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Research Article

AN ASSESSMENT OF FINANCIAL PERFORMANCE OF SELECTED STEEL MANUFACTURES IN INDIA WITH MCDM TECHNIQUE OF MOORA AND TOPSIS WITH CRITIC BASED WEIGHT DETERMINATION

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A B S T R A C T

Due to its forward linkages with other sector like construction, transport, manufacturing, etc the steel industry plays an important role in development of a country. In India production of steel has increased substantially since independence and today it ranks as a second largest producer of steel in the world. Apart from this India is also third largest consumer of steel in the world. The steel sector contributes two percent of GDP and provides employment to approximately 6 lakh workers. In last few years rapid expansion of capacity in many countries of the world including China and India and overall unfavourable macroeconomic conditions prevailing in the world has depressed the international prices of steel. This has affected Indian steel producers as well. Many of the major steel producers who expanded their capacity by debt finance are facing the liquidation threat or are before National Company Law Appellate Tribunal. This study is undertaken with the object of evaluating financial performance of major steel producers on multi-parameters of profitability, liquidity, solvency, debt coverage and management efficiency. The study uses two MCDM techniques –MOORA and TOPSIS for aggregation and evaluation of seven major steel producers in India. Using CRITIC method to determine weights of the criteria's the study finds that the three best firms in the steel sector of India are: Manaksia Steel, Jindal Steel and JSW. Though ranking generated by MOORA, Reference Point Method and TOPSIS slightly vary. However, Spearman's rank correlation indicates significantly high positive correlation between the ranks generated by the three approaches. Hence, study concludes that the MOORA technique is reliable technique that can be used in financial analysis of firms.

INTRODUCTION

The steel industry plays an important role in the development of the country because of its forward linkages with other sectors of the economy like construction, auto, engineering, shipping etc. If one looks around at the developed economies of the world, then one finds that there exists a strong iron and steel industry at the base of their economic development. Production of Iron and iron tools was known to Indians from early times. The famous iron pillar in Delhi, built in around 300 A.D. is the testimony of perfection achieved by our iron master. However, the modern steel industry emerged 1907 after the establishment of Tata Iron and Steel Company (TISCO) at Sakchi in Bihar, followed by the Indian Iron and Steel Company Ltd., in the year 1918 at Bornu in West Bengal, The Steel Corporation of Bengal Ltd., was set up in 1937 in association with Indian Iron and Steel Company for manufacturing steel. In 1923 the State Government of Mysore set up an iron works at Bhadrabati known as Mysore Iron and Steel Works, thereafter named as Visvesvaraya Iron and Steel Ltd. After independence, various plans since 2nd five year plan emphasised in the development of iron and steel industry. The numbers of steel plants were set up in different parts of the country which were then consolidated into Steel Authority of India (SAIL). Today, steel industry contributes roughly around 2 percent to our GDP and provides employment to about more than 6 lakh people (India Steel 2019). After the reforms of 1991, this industry is liberalised to a great extent as a result number of new firms entered into the sector and existing firms expanded their production facility. The net result was a significant expansion of domestic steel capacity. In 2018 Indian crude steel production stood at 106.5 MTPA making it a second largest producer of crude steel in the world after china, according to the World Steel Association. Apart from being the largest producer, India is also 3rd largest consumer of finished steel in the world. India's steel sector is highly concentrated as 51 percent of existing capacity lay in the hands of 5 top steel producers. Further, the ownership of the Indian Steel Industry can be bifurcated into the public and private sector, it is the private sector with almost 78 percent share of production,

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dominates the steel sector. However, over the last few years, the steel sector is on downturn due high input costs and weak macroeconomic environment both domestically as well as globally. Further, there is considerable over capacity build up in China that is likely to keep future prices of steel in the world lower. This will squeeze the margin of steel producers around the world.

In this article attempt is made to assess the financial performance of the selected primary steel producers in India. The companies that are under the National Company Law Appellate Tribunal (NCLAT) with a liquidation proceeding are excluded from analysis. In all, seven companies belonging to primary segment are considered in the analysis. The performance is evaluated by using ratios that gauges Profitability, Liquidity, Solvency, Debt-coverage, management efficiency are considered. The ratios considered are outlined in detail in the methodology section. The multiple ratios used give multiple pictures about the performance of the firm and hence creates confusion in outlining best performing firm. To overcome this confusion, in recent years, Multi-criteria Decision Making (MCDM) techniques are widely used. Zavadskas & Turskis (2011) give a brief account of various MCDM or MODM methods used in economic literature. The MCDM methods are used to transform multiple criteria used in decision-making to a single criterion for decision-making (optimization) that makes decision making much easier. From the large number of techniques available, this study proposes to use Multi-Objective Optimization on the basis of Ratio Analysis (MOORA) method developed by Brauers and Zavadskas (2006) and develop weights objectively by using CRITIC method. The logarithm used in the calculation is discussed in methodology section below. The data used in the analysis is for the period 2013-14 to 2017-18. The result obtained will then be verified by another similar and widely used MCDM technique called the Technique for Order Preference by Similarity to ideal Solution (TOPSIS) method.

Review of Literature

There are large numbers of studies that uses financial ratios and aggregation of these ratios by the MCDM methods for performance evaluation. For instance study by Islamoglu, M., Apan, M., and Oztel, A (2015) evaluates the financial performance of real estate and infrastructure firms listed on the Istanbul stock exchange with financial ratio analysis and entropy based TOPSIS method. Farrokh, M., Heydari, H., and Junani, H., (2016) uses financial ratio analysis along with two MCDM approaches, namely, VIKOR and TOPSIS for evaluating the financial performance of Basic Metal Companies operating in Iran. Hajihassani (2015 a) to evaluate the performance of 28 cement companies listed on the Tehran Stock Exchange by using financial ratios with VIKOR. Moradi and Janatifar (2014) evaluate the financial performance of automobile companies listed on the Tehran Stock Exchange by using financial ratio analysis. The study determines the weight of the criteria's by using Logarithmic Fuzzy Preference Programming (LFPP) and TOPSIS is used to evaluate and rank alternatives. Raikar A.V. (2018 a) measures the financial performance of the cement firms in India by using financial ratio analysis and VIKOR. The study generates weights of the criteria's by the AHP method. Raikar, A.V. (2018 b) evaluates performance of cement companies by using financial ratios with entropy based weight determination and the TOPSIS method. Kandsar, MYF & Esmi, S (2015) use AHP to determine weights and fuzzy TOPSIS for aggregation and ranking of 15 companies listed on the Tehran Stock Exchange by using financial ratio's as a criteria's for optimisation. Siew, L.W. *et al* (2017) by using selected financial ratios as the criteria analyses performance of selected banks in Malaysia by using TOPSIS method of the MCDM. Isseveroglu & Sezer (2015) use financial ratios and TOPSIS method to evaluate the performance of pension companies in Turkey. Sakinc, O.S. (2016) using financial ratios assesses the performance of the Turkish state bank's by using Grey Relational Approach (GRA) and TOPSIS. The study then compares the results derived by GRA and TOPSIS. Gundogdu, A (2015) assesses the performance of the foreign banks established in the Turkey by using TOPSIS method. The study uses financial ratios as a criteria's for performance evaluation. Basdar, C. & Alper, D. (2017) uses financial ratios as a criterion for assessing the financial performance of factoring companies listed on the Istanbul exchange. The multiple ratios used in the study is aggregated by using two MCDM methods namely TOPSIS and ELECTRE. Sharma, A. et. al. (2017) uses PROMETHEE, AHP and TOPSIS to evaluate financial performance of seven banks listed on the National Stock Exchange (NSE). As a criteria's for evaluation it considers financial ratios from four broad areas viz., Growth, performance, valuation and liquidity. Areas, Guler *et al* (2018) uses TOPSIS to measure financial performance of intermediary financial institutions operating in Turkey by using various criteria's that also include financial ratios. The relative importance of various criteria's is measured by the entropy method and TOPSIS is used for assessment of the overall performance of the financial institutions. Kazan, H., and Ozdemir, O (2014) uses TOPSIS method to evaluate the financial performance of the fourteen large scale conglomerates listed on the Istanbul Stock Exchange. The criteria used in the evaluation are the various ratios measuring Liquidity, Financial Structure, Activity ratios, and Profitability ratios. In all, 19 criteria's or ratio are considered by the study, the relative weights or priority values of these criteria's are calculated by the CRITIC Method.

Dedania, H.V. *et al* (2015) using financial ratio study measures the performance 13 IT companies by using various MCDM techniques like SAW, AHP, p-VIKOR and p-TOPSIS. The weights of the criteria's are objectively determined by CRITIC method. Ucuncu, T. et. al. (2018) the financial performance of seven companies in the paper industry traded at Borsa Istanbul by using financial ratios as a criteria's and TOPSIS method for evaluating and ranking of alternatives. The study uses an equal weight approach for determination of weights of criteria. Alenjagh, R.S. (2013) by using 17 financial ratios evaluates and ranks insurance companies listed on the Tehran Stock Exchange by using MCDM technique of PROMETHEE. The relative importance of the criteria or weights of the criteria's is determined by the Analytic Network Process (ANP). Sorayaei, A. et. al. (2014) uses a financial ratio that measures Liquidity, Structure of Assets, Profitability, and Capital Adequacy as a criteria's for performance evaluation of 10 banks listed on the Tehran Stock Exchange. The weight of the criteria's is determined by the fuzzy AHP and ELECTRE method is used for evaluation and ranking of banks. Cetin, M.K. & Cetin, E.I. (2010) evaluates the performance of the 13 Turkish banks listed on the Istanbul Stock Exchange on the broad parameters of Capital Adequacy, Asset Quality, Liquidity, Profitability, Income Expenditure structure, Group Share, and Sectoral

Share. The weight of criteria's is determined by fuzzy AHP and TOPSIS is used to sort and rank the alternatives. Yalcin, N. *et. al*., (2012) uses both traditional accounting based financial performance (AFP) and value based financial performance methods (VFP) to evaluate performance of the manufacturing companies in Turkey by using TOPSIS and VIKOR. The weights of the criteria's are determined by the fuzzy AHP. Fai, L.K., et.al., (2016) evaluates, compares and ranks the companies operating in the financial sector in the Malaysian Stock Market by using financial ratio as a criteria's and the TOPSIS method for aggregation of performance for the assessment and ranking. The study uses the data of 23 companies for the period 2012 to 2014 and gives equal weights to the criteria's. Inani, S.K & Gupta, R. (2017) assesses the performance of the nine IT firms listed on the NSE with data for the period 2011 to 2015. The study uses financial ratios as a criteria and TOPSIS for evaluating firms on multiple criteria's. Onder, E & Hepsen, A. (2013) in their study based on the data for the period 2002-2011 develops the model for forecasting financial performance of banks for the period 2012-2015. As a forecasting tool the study uses classical time series methods like moving averages, exponential smoothing, Brown single parameter, linear exponential smoothing, Brown's second-order exponential smoothing, Holt's two parameter linear exponential smoothing and decomposition methods on financial ratios of the banks in Turkey. On the opinion expressed by the experts, the study uses AHP technique to determine the relative priorities of the criteria. The TOPSIS method is used for grading, sorting and ranking of the alternatives. Esfahanipour, A and Ardakani, H.D.(2015) uses PROMETHEE and TOPSIS for evaluation of holding companies listed at Tehran Stock Exchange by using financial ratios as criteria or indicators that measures liquidity, leverage, activity, profitability and productivity. The relative priorities of criteria is determined by fuzzy AHP. Alper, D and Basdar, C. (2017) evaluates performance of the six factoring companies listed on Istanbul exchange by using financial ratios as a criteria and widely used MCDM method of TOPSIS and ELECTRE. The concordance matrix is used to generate weight of the criteria's.

From the above review of literature, it is clear that the TOPSIS is the most favoured tool for performance evaluation and ranking of alternatives on the basis of financial ratio analysis, though other methods are also used. The MOORA is a relatively new method and in the recent years, it is increasingly used in decision making. The financial ratio's as a criteria or objectives for optimisation is used in MOORA method by Stanujkic, D *et al* (2013). He uses apart from MOORA, SAW, GRA, CP, VIKOR, TOPSIS for evaluating performance of Serbian banks by using financial ratios. The study finds that the different results are produced by different methods. Dincer, H. (2015) analyses the stock selection problem by evaluating and ranking the performance of banks listed on Borsa Istanbul (BIST) by using ratios that captures market share, capital ratio, asset quality, liquidity, interest efficiency, non-interest productivity, market to book value and price earning. The study uses fuzzy AHP for prioritization of criteria and MOORA for aggregation of performance. Apart from using it for financial performance assessment the MOORA technique is widely used for many other multi-objective decisions making. Chakraborty, S. (2011) uses it for solving different decision making, problem frequently encountered in real time manufacturing. Brauer, W.K.M (2008) uses it for contractor selection, Brauers, W.K.M. et. al. (2008) uses for road design. Bhandari, S.B. and Nalmpantis, D (2018) apart from AHP, PROMETHEE, TOPSIS uses MOORA method for rural road selection in Nepal. Kecek, G & Demirag, F (2016) uses MOORA along with the TOPSIS for selecting the best laptop from various alternatives. Groener, Ali et. al. (2013) uses AHP to prioritize criteria's and MOORA method to rank location alternative of the bank branch. Karande, P & Chakraborty, S (2012 a) uses fuzzy variant of MOORA technique for evaluation of best enterprise resource planning (ERP) system for the firm. Gadakh, V.S. (2011) uses MOORA method for selecting suitable milling process parameters in different milling processes. Dey, B. *et al* (2012) applies Fuzzy MOORA for selection of alternatives in the supply chain. Determining weights of the criteria by fuzzy AHP, the study focused on selection of strategies for warehouse location and vendor/supplier selection. Brauers WKM et. al. (2007) applies MOORA technique for developing models for European economic integration of the transition economies of Central and Eastern Europe. Balezentis, A. *et al* (2010) used a multiplicative form of MOORA known as MULTIMOORA to evaluate the position of Lithuania in European Union. Karande, P & Chakraborty, S (2012 b) by using MOORA, reference point approach and multi MOORA techniques undertakes ranking of material alternatives. The MOORA with reference point method is also innovatively applied by the Brauers & Javadskas (2006) for assessment and sorting of projects for privatisation in transition economy. Mesran *et al* (2017) uses MOORA method for student's admission assessment. Kalibatas and Turkis (2008) uses MOORA method to evaluate inner climate of building and to identify the factors causing deviation in inner climate of building. El Santawy and Ahmed (2012) uses MOORA technique for solving project selection problem based on criteria of economic desirability, technical issues, environmental factors and social factors. The study determines the weight of the criteria's by using standard deviation approach. Vujucic, M.V. et. al. (2017) uses MOORA along with SAW technique for selection of Air conditioners. The study uses criteria weights generated by objective method of Entropy and CRITIC. The study finds that the ranks generated by all the variants of MOORA-CRITIC and SAW-Entropy show a significant positive correlation.

Methodology:

The study assesses the performance of the steel companies listed on the National Stock Exchange by using financial ratios that measure broadly Profitability, Liquidity and Solvency, Debt coverage, and Management efficiency. The ratios used are given below along with their weights in table 1. The weights of the criteria's are determined by using the method of Criteria Importance through Inter-criteria Correlation (CRITIC) method.

Critic Method of Weight Determination

The critic is an objective method of weight determination that uses information contained in the decision matrix in the form of the degree of deviation of variant value from given mean value of the criteria. The logarithm of developing weights under critic method is as follows:

Critic method derives weights of the criteria objectively from the data matrix. Let X=$[x_{ij}]$ be the data matrix. By

normalisation x_{ij} is converted into r_{ij} that translates all values of criteria's into$[0,1]$. The transformation is based the ideal point concept.

$$r_{ij} = \frac{x_{ij} - x_j^{min}}{x_j^{max} - x_j^{min}} \quad (1)$$

Each vector has a standard deviation, which measures the deviation of variant values from the mean value of the criteria. The amount of the information contained in the criteria (C_j) is given as:

$$C_j = \sigma_j \sum_{i=1}^{m} 1 - r_{ij} \quad (2)$$

The criteria's weights are then obtained by normalising the C_j as under:

$$w_j = \frac{c_j}{\sum_{i=1}^{m} c_i} \quad (3)$$

Moora Method

The Multi-Objective Optimisation on the Basis of Ratio Analysis (MOORA) is relatively new method in MCDM literature propounded by Brauers and Zavadskas (2006). It is widely used in performance evaluation of alternatives in many fields, its use in financial performance evaluation of business entities is limited though it can be successfully used in such evaluation. The MOORA logarithm starts with an initial data matrix:

$$X = [x_{ij}] \quad (4)$$

Where x_{ij} is the response of alternative i on objective j; $j = 1,2, \ldots\ldots\ldots n$ are criteria's and $i = 1,2 \ldots\ldots\ldots m$ are the alternatives.

In MOORA ratio system is used which is obtained as a ratio of response of an alternative on objective to square root of sum of square of each alternative, i.e.

$$x_{ij}^* = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} (x_{ij})^2}} \quad (5)$$

The $xij*$ are dimensionless numbers belonging to the interval $[0,1]$ and represents the normalised response of the alternative i to objective j.

For optimisation, the responses are added if benefit criteria and subtracted if cost criteria.

$$y_i^* = \sum_{j=1}^{g} x_{ij}^* - \sum_{j=g=1}^{n} x_{ij}^* \quad (6)$$

In above formula g and g+1 are the criteria to be maximised (benefit criteria's) and minimised (Cost criteria's) respectively. If the decision maker wants to give more importance to a particular criterion than others; in such a case additional steps have to be performed to derive a weighted decision matrix.

$$WX = [w_j x_{ij}^*] \quad (7)$$

The ranking values from the above can be derived similar to step (6)

$$y_i^* = \sum_{j=1}^{g} w_j x_{ij}^* - \sum_{J=g+1}^{n} w_j x_{ij}^* \quad (8)$$

The Alternatives are to Be Ranked as

$y_i^* = \{A_i | \max_i y_i^*\}$ i.e. by the listing of alternative based on y_i^* in descending order.

Reference Point Method

The reference point method of MOORA uses normalised decision matrix shown in the equation (5) that measures normalised performance of the i[th] alternative on j[th] criteria. A maximum reference point is then determined from the normalised decision matrix for each of the criteria. According to Brauers and Zavadskas (2006, 2009) the Tchebycheff min-max approach is best suited for determination of the reference point. The Tchebycheff min-max approach is formulated as:

$$\min_i \{\max_j |r_j - x_{ij}^*|\} \quad (9)$$

In above formula, x_{ij}^* is the normalised value of the i[th] alternative on the j[th] criteria and r_j is the reference point or the most desirable performance of the j[th] criteria.

The r_j is determined by using following equation (10)

$r_j = \max_j x_{ij}^*$; if benefit criteria; and

$$r_j = \min_j x_{ij}^* \text{ ; if Cost criteria.} \quad (10)$$

In case decision maker gives different weights to different criteria's then equation (9) can be reformulated as:

$$\min_i \{\max_j w_j r_j - w_j x_{ij}^*\} \quad (11)$$

Based on the assessment value, the alternatives are then ranked by finding maximum total deviation from the reference points or in other word alternatives are ranked in ascending order.

Topsis

Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) is widely used in financial performance evaluation of business entities. According to Olson (2004) there are six steps involved in computation of TOPSIS. These are as follows:

Step 1: Collection of data for n-criteria and m alternatives which will yield us data matrix as specified in equation (4) above. i.e.

$$X = [x_{ij}] \quad (12)$$

Where $i = 1,2,3, \ldots\ldots\ldots m$are alternatives to be evaluated on the criteria's or objectives $j = 1,2,3, \ldots\ldots\ldots\ldots n$.

Step 2: Normalise decision matrix preferably by vector normalisation method or other appropriate method of normalisation. If the vector normalisation method is used, then the equation would be:

$$N = [x_{ij}^*] = x_{ij} \Big/ \sqrt{\sum_{i=1}^{m} (x_{ij})^2} \; ; if\ benefit\ criteria$$

$$= [x_{ij}^*] = \sqrt{\sum_{i=1}^{m} (x_{ij})^2} \Big/ x_{ij} \; ; \quad if\ Cost\ criteria \quad (13)$$

Step 3: Develop a weighted matrix by using weights of the criteria or assigning relative priorities to the criteria. Here, weights are determined by the CRITIC method and same weights that are used in MOORA method are used. This yields weighted decision matrix as shown in equation (14).

$$WN = v_{ij} = [w_j x_{ij}^*] \quad (14)$$

Step 4: Determine form weighted normalised decision matrix, the Positive Ideal Solution (PIS) and Negative ideal Solution (NIS)

$$PIS = (v_1^+, v_2^+, v_3^+ \dots\dots v_n^+)\ if\ \left(\max_j v_{ij}\ ; if\ j \in BC\right)\left(\min_j v_{ij}\ ; if\ j \in\ CC\right)$$

$$NIS = (v_1^-, v_2^-, v_3^-, \dots\dots v_n^-)\ if\ \left(\min_j v_{ij}\ if\ j \in\ BC\right)\left(\max_j v_{ij}\ ; if\ j \in CC\right)$$

Where BC denotes benefit criteria and CC denotes cost criteria.

Step 5: Calculate the separation measure with n-dimensional Euclidian distance of each alternative from PIS and NIS respectively as follows:

$$d_i^+ = \sqrt{\sum_{j=1}^{n}\left(v_{ij} - v_j^+\right)^2}\ ;\ \ i = 1,2,3, \dots . m.$$

$$d_i^- = \sqrt{\sum_{j=1}^{n}\left(v_{ij} - v_j^-\right)^2}\ ; i = 1,2,3, \dots\dots . m\ .$$

Step 6: Calculate relative closeness to ideal solution as a ratio of:

$R = \frac{d_i^-}{d_i^+ + d_i^-}$ based on the R rank the alternatives in descending order.

Data Analysis

The requisite data on seven major steel companies is compiled from the website moneycontrol.com. The companies or Decision Making Units (DMUs) considered for analysis Tata Steel, SAIL, JSW, Steel Exchange, VISA Steel, Manaksia Steel, and Jindal Power and Steel.

The steel sector is cyclic in nature and currently passes through the downturn. There is a huge build up of excess capacity around the world. This has affected many steel producers operating in India. Some of the major producers like Bhusan steel, Essar Steel are under liquidation proceedings in the National Company Law Appellate Tribunal (NCLAT) and banks are making frantic efforts to sell their assets. There are large fluctuations in financial performance over the period of study. In spite of it, this study considers average performance for the period 2013-14 to 2017-18. The table 2 reflects the average of the ratios for the period 2013-14 to 2017-18. The average for the period may not reflect the true picture of year on year financial performance. However, in spite of this limitation, the major contribution of the study would be to identify whether MOORA technique is as sound as TOPSIS in classification and sorting/ ranking of the companies by using financial ratio analysis.

The MOORA generated assessment values are indicated in table 3 and that of the Reference Point Method in table 4. The study lists the Manaksia Steel as the best Decision Making Unit (DMU) in India on the basis of average financial performance for the period 2013-14 to 2017-18. Though, it does not have a high profit margin but has a positive GPM and NPM. On the other hand, DMU like Tata Steel has a highest OPM and positive GPM but its NPM is negative, indicating that it reeling under high debt cost as well as high depreciation provisioning. In the study D-E ratio is considered as a cost criteria, the data indicate that the VISA Steel has the highest ratio followed by the Tata Steel and Jindal steel. The ratio is less than one for Manaksia Steel and SAIL, hence, stronger

Table 1 Ratios Used In Financial Analysis With Critic Based Weight Determination

	Abbreviations Used	Formula for Calculation	Weights	Benefit (BC) or Cost (CC) Criteria
Profitability Ratios	OPM	$\text{Operating Profit Margin} = \frac{\text{Operating Profit}}{\text{Net Sales}} \text{ x } 100$	**0.080**	BC
	GPM	$\text{Gross Profit Margin} = \frac{\text{Gross Profit}}{\text{Total Revenue}} \text{ x}100$	**0.057**	BC
	NPM	$\text{Net Profit Margin} = \frac{\text{Net Profit}}{\text{Revenue}} \text{ x}100$	**0.050**	BC
	RONW	$\textbf{Return on net Worth} = \frac{\textbf{Net Income}}{\textbf{Shareholder's Equity}} \textbf{ x 100}$	**0.080**	BC
Liquidity Ratios	C-RATIO	$\text{Current Ratio} = \frac{\text{Current Assets}}{\text{Current Liabilities}} \text{ x } 100$	**0.079**	BC
	Q-Ratio	$\text{QuickRatio} = \frac{\text{Current Assets} - \text{Inventories}}{\text{Current Liabilities}} \text{x } 100$	**0.099**	BC
Solvency Ratios	D-E Ratio	$\text{DebtEquityRatio} = \frac{\text{Total Liability}}{\text{Total Share Holders Equity}} \text{x } 100$	**0.100**	CC
	D-C Ratio	$\text{Debt Coverage Ratio} = \frac{\text{Net Operating Income}}{\text{Debt Service}} \text{ x } 100$	**0.067**	BC
	I-C Ratio	$\text{Interest Cover Ratio} = \frac{\text{EBIT}}{\text{Interest Expense}} \text{ x } 100$	**0.096**	BC
Management Efficiency Ratios	ITOR	$\text{Inventory Ratio} = \frac{\text{Cost of Goods Sold}}{\text{Average Inventory}} \text{ x } 100$	**0.073**	BC
	DTOR	$\textbf{Debtors Turnover Ratio} = \frac{\textbf{Receivables (short term debt)}}{\textbf{Total Sales} *} \textbf{x 100}$	**0.081**	BC
	FATOR	$\text{Fixed Assets Turnover Ratio} = \frac{\text{Net Sales}}{\text{Gross Fixed Assets} - \text{Accumulated Depreciation}} \text{x } 100$	**0.097**	BC
	NODWC	$\text{Days ofWorking Capital} = \frac{\text{Net Working Capital}}{\text{Average Daily Sales}} \text{x } 100$	**0.042**	BC

Table 2 Average Ratios For The Period 2013-14 To 2017-18 Of Selected Steel Companies In India

	Profitability ratio				Liquidity ratio		Debt coverage ratio			Management efficiency ratio			
	OPM	GPM	NPM	RONW	C- Ratio	Q-Ratio	DE Ratio	I-C Ratio	D-C Ratio	ITOR	NODWC	FATOR	NODWC
Tata steel	20.00	8.75	-18.08	42.73	0.32	0.43	9.81	0.39	0.78	3.72	7.50	0.33	169.34
Sail	3.85	-1.16	-1.46	-1.70	0.68	0.47	0.94	0.74	1.98	3.19	12.78	0.65	-38.91
Jsw steel	19.84	13.78	2.40	5.65	0.82	0.61	1.25	2.24	3.15	6.52	18.26	0.99	19.16
Steel exchange	7.01	5.04	-5.14	-7.60	0.74	0.562	5.45	0.79	0.99	2.15	5.65	1.58	88.72
Visa steel	1.05	-6.65	-35.15	-14.41	0.18	0.21	14.46	-1.48	0.56	8.35	13.89	0.45	-368.47
Manaksia steel	6.80	4.90	3.05	6.35	1.13	2.72	0.50	4.93	6.84	4.89	4.12	4.27	192.94
Jindal steel	11.95	8.13	11.95	15.31	1.85	1.76	2.58	1.59	2.24	6.05	8.12	2.50	-0.31
Summ	70.49	32.79	-6.28	46.33	5.72	6.21	34.99	9.22	16.54	34.87	70.33	10.77	62.46

Sr.no.	Name of DMU	MOORA	Reference point method	TOPSIS	
1	Tata steel	4	4	4	Spearman's rank correlation between moora & reference point method: R_s=0.96429;$p\ (two\ tailed) = 0.0045 < 0.01$
2	Sail	5	6	6	
3	Jsw steel	3	3	3	Spearman's rank correlation between moora & topsis: R_s=0.92857 ; $p\ (two\ tailed) = 0.00252 < 0.01$
4	Steel exchange	6	5	5	
5	Visa steel	7	7	7	Spearman's rank correlation between reference point method & topsis: R_s=0.96429; $p\ (two\ tailed) = 0.0045 < 0.01$
6	Manaksia steel	1	1	2	
7	Jindal steel	2	2	1	

performance is displayed by these firms especially by the Manaksia Steel. In fact, steel sector cyclical in nature and at present is on a downward phase of the trade cycle. In this phase, many of the companies like Bhusan Steel and Essar Steel that had raised the debt fund excessively are facing liquidation proceedings in the National Company Law Appellate Tribunal. If one glace at other ratios as well as the ranking of the Manaksia Steel as number one appears to be quite justified. The MOORA method and Reference Point MOORA method list the Manaksia Steel as the best among the lot. The number two position is occupied by the Jindal Power and Steel. Glance at the financial ratios indicates that the company has good OPM and positive GPM and NPM. Its debt equity ratio also within a manageable level and other indicators also indicates positive performance except NODWC, which is negative. Both the MOORA as Reference Point Method of MOORA list this company as second best among the lot.

The third position is occupied by the JSW steel company has high OPM and positive GPM and NPM. It has low DE ratio and other management ratios are also good. Both the MOORA methods as well as a reference point method ranks it as the third best among the DMUs considered for evaluation. The fourth rank by both the method is given to the Tata Steel and fifth rank is given to the SAIL by the MOORA method, but the reference point method of MOORA gives it a sixth rank. Whereas, the MOORA method gives sixth rank to Steel Exchange, but, reference point MOORA method gives it a fifth rank. The seventh or the last rank is given by both the methods to VISA steel.

To verify the ranks generated by both the methods of MOORA, the study used another similar MCDM method of TOPSIS. The ranking generated by the TOPSIS is shown in the table 3. It gives the following order:

1. Jindal Steel;
2. Manaksia Steel;
3. JSW;
4. Tata Steel;
5. Steel Exchange;
6. SAIL;
7. VISA Steel

In order to study how close are the ranking generated by these different models, the study uses Spearman's rank correlation (R_S). The study finds that there is a significant positive correlation between the ranks generated by the MOORA Method and Reference Point Method of MOORA with $R_s = 0.964$ with $p\ (two\ tailed) value = 0.00045$. This indicates that the ranks generated by both the methods are highly consistent. Further, the evaluation of ranking generated by TOPSIS and MOORA method shows the high positive Spearman's rank correlation with R_s =0.929 with $p\ (two - tailed) value$ =0.00252. Also Spearman's Rank correlation between TOPSIS and Reference Point MOORA Method is: R_s=0.964 with two tailed $p - value$ =0.00045. This again indicates that there is high positive correlation between the ranks generated by the TOPSIS and Reference Point MOORA Method. Thus, to conclude, MOORA method with both its approaches can be a reliable technique for grading or ranking of the DMUs on its financial performance. Such ranking has wide utility for managerial decision making as well as for financial analyst in portfolio selection by using ratios as multiple criteria of decision making.

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