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Evaluation of Fim Performance under Merger and Acquisition Effect: An Integrated LOPCOW-PIV Approach

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ABSTRACT

Merger and Acquisition (MA) is one of the critical strategic decisions for the firms that impact the existence and growth of the organizations. The present paper undertakes the context of MA and aims to compare performance of some of the recent acquirers using fundamental financial ratios and market indicators. The study period spans over four consecutive financial years (FY 2019-20 to FY 2022-23). To carry out a comprehensive evaluation of firm performance, the current work uses a multi-criteria decision-making (MCDM) framework of LOPCOW (Logarithmic Percentage Change-driven Objective Weighting) and PIV (Proximity Index Value) methods. To aggregate the year wise rankings of the firms, Borda Count and Rank Index Method (RIM) is used. It is observed that ROE (C1), Net Profit Margin (C4) and EPS (C9) obtained the highest weights over the study period. On aggregate, we find that Infosys (A4), HUL (A3) and ITC (A1) show top performance while Vodafone (A11), PVR Inox (A9) and IDFC First Bank (A13) remain in the bottom bracket. The comparative analysis with other MCDM models reveals that the ranking results are consistent while the outcome of the sensitivity analysis reflects the stability. The present work provides a new perspective to the investors, policy makers and analysts.

1. Introduction

Mergers and acquisition (MA) are a critical corporate decision with long-term strategic and financial implications for firms. MA entails the consolidation of constituent organizations. During the merger, two participating firms combine to form a new entity, while the parent organization acquires the stake in the target company. Through restructuring, MA implies financial and resource consolidation [31; 34; 52]. The MA decision is of interest to several stakeholders, such as acquirers (buyers or parents), target companies (sellers), regulators (governments or regulating bodies), investors, bankers, and legal bodies (advisors). The decision of MA involves intra-industry and inter-industry firms, as well as firms at various stages of production [21]. MA is designed to achieve

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sustainable business growth and a competitive advantage through enhanced financial performance [6; 58]. The firms adopt MA as a dynamic strategy for rapid expansion in both domestic and global markets, strengthening market share through inorganic growth, creating a niche, assimilating knowledge, tapping cutting-edge innovation, consolidating costs, diversifying, and building resilience under uncertain conditions [35]. MA also brings significant transformations in governance and makes a positive impression on shareholders. Most often, MA helps firms to solve the agency cost problem [36]. MA is a crucial decision that can make or break a firm in the long run. Besides organizational-level development, through successful MA, firms contribute notably to sustainable socio-economic growth [24]. However, the uncertainties prevailing over the business environment posit significant challenges to achieve effective MA [17; 25].

Several past studies [26; 30; 66; 76] have examined the effect of MA on firm performance. MA has a significant impact on firm performance in many ways. First, MA helps to improve the bottom line and has a positive effect on firm valuation and operational efficiency. The combined entity fosters a capability enhancement. Secondly, an effective MA garners a positive market perception, enhancing the trust of investors and the firm's image. This enables the organizations to increase their market capitalization. Third, through a successful MA, firms reap a competitive advantage and move forward toward long-term sustainability. However, the existing literature also notes some concerns, such as adverse effects on technology MA and cross-industry MA, the timing of implementing MA (experts recommend having MA in the growth stage), agency cost issues, and others.

MA has a significant effect on the earnings quality of the firms. An effective MA contributes to revenue growth. Through MA, the firms improve their efficiency and optimize their costs. The combined entity enhances the potential for venturing into new markets and revenue streams, and subsequently provides avenues for stable and diversified earnings. However, MA also brings in some downside risks such as the possibility of operational disruptions, volatility in the market dynamics, lack of synergy, variations in the valuations, possibility of short-term downfall in the reported earnings, and adverse impact on market perception, agency cost problem, and ethical concerns [30; 76].

1.1 Related work on MA

Over the years, MA has garnered intriguing responses from the academic and corporate arenas. The researchers and decision makers from various domains like accounting and finance, strategy, marketing, HR and operations have investigated the motives and effectiveness of MA decisions vis-à-vis firm performance and valuation, market reaction, and stakeholders' involvement [24; 55]. The researchers Welch et al. [73] harped on the need for a thorough investigation of the individual activities involving various actors in the pre-MA phase and the temporal dynamics of the process. Of late, the firms have been putting concerted efforts to bring off sustainable performance, focusing on environment, society and governance (ESG) aspects. In this regard, the study by Tampakoudis and Anagnostopoulou [64] investigated the impact of management accounting (MA) decisions on the ESG performance and market value of European firms. It is observed that through MA, there was an improvement in the ESG performance of both acquirers and acquirees, which bolsters market value and recognition. The work of Barros et al. [11] also reflected the observations of Tampakoudis and Anagnostopoulou [64] as the researchers noticed a gradual growth in the firm performance in the post-merger phase. In the context of banking performance, past studies Bunmi et al. [16] have shown that MA improves profitability and total asset levels, and subsequently enhances the capital structure. The study of Eliason et al. [26] reported the negative consequence of MA for organizational process and talent management. Borodin et al. [15] also contended that improvements in financial performance do not occur in all cases of MA.

For a successful MA, the managers' roles and capability stand instrumental. The managers play essential roles in ensuring operating efficiency, better control over the cost, revenue growth and organizational synergy which help the firms to reap the competitive advantage and long-term performance excellence [20]. The success of MA depends on multiple aspects such as firm size, debt positions of acquirees, pre- and post- MA financial performance, market sentiments, acquisition experience, research and development capabilities, socio-economic and geographical factors, organizational culture, integration depth and so on [37]. With the massive developments in technology, knowledge assimilation, use and dissemination, digital capability and organizational change interventions have become critical success factors for MA [33]. Cumming et al. [21] considered the importance of good governance, accounting control, and firm valuation in realizing the benefits of MA.

The existing literature demonstrates the use of various financial indicators and measuring variables to evaluate the impact of MA. In particular, the researchers advocated for using accounting measures based on financial ratios to assess firm performance in relation to MA [4]. Patel [50] inquired about the impact of MA on return on equity (ROE), return on assets (ROA), net profit, earnings per share (EPS), yield on advance and investment, and profit per employee for Indian banks. The author found an adverse effect of MA on yield, return, and net profit, though there was an increase in assets, equity, investment, advances, and profit per employee. In their work Bianconi and Tan [13], the researchers examined the effect of MA on firm value. The study analyzed a large sample of 65,521 MA deals worldwide over ten years. As a measure of firm value, the authors used enterprise value (EV) to earnings before interests, tax, depreciation and amortization (EBITDA). The study exhibits a positive impact of MA on firm value, while the medium-term effect is found to be unsatisfactory. Renneboog and Vansteenkiste [56] highlighted the limitations of using short-term results (after MA) to predict long-term success, particularly for public sector acquirers, due to a lack of strategic fit. Borodin et al. [15] conducted a comparative analysis of US and European acquirers. The authors examined the relationship between return on sales (ROS) and the equity-to-enterprise value ratio. To investigate the post-MA performance, the researchers utilized several financial indicators, including operating profit, EBITDA, Pre-tax operating cash flow, net operating cash flow, and return on assets (ROA).

The work of Gupta et al. [32] probed into the effect of MA on value creation through sales growth by the firms. The authors focused on assessing the post-MA lagged synergy effect. Yusuf and Ichsan [81] worked on the banking sector to explore the MA effect. The researchers took into consideration variables such as return on assets (ROA), non-performing financing (NPF), fixed deposit receipt (FDR), operational costs as a percentage of operational revenues, loan-to-deposit ratio, and capital adequacy ratio. Aggarwal and Garg [2] stressed three aspects, such as profitability, liquidity, and solvency, to select variables like ROE, return on capital employed (ROCE), ROA, liquid ratio, quick ratio, debt equity ratio, and interest coverage ratio (ICR) for comparing the pre- and post-MA performance. In their work, Liu et al. [42] also considered earnings and losses to gauge the effect of MA. The study of Dağıstanlı [22] selected ratios like ROA, ROE, ROS, firm size, and leverage. In other studies [67; 69] in addition to the previously discussed ratios, the authors considered fixed asset, CPM, current ratio, sales turnover, market-to-book ratio, market value added (MVA), economic value added, cash flow value added, cash flow return on investment, collection period, inventory turnover ratio, equity growth, stock turnover and return as the criteria for assessing MA performance.

It is evident from the above discussion on past studies that a sizeable number of inquiries have been made to understand the effect of MA on firm performance. The researchers considered accounting measures on several occasions. However, the literature needs to be adequately contributed to with a holistic assessment of MA on firm value and performance. We also find a

requirement for standalone year-wise performance assessments to discern the impact of MA. Past studies have primarily utilized time series models and causal analysis. However, the effectiveness of MA depends on multiple criteria. Hence, it calls for a potential application of multi-criteria decision-making (MCDM) models to compare firms. MCDM methods evaluate the performance of available choices, taking into account the weighted effects of the criteria [38]. The existing literature reveals instances where researchers have applied MCDM models in the context of MA (Table 1).

Table 1
Some recent work on using MCDM related to MA

Authors	Method used	Approach	Problem addressed
Li et al. [40]	Slack-based DEA	Crisp set	Measuring MA efficiency
Aksoy [3]	Entropy-MAIRCA framework	Crisp set	Evaluation of market performance vis-à-vis MA
Opoku-Mensah et al. [47]	COPRAS	Interval-valued intuitionistic fuzzy (IVIF) set	Examining the government's role in ensuring synergy in MA
Rishi et al. [57]	AHP	Fuzzy set	Barriers to a successful MA
Dağıstanlı [22]	TOPSIS	Hesitant fuzzy set	Evaluation of MA performance
Venugopal et al. [67]	CoCoSo and ROV	Crisp set	Compare firm performance based on accounting measures.

Therefore, it is evident that the use of MCDM for evaluating the effect of MA on firms' financial performance and valuation is recognized in the literature. Nevertheless, the application of a comprehensive MCDM-based framework is limited.

1.2 Research gaps and objectives

The present study draws its motivation from two gaps in the literature, such as a) the need for a year-wise performance evaluation on account of MA, and b) the development of a comprehensive MCDM-based framework for assessment of MA performance. The research questions that the present work intends to inquire are as follows.

RQ 1. To what extent the firms differ in their performances with respect to MA event?

RQ 2. How can a reliable MCDM framework be developed to discern the performances of the firms?

1.3 Research approach

To this end, the present paper proposes a hybrid LOPCOW-PIV framework for comparing firm performance. In this paper, we consider 14 Indian firms underwent MA deals in recent time. To compare their performance, we set 11 criteria (financial indicators). The details are given in the subsequent section. The LOPCOW (Logarithmic Percentage Change-driven Objective Weighting) method has been developed by [28] to derive criteria weights. Compared to the Entropy method, LOPCOW provides a balanced distribution of criteria weights through adjusting the performance values of the alternatives with the variability for each criterion. The use of a logarithmic function for calculating the percentage values helps in the rational distribution of the criteria weights. Furthermore, Entropy method suffers from the presence of negative or zero values in the decision matrix. LOPCOW removes this barrier. In comparison with the CRITIC method, LOPCOW does not consider correlations among the criteria. LOPCOW enables the decision-maker to work with a large data matrix efficiently and reliably. LOPCOW does not suffer from presence of any outlier performance values and does not require sorting of criteria for calculating the weights [36-37]. LOPCOW method has been found increasingly used in social science, management, engineering and basic science fields [64].

To rank the alternatives (i.e., the firms) the present paper makes use of proximity-indexed value (PIV) method [45]. PIV method offers a number of benefits as compared with popular distance-based approaches like TOPSIS or EDAS. The TOPSIS method is often criticized for the rank reversal phenomenon (RRP). The PIV method does not suffer from RRP. Compared to the EDAS method, PIV does not consider average solution. It works on ideal values. Moreover, it uses a simple calculation of separation from ideal values. PIV has a lower computational complexity and exhibits less sensitivity to data variability [61]. Several researchers have applied PIV in various contexts [59].

1.4 Contributions

The present paper contributes to the volume of literature in two ways. First, in the Indian context, this work provides a holistic, multi-period evaluation of firm performance under MA. In this work, an integration of two perspectives, namely market valuation and fundamental efficiency, is undertaken. Secondly, the present study employs a hybrid MCDM framework utilizing LOPCOW, PIV, Borda Count, and the Rank Index Method (RIM) to evaluate the effect of MA.

The remaining parts of the present paper are described as follows. Section 2 provides the details of the application. Section 3 describes the steps of the LOPCOW-PIV approach. In section 4, key results are exhibited. Section 5 discloses the findings and discusses the inference and implications. Finally, section 6 concludes the paper and mentions some of the future scopes.

2. Case Study

As stated earlier the present work intends to compare the performance of selected firms underwent MA in recent time. In this section, we briefly describe the case study.

2.1 Sample

The selection of companies has been done on the basis of public announcement of some recent MA events (in past 5 years) since 2019 which were in the headline to enhance market presence and hence dive the stock market in positive side. In the following table (Table 2), the list of firms (acquiring firms under comparison in this paper) is exhibited.

Table 2
List of firms for comparison

S/L	Company Name	Description
A1	ITC	Target company: Sunrise Foods Pvt. Ltd (July 2020)
A2	RIL	Target company: 60% of Vitalic Health (August, 2020)
A3	HUL	Target company:GlaxoSmithKline Consumer Limited (Apr, 2020)
A4	Infosys	Target company: Kaleidoscope Innovation (September, 2020)
A5	Adani Green Energy Ltd (AGEL)	Target company: SB Energy Holdings Ltd (SB Energy India) (May, 2021)
A6	Thyrocare	Merger/ Acquirer company: PharmEasy (June 2021)
A7	Adani Enterprise	Target company: The Quint (Jan, 2023)
A8	NDTV	Merger/ Acquirer company: Adani Enterprise (December, 2022)
A9	PVR Inox	Merger of PVR and Inox (February 2023)
A10	HDFC Bank	Merger of HDFC Bank and HDFC Ltd. (July, 2023)
A11	Vodafone Idea	Acquirer company: Govt Acquires Majority Share in Vodafone-Idea (Acquisition February, 2023)
A12	Axis Bank	Target company: Citibank's Retail Business (March, 2023)
A13	IDFC First Bank	Merger with IDFC Ltd (July, 2023)
A14	Bata India	Acquirer company: LIC (March, 2023)

In some occasions, we mention the target firms as the information regarding the acquiring firms is not listed to the stock exchange.

2.2 Data

Data of the merger companies and acquired and target companies have been taken from different sources like Prowess IQ and moneycontrol.com and company website. The period of the study comprises of four consecutive financial years such as FY 2019-20, 2020-21, 2021-22 and 2022-23

2.3 Criteria

In this study, accounting measures reflecting internal and market performance of the firms have been considered. In line with the discussions made in the extant literature, the aspects like profitability (ROE, ROCE, ROA, NPM), efficiency (ATR), liquidity (QR), valuation (Enterprise Value, Market Capitalization) and market performance (EPS, P/BV, stock return) have been considered for selection of criteria to compare the firms (See Table 3).

Table 3
Description of the criteria

S/L	Criteria	Description	Direction	Reference
C1	Return on Net worth / Equity (%)	How efficiently the firm is able to generate profit from equity financing.	Higher is better	[72]
C2	Return on Capital Employed (%)	Earnings before interests and taxes with respect to the capital put in use.	Higher is better	[48]
C3	Return on Assets (%)	Ability of the firm to generate profit utilizing the assets effectively.	Higher is better	[72]
C4	Net Profit Margin (%)	Earnings after tax with respect to net sales	Higher is better	[46]
C5	Asset Turnover Ratio (%)	Efficiency of the firms to use of assets for generating sales	Higher is better	[72]
C6	Quick Ratio (%)	Ability of the firm to meet the short-term liabilities using its current assets.	Higher is better	[62]
C7	Enterprise Value (Rs. Million)	Reflects the market value of the firms	Higher is better	[23]
C8	Market Capitalization (Rs. Million)	Value of the outstanding common shares	Higher is better	[51]
C9	EPS (Value)	Earnings made by the firm for each share of stock	Higher is better	[7]
C10	Price/ BV (Value)	Indicative of company's valuation at market with respect to the book value	Higher is better	[9]
C11	Stock return (Value)	Natural log of (Closing price of current period / Closing price of immediate previous period)	Higher is better	[48]

3. Method

In this section we briefly summarize the computational steps of the MCDM methods used in the study. As stated before, the current work makes use of LOPCOW (for deriving criteria weights), PIV (for performance-based ranking of the firms), Borda Count and RIM (for aggregation of year wise ranks). The steps of the methodological framework are depicted in Figure 1.

In what follows are the procedural steps for the methods used in this study.

Notations

$V = \left(v_{ij}\right)_{m\times n}$: Decision matrix.

$i = 1, 2, ...m$ is the number of alternatives and $j = 1, 2, ...n$ is the number of criteria.

$N = \left(n_{ij}\right)_{m\times n}$: Normalized decision matrix.

W_j: Weight of the j^{th} criterion such that $W_j \geq 0; \sum_{j=1}^{n} W_j = 1$

$R = \left(r_{ij}\right)_{m\times n}$: Weighted normalized decision matrix.

δ_{ij} : Proximity index value of the i^{th} alternative to the ideal solution under j^{th} criterion

Ψ_i : Overall proximity of the i^{th} alternative

f_{ik} : Rank frequency number for the i^{th} alternative at k^{th} rank position.

ξ_{ik} : Membership degree of the i^{th} alternative at k^{th} rank position.

ϕ_i : Final rank index of the i^{th} alternative

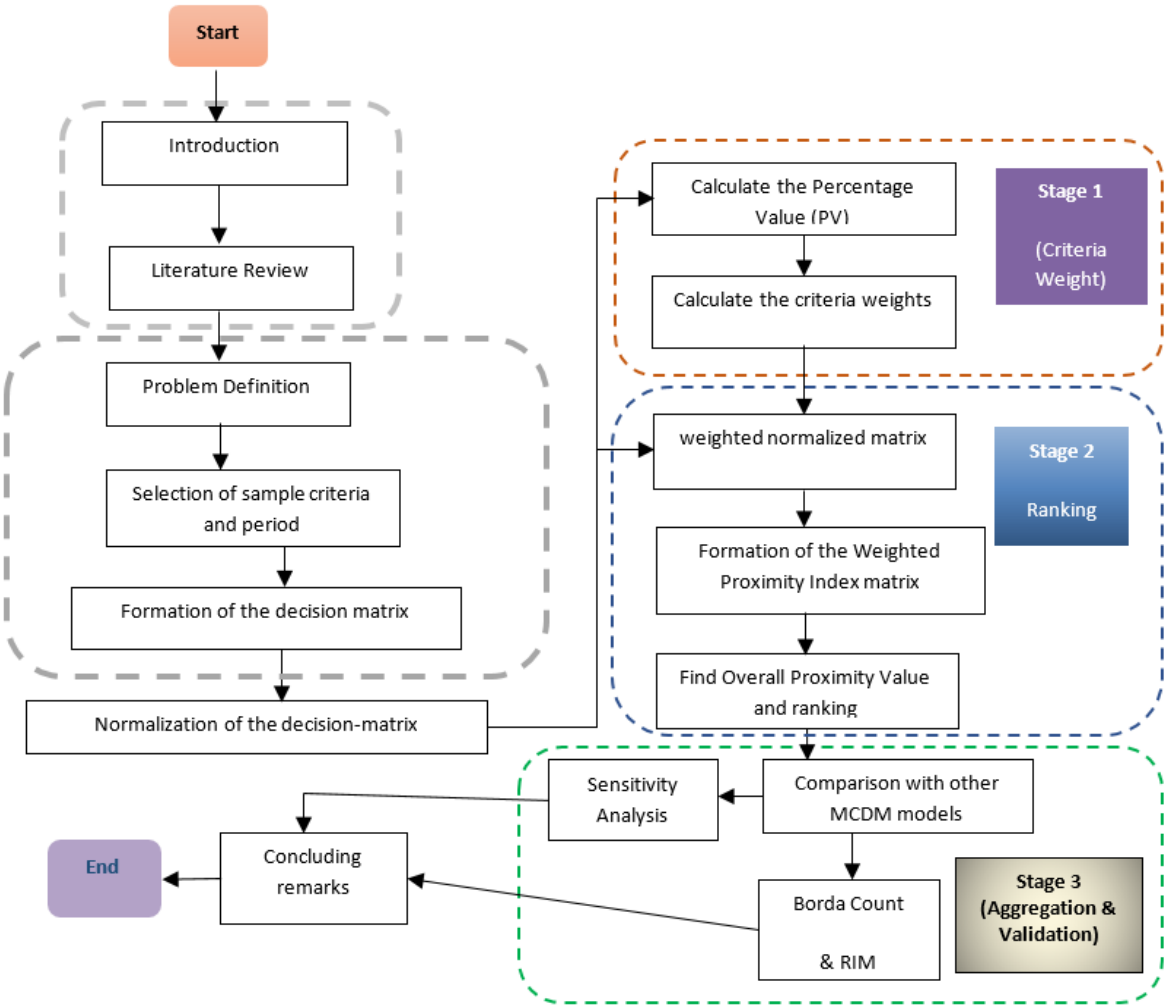

Fig. 1. Flowchart of the research methodology

3.1 LOPCOW

The steps of the LOPCOW method Ecer and Pamucar [28] are discussed below.

Step 1. Normalization of the initial decision matrix

Using the conventional linear max-min normalization the elements of the normalized decision-matrix are obtained as

$$n_{ij} = \begin{cases} \dfrac{v_{ij} - v_j^{\min}}{v_j^{\max} - v_j^{\min}}; \text{ j is beneficial type} \\ \dfrac{v_j^{\max} - v_{ij}}{v_j^{\max} - v_j^{\min}}; \text{ j is non-beneficial type} \end{cases} \quad (1)$$

Step 2. Calculate the percentage value (PV) for each criterion

Taking the natural log of the ratio of mean square to the standard deviation (σ) of the

performance values of the alternatives, PV for j^{th} criterion is computed as

$$\alpha_j = \left| \ln \left(\frac{\sqrt{\frac{\sum_{i=1}^{m} n_{ij}^2}{m}}}{\sigma} \right) .100 \right| \tag{2}$$

Due to presence of the natural log operator and division by standard deviation, the weights of the criteria are rationally calculated.

Step 3. Calculation of the weights of the criteria

The weights for the criteria are calculated as

$$W_j = \frac{\alpha_j}{\sum_{j=1}^{n} \alpha_j} \tag{3}$$

3.2 PIV

The steps of PIV method, as described by Mufazzal and Muzakkir [45], are given below.

Step 1. Normalization of the decision matrix

Here, the normalization approach defined by (1) is followed.

Step 2. Develop the weighted normalized decision matrix

The values for the elements of the weighted normalized decision matrix are calculated by

$$r_{ij} = W_j n_{ij} \tag{4}$$

Step 3. Calculated the proximity values of the alternatives to the ideal solution under each criterion to formulate the weighted proximity index (WPI) matrix

The values of the members of WPI are obtained as follows.

$$\delta_{ij} = \begin{cases} r_j^+ - r_{ij}; \text{ j is beneficial type} \\ r_{ij} - r_j^-; \text{ j is non-beneficial type} \end{cases}$$
$$r_j^+ = \underset{j}{Max}(r_{ij}); \; r_j^- = \underset{j}{Min}(r_{ij}) \tag{5}$$

Step 4. Calculate the overall proximity value for each alternative

$$\Psi_i = \sum_{j=1}^{n} \delta_{ij} \tag{6}$$

The decision rule suggests that the alternative with the least Ψ_i value should be ranked first and other alternatives are subsequently ranking in the descending order of Ψ_i values.

3.3 Borda Count

The Borda Count method was introduced date back Borda J [14] for aggregating preferences of the opinion-makers during voting. Afterward, the method has been used to aggregate the ranking results obtained by using various MCDM models [10; 53]. In this work we use the Borda Count method for obtaining the aggregated rank of each alternative over the total study period. The procedural steps for aggregation of year wise ranking results are described below.

Step 1. Obtain the year wise ranking of the alternatives using the MCDM model.

Step 2. Allocation of points to the alternatives

Each alternative is allocated a position-based point for every year. Suppose for a given year, the i^{th} alternative holds the first rank. Then the alternative is assigned a point value = $(m-1)$ = the number of alternatives succeeding to the same. In a similar way, the second-best alternative is assigned a point value of $(m-2)$ and so on.

Step 3. Obtain the total point value for each alternative

The alternative that obtains the highest total point value will be treated as the best possible choice. The other alternatives are ranked in descending order based on the obtained total point values.

3.4 RIM

RIM has been developed as an aggregation technique for the MCDM models [53]. The method has been used in various situations for aggregation purpose [39; 42; 70]. The procedural steps are as follows.

Step 1. Construct the rank frequency matrix

Suppose there are m alternatives. Therefore, the values for the rank frequency matrix $RF=\left(f_{ik}\right)_{m\times m}$ are obtained as

$$f_{ik}=\sum_{t=1}^{t} s_{ik}^{(t)} \tag{7}$$

$s_{ik}^{(t)}$ denotes the rank state variable for the i^{th} alternative at a given rank position k for the t^{th} year ($i=1,2...m;\ k=1,2...m;\ t=1,2...t$)

Step 2. Derive the membership degree for each alternative

The membership degree for the i^{th} alternative at a given rank position k is obtained as

$$\xi_{ik}=\frac{f_{ik}}{t};\ \sum_{k=1}^{m}\xi_{ik}=1 \tag{8}$$

Step 3. Compute the final rank index score

The final rank index score for the i^{th} alternative is computed as

$$\phi_i=\sum_{k=1}^{m} k\xi_{ik} \tag{9}$$

The alternative which holds the least final rank index score is ranked first.

4. Findings

In this section we exhibit the results of data analysis using the methods described in section 3. The decision matrices for various years are given in Appendix A.

First, we proceed to find the criteria weights using LOPCOW method. By applying equation (1) the initial decision matrix is normalized. In this study, 14 firms are compared subject to the effects of 11 criteria over a period of four consecutive financial years FY 2019-20, 2020-21, 2021-22 and 2022-23. Therefore, we have $m=14,\ n=11$ and $t=4$. It may be noted that all criteria are of beneficial (i.e., higher is better) type. Table 4 provides the normalized decision matrix for FY 2019-20 as an example.

Table 4
Normalized decision matrix (FY 2019-20)

Criteria/ Alternatives	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
A1	0.933	0.370	0.785	1.000	0.306	0.055	0.121	0.280	0.668	0.043	0.179
A2	0.915	0.156	0.530	0.878	0.175	0.006	0.562	1.000	1.000	0.019	0.325
A3	1.000	1.000	1.000	0.920	1.000	0.045	0.290	0.268	0.839	1.000	0.505
A4	0.934	0.391	0.771	0.931	0.493	0.153	0.153	0.302	0.881	0.061	0.341
A5	0.917	0.152	0.513	0.886	0.098	0.086	0.015	0.146	0.563	0.262	1.000
A6	0.930	0.485	0.752	0.932	0.458	0.095	0.001	0.001	0.692	0.102	0.376
A7	0.927	0.285	0.558	0.853	0.590	0.036	0.010	0.175	0.613	0.055	0.402
A8	0.912	0.163	0.510	0.861	0.162	0.032	0.000	0.000	0.574	0.000	0.287
A9	0.909	0.163	0.488	0.836	0.226	0.017	0.004	0.006	0.609	0.057	0.272
A10	0.924	0.099	0.508	0.948	0.000	0.944	1.000	0.595	0.790	0.034	0.276
A11	0.000	0.000	0.000	0.000	0.098	0.000	0.061	0.044	0.324	0.005	0.000
A12	0.909	0.092	0.484	0.845	0.000	1.000	0.479	0.181	0.000	0.010	0.133
A13	0.886	0.079	0.453	0.740	0.000	0.504	0.076	0.029	0.419	0.000	0.040
A14	0.926	0.279	0.614	0.886	0.413	0.068	0.009	0.008	0.787	0.126	0.344

Example of calculation

$$n_{12} = \frac{v_{12} - v_2^{\min}}{v_2^{\max} - v_2^{\min}} = \frac{29.26 - (-6.11)}{89.49 - (-6.11)} = \frac{35.37}{95.6} \approx 0.370$$

Next, by applying the equations (2) and (3) the criteria weights for FY 2019-20 are calculated. For example, PV for the 2nd criterion is calculated as

$$\alpha_2 = \left| \ln \left(\frac{\sqrt{\frac{\sum_{i=1}^{14} n_{i2}^2}{14}}}{\sigma} \right) .100 \right| = \left| \ln \left(\frac{\sqrt{\frac{n_{12}^2 + n_{22}^2 + n_{32}^2 + ... + n_{(14)2}^2}{14}}}{\sigma} \right) .100 \right|$$

$$= \left| \ln \left(\frac{\sqrt{\frac{0.1369 + 0.0245 + ... + 0.0777}{14}}}{0.2518} \right) .100 \right| = 35.5946$$

In this way, the PVs for all other criteria are obtained. The weight of the 2nd criterion is calculated as

$$W_2 = \frac{\alpha_2}{\sum_{j=1}^{11} \alpha_j} = \frac{\alpha_2}{\alpha_1 + \alpha_2 + ... + \alpha_{11}} = \frac{35.5946}{127.7697 + 35.5946 + ... + 49.7849} = 0.0568$$

In this way, the weights of all criteria are calculated for FY 2019-20 and recorded in Table 5.

Table 5
Calculation of criteria weights (FY 2019-20)

Criteria	C1	C2	C3	C4	C5	C6
PV	127.7697	35.5946	98.6604	125.2043	33.6663	14.1658
W	0.2038	0.0568	0.1574	0.1997	0.0537	0.0226
Criteria	C7	C8	C9	C10	C11	
PV	16.2595	21.0980	97.0829	7.6328	49.7849	
W	0.0259	0.0337	0.1549	0.0122	0.0794	
(Sum (PV)=	626.919)					

The similar approach is followed to calculate the criteria weights for all other FYs (see Table 6).

Table 6
Calculation of criteria weights for all FYs

	Criteria weights					
Year	C1	C2	C3	C4	C5	C6
FY 19-20	**0.2038**	0.0568	0.1574	0.1997	0.0537	0.0226
FY 20-21	0.1776	0.0817	0.1443	**0.1959**	0.0487	0.0221
FY 21-22	0.1828	0.0811	0.1281	0.1858	0.0673	0.0230
FY 22-23	0.1119	0.0786	0.1441	**0.2134**	0.0561	0.0224
Year	C7	C8	C9	C10	C11	
FY 19-20	0.0259	0.0337	0.1549	0.0122	0.0794	
FY 20-21	0.0310	0.0342	0.1808	0.0165	0.0673	
FY 21-22	0.0354	0.0375	**0.1860**	0.0105	0.0626	
FY 22-23	0.0334	0.0383	0.1370	0.0601	0.1047	

It is seen that C4 in two occasions hold the highest weight. For other two years, it is also on the higher side. Therefore, it may be inferred that calculation reflects the higher preference for net profit margin (C4). The next job is to compare the firms and rank them using PIV method. In this regard, the normalized decision matrices and calculated weights are first used to construct the weighted normalized decision matrices, given in Table 7-9.

In what follows is a sample demonstration of ranking of alternatives for FY 2019-20. After obtaining the normalized decision matrix (see Table 4), we utilize equations (4) to (6) and calculated criteria weights to determine the overall proximity value (OPV) for each alternative.

Table 7
Weighted normalized decision-matrix (FY 2019-20)

Criteria/ Alternatives	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
A1	0.1901	0.0210	0.1235	0.1997	0.0164	0.0012	0.0031	0.0094	0.1034	0.0005	0.0142
A2	0.1865	0.0089	0.0834	0.1753	0.0094	0.0001	0.0146	0.0337	0.1549	0.0002	0.0258
A3	0.2038	0.0568	0.1574	0.1837	0.0537	0.0010	0.0075	0.0090	0.1300	0.0122	0.0401
A4	0.1904	0.0222	0.1213	0.1860	0.0265	0.0034	0.0040	0.0102	0.1364	0.0007	0.0270
A5	0.1869	0.0086	0.0808	0.1770	0.0053	0.0020	0.0004	0.0049	0.0872	0.0032	0.0794
A6	0.1895	0.0275	0.1183	0.1861	0.0246	0.0021	0.0000	0.0000	0.1072	0.0012	0.0299
A7	0.1890	0.0162	0.0878	0.1704	0.0317	0.0008	0.0003	0.0059	0.0950	0.0007	0.0320
A8	0.1859	0.0092	0.0803	0.1720	0.0087	0.0007	0.0000	0.0000	0.0889	0.0000	0.0228
A9	0.1852	0.0092	0.0768	0.1670	0.0121	0.0004	0.0001	0.0002	0.0943	0.0007	0.0216
A10	0.1882	0.0056	0.0799	0.1892	0.0000	0.0213	0.0259	0.0200	0.1224	0.0004	0.0219
A11	0.0000	0.0000	0.0000	0.0000	0.0053	0.0000	0.0016	0.0015	0.0501	0.0001	0.0000
A12	0.1852	0.0052	0.0762	0.1687	0.0000	0.0226	0.0124	0.0061	0.0000	0.0001	0.0105
A13	0.1805	0.0045	0.0713	0.1477	0.0000	0.0114	0.0020	0.0010	0.0650	0.0000	0.0032
A14	0.1886	0.0158	0.0966	0.1769	0.0222	0.0015	0.0002	0.0003	0.1219	0.0015	0.0273

For instance, the weighted normalized value for A1 under C2 is calculated as

$$r_{12} = W_2 n_{12} = 0.0568 \times 0.370 = 0.0210$$

In this way, we calculate the weighted normalized values for all alternatives under the influence of different criteria.

Table 8
Weighted normalized decision-matrix (FY 2020-21)

Criteria/ Alternatives	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
A1	0.1648	0.0683	0.1301	0.1959	0.0003	0.0006	0.0037	0.0096	0.1409	0.0009	0.0064
A2	0.1236	0.0245	0.0839	0.1871	0.0133	0.0006	0.0209	0.0342	0.1808	0.0006	0.0186
A3	0.1505	0.0503	0.1094	0.1895	0.0319	0.0008	0.0080	0.0094	0.1662	0.0021	0.0000
A4	0.1732	0.0766	0.1333	0.1916	0.0433	0.0031	0.0080	0.0105	0.1755	0.0014	0.0235
A5	0.1623	0.0367	0.0804	0.1881	0.0082	0.0001	0.0025	0.0050	0.1320	0.0165	0.0660
A6	0.1776	0.0817	0.1443	0.1940	0.0425	0.0029	0.0001	0.0000	0.1540	0.0019	0.0203
A7	0.1295	0.0582	0.0813	0.1814	0.0487	0.0008	0.0016	0.0058	0.1331	0.0046	0.0673
A8	0.1411	0.0433	0.0906	0.1906	0.0142	0.0004	0.0000	0.0000	0.1358	0.0003	0.0277
A9	0.0000	0.0000	0.0415	0.0000	0.0014	0.0007	0.0001	0.0002	0.0000	0.0008	0.0037
A10	0.1465	0.0198	0.0780	0.1943	0.0000	0.0221	0.0310	0.0206	0.1598	0.0008	0.0170
A11	0.1055	0.0041	0.0000	0.1175	0.0097	0.0000	0.0026	0.0015	0.1119	0.0000	0.0444
A12	0.1229	0.0184	0.0744	0.1856	0.0000	0.0214	0.0143	0.0063	0.0929	0.0005	0.0216
A13	0.1123	0.0163	0.0732	0.1814	0.0000	0.0132	0.0023	0.0010	0.1263	0.0004	0.0328
A14	0.0917	0.0123	0.0638	0.1769	0.0242	0.0019	0.0002	0.0003	0.1218	0.0018	0.0027

Then we find out the ideal solution with respect to each criterion. Since, in this study, all criteria are of beneficial type, we derive the ideal values as follows.

$$r_1^+ = \underset{i=1,2...14}{Max}(r_{i1}) = 0.2038; r_2^+ = 0.0568; r_3^+ = 0.1574; r_4^+ = 0.1997$$

$$r_5^+ = 0.0537; r_6^+ = 0.0226; r_7^+ = 0.0259; r_8^+ = 0.0337; r_9^+ = 0.1549$$

$$r_{10}^+ = 0.0122; r_{11}^+ = 0.0794$$

Table 9
Weighted normalized decision-matrix (FY 2021-22)

Criteria/ Alternatives	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
A1	0.1656	0.0669	0.1108	0.1818	0.0321	0.0007	0.0044	0.0108	0.1238	0.0003	0.0114
A2	0.1200	0.0250	0.0608	0.1501	0.0190	0.0005	0.0285	0.0375	0.1860	0.0002	0.0150
A3	0.1475	0.0468	0.0871	0.1646	0.0307	0.0008	0.0070	0.0110	0.1583	0.0006	0.0030
A4	0.1828	0.0800	0.1150	0.1704	0.0460	0.0022	0.0115	0.0118	0.1760	0.0006	0.0163
A5	0.0861	0.0157	0.0460	0.1325	0.0203	0.0000	0.0046	0.0054	0.1066	0.0105	0.0626
A6	0.1788	0.0811	0.1281	0.1824	0.0424	0.0039	0.0000	0.0000	0.1463	0.0004	0.0050
A7	0.1395	0.0510	0.0572	0.1383	0.0673	0.0005	0.0033	0.0064	0.1160	0.0025	0.0273
A8	0.1448	0.0420	0.0767	0.1798	0.0135	0.0004	0.0000	0.0000	0.1196	0.0003	0.0501
A9	0.0000	0.0045	0.0256	0.0623	0.0045	0.0003	0.0002	0.0002	0.0000	0.0005	0.0208
A10	0.1400	0.0159	0.0523	0.1858	0.0005	0.0230	0.0354	0.0226	0.1610	0.0002	0.0072
A11	0.0968	0.0000	0.0000	0.0000	0.0059	0.0000	0.0032	0.0016	0.0951	0.0000	0.0160
A12	0.1285	0.0140	0.0501	0.1684	0.0000	0.0202	0.0167	0.0069	0.1323	0.0001	0.0103
A13	0.0987	0.0133	0.0468	0.1350	0.0018	0.0153	0.0026	0.0011	0.1006	0.0001	0.0000
A14	0.1124	0.0254	0.0558	0.1411	0.0289	0.0013	0.0003	0.0003	0.1178	0.0008	0.0169

The proximity value for A1 to the ideal solution r_1^+ with respect to C1 is obtained as

$$\delta_{11} = r_1^+ - r_{11} = 0.2038 - 0.1901 = 0.0137$$

In similar way the proximity values for all alternatives to ideal solutions subject to various criteria are obtained. Next, we find the overall proximity score for the alternatives. For instance, OPV for A1 is obtained as

$$\Psi_1 = \sum_{j=1}^{11} \delta_{1j} = \delta_{11} + \delta_{12} + ... + \delta_{1(11)} = 0.3173$$

Table 10 exhibits the OPVs for all alternatives and their ranks (for FY 2019-20).

Table 10
Ranking of alternatives (FY 2019-20)

Company	ψ	Rank	Company	ψ	Rank
A1	0.3173	5	A8	0.4315	10
A2	0.3073	3	A9	0.4323	11
A3	0.1449	1	A10	0.3251	6
A4	0.2718	2	A11	0.9415	14
A5	0.3644	8	A12	0.5130	12
A6	0.3134	4	A13	0.5136	13
A7	0.3704	9	A14	0.3471	7

In the similar fashion, we find out the ranking of the alternatives for all FYs (see Table 11).

Table 11
Summary of year wise ranking of the alternatives

Year/ Company	Rank 19-20	20-21	21-22	22-23	Year/ Company	Rank 19-20	20-21	21-22	22-23
A1	5	3	3	2	A8	10	9	7	11
A2	3	8	6	5	A9	11	14	14	13
A3	1	4	4	3	A10	6	7	5	4
A4	2	1	1	1	A11	14	13	13	14
A5	8	6	11	12	A12	12	11	9	8
A6	4	2	2	10	A13	13	10	12	9
A7	9	5	8	6	A14	7	12	10	7

It is evident that there are variations in the ranking order year-on-year. Hence, it is required to aggregate the year wise ranking for getting an overall ranking order. To this end, both Borda count and RIM methods are utilized. Table 12 and 13 show the calculations for RIM method.

Table 12
Rank frequency matrix

Company	Rank positions													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
A1	0	1	2	0	1	0	0	0	0	0	0	0	0	0
A2	0	0	1	0	1	1	0	1	0	0	0	0	0	0
A3	1	0	1	2	0	0	0	0	0	0	0	0	0	0
A4	3	1	0	0	0	0	0	0	0	0	0	0	0	0
A5	0	0	0	0	0	1	0	1	0	0	1	1	0	0
A6	0	2	0	1	0	0	0	0	0	1	0	0	0	0
A7	0	0	0	0	1	1	0	1	1	0	0	0	0	0
A8	0	0	0	0	0	0	1	0	1	1	1	0	0	0
A9	0	0	0	0	0	0	0	0	0	0	1	0	1	2
A10	0	0	0	1	1	1	1	0	0	0	0	0	0	0
A11	0	0	0	0	0	0	0	0	0	0	0	0	2	2
A12	0	0	0	0	0	0	0	1	1	0	1	1	0	0
A13	0	0	0	0	0	0	0	0	1	1	0	1	1	0
A14	0	0	0	0	0	0	2	0	0	1	0	1	0	0

Note that each cell value denotes number of times the corresponding rank position held by the concerned alternative. For example, in case of A1, $f_{13} = 2$ means that A1 held 2 times the 3rd rank position during the study period of four years. Using the Table 12 we obtain the membership degrees for all alternatives (the number of periods aggregated is four, i.e., t = 4), given in Table 13.

Table 13
Membership degrees of the alternatives

Company	Rank positions													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
A1	0.00	0.25	0.50	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A2	0.00	0.00	0.25	0.00	0.25	0.25	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00
A3	0.25	0.00	0.25	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A4	0.75	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A5	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.25	0.00	0.00	0.25	0.25	0.00	0.00
A6	0.00	0.50	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00
A7	0.00	0.00	0.00	0.00	0.25	0.25	0.00	0.25	0.25	0.00	0.00	0.00	0.00	0.00
A8	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.25	0.25	0.25	0.00	0.00	0.00
A9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.25	0.50
A10	0.00	0.00	0.00	0.25	0.25	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50
A12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.00	0.25	0.25	0.00	0.00
A13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.00	0.25	0.25	0.00
A14	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.25	0.00	0.25	0.00	0.00

For example, the membership degree for A1 at 3rd position is obtained as

$$\xi_{13} = \frac{f_{13}}{4} = \frac{2}{4} = 0.50$$

Then, we calculate the rank index scores for all alternatives (Table 14).

Table 14
Calculated rank index scores for all alternatives

Company	Score	Rank	Company	Score	Rank
A1	3.25	3	A8	9.25	10
A2	5.50	5	A9	13.00	13
A3	3.00	2	A10	5.50	6
A4	1.25	1	A11	13.50	14
A5	9.25	9	A12	10.00	11
A6	4.50	4	A13	11.00	12
A7	7.00	7	A14	9.00	8

We also apply Borda Count method to aggregate year wise ranking (see Table 15).

Table 15
Overall ranking of alternatives aggregating year wise result (Borda Count)

Company	Rank based number				Borda Count	Final Rank_ BORDA
	19-20	20-21	21-22	22-23		
A1	9	11	11	12	43	3
A2	11	6	8	9	34	5
A3	13	10	10	11	44	2
A4	12	13	13	13	51	1
A5	6	8	3	2	19	9
A6	10	12	12	4	38	4
A7	5	9	6	8	28	7
A8	4	5	7	3	19	10
A9	3	0	0	1	4	13
A10	8	7	9	10	34	6
A11	0	1	1	0	2	14
A12	2	3	5	6	16	11
A13	1	4	2	5	12	12
A14	7	2	4	7	20	8

It is seen that Borda Count and RIM method provides consistent aggregated ranking.

4.1 Comparison with other MCDM models

The effectiveness of the ranking result obtained by MCDM models depend on several external conditions like selection of normalization technique, number of alternatives and criteria and their selection, interplay between an alternative and criterion, procedural steps to calculate the final

appraisal score and so on [50]. Hence, it is a custom to compare the ranking results of several MCDM models to ascertain the reliability of the outcome. In this work, we compare the result obtained by using our PIV model with other MCDM methods like MABAC, SAW [72] and CRADIS. Figure 2 shows the result of comparative analysis of MCDM models for FY 2019-20, which reflects that there is no change in the ranking order. In the similar way, we conduct the comparative analysis for all other years and do not find any significant change. Hence, the result obtained in this study is reliable.

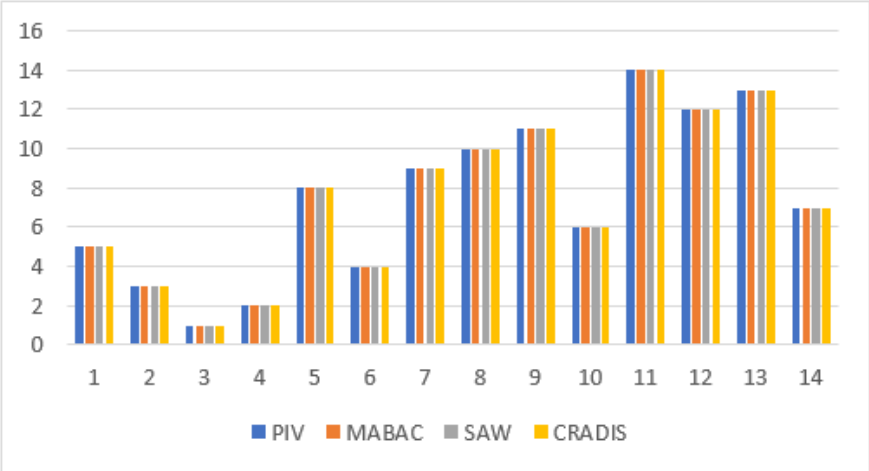

Fig. 2. Comparison of ranking by MCDM models (FY 2019-20)

4.2 Sensitivity analysis

Often it is seen that there is a significant instability in the result obtained by a MCDM model subject to variations in the external conditions [77]. Some variations like changes in the criteria weights (subsequently, creating difference in the criteria influences), alternation of criteria and alternative set (changing the dynamics of decision-matrix), exchange of optimal and sub-optimal effects among others often influence the final outcome and cause instability of the results [27; 54; 60; 64; 71]. To examine the stability of the result obtained by using PIV method, a sensitivity analysis is carried out. We follow the scheme suggested in the extant literature [50], i.e., varying the weights of the criteria (see Table 16).

Table 16
Experimental cases for sensitivity analysis (FY 21-22)

Cases	C1	C2	C3	C4	C5	C6
Initial	0.1828	0.0811	0.1281	0.1858	0.0673	0.0230
Case 1	0.1846	0.0830	0.1300	0.1876	0.0691	0.0249
Case 2	0.1865	0.0848	0.1318	0.1895	0.0710	0.0267
Case 3	0.1884	0.0867	0.1337	0.1913	0.0728	0.0286
Case 4	0.1902	0.0886	0.1355	0.1932	0.0747	0.0305
Case 5	0.1921	0.0904	0.1374	0.1951	0.0766	0.0323
Case 6	0.1939	0.0923	0.1393	0.1969	0.0784	0.0342
Case 7	0.1958	0.0941	0.1411	0.1988	0.0803	0.0360
Case 8	0.1977	0.0960	0.1430	0.2006	0.0821	0.0379
Case 9	0.1995	0.0979	0.1448	0.2025	0.0840	0.0398

Table 16 (Contd.)
Experimental cases for sensitivity analysis (FY 21-22)

Cases	C7	C8	C9	C10	C11
Initial	0.0354	0.0375	0.1860	0.0105	0.0626
Case 1	0.0373	0.0393	0.1674	0.0123	0.0645
Case 2	0.0391	0.0412	0.1488	0.0142	0.0664
Case 3	0.0410	0.0430	0.1302	0.0160	0.0682
Case 4	0.0429	0.0449	0.1116	0.0179	0.0701
Case 5	0.0447	0.0468	0.0930	0.0198	0.0719
Case 6	0.0466	0.0486	0.0744	0.0216	0.0738
Case 7	0.0484	0.0505	0.0558	0.0235	0.0757
Case 8	0.0503	0.0523	0.0372	0.0253	0.0775
Case 9	0.0522	0.0542	0.0186	0.0272	0.0794

We do not notice any significant variations in the ranking order. In similar way, we perform SA for all other years and do not notice significant instability. Therefore, we contend that the result is stable. Figure 3 shows the result of SA for FY 2021-22.

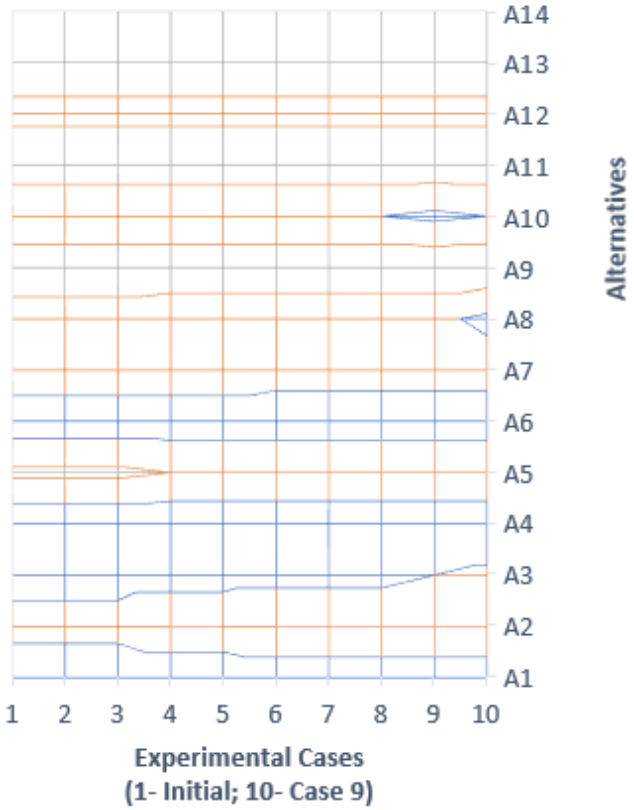

Fig. 3. Sensitivity analysis outcome (FY 2021-22)

5. Discussion

The study reveals some interesting observations. The calculation of year wise criteria weights indicates that there is no criterion that held highest weight every period. It reflects variations in the influence of the criteria on the alternatives. From Table 6 it is observed that ROE (C1), Net Profit Margin (C4) and EPS (C9) obtained the highest weights over the study period. The significance of ROE in the context of successful MA can be traced in existing body of literature. The study pointed out that in the post-MA phase ROE is the only indicator got most affected for the banks. The study of Gupta et al. [32] also considered ROE as a significant indicator to showcase the effect of MA. [30] advocated for achieving an improvement in ROE covering the acquisition price for the success of MA. In some other studies Aggarwal and Garg [2] Dağıstanlı [22], the authors delineated on the success or

failure of MA in terms of profitability and synergy by analyzing ROE. Moreover, a potential investor looks at ROE as an essential indicator that showcases the profitability of a firm.

Net profit margin (C4) obtained the highest weight for two FYs. One of the fundamental motives for MA is to improve the net profit [35; 52]. An increase in the net profit margin not only helps to improve the bottom line and financial health of the organization but also attracts potential investments and affect the stock price [19; 50]. Therefore, net profit margin stands as an essential indicator to gauge the effect of MA. Further, Choiriyah et al. [19] argued that EPS is a significant influencer of stock price movement. To sum up, the calculated weights exhibit a dominance of the criteria related to earning which an essential motive for MA [52]. Thus, the calculated weights support the views of the literature.

Looking at year wise ranking it is observed that there are variations in the ranking order of the firms supporting the fundamental motive behind undertaking the present research. The present research is distinct in two ways, such as year wise standalone assessment of MA performance over four consecutive financial years and multiple-indicators based comprehensive evaluation of firm performance. On aggregate, we find that Infosys (A4), HUL (A3) and ITC (A1) showed top performance while Vodafone (A11), PVR Inox (A9) and IDFC First Bank (A13) remained in the bottom bracket. It can be inferred that IT and FMCG firms demonstrated a better effect of MA as it helped them to diversify and expand. From Table 11 that A4 gained the top performance since FY 20-21 and hold the top position thereof. Despite the recent pandemic, the IT firm like Infosys could show better financial performance. The top performance of A4 refutes the views of [68]. On the other hand, some studies like Amudha and Kaviarasan [5] found that MA helped in increasing the stock price and profitability of the acquirer in IT sector. However, a better performance of FMCG firms on account of MA has been reported by the past studies [68]. We notice that telecom company like A11, entertainment and media firm like PVR and IDFC bank did not perform well during MA. In past few years, Vodafone has faced a stiff challenge from Jio and also from the other major players in telecom industry. In fact, the telecom sector has shown a significant competitive dynamic in recent years. The entertainment and media sector has also been impacted with the advent of OTT. The company like PVR Inox has also faced a notable change in the competitive space. The banking sector has suffered notably due to recent pandemic. We surmise that the poor performance of A11, A9 and A13 could be because of changes and dynamics in the competitive space and volatility in the business environment.

From the technical point of view, it is noted that our model shows a considerable reliability and stability. The comparative analysis of various MCDM models with our method shows that there is a significant consistency in the ranking order. It indicates that the MCDM models converge to a unanimous decision. Further, the sensitivity analysis reveals that there is no significant variation in the ranking order despite changes in the external conditions. For instance, in FY 21-22, the criterion C9 (EPS) obtained the highest weight. On varying the weight of C9 and other criteria (reduction of 10% at every step while increasing the weights of others proportionately) the ranking of the top three and bottom three performers did not vary. There have been minor variations for some other alternatives. The same pattern has been found for all other years. Therefore, the framework used in this paper is simple yet provides a reliable and stable solution.

Hybrid MCDM models face some limitations. Hybridization of several MCDM models leads to complexity in design and implementation. The data requirement varies from model to model. Bringing all requirements to one platform is a concern. The MCDM models also different in terms of approaches to find out final appraisal scores. Some models use simple additive approach while some others use utility based or ratio-based method. Some methods use normalization at the beginning while there are methods that do not use normalization of decision matrix or carry out at the end. A deep understanding of each model is required. The models need to be compatible. In many instances,

seamless integration becomes an issue. There is another concern of lack of ability to generalize the findings. Sometime overfitting becomes a challenge. Hybridization often undermines the reliability and validity of the results. Finally, the present paper uses a time span to gauge MA performance. However, this paper has not used the econometric approach [74].

The weighting methods using objective information are data-driven. The weights are calculated using empirical evidences by applying mathematical models and statistical methods. There are several objective weighting methods like Entropy method, CRITIC (Criteria importance through inter-criteria), SD (standard deviation) method, SV (standard variance) procedure, mean weight or MW method among others. LOPCOW is a recently developed objective weighting method. The advantages of objective methods over their subjective counterparts include minimization of bias (that might occur because of subjective judgement), accurate reflection of criteria influence, better consistency and transparency, ease of implementation, reproducibility and scalability and ability to handle large dataset. However, subjective methods provide a better flexibility than objective approaches and help the decision-making evolving with theories and consider opinions of the domain experts [1; 18; 49]. In view of the same, the present model is limited to objective information which could be further extended by using fuzzy numbers [32], spherical fuzzy numbers [78], Pythagorean Fuzzy [8], linear Diophantine fuzzy [79], neutrosophic fuzzy [12]complex T-Spherical fuzzy [61], interval-valued fuzzy [55], intutionistic fuzzy [43], neural Bayesian or DEA [44].

The research has several implications. Firstly, the present research provides a comprehensive, multi-criteria-based evaluation of firm performance for both the pre- and post-M&A periods. Earlier studies attempted to determine the effect of MA on firm performance by examining the causal impact on various financial indicators in a fragmented manner. In this context, the present work demonstrated a continuum of year-wise standalone performances to enfold the pattern of the effect of MA. Furthermore, in the current work, we have considered accounting measures that reflect the internal and market performance of the firms. Thus, the present work provides a clinical introspection of firm performance. In effect, the approach and outcome of the current study shall provide a new strategic framework for the market analysts and corporate decision-makers. In addition, the technical strength and simplicity of the integrated analytical framework, utilizing LOPCOW, PIV, RIM, and Borda count methods, offer an effective technique for researchers to apply in real-life problems. Nevertheless, the proposed approach of the current work will also be of use to investors who wish to analyze firm performance (especially acquirers) when deciding on an investment.

6. Conclusion and Future Scope

In the current research an inquiry has been made to discern the performance of some of the firms that closed the deal of MA in recent time. A total 14 such firms across the industries have been compared under the effect of 11 financial indicators (comprising of accounting measures indicating internal and market performance) over four consecutive financial years 2019-20 to 2022-23. To compare the firms, we have considered the aspects like profitability (ROE, ROCE, ROA, NPM), efficiency (ATR), liquidity (QR), valuation (Enterprise Value, Market Capitalization) and market performance (EPS, P/BV, stock return). It is observed that ROE, NPM and EPS held the higher calculated weights over the years. We have observed that there is a variation in the ranking order over the years. However, it is noticed that IT and FMCG companies like Infosys, HUL and ITC remained in the top frame while the companies like PVR, Vodafone and IDFC bank did not perform well on aggregate. The present paper has used an integrated framework of LOPCOW, PIV, RIM, and Borda count methods that offers a simple yet reliable and stable results.

The current work has several significances from theoretical and practical point of views. First, the present work is apparently a rare one that developed a multi criteria based holistic evaluation

framework (integrating market valuation and fundamental performance) to assess firm performance vis-à-vis MA in Indian context. Second, the ongoing work has demonstrated a nuanced approach to emphasize key performance indicators such as ROE, NPM and EPS for evaluating MA performance. The KPIs shall help the investors and market analysts to follow an easy approach for examining investment potentials. This would also help in developing a reliable strategic framework for analyzing firm performance post-MA. This can aid in making informed investment decisions and formulating policies. Third, the current study has developed an innovative hybrid MCDM framework as a symbiosis of multiple reliable methods like LOPCOW, PIV, Borda Count and RIM. The developed framework shall be useful in various practical decision-making problems.

The present paper has a number of scopes for further extensions. First, the current work has considered accounting based measures wherein we have not included the aspects like employee performance, cultural change, financial stability, dividend payout etc. In a future work, these criteria can be considered for exploring MA performance. Secondly, a future work may consider short-term stock market reaction on MA and design an event study to understand the stock market performance. Thirdly, a causal model may be established and examined to understand the impact of value generation and value realization by the firms through MA. In this regard, the mediating and moderating roles of firm size, product line, years of existence, asset base, reputation, CEO quality and governance can also be examined. To this end, our technical framework may be extended using fuzzy and rough numbers to carry out the analysis based on subjective information. Nevertheless, the present study provides distinct benefits to the researchers, analysts and policy-makers.

Author Contributions

Conceptualization: all authors; Data collection and curation: SD; Methodology: SB, DB; Data analysis: SD, SB; Validation: SB, DB, GM; Writing original draft: SD, SB; Writing editing and finalization: DB, GM; Supervision: GM

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Data Availability Statement

We have used secondary data available in the public domain. Necessary information is provided in the Appendix section to reproduce the results shown in the paper. We declare that no ethical violation has been made. The views expressed in this paper are of the researchers only.

Conflicts of Interest

The authors declare no conflict of interest and no known competing financial interests

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Declaration

The authors would like to declare that the present work is an original work and has not been submitted as of now.

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Appendix A.

Table A.1.
Decision Matrix for FY 2019-20

Criteria/ Alternative	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
A1	23.63	29.26	20.11	33.17	60.63	1.18	204588.2	544645.97	12.31	3.3	-49.08
A2	7.89	8.84	3.18	9.17	34.67	0.33	950998.06	1940858.37	48.75	1.8	-11.92
A3	83.89	89.49	34.37	17.37	197.86	1.02	491383.4	520551.94	31.13	61.81	33.91
A4	24.97	31.28	19.17	19.66	97.53	2.88	259077.74	588042.73	35.68	4.38	-7.90
A5	9.32	8.43	2.09	10.76	19.49	1.73	25452.33	284832.8	0.86	16.7	160.18
A6	20.97	40.25	17.92	19.77	90.65	1.88	2611.19	3345.55	15.01	6.92	1.16
A7	18.58	21.12	5.03	4.31	116.73	0.85	17072.6	341236.54	6.35	4.02	7.87
A8	5.26	9.43	1.88	5.86	32.11	0.78	242.34	1428.04	2.02	0.66	-21.52
A9	2.06	9.45	0.41	0.91	44.79	0.53	6857.75	12963.56	5.87	4.15	-25.30
A10	15.35	3.33	1.71	22.86	0.09	16.62	1692584.96	1154649.98	25.74	2.76	-24.36
A11	-812.45	-6.11	-31.95	-163.55	19.53	0.23	102837.51	87691.68	-25.45	0.99	-94.71
A12	1.91	2.68	0.17	2.59	0.08	17.6	810126.08	352292.56	-60.94	1.26	-60.93
A13	-18.66	1.4	-1.91	-18.05	0.11	8.98	129274.13	57234.77	-14.93	0.66	-84.48
A14	17.23	20.54	8.75	10.7	81.75	1.41	14861.37	17202.77	25.44	8.34	-7.14

Table A.2.
Decision Matrix for FY 2020-21

Criteria/ Alternative	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
A1	22.08	28.02	18.2	28.65	0.62	0.76	264951.38	542586	10.59	4.56	28.702
A2	6.73	5.82	3.65	13	28.11	0.73	1479239.4	1920898.35	47.24	2.72	66.036
A3	16.76	18.9	11.67	17.29	67.52	0.95	566917	529915.07	33.85	12.04	9.238
A4	25.23	32.23	19.21	21	91.45	2.74	565049.5	591924.4	42.36	8.15	80.997
A5	21.15	12.02	2.54	14.71	17.29	0.39	177840.52	279637.17	2.33	100.36	210.575
A6	26.88	34.81	22.69	25.25	89.85	2.56	4766.23	3287.3	22.65	10.72	71.031
A7	8.93	22.91	2.83	2.76	102.82	0.94	115697.33	327767.42	3.35	27.46	214.487
A8	13.27	15.37	5.75	19.2	29.95	0.57	421.29	1401.93	5.88	1.28	93.585
A9	-39.31	-6.62	-9.71	-320.52	3.02	0.85	7814.17	12961.11	-119.07	4.04	20.486
A10	15.27	3.42	1.78	25.74	0.08	17.58	2196567.47	1157805.28	27.96	4.04	61.009
A11	0.000	-4.53	-22.79	-111.08	20.51	0.29	182054.95	85231.79	-16.11	-0.7	144.665
A12	6.48	2.7	0.66	10.35	0.07	17.05	1012067.14	353249.67	-33.64	2.1	75.119
A13	2.53	1.66	0.27	2.83	0.11	10.62	161343.06	56619.57	-2.84	1.78	109.250
A14	-5.13	-0.36	-2.7	-5.28	51.2	1.75	16960.12	17094.16	-7.02	10.26	17.497

Table A.3.
Decision Matrix for FY 2021-22

Criteria/ Alternative	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
A1	24.52	31.23	20.05	26.72	0.770	0.89	305195.7	549827.13	12.22	5.03	16.640
A2	8.28	8.24	4.44	9.22	0.480	0.7	1954716.18	1897183.14	57.77	3.78	30.521
A3	18.08	20.19	12.64	17.22	0.740	0.98	477861.75	559108.74	37.53	9.87	-15.006
A4	30.63	38.46	21.36	20.43	1.080	2.1	789898.32	598130.93	50.48	11.57	35.411
A5	-3.81	3.11	-0.2	-0.54	0.510	0.31	316175.76	273261.44	-0.37	196.89	210.575
A6	29.2	39.07	25.46	27.07	1.000	3.43	4081.14	3282.54	28.74	7.86	-7.473
A7	15.23	22.52	3.32	2.68	1.550	0.75	225423.31	323235.92	6.55	46.86	76.902
A8	17.12	17.56	9.39	25.62	0.360	0.6	1472.05	1388.39	9.18	4.22	163.249
A9	-34.46	-3.01	-6.55	-39.42	0.160	0.55	12655.07	12826.17	-78.42	8.44	52.168
A10	15.39	3.22	1.78	28.93	0.070	18.77	2429205.81	1145336.14	39.49	3.4	0.942
A11	0.000	-5.5	-14.56	-73.87	0.190	0.35	218786.7	82306.52	-8.79	-0.51	34.118
A12	11.3	2.2	1.1	19.33	0.060	16.52	1146320.64	348174.7	18.46	2.03	12.664
A13	0.69	1.82	0.07	0.84	0.100	12.54	177477.26	55049.75	-4.77	1.17	-26.377
A14	5.56	8.48	2.86	4.22	0.700	1.38	24251.73	17004.84	7.85	13.9	37.507

Table A.4.
Decision Matrix for FY 2022-23

Criteria/ Alternative	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
A1	27.74	35.39	22.79	28.39	0.84	0.89	472724.94	550451.37	15.09	7.05	44.570
A2	9.220	10.210	4.960	8.360	0.600	0.810	1736200.43	1919511.3	65.33	3.29	-9.180
A3	19.830	21.990	13.860	16.840	0.840	1.030	596884.25	549886.59	42.4	11.97	24.839
A4	34.340	43.030	22.960	18.760	1.240	1.900	585675.96	592567.89	56.09	8.74	-25.503
A5	-6.680	2.730	-1.140	-4.290	0.270	0.460	152175.04	281^{110}.32	-2.07	28.47	-54.677
A6	10.930	15.460	9.310	11.710	0.800	2.850	2258.01	3264.27	10.76	4.37	-52.897
A7	11.640	19.440	4.040	2.410	2.180	0.930	201080.39	326051.72	14.23	14.32	12.617
A8	7.650	5.730	4.520	12.960	0.350	0.560	1237.3	1394.51	4.44	3.32	6.079
A9	-4.530	2.580	-2.020	-9.350	0.300	0.320	16487.49	12991.04	-33.99	2.05	-17.688
A10	15.740	2.970	1.780	27.290	0.070	19.480	2871198.57	1126936.56	57.69	3.21	11.703
A11	0.000	-3.940	-14.130	-69.910	0.210	0.300	229380.49	84500.47	-6.02	-0.38	-42.264
A12	7.630	1.570	0.720	11.240	0.070	16.760	1331259.85	348607.04	21.76	2.11	15.114
A13	9.470	2.160	1.010	10.720	0.110	14.030	227522.57	54370.91	1.17	1.42	38.887
A14	22.250	21.830	9.770	9.240	1.020	0.850	17714.93	16975.27	24.83	12.72	-29.772