



## Forecasting the Rankings of Banks by Return on Assets in Turkish Banking Sector with Topsis, Fuzzy Topsis and Grey Relational Analysis Techniques

Mehmet Ozcalici

Assist. Prof. Dr., Kilis 7 Aralik University, Faculty of Economics and Business Administration Kilis/Turkey

Mete Bumin

Ph.D. Head of Department, Banking Regulation and Supervision Agency of Turkey, Ankara/Turkey

Yucel Ayricay

Assoc.Prof.Dr. Kahramanmaras Sutcu Imam University, Faculty of Economics and Business Administration, Kahramanmaras/Turkey

### ABSTRACT

*Banks play an important role in any economy due to their unique mission of financial intermediation and asset allocation. Therefore, forecasting the rankings of banks for the next period becomes a crucial issue for decision makers in investment decision-making process. In this study, Technique for order of preference by similarity to ideal solution (TOPSIS), fuzzy TOPSIS and Grey Relational Analysis (GRA) have been adopted to forecast the rankings of return on asset of Turkish banking sector. Financial indicators dataset for the period of December 2014 is utilized to rank the performance of the banks and the results are compared with the actual rank of banks in the period March 2015. Overall results indicate that fuzzy TOPSIS outperformed other techniques in forecasting rankings of banks.*

**KEYWORDS :** forecasting, bank performance, fuzzy TOPSIS

### INTRODUCTION

Bank profitability can be seen as an indicator of the performance of the banking system, as it drives a wedge between the interest rate received by savers on their deposits and the interest paid by lenders on their loans. Bank profitability will affect the cost of bank finance for firms, the range of investment projects and thus economic growth (Demirguc-Kunt and Huizinga, 1999).

Industries, governments and academics have always been interested in the evaluation or the forecasting of the performance of banks. Performance evaluation as well as forecasting serves as a basis for organizational improvement and criteria for the management of the banks. Different performance evaluation methods are suggested in literature. These methods include multivariate statistical analysis, data envelopment analysis, analytic hierarchy process, fuzzy set theory and grey relation analysis, balanced scorecard and financial statement analysis. These methods have their own drawbacks (Ho, 2006) as well as their own advantages. In addition, none of these attempts has been entirely conclusive or unchallenged (Bikker and Bos, 2008).

The purpose of this study is to forecast the rankings of banks based on return on assets by using TOPSIS, Fuzzy-TOPSIS and GRA analysis. This study has been organized as follows: a literature review on the performance measurement of banks through different methods is given in section 1. In section 2, the basic principles of techniques are presented. Section 3 is dedicated to the results of the analysis. In addition, in the last section, conclusion and suggestions for the future studies are given.

### LITERATURE REVIEW

Ho and Wu (2006) employed grey relational analysis in order to benchmark the performance indicators for banks. Ravi, Kurniawan and Kumar (2007) applied soft computing systems for bank performance prediction. Different soft computing systems are created to identify failing banks. They concluded that ensemble systems offer a more accurate, robust and useful system for bank performance prediction. Tsai and Shan (2008) employed AHP and GRA method to evaluate the credit extension ability of firms in the banking sector. It is concluded that operational and management characteristics of the companies that the banks are in relation with play as an important role as the traditional financial criteria. Wu, Tzeng and Chen (2009) proposed a fuzzy multi criteria decision-making approach to evaluate the performance of banks. At total, 23 indicators including both financial and nonfinancial indicators are utilized as inputs to techniques

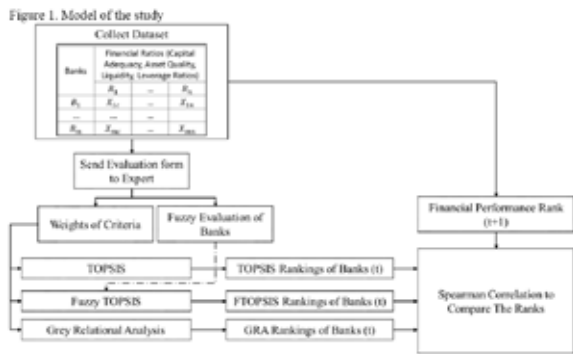
namely TOPSIS, AHP and VIKOR in order to rank the alternatives. At the end of the study, the factors that have most impact on performance of the banks are reported.

In literature, there are also studies realized by different methods to measure the performance of banks operating in Turkish banking sector. Onder, Tas and Hepsen (2013) evaluated the performance of Turkish banks using analytical hierarchy process and TOPSIS methods. At the end of the study three best performing banks are reported. Bulgurcu (2012) applied TOPSIS methodology to evaluate the performance of technology firms in ISE market. The author used 10 financial ratios calculated from financial statements as inputs and ranked the firms following TOPSIS methodology. The author also compared the results with the market value of firms. The author concluded that the TOPSIS and market value ranks differed substantially from each other. Secme, Bayraktaroglu and Kahraman (2009) also applied TOPSIS and Analytic Hierarchy Process to evaluate the performance of Turkish banking sector. Fuzzy analytic hierarchy process and TOPSIS methodology are utilized in their study and financial and non-financial indicators are used as inputs. At the end of the study, it is concluded that non-financial indicators are also play important role in evaluating the performance of banks.

Bayyurt (2013) used TOPSIS, Electre III and Data Envelopment Analysis in order to compare the performance of domestic and foreign owned banks operating in Turkey. At the end of the study, it is reported that foreign banks show better performance than domestic ones. Dogan (2013) employed grey relational analysis in order to assess the performance of Turkish banking sector. The author selected ten banks and ten criteria to compare the performance of banks. At the end of the study, author reported the ranks of the banks. Ic (2012) applied fuzzy TOPSIS to create a credit risk concentration allocation model and reported that the model produced satisfactory results.

### METHODS

The proposed forecasting approach is depicted in Figure 1. Experiment is started by collecting the financial dataset. Then evaluation form is sent to expert to fuzzy evaluation of banks as well as evaluation of criteria. The last step is to compare the results with actual rankings for the next period.



**Figure 1. Model of the study**

**TOPSIS Method**

The idea behind TOPSIS is to find an alternative, which is close to ideal solution and far away from negative-ideal solution. The ideal solution is the combination of the best performance values while the negative solution is the combination of the worst performance values. Proximity to each of these performance poles is measured in the Euclidean sense, with optional weighting of each attribute (Kahraman, 2008).

**Fuzzy TOPSIS Method**

The fuzzy set theory was introduced by (Zadeh, 1965). In his study, Zadeh introduced a theory whose objects are sets with boundaries that are not precise (Klir and Yuan, 1995). The membership in a fuzzy set is not a matter of affirmation or denial, but rather a matter of a degree.

In this study, an expert who is working in a commercial bank and have experience in Turkish banking sector for more than 10 years directly use linguistic variables to evaluate the importance of the criteria and the ratings of each bank with respect to various criteria using the variables in Table 1.

**Table 1. Linguistic variables for the importance weight of each criterion**

Weights for Criteria			Ratings for Alternatives		
Very Low	VL	(0,0,0,0,0,1)	Very Poor	VP	(0,0,1)
Low	L	(0,0,0,1,0,3)	Poor	P	(0,1,3)
Medium Low	ML	(0,1,0,3,0,5)	Medium Poor	MP	(1,3,5)
Medium	M	(0,3,0,5,0,7)	Fair	F	(3,5,7)
Medium High	MH	(0,5,0,7,0,9)	Medium Good	MG	(5,7,9)
High	H	(0,7,0,9,1,0)	Good	G	(7,9,10)
Very High	VH	(0,9,1,0,1,0)	Very Good	VG	(9,10,10)

**Grey Relational Analysis**

In Grey Relational Analysis (GRA), the global comparison between two sets of data is undertaken instead of local comparison by measuring the distance between two points. Thus it avoids the side effect of subjective setting of parameters within the model (Chan and Tong, 2007).

GRA is a member of Grey System Theory that is initiated by Deng Joung in 1982. The GRA is a quantitative analysis to search the similarity and dissimilarity among observations in developing progression (Deng, 1989).

**ANALYSIS**

**Dataset Description**

The seven biggest privately owned commercial banks in Turkey is selected in this study. The banks are selected by considering the highest market share of the banks in the banking sector of Turkey. The seven privately owned commercial banks with their share in the total assets of the sector for the period of December 2014 (2014/12) are; Turkiye Is Bankasi - TIB (11.92 %), Turkiye Garanti Bankasi - TGB (10.98 %), Akbank - AKB (10.30 %), Yapi Kredi Bankasi - YKB (9.40 %), Finansbank - FIN (3.77 %), Denizbank - DNZ (3.48 %) and Türk Ekonomi Bankasi - TEB (3.40 %). Total asset shares of these seven banks that are included in the analysis is reached 52.7 % of the Turkish banking sector.

The data utilized in this study have been retrieved from the website

of the Banks Association of Turkey (BAT – [www.tbb.org.tr](http://www.tbb.org.tr)) which regularly issues financial statements of the banks operating in Turkish banking sector.

The financial indicators used in this study for the period of 2014/12 and weights of criteria which are determined by expert using the scale in Table 1 are as follows:

- Equity / Risk Weighted Assets (E/RWA) – Very High
- Equity / Total Assets (E/TA) – High
- Non-Performing Loan (Gross) / Total Loans (NPL/TL) – Very High
- Financial Assets / Total Assets (FA/TA) – Medium High
- Total Deposits / Total Assets (TD/TA) – High
- Funds Borrowed / Total Assets (FB/TA) – Medium High
- Liquid Assets / Total Assets (LA/TA) – High

Return on Assets Ratio (ROA) is used for assessing the profitability of the bank. This ratio is used as financial performance indicator of banks and is calculated by dividing annualized net profit of the banks to total assets of the banks for the period of March 2015 (2015/3) in this study.

The dataset used in this study is presented in Table 2.

**Table 2. Dataset of the study**

Period	2014/12							2015/3
	E/RWA	E/TA	NPL/TL	FA/TA	TD/TA	FB/TA	LA/TA	
TIB	0.160	0.123	0.016	0.176	0.562	0.087	0.280	0.0138
TGB	0.152	0.119	0.025	0.197	0.550	0.148	0.254	0.0139
AKB	0.152	0.122	0.018	0.246	0.552	0.102	0.318	0.0148
YKB	0.150	0.106	0.036	0.138	0.580	0.100	0.258	0.0093
FIN	0.170	0.114	0.054	0.166	0.559	0.065	0.211	0.0128
DNZ	0.141	0.082	0.039	0.155	0.620	0.108	0.286	0.0077
TEB	0.140	0.094	0.025	0.085	0.626	0.144	0.235	0.0108

**Results of the Analysis**

Total results of three techniques as well as the average of three models are presented in Table 3. The results revealed that the model is produced useful rankings. However, additional tests are required for a sound justification of its statistical significance. Spearman's Rho correlation analysis is applied to compare the results of each technique and ROA for the period (t+1). The null hypothesis of the Spearman's rank-correlation test is "there is no similarity between the two rankings". The level of significance is selected as. The p value for Fuzzy TOPSIS technique is calculated less than 0.05 which implies that the difference in the two rankings (FTOPSIS ranks and ) is statistically insignificant. Based on these results it is possible to claim that the rankings obtained by the FTOPSIS can be used to forecast the return on assets.

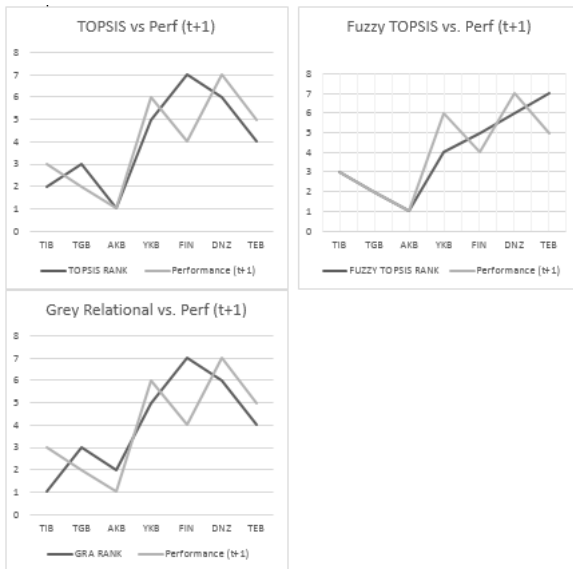
**Table 3. Forecasting Results**

Banks	TOPSIS	FTOPSIS	GRA	Ranking Results			Ranking Difference			
				TOPSIS	FTOPSIS	GRA	ROA (t+1)	TOPSIS	FTOPSIS	GRA
TIB	0.793	0.609	0.991	2	3	1	3	-1	4	-3
TGB	0.609	0.619	0.956	3	2	3	2	1	1	2
AKB	0.837	0.626	0.984	1	1	2	1	0	1	1
YKB	0.461	0.604	0.937	5	4	5	6	-1	5	0
FIN	0.363	0.597	0.924	7	5	7	4	3	2	5
DNZ	0.409	0.558	0.925	6	6	6	7	-1	7	-1
TEB	0.477	0.542	0.945	4	7	4	5	-1	8	-4
Spearman Rank Correlation Test:							0.750	0.821*	0.679	0.714

\*p&lt;0.05

In Figure 2 the performance of banks versus result of analysis with TOPSIS, FTOPSIS and GRA models are presented. As it is clearly observed in the Figure 2, all of the analysis have produced similar ranking results with actual performance of banks in the period of 2015/3, by using the financial indicators of the period 2014/12.

**Figure 2. Rank comparisons**



## CONCLUSION

The globalization is increased the importance of forecasting the financial performance of banking sector, especially in emerging markets. In this context, this study utilized TOPSIS, Fuzzy TOPSIS and GRA for forecasting the rankings of banks by ROA for commercial banks operating in Turkish banking sector.

The Spearman's rho correlation coefficient indicate that fuzzy TOPSIS analysis has produced the most similar ranks with the ranks of ROA for the next period. In other words, fuzzy TOPSIS method out-performed TOPSIS and GRA methodology when predicting the rankings of ROA.

One of the aim of this study is to propose a decision support tool for financial market decision makers. By considering the findings of this study, it is possible to state that fuzzy TOPSIS method is a powerful tool in forecasting the ranking of banks by ROA.

In future studies, the proposed forecasting approach can be applied to non-banking financial sectors such as insurance, factoring and leasing companies. In addition, the ability of forecasting ROA of different multi criteria decision-making tools (such as AHP, Vikor etc.) can be tested with financial data of emerging or developed financial markets. Future researchers are encouraged to assess the methods used in this study to forecast the ranking of banks by performance indicators such as return on equity and net interest margin in turbulent times such as in financial crisis.

## REFERENCES

- [1] Bayyurt, N (2013). Ownership effect on bank's performance: Multi criteria decision making approaches on foreign and domestic Turkish banks, *Procedia-Social and Behavioral sciences*, 99: 919-928. || [2] Bikker, J and J Bos (2008). Bank Performance A theoretical and empirical framework for the analysis of profitability, competition and efficiency, Routledge, New York. || [3] Bulgurcu, B K (2012). Application of TOPSIS technique for financial performance evaluation of technology firms in Istanbul Stock Exchange, *Procedia - Social and Behavioral Sciences*, 62:1033-1040. || [4] Chan, J W K and T K L Tong (2007). Multi-criteria material selections and end-of-life product strategy: Grey relational analysis approach, *Materials and Design*, 28:1539-1546. || [5] Demircug-Kunt, A and Huizinga, H (2000). Determinants of commercial bank interest margins and profitability: Some international evidence. *The World Bank Economic Review*, 13, 179-408. || [6] Deng, J (1989). Introduction to Grey System Theory. *The Journal of Grey System*, 1(1), 1-24. || [7] Doğan, M (2013). Measuring bank performance with Grey Relational analysis: The case of Turkey, *Ege Academic Review*, 13(2):215-225. || [8] Ho, C T and Y S Wu (2006). Benchmarking performance indicators for banks, *Benchmarking: An International Journal*, 13(2): 147-159. || [9] Ho, C T (2006). Measuring bank operations performance: an approach based on Grey Relation Analysis, *Journal of the Operational Research Society*, 57:337-349. || [10] İç, Y T (2012). Development of a credit limit allocation model for banks using an integrated Fuzzy TOPSIS and linear programming, *Expert Systems with Applications*, 39:5309-5316. || [11] Kahraman, C (2008). Fuzzy Multi-Criteria Decision-Making Theory and Applications with Recent Developments, Springer, New York. || [12] Klir, G J and B Yuan (1995). Fuzzy sets and fuzzy logic Theory and applications, Prentice Hall, New Jersey. || [13] Önder, E, N Taş and A Hepşen (2013). Performance evaluation of Turkish Banks Using Analytical Hierarch Process and TOPSIS methods, *Journal of International Scientific Publication: Economy & Business*, Vol (7). Part (1). 470:53. || [14] Ravi, V, H Kurniawan, P KKT and P.R. Kumar. (2007). Soft computing system for bank performance prediction, *Applied Soft Computing*. 8(1):305-315. || [15] Seçme, N Y, A Bayraktaroğlu and C Kahraman (2009). Fuzzy performance evaluation in Turkish Banking Sector using Analytic Hierarch Process and TOPSIS, *Expert Systems with Applications*, 36:11699-11709. || [16] Tsai, L C and C Y Shan (2008). Evaluating the emerging industry credit ability for banking sector using AHP and GRA: A case study in Taiwanese Solar Energy Industry, *The Journal of Grey System*, 4:359-374. || [17] Wu, HY, G H Tzeng and YH Chen (2009). A fuzzy MCDM approach for evaluating banking performance based on Balanced Scorecard, *Expert Systems with Applications*, 36:10135-10147. || [18] Zadeh, L A (1965). Fuzzy Sets, *Information and Control*, 8(3):338-353. ||