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Using TOPSIS Method for Financial Performance Assessment: A Study of Selected Scheduled Banks in Bangladesh
Analysis of Financial Performance of Banks with TOPSIS and Fuzzy TOPSIS Approach

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ABSTRACT

Several studies have examined the financial performance of banks using multi-criteria decision-making methods such as TOPSIS and Fuzzy TOPSIS. These studies seek to assess the efficiency of banks in competitive and uncertain environments. One of these studies examined the performance of 19 Bangladeshi banks in the period 2000 to 2013 using the TOPSIS method. This study compared the performance of public, private and foreign banks and showed that foreign and private banks have better overall performance than public banks. This study was conducted using 25 financial ratios in four main categories and weighting with the Shannon entropy method. Also, another study examined the performance of the top seven banks in Turkey in the period 2014 to 2018 using the TOPSIS and Fuzzy TOPSIS methods. This study showed that both methods provide similar results in performance evaluation. By emphasizing the importance of measuring bank performance, these studies help investors, customers, and policymakers make better decisions and clarify the key role of performance evaluation in improving bank strategies.

1-Problem Definition:

The main issue of both papers is to assess and compare the financial performance of banks in competitive and uncertain environments using multi-criteria decision-making (MCDM) methods. The first paper examines the performance of Bangladeshi banks (public, private, and foreign) during the period 2000-2013, focusing on comparing the performance of private and foreign banks with public banks, and uses the TOPSIS method to rank them. The second paper examines the challenge of assessing and ranking bank performance in a more general level and, while proposing TOPSIS and Fuzzy TOPSIS methods for assessment, emphasizes the importance of selecting appropriate criteria and dealing with uncertainty. Both papers seek to provide a precise and efficient method for assessing the financial performance of banks to help them improve their competitive position and make better strategic decisions. Ultimately, the common goal of both studies is to fill the existing research gap in the field of assessing bank performance using MCDM methods.

1. Problem Classification:

 1-2 Paper 1:

Main Topic: Using TOPSIS Method for Financial Performance Evaluation: A Study of Selected Scheduled Banks in Bangladesh

 1-1-2 Subject Area:
•Finance: Specifically, financial performance evaluation and analysis.
•Banking: A study focused on the banking industry in Bangladesh.

2-1-2 Type of Research:
•Quantitative: Based on numerical data (financial ratios) and statistical analysis.
•Multi-Criteria Decision Making (MCDM): Using TOPSIS method as the main method.
2.1.3 Objective:
•Comparative analysis: Comparing the performance of public, private and foreign banks.
 •Performance assessment: Examining the financial health and performance of banks based on various ratios.

2.1.4 Methodology:
•TOPSIS method: To rank banks based on their proximity to the ideal solution.
•Shannon entropy method: To determine the weight of financial ratios.

2.1.5 Geographical scope:
•Bangladesh: The study is limited to the banking sector of Bangladesh.

2.1.6 Time period:
:2000-2013 •Examining data in this specific time period.

2.1.7 Data structure and indicators:
 19 •banks: Including 3 public banks, 12 private banks and 4 foreign banks.
 25 •Financial Ratios: Categorized into four main groups:
o Profitability and Efficiency Ratios
o Size and Growth Indicators
o Strength and Stability Ratios
o Asset Quality Ratios

 2-1-8 Findings:
 •Foreign and Private Banks Perform Better Than State-Owned Banks.
In summary, this paper is a quantitative study in the field of finance and banking that compares and evaluates the financial performance of Bangladeshi banks during the period 2000 to 2013 using the TOPSIS method. This paper aims to determine the superiority of the performance of private and foreign banks over

state-owned banks and concludes that private and foreign banks perform better.

2-2 Second article:

Main topic: Analyzing the financial performance of banks with the TOPSIS and Fuzzy TOPSIS approach

2-2-1 Article type:
•Analytical research paper: The present article is a research study that aims to evaluate and rank the financial performance of banks. This article examines the problem using quantitative methods and data analysis.

2-2-2 Main topic:
•Evaluating the financial performance of banks: The main topic of the article is evaluating and ranking the financial performance of banks in a competitive and uncertain environment. The aim is to provide a framework for better understanding and improving the financial performance of banks.

2-2-3 Methodology:
•Multi-criteria decision-making methods (MCDM): The article uses TOPSIS and Fuzzy TOPSIS methods as the main tools for performance evaluation. These methods have been selected due to their greater sensitivity in uncertain conditions.
•Data Analysis: The article analyzes and compares the performance of Turkish banks by examining the actual financial data from 2014 to 2018.
•Fuzzy Set Theory: In part of the article, the fuzzy set theory and its application in performance evaluation are examined.

2-2-4 Structure of the article:
•Introduction: Defining the problem and the importance of the subject, the necessity of using advanced methods.
•Literature Review: Reviewing previous studies and different methods of evaluating financial performance.
•Methodology: Introducing TOPSIS and Fuzzy TOPSIS methods and how to use them in evaluation.
•Data Analysis: Presenting and analyzing the financial data of banks and related financial ratios.
•Results and Discussion: Presenting the results of the evaluations and comparing different methods.
•Conclusion: Summarizing the findings and making suggestions.

2-2-5 Application Areas:
•Finance and Banking: The paper is categorized in the field of finance and banking, and its results are useful for bank managers, financial analysts, and researchers in this field.
•Multi-Criteria Decision Making: Also, the paper can be categorized in the field of multi-criteria decision making (MCDM) and the application of quantitative methods to solve complex problems.

2-2-6 Keywords:
•Financial performance, banks, TOPSIS, Fuzzy TOPSIS, financial criteria, multi-criteria decision making

1. Mathematical modeling:

3-1 First paper:
Data preparation and weighting of criteria
In this study, first, 25 financial ratios in four main categories (including profitability ratios, efficiency, size and growth, strength and stability, and asset quality) were calculated for 19 selected Bangladeshi banks during the period 2000 to 2013. Then, the Shannon entropy method is used to determine the relative importance of each of these ratios. The Shannon entropy method mathematically, without the intervention of personal opinion, determines the weight of each ratio based on the amount of diversity and information it provides. These weights are used in the next steps to calculate the final score of each bank.

Implementing the TOPSIS method and calculating ideal solutions
After weighting, to implement the TOPSIS method, first the decision matrix consisting of financial ratios is normalized. Then, using the weights calculated in the previous step, a weighted decision matrix is created.

Next, based on the weighted decision matrix, two ideal solutions are defined: the positive ideal solution (including the best values for each criterion) and the negative ideal solution (including the worst values for each criterion). The goal of TOPSIS is to rank the options (banks) based on their distance from these two ideal solutions.

Bank Ranking and Conclusion
In the final step, the distance of each bank from the positive and negative ideal solutions is calculated. Then, based on these distances, a relative proximity index is calculated that shows how close each bank is to the positive ideal solution and how far it is from the negative ideal solution. Finally, the banks are ranked based on this index. Banks that are closer to the positive ideal solution receive a better ranking. Finally, the results of the bank ranking are obtained and analyzed using this mathematical model.

3-2 Second Paper:
In this paper, mathematical modeling for evaluating the financial performance of banks using Multi-Criteria Decision Making (MCDM) methods, specifically TOPSIS and Fuzzy TOPSIS, is presented. The main objective is to rank banks based on key financial criteria in order to accurately assess their performance in a competitive environment. The data used consists of various financial ratios from the seven largest Turkish banks in the period 2014-2018, extracted from the official reports of the Turkish Banks Association.

The TOPSIS method begins by forming a decision matrix in which banks are placed as options and financial ratios as criteria. After normalizing the data to create a uniform scale, the weights for each criterion are determined based on its relative importance. Then, by calculating the distance of each bank from the positive ideal solution (the best possible case) and the negative ideal solution (the worst possible case), the banks are ranked. The bank that has a smaller distance from the positive ideal solution will perform better.

Next, the Fuzzy TOPSIS method is used to consider the uncertainty and ambiguity in the financial data. This method works similarly to TOPSIS, but instead of using exact numbers, fuzzy numbers are used to model the uncertainties and provide a more accurate ranking. Finally, a sensitivity analysis is performed on the weights to examine the stability of the ranking results against possible changes in the weights of the criteria. This analysis helps decision makers to have more confidence in the results obtained from the modeling.

1. Problem Solving Method:

 4-1 First Paper:
Data Collection and Calculation of Financial Ratios At the beginning of the process, financial data related to 19 commercial banks operating in Bangladesh, including public, private and foreign banks, were collected during the period 2000 to 2013. This data was extracted from the annual reports of the banks and included information required to calculate 25 key financial ratios. These ratios were categorized into four main categories including profitability and efficiency ratios, size and growth indicators, financial strength and soundness ratios, and asset quality ratios. The purpose of calculating these ratios was to provide quantitative criteria for evaluating and comparing the financial performance of different banks.

Weighting the criteria using the Shannon entropy method After calculating the financial ratios, the Shannon entropy method was used to determine the relative importance of each of them in the overall assessment of the banks' performance. This method automatically assigns a weight to each ratio based on the amount of information and diversity in the data. Ratios that have more diversity and provide more important information receive more weight. This approach avoids the application of subjective and personal weights and leads to more accurate and fair results. The weights obtained from this step are used in the next step to rank the banks.

Ranking of banks using the TOPSIS method Finally, the TOPSIS method has been used to rank banks based on their financial performance. This method is a multi-criteria decision-making method that ranks options (here banks) based on their proximity to an ideal solution and distance from a non-ideal solution. In this method, first a decision matrix is created based on normalized financial ratios and then

a weighted decision matrix is calculated using the weights obtained from the Shannon entropy method. Next, the distance of each bank from the positive and negative ideal solution is calculated and based on these distances, a relative proximity index is determined. Banks are ranked based on this index; in such a way that banks that are closer to the positive ideal solution obtain a higher rank. This process allows for systematic comparison of bank performance based on multiple criteria.

4-2 Paper Two:

Problem Definition and Method Selection

The present paper aims to evaluate and rank the financial performance of banks in competitive and uncertain conditions. The main problem is to measure and compare the performance of banks based on a set of relevant financial criteria. Due to the complexity and multi-criteria nature of this problem, multi-criteria decision-making (MCDM) methods are used. Specifically, the TOPSIS method (Sorting Technique Based on Similarity to the Ideal Solution) and its fuzzy version, Fuzzy TOPSIS, are used. These methods are selected because they are capable of working with multiple and conflicting criteria and Fuzzy TOPSIS can also take into account the uncertainties in the financial data. The ultimate goal of this study is to identify the factors that significantly affect the financial performance of banks and provide an accurate ranking of banks based on these factors.

TOPSIS Method Implementation

To implement the TOPSIS method, first, key financial criteria and indicators that indicate the performance of banks are identified and selected. Then, a decision matrix is formed in which banks are considered as options and financial criteria as features. Financial data for the top seven banks in Turkey for the period 2014-2018 are extracted from the reports of the Turkish Banks Association and then normalized to make them comparable. Weights are assigned to each criterion that indicate its relative importance in determining overall financial performance. In the next step, positive and negative ideal solutions are determined and the distance of each bank from these solutions is calculated. Finally, banks are ranked based on their relative proximity to the positive ideal solution; that is, the bank that is closer to the best scenario receives a higher rank.

Implementation of Fuzzy TOPSIS Method and Sensitivity Analysis

In order to deal with the uncertainty in financial data, the Fuzzy TOPSIS method has been used. This method replaces exact values with fuzzy numbers so that the model can handle ambiguity and uncertainty in real conditions. The steps of Fuzzy TOPSIS are similar to the classical TOPSIS method, but the calculations are performed using fuzzy mathematical operations. This approach is considered more suitable for the banking sector where risk and uncertainty are high. To ensure the stability of the results, a sensitivity analysis is performed by changing the weights assigned to different financial criteria and the impact of these changes on the final ranking of banks is examined. This analysis shows whether the ranking of banks is strongly dependent on the weight of specific criteria or not.

1- Literature Review

5-1 First Article:

Review of Existing Literature and Justification of Research Methodology

The article begins well with a comprehensive review of the existing literature on the evaluation of bank financial performance. The authors rightly point out the importance of evaluating bank financial performance in the Bangladeshi economy and the use of multi-criteria decision-making methods for this purpose. They show that the TOPSIS method is known as a widely used method in this field and list its advantages over other methods. The literature review in this article clearly shows that the TOPSIS method is suitable for evaluating and ranking banks and that previous studies have also used it. This review provides a good justification for choosing the TOPSIS method in this study. It also points out the gaps in the literature, such as the lack of a similar study on Bangladeshi banks and the use of more accurate weighting with the Shannon entropy method.

Emphasis on Innovation and Limitations of Existing Literature

Despite the widespread use of the TOPSIS method in assessing bank performance, the article rightly points

out that previous research has focused mainly on banks in other countries (such as Turkey and Iran) and has rarely examined Bangladeshi banks. This clearly shows that the present study is a step forward in this field and helps fill a research gap. By emphasizing this gap, the article justifies the necessity of conducting the present study and emphasizes its innovation. Also, the authors point out the limitations of previous studies, such as the use of limited criteria or short time periods, and try to achieve more comprehensive results by using broader data and more precise methods. However, the article could have provided a more comprehensive literature review by addressing more qualitative factors affecting bank performance, such as management and innovation.

5-2 Second article:

Literature The article reviews various methods for evaluating the financial performance of banks and emphasizes the necessity of using multi-criteria decision-making methods (MCDM) such as TOPSIS and Fuzzy TOPSIS. The results show that, given the rapid changes in the economic environment and increasing competition, the need for effective and up-to-date assessments to measure bank performance is more important than ever. The existing literature points to the strengths and weaknesses of conventional methods, such as ratio analysis, as well as assessment models such as CAMELS and DEA, which can be effective tools for measuring bank efficiency. The use of these methods can help to better understand the challenges that banks face.

The article also points to the diversity of methods used and the challenges they pose. In particular, the insufficient accuracy of classical methods in uncertain and competitive conditions is recognized as one of the main problems. Therefore, the need for new and innovative approaches, such as TOPSIS and Fuzzy TOPSIS, seems essential to optimize evaluations. Also, integrating quantitative and qualitative information in evaluating bank performance and paying attention to the effects of the economic and social environment can improve the accuracy of the results and provide deeper insights. Finally, the article emphasizes the need to pay attention to global and macro conditions in the evaluations carried out in order to increase the validity of the results.

Aspect	Paper 1: "Using TOPSIS Method for Financial Performance Assessment: A Study of Selected Scheduled Banks in Bangladesh"	Article 2: "Analysis of Banks' Financial Performance with TOPSIS and Fuzzy TOPSIS Approach"
Main topic	Evaluating and comparing the financial performance of selected banks in Bangladesh using TOPSIS method.	Evaluation and comparison of banks' financial performance with emphasis on TOPSIS and Fuzzy TOPSIS approaches.
Geographical/temporal scope	Limited to Bangladeshi banks during the period 2000-2013.	Without specific geographical limitations, referring to the study of Turkish banks in the period 2014-2018 as an example.
Main objective	Determining the performance superiority of private and foreign banks over public sector banks in Bangladesh.	Providing a framework for evaluating the efficiency of banks in competitive and uncertain environments, and comparing the efficiency of TOPSIS and Fuzzy TOPSIS.
Main research method	TOPSIS method with weighting of criteria using Shannon entropy.	Using TOPSIS and Fuzzy TOPSIS methods.
Evaluation criteria	25 financial ratios in four main categories: profitability and efficiency, size and growth, strength and stability, asset quality.	Financial metrics affecting bank performance (not specified).
Type of data	Financial data from annual reports of selected banks.	Bank financial data.
Main focus	Comparing the performance of banks based on ownership structure (public, private, foreign) in Bangladesh.	Emphasis on multi-criteria evaluation methods and their ability to manage uncertainty and aid decision making.

Main conclusion	Private and foreign banks have better financial performance than public sector banks.	Both TOPSIS and Fuzzy TOPSIS methods provide similar results and are efficient methods for performance evaluation.
Recommendations	Using the results for investors, customers and banking policy makers to make better decisions.	Using the methods to evaluate the position of banks, improve strategies, and increase financial efficiency.
Distinguishing point	Focusing on a specific case study in Bangladesh and comparing based on ownership structure.	Focus on developing a comprehensive evaluation framework with emphasis on MCDM methods and uncertainty management.

Conclusion:

The studies conclude that multi-criteria decision-making methods (MCDM), especially TOPSIS and Fuzzy TOPSIS, are powerful and efficient tools for evaluating and comparing the financial performance of banks in competitive and uncertain environments. These methods, by considering multiple financial criteria and weighting them according to their importance, allow banks to obtain a comprehensive and accurate picture of their performance.

The first paper, which examines Bangladeshi banks, shows that private and foreign banks generally perform better financially than state-owned banks. The study uses the TOPSIS method to rank banks based on 25 key financial ratios and shows that the ownership and management structure of banks has a significant impact on their performance. The results of this research are useful for investors, customers, and policymakers, helping them make more informed decisions about investment, deposit, and banking policy formulation.

The second article, focusing on MCDM methods in general, emphasizes the importance of accurately assessing the financial performance of banks in complex and changing environments. This article shows that TOPSIS methods, and in particular Fuzzy TOPSIS, with their ability to handle uncertainties, can be valuable tools for assessing bank performance. These methods help banks identify their strengths and weaknesses and make better strategic decisions based on data. This article also emphasizes the importance of choosing appropriate financial metrics, evaluating bank performance periodically, and using the results obtained for continuous improvement.

Finally, both studies conclude that the use of MCDM methods, especially TOPSIS and Fuzzy TOPSIS, helps banks make more informed decisions in competitive environments and achieve financial stability and sustainability. These methods are not only a tool for performance evaluation, but also serve as a tool for continuous improvement and achieving competitive advantage. These studies show that accurate and regular evaluation of banks' financial performance is an essential step for success and sustainability in the banking industry.

Resources
1. APPLICATION OF TOPSIS METHOD FOR FINANCIAL PERFORMANCE
2. Financial Performance Analysis of Banks with Topsis and Fuzzy Topsis Approaches.pdf