Performance Analysis of Public Banks in Turkey

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Abstract

As financial institutions bridging investors and depositors, banks play an important role in the national economy. Efficient operation of the banking sector is crucial for the strategic objectives of banks as well as investors and the national economy. In other words, if the banking system does not work properly, national economy is badly affected. Therefore, performance measurement in the banking sector is an important issue that should be taken seriously.

In this study, the performance of public banks in Turkey, from 2005 to 2014, was measured by an integrated model combining the Analytic Hierarchy Process (AHP) and the Operational Competitiveness Rating method (OCRA). The input and output weights were calculated by AHP while efficiency of the banks was measured by OCRA. The study reveals that Vakifbank showed the highest performance until 2012, but Ziraat Bank took the lead in 2012.

Keywords:

Bank Performance, Analytic Hierarchy Process, Competitiveness Operational Rating, Turkey

JEL Classification: C6, C44, C67, G21

1. Introduction

Commercial banks are institutions that play a central role in the financial system of a country. Banking sector should keep working effectively, for this is vital for the national economy. It is because banks are financial agents that help use savings properly and undertake brokerage activities in a sector where resources are limited. Severe competition in the banking sector makes it essential for banks to use their deposits effectively. Therefore, they need to measure their efficiency at regular intervals and take necessary precautions to maximize their performance. Financial institutions with higher performance become more robust against financial crises caused by domestic or external influences. So they can evade a financial crisis with the least cost.

Measurement systems used in the performance and efficiency analysis in the banking sector can be divided into three basic groups structurally: *ratio analyses, parametric and non-parametric methods*. All the methods within these groups have their own advantages and disadvantages (İnan, 2000: 83). Parametric and non-parametric methods are called frontier analysis methods, which differ from each other depending on whether the technical or economic efficiency is measured (Ekren and Emirali, 2002: 8).

Measuring the efficiency and performance of banks involves a large number of inputs and outputs. However, there is no agreement on what these inputs and outputs are. Determined in the light of literature review, *deposits, interest expenses and other expenses* were used as the inputs in this study while *loans, interest incomes and other incomes* were used as the outputs. Obtained from the 2015 resources of the Union of Turkish Banks (www.tbb.org.tr), the data of 2005-2014 of 3 public banks in Turkey were used to present a model to measure the efficiency of the banks. It is an integrated model combining the Analytic Hierarchy Process (AHP) and the Competitiveness Operational Rating (OCRA). The input and output weights were determined by AHP while the efficiency of the three banks between 2005 and 2014 was measured by OCRA.

The second part of the study focuses on the literature review. The third part deals with theoretical structure of AHP and OCRA methods. The application of the model was realized in the fourth part. In the final part, the results were analyzed and recommendations were made for future researchers.

2. Literature Review

The literature review showed that the Data Envelopment Analysis (DEA) is the most used method in the measurement of the performance and efficiency of the banking sector. Fethi and Pasiouras (2010) reviewed a total of 196 studies on bank efficiency and performance, and found that nearly 151 of them used DEA and related techniques. For instance, Zaim (1995) studied the effect of the financial liberalization policies on the efficiency of the banks after 1980. Yıldırım (2002) investigated the efficiency of the Turkish banking sector between 1988 and 1999 according to the macroeconomic conditions; Günay and Tektaş (2006) investigated the performance of the Turkish banks during the pre-crisis and crisis periods between 1990 and 2001. Deniz et al. (2000), Işık et al. (2003), Demir and Astarcıoğlu (2007), and Erdem and Erdem (2008) all studied by using DEA to measure the efficiency of Turkish banks. Among other studies carried out through DEA are Bank of Taiwan in 2000 by Kao and Liu (2004); banks of 11 candidate countries for EU between 2001-2003 by Stavarek (2006); Greek commercial banks from 2000 to 2004 by Pasiouras (2008); banking system of seven countries in Central

and Eastern Europe between 2004-2008 by Andries (2011); the Chinese banks in 2007-2008 by Avkiran (2011); the banks of Nepal between 2007-2011 by Thagunn and Poudel (2012), and the efficiency of the Tunisian banks between 1990-2009 by Ayadi and Ellouze (2013). In addition, many other DEA based studies on the measurement and evaluation of bank performances can be found in the literature, such as Bauer et al. (1998), Camanho and Dyson (2006), and Portela and Thanassoulis (2007).
Different methods for measuring bank performances, separately or integrally used, can be found in the literature. For example, Mareschal and Brans (1991), Mareschal and Mertens (1992), Zopounidis and Doumpos (2010) used the PROMETHEE method. Home (2006) employed Gray Relation Analysis, Garcia et al. (2010) used goal programming, and Phuong Ta and Yin Har (2000) used the AHP.
There are also many studies based on the fuzzy approximation methods to measure financial parameters in the banking sector. For example, Weifeng and Huihuan (2008) as well as Ishizaka and Nguyen (2013) recommended the fuzzy AHP. Seçme et al. (2009), Mahrooz et al. (2013), Akkoç and Vatansever (2013) used the fuzzy AHP and fuzzy TOPSIS. Mandic et al. (2014) applied the fuzzy AHP and TOPSIS method to measure the performance of the banking sector in Serbia.
Among those who employed statistical methods are Ibrahim (2014) in the comparative study of Dubai Commercial Bank and Abu Dhabi National Bank; Abata (2014) in the performance measurement of the commercial banks in Nigeria; Kaya and Pastory (2013) in the performance analysis of 11 banks in Tanzania, and Kiptui (2014) in the performance measurement of the commercial banks in Kenya.

3. METHODOLOGY

3.1. Analytic Hierarchy Process

AHP is a Multiple Criteria Decision Making (MCDM) method developed by Saaty (1980), which is widely used to solve problems in different areas. AHP is an easy method whereby the decision alternatives, determined according to the factors set by the decision maker, are put in order of importance. AHP makes it possible to evaluate qualitative and quantitative criteria, and also it helps to add human judgments in the decision-making process. (Saaty, 1980)

The steps of the AHP process are described below (Saaty, 1994):
Step 1: Establishment of the Hierarchical Structure.
AHP defines the problem in a hierarchical structure consisting of minimum one factor in each level. It is based on the assumption that a factor below has an impact on another one above. Therefore, the aim is to determine by making pairwise comparisons to what extent a lower factor affects a higher one. AHP hierarchy should be established in at least three levels. The upper level includes the goal while the bottom one consists of the decision alternatives.
Step 2: Creating the Pairwise Comparison Matrices
While creating pairwise comparison matrices, factors in a level in the hierarchical structure are compared with the others in the upper level in pairs. The comparison of the alternatives is made separately to each factor, and as a result, there are as many pairwise comparison matrices as the number of factors. The comparison scale proposed by Saaty, shown in Table 1, is used in the creation of these matrices (Saaty, 2007). Such intermediate values as 2, 4, 6, and 8 can also be used if necessary.
The comparison of each element is realized in the corresponding level and the calibration of them is done on the numerical scale. This requires n(n-1)/2 comparisons, where n is the number of elements with the considerations that diagonal elements are equal or '1' and the other elements will simply be the reciprocals of the earlier comparisons (Saaty, 1999). These comparison matrices are size n × n as formulated in Equation (1).

Table 1: Comparison Scale

Intensity of Importance	*Definition*	*Explanation*
1	Equal Importance	Two activities contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favor one activity over another
5	Strong importance	Experience and judgment strongly favor one activity over another
7	Very strong or demonstrated importance	An activity is favored very strongly over another; its dominance demonstrated in practice
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation

$$A = \begin{bmatrix} 1 & a_{12} & \dots & a_{1n} \\ a_{21} & 1 & \dots & a_{21} \\ \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots \\ \dots & \dots & \dots & \dots \\ a_{n1} & a_{n2} & \dots & 1 \end{bmatrix}, \qquad a_{ji} = \frac{1}{a_{ij}}, \qquad i, j = 1, \dots, n \tag{1}$$

Step 3: Creating the Normalized Decision Matrix.
The pairwise comparison matrix formulated in Equation (1) is normalized by using Equation (2)

$$a'_{ij} = \frac{a_{ij}}{\sum_{i=1}^{n} a_{ij}} \tag{2}$$

Step 4: Calculating the Factor Weights
Factor weights are calculated by applying Equation (3) to the elements of the matrix normalized by Equation (2)

$$w_i = \left(\frac{1}{n}\right)\sum_{i=1}^{n} a'_{ij}, \qquad i, j = 1, 2, \dots, n \tag{3}$$

Step 5: Calculating Consistency Index and Consistency Ratio
The consistency of the matrix of the pairwise comparisons should be checked. If the *Consistency Ratio* (CR) is over 0.10, it means that the matrix is inconsistent. When this ratio is exceeded, the pairwise comparison matrix should be revised with different values (Saaty, 1980). To determine if the matrix is consistent, the *Consistency Index* (CI) coefficient must be calculated. CI is calculated by using Equation (5) (Saaty, 1994). In order to calculate CI, the $\boldsymbol{\lambda_{max}}$, known as eigenvalue, should be calculated first. The eigenvalue is calculated by Equation (4). In addition, in order to evaluate the consistency, the *Random Index* (RI) value must be found. RI value corresponding to the size of each matrix is given in Table 2. After the CI and RI are determined, CR is calculated according to the Equation (6).

Table 2: Random Index Values

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14
RI	0,00	0,00	0,58	0,90	1,12	1,24	1,32	1,41	1,45	1,49	1,51	1,53	1,56	1,57

$$\lambda_{max} = \frac{1}{n} \cdot \sum_{i=1}^{n} \left[\frac{\sum_{j=1}^{n} a_{ij} \cdot w_j}{w_i}\right] \tag{4}$$

$$TI = \frac{\lambda_{max} - n}{n - 1} \tag{5}$$

$$TO = \frac{TI}{RI} \tag{6}$$

3.2. OCRA
OCRA is a simple and convenient method developed by Parkan (1994) to solve performance and efficiency analysis problems. OCRA is used in the measurement of the relative efficiency of the *Product Units* (PU) producing similar outputs using similar inputs. OCRA has been implemented in various areas successfully, such as investment banking, performance measurement of service buildings of public institutions, industrial enterprises, hotels and food production facilities (Peters and Zelewski, 2010).
In OCRA, input and output values should be different than zero to avoid zero division error in the normalization process. There is no way in OCRA to determine the input and output weights, called *Calibration Constants* in literature. The input and output weights can be calculated by simple scoring techniques such as cost-benefit analysis or by detailed evaluation methods such as AHP. It is possible to specify the input and output weights by using a scale in benefit-cost analysis. For example, in a scale going from 1 to 5; 5 shows the highest weight while1 symbolizes the lowest weight.
The sum of $\boldsymbol{a_m}$and $\boldsymbol{b_h}$values denoting the input and output weights should be 1 (Parkan, 2003). This is shown in Equation (7). The sum of the input and output weights may not be 1 depending on the method used. In this case, the normalized weight values are calculated by dividing the weight value of each factor, which is not normalized, by the total factor weight value.

$$\sum_{m=1}^{M} a_m + \sum_{h=1}^{H} b_h = 1 \tag{7}$$

OCRA is a six-step process (Parkan and Wu, 2000; Peters and Zelewski, 2010):
Step 1: Calculation of the Unscaled Input Index
By taking the inputs into account, the unscaled Input Index, $\mathbf{i^k}$, is calculated for each PU by using the Equation (8).

$$i^k = \sum_{m=1}^{M} a_m \frac{\max_{n=1,\dots,K}(X_m^n) - X_m^k}{\min_{n=1,\dots,K}(X_m^n)}, \qquad \forall n = 1, \dots, K;\ X_m^n > 0;\ \forall k = 1, \dots, K \tag{8}$$

Step 2: Calculation of the Unscaled Output Index
Taking into account the outputs, unscaled output index, $\mathbf{o^k}$, is calculated for each PU, using the Equation (9).

$$o^k = \sum_{h=1}^{H} b_h \frac{Y_h^k - \min_{n=1,\dots,K} Y_h^n}{\min_{n=1,\dots,K} Y_H^n}, \qquad \forall n = 1, \dots, K;\ Y_h^n > 0;\ \forall k = 1, \dots, K \tag{9}$$

Step 3: Scaling Input Indices
The scaling is done by subtracting the minimum value of the input index set from ***kth*** input index value of each PU by using the Equation (10).

$$I^k = i^k - \min_{n=1,\dots,K} i^n, \qquad \forall k = 1, \dots, K \tag{10}$$

Step 4: Scaling Output Index
The scaling is done by subtracting the minimum value of the index set from ***kth*** output index value of each PU by using the Equation (11).

$$O^k = o^k - \min_{n=1,\dots,K} o^n, \qquad \forall k = 1, \dots, K \tag{11}$$

Step 5: Calculation of the Unscaled Efficiency Index
The unscaled efficiency index is calculated by adding the scaled input index value and output index value of each PU using the Equation (12).

$$e^k = I^k + O^k, \qquad \forall k = 1, \dots, K \tag{12}$$

Step 6: Calculation of the Scaled Efficiency Index
The scaled efficiency index is calculated by subtracting the smallest element in the unscaled efficiency index from each of the elements in the set using the Equation (13).

$$E^k = I^k + O^k - \min_{n=1,\dots,K}(I^n + O^n), \qquad \forall k = 1, \dots, K \tag{13}$$

3.3. Flow Diagram of the Model

The data used to measure the efficiency of the public banks from 2005 to 2014 was obtained from the books of the relevant years, titled "Our Banks", published by the Union of Turkish Banks (UTB) (Table 3). The literature review resulted in 2 inputs and 2 outputs: *Deposits and interest expenses and other expenses* as inputs and, *loans and interest incomes and other incomes* as outputs.
OCRA has no application for determining the input and output weights. The input and output weights were calculated by AHP. The performances of the banks for each year were determined by OCRA method. The flow chart of the model is shown in Figure 1 below.

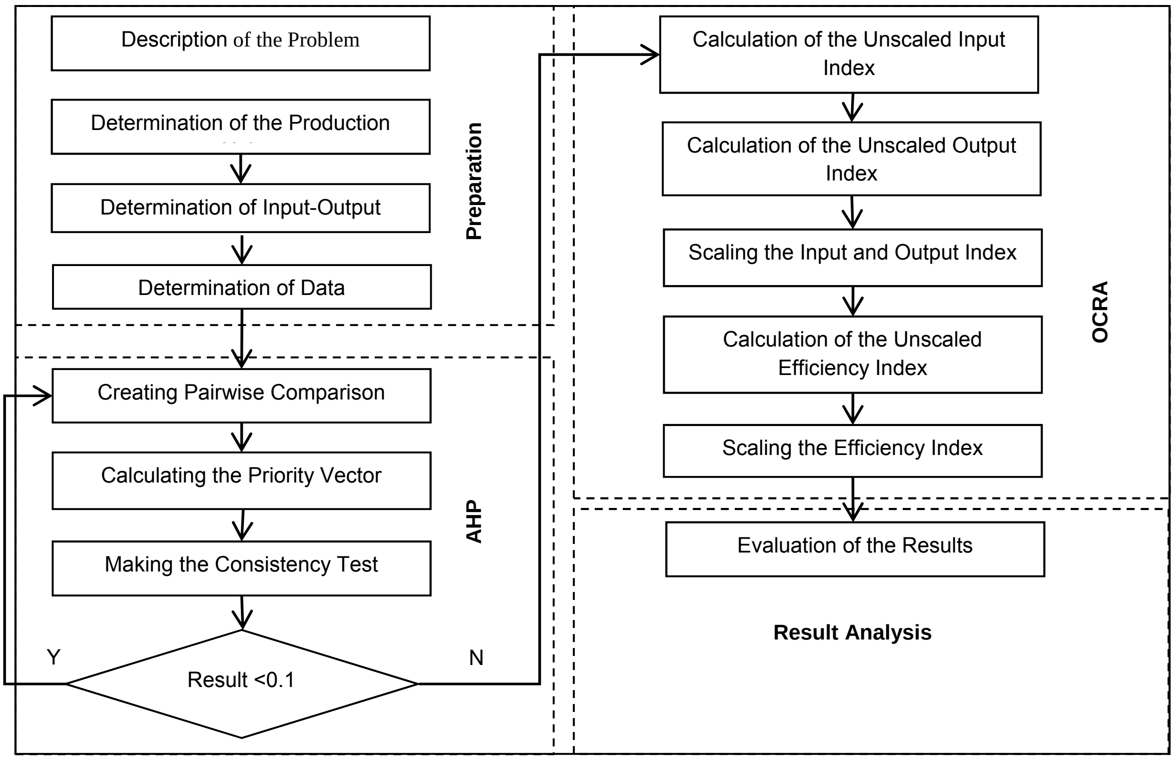

Figure 1: Flow Diagram

4. Results And Discussion

The data of all the three banks related to the years 2005-2014 was obtained from the books published by the Union of Turkish Banks (Table 3).

Table 3: Data of Banks

Name of Bank		Ziraat Bank (ZB)									
Year		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
PU (k)		1	2	3	4	5	6	7	8	9	10
Inputs	*Deposits*	51.778	59.653	68.250	83.883	98.529	125.796	113.067	118.966	141.735	153.255
	Interest expenses and other expenses	5.066	6.034	7.528	9.266	8.134	7.036	8.465	7.910	6.631	9.558
Outputs	*Loans*	13.425	17.371	21.604	30.836	36.729	57.443	71.430	71.426	111.048	141.915
	Interest incomes and other incomes	8.956	10.317	12.096	14.304	15.016	13.913	14.736	16.090	16.698	20.345
Name of Bank		**Halkbank (HB)**									
Year		**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
PU (k)		11	12	13	14	15	16	17	18	19	20
Inputs	*Deposits*	20.898	27.188	30.841	40.271	43.950	54.782	66.247	79.974	100.756	103.708
	Interest expenses and other expenses	2.793	3.195	3.956	4.667	3.708	3.160	3.805	4.515	4.376	6.340
Outputs	*Loans*	6.219	11.646	18.121	25.836	34.458	44.296	56.216	65.894	84.848	101.677
	Interest incomes and other incomes	4.142	5.258	6.475	7.565	7.550	7.508	8.650	10.273	11.000	13.159
Name of Bank		**Vakifbank (VB)**									
Year		**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
PU (k)		21	22	23	24	25	26	27	28	29	30
Inputs	*Deposits*	22.946	24.842	28.863	37.120	44.652	47.701	60.939	67.242	81.533	91.757
	Interest expenses and other expenses	2.273	2.824	3.677	4.439	3.326	3.153	3.607	4.672	4.431	6.722
Outputs	*Loans*	11.905	18.043	23.470	30.502	34.573	44.861	57.309	68.133	86.752	104.584
	Interest incomes and other incomes	4.017	5.057	6.104	7.218	7.204	6.962	7.990	9.887	10.670	13.495

The input and output weights were determined by means of AHP after the creation of pairwise comparison matrices. Then the matrix was normalized and subsequently, the factor weights, called the *Priority Vector* (PV), were calculated by means of the Equations (2) and (3). Table 4 shows the pairwise comparison matrix, and PV.

Table 4: Pairwise Comparison Matrix and Priority Vector

	Deposits	*Interest expenses and other expenses*	*Loans*	*Interest incomes and other incomes*	*PV*
Deposits	1,000	7,000	1,000	7,000	0,451
Interest expenses and other expenses	0,143	1,000	0,200	1,000	0,071
Loans	1,000	5,000	1,000	7,000	0,415
Interest incomes and other incomes	0,143	1,000	0,143	1,000	0,065

After the input and output weights were determined, the unscaled input index was calculated. The unscaled input index, shown in table 5, was formed by the Equation (8). The input indices were calculated for all PUs.

Table 5: Unscaled Input Index

PU (k)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
ZB	2,3303	2,1301	1,8979	1,5063	1,2255	0,6714	0,9014	0,7915	0,3400	0,0000
PU (k)	11	12	13	14	15	16	17	18	19	20
HB	3,0678	2,9194	2,8168	2,5911	2,5417	2,3250	2,0574	1,7390	1,2949	1,1698
PU (k)	21	22	23	24	25	26	27	28	29	30
VB	3,0398	2,982	2,868	2,666	2,538	2,4781	2,1782	2,0089	1,708	1,4158

Similarly, the unscaled output index was calculated using the Equation (9). Table 6 shows the unscaled output index for all the PUs.

Table 6: Unscaled Output Index

PU (k)	1	2	3	4	5	6	7	8	9	10
ZB	0,5609	0,8462	1,1575	1,8093	2,2141	3,5786	4,5254	4,5470	7,2010	9,3200
PU (k)	11	12	13	14	15	16	17	18	19	20
HB	0,0020	0,3823	0,8341	1,3666	1,9417	2,5976	3,4116	4,0837	5,3604	6,5184
PU (k)	21	22	23	24	25	26	27	28	29	30
VB	0,3266	0,7161	1,0650	1,5085	1,7418	2,3240	3,0755	3,7646	4,8618	5,9864

In the next step, the Equation (10) was used to do the scaling. Thus, the PU with the lowest value was given 0. The Scaled Input Index is shown in Table 7.

Table 7: Scaled Input Index

PU (k)	1	2	3	4	5	6	7	8	9	10
ZB	2,3303	2,1301	1,8979	1,5063	1,2255	0,6714	0,9014	0,7915	0,3400	0,0000
PU (k)	11	12	13	14	15	16	17	18	19	20
HB	3,0678	2,9194	2,8168	2,5911	2,5417	2,3250	2,0574	1,7390	1,2949	1,1698
PU (k)	21	22	23	24	25	26	27	28	29	30
VB	3,0398	2,9817	2,8682	2,6662	2,5385	2,4781	2,1782	2,0089	1,7080	1,4158

Similarly, the output index values of the PUs were also scaled. Table 8 shows the scaled output index.
After creating the scaled index for the inputs and outputs, the *Unscaled Efficiency Index* (UEI) was formed by using the Equation (12). Table 9 shows the UEI for the PUs.
Finally, by subtracting the smallest element in the UEI from each of the elements in the set using the Equation (13), the scaled efficiency index (SEI) was calculated. Table 10 gives the scaled efficiency index for the PUs.

Table 8: Scaled Output Index

PU (k)	1	2	3	4	5	6	7	8	9	10
ZB	0,5588	0,8442	1,1555	1,8073	2,2121	3,5766	4,5233	4,5450	7,1990	9,3179
PU (k)	11	12	13	14	15	16	17	18	19	20
HB	0,0000	0,3803	0,8321	1,3646	1,9397	2,5956	3,4095	4,0817	5,3583	6,5164
PU (k)	21	22	23	24	25	26	27	28	29	30
VB	0,3775	0,8039	1,1830	1,6703	1,9418	2,6244	3,4718	4,2248	5,4801	6,7158

Table 9: Unscaled Efficiency Index

KVB (k)	1	2	3	4	5	6	7	8	9	10
ZB	2,8892	2,9743	3,0534	3,3135	3,4376	4,2480	5,4248	5,3365	7,5390	9,3179
KVB (k)	11	12	13	14	15	16	17	18	19	20
HB	3,0678	3,2997	3,6489	3,9557	4,4814	4,9206	5,4670	5,8207	6,6532	7,6862
KVB (k)	21	22	23	24	25	26	27	28	29	30
VB	3,4173	3,7856	4,0513	4,3366	4,4802	5,1025	5,6500	6,2337	7,1881	8,1316

Table 10: Scaled Efficiency Index

KVB (k)	1	2	3	4	5	6	7	8	9	10
ZB	0,0000	0,0852	0,1642	0,4244	0,5485	1,3588	2,5356	2,4473	4,6499	6,4288
KVB (k)	11	12	13	14	15	16	17	18	19	20
HB	0,1786	0,4105	0,7597	1,0665	1,5922	2,0314	2,5778	2,9315	3,7640	4,7970
KVB (k)	21	22	23	24	25	26	27	28	29	30
VB	0,5281	0,8964	1,1621	1,4474	1,5911	2,2133	2,7608	3,3446	4,2989	5,2424

The AHP-OCRA based study with public banks demonstrated that VB had showed the best performance till 2012. It was found that starting from 2012, ZB started operating with higher efficiency (Figure 2).

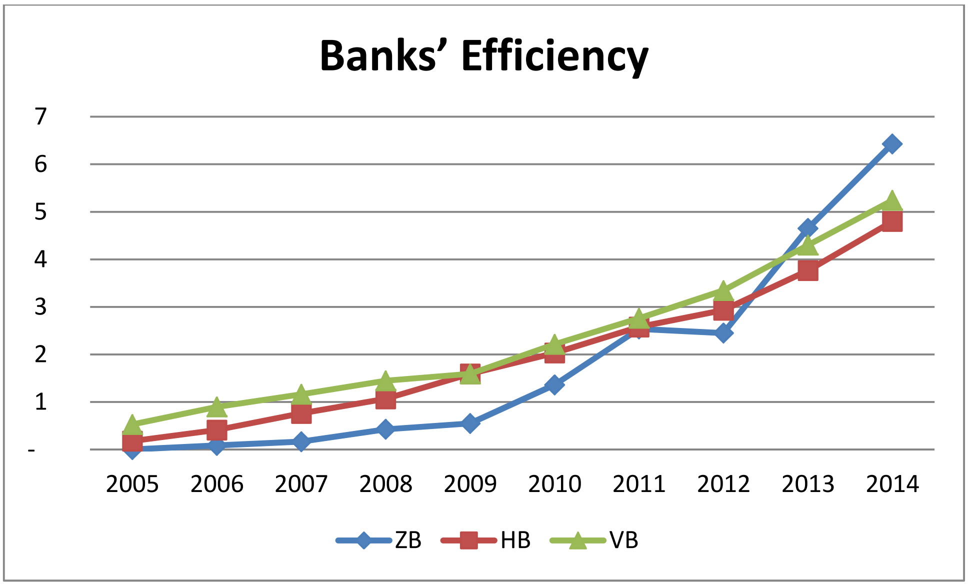

Figure 2: Banks' Efficiency

5. Conclusion And Recommendations

The evaluation of the inputs-outputs using AHP showed that the *Deposits* was found to be the highest weight factor with 45.1%. The *loans* was the second most important factor after the *deposits* with 41.5%. The *Interest and non-interest expenses*, and *Interest incomes and other incomes* were found to be the least important inputs and outputs.

The AHP-OCRA based study showed that VB had the highest efficiency until 2012. Starting from 2013, ZB was found to be showing the best performance. Between 2005 and 2012, the 1st place in ranking was occupied by VB. HB was the 2nd, and ZB was the 3rd. In 2012, HB was the least efficient bank. The efficiency ranking as from 2013 showed that the 1st place was held by ZB, the 2nd by VB, and the 3rd by HB. The study also showed that starting from 2012, ZB increasingly showed a serious efficiency, and became the most efficient bank in 2013 although it was the most inefficient bank until 2012.

The model put into practice in this study based on AHP-ORCA can be compared with future studies based on other DEA models as well as such frequently used MCDM methods as MOORA (Multi-Objective Optimization on the basis of Ratio Analysis), VIKOR (Vise Kriterijumska Optimizacija I Kompromisno Resenje), and the Gray Correlation Analysis. Also, by changing the inputs and outputs, the results can be reanalyzed.

The model can run on software such as Excel, without requiring any compelling knowledge of mathematics. Thus, it could easily be implemented by sector managers. The model can also be used in many other areas by changing the inputs and outputs.

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