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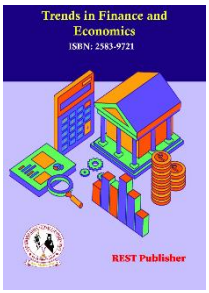

Ranking Financial Metrics for Investment Optimization: Insights from the VIKOR Methodology

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Abstract: *This research investigates complex relationship for financial progress investment decisions in various contexts. Using the VIKOR method, we evaluate and rank investment alternatives based on financial and non-financial factors, a multi-criteria optimization approach. Building on existing research, we Analyse the impact of financial literacy, market inefficiency, and managerial expertise on investment. outcomes. This study examines how financial development shapes economic growth, environmental sustainability, and corporate expansion, particularly in cross-border investments. Our findings indicate that financial reporting quality plays a key role in investment decisions, with liquidity considerations, audit restrictions, and political influences acting as moderating factors. We further demonstrate that in imperfect capital markets, the financial system significantly influences corporate investment decisions, especially in uncertain environments. In addition, this study highlights the increasing importance of intangible investments, especially research and development expenditures, which are becoming a major component of corporate assets, despite valuation challenges. This methodological framework combines financial measures with non-financial indicators, recognizing that financial measures are the primary choice because most companies comply with generally accepted accounting principles (GAAP). By using the VIKOR method, we effectively rank investment alternatives in a variety of situations, from material selection in engineering to project evaluation in commercial contexts. This study advances the literature by providing a holistic approach to investment decision-making that integrates financial performance indicators with broader economic and social factors. These results provide important insights for policymakers, business strategists, and financial analysts improve investment decisions in an increasingly complex and globalized marketplace.*

Keywords: *VIKOR method, financial development, investment decisions, multi-criteria decision making (MCDM), financial reporting quality (FRQ).*

1. INTRODUCTION

We also examine The income distribution data used in this context are obtained from Feininger and Square dataset, which compiles income quintiles from various sources across many countries. We use the Gini coefficient to measure income distribution because it covers a wide range countries or economies. This parameter is then combined with the financial-depth measure indicator to create a new variable, DEPTHGINI. In addition, initial income interacts with financial depth to create the variable DEPTHGDP. [1] Do real estate investment trusts (REITs) increase or decrease shareholder value? What is the relationship between investment decisions and overall investment performance? How do REITs finance their acquisitions, and are their financial strategies consistent with or significantly different from those of typical U.S. stock market companies? And, how have performance trends evolved over time? More than four decades after Congress introduced REITs to American investors, many of these questions remain unanswered remain largely unexamined. [2] This situation has not only created a constant demand for modern information, communication and geographic information systems, but also led to the emergence of a unique scientific research field. This research focuses on assessing The impact of investments in digital technologies for smart cities, associated infrastructure, various products and services. This

includes intelligent systems for electricity and water supply, environmental monitoring and other advanced infrastructure solutions. [3] Our study reveals the following findings: First, while the primary focus of most research Financial Reporting Quality (FRQ) and investment, a closer look at secondary objectives – in terms of the variables studied – reveals a key importance for cash flow. This is followed by studies examining the direct relationship between FRQ and investment, as well as research on audit and control, political and economic factors, and finally, ownership and leadership. Second, we find that the most commonly used research methodology relies on regression models using secondary data from the stock market. This is followed by survey-based approaches and quasi-natural experiments. [4] In an ideal situation with perfectly efficient and complete capital markets, a firm's financial position does not affect its actual investment choices, as Modigliani and Miller have shown. However, in the presence of market imperfections or incompleteness—external capital is more expensive than internal funds—the financial structure can significantly affect corporate investment decisions, especially for firms facing uncertainty. Researchers such as Greenwald, Stieglitz, Weiss, Myers, and Maloof have highlighted these market imperfections and argued that they are caused by asymmetric information problems within capital markets. [5] This study attempts Assessing Both real and financial barriers play a crucial role in shaping the international expansion of firms. From a theoretical perspective, these barriers influence a company's ability to enter and compete in foreign markets. Real barriers, such as regulatory constraints, cultural differences, and logistical challenges, can increase operational complexity and costs. Financial barriers, including limited access to capital, exchange rate fluctuations, and investment risks, affect a firm's capacity to fund international growth. [6] The results of the multiple linear regression test indicate that positive values of the fixed and variable coefficients indicate a direct relationship in the equation. The T-test results reveal that the financial literacy variable does not plays a major role in shaping investment decisions. However, the F-test results indicate that, collectively, financial literacy, financial behaviour, and income significantly influence investment choices. [7] Over the past two decades, the nature of corporate investments has undergone significant changes, with intangible investments growing rapidly and constituting a significant portion of a company’s assets – assets that are inherently challenging to value. Research and development (R&D) expenditures are particularly strategic and sensitive because they are essential in the early stages of the production process and reflect a company’s strategic direction. Decision-making in this area, driven by knowledge acquisition and intellectual property rights, is often irreversible and can profoundly shape a company’s trajectory, sometimes putting it at risk. [8] To make informed decisions, alternative initiatives must be evaluated against a certain standard. In this context, financial metrics help translate abstract corporate social performance (CSP) metrics into universally understood corporate language. In addition, CSP investments often undergo intense scrutiny, requiring managers to clearly measure their impact on financial performance. Projects without measurable financial outcomes are vulnerable to shifts in public opinion, leadership changes, and fluctuations in economic cycles. [9] The interest in understanding how women respond to financial information and assessing their financial literacy extends beyond academic researchers. Investment firms, financial planners, and governments around the world are increasingly focusing on Improving consumer knowledge in personal finance can be effectively achieved through educational programs. These efforts provide individuals with the skills to effectively use financial information and make more informed, confident decisions when purchasing or using goods and services. [10] A key, often overlooked factor that Can significantly influence the direction of a company. Expertise and reputation a company's management team plays a key role in shaping its financial and investment strategies. Practitioners such as venture capitalists and financial analysts widely view management quality as a key indicator of a company's overall strength and will also serve as an indicator of future performance. Experienced and well-respected managers can act as a form of "certificate" for their company's quality in financial markets, helping to reduce information asymmetries between internal shareholders and external investors. [11] The second major research question explored in this study is the impact of The impact of Financial development plays a significant role in promoting environmental sustainability and driving China’s economic growth. By improving access to capital, financial development supports investments in green technologies, sustainable infrastructure, and environmentally friendly business practices. In addition, a well-developed financial system enhances economic expansion by facilitating efficient resource allocation, fostering innovation, and supporting industrial transformation. [12] More significantly, financial metrics are widely accepted and adhere to the principles of Generally Accepted Accounting Principles (GAAP). They remain the preferred choice for most organizations, as Non-financial indicators, including customer satisfaction, quality, market share, and human resources, are often considered less important compared to financial metrics data. In addition, managers tend to prioritize financial performance indicators, which greatly influence organizational strategy, especially in the short term. [13] The potential benefits of the market-value approach have long been recognized; however, analytical findings are limited. The main obstacle preventing this approach from reaching

its full potential is the lack of a comprehensive theory that explains the impact The Impact the Impact Financial structure significantly influences market valuations because it determines a company's capital structure and risk profile. These effects can be assessed using objective market data, which provides insights into how different financial choices affect stock prices, debt levels, and overall company value. [14] This study seeks Assessing the significance of real and financial barriers to firms' international expansion from theoretical and empirical perspectives. This study is driven by recent theoretical research that emphasizes the important impact of productivity on firms. Such inefficiencies can create barriers to obtaining optimal financing, which in turn can lead to constraints on international expansion and investment decisions. Understanding these financial frictions is essential to improving contractual structures and fostering more efficient cross-border investments global expansion. [15]

2. MATERIALS AND METHOD

log Cash flow: Maintain a record of business cash receipts using a register. A cash receipt business register serves as a supporting document for tracking cash transactions, especially in situations where receipts or a cash register are not available.
Cost efficiency: Cost efficiency involves reducing costs by improving a product or process operate more efficiently. This approach improves a company's profitability by reducing purchasing costs and increasing overall operational efficiency.
Debt ratio: The debt-to-equity ratio refers to the ratio of a company's total debt to its total assets. It is usually expressed as a decimal or percentage. It serves as an important financial metric for assessing a company's leverage and overall financial stability indicating the extent to which a company's assets are financed through debt.
Exporter dummy: An exporter is an individual or company authorized by a government agency to transport goods across a country's borders. As the seller of goods, the exporter receives payment from a foreign buyer.
lot Size: Lot size in futures and options contracts refers to the minimum The amount of shares allowed to be bought or sold is determined by the terms and conditions specified in the agreement. The primary regulatory body overseeing this process is the Securities and Exchange Board of India (SEBI) determines lot sizes for all stocks and indices approved for trading on F&O exchanges.
count: The word "count" comes to English from the French word comet, which in turn comes from the Latin word comes - specifically its accusative form committee. It originally meant "deputy" or "assistant" and was used as a title to refer to someone appointed to represent a ruler.
mean: The mean is the average of a given set of values, indicating the even distribution of data points within a dataset. It is one of the three primary Indicators of central tendency, including the mean and mode.
min: Mint, which signifies coolness and freshness, is a gender-neutral name that means "quick" and "smart," indicating that your child may naturally excel in academics or sports.
max: In mathematics, a maximum refers to the point at which a function reaches its highest value. If this value is greater than or equal to all other values of the function, it is called an absolute maximum. If it is greater than the values at nearby points, it is called a relative or local maximum.

VIKOR method: Once the material selection criteria have been identified and a list of materials suitable for a particular engineering application has been narrowed down, the optimal material can be ranked and determined using the extended VIKOR method. The VIKOR method is a well-established multi-criteria decision-making approach designed to handle complex systems by evaluating and prioritizing alternatives with conflicting criteria. It ranks options by assessing their proximity to the best solution, where compromise ranking is based on achieving a balance through mutual concessions. [16] Furthermore, this study extends beyond assessing the selection of suitable It can be used by employees in educational institutions, and is also applicable to decision-making in various fields based on multiple criteria rest of the paper is structured as follows: The next section provides a brief overview of the problem under consideration. The subsequent sections describe the VIKOR methodology, including its practical steps, application, and finally, the conclusions drawn from the study. [17] A combination of fuzzy AHP and entropy This method assigns weights to risk factors, while the extended fuzzy VIKOR approach ranks failure modes based on their overall risk levels. As a result, a risk assessment framework that combines the joint weighting and fuzzy VIKOR method has been developed to address the challenges in FMEA. To evaluate its effectiveness and applicability, the proposed model is implemented to assess the risks associated with a general anaesthesia procedure in a university hospital. [18] This paper discusses the selection of the optimal project from five available alternatives evaluated on the basis of four criteria that serve as dynamic indicators of financial performance throughout the life of the project. To facilitate The VIKOR method, a widely used approach in the

decision-making process, assists in ranking and selecting alternatives considering multiple conflicting criteria multi-criteria optimization approach, is used as the most suitable technique. The following table presents the financial performance indicators used as criteria for ranking investment projects. [19] The extended versions of the VIKOR method mentioned above all rely on different types of quantitative data, making them unsuitable for qualitative situations. Since Hesitancy Fuzzy Linguistic Term Sets (HFLTS) are a recent advance in linguistic modelling that provides improved flexibility in representing human cognition. Naturally, extending the VIKOR method to hesitant fuzzy linguistic contexts allows for a more comprehensive decision-making approach, making it valuable for further study and application. [20]. The ELECTRE I method is designed for choice problems, while the VIKOR method focuses on ranking problems. This research introduces a new approach that combines the benefits both approaches that is simple and practical for real-world applications. The proposed method accounts for the ambiguity in decision data and incorporates a group decision-making process. Linguistic variables represent the degree of preference between different criteria. This method allows a group of decision makers to independently express their perspectives using linguistic terms, which are then aggregated through a fuzzy decision matrix and criterion weights. [21] We have developed a procedure to solve multi-attribute group decision making (MAGDM) problems, this study proposes an approach in which all attribute values are represented as interval-valued intuitive fuzzy numbers (IVIFNs), with only partial information available in the attribute weights. This method extends the VIKOR technique into the interval-valued intuitive fuzzy framework, incorporating various distance measures to assess the closeness of each alternative to the interval-valued intuitive fuzzy positive ideal solution (PIS). The improved VIKOR method is then used to rank the alternatives and identify the optimal choice. Finally, a numerical example is presented to validate the approach and illustrate its performance. [22] The VIKOR method is a valuable tool for multi-criteria analysis and is widely used in business ranking problems within business management. However, its application in environmental analysis is relatively limited. This study uses the VIKOR approach to rank and prioritize land use control strategies for sub-basins within the Cheng-Wen Reservoir catchment. Five criteria, including geographical and meteorological factors, were considered. The findings indicate that land use controls should be prioritized for sub-basins located near the outlet, as they pose a greater risk to reservoir water quality compared to other sub-basins. [23] To address the challenges of selecting lean tools for manufacturing systems, especially when each option is evaluated using unique criteria, this research presents a modified VIKOR method. Numerical examples, including two solved problems and a case study, are presented to verify and illustrate the effectiveness of the proposed model. These applications illustrate the practical implementation of the method and confirm its effectiveness. The results highlight the effectiveness and usefulness of the modified approach. [24] To achieve in this approach, the PDHL-VIKOR method improves upon the traditional VIKOR technique by introducing improvements for more effective decision making approach by providing a detailed analysis of the relationships between the best positive and negative solutions for each alternative. In addition, PDHLs capture expert evaluations more accurately compared to DHHFLTs. Since the improved The VIKOR method provides a more comprehensive solution for multi-criteria decision-making (MCDM) problems, this approach provides a more effective solution compared to traditional methods following traditional VIKOR approach, the PDHL-VIKOR method stands out as an optimal choice for experts in addressing MCDM challenges. [25] This study determines the optimal location that ensures both profitability and productivity for a company. To illustrate the facility location selection process, data from a popular label manufacturing company in Turkey is used. This study proposes a facility location analysis using AHP and VIKOR methods. The opinions of experts, both subjective and objective, are transformed into a quantitative form through The Analytical Hierarchy Process the Analytical Hierarchy Process (AHP) is used to determine the relative importance of the evaluation criteria. [26] The VIKOR method is a decision-making approach used to rank and select alternatives based on multiple criteria ranking process can be performed using weighted values for various criteria, which helps to analyze their influence on the suggested compromise solution uses the VIKOR method, which serves as a useful tool for decision-making based on multiple criteria particularly useful when decision-makers are unable or hesitant to define their preferences in the early stages of system design. The resulting compromise solution is generally well-accepted because it improves the "group utility" For most individuals, this aims to minimize personal impact while maximizing overall benefits dissatisfaction opposing party. [27] This section explores the use of a The VIKOR-based approach is designed to address the challenges of multi-criteria decision making (MCDM) when evaluation data is represented using hesitant fuzzy elements (HFEs). As highlighted in the introduction, decision makers often prefer to express their judgments using hesitant fuzzy expressions preferences as a spectrum of values rather than a single fixed number, especially early evaluation stages. Furthermore, when multiple individuals from different disciplines are involved in a decision-making problem, it is challenging to reach a consensus preference value for a particular alternative with respect to a

particular criterion. [28] This study demonstrates the effective use of the VIKOR method in identifying the most suitable magnesium alloy for automotive applications. The method provides a straightforward yet effective ranking approach for evaluating proposed materials. In this case, the assigned weights significantly influenced the selection process, with AZ emerging as the best ranked material. The proposed approach is adaptable and can be extended beyond material selection to various industries and organizations by adjusting the attributes and selection criteria in different fields. [29] The process of determining the graduation of Side Catechism participants at GKI involves evaluating each learner over a period of time by reviewing their learning outcome documents. This is followed by a re-evaluation of the available alternatives based on predetermined criteria including exam value, attendance, leadership, and attitude. By using the VIKOR method, each criterion is assigned unique values and weights according to decision-making priorities. This approach enables an effective and structured graduation assessment for each participant in the Side Catechism program. [30]

3. RESULTS AND DISCUSSION

TABLE.1 Financial investments

	count	mean	min	**max**
log Cash flow	24.67	47.18	83.92	64.82
Cost efficiency	86.13	82.38	52.93	36.69
Debt ratio	74.82	92.45	84.72	39.57
Exporter dummy	25.73	16.37	80.42	74.83
lot Size	93.27	28.93	37.26	63.82

Table 1 presents financial investment data analyzed using the VIKOR method, focusing on key metrics such as cash flow, cost efficiency, debt ratio, exporter's profit margin, and lot size. The average recorded cash flow is 47.18, with values ranging from 24.67 to a peak of 83.92. Cost efficiency, despite its high average of 82.38, fluctuates significantly between 86.13 and 36.69. The debt ratio reaches a maximum of 92.45, with a minimum of 39.57. The exporter's profit margin varies from 16.37 to 80.42, while the lot size averages 28.93 and 63.82.

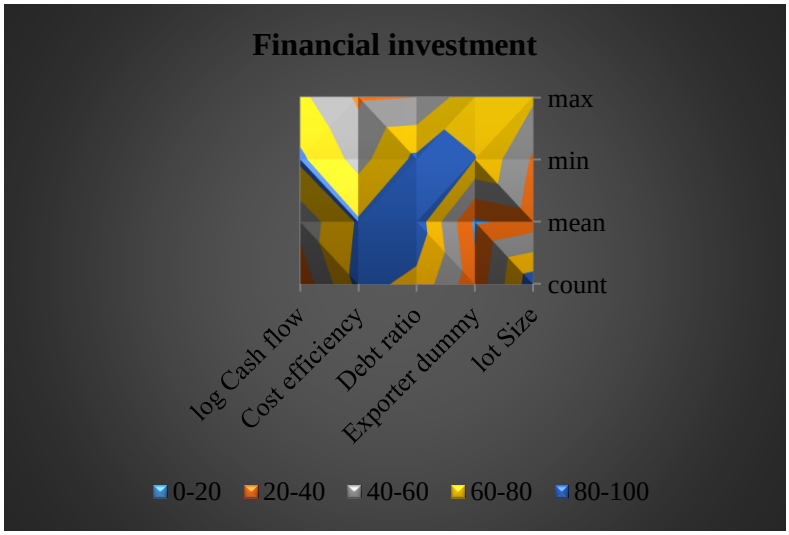

FIGURE:1 Financial investments

The VIKOR method enables a comprehensive assessment of financial investments by assessing key metrics such as cash flow, cost efficiency, debt ratio, exporter's margin and lot size. The record cash flow averages 47.18, with values ranging from 24.67 to 83.92. Cost efficiency, with an average of 82.38, reflects strong operational performance despite a low of 52.93. The debt ratio, which is critical for financial stability, reaches a high of 92.45 and a low of 39.57. The exporter's margin and lot size further highlight investment variability, underscoring the importance of strategic financial planning to improve economic performance.

TABLE.2 Calculation Sj, Rj

	count	mean	min	max	Sj	Rj
log Cash flow	0	0.148758	0.004214	0.216558	0.369529	0.216558
Cost efficiency	0.22398	0.03309	36.69	0.122578	37.06965	36.69
Debt ratio	0.182762	0	0	0.1322	0.314962	0.182762
Exporter dummy	0.003863	0.25	0.022651	0.25	0.526514	0.25
lot Size	0.25	0.208728	0.25	0.213217	0.921944	0.25

The application of the VIKOR method in estimating financial metrics is demonstrated in Table 2, which describes the calculation of Sj and Rj for various investment factors. The log cash flow has an average of 0.148758, with a peak value of 0.216558 and a uniform Rj of 0.216558. The cost efficiency shows considerable variation, reaching a maximum of 36.69 and Sj of 37.06965. The debt ratio remains stable, with an average of 0.182762. The exporter dummy and lot size show a well-balanced distribution, with lot size standing out due to its high Sj value of 0.921944, which influences financial decision-making and investment prioritization.

TABLE.3 Calculation Qj

	Sj	Rj	Qj
log Cash flow	0.802645	0.369529	0.001921
Cost efficiency	73.88223	37.06965	1
Debt ratio	0.629924	0.314962	0
Exporter dummy	1.026514	0.526514	0.005585
lot Size	1.385161	0.921944	0.013412

Table 3 demonstrates the convergence of financial metrics using the VIKOR method, focusing on the Qj values obtained from Sj and Rj. The log cash flow has a low Qj of 0.001921, indicating strong financial stability. The cost efficiency, with maximum Sj (73.88223) and Rj (37.06965), results in a maximum Qj of 1, indicating significant inefficiency. The debt ratio is constant with a Qj of 0, reflecting an optimal financial structure. The exporter dummy and lot size have moderate Qj values of 0.005585 and 0.013412, respectively, showing their varying impact on financial decision-making and investment prioritization within the VIKOR framework.

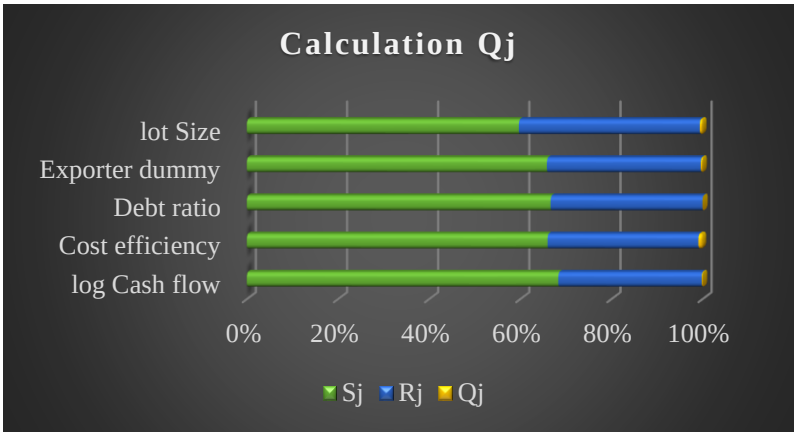

FIGURE:2 Calculation Qj

Figure 2 depicts the calculation of \(Q_j \) using the VIKOR method, emphasizing the impact of Sj and Rj on financial decision making. The cash flow registers a minimum Qj of 0.001921, indicating strong financial stability. Cost efficiency, with a maximum Qj of 1, indicates inefficiency. The debt ratio is optimal with a Qj of 0, while the exporter's dummy and lot size show modest Qj values of 0.005585 and 0.013412, respectively. These variations underscore the need for strategic financial planning within the VIKOR framework to improve efficiency, manage risk, and improve overall investment performance.

TABLE.4 Rank

	Rank
log Cash flow	3
Cost efficiency	5
Debt ratio	2
Exporter dummy	4
lot Size	1

Table 4 shows the ranking of financial metrics using the VIKOR method, emphasizing their importance in decision making. Lot size takes the first place, highlighting its essential role in investment optimization. Debt ratio is in second place, underlining its importance in maintaining financial stability. Record cash flow ranks third, indicating a moderate impact on financial performance. Exporter dummy ranks fourth, demonstrating its relevance but low priority compared to other factors. Cost efficiency is placed last, indicating inefficiencies that can affect overall financial outcomes. These rankings assist in strategic decision making by balancing risk, efficiency, and profitability for improved financial management and investment success.

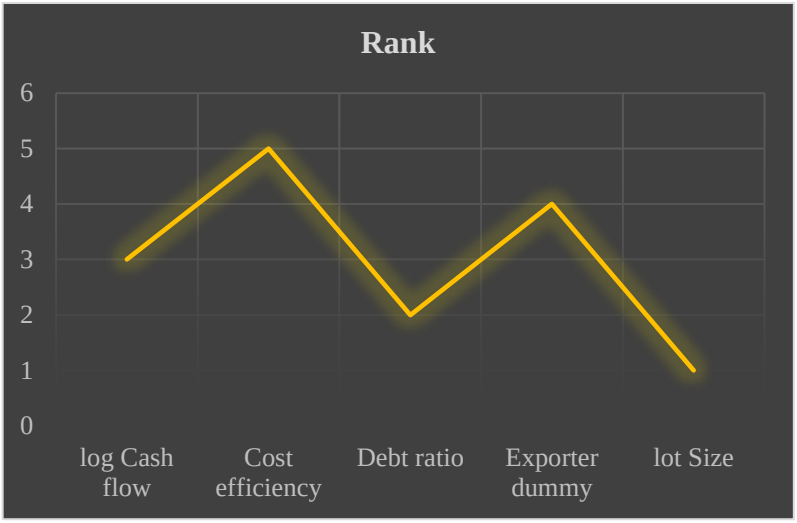

FIGURE:3 Rank

Figure 3 depicts the ranking of financial metrics using the VIKOR method, highlighting their importance in decision-making. Lot size has the highest ranking, indicating its important role in investment strategies, followed by debt ratio in second place. Record cash flow, exporter fake and cost efficiency occupy third, fourth and fifth places, respectively, which show their varying impact on financial performance. This ranking provides valuable insights into improving financial strategies by focusing on key factors that improve sustainability, efficiency and profitability. Recognizing these rankings supports data-driven investment decisions, leading to improved financial management and stronger competitiveness.

4. CONCLUSION

This study demonstrates the effective use of the VIKOR method in assessing financial investment metrics to improve decision making. Five key financial parameters – record cash flow, cost efficiency, debt ratio, exporter's margin and lot size – were analyzed to determine their relative importance in investment optimization. The findings establish a clear ranking, with lot size being the most influential factor, followed by debt ratio and lot cash flow. The calculated Qj values reinforce this priority, demonstrating the significant impact of lot size. Our results are consistent with previous research on market imperfections and asymmetric information, emphasizing The impact of financial structure on corporate investment decisions choices VIKOR method effectively captures these issues by measuring the proximity to the optimal solution. In addition, this study highlights the link between financial metrics and corporate strategy. While non-financial measures are gaining recognition, financial indicators remain important, especially for short-term planning and investment decision-making. Integrating the VIKOR method with financial analysis provides a comprehensive framework for evaluating investment

alternatives based on multiple criteria. Despite its high average value of 82.38, cost efficiency is the lowest in our prioritization model, indicating that while operational efficiency is important, other factors can Directly affect investment decisions. The main level of debt ratio reinforces its essential role in ensuring financial stability and maintaining investor confidence. This research contributes to the growing development of Using multi-criteria decision making (MCDM) in finance by integrating various evaluation factors demonstrating practical implementation the VIKOR method to rank investment priorities and optimize resource allocation. Its adaptability allows for customization across industries by adjusting the criteria based on specific organizational needs. Ultimately, using the VIKOR method improves the interoperability of financial metrics, providing a structured approach to investment decision-making. Prioritizing lot size, debt ratio, and cash flow management helps fund managers develop more effective strategies that balance risk, sustainability, and profitability. Future studies should examine how these rankings vary across industries and economic conditions to further refine financial investment strategies.

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