EVALUATING THE RELATIVE EFFICIENCY OF BANKS IN MALAYSIA: A HYBRID DEA-AR/AHP APPROACH

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Keywords: Data Envelopment Analysis, Analytic Hierarchy Process, Assurance Region, Commercial Banks.

1. Introduction

One of the most broadly used non-parametric methods for calculating the effectiveness boundary is Data Envelopment Analysis (DEA), a mathematical optimization approach. In comparison to other institutions in the sector, DEA simply proves which ones are operating extra proficiently. Plus, DEA can highlight the poorly performing area that needs to be improved (Ar & Kurtaran, 2013). As a result, most financial institutions used this method to determine the relative efficiency which allows individual bank performance to be measured and compared to other banks.

However, there are several disadvantages when using DEA applications. Unrealistic weight and shortage discrimination power dispersion are two interrelated issues that have long been recognized (Bal et al., 2010). When the amount of DMUs is small in comparison to variables, this common DEA problem becomes even more complicated (Despotis, 2002). When a DMU has a zero or extreme value, it is frequently evaluated as productive. Thus, the unrealistic weight dispersion problem occurs. The shortage of discriminating power arises when the amount of DMUs under review is insufficient compared to the total number of variables. In other words, DEA generally evaluates many inputs and outputs as 1 which indicates that the unit is efficient. The aim of this study is to measure the efficiency of the 20 commercial banks in Malaysia by referring to the financial annual report from each bank from 2016 to 2020. This study uses secondary data which was obtained from Bursa Malaysia.

2. Methodology

Figure 1 shows the flowchart summarizing an execution of the DEA with Assurance Region (AR) along with the Analytic Hierarchy Process (AHP) method. The left side of

the flowchart depicts the general process of integrating the AR approach with the original DEA method, while the right side depicts the AHP procedure for determining the weight bounds to be incorporated into the AR weight restriction constraints. The flowchart comprises three stages.

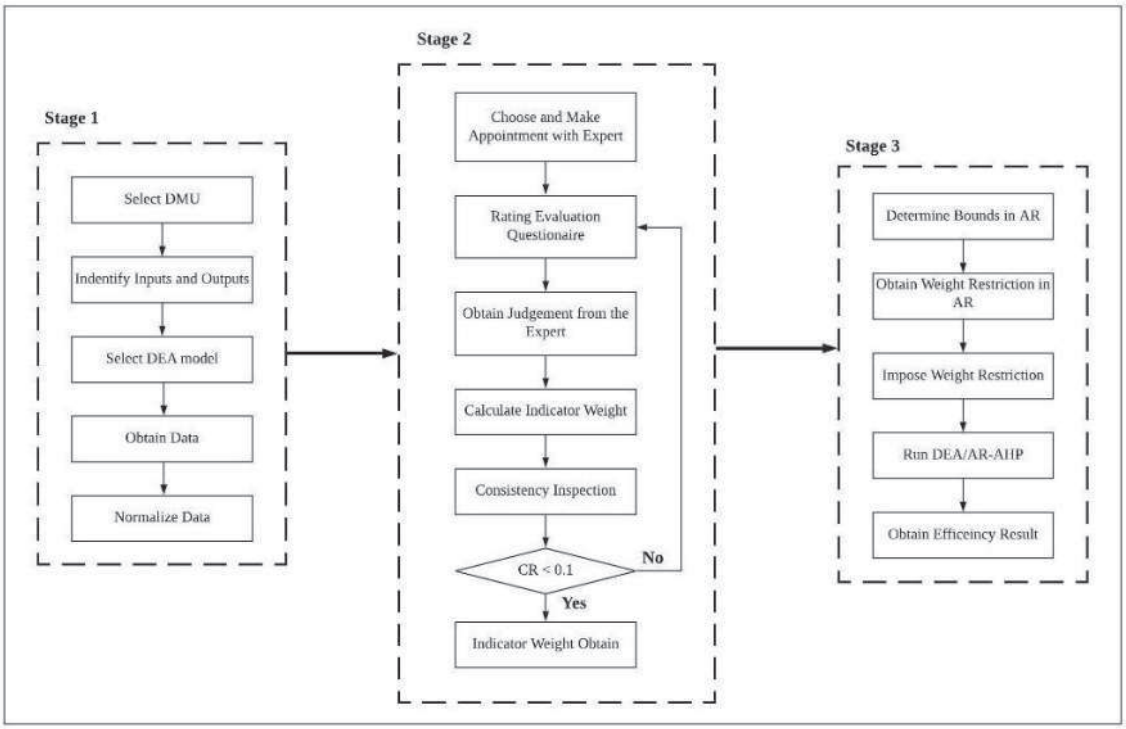

Figure 1: Research Flowchart

All of the procedures required to integrate the AR technique into DEA and have been performed after defining the lower and upper bounds of input and output. Thus, the formulation of hybrid method for DEA-AR/AHP is presented below:

$$Min\ E=\sum_{i=1}^{4} v_i x_{io} - u_o \tag{1}$$

Subject to:

$$\sum_{r=1}^{3} u_r y_{ro} - \sum_{i=1}^{4} v_i x_{io} - u_o \le 0;\ \ j = 1,2,...,20. \tag{2}$$

$$\sum_{r=1}^{3} u_r y_{ro} = 1, \tag{3}$$

$$0.5802 \le \frac{v_1}{v_2} \le 3.4470,\quad 0.1743 \le \frac{v_1}{v_3} \le 1.0000, \tag{4}$$

$$0.3843 \le \frac{v_1}{v_4} \le 2.3617,\quad 0.1743 \le \frac{v_2}{v_3} \le 0.5000, \tag{5}$$

$$0.3843 \leq \frac{v_2}{v_4} \leq 1.1809, \quad 1.3246 \leq \frac{v_3}{v_4} \leq 3.9319, \tag{6}$$

$$0.3214 \leq \frac{u_1}{u_2} \leq 1.5720, \quad 0.3333 \leq \frac{u_1}{u_3} \leq 4.7221, \tag{7}$$

$$0.7788 \leq \frac{u_2}{u_3} \leq 4.0000 \tag{8}$$

$$u_j v_j \geq 0, \quad u_o \text{ sign free} \tag{9}$$

where

x_{io} : the value of *i*th input for DMU_o

y_{io} : the value of *i*th output for DMU_o

v_i : weight for inputs

u_r : weight for outputs

3. Results

As indicated by Table 1, when standard DEA is used, many zero weights are assigned to the selected inputs and outputs. For example, CB8 has zero weights that are given to 5 variables. It designates that all 5 variables are taken no notice in the efficiency assessment. The efficiency score was obtained based on 1 input and 1 output only. Another example is CB9. The DMUs efficiency score is only based on 1 input and 1 output where the rest are equal to zero. Furthermore, CB14, CB14 and CB17 have zero weights that are given to 5 variables. Thus, the efficiency scores are only based on 1 input and 1 output. However, when applied to the DEA-AR/AHP method, all the zero weights are eliminated. It shows that the DEA-AR/AHP method has successfully reduced zero weights in input and output factors by incorporating value judgements. By using the DEA method, 17 banks were found efficient. However, when applying the DEA-AR/AHP model, only 11 banks were classified as efficient. Hence, it is proven that DEA-AR/AHP method has improved the discrimination power.

4. Conclusion

Efficiency is very important for DEA to improve in discrimination power and eliminate zero weight, therefore valid measurement can be found. However, it is not easy to measure the efficiency of the bank because it has many outputs and inputs. The main contribution of this study is to incorporate expert judgements for the efficiency of the bank. Using DEA method only in measuring the efficiency is insufficient because there are two major problems which are unrealistic weight and poor discrimination power.

Table 1: Weight Distribution of Input and Output Variables using DEA and DEA-AR/AHP Models for Year 2020

DMU	DEA-BCC Output Orientation Model								DEA-AR/AHP – BCC Output Orientation Model							
	Input Weight				Output Weight			Efficiency	Input Weight				Output Weight			Efficiency
	v_1	v_2	v_3	v_4	u_1	u_2	u_3		v_1	v_2	v_3	v_4	u_1	u_2	u_3	
CB1	0	0.3275	0.6725	0	0	1	0	100.00%	0.1749	0.1643	0.4325	0.2282	0.1861	0.6903	0.1236	95.31%
CB2	0.1185	0.0726	0.0415	0.7674	1	0	0	100.00%	0.3101	0.1136	0.2991	0.2773	0.2314	0.6534	0.1152	82.13%
CB3	0	0.3801	0	0.6199	0	1	0	57.29%	0.1726	0.2921	0.4602	0.0752	0.0550	0.5787	0.3663	29.71%
CB4	0.1960	0.1286	0.2018	0.4737	0.1384	0.8616	0	91.19%	0.3059	0.2104	0.2138	0.2700	0.2126	0.7233	0.064	75.24%
CB5	0	1	0	0	0.8676	0	0.1324	100.00%	0.2223	0.1522	0.4314	0.1941	0.5603	0.3318	0.1078	100.00%
CB6	0	0	0	1	0	0.6957	0.3043	100.00%	0.2308	0.1511	0.4353	0.1828	0.1320	0.5482	0.3199	100.00%
CB7	0.7887	0.2113	0	0	0.3331	0	0.6669	100.00%	0.2710	0.1662	0.3789	0.1839	0.4371	0.2709	0.2921	92.69%
CB8	1	0	0	0	0	0	1	100.00%	0.2906	0.1333	0.4602	0.1159	0.1276	0.3196	0.5528	100.00%
CB9	1	0	0	0	1	0	0	100.00%	0.2049	0.174	0.4211	0.200	0.6047	0.3434	0.0519	100.00%
CB10	0.3231	0.6769	0	0	0	0.2284	0.7716	100.00%	0.1235	0.2121	0.4544	0.2100	0.1744	0.6527	0.1729	100.00%
CB11	0	0.2929	0.5540	0.1531	0	0.6320	0.3680	100.00%	0.1884	0.2849	0.4032	0.1235	0.0789	0.4301	0.4910	95.15%
CB12	0	1	0	0	0.3113	0	0.6887	100.00%	0.2339	0.1980	0.4257	0.1424	0.2570	0.1749	0.5681	97.33%
CB13	0.1011	0.8989	0	0	0.3887	0.3883	0.2230	100.00%	0.1071	0.1704	0.4899	0.2325	0.4523	0.4166	0.1310	100.00%
CB14	0	0	0	1	1	0	0	100.00%	0.2415	0.1478	0.4379	0.1728	0.5105	0.4275	0.0620	74.83%
CB15	0.1157	0.8843	0	0	0.8592	0.1178	0.0230	100.00%	0.1444	0.7173	0.0773	0.061	0.0568	0.7505	0.1927	100.00%
CB16	0	0	0	1	0.2247	0	0.7753	100.00%	0.4328	0.1636	0.3230	0.0807	0.0522	0.3366	0.6112	100.00%
CB17	0	0	1	0	0	0	1	100.00%	0.1699	0.2036	0.5327	0.0938	0.0030	0.0786	0.9185	100.00%
CB18	0	0.1879	0.8121	0	0.8702	0	0.1298	100.00%	0.1227	0.1942	0.3391	0.3440	0.5957	0.2874	0.1168	100.00%
CB19	0	0	1	0	0.9930	0.0070	0	100.00%	0.1576	0.6516	0.0550	0.1358	0.1287	0.8699	0.0015	100.00%
CB20	0	0.4051	0	0.5949	0.5424	0.4576	0	99.61%	0.0957	0.1125	0.5319	0.2599	0.5247	0.4411	0.0342	88.69%

Interestingly, the result found by using the hybrid DEA-AR/AHP method, all aforementioned problems were solved. The zero weights were eliminated whereby, all the variables are taken into account which leads to more realistic results. Besides, by applying hybrid DEA-AR/AHP method has improved the discrimination power in DEA where a smaller number of DMU are found efficient.

From the results, we found that Deposits from Customer and Interest Income are the important input and output that are chosen from the experts respectively. Thus, the efficiency of the banks can be measured efficiently. 7 banks were found efficient for both models used for all five consecutive years and they are United Overseas Bank (Malaysia) Berhad, CIMB Bank Berhad, India International Bank (Malaysia) Berhad Industrial and Commercial, Citibank Berhad, Deutsche Bank (Malaysia) Berhad. Mizuho Bank (Malaysia) Berhad and Public Bank Berhad. These banks have utilized their resources efficiently to produce outputs. These banks could be considered as examples of good performance banks. To become efficient, all inefficient banks should learn strategies and practices adopted by efficient banks in transforming their inputs to outputs.

5. References

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