1: input oriented CCR and BCC models

Input oriented CCR model	Input oriented BCC model	
$\boldsymbol{\theta^* = \min \theta}$	$\theta^* = \min \theta$	
Subject to constraints	Subject to constraints	
$\boldsymbol{\sum_{j=1}^{n} \lambda j \; x_{ij} \leq \theta x_{io}}$	$\sum_{j=1}^{n} \lambda j \; x_{ij} \leq \theta x_{io}$	$i = 1,2, \ldots \ldots \ldots .., m;$
$\boldsymbol{\sum_{j=1}^{n} \lambda j \; y_{rj} \geq y_{ro}}$	$\sum_{j=1}^{n} \lambda j \; y_{rj} \geq y_{ro}$	$r = 1,2, \ldots \ldots \ldots .., s;$
	$\sum_{j=1}^{n} \lambda j \; = 1$	j= 1,2,……………….,n
$\boldsymbol{\lambda j \geq 0}$	$\lambda j \geq 0$	

Where θ^* (optimal theta) represents efficiency score of a single DMU (bank in the study). A score of 1 implies that DMU is technically efficient otherwise inefficient if the score is below 1 or equal to 0. x_{io} and y_{ro} are the i^{th} input and r^{th} output for DMU_0 respectively and λ represents a non- negative vector (constant) of all variables (for DMU j= 1 to n).

Selection of relevant Variables in DEA

The most difficult task, while working out efficiency of banks, is to choose the appropriate and related inputs and outputs. There is no unanimity as to what constitute input and output the bank (Casu & Girardone, 2002; Sathye, 2003). However, two frequently used approaches are indicated by the literature on banking efficiency i.e., production approach and intermediation approach. These approaches discriminate banks' activities on traditional function that it performs. Production approach initially introduced by (Benston, 1965) views banks as units providing services to customers (also known as Service provision approach). This approach considers only operating costs and ignores interest paid on borrowed funds. On the other side, intermediation approach suggested by (Sealey & Lindley, 1977) considers banks as intermediary bridging funds between lenders and borrowers. Neither of two approaches fully covers the functions of banks; however, intermediation approach has been used in majority of studies on banks' efficiency. Therefore, this study used intermediation approach for selection of inputs and outputs and are reported in table 2.

Input Variables	***Output variables***
1. *Labor (Number of employees)* 2. *Physical Capital (Fixed Assets)* 3. *Borrowed Funds (Deposits, borrowings and other liabilities)*	4. *Net advances* 5. *Investments* 6. *Lending's to financial institutions*

Table 2: List of input-output variables

Sample, data and analysis

Once inputs and outputs in DEA are decided, then next step is to decide number of DMUS (i.e., banks) to be included in the sample. There is no specific criteria for determining sample size under DEA setting. However, some common rule of thumbs are available for the purpose of sample size determination. Two such rules provided by (Cooper, Seiford, & Tone, 2007) are: 1) that number of DMUS should at least be more than product of inputs and outputs (sample size is greater than product of number of inputs and outputs) and 2) that number of DMUs be more than three times the sum of number of inputs and number of outputs. The sample size in this study comprises of 32 commercial banks which is more than minimum requirements under both of above rules of thumb. The next step after sample size determination is to collect data on inputs and outputs selected. Secondary data tools were used and data were obtained for the year 2009 from state bank of Pakistan official website (www.sbp.org.pk) and financial statements of individual commercial banks in Pakistan. The data was then analyzed through Excel solver 2007and MaxDea 6.6.

FINDINGS AND DISCUSSIONS

This section provides relative efficiencies of 32 Commercial Banks in Pakistan for the year 2009. The scores of relative efficiency were computed using input oriented CCR and BCC models of DEA. The input oriented models measures the relative efficiency of banks by assuming the minimum amount of inputs to produce given level of outputs. The table 4 displays descriptive statistics of technical efficiency scores.

Table 3: Descriptive Statistics of Technical efficiency Scores

Statistics	All Banks	Efficient Banks	Inefficient Banks
N	32	13	19

Average TE	93%	100%	89%
SD	0.101	0.00	0.109
Minimum	61%	100%	61%
Q1	91%	100%	84%
Median	97%	100%	92%
Q3	100%	100%	96%
Maximum	100%	100%	99%
Average TIE	7%	100%	11%
Note: Q1= first quartile, Q3 = third Quartile, SD= standard deviation, N= number of banks, TE = Technical Efficiency, TIE= technical inefficiency			

Magnitude of Technical, Pure technical and Scale efficiency

Table 4 displays overall efficiencies (TE) of 32 commercial banks with corresponding level of inefficiencies (TIE) computed by using input oriented CCR model of data envelopment analysis. The analysis shows that there is more unevenness in efficiency levels ranging from 61% to 100 %. The average score was observed at 0.93 leaving a gap of 7% in the optimum use of inputs. It means that commercial banks on average could produce the same level of outputs with 93% of inputs currently used or the same level of outputs could be produced with 7% less inputs utilized at present. It also indicates that commercial banks can reduce its inputs of Number of employees, fixed assets, borrowed funds by at least 7% and still produce at the given level. However, the input reduction can vary from bank to bank in the analysis. By way around, the same results can also be interpreted as (1/0.93=1.07) that commercial banks can produce 1.07 times more output at the given level of inputs.

Table 4: Technical, Pure technical and Scale efficiencies of commercial banks in Pakistan

Code	***Bank***	**TE**	**TIE**	**PTE**	**PTIE**	**SE**	**SIE**	**RTS**
CB	*Citi Bank*	1	0	1	0	1	0	CRS
DB	*Deutsche Bank*	1	0	1	0	1	0	CRS
TKYO	*The Bank Tokyo,*	1	0	1	0	1	0	CRS
BP	*Burj Bank*	1	0	1	0	1	0	CRS
DIB	*Dubai Islamic*	1	0	1	0	1	0	CRS
FYB	*Faysal Bank*	1	0	1	0	1	0	CRS
HBL	*Habib bank ltd.*	1	0	1	0	1	0	CRS
HMP	*Habib Metropolitan*	1	0	1	0	1	0	CRS
MCB	*Muslim Commercial Bank*	1	0	1	0	1	0	CRS
SMBA	*Samba Bank*	1	0	1	0	1	0	CRS
BOK	*The Bank of Khyber*	1	0	1	0	1	0	CRS

BOP	*The Bank of Punjab.*	1	0	1	0	1	0	CRS
BARK	*Barclays Bank*	0.94	0.06	0.98	0.02	0.96	0.04	DRS
HSBC-M	*HSBC Middle East*	0.97	0.03	1	0	0.97	0.03	DRS
ABL	*Allied Bank*	0.97	0.03	1	0	0.97	0.03	DRS
ASKL	*Askari Bank*	0.92	0.08	0.92	0.08	0.99	0.01	DRS
BAF	*Bank Al-Falah*	0.87	0.13	0.87	0.13	1	0	DRS
BIP	*Bank Islami Pakistan*	0.61	0.39	0.64	0.36	0.96	0.04	DRS
JS	*JS bank*	0.81	0.19	0.82	0.18	0.99	0.01	DRS
MBL	*Meezan bank*	0.78	0.22	1	0	0.78	0.22	DRS
NIB	*NIB Bank*	0.96	0.04	0.96	0.04	1	0	DRS
SCB	*Standard Chartered Bank*	0.99	0.01	1	0	0.99	0.01	DRS
UBL	*United bank ltd.*	1	0	1	0	1	0	DRS
NBP	*National bank of Pakistan.*	0.96	0.04	1	0	0.96	0.04	DRS
HSBC-O	*HSBC Oman*	0.63	0.37	1	0	0.63	0.37	IRS
ALBRKA	*Albaraka Bank*	0.91	0.09	0.93	0.07	0.98	0.02	IRS
BAH	*Bank Al-Habib*	0.96	0.04	0.96	0.04	1	0	IRS
KASB	*KASB bank*	0.9	0.1	0.91	0.09	0.99	0.01	IRS
SILK	*Silk Bank*	0.81	0.19	0.82	0.18	0.99	0.01	IRS
SONRI	*Soneri Bank*	0.96	0.04	0.96	0.04	1	0	IRS
SUMIT	*Summit Bank*	0.99	0.01	1	0	0.99	0.01	IRS
FWB	*First Women Bank*	0.9	0.1	0.98	0.02	0.91	0.09	IRS
Average		0.93	0.07	0.96	0.04	0.97	0.03	

TE = Technical Efficiency, TIE=technical inefficiency, PTE= pure technical efficiency, PTIE= pure technical inefficiency, SE=scale efficiency, SIE= Scale inefficiency, RTS= Return to scale

In current study, 13 banks were indicated as Technical efficient as shown in table 4. These banks were identified as best performer within the sample of study and they together form best practice frontier for inefficient banks in the industry. The line connecting these efficient banks is known as efficient frontier. It means that these efficient banks were better in using their resources compared to inefficient banks. In DEA context, these banks are called peers and set standard or benchmark for the inefficient ones to follow in order to become efficient. Therefore, best or standard or peers in the study were identified as bank of TOKOYO, DB, BP, BOK, Samba, DIB, CB, HMB, FYB, BOP, HBL, MCB and UBL. The inefficiency level in the current study ranges from 0.61 for Bank Islami Pakistan to 0.99 for summit bank. It implies that Bank ISLAMI and Summit bank can improve its efficiency by reducing the current level of inputs usage by 39% and 1% respectively while attaining the current level of outputs.

Discrimination of Efficient Banks

To distinguish among efficient banks, the researcher divided the efficient banks in three classes on the basis of number of times efficient banks were quoted as a reference or best practice bank for inefficient banks. The classes were titled as “Highly Robust Bank, Marginally robust and efficient by default. The highly robust banks are those which have been quoted maximum number of times as a benchmark or standard performer for inefficient banks. These are the banks which have been preferred on large number of factors and they will remain efficient unless a misfortune happens in their operations. While marginally robust banks comprise those which are quoted less frequently as a benchmark for inefficient banks in the sample under study. These are the banks which can become inefficient with slight increase or decrease in their inputs usage and outputs achieved. Whereas, efficient by default group of banks are those with zero frequency count and do not possess the qualities of being followed by inefficient banks in the sample.

Table 5: Ranking of efficient banks

Highly Robust	**Marginally Robust**	**Efficient by Default**
BOP(14)	Samba (3)	DIB (0)
HMP(13)	Tokyo (2)	HBL (0)
MCB(12)	CB (2)	UBL (0)
BP (11)	DB (1)	
FYB (11)	BOK (1)	
Note: Figures in brackets represent number of times a bank was quoted as benchmark for inefficient Banks		

The criteria for highly, marginally or default is decided on the basis of no of times an efficient bank was observed as a reference set for inefficient banks. The banks with frequency of more than 10 were classified as highly robust, less than 10 but more than 0 were grouped as marginally robust and frequency of zero were classified as efficient by default. The bank of Punjab was the highly robust bank with highest no of times used as a reference set for inefficient banks and therefore ranked as no 1 in the group.

Discrimination of Inefficient banks

Like ranking of efficient banks in the aforementioned section, an attempt was made by the researcher to differentiate inefficient banks on the basis of its efficiency scores. For this purpose, the efficiency scores of inefficient banks were divided into four quartiles i.e., first quartile (Q1), median, third quartile Q3 and fourth quartile respectively. Then inefficient banks were grouped into four classes on the basis of these quartiles values.

Table 6: Ranking of Inefficient Banks

Highly Inefficient	*BIP, HSBC-O, MBL*
Below average	*JS, SILK, BAF,FWB, KASB, ALBARKA*
Above average	*ASKL, BARK, SONERI, BAH, NIB, NBP, HSBC-M, ABL*
Slightly inefficient	*SUMIT, SCB*

The banks below Q1 was classified as highly inefficient, between Q1 and median as below average, between median and Q3 as above average and above Q3 as slightly inefficient. Highly inefficient banks are those having worst performance and can be targeted to be merged with other bank or may be acquired by another bank. Slightly inefficient are those which operate at level near to efficient banks and a small improvement in their performance can lead them to become fully efficient.

Causes of Inefficiency and suggested Remedy

For understanding the concept of slacks and its significance in evaluating the performance of banks, a case of BAH is taken as an example to illustrate the concept in practical terms. Looking at TE column of table 4 which shows technical efficiency commonly referred to as Farrell's efficiency, the technical efficiency of BAH is observed at 96%. This score indicates that BAH has to reduce all its inputs usage by 4% (100%-96%) to become technically efficient. This inefficiency of 4% is termed as radial inefficiency under CCR model in DEA. If we look at the input slacks column, it shows 29% reduction in NOE, 0% in BF and 64% in PC. The potential improvement displays the total reductions in inputs (Radial inefficiency plus input slacks). The same interpretation can be made for the rest of inefficient bank in table 4. The maximum average potential reduction in inputs were observed in physical capital (35%) followed by number of employees (25%) and Borrowed funds (11%). Hence, inefficiency was mainly caused by excessive investments in physical capital (fixed assets)

Table 7: Radial inefficiency, Input Slacks and potential improvement

		input slacks			**Potential input Improvement**			**Output Slacks**		
Bank	TE	NOE	BF	PC	NOE	BF	PC	LFI	INV	ADV
BARKL	94%	-1%	0%	0%	-7%	-6%	-6%	0%	0%	0%

HSBC	97%	-30%	0%	0%	-33%	-3%	-3%	24%	0%	0%
HSBC-Oman	63%	-35%	0%	0%	-72%	-37%	-37%	25%	50%	0%
ALBRKA	91%	0%	0%	-60%	-9%	-9%	-69%	0%	0%	0%
ABL	97%	-3%	0%	0%	-6%	-3%	-3%	0%	0%	0%
ASKL	92%	-3%	0%	-5%	-11%	-8%	-13%	0%	0%	0%
BAF	87%	0%	0%	-21%	-13%	-13%	-34%	0%	0%	0%
BAH	96%	-29%	0%	-64%	-33%	-4%	-68%	50%	0%	0%
BIP	61%	-4%	0%	-12%	-43%	-39%	-51%	0%	0%	0%
JS	81%	-20%	0%	-50%	-39%	-19%	-69%	0%	0%	0%
KASB	90%	0%	0%	-67%	-10%	-10%	-77%	0%	0%	0%
MBL	78%	-33%	0%	0%	-55%	-22%	-22%	0%	0%	0%
NIB	96%	-49%	0%	0%	-53%	-4%	-4%	0%	0%	0%
SILK	81%	0%	0%	-27%	-19%	-19%	-46%	0%	0%	0%
SONERI	96%	0%	0%	-27%	-4%	-4%	-31%	0%	0%	0%
SCB	99%	0%	0%	-22%	-1%	-1%	-23%	0%	0%	0%
SUMIT	99%	0%	0%	-62%	-1%	-1%	-63%	0%	0%	0%
FWB	90%	-55%	0%	-8%	-65%	-10%	-18%	0%	0%	3%
NBP	96%	0%	0%	-33%	-4%	-4%	-37%	0%	0%	0%
Average	89%	-14%	0%	-24%	-25%	-11%	-35%	5%	3%	0%

Note: TE= Technical Efficiency, NOE= Number of Employees, BF= Borrowed Funds, PC= Physical capital, LFI= Lending's to Financial Institutions, INV= Investments, ADV= Advances.

CONCLUSION

The study applied input oriented CCR and BCC models of data envelopment analysis to assess the efficiency of commercial banks in Pakistan for the year 2009. The inputs and outputs variables were selected on the basis of widely used intermediation approach for banks. Under intermediation approach, labor, physical capital and borrowed funds were chosen as inputs while net advances, investments and lending's to financial institutions were selected as outputs. A sample of 32 banks were chosen based on two mostly quoted rules of thumb proposed by (Cooper et al., 2007). The empirical results indicated a level of efficiency at an average of 93% indicating a deficiency gap of 7%. This inefficiency was mainly caused by diseconomies of scale (SE = 4%) and management ineffectiveness (PTE = 3%). On the basis of efficiency scores, efficient banks were classified into three classes i.e., Highly Robust, marginally robust and efficient by default. Among the highly robust or efficient banks were BOP, HMP, MCB, BP, and FYB; while Samba, Tokyo, CB, DB, and BOK as marginally efficient and DIB, HBL, and UBL as efficient by default.

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