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INNOVATION IN FINANCIAL HEALTH ASSESSMENT: APPLYING MCDM TECHNIQUES TO BANKS IN VIETNAM

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ABSTRACT

Assessing the financial health of banks is crucial to ensure the stability of the financial system. This is not only a way to safeguard the interests of customers and shareholders but also to prevent inherent risks and ensure reliability in banking operations. Thus, evaluating financial health plays a crucial role in maintaining stability and sustainable development in the banking sector. This study employed three methods: RAM (Root Assessment Method), PSI (Preference Selection Index), and SRP (Simple Ranking Process), to assess the financial health of twenty-eight banks in Vietnam. Capital adequacy rating, asset quality rating, management rating, earnings rating, liquidity rating, and sensitivity to market risk rating are the six criteria used to characterize each bank. The evaluation results using these three methods were compared with each other and with the evaluation using the CAMELS rating system. The study identified banks with good financial health and those with weak financial health. The notable point is that the results of ranking financial health of banks using three methods: RAM, PSI, and SRP, and according to the CAMELS system are quite similar. These findings are vital in providing valuable information for managers and investors, aiding them in making informed decisions regarding investment, risk management, and development strategies based on empirical data.

Keywords: *evaluation of banks' financial health, MCDM method, RAM method, PSI method, SRP method*

1. INTRODUCTION

Assessing the financial health of banks is an undeniable process, especially in the context where banks play a crucial role in the financial and economic system of a country (Khammassi *et al.*, 2024; and Mastilo, 2016). This evaluation not only provides necessary information for investors and regulatory agencies but also determines the reliability and stability of the entire banking system (Nguyen, 2022; and Mastilo *et al.*, 2021). One of the main reasons for evaluating the financial health of banks is to ensure the stability and safety of the financial system. Through this, management organizations can identify and address potential issues before they become risks to the entire system (Schinasi, 2005). Additionally, evaluating financial health helps banks manage risks effectively. By measuring and evaluating indicators such as non-performing loan ratios, capital adequacy ratios, and profitability, banks can formulate preventive strategies and minimize financial risks (Bhatt *et al.*, 2023). Furthermore, evaluating financial

health also presents an opportunity for banks to enhance performance and competitiveness. By understanding factors affecting their financial health, banks can adjust business strategies and focus on core areas to optimize profits and growth (Shiyyab *et al.*, 2023). Ultimately, evaluating financial health also builds trust from customers and the community. When people and organizations have confidence in the stability and reliability of banks, they tend to save and invest more, thus promoting the economic and financial development of the country (Shiyyab *et al.*, 2023). In summary, evaluating the financial health of banks is not only an important process but also a key factor in ensuring the stability, safety, and development of the global financial and economic system.

Assessing the financial health of banks can be done by considering individual components such as financial reports, capital adequacy ratios, loan-to-deposit ratios, business activity analysis, etc. (Peter & Sylvia, 2008; and Anginer *et al.*, 2019). Additionally, a comprehensive assessment of banks' financial health is ranking banks based on multiple parameters using Multi-Criteria Decision-Making (*MCDM*) methods (Zopounidis & Doumpos, 2017; and Zavadskas *et al.*, 2019). *MCDM* methods have been widely used not only in the banking sector (Barrera *et al.*, 2022; Ozcalici & Bumin, 2020; Sam *et al.*, 2020; Roy & Shaw, 2022; Khan, & Wang, 2023; Abdel-Basset *et al.*, 2021; Badi & Elghoul, 2023; and Ozcalici & Bumin, 2020) but also in various other fields such as mechanics (Dung *et al.*, 2021; Nguyen & Do, 2021; and Do, 2022), construction (Zhu et al., 2021; and Assaf *et al.*, 2023), sports (Hatem & Ikram, 2023), education (Uyen & Thu, 2023), petroleum (Wang *et al.*, 2020), economy (Mešić *et al.*, 2022; and Jana *et al.*, 2024), transportation vehicles (Puška *et al.*, 2023), industrial equipment (Truong *et al.*, 2023), environment (Le, 2023; and Trung *et al.*, 2024), etc.

This study focuses on evaluating the financial health of banks in Vietnam using *MCDM* techniques. The number of existing *MCDM* methods is very large, and incomplete syntheses indicate that it exceeds the figure of over 200 methods (Do *et al.*, 2024). Classification of *MCDM* methods has been carried out from various perspectives. Several recent classification approaches by scholars can be listed as follows. Based on operational basis and main computational method, *MCDM* methods are categorized into four groups, including the group of superior ranking methods, the group of compromise ranking methods, the group of distance-based ranking methods, and the group of pairwise comparison methods (Zakeri *et al.*, 2023; and Zakeri *et al.*, 2024). Considering the need for weighting criteria and normalization of data during the process of ranking alternatives, *MCDM* methods are divided into four groups: methods requiring both criteria weighting and data normalization, methods requiring only criteria weighting without data normalization, methods requiring only data normalization without criteria weighting, and methods requiring neither of the above tasks to be performed (Baydaş, 2022; Tran, 2022; Grierson, 2008; and Do, 2022). For *MCDM* methods requiring data normalization, they are further divided into two groups, including methods requiring data normalization once and methods requiring data normalization more than once (Wen *et al.*, 2020; Tešić *et al.*, 2024; and Puska *et al.*, 2024), etc.

Thus, it can be seen that the diversity in the set of *MCDM* methods makes the decision of choosing which *MCDM* method to use a complex one. Many studies have indicated that for each specific problem, there are suitable *MCDM* methods to use and there are unsuitable ones, and it cannot be said that one method is better than another (Reda & Omer, 2022; and Ziemba *et al.*, 2023). Therefore, there have also been many studies emphasizing that to ensure accuracy in solving a specific problem, it is necessary to apply several different *MCDM* methods (Aydin and Gümüs, 2022; Widianta *et al.*, 2018; and Qureshi & Rachid, 2022).

In this study, three different methods were concurrently used, including *RAM*, *PSI*, and *SRP*.

RAM is a newly proposed method as of September 2023, capable of balancing profit and cost criteria. When using *RAM*, users need to perform both data normalization and weighting for criteria (Alireza, 2023). When using the *PSI* method, users only need to normalize data without weighting criteria (Maniya & Bhatt, 2010; and Do *et al.*, 2023). Conversely, when using the *SRP* method, users only need to weight criteria without normalizing data (Zakeri *et al.*, 2023). This is a new method introduced in 2024 and is recommended for use when the number of alternatives to be ranked is greater than five (Zakeri *et al.*, 2024). The utilization of these new methods with different characteristics aims to produce the most objective results.

The objective of this study is to develop a method for evaluating the financial health of banks in Vietnam, based on *MCDM* techniques such as *RAM*, *PSI*, and *SRP*. The study aims to provide a comprehensive and objective approach to assessing the financial health of banks, thereby helping managers and investors better understand the risks and opportunities in the banking environment in Vietnam. This research offers a novel evaluation method using *MCDM* techniques, enhancing objectivity and consistency in the evaluation process. By comparing and analyzing the three methods of *RAM*, *PSI*, and *SRP*, this study provides insights into the diversity and flexibility of financial health assessment techniques. The rapid growth of the banking system in Vietnam has created a pressing need for effective and comprehensive methods of financial health evaluation. This study aims to contribute to this field by researching and applying modern analytical techniques, thus providing the banking community in Vietnam with a useful tool for evaluating and managing financial risks. The literature review on the evaluation of banks in Vietnam constitutes the content of Chapter 2. The sequence of steps in applying the *RAM*, *PSI*, and *SRP* methods is presented in Chapter 3 of this paper. The application of these three methods to evaluate the financial health of banks in Vietnam is presented in Chapter 4. The discussion on the research findings is presented in Chapter 5. The conclusion of the study wraps up this paper.

2. LITERATURE REVIEW

Vietnam has a dynamic young workforce, effectively seizing opportunities to participate in the Fourth Industrial Revolution. There's been a significant surge in mobile subscriptions, with citizens increasingly shifting towards electronic payments, driving the rapid development of digital banking. This poses a considerable challenge for banks as they continually strive to meet the growing demand for online payment services (Phan & Bui, 2017). The country is currently attracting considerable foreign investment due to its open management mechanisms and governmental incentives. The relaxed regulations and financial support have fostered a favorable business environment, particularly in the banking sector (https://baochinhphu.vn/). Consequently, banks are tirelessly working to enhance service quality and meet the demands of both customers and foreign investors. Therefore, assessing the financial health of banks is a crucial step in ensuring the stability and sustainability of the financial system. This not only helps mitigate risks and crises but also promotes the sustainable development of the economy, while instilling trust and confidence from customers and investors (Quynh, 2023). Recently, a few studies have been conducted to compare banks in Vietnam, providing favorable conditions for managers, investors, and even individuals to access the best products. The ranking of five banks was carried out using the *Fuzzy TOPSIS* method (Dinh *et al.*, 2018). Evaluating the efficiency of 23 banks during the Covid-19 pandemic period was done using the *TOPSIS* method (Nguyen et al., 2021). The *MAIRCA* method was applied to evaluate open banks. The concept of "Open Banking" refers to a business model in the banking industry where banks share customers' financial data with third parties through application programming interfaces. This enables third parties, such as app developers or financial service providers, to access and utilize this data to offer new

products and services or improve existing services for customers (Ngo *et al.*, 2022). To draw conclusions about bank mergers, the *TOPSIS* method was also used to rank banks with a high amount of bad debts (Tran *et al.*, 2020).

Although there have been some studies on ranking or assessing the financial health of banks in Vietnam as mentioned above. However, the results of ranking banks in these studies are often conducted by a specific *MCDM* method. This reduces the reliability of the evaluation results because many studies have indicated that the ranking of options may change when ranked by different *MCDM* methods (Bošković *et al.*, 2023; and Nedeljković *et al.*, 2024). This is considered the first gap. Another particular issue is that the evaluation results of banks in Vietnam using *MCDM* methods in published studies have not been compared with the results of any organization. This is considered the second gap. To fill these two gaps, this study evaluates the financial health of banks in Vietnam using three methods simultaneously *RAM*, *PSI*, and *SRP*. In Chapter 1, the reasons for the utilization of these three methods are clearly outlined. The evaluation results of banks by these three methods will be compared with each other and compared with the evaluation results by the CAMELS bank ranking system.

3. MCDM METHODS USED

3. 1. THE RAM METHOD

Use the following steps to rank alternatives using the *RAM* method (Alireza, 2023):

Step 1: Construct a decision matrix consisting of m rows and n columns, where m and n correspond to the number of alternatives to be ranked and the number of criteria for each alternative, respectively. Let x_{ij} denote the value of criterion j for alternative i, with $j = 1 \div n$, $i = 1 \div m$.

Step 2: Normalize the data according to formula (1).

$$r_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}} \quad (1)$$

Step 3: Calculate the normalized values considering the weights of the criteria according to (2). Where w_j represents the weight of the *j-th* criterion.

$$y_{ij} = w_j \cdot r_{ij} \quad (2)$$

Step 4: Calculate the total normalized scores considering the weights of the criteria according to (3) and (4). The letters *B* and *C* are used to denote criteria corresponding to profit and cost.

$$S_{+i} = \sum_{j=1}^{n} y_{+ij} \quad if \quad j \in B \quad (3)$$

$$S_{-i} = \sum_{j=1}^{n} y_{-ij} \quad if \quad j \in C \quad (4)$$

Step 5: Calculate the score of each alternative according to (5).

$$RI_i = \sqrt[2+S_{-i}]{2 + S_{+i}} \quad (5)$$

Step 6: Rank the alternatives in descending order of their scores.

3. 2. THE PSI METHOD

The ranking sequence of alternatives using the *PSI* method is as follows (Maniya & Bhatt, 2010; and Do *et al.*, 2023):

Step 1: Similar to step 1 of the *RAM* method.

Step 2: Normalize the data using formulas (6) and (7).

$$n_{ij} = \frac{y_{ij}}{y_j^{max}} if \quad j \in B \tag{6}$$

$$n_{ij} = \frac{y_j^{min}}{y_{ij}} if \quad j \in C \tag{7}$$

Step 3: Calculate the average value of the normalized values using formula (8).

$$n = \frac{1}{n}\sum_{i=1}^{n} n_{ij} \tag{8}$$

Step 4: Quantities φ_j, $\emptyset_j$, β_j are calculated using the corresponding formulas (9), (10), and (11).

$$\varphi_j = \sum_{i=1}^{n} [n_{ij} - n]^2 \tag{9}$$

$$\emptyset_j = [1 - \varphi_j] \tag{10}$$

$$\beta_j = \frac{\emptyset_j}{\sum_{j=1}^{m} \emptyset_j} \tag{11}$$

Step 5: Formula (12) is used to calculate scores for the alternatives.

$$P_i = \sum_{j=1}^{m} n_{ij} . \beta_j \tag{12}$$

Step 6: Rank the alternatives in descending order of their scores.

3. 3. THE SRP METHOD

Ranking alternatives using the *SRP* method follows these steps (Zakeri *et al.*, 2023):

Step 1: Similar to step 1 of the *RAM* method.

Step 2: Internally rank the alternatives, meaning rank the alternatives for each criterion using natural numbers. For criterion j, the rank of alternative i is denoted as r_{ij}. The best alternative is ranked 1 (i.e., $r_{ij} = 1$), and vice versa. If two alternatives are equal, they have the same rank.

Step 3: Calculate scores for each alternative according to formula (13).

$$S_i = \sum_{j=1}^{n} r_{ij} \cdot w_j \tag{13}$$

Step 4: Rank the alternatives in ascending order of their scores.

4. RANKING THE FINANCIAL HEALTH OF BANKS IN VIETNAM

In the CAMELS rating system, banks are typically ranked based on six criteria: capital adequacy rating (*C1*), asset quality rating (*C2*), management rating (*C3*), earnings rating (*C4*), liquidity rating (*C5*), and sensitivity to market risk rating (*C6*) (https://ncua.gov/files/letters-credit-unions/camels-rating-system-appendix-a.pdf). Nguyen (2020) aggregated the ranking results of 28 banks in Vietnam for each individual criterion, meaning she obtained six different sets of results. After having these six sets of results, she applied the CAMELS system's ranking method to rank the banks based on all six criteria. The authors of this paper utilized her synthesized results on individual ranking for each criterion and summarized them as shown in Table 1. This study will apply *MCDM* methods to rank the financial health of banks. The ranking results of banks using *MCDM* methods in this paper will be compared with the ranking results of the CAMELS system.

Table 1. Ranking data of banks for each individual criterion

Banks	*C1*	*C2*	*C3*	*C4*	*C5*	*C6*
ABB	11	11	13	11	9	20
ACB	16	22	16	8	22	7
BAC A	15	18	16	18	14	19
BID	26	2	2	15	21	1
CTG	20	5	3	13	16	2
EIB	8	13	11	23	24	14
HDB	9	22	25	7	3	11
KLB	12	26	28	24	10	26
LIEN VIET	20	10	25	10	10	12
MBB	7	20	8	2	10	6
MSB	6	11	13	19	13	17
NAM A	25	3	23	12	24	21
NCB	24	16	18	27	20	22
OCB	5	22	19	2	1	18
PG	3	7	6	22	26	27
SCB	28	25	19	28	28	4
SEA	18	9	5	17	4	16
SGB	2	27	22	15	18	28
SHB	26	6	7	14	22	10
STB	22	4	19	21	27	5
TCB	1	18	4	5	5	7
TP	10	21	11	2	2	15
VCB	19	14	1	9	14	3
VIB	13	17	9	5	5	13
VIET A	23	5	9	24	8	23
VIETCAPITAL	17	1	27	26	17	25
VPB	4	8	24	1	7	9
VIETBANK	14	28	15	19	19	24

Source: Nguyen (2020)

According to the aggregated data in Table 1, the rankings of banks regarding each individual criterion vary significantly. For instance, Bank BID has a ranking of 1 in *C6*, ranks 2 in both *C2* and *C3*, but ranks 26 in *C1*. Another case is Bank OCB, which ranks 1 in *C5*, 2 in *C4*, 5 in *C1*, but has relatively poor rankings in *C2*, *C3*, and *C6*, with ranks of 22, 19, and 18, respectively. For other banks, the differences in rankings across criteria are also evident. This makes it challenging to identify which banks have weak financial health to take comprehensive measures to evaluate the overall financial and management situation of the bank. Subsequently, measures need to be applied to strengthen finances and improve management, which may include reassessing business strategies, enhancing risk monitoring and control, or even intervention from financial regulatory and supervisory authorities. Of course, it is also challenging to determine which banks have good financial health to continue monitoring and periodic evaluation measures to ensure stability. Additionally, this may also involve considering expanding business

operations and developing new products and services to enhance efficiency and sustainable growth. Identifying banks with strong or weak financial health will also enable timely recommendations for investors, managers, and individual stakeholders. Therefore, evaluating banks based on all six criteria in Table 1 is necessary. Because the CAMELS Rating System does not disclose how much weight is assigned to each criterion, in this study, the weights of the criteria were all chosen to be equal.

Applying the steps of the *RAM* method has calculated the scores RI_i of each bank and ranked them. Applying the steps of the *PSI* method has calculated the scores P_i of each bank and ranked them. Applying the steps of the *SRP* method has calculated the scores S_i of each bank and ranked them. In this study, the weights of the criteria were chosen to be equal. All calculated values have been synthesized in Table 2. The ranking results of banks according to the CAMELS rating system have also been summarized in the last column of this table.

Table 2. Ranking of banks by different methods

Banks	RAM method		PSI method		SRP method		CAMELS Rating System (Nguyen (2020))
	RI_i	Rank	P_i	Rank	S_i	Rank	
ABB	1.42522	11	0.08725	17	11.00000	10	11
ACB	1.42762	17	0.09771	14	16.66667	19	16
BAC A	1.42890	21	0.05880	25	16.83333	20	20
BID	1.42403	8	0.24821	6	12.33333	11	8
CTG	1.42288	4	0.15582	8	10.16667	7	4
EIB	1.42788	19	0.06304	23	16.16667	18	18
HDB	1.42557	12	0.13420	11	13.00000	13	12
KLB	1.43271	26	0.05105	27	21.00000	26	26
LIEN VIET	1.42698	15	0.08688	18	15.00000	16	15
MBB	1.42206	3	0.30163	4	8.16667	3	2
MSB	1.42582	13	0.07426	21	12.50000	12	13
NAM A	1.43000	22	0.09118	16	18.16667	22	22
NCB	1.43281	27	0.04418	28	22.00000	27	27
OCB	1.42410	9	0.38360	2	9.50000	6	8
PG	1.42755	16	0.09627	15	13.33333	14	16
SCB	1.43360	28	0.06091	24	26.00000	28	28
SEA	1.42433	10	0.09840	13	10.50000	9	10
SGB	1.43068	23	0.10340	12	17.83333	21	23
SHB	1.42666	14	0.08477	19	14.83333	15	14
STB	1.42858	20	0.08319	20	18.66667	23	19
TCB	1.42015	1	0.27000	5	5.66667	1	1
TP	1.42321	6	0.32509	3	8.66667	4	6
VCB	1.42305	5	0.20928	7	10.33333	8	5
VIB	1.42334	7	0.15078	9	9.33333	5	7
VIET A	1.42766	18	0.07347	22	15.00000	17	21
VIETCAPITAL	1.43073	24	0.13789	10	18.66667	23	24
VPB	1.42203	2	0.55115	1	7.66667	2	2
VIETBANK	1.43169	25	0.05318	26	20.00000	25	25

Source: Author's calculation

Observing the data in Table 2, it is evident that banks have different rankings when ranked by different methods. This is understandable as the ranking results of alternatives by different *MCDM* methods are not entirely identical (Bošković *et al.*, 2023; Nedeljković *et al.*, 2024; and Mastilo *et al.*, 2024). However, we still notice that some banks have unchanged rankings when ranked by different methods. For example, TCB bank maintains the 1st rank when ranked by both the *RAM* and *SRP* methods, and even when ranked by the CAMELS system. VPB bank also holds the 2nd rank when ranked by both *RAM* and *SRP* methods, as well as by the CAMELS system. Several other banks also maintain unchanged rankings when evaluated by at least 3 out of the 4 different methods, such as KLB, NCB, SCB, etc. This implies that the rankings of banks do not change significantly when ranked by different methods. To reinforce this observation, the Spearman rank correlation coefficient has been used. This coefficient has been widely employed to assess the stability of ranking alternatives by different methods (Muhammad *et al.*, 2021; and Trung *et al.*, 2024). It is calculated using formula (14), where D_i represents the difference in ranking of alternative i when ranked by two different methods. In Table 3, the values of the coefficient *S* are summarized.

$$S = 1 - \frac{6\sum_{i=1}^{m} D_i^2}{m(m^2-1)} \tag{14}$$

Table 3. Spearman Rank Correlation Coefficient Values

Rating method	RAM method	PSI method	SRP method	CAMELS System
RAM method	1	0.81445	0.97947	0.99589
PSI method		1	0.81856	0.81746
RSP method			1	0.97373
CAMELS System				1

Source: Author's calculation

We observe that $S \in [0.81445 \div 1]$, reaffirming once again that there is very little change in the rankings of banks when ranked by different methods (Muhammad *et al.*, 2021; and Trung *et al.*, 2024). This statement instills strong confidence in the bank rankings. It also demonstrates that ranking the financial health of banks using the *RAM, PSI*, and *SRP* methods yields equivalent results to using the CAMELS system. Accordingly, the data in Table 2 shows that the banks belonging to the group of banks with the best financial health include TCB, VPB, MBB, and TP. Conversely, some banks exhibit weaknesses, such as BAC A, KLB, NCB, and SCB.

5. DISCUSSION

The observation of different rankings for banks across various methods highlights the inherent variability in the assessment of financial health using different *MCDM* techniques. While it is expected that different methods may yield differing rankings due to their distinct criteria and weighting schemes, it is noteworthy that some banks maintain consistent rankings across multiple methods. This suggests a degree of stability in the evaluation of certain banks' financial health regardless of the method used.

The utilization of the Spearman rank correlation coefficient further validates the observation of ranking stability. The coefficient's values falling within the range of [0.81445÷1] indicate a high degree of consistency in the rankings across different methods. This strengthens the confidence in the reliability of the rankings and suggests a robustness in the evaluation process.

The findings affirm the equivalence between ranking methodologies, namely *RAM*, *PSI*, and

SRP, and the established *CAMELS* system. The identification of the same banks as exhibiting either strong financial health or weaknesses across different methods underscores the effectiveness of these alternative techniques in assessing financial stability.

The consistent identification of certain banks, such as TCB, VPB, MBB, and TP, as having robust financial health, along with the recognition of weaknesses in others like BAC A, KLB, NCB, and SCB, carries significant implications. These insights can guide decision-making for stakeholders, including bank managers, investors, and regulators, in allocating resources, implementing risk management strategies, and fostering stability within the banking sector.

6. CONCLUSION

The financial health rankings of twenty-eight banks in Vietnam using the *RAM, PSI*, and *SRP* methods have been conducted in this study. The Spearman rank correlation coefficient has been used to compare the ranking results of these three methods with each other and with the ranking method of the CAMELS system. Some conclusions drawn are as follows:

- The financial health rankings of banks using the *RAM, PSI*, and *SRP* methods, and according to the CAMELS system, are quite similar.
- Banks TCB, VPB, MBB, and TP are identified to have good financial health. Conversely, banks BAC A, KLB, NCB, and SCB have poor financial health. This exploration will be highly beneficial for managers, investors, and even banks themselves in identifying appropriate adjustment solutions.
- This study only ranks the financial health of 28 banks in Vietnam. Expanding the sample and including more banks could provide a more comprehensive view of the financial situation in the banking industry. Additionally, researching and developing predictive models to assess and forecast the financial health of banks in the future can help managers and investors make strategic decisions.
- This study only considers the case where the weights of the criteria are equal. The ranking of financial health of banks could vary if weights are assigned differently to criteria. This study did not determine the weights assigned to criteria according to the CAMELS Rating System. This is considered the major limitation of this study. Moreover, if the criteria for assessing the financial health of banks are fuzzy sets, applying the original *RAM, PSI*, and *SRP* methods would not be feasible. The application of fuzzy theory to develop *fuzzy-RAM*, fuzzy-PSI, and *fuzzy-SRP* methods needs further investigation in cases where fuzzy sets are present.

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