

Economic Performance and Resource Utilisation: Empirical Evidence from India's Iron and Steel Industry

Dhiraj Kumar¹, Dr. Debasis Chakraborty²

¹Research Scholar, Department of Humanities and Social Sciences, National Institute of Technology Durgapur, West Bengal, India, dkumar.dsp@sail.in

²Assistant Professor, Department of Humanities and Social Sciences, National Institute of Technology Durgapur, West Bengal, India, dchakraborty.hu@nitdgp.ac.in

Article History:

Received: 30-05-2024

Revised: 01-07-2024

Accepted: 20-07-2024

Abstract:

This study examines the economic performance and resource utilization of the Indian iron and steel industry, with a specific focus on six prominent Indian companies. Through empirical research, we investigate the correlation between current sales and lagging sales, raw materials, power and fuel, remuneration to employees, repairs and maintenance, and overall expenses. The study demonstrates that previous sales performance has a substantial impact on present sales, highlighting the significance of customer loyalty and maintaining a strong position in the market. Allocating resources to raw materials, stores, and spares is crucial for improving production processes and product quality, which in turn leads to increased sales. Nevertheless, increased expenses associated with electricity, gasoline, and water have a detrimental influence on sales, emphasizing the importance of efficient cost control. The favourable impact of repairs and maintenance on sales underscores the need to keep equipment and facilities in optimal functioning order. The results indicate that a deliberate distribution of overall expenditures enhances sales performance, offering significant perspectives for optimizing resource allocation and operational strategies in the iron and steel sector. This study provides practical implications for policymakers and managers seeking to stimulate growth and enhance profitability in this industry.

Keywords: Indian iron and steel industry, economic performance, resource utilization, empirical analysis.

1. Introduction:

The iron and steel sector has historically been fundamental in driving industrialization and economic progress worldwide, and India is no exception. India's iron and steel business is a crucial component of the country's economy, making it one of the leading global manufacturers of steel. This sector substantially contributes to the GDP and offers a wide range of employment possibilities.

The industry encounters numerous problems, such as fluctuating raw material prices, rigorous environmental requirements, and changing global market dynamics. These problems require a strategic allocation of resources to maintain competitiveness and profitability. Roy and Singh (2020) highlight the crucial need for efficient resource use for the long-term viability and financial success of steel enterprises in a highly competitive global market. The empirical study is crucial for comprehending how these organizations effectively allocate their resources to impact economic results.

This study utilizes actual data from six companies to assess the efficacy of various resource allocation techniques in promoting sales. This article provides comprehensive insights into the methods that can improve economic performance and sustainability in the Indian iron and steel sector by examining the correlation between current sales and selected dependent variables.

The primary aim of this study is to examine the influence of different resource inputs on the present sales of the chosen organizations. The independent variable in this study is the current sales, whereas the dependent variables are lagged sales, raw materials, power and fuel costs, compensation to staff, repairs and maintenance, and overall total expenses. This approach enables a detailed examination of how previous performance and allocation of resources affect current economic performance. The current body of literature establishes a basis for comprehending the aspects that impact the economic performance of steel enterprises. Sahu et al. (2019) argue that the production efficiency and financial performance of steelmakers are greatly influenced by the cost and availability of raw materials. This demonstrates that effective management of raw materials is essential for ensuring cost-effectiveness and profitability. Gupta and Sharma (2018) emphasize the significance of energy consumption, stating that optimizing power and fuel utilization is crucial for reducing production costs and improving profitability in the steel business. Efficient energy utilization is thus a crucial factor in achieving operational success.

Another crucial factor is the function of human capital, namely employee salary. Das and Bhattacharya (2021) emphasize that investing in employee remuneration and welfare is crucial for sustaining a motivated workforce and attaining elevated productivity levels. This viewpoint emphasizes the significance of human resource management in improving productivity and, as a result, economic performance.

Gaining insight into the relationship between resource usage and economic performance is crucial for strategic planning and operational management. This research enhances the current knowledge by giving empirical evidence on the factors that influence sales performance in the Indian iron and steel sector.

2. Literature Review:

The path of total factor productivity (TFP) growth in the Indian iron and steel sector demonstrates the important consequences of economic changes. According to Ray (2010), there is a clear decrease in total factor productivity (TFP) after the reform period compared to before the reform period. The gain in total output is mostly due to increased inputs rather than advances in productivity. The study emphasizes the susceptibility of TFP growth to capital-deepening, indicating that productivity improvements were mostly dependent on increases in capital. Schumacher and Sathaye (1998) have conducted a thorough analysis of the interconnection between productivity, energy efficiency, and environmental impact in India's iron and steel industry. Their study, conducted between 1973 and 1994, revealed a decrease in production resulting from protective policies and inefficiencies in public sector plants. Nevertheless, the process of liberalization in the 1990s resulted in increased productivity and revealed significant opportunities for enhancing energy efficiency and reducing carbon emissions by implementing state-of-the-art technologies. The transition highlights the crucial importance of legislative frameworks and technical breakthroughs in

improving industrial productivity and sustainability. In his study, Ohlan (2018) explores energy efficiency by employing firm-level data envelopment analysis. He discovers significant enhancements in energy efficiency and a decrease in energy intensity between 2004 and 2012. Although there have been improvements, Ohlan highlights the significant opportunity for more decreases in energy consumption, especially among smaller companies. The positive link seen between larger business size, higher labor productivity, and greater energy efficiency highlights the importance of economies of scale and labor optimization in attaining energy efficiency.

The capital structure decisions and working capital management have a significant impact on the financial dynamics of the Indian iron and steel sector. Banerjee and Das (2014) examine the elements that affect corporate financial performance, highlighting financial leverage, debt servicing capacity, and business size as important determinants of profitability. Their research emphasizes the crucial significance of effectively managing the capital structure to improve the financial performance of a company. According to Paul and Mukherjee (2018), efficient management of working capital plays a crucial role in sustaining profitability in industries that require a large amount of capital. The literature has focused on the efficiency of both governmental and private-sector organizations. Debnath and Shankar (2014) utilize data envelopment analysis (DEA) to assess the technical and scale efficiency. Their findings indicate that public sector undertakings (PSUs) face unfavorable circumstances in comparison to private manufacturing units. A considerable proportion of private units exhibit technical and scale inefficiency. The inefficiency is caused by operational difficulties and a less-than-optimal size of activities, emphasizing the necessity for strategic interventions to improve efficiency.

Effective environmental management methods are crucial for minimizing energy intensity and carbon emissions. Haider et al. (2019) analyze the implementation of environmental management systems (EMS) in Indian companies and find company size, age, and ownership structure as important factors that drive EMS adoption. Their study showcases the efficacy of EMS certification in diminishing energy intensity, with TATA Steel surpassing other prominent Indian steel businesses in terms of carbon emission intensity. Nevertheless, the industry as a whole fall behind worldwide standards, suggesting ample opportunities for substantial enhancements in environmental performance.

Azeez (2002) conducts a comprehensive examination of capacity utilization in the Indian manufacturing industry between 1974 and 1998. The study identifies different periods characterized by notable oscillations, which are mostly influenced by supply and demand issues rather than economic changes. This discovery implies that the overall economic conditions and market dynamics have a greater impact on determining the levels of capacity utilization than policy changes alone. The scholarly literature on the Indian iron and steel industry highlights several key topics: the influence of economic reforms on productivity patterns, the relationship between energy efficiency and environmental sustainability, the significance of financial management in determining corporate performance, and the complex dynamics of capacity utilization. Together, these studies offer a thorough comprehension of the complex challenges and possibilities confronting the industry, providing valuable insights for policymakers, industry participants, and researchers seeking to

improve the economic performance and sustainability of the Indian iron and steel sector.

3.1. Public sector Steel company in India

3.1.1. Brief Structure of Steel Authority of India Limited (SAIL):

Steel Authority of India Limited (SAIL) was founded on January 24, 1973, to oversee the activities of many steel factories that were formerly part of Hindustan Steel Limited (HSL). HSL, established on January 19, 1954, oversaw the operations of the Rourkela Steel Plant in Orissa and later expanded to include three other integrated steel factories. SAIL has expanded to become one of the largest steel producers in India and the 20th largest in the world as of 2023, with an annual revenue of over Rs. 100,000 crore. The company has a high degree of vertical integration and self-sufficiency in its iron ore production. It serves both domestic and foreign markets by offering a diverse array of steel products. SAIL manages five integrated steel factories situated in Durgapur, Bhilai, Rourkela, Bokaro, and Burnpur. These plants collectively have a production capacity of around 21 million tonnes of crude steel per year. In addition, SAIL has three distinct steel mills in Salem, Durgapur, and Bhadravati that specialize in the manufacturing of special and alloy steels. Furthermore, SAIL has a separate factory in Chandrapur that is solely dedicated to the production of ferro-alloys.

3.1.2. RashtriyaIspat Nigam Ltd. (RINL):

RashtriyaIspat Nigam Ltd. (RINL), sometimes referred to as Visakhapatnam Steel Plant (VSP), is a government-owned steel manufacturer situated in Visakhapatnam, Andhra Pradesh. RINL possesses an integrated steel manufacturing capability of approximately 7.3 million tonnes per year (MTPA). The plant is renowned for producing superior long products, such as rebar, wire rod, and structural steel, principally catering to the building and infrastructure industries. RINL employs cutting-edge technologies, such as a state-of-the-art blast furnace and oxygen plant, to optimize production efficiency and reduce environmental footprint. The organization is dedicated to implementing sustainable practices and has obtained multiple certifications for its quality management and environmental management systems.

3.2. Private sector Integrated steel plants in India:

3.2.1. ArcelorMittal Nippon Steel India Ltd. (AM/NS India):

ArcelorMittal Nippon Steel India is a prominent steel manufacturer in India, formed through a partnership between ArcelorMittal and Nippon Steel Corporation. The company runs a steel plant in Hazira, Gujarat, with a combined capacity of 8.6 million tonnes per year (MTPA). The Hazira facility employs cutting-edge technology to manufacture a diverse array of steel products, encompassing both flat and long goods, to meet the needs of multiple industries, including automotive, construction, and infrastructure. AM/NS India is dedicated to implementing sustainable practices and has made substantial investments in energy-efficient technologies, such as the utilization of waste heat recovery systems. Besides Hazira, the corporation possesses establishments in Odisha and Jharkhand, with the aim of augmenting its production capacities and broadening its range of products.

3.2.2. JSW Steel Ltd.:

JSW Steel Ltd. is a prominent member of the JSW Group and stands as one of India's largest integrated steel makers, boasting a remarkable production capacity of over 18 million tonnes per

annum (MTPA). The corporation has several factories, one of which is a substantial facility located in Vijayanagar, Karnataka. This particular factory has an annual capacity of approximately 12 million tons. JSW Steel is renowned for its extensive product portfolio, which encompasses hot-rolled, cold-rolled, and coated steel. These goods cater to a variety of industries, including construction, automotive, and appliances. The corporation prioritizes innovation and sustainability, allocating resources to modern technology to enhance efficiency and minimize emissions. JSW Steel has also expanded its global reach by selling its products to more than 100 nations.

3.2.3. Jindal Steel & Power Ltd. (JSPL):

Jindal Steel & Power Ltd. is a leading participant in the Indian steel sector, boasting a production capacity of around 9 million tonnes per annum (MTPA). The corporation possesses integrated steel factories situated in Raigarh, Chhattisgarh, and Angul, Odisha. The Raigarh factory of JSPL employs the direct reduced iron (DRI) method and is equipped with capabilities for manufacturing sponge iron, billets, and various long products such as TMT bars and structurals. The Angul facility, boasting a capacity of 1.8 million tonnes, is outfitted with cutting-edge equipment to manufacture flat steel products. JSPL is dedicated to sustainability and has implemented several steps to decrease its carbon impact, such as utilizing renewable energy sources. In addition, the corporation places significant emphasis on community development and the implementation of corporate social responsibility (CSR) activities.

3.2.4. Tata Steel Ltd.:

Tata Steel Ltd. is a prominent and long-standing steel manufacturer in India, known for its large-scale manufacturing capability of around 19.6 million tonnes per annum (MTPA). The corporation manages multiple steel facilities throughout the nation, including its primary factory in Jamshedpur, Jharkhand, which was founded in 1907. Tata Steel manufactures a diverse array of goods, encompassing both flat and long steel, and has a robust presence in the automotive, construction, and infrastructure industries. The organization is renowned for its dedication to sustainability and innovation, as it has successfully executed numerous efforts to decrease carbon emissions and improve resource efficiency. Tata Steel is renowned for its emphasis on corporate social responsibility (CSR) and community development, actively contributing to the well-being of the communities in which it operates. The company has made substantial investments in upgrading its facilities and implementing cutting-edge technology to sustain its competitive advantage in the worldwide steel industry.

4. Data and Methodology:

The objective of this study is to examine the economic performance and resource allocation in the iron and steel sector in India. The research aims to comprehend the impact of several crucial input components, such as previous sales, raw materials, electricity and fuel, employee remuneration, overall expenses, and repairs and maintenance, on the present sales. The firms being analyzed include ArcelorMittal Nippon Steel India Ltd., JSW Steel Ltd., Jindal Steel & Power Ltd., RashtriyaIspat Nigam Ltd., Steel Authority of India Ltd., and Tata Steel Ltd. The data for these firms, from the year 1991 to 2020, has been used to examine the causal relationship between the variables. The study is based on the theoretical framework of the production function method, which

investigates the connection between inputs employed in production and the resulting output. The utilization of the production function approach is prevalent in the field of economics to examine the effectiveness and efficiency of organizations. Within this framework, the present sales (output) of the enterprises are represented as a function of different input elements.

The production function used for this study can be represented as:

$$S_t = f(S_{t-1}, RM_t, PF_t, CE_t, RMaint_t, TE_t)$$

Table I. Notations and Definitions of Variables

Variables (Notations)	Definitions
Current Sales (S_t)	Revenue generated from sales in the current period.
Lagged Sales (S_{t-1})	Sales from the prior period are considered an independent variable. It is used to measure the impact of previous performance on present sales.
Raw Materials (RM_t)	Amount of money spent on raw materials that are utilized in the production process.
Power and Fuel (PF_t)	Represents the cost of electricity and fuel needed for production activities.
Compensation to Employees (CE_t)	Whole remuneration is provided to employees, encompassing their wages, salaries, and benefits.
Repairs and Maintenance ($RMaint_t$)	Amount of money spent on repairing and maintaining equipment and infrastructure.
Total Expenses (TE_t)	All operational expenditures accrued by the company.

Note: The table I presents the notations and definitions of all concerned variables used in the empirical exercises of the study where the standard measures of the variables are taken into the analyses.

Source: Presented by authors using CMIE Prowess databases

The dependent variable Current Sales functions as the principal indicator of economic performance for the companies being analyzed. The independent variables are lagged sales, raw materials, power and fuel, compensation to employees, repairs and maintenance, and total expenses. Lagged Sales is assumed that past sales volumes can influence present sales by virtue of an established market position and client loyalty. Optimizing the use of raw materials is essential for producing goods at a low cost and has a direct impact. Optimizing energy utilization can increase productivity and save expenses, hence positively influencing sales. Providing sufficient remuneration is anticipated to enhance employee productivity and morale, thereby improving overall efficiency and sales performance. Providing sufficient remuneration is anticipated to enhance employee productivity and morale, thereby improving overall efficiency and sales performance. Effective maintenance practices guarantee the efficient operation of manufacturing processes, minimize periods of inactivity, and boost productivity, hence potentially increasing sales. Total Expenses encompass all operational expenditures accrued by the company. Although essential for conducting

business, excessive expenditures can gradually erode profitability and have a detrimental effect on sales. This variable provides insights into the cost management effectiveness of the firms.

5. Empirical Model

To empirically test the theoretical framework, the following linear regression model is used:

$$S_t = \beta_0 + \beta_1 S_{t-1} + \beta_2 RM_t + \beta_3 PF_t + \beta_4 CE_t + \beta_5 TE_t + \beta_6 RMaint_t + \epsilon_t$$

where:

- β_0 = Intercept
- $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$ = Coefficients for the respective variables
- ϵ_t = Error term

Table II. Descriptive Statistics of Variables

Variable	Mean	Std. Dev.	Minimum	Maximum	Observations
S_{t-1}	190930	196945.8	0.8	841329.2	173
RM_t	83931.59	93332.13	1.2	427690	173
PF_t	14815.25	16628.76	17.6	64370	172
CE_t	17181.08	24815.66	0.1	105110.2	173
RMaint_t	5404.17	7332.336	4	34213.1	172
TE_t	187106.9	187839.4	9.7	696510	173

Note:The table II presents the descriptive statistics (mean, median, range and standard deviation) of all underlying variables used in the empirical study, as calculated by authors on selected 6 iron and steel plants over 1991-2020

Source:Estimated by authors using CMIE Prowess databases

6. Empirical Results:

The regression analysis uncovers significant correlations between current sales and the independent variables, shedding light on crucial aspects that impact the economic success of enterprises in the Indian iron and steel industry. The impact of each variable is thoroughly explained below as per table 4.

Impact of Lagged Sales on Current Sales:The presence of a substantial positive coefficient for previous sales highlights a robust and enduring influence on current sales. This finding indicates that previous sales performance has a significant impact on current sales. Companies that have experienced better sales in the previous year are more inclined to retain or enhance their sales in the current year, potentially as a result of client loyalty, consistent market presence, and ongoing business operations that continue from one period to another. The persistence effect seen in this study demonstrates the consistent and enduring sales habits of the enterprises being analyzed.

Role of Raw Materials, Stores, and Spares: A positive and substantial coefficient for raw materials suggests that investing in raw materials, shops, and spares is essential for increasing sales.

Companies that commit more resources to these inputs can improve their manufacturing processes, resulting in increased output and higher-quality products. This, in turn, enhances their capacity to produce revenue. This discovery highlights the significance of effectively managing the conceptual and operational aspects of resources to guarantee consistent and high-quality production of raw materials.

Effect of Power, Fuel, and Water Charges:The presence of a notably negative coefficient for power, fuel, and water charges indicates that increased operational expenses related to these inputs have a detrimental impact on sales. This can be linked to the correlation between rising expenses and the decline in the company's profitability, which therefore restricts its capacity to allocate resources towards essential domains like marketing, research and development, or employee training. Efficient cost management is crucial for sustaining profitability and competitiveness in the sector.

Table III. Correlation Matrix of Variables

Variables	S_t	S_{t-1}	RM_t	PF_t	CE_t	$RMaint_t$	TE_t
S_t	1						
S_{t-1}	1	1					
RM_t	0.9366	0.9366	1				
PF_t	0.7107	0.7107	0.7942	1			
CE_t	0.731	0.731	0.6106	0.5729	1		
$RMaint_t$	0.7957	0.7957	0.6225	0.3624	0.6986	1	
TE_t	0.9897	0.9897	0.9549	0.7592	0.7342	0.7693	1

Note:The table III showcases the correlation matrix of all concerned variables. The correlations between variables in most of the cases are statistically significant as indicated by *** and **, i.e. 1% and 5% significance levels respectively

Source:Estimated by authors using CMIE Prowess database

Impact of Compensation of Employees: The insignificant correlation for employee compensation suggests that variations in employee pay do not consistently affect sales in this dataset. This finding implies that although staff compensation is an important component of operational expenses, its direct impact on sales success may not be significant. Additionally, it could suggest that other variables, such as personnel productivity and efficiency, have a greater impact on sales results.

Importance of Repairs and Maintenance:The significance of repairs and maintenance is underscored by the positive and substantial coefficient, emphasizing the necessity of maintaining equipment and facilities in their best operational state. Implementing routine maintenance procedures decreases the probability of malfunctions and guarantees seamless manufacturing operations, resulting in increased sales. This discovery emphasizes the importance for companies to allocate resources towards routine maintenance to maintain operational efficiency and improve their production capacities.

Table IV. Results of GMM Estimations

Dependent Variable: S_t	
Method: Dynamic Panel GMM	
Variables	Coefficients
S_{t-1}	0.1828*** (0.0405)
RM_t	0.2227** (0.0939)
PF_t	-0.8313*** (0.2046)
CE_t	0.2437 (0.1540)
$RMaint_t$	1.1576** (0.4454)
TE_t	0.7420*** (0.0615)
Constant	2644.849 (2,481.0120)
Observations	158
No of instruments	158
Wald chi2(6)	12696.56
Prob > chi2	0

Notes: Table 4 provides the results of the dynamic panel GMM estimations observing the impact of lagged sales and the other independent variables on current sales in the case of selected 6 iron and steel companies from 1991-2020. Estimated parameters along with their p-values (in parentheses) are presented, where ** and *** denote statistical significance levels at 5 and 1%, respectively

Source: CMIE Prowess

Overall Impact of Total Expenses: The presence of a positive coefficient for total expenses suggests that higher levels of spending, when carefully distributed, lead to a rise in sales. This finding implies that steel factories that allocate resources to different operational factors, such as production, maintenance, and employee welfare, are more likely to achieve improved sales success. It emphasizes the significance of a well-balanced and carefully designed spending strategy to stimulate growth and enhance profitability. This discovery is consistent with the more comprehensive knowledge that making strategic investments in critical operational areas can greatly enhance a company's sales and overall performance.

7. Conclusion:

The empirical examination of the Indian iron and steel business emphasizes the complex aspects that influence present sales performance, including the long-lasting impact of historical sales and the strategic significance of different operational factors. The presence of a notable positive coefficient for lagged sales indicates a robust persistence effect, wherein the past sales performance exerts a considerable impact on the current sales. This can be attributed to elements such as client loyalty, long-standing market presence, and ongoing business operations from one time to another. Companies that had better sales in the previous year are more likely to sustain or improve their sales in the current year, highlighting the significance of establishing a strong and steady sales base. Investing in raw materials, retailers, and spares is crucial for driving sales growth. The positive and substantial coefficient for raw materials suggests that enterprises who spend a greater amount of resources to these inputs might optimize their manufacturing processes, resulting in increased output and enhanced product quality. Consequently, this improves their capacity to create sales by efficiently addressing market demand and sustaining a competitive advantage. On the other hand, the considerably negative coefficient for power, fuel, and water charges (PFW) indicates the detrimental effect of increased operational expenses on sales. Rising expenses in these domains diminish a company's profitability and curtail its ability to allocate resources to other vital domains such as marketing, research and development, or staff training. Efficiently controlling these expenses is crucial for sustaining profitability and competitiveness, as uncontrolled operational costs can impede a company's potential for growth. The insignificance of the coefficient for employee compensation implies that changes in employee pay do not consistently affect sales in the dataset. Nevertheless, the significance of upholding a driven and efficient workforce remains unaffected, as the contentment and output of employees can indirectly impact operational effectiveness and total business prosperity. Repairs and maintenance (RPM) are crucial for maintaining production processes and sales performance. The presence of a positive and statistically significant coefficient for RPM underscores the criticality of maintaining equipment and facilities in an optimal state of operation. Implementing routine maintenance procedures decreases the probability of equipment failures and interruptions in production, guaranteeing a seamless and continuous manufacturing process, and ultimately leading to increased sales. Finally, the presence of a positive coefficient for total expenses suggests that larger expenditures, when carefully distributed, lead to better sales. This discovery emphasizes the significance of a well-balanced and well-devised spending strategy that allocates funds to several operational facets, including production, maintenance, and personnel well-being. Companies that efficiently oversee and distribute their resources are more inclined to achieve superior sales performance and overall expansion.

These insights offer essential direction for policymakers and managers in the iron and steel industry. Companies can enhance their resource allocation and operational strategies to promote growth and profitability by comprehending the interplay of these aspects. This comprehensive analysis emphasizes the necessity of adopting a holistic approach to sales performance management to achieve long-term success in the competitive Indian iron and steel industry. This approach should encompass past accomplishments, investment in high-quality resources, effective cost management,

and

regular

maintenance.

References:

- [1] Banerjee, A., & Das, S. (2014). Determinants of Corporate Financial Performance Relating to Capital Structure Decisions in Indian Iron and Steel Industry. *Journal of Economics and Finance*, 5(1), 14-22.
- [2] Debnath, R. M., & Shankar, R. (2014). Efficiency in the Indian iron and steel industry – an application of data envelopment analysis. *Journal of Advances in Management Research*, 11(2), 160-182.
- [3] Haider, S., et al. (2019). Corporate environmental responsibility, motivational factors, and effectiveness: A case of Indian iron and steel industry. *Journal of Public Affairs*, 19(4), e1976.
- [4] Ohlan, R. (2018). Energy Efficiency in India's Iron and Steel Industry: A Firm-level Data Envelopment Analysis. *Strategic Planning for Energy and the Environment*, 37(1), 42-63.
- [5] Paul, P., & Mukherjee, C. (2018). Analysis of the Effect of Working Capital Management on Profitability of the Firm: Evidence from Indian Steel Industry. *Journal of Applied Finance and Banking*, 8(2), 25-38.
- [6] Ray, S. (2010). Trend in Total Factor Productivity Growth in Indian Iron and Steel Industries Under a Liberalized Trade Regime: An Empirical Analysis with Adjustment for Capacity Utilization. *Economic and Political Weekly*, 45(48), 93-101.
- [7] Schumacher, K., & Sathaye, J. (1998). Productivity in India's iron and steel industry declined due to protective policies, but is improving with liberalization and adoption of more energy-efficient technology. *Energy Policy*, 26(4), 199-214.
- [8] Das, S., & Bhattacharya, P. (2021). "Employee compensation and productivity: An empirical analysis of the Indian steel industry." *Journal of Industrial Economics*, 29(3), 235-250.
- [9] Gupta, R., & Sharma, M. (2018). "Energy consumption and efficiency in the steel industry: A critical analysis." *Energy Policy*, 47(2), 112-123.
- [10] Roy, A., & Singh, R. (2020). "Resource utilization and sustainability in the global steel industry." *International Journal of Industrial Management*, 35(1), 75-89.
- [11] Sahu, P., Mukherjee, A., & Banerjee, S. (2019). "Impact of raw material costs on the economic performance of Indian steel companies." *Journal of Economic Studies*, 27(4), 312-328.