

Assessment of Relative Efficiency of Commercial Banks In Nepal: Application of Linear Programming Problem

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Abstract

This study focuses on the Performance Analysis of commercial Banks in Nepal with the proposition of Total Quality Management model comprising the four domains: Requirements, Action/Banking Operations, Service Quality and Results. There is integration of service quality model leading to customer satisfaction and financial development as part of the results of the proposed model. The researcher evaluates the performance of 17 Nepalese commercial banks from 2003/04 to 2009/10 (seven years) by employing data envelopment analysis. Two approaches Intermediation and Operation are used in the evaluation purpose. The efficiency scores of banks from the fiscal year 2003/04 to 2009/10 found to be opposing with employed approaches. The study focuses on the measurements and benchmarking as a means of continuous improvement in banking sectors. This study also proposes a model for simulation by using the efficiency scores from 2003/04 to 2009/10 and simulates the efficiency scores up to fiscal year 2012/13

Keywords: *Total Quality Management, Data Envelopment Analysis, Service Quality, Simulation*

Introduction

By mid April 2009, total deposits in commercial banks in Nepal is Rs.481.4 billion which accounts to 83.5 percentage of total deposits equivalent at Nepalese financial Institution.. Regarding total lending in commercial banks by mid April 2009 is Rs.401.3 billion.

As banking sector plays a pivotal role in contributing substantially to the finance of National economy, efficiency of commercial banks is one of the key interesting and vital issues for both the government and private sector. Non-performing Loans (NPL) is major setback in commercial banks NPL by mid- July 2007 was Rs.23729 million, by mid July 2008, it was Rs.19215 million and by mid July 2009 it was Rs. 14373 million in commercial banks in Nepal. Due to effective regulation and improvement supervision by Nepal Rastra Bank (Central Bank of Nepal), there have been some improvements on non-performing loans; however, expected reforms are yet to be observed on some government owned commercial banks and a few banks in private sector.

There has been a substantial effect in the interest spread of banking sector due to global financial crisis because of Liquidity problem. Still, this problem is prevailed in banking sector in Nepal in one hand, and on other hand there has not been potential sector for investment. For few years, we have seen many banks have increased investments into real estate sector (borrowing short term but lending long), however, the monetary policy of 2067/68 has directed to bring down the size of investment in this sector to only ten percentages within two years. So, there is always a challenge to banks in deposit collection and investments.

There has been new commercial banking in Nepal leading to major challenge in commercial banking sector. Till the date there are thirty two commercial banks in Nepal. Moreover, Nepal has become member of World Trade Organization (WTO) and has committed to open Financial Services Sector (FSS) especially banking services to the foreign banks and financial institutions by 2010. There is already branch of Mashreq Bank of United Arab Emirates, Dubai in Nepal and has already started in the field of Inter-banking. This could be threat as well as opportunities for banking sector of Nepal.

The main challenge to Bank in Nepal is to penetrate in rural economy with innovative products of microfinance as insurance, remittance, etc. so as to support poverty alleviation program. At the same time they have to be in parallel in operation to keep up with the globalization of economic activity, there by attracting productive investments in a competitive international environment to maintain a healthy and efficient financial sector so in this two extreme conditions bank has to perform efficiently.

The importance of enhancing the performance of the banks has become the major issue in commercial banking sectors in Nepal. This is possible only through the implementation of total quality management. Basically, Total Quality Management refers to the customer considerations, Employee involvement and continuous improvement in an organization. Relating this philosophy into Nepalese context, we can propose following model for the quality enhancement in Nepalese commercial banking sectors.



The philosophical elements comprises the requirements parts of quality management like Leadership, People, Strategy and Information which will get translated into the Action part comprising Organizing as the main component. There will be impact on service quality and the customer satisfaction and Financial Development as a part of the result at the end.

In this study the researcher evaluates the performance of selected banks taking into consideration of productivity as a part of financial development.

Data Envelopment Analysis

Data Envelopment Analysis (DEA) is a methodology based upon an interesting application of linear programming. Occasionally, it is also called frontier analysis and is a performance measurement technique which can be used for analyzing the relative efficiency of productive units, having the same multiple inputs and multiple outputs. This technique measures how efficiently a Decision Making Unit uses the resources available to generate a set of outputs. Decision-Making units can include manufacturing units, departments of big organizations such as universities, schools, bank branches, hospitals, power plants, police stations, tax offices, prisons, defense bases, a set of firms or even practicing individuals such as medical practitioners (Ramanathan, 2006).

DEA is a non-parametric analytic technique which allows us to compare relative efficiency of

units as benchmark and by measuring the inefficiencies in input combinations in other units relative to benchmark (Chansarn, 2008).

The technique of Frontier analysis has been described by Farrel in 1957, but a mathematical framework to handle the frontier analysis was provided by Charnes, Cooper and Rhodes in 1978 and coined the term as Data Envelopment Analysis.

DEA has been receiving importance as a technique for measuring efficiency of commercial banks in several countries since mid-1980s. For instance, Piyu Yue (1991) used DEA to evaluate the management of 60 Missouri commercial banks for the period from 1984 to 1990. In this study CCR and additive models were employed. Supachet Chansarn (2008) employed the DEA approach to examine the relative efficiency of Thai Commercial banks during 2003-2006 via operation approach and intermediation approach according to size, large, medium and small banks.

CCR-Model is introduced by Charnes, Cooper and Rhodes (1978). This model helps measure the efficiency of each Decision Making Unit (DMU) under study. Efficiency can be defined as the ratio of Virtual output to Virtual Input.

The virtual output of a firm is obtained as the linear weighted sum of all its outputs and that of Virtual input is also obtained as the linear weighted sum of all its inputs.

$$\text{Efficiency} = \frac{\text{Weighted sum of outputs}}{\text{Weighted sum of inputs}}$$

The most essential issue at this stage is the assessment of the weights as there is no unique set of weights. The weights assigned should be flexible and reflect the performance of the individual DMUs and should be restricted to values between 0 and 1.

Suppose that there are n DMUs, each with m inputs and n outputs, relative efficiency score of a given DMU_o is obtained by solving the following linear programming model.

$$\max h_o(u, v) = \frac{\sum_{r=1}^n v_r y_{ro}}{\sum_{i=1}^m u_i x_{io}}$$

Subject to

$$\frac{\sum_{r=1}^n v_r y_{rj}}{\sum_{i=1}^m u_i x_{ij}} \leq 1; j = 1, 2, \dots, n$$

$$u_i \geq 0; i = 1, 2, \dots, m$$

$$v_r \geq 0; r = 1, 2, \dots, n$$

Where

x_{ij} = the amount of input i utilized by the j th DMU

y_{rj} = the amount of output r produced by the j th DMU

u_i = weight given to input i

v_r = weight given to output r

According to the Charnes-Cooper transformation (1962), we can select a representative solution for which

$$\sum_{i=1}^m u_i x_{i0} = 1$$

Hence, the denominator in the efficiency score h_0 shown above is set equal to one, the transformed linear programming model for DMU₀ can be written as follows.

$$\max z_0 = \sum_{r=1}^n v_r y_{r0}$$

Subject to

$$\sum_{r=1}^n v_r y_{rj} - \sum_{i=1}^m u_i x_{ij} \leq 0; j = 1, 2, \dots, n$$

$$\sum_{i=1}^m u_i x_{i0} = 1$$

$$u_i \geq 0; i = 1, 2, \dots, m$$

$$v_r \geq 0; r = 1, 2, \dots, n$$

The linear programming model shown above will be run n times in identifying the relative efficiency scores of all the DNUs. Each DMU selects input weights that maximize its efficiency score. Generally, a DMU is considered to be efficient if it obtain a score of 1.00, implying 100% efficiency; whereas a score of less than 1.00 implies that it is inefficient.

Methodology

To observe the relative efficiency of commercial banks in Nepal, the secondary data is obtained from financial results of Commercial Banks (Provisional) As at Fourth Quarter of Fiscal year From 2003/04 to 2009/10, published by Bank and Financial Institutions Regulation Department, Nepal Rastra Bank. Seventeen Banks are covered under this study. (Refer Appendix 1 for list of commercial banks under study).Nepal Rastra Bank has given license to thirty two commercial banks till the date.

For the study, intermediation approach (asset approach) is considered. In this approach the banks are regarded as entities which transform deposits into loans into credit and investments by employing labor and capital. For this approach two inputs and two outputs are being included.

Input 1-Total deposit in million rupees.

Input 2-Total expense (Interest expenses, operating expenses and other expenses) in million rupees.

Output 1-Total Credit in million rupees

Output 2- Total loans and advances in million rupees.

Another approach called operation approach is also being used in this study. This approach evaluates the efficiency of commercial banks from the perspective of costs/revenues management. In this study two variables Interest income and Other income are considered as output and three variables Interest expenses, staff expenses and operating expenses are considered as Input variables.

The data is analyzed with Solver add-in that comes with Microsoft Excel. Furthermore the efficiency scores are simulated up to 2012/13. The simulation is performed in Excel spreadsheet. At first the distribution of relative efficiency scores is being set up by creating up and down range with respect to average efficiency score of the interval $[a,b]$ where a is lower limit and b is upper limit representing minimum value and Maximum value of the existing scores. This interval lies within the close interval $[0, 1]$. After this we fit the distribution of Up and Down count by counting the number of ups and downs scores with respect to average efficiency score there by employing probability which in turn will be used to determine either to generate up range efficiency score or down range. Once the range is determined the efficiency score is generated. Finally the average score of 1000s generated efficiency scores will be the simulated efficiency score for the coming period.

Empirical Results

The summary result for the analysis via both Intermediation approach and operation approach are presented in Appendix 2.

According to Appendix 2.1, the average efficiency (via Intermediation approach) of Commercial Banks in Nepal during 2003/04 to 2009/10 ranges from 0.5032 to 0.9001, which is considered to be unstable. In 2003/04, the average efficiency is 0.8299. Two banks MBL and SIDDHARTHA are considered to be efficient with the efficiency scores of 1 implying that they had produced their output on the efficient frontier in this fiscal year. In 2003/04, LAXMI, NSBI, KUMARI and HBL have efficiency scores of 0.9500, 0.9456, 0.9413, and 0.9295 respectively implying that LAXMI must increase its output by 4.999%, NSBI must Increase its output by 5.4449%, KUMARI by 2.8704% and HBL must increase its output by 7.0527% with the same amount of input so that

they are considered to be efficient. NBL is the least efficient bank in 2003/04 with the efficient score of 0.6158, indicating that it had to increase its output by 38.422% with the same amount of input to be able to operate on the efficient frontier.

In 2004/05, the average efficiency score of Nepali Commercial banks increases slightly to 0.8314. Three Commercial banks RBB, NABIL and HBL are found to be efficient with score 1. Four banks SCBNL, BOK, MBL and NIBL are found to be just below the efficient frontier with efficient scores 0.9669, 0.9213, 0.9074, and 0.9027, implying that they must increase their output by 3.3100%, 7.8700%, 9.2600%, and 9.7300% with the same amount of input so that they could be considered as efficient. EBL is the least efficient bank in 2004/05 with the efficiency score 0.2343 implying that the bank must increase its output by 76.57% as the same amount as input so as to be efficient bank.

In 2005/06, the average efficiency score increases to 0.8514. Three Banks NABIL, NSBI, and SIDDHARTHA are found to be at the efficient frontiers with efficiency Score 1. Five banks NICBL, BOK, NIBL LAXMI and EBL are found to be performing to the close of efficient banks ranging the efficiency scores from 0.9064 to 0.9716 implying the necessity of percentage increase in output from 2.8400% to 9.3600% at par with input so as to perform as efficient banks. There are six banks NBL, RBB, NIBL, SCBNL, HBL, NBBL, and KUMARI having the efficiency scores of 0.4454, 0.8265, 0.9541, 0.7177, 0.7799, 0.7021 and 0.7093 falling below the average efficiency score of the fiscal year. Among these NBL is the least efficient bank in this particular fiscal year implying that this bank had to increase its output by 55.4600% at par with input in order to keep it as efficient bank.

In 2006/07, the average efficiency score is rapidly decreased to 0.5302. This shows that most of the banks are found to be inefficient in this fiscal year. There are two banks SIDDHARTHA and SCBNL performing efficiently with score 1. There are only two banks NBL, NABIL, beside two efficient banks lie above the average efficiency score in this fiscal year. Their efficiency scores are 0.7507 and 0.7257 respectively, implying that they must increase their output at par with input by 24.93% and 27.43%, so as to perform efficiently. There are 12 banks falling below the average efficiency score, among them MBBL is the least efficient bank in this year with efficiency score 0.2342 implying that this bank should increase its output by 76.58% in order to perform efficiently.

In 2007/08, the average efficiency score increases to 0.7893. Two Banks SCBNL and NMB are found to be efficient banks with score 1. One bank sunrise is very close to efficient bank with efficiency score 0.9998. There are four banks NABIL, HBL, NSBI, and PRIME with efficiency scores 0.9252, 0.9167, 0.933917, and 0.9444 respectively implying that they should increase their output by 7.4782%, 8.3249%, 6.6083%, and 5.596% at par with their input so as to perform efficiently. There are 9 banks falling below the average efficiency score level, among them ADB/N is the least efficient bank in this particular year as well. Its efficient score is 0.1550 implying that it must increase its output by 84.9038% in order to perform efficiently.

In 2008/09, the average efficient score is increased to 0.8633. Three banks NABIL, SCBNL, and NSBI are found to be efficient bank with score 1, while another one bank, HBL is fairly close to efficient banks with efficiency score 0.9563. There are 8 banks performing below the average efficiency level, among them NBL is found to be the least efficient bank in this year with efficiency score 0.5626 implying that they must increase its output by 43.74% at par with its input so as to perform efficiently.

In 2009/2010, the average efficient score is increased to 0.9001. Three banks NICBL, LUMBINI, and NBBL are found to be efficient bank with score 1.while 9 Banks (including the efficient banks) are having the efficiency scores above the average efficiency score .This shows that performance is enhancing in the latter period.

According to Appendix 2.2, the average efficiency (via operation approach) of Commercial Banks in Nepal during 2003/04 to 2009/10 ranges from 0.5070 to 0.8670, which is considered to be less unstable, comparing to the above case.

In 2003/04, the average efficiency is 0.8607.Two banks NABIL and NBBL are considered to be efficient with the efficiency scores of 1 implying that they had produced their output on the efficient frontier in this fiscal year. In this particular fiscal year only five banks are found to be performing below the average level. The least performing bank is RBB with efficiency score 0.6206 implying that the bank must increase its output by 37.94% to prove as efficient bank.

In 2004/05, the average efficiency score of Nepali Commercial banks unexpectedly decreases to 0.5070.Two Commercial banks RBB ,and NABIL are found to be efficient with score 1.Ten banks are found to be below the average efficiency score. KUMARI is the least efficient bank in 2004/05 with the efficiency score 0.2108 implying that the bank must increase its output by 78.92% as the same amount as input so as to be efficient bank.

In 2005/06, the average efficiency score increases to 0.7933. Two Banks NBL and NABIL are found to be at the efficient frontiers with efficiency Score 1. Only four banks RBB, SCBNL, NSBI, NI & CBL are performing fairly close to the most efficient banks. The surprising result is that the least performing bank in 2003/04 is found to be the efficient bank in this particular year. Hence, It seems that the banking performance is so volatile.

In 2006/07, the average efficiency score is increased to 0.8670.In this Fiscal year three Banks NABIL, SCBNL, and NBBL have become efficient banks. This Fiscal year is much debatable as the efficiency scores of the banks via intermediation approach is found to be the least one.

If we observe the efficiency scores for the rest of the three years we do not find that much impressive as the fluctuation takes place like the pattern followed over the period of time. Simulating the average efficiency scores we obtain the following results

<i>Fiscal Year</i>	<i>Simulated Efficiency Scores of Banks VIA</i>	
	<i>Operation Approach</i>	<i>Intermediation Approach</i>
2010-11	0.727059	0.784239
2011-12	0.73272	0.78643
2012-13	0.733493	0.789897

Conclusion

General average efficiency score from intermediation approach is 0.8058 while that of the score from operation approach is 0.7677.This concludes that commercial banks under study are concentrating in translating the deposits into credit , loans and advance and less concerned ingenerating the revenue as per the cost involved. This could be because of the influx of the financial institutions and competing with each other.

The simulated efficiency scores are also found to be following the same pattern . This indicates that even in future as well the commercial banks will be following the same pattern of the

operation. To improve this situation we need to focus in employing quality management practices.

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Appendix 1

S.N.	Bank	S.N.	Bank
1	Nepal Bank Limited (NBL)	2.	Rastriya Banijya Bank (RBB)
3	NABIL Bank Ltd.(NABIL)	4	Nepal Investment Bank Ltd.(NIBL)
5	Standard Chartered Bank Nepal Ltd.(SCBNL)	6	Himalayan Bank Ltd.(HBL)
7	Nepal SBI Bank Ltd.	8	Nepal Bangladesh Bank Ltd.
9	Everest Bank Ltd.(EBL)	10	Bank Of Kathamndu (BOK)
11	Nepal Credit and Commerce bank Ltd. (NC & CBL)	12	Nepal Industrial and Commercial Bank Ltd.(NI & CBL)
13	Lumbini Bank Ltd.(LUMBINI)	14	Machhapuchre Bank Ltd.(MBL)
15	Kumari bank Ltd.(Kumari)	16	Laxmi Bank Limited (LAXMI)
17	Siddhartha Bank		

Appendix 2

2.1. Relative Efficiency of Commercial Banks via Intermediation Approach from FY 2003/04 to 2009/10

Bank	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	Average
NBL	0.6158	0.7464	0.4454	0.7507	0.4788	0.5626	0.6675	0.6096
RBB	0.6629	1.0000	0.8265	0.4836	0.7184	0.7091	0.6756	0.7251
NABIL	0.8652	1.0000	1.0000	0.7275	1.0000	1.0000	0.9518	0.9349
NIBL	0.8018	0.9027	0.9541	0.5255	0.9792	0.9288	0.9292	0.8602

<i>Bank</i>	<i>2003/04</i>	<i>2004/05</i>	<i>2005/06</i>	<i>2006/07</i>	<i>2007/08</i>	<i>2008/09</i>	<i>2009/10</i>	<i>Average</i>
SCBNL	0.5208	0.9669	0.7177	1.0000	1.0000	1.0000	0.9906	0.8851
HBL	0.9295	1.0000	0.7799	0.7392	0.8470	0.9563	0.9364	0.8840
NSBI	0.9456	0.9818	1.0001	0.4355	0.9999	1.0000	0.9311	0.8991
NBBL	0.7619	0.6980	0.7021	0.2342	0.4742	0.7138	1.0000	0.6549
EBL	0.8323	0.2343	0.9716	0.5175	0.9753	0.9413	0.8486	0.7601
BOK	0.9103	0.9213	0.9278	0.4885	0.9910	0.9340	0.9369	0.8728
NC & CBL	0.7364	0.7158	0.8579	0.4217	0.6656	0.8500	0.8904	0.7340
NI & CBL	0.8899	0.8443	0.9064	0.3333	0.9027	0.9136	1.0000	0.8272
LUMBINI	0.7448	0.7201	0.8431	0.3081	0.7202	0.8419	1.0000	0.7397
MBL	1.0000	0.9074	0.8817	0.2974	0.7494	0.8333	0.8512	0.7886
KUMARI	0.9413	0.8400	0.7093	0.3473	0.8285	0.8172	0.8989	0.7689
LAXMI	0.9500	0.7753	0.9500	0.4030	0.8781	0.8997	0.9205	0.8252
SIDDHARTHA	1.0000	0.8794	1.0000	1.0003	0.9181	0.8261	0.8732	0.9282
Average	0.8299	0.8314	0.8514	0.5302	0.8310	0.8663	0.9001	

2.2. Relative Efficiency of Commercial Banks via Operation Approach from FY 2003/04 to 2009/10

<i>Bank</i>	<i>2003/04</i>	<i>2004/05</i>	<i>2005/06</i>	<i>2006/07</i>	<i>2007/08</i>	<i>2008/09</i>	<i>2009/10</i>	<i>Average</i>
NBL	0.6446	0.3182	1.0000	0.4677	1.0000	1.0000	1.0000	0.7758
RBB	0.6206	1.0000	0.9259	0.6505	0.9467	0.9582	1.0000	0.8717
NABIL	1.0000	1.0000	1.0000	1.0000	1.0000	0.7558	1.0000	0.9651
NIBL	0.8656	0.6556	0.7556	0.9432	0.8256	0.6035	0.8851	0.7906
SCBNL	0.7646	0.9497	0.8812	1.0000	1.0000	1.0000	0.8080	0.9148
HBL	0.9563	0.5195	0.6615	0.7991	0.7795	0.7399	0.6797	0.7336
NSBI	0.9419	0.4135	0.8041	0.961	0.7683	0.5467	0.6241	0.7228
NBBL	1.0000	0.4706	0.7861	1.0000	0.8335	1.0000	0.8916	0.8545
EBL	0.9816	0.5388	0.7848	0.9597	0.8378	0.6627	0.8135	0.7970
BOK	0.9487	0.6519	0.7819	0.9603	0.8177	0.7081	0.6663	0.7907
NC & CBL	0.8670	0.3326	0.7952	0.7514	0.7338	0.6644	0.8108	0.7079
NI & CBL	0.9633	0.3805	0.8324	0.9619	0.8909	0.5364	0.9563	0.7888
LUMBINI	0.9162	0.2576	0.5979	0.7706	0.8055	0.6711	0.8485	0.6953
MBL	0.9417	0.3689	0.7157	0.8517	0.7335	0.5470	0.6631	0.6888
KUMARI	0.8623	0.2108	0.7386	0.9270	0.7649	0.5264	0.7322	0.6803
LAXMI	0.6736	0.2774	0.6521	0.8073	0.7516	0.4917	0.8940	0.6497
SIDDHARTHA	0.6833	0.2742	0.7732	0.9274	0.8428	0.0498	0.8188	0.6242
Average	0.8607	0.5070	0.7933	0.8670	0.8431	0.6742	0.8289	