

# An Analysis of the Efficiency of the Mauritian Banking Sector Using the Data Envelopment Analysis (DEA)

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## Abstract

The purpose of this study is to analyse the efficiency of banks operating in the Mauritian economy through the Data Envelopment Analysis. The DEA methodology has been applied and scores were generated to assess the efficiency levels of Mauritian banks. The study concentrates on 10 sampled banks out of the 22 banks operating in the economy for the period 2011 to 2015.

## Keywords

Data Envelopment Analysis, Efficiency, Banking Sector

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## 1. Introduction

Efficiency is an important concept in any economy. Efficiency means using few inputs to produce more outputs. It likewise implies performing duties without committing errors. As quoted by J. R. D. Tata, "Productivity and efficiency can be achieved only step by step with sustained hard work, relentless attention to details and insistence on the highest standards of quality and performance." Mauritius is a middle-income country which has gained independence in 1968. In every business, efficiency is an important aspect which is why the Bank of Mauritius lays emphasis on Mauritian banks to be efficient and avoid wastage. Mauritius is a middle-income country which has gained independence in 1968. Throughout the years, the Mauritian banking system has evolved and is one of the pillars of the Mauritian economy. With the advent of technology and internet, people have been more exposed to diverse banking services. As such, banks have grown and became an integral part of the economy. In every business, efficiency is an important aspect which is why the Bank of Mauritius lays emphasis on Mauritian banks to be efficient and avoid wastage.

The motivation of our study is to test the proficiency of Mauritian banks for

the period 2011-2015 through the Data Envelopment Analysis (DEA) which is a popular methodology for testing efficiency for banks and other firms.

## 2. Review of Literature

Efficiency of the banking system is a standout amongst the most imperative issues in the financial market as efficiency of banks can influence the soundness of banking industry and thus the viability of whole monetary system [1]. [2] provided a survey that encapsulates the principle conclusions of 130 financial institutions' empirical studies in 21 countries employing different efficiency estimations methods. [3] was the first to enquire deeply in the issue to measure productivity and efficiency at micro level. He gave new perceptions on two issues namely:

- how to define efficiency and productivity; and
- how to calculate the benchmark technology and efficiency measures

As defined by [4] "*Data Envelopment Analysis* is a nonparametric, 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)". [5] utilised the DEA methodology to examine on the efficiency of European banks. They tried to find out whether the productive efficiency of banks has increased or not. [6] examined the productive efficiency of US commercial banks. Study revealed a correlation between efficiency and independent measures of performance, including secret appraisals made by bank inspectors [4] studied the efficiency of banks in Croatia. The main results demonstrated that foreign banks are, by and large, the most efficient. In addition, [5] [7] [8] [9] and [10] also studied the use of DEA in financial institution.

Sherman and Gold were the first ones to study banks through DEA in 1985. They found that 6 out of 14 deposit bank branches in the US attained full efficiency. The explanation behind the inefficiency of different branches were poor administration, branch size, number of staff and operational expenses. [11] applied the DEA methodology in Nigeria to measure the performance of banks and concluded that long existing banks were more efficient ones. In contrast, an indirect positive effect of banks age and overall efficiency was noted by (2010) [12] for Syrian banks. [13] in their study concluded that public banks were less efficient than private banks in Taiwan and efficient banks yielding a higher level of profits. In Croatia, [4] in Croatia and (2009) [14] in Romania through the DEA methodology showed that foreign owned banks attained a better performance in terms of efficiency compared to local banks. However, [15] found that in Malaysia during 2000 to 2006, local banks were mainly more efficient than foreign banks. [16] examined the impacts of geographic extension on bank proficiency in subtle elements unlike [17] who ignored the geographic aspect in their study in Canada.

[18] concluded that bank efficiency and effectiveness are not correlated while applying DEA in Pakistani banks. [19] evaluated the efficiency of 22 Vietnamese banks using the DEA with information from the year 2008. He found that the mean efficiency scores of the banks were close to the optimal one. [12] found an indirect positive effect of banks age and overall efficiency for banks in Syria

which is in contrast with other studies like [4] in Croatia.

### 3. Data and Methodology

This study attempts to analyse the efficiency of 10 sampled banks operating in the Mauritian economy through the Constant Returns Scale Data Envelopment Analysis model. For the purpose of this test, the DEAP Version 2.1 by Coelli T.J will be used. This list of Inputs and outputs are as follows:

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

The aim of DEA is to build up a non-parametric equation. DEA is introduced via a ratio form.

Assume there are  $K$  inputs and  $M$  outputs on each  $N$  firms or commonly referred as DMU's in DEA literature. For the  $i$ -th DMU, these are represented by vectors  $x_i$  and  $y_i$  respectively. For each DMU, we would like to obtain a measure of the ratio of all outputs and inputs which can be shown by the following notation:  $uy/vx_p$ , where  $u$  is an  $M \times 1$  vector of output weights and  $v$  is a  $K \times 1$  vector of input weights. Therefore, the mathematical programming problem is as follows:

$$\text{MAX}_{u,v} (uy_i/vx_i); \quad uy_i/vx_i \leq 1 \\ u, v \geq 0$$

The above formulae involve finding values for  $u$  and  $v$  however the issue with this formula is that it will yield a limitless number of solutions. To avoid this, we can impose a constraint  $vx_i = 1$  when finding values for  $uy_i$  and vice versa. When the constraint is finally applied, the equation will be:

$$\text{MAX}_{u,v} (uy_i); \quad vx_i = 1 \\ u, v \geq 0$$

## 4. Analysis

### 4.1. Results from DEAP 2.1

BANKS	2011	2012	2013	2014	2015	MEAN
Afrasia	0.397	0.479	0.814	1.000	0.508	0.6396
Bank One	0.387	0.503	0.469	0.45	0.425	0.4468
Banque des Mascareignes	0.448	0.426	0.425	0.589	0.529	0.4834
Barclays	0.352	0.434	0.448	0.499	0.557	0.4580
Baroda	1.000	1.000	1.000	1.000	1.000	1.0000
Deutsche Bank	0.457	0.524	0.708	0.539	0.37	0.5196
HSBC	1.000	1.000	1.000	1.000	1.000	1.0000
Investec	0.730	0.322	1.000	1.000	1.000	0.8104
MCB	0.438	0.635	0.749	0.625	0.530	0.5954
SBM	0.539	0.762	0.818	0.734	0.615	0.6936
MEAN SCORE	0.5748	0.6085	0.7431	0.7436	0.6534	

#### **4.2. 2011**

In 2011, the mean efficiency score of the sampled banks adds up to 57.48% which is slightly above average, that is, 50%. Out of the 10 banks, Baroda bank and HSBC were fully efficient as they scored 1. This implies that for these 2 commercial banks the proportion of outputs to inputs and usage of resources have been the most elevated in relation to the less productive ones. 80% of the banks underperformed and were inefficient in this sense as they scored less than 50% with exception of Investec and SBM who scored 73% and 53.9% respectively. Afrasia, Bank one and Barclays got less than 40% as scores. For these banks, we can see that similar output level can be obtained by diminishing the required input level.

#### **4.3. 2012**

In 2012, the average efficiency score of banks was 60.85% which indicates and increase in efficiency of resource utilisation by banks. HSBC and Baroda bank remained fully efficient in 2012 and maintained their good performance. Overall, most banks experienced a rise in their efficiency scores except for Banque des Mascareignes and Investec Bank who followed a downward trend between 2011 and 2012. The overall rise could be attributed to an increase in interest margin and non-interest margins from 2011 to 2012. Compared to the most efficient banks, the others continued to underperform in 2012 with Investec taking a huge drop 32% which clearly depicts that the bank has not been able to convert inputs to outputs as effective as HSBC and Baroda bank.

#### **4.4. 2013**

The efficiency score for banks in 2013 was 74.31% which represents a huge increase compared to 2011 and 2012. Again, Baroda bank and HSBC continued to excel in this domain by scoring a score of 1 while most banks continued to bolster their position in terms of efficiency in resource utilisation. The surprise came from Investec bank who out of nowhere became full efficient.

#### **4.5. 2014**

The average DEA score in 2014 remained more or less the same compared to 2013, that is, 74.36%. Bank of Baroda, Investec and HSBC continued their brilliant work by scoring maximum efficiency. Afrasia managed to score 1 in our tests. We could see this coming as they managed to score 81% the year before. Only Banque des Mascareignes and Barclays managed to improve while all the remaining banks experienced a fall in their efficiency score.

#### **4.6. 2015**

For the last year of our study, the overall efficiency of the sampled banks dropped to 65.34%. Baroda, Investec and HSBC continued with their good performance as they maintained their efficiency score of 1. Afrasia recorded a fall in its efficiency score from 1 in 2014 to 50.8%. The last year of study showed that

past performance may not always give the right trend and direction for the future. This applies for Afrasia bank who had a drop compared to the efficient units as the bank was not able to capitalise on its exceptional performance in 2014.

#### **4.7. Afrasia**

The trend for Afrasia bank has been an upward one except for the last year. In 2011, the bank scored 39.7% which is its lowest for the years between 2011 to 2015. In 2013, Afrasia bank made a heroic performance as the institution recorded a score of 81.4% which is nearly the double compared to 2012. This performance really lies in the way Afrasia bank has been able to manage its interest expenses and interest incomes.

#### **4.8. Banks One**

The average efficiency score for Bank one which is a foreign bank over the 5 years is 44.68%. The bank achieved its highest point in 2012 and then it followed a downward trend for the next three years. Overall the bank was not able to utilise its resources efficiently since the bank was not able to at least achieve more than 50% of efficiency during that period. Non-interest income even fell from Rs 286,234,000 (2012) to Rs 118,965,000 (2013) despite an increase in non-interest expense from Rs 380,916,000 to Rs 399,398,000 during 2012/2013. This shows that despite Bank one was being effective by investing in both interest and non-interest income, they were not able to attain efficiency. The performance compared to the leading banks in terms of efficiency of Bank one is rather poor.

#### **4.9. Banque Des Mascareignes**

Banque des Mascareignes's performance somewhat reflects that of Bank One. Prior to 2014 the bank had an efficiency score of less than 50% with 2012 and 2013, 42.6% and 42.5% respectively which are the lowest for the institution during the period 2011 to 2015. The reason is that compared to the most efficient banks, Banque des Mascareignes was unable to retrieve benefits as income from investing in interest and non-interest expenses. For the five years, non-interest income remained lower to non-interest expenses. The slight increase in 2014 and 2015 is explained by the fact that the bank reduced expenses on both interest and non-interest items and the respective incomes remained more or less unchanged.

#### **4.10. Barclays Bank**

Barclays bank has improved its efficiency over the time. The chart above shows that the bank's efficiency has increased over time as it recorded a yearly increase from 35.2% to 55.7% in 2015. Despite the fact that the bank underperformed in this segment, there is positive signs for the future. Opportunities for improvement were also found in Vietnamese banks by Dang-Thang (2010). Barclays spent heavily on interest expenses compared to other banks as in 2012 the figure

amounted to Rs 1,263,000,000 but gradually decreased to Rs 902,368,000 in 2015. This shows that being effective does not guarantee efficiency. However, the trend shows some positive signs for the future.

#### **4.11. Baroda Bank and HSBC**

Baroda bank (1962) had an exceptional performance for the five years as the bank was able to manage resources efficiently over the five years. Baroda is termed in our study as the best producer and is a benchmark for other banks. The bank's interest income over the years was higher to the interest expenses. Along with Bank of Baroda, HSBC, founded in 2006 also had an efficiency score of 1 throughout the five years. The bank performed well in both the interest and non-interest aspects as income was greater than expenses during the period. It is quite commendable with the fact that HSBC spent on average Rs 88,870,834 on interest and income on average amounted to Rs 1,555,405,834. This herculean performance is due to a good management of funds by managers. Both banks concentrated on being efficient in terms of deposits and lending.

#### **4.12. Investec Bank**

The performance of Investec Bank is an example of achieving targets with proper planning and decisions. In 2011, the bank scores 73% in efficiency but that figure dropped to 32% in 2012. The reason behind this drop is because during 2012 the efficient banks performed better than Investec. However, post 2012, Investec managed to reduce the level of interest expense but at the same time increasing interest income for 2013, 2014 and 2015. The bank was thus fully efficient for these periods. It is quite remarkable the way Investec became efficient over the years. During the last years of our study, Investec managed to use its resources effectively. Investec managed to be as efficiency as HSBC and Baroda banks who were still being efficient since 2011.

#### **4.13. MCB**

Mauritius Commercial Bank is the number one commercial bank of our economy and is also 2016 The Banker's Bank of the year for Mauritius. The performance of MCB in terms of efficiency is not that good compared to the efficient ones. In 2011, the bank scored 43.8% in efficiency and managed to improve this figure to 74.9% in 2013. MCB scored 62.5% and 53% for 2014 and 2015 respectively. The bank increased its interest expenses during the last two years but interest income rose less than proportionately and also as compared to the efficient banks, MCB was not utilising its resources efficiently. The case for MCB shows that despite being the best bank of Mauritius and also collecting award for best Mauritian bank in 2012, 2015 does not guarantee efficiency in operations.

#### **4.14. SBM**

The State Bank of Mauritius (1973) scored an average efficiency score of 69.63% which is around 70%. The lowest score was in 2011 while the highest score was

in 2013. This shows the reasons for the high and low figures for the bank. Interest income in 2011 was the lowest Rs 4,727,620,000 while the highest figure recorded Rs 9,333,865,000 was in 2013. This shows the reasons for the high and low figures for the bank. Prior to 2013, SBM had an increasing tendency but post 2013 the bank face a downward trend in terms of efficiency.

## 5. Conclusion

Mauritius is a reliable centre for banking services. Banks operate in a sane and dynamic environment along with laws and regulations that aims at the smooth running of the Mauritian Banking System. Mauritian banks need to concentrate more on being efficient rather than on being only effective and profitable. Moreover, they increase productivity of banks through enhanced technology and trainings. Blockchain may be a solution to be more efficient. To sum up, some banks have shown positive trends and we can be more optimistic about the future and hope that banks invest well in their interest inputs and achieve desired interest outputs.

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