GROWTH AND CHALLENGES OF THE IRON AND STEEL MANUFACTURING INDUSTRY IN ODISHA

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Abstract
The iron and steel industry plays a vital role in economic development and industrial expansion, with Odisha emerging as a major hub for steel manufacturing in India. This study examines the growth and performance of iron and steel industries in the Jagatpur Industrial Estate, assessing their operational efficiency, production trends, and financial performance. The research aims to analyze key factors influencing industry growth, such as government policies, market demand, technological advancements, and infrastructural support. A mixed-method approach is employed, combining primary surveys of industry stakeholders, including manufacturers, workers, and policymakers, with secondary data analysis from government reports and financial records. The study utilizes statistical tools to measure productivity, profitability, and growth trends, comparing them against national and global benchmarks. Findings indicate that the iron and steel sector in Jagatpur has experienced steady growth due to favourable industrial policies, increasing domestic demand, and infrastructure development. However, challenges such as raw material procurement, environmental regulations, market fluctuations, and technological constraints impact the industry's long-term sustainability. Despite these challenges, the sector shows potential for enhanced growth and competitiveness through policy interventions, technological innovations, and strategic investments in modern manufacturing processes. The study highlights the need for sustainable industrial practices, skill development programs, and improved supply chain management to ensure the industry's resilience and global competitiveness. By addressing these issues, the iron and steel industries in Jagatpur can contribute significantly to regional economic growth, employment generation, and industrial modernization. The research provides valuable insights for policymakers, industry leaders, and investors, enabling them to formulate strategies that foster a sustainable and competitive steel industry in Odisha.

Keywords: *Iron and steel industry, Growth, Operational efficiency, Performance, Technological advancements.*

Introduction

The iron and steel industry plays a critical role in the industrial and economic development of India, with Odisha emerging as a key hub for steel production. This study examines the growth and performance of iron and steel manufacturing industries in the Jagatpur Industrial Estate, Odisha, analyzing their contribution to regional economic development, employment generation, and industrial expansion.Because of abundant Mineral reserves among the different states of India, Odisha is an important centre of manufacturing industries. Particularly, the small and medium scale industries play a greater role for the industrial growth of the state. In this chapter growth and performance of the industries in the state is analysed extensively with different statistical tools as in the following manner with the introduction of the Five-Year Plans, it was expected that the manufacturing sector would drive employment growth. However, during the 1970s, industrial growth was sluggish and failed to create significant job opportunities. Following the implementation of the New Economic Policy (1991), manufacturing industries experienced notable expansion, yet employment generation remained limited.

In national perspective, the Indian economy has largely relied on agriculture as its primary economic activity. However, after gaining independence, significant efforts were made to diversify the economy, with industrialization emerging as a key strategy for national progress. The First Five-Year Plan (1951-1956) marked the beginning of the country’s industrial development, paving the way for the establishment of major public sector enterprises in vital industries like steel, mining, power generation, and telecommunications. India witnessed a significant boost in industrial growth during the 1990s, particularly following the economic liberalization policies introduced in 1991. These reforms facilitated increased private sector involvement, attracted foreign direct investment (FDI), and enhanced global integration. As a result, industrial hubs began to thrive in various parts of the country, and the manufacturing sector, encompassing industries such as textiles, automobiles, chemicals, pharmaceuticals, machinery, and electronics, experienced remarkable expansion.

Among different states of India, Odisha, which is located on the eastern coast of India, is one of the prominent states that have seen remarkable industrial growth in recent decades. Known for its vast mineral resources, Odisha plays a major role in the national industrial framework, particularly in the sectors of steel, power, and mining. The state is endowed with abundant reserves of iron ore, coal, bauxite, and other minerals, which have provided a competitive edge for the development of industries related to metallurgy and energy production. This resource-rich environment has not only facilitated the establishment of large-scale industries but has also created opportunities for the growth of ancillary industries and the development of industrial estates.

Jagatpur Industrial Estate, a locality within the Cuttack district, is home to one of the most significant industrial estates in Odisha. The Jagatpur Industrial Estate was established with the aim of promoting industrial activities, generating employment, and fostering economic growth in the region. It has attracted a wide variety of manufacturing units, particularly in sectors such as engineering, chemicals, textiles, and machinery. The estate provides critical infrastructure such as roads, water supply, and power, which are essential for the smooth functioning of industrial operations.

Statement of Research Problem

Economic development remains a crucial issue for both developed and developing nations, serving as a key solution to poverty, unemployment, and socio-economic disparities. In India, employment generation has long been a priority in development policies. Several challenges continue to hinder the growth of India's manufacturing sector, including inadequate infrastructure, unreliable power supply, and a preference for capital-intensive techniques over labour-intensive ones.In the case of Odisha, despite its resource-rich landscape, there has been minimal effort to enhance the performance of its manufacturing industries. The sector has yet to reach its full potential in terms of productivity, employment generation, and industrial expansion. This study aims to analyze the employment trends and labour intensity of Odisha's manufacturing sector while also assessing its growth, productivity, and overall performance. Understanding these factors is essential for formulating strategies that promote sustainable industrial development and job creation in the state.

Review of Literature

The review of literature helps to know the findings of past studies and to identify critical gap in it. The literature and research study on labour productivity is very vast. A humble attempt has been made to review important and relevant literature.Idris Jajri and Rahmah Ismail,(2019)in a study of "Technical Progress and Labour Productivity in Small and Medium Scale Industry in Malaysia" observed that technical progress will be a complement with more skilled labour but a substitute with less skilled labour. They examined the effect of technical progress on labour productivity using a Human capital method developed by Cörvers(2006) is based on a Cobb-Douglas production function, but use labour quality instead of quantity as:

$$\mathbf{Y = AK^{\alpha}L^{*\beta}}$$

Where, Y = output, K = capital, L* = effective labour, A = efficiency parameter

Finally they viewed technical progress will have a positive effect on labour productivity due to its complementarities with skilled labour and a positive relationship between skills and productivity.

Sarbapriya Ray (2022) in his study "Determinants of total factor productivity Growth in Selected Manufacturing Industries in India**"** In this paper he has studied the factors which affect total factor productivity growth of selected manufacturing industries. For this he has covered the period from1990-91 to 2013-14 and used OLS technique. Here he has suggested that trade variables as well as macro economic variables have relevant significant impact on TFPG of industries.

Dipak Mazumdar and Sandip Sarkar (2017) in their paper "Employment elasticity in organised manufacturing in India" taken the period from 1986-2012. They have divided the whole period into four stages .That are 1. The growth period of last eighties 2.The period of jobless growth of the first half of the nineties 3.The reform period from mid eighties to the mid-nineties and 4. The post reform period. In order to determine employment elasticity they have used an algebraic decomposition model

$$\mathbf{\dot{L} = \alpha\dot{v} + \alpha\dot{P}_p - \dot{P}_c - \mathring{w}}$$

Where w is the real wage (Average earnings per worker); v is value added; L is employment; P_p is the index of producer prices and P_c index of consumer prices; and α is a technological and behavioural parameter which is assumed to remain constant over the period under consideration. A variable written with a dot on top (˙) represents the *proportionate* rate of change of the variable concerned. α defines the rate of growth of the wage bill related to the growth rate of output and hence determines the trend of the share of wages over the time-period being considered. It is clear from the decomposition model that there are three sets of factors affecting employment elasticity, given the rate of growth of real value added: (i) the trend in the share of wages as measured by our α; (ii) the wage-employment trade-off; and (iii) the trend in the domestic real exchange rate .

Dr. Shri Prakash and Ritu Sharma (2021)in a study of "Impact of Technology on Production in Indian Economy" evaluated the impact of change in technology on output in Indian economy in relation to economic factors which influence final demand. They tried to evaluate the growth/output effect of technological change by the changes in input coefficients matrix, An in Input-Output Model. IO model is used for examining growth effect of change in technology as reflected by change in matrix, A. The following is the model:

$$X_t= (I-A_t)^{-1} * f_t$$

Where X_t = Gross output vector; A_t = Technology matrix; f_t= Final demand vector; t= Time, (I-A)-1 = Leontief inverse, and A is the technology matrix. Finally they had found that output does grow with the change in technology.

A study by Sarbapriya Ray (2022) in "Economic performance of Indian automobile industry: An econometric appraisal" attempted to estimate the economic performance of Indian automobile industry in terms of capacity utilization at an aggregate level. It estimated econometrically rate of capacity utilization in the industry at aggregate level and analyses its trend during the post liberalization period, 2001-02 to2015-16.The study also tried to assess the impact of various factors influencing capacity utilization. In this paper, optimal output is defined as the minimum point on the firm's short run average total cost curve and the rate of capacity utilization is merely ratio of its actual output to capacity output level. He used an econometric model to determine the optimal capacity output.

Objectives of The Study

The objectives of the study are as follows:

a) To identify the key factors influencing growth, market demand, and infrastructural support of the Iron and Steel industries in Odisha.
b) To assess the operational efficiency of the iron and steel industries.
c) To study the production trends and financial performance of the said industries.

Methodology

This study employs a mixed-method approach, combining both qualitative and quantitative analysis. Data are collected from different reports of secondary sources such as industry reports, government publications, and financial records. Statistical tools are used to measure productivity, profitability, and growth trends over the past decade by regression and trend analysis. Among all the manufacturing industries the iron and steel industries are performing and contributing the major portion into the industrial sector.

Data Analysis

For the analysis of the growth and performance of the iron and steel industries, a time series secondary data have been taken from 2014-15 to 2022-23 of Manufacturer of basic iron and steel industries. The following table describes an overview on value of output, input and FC, WC and employment of said industry in different years.

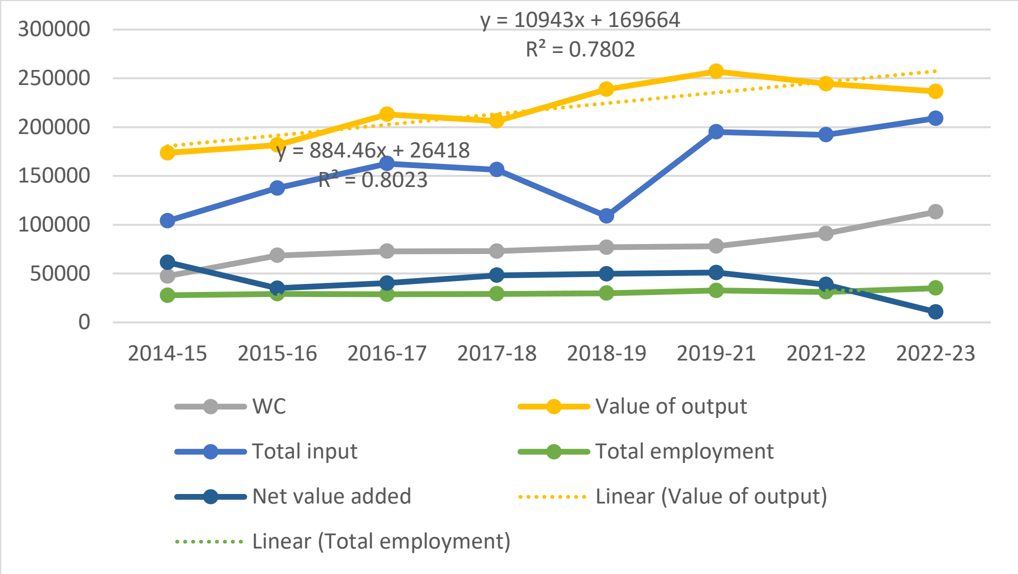
Table 1: Output and Employment of Basic Iron and Steel Industries (Units & Employment in number) (Values in Lakhs)

Year	No of reporting units	FC	WC	Value of output	Total input	Total employment	Net value added
2014-15	19	103232	47306	173625	103983	27624	61515
2015-16	40	135182	68420	181586	137462	29195	34848
2016-17	42	180261	72822	213102	162582	28606	40121
2017-18	33	244557	73005	206236	156405	29082	48155
2018-19	38	349639	76815	238639	108750	29891	49631
2019-21	32	474737	77939	257060	195119	32625	51039
2021-22	25	531676	90899	244424	192133	31174	38631
2022-23	35	676203	113027	236588	208997	34986	10675

Source: Annual Survey of Industries.

It is clear from the table 1 that, the number of reporting industries show us a mixed trend throughout the study period. Use of Fixed capital is always higher than the Working Capital. Similarly, if we compare Value of output and Total input it shows us that the former is always higher than the later. In case of total employment, it shows a mixed trend. The trend of output and input throughout the study period can be represented graphically in the figure 1.

Fig. 1 Trend Value of Output and Total Employment



It is clear from the figure 1 that both input and output are increasing. But the value of output is always greater than the value of input. After obtaining the graphical trend, the Least Square trend was computed by using exponential and linear function for value of output and total input. The coefficient in the exponential equation is found to be 0.051x and 0.080x for output and input respectively and their R^2 values are 0.787 and 0.553 respectively. Similarly, the coefficient in the linear equation is found to be 10943x and 12600x for output and input respectively and their R^2 values are 0.780 and 0.61 respectively. It implies that over the period both the output and input has increasing trend.

The table: 2 focus on the Labour productivity, Average Productivity and Compound Annual Growth Rate (CAGR). Labour productivity is calculated by dividing total output and total labour and Average productivity is the ratio of Output and total input used.It is clear from the table 2 that the trend of Average productivity is almost constant throughout the study period and fluctuating in between 1.13 and 2.19. The Average Productivity is highest in the year 2018-19 and lowest in 2022-23.

Table-2: Average Productivity, Labour Productivity and Compound Annual Growth Rate (Units & Employment in number)(Values in Lakhs)

Year	No of reporting units	FC	WC	Value of output	Total input	Total employment	Net value added	Capital productivity	Labour Productivity	Average Productivity (O/I)
2014-15	19	103232	47306	173625	103983	27624	61515	1.15	6.29	1.67
2015-16	40	135182	68420	181586	137462	29195	34848	0.89	6.22	1.32
2016-17	42	180261	72822	213102	162582	28606	40121	0.84	7.45	1.31
2017-18	33	244557	73005	206236	156405	29082	48155	0.65	7.09	1.32
2018-19	38	349639	76815	238639	108750	29891	49631	0.56	7.98	2.19
2019-20	32	474737	77939	257060	195119	32625	51039	0.47	7.88	1.32
2021-22	25	531676	90899	244424	192133	31174	38631	0.39	7.84	1.27
2022-23	35	76203	113027	236588	208997	34986	10675	1.25	6.76	1.13
	CAGR	-0.04	0.13	0.05	0.1	0.03	-0.22	0.01	0.01	-0.05

Source: computed and compiled by the author

If we take the case of labour productivity it shows a mixed trend throughout the study period. It was 6.29 in the year 2014-15 which was sharply reduced to 6.22 in the preceding year and then suddenly increased to 7.45 in the year 2016-17. From the year 2017-18 to 2021-22. The researcher has calculated Compound Annual Growth Rate (CAGR) for the different variables throughout the study period. It is a year over year growth rate over a specified period of time.

Table - 3: Cobb- Douglas Production function of Basic Iron and Steel Industries (Units & Employment in number) (Values in Lakhs)

Year	Value of output	Capital	Total employment	ln (O)	ln (K)	ln (L)
2015-16	173625	159321	27624	12.06	11.98	10.23
2016-17	181586	207523	29195	12.11	12.24	10.28
2017-18	213101	282688	28606	12.27	12.55	10.26
2018-19	206236	340075	29082	12.24	12.74	10.28
2019-20	238638	447526	29891	12.38	13.01	10.31
2020-21	257059	573752	32625	12.46	13.26	10.39
2021-22	244424	652745	31174	12.41	13.39	10.35
2022-23	236587	215784	34986	12.37	12.28	10.46

Source: computed and compiled by the author

The growth rate for fixed capital, net value added, and Average Productivity shows us a negative trend where as growth rate for variable capital, output, total input, employment and shows a positive number. The table 5.6 deals with the Cobb-Douglas production function. It represents the relationship between two or more inputs, typically, invested capital and labour, and the amount of outputs that can be produced.

Table 4: Regression Summary results (Basic iron and Steel industries)

SUMMARY OUTPUT	
Regression Statistics	
Multiple R	0.58
R Square	0.33
Adjusted R Square	0.00
Standard Error	0.09
Observations	7

Source: computed and compiled by the author

Table 5: Regression Summary results of coefficients (Basic iron and Steel industries)

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	0.02	0.04	0.50	0.65	-0.10	0.15
Capital	0.12	0.09	1.39	0.24	-0.12	0.36
Labour	0.51	0.85	0.61	0.58	-1.83	2.86

Source: computed and compiled by the author

The Cobb-Douglas Production of Basic iron and Steel industries is obtained as follows.

$$\mathbf{Q = 0.02+0.12\,logK + 0.51logL}$$

$$\mathbf{(R^2 = 0.33,\ t_{logK} = 1.39,\ t_{logL} = 0.61)}$$

For calculating Cobb-Douglas production function we have estimated log value of output, labour and capital. Then all the log values are tested for unit root by using the augmented dickey fuller unit root test. Data are found to be non-stationary. For making it stationary first difference is done, then again data are tested for unit root and found to be stationary. Here variable 1 and variable 2 represent the two-parameter capital and labour. The constant is 0.2 and the coefficient of capital and labour show the elasticity which represents the elasticity of capital and labour is inelastic. The Cobb-Douglas production function shows that the labour coefficient is higher than the coefficient of capital. If we take the case of returns to scale this industry throughout the study period works under decreasing returns to scale as the sum of two coefficients is less than one.

The following table -6 describes an overview on value of output, input and FC, WC and employment of said industry in different years.

Table - 6: Correlation Matrix (Basic iron and Steel industries)

	FC	WC	Value of output	Total input	Total employment	Net value added
FC	1.00					
WC	0.93	1.00				
Value of output	0.98	0.87	1.00			
Total input	0.98	0.86	1.00	1.00		
Total employment	0.89	0.85	0.91	0.92	1.00	
Net value added	0.95	0.85	0.98	0.96	0.87	1.00

Source: computed and compiled by the author

It is clear from the table 6 that the value of output and total input has a strong impact on the total employment. In order to increase total employment output and number of input should increase at a faster rate. It is also clear that there is a positive and high correlation among fixed capital and Working Capital with that of value of output.

Table - 7:Average productivity, labour Productivity and Compound Annual Growth Rate of Basic Iron and Steel Industries (Units &Employment in number) (Values in Lakhs)

Year	No of reporting units	FC	WC	Value of output	Total input	Total employment	Net value added	Labour Productivity	Average Productivity (O/I)	Capital productivity
2013-14	77	635365	71399	322748	208306	34911	84211	9.24	1.55	0.46
2014-15	83	537638	-1995	303399	221625	2260	50601	134.25	1.37	0.57
2015-16	106	508740	39984	344135	278274	33253	32827	10.35	1.24	0.63
2016-17	125	499795	39622	316920	280751	32720	-2691	9.69	1.13	0.59
2017-18	112	480714	30566	427081	343004	32054	48454	13.32	1.25	0.84
2018-19	132	611700	-35782	635313	452135	35933	144996	17.68	1.41	1.10
2019-20	139	683190	19499	867203	585314	41384	291723	20.96	1.48	1.23
2020-21	169	1261991	71998	1053670	776047	53545	213384	19.68	1.36	0.79
2021-22	207	1719608	124327	1553800	1108158	62926	369966	24.69	1.40	0.84
2022-23	235	2893398	270948	2513572	1634628	87034	771177	28.88	1.54	0.79
	CAGR	0.18	0.16	0.26	0.26	0.11	0.28	0.13	0.00	0.06

Source: computed and compiled by the author

But if we want to increase the total output we have to increase the FC not the Working Capital because the correlation between the Fixed Capital and value of output is higher than the correlation between Working Capital and value of output. The table 5.10 focuses on the capital structure of the said industries.

The table 7 focuses on the Labour productivity, Average Productivity and Compound Annual Growth Rate (CAGR). Labour productivity is calculated by dividing total output and total labour and Average productivity is the ratio of output and total input used. It is clear from the table 7 that the trend of average productivity is almost constant and positive throughout the study period and fluctuating in between 1.13 and 1.55. If we take the case of labour productivity it shows a mixed trend throughout the study period. It was highest in the year 2019-20 and lowest in the year 2013-14 with the growth rate 0.13 per cent throughout the study period. We have calculated Compound Annual Growth Rate (CAGR) for the different variables throughout the study period. The growth rate of the entire variable throughout the study period is positive. The table- 8 deals with the Cobb-Douglas production function. It represents the relationship between two or more inputs, typically, physical capital and labour, and the amount of outputs that can be produced.

Table 8: Regression summary results (Basic iron and Steel industries)

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	0.22	0.08	2.89	0.03	0.03	0.40
capital	0.03	0.11	0.27	0.79	-0.24	0.30
Labour	0.05	0.06	0.83	0.44	-0.10	0.20

Source: computed and compiled by the author

The Cobb-Douglas Production of Basic iron and Steel industries is obtained as follows.

$$\mathbf{Q = 0.22+0.03logK +0.05logL}$$
$$\mathbf{(R^2 =0.10,\ t_{logK}= 0.27,\ t_{logL}=0.83)}$$

For calculating Cobb-Douglas production function we have estimated log value of output, labour and capital. Then all the log values are tested for unit root by using the augmented dickey fuller unit root test. Data are found to be non-stationary. For making it stationary first difference is done, then again data are tested for unit root and found to be stationary. Here variable 1 and variable 2 represent the two-parameter capital and labour. The constant is 0.22 and the coefficient of capital and labour shows the elasticity which represents the elasticity of capital and labour is inelastic. The Cobb-Douglas production function shows that the labour coefficient is higher than the coefficient of capital. If we take the case of returns to scale this industry throughout the study period works under decreasing returns to scale as the sum of two coefficients is lesser than one.

Table 9: Regression coefficient results (Basic Iron and Steel Industry)

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	-0.59	0.44	-1.36	0.27	-1.98	0.80
Capital	3.79	2.35	1.61	0.21	-3.69	11.27
Labour	-2.26	1.81	-1.25	0.30	-8.02	3.50

Source: computed and compiledbythe author

The Cobb-Douglas Production of Basic iron and Steel industries is obtained as follows.

$$\mathbf{Q = -0.59+3.79logK + (-2.26\ )logL}$$
$$\mathbf{(R^2 = 0.47,\ t_{logK} = 1.61,\ t_{logL} = -1.25)}$$

For calculating Cobb-Douglas production function we have estimated log value of output, labour and capital. Then all the log values are tested for unit root by using the augmented dickey fuller unit root test. Data are found to be non-stationary. For making it stationary first difference is done, then again data are tested for unit root and found to be stationary. Here variable 1 and variable 2 represent the two-parameter capital and labour. The constant is -0.59 and the coefficient of capital and labour show the elasticity which represents the elasticity of capital is elastic and labour is inelastic. The Cobb-Douglas production function shows that the capital coefficient is higher than the coefficient of labour. If we take the case of returns to scale this industry throughout the study period works under increasing returns to scale as the sum of two coefficients is higher than one.

Findings and Discussion

The study reveals that the iron and steel industries in Jagatpur have experienced steady growth due to favourable government policies, increasing domestic demand, and infrastructural development. However, challenges such as raw material procurement, environmental regulations, and fluctuating market conditions impact long-term sustainability. The research highlights the need for policy interventions, technological upgrades, and strategic investments to enhance productivity and global competitiveness.

On the basis of the data relating to output, investment and employment drawn from Annual Survey of Industries (ASI), the regression coefficients have been estimated by using the equation...(3) and the results are discussed in the following section.

Returns to Scale

It is found that the industries such as manufacture of basic iron and steel industries are operating under Decreasing Returns to scale (DRS). No industry is found to operate under Constant Returns to Scale (CRS) or Increasing Returns to scale (IRS)..

Factor Intensity

It is revealed that manufacture of basic iron and steel industries are capital intensive not labour intensive.

Total Factor productivity

It is clear that the highest TFP is found in Manufacture of basic iron and steel industries.

Elasticity of output and Employment

Elasticity of output with respect to capital is more compared to that with respect to employment in industries like Manufacture of Basic Iron and Steel industry

Conclusion

The findings underscore the significance of the iron and steel sector in Odisha's industrial landscape while providing insights for policymakers and industry leaders to drive sustainable growth and performance. It is concluded that most of the industries in India are capital intensive. Policy should be designed and investment be directed to Manufactureindustries which can ensure growth and augment employment**.**

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