

A Study of Productivity Management at Tata Steel Limited: An Empirical Analysis

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Abstract

Productivity is the single most important indicator of the operating efficiency of a manufacturing enterprise, since it links the value of output generated to the resources consumed in generating it. This paper examines the productivity performance of Tata Steel Limited (standalone, India operations), Asia's oldest integrated private steel producer, over a ten-year period from 2016-17 to 2025-26. Using sales as the measure of output and materials, labour (employee cost) and overheads as the three principal inputs, the paper computes material productivity, labour productivity, overhead productivity and total factor productivity ratios for each year of the study period. Actual productivity indices (base year 2016-17 = 100) are compared with the linear trend values obtained through the least-squares method ($Y = a + bX$), and the goodness of fit between the actual and trend series is tested using the Chi-square test. The results show that while labour productivity and overhead productivity of the company have registered a statistically significant improving trend, material productivity has declined sharply, driven largely by volatile raw-material and coking-coal prices and the post-2022 corporate amalgamations that enlarged the base of materials consumed. The paper concludes with suggestions for strengthening material productivity while sustaining the gains already achieved in labour and overhead efficiency.

Keywords: Productivity Management, Productivity Analysis, Labour Productivity, Material Productivity, Overhead Productivity, Tata Steel Limited.

Introduction

Productivity denotes the ratio between output produced and the input consumed in producing it. In a capital- and material-intensive industry such as iron and steel, productivity management assumes special significance because raw-material costs (iron ore, coking coal and other inputs) typically account for the largest share of the cost structure, while capacity utilisation, technology upgradation and workforce efficiency determine how effectively a rupee of input is converted into a rupee of output.

Tata Steel Limited, incorporated in 1907, is the flagship steel company of the Tata Group and one of the largest integrated steel producers in India, with captive iron-ore and coal linkages that partially insulate its domestic (standalone) operations from global raw-material price volatility. Over the study period the company has gone through major structural changes — the Bhushan Steel (Tata Steel BSL) acquisition, the amalgamation of several group companies (Tata Steel Long Products, Tata Metaliks,

Tinplate, TRF, Indian Steel & Wire Products, Tata Steel Mining and S&T Mining) into the parent company with effect from 1 April 2022, and swings in global steel and coking-coal prices, including the sharp COVID-19 disruption in 2020-21 and the price boom of 2021-22. These events make Tata Steel a particularly instructive case for a longitudinal productivity study.

Objectives of the Study

- To measure material productivity, labour productivity, overhead productivity and total productivity of Tata Steel Limited for the period 2016-17 to 2025-26.
- To construct actual productivity indices (with 2016-17 as base year) and to compare them with trend values obtained by the least-squares linear trend method ($Y = a + bX$).
- To test, using the Chi-square test, whether the deviation of the actual productivity index from the trend index is statistically significant.
- To identify the factors responsible for the observed trend in each productivity ratio.
- To offer suggestions for improving the productivity performance of the company.

Review of Literature

The literature on productivity measurement and management provides the conceptual foundation for this study. Sumanth (1984) defined total productivity as the ratio of tangible output to the sum of all tangible input factors and developed the Total Productivity Model widely used in manufacturing firms to disaggregate productivity into partial measures such as labour, capital, material and energy productivity. Prokopenko (1987), in the International Labour Organisation's handbook on productivity management, emphasised that productivity improvement in an enterprise is a continuous management process requiring measurement, evaluation, planning and improvement of productivity ratios at the level of the firm, and distinguished between partial productivity ratios (output per unit of a single input) and total-factor productivity ratios.

Drucker (1954) had earlier argued that productivity of resources, and not merely profit, is the true test of managerial competence, a view that underlies the practice of computing input-wise productivity ratios rather than relying on profitability ratios alone. In the Indian context, studies published by the Confederation of Indian Industry and the National Productivity Council have periodically benchmarked the productivity of Indian steel producers, including Tata Steel, against global peers on parameters such as labour productivity per employee and energy consumption per tonne of crude steel, generally finding that Tata Steel's Indian operations rank among the more efficient integrated steel plants globally on account of captive raw-material linkages and continuous capacity modernisation.

For empirical work of this kind, Indian corporate-finance literature commonly draws financial data from stock-exchange filings and financial-data aggregators such as BSE India, NSE India, Moneycontrol and Screener.in, since listed companies are statutorily required to file quarterly and annual audited standalone and consolidated financial results with these exchanges under SEBI's Listing Obligations and Disclosure Requirements Regulations, 2015. This study follows the same convention, using the standalone financial statements of Tata Steel Limited as filed with BSE/NSE and disseminated through Moneycontrol and allied platforms, since the standalone accounts most closely reflect the productivity of the company's core Indian steel-making operations, as distinct from the consolidated accounts which also include the European and South-East Asian subsidiaries.

Methodology of the Study

Nature of the study: The study is descriptive and analytical, based entirely on secondary data.

Period of the study: Ten financial years, from 2016-17 to 2025-26 (India's financial year runs from 1 April to 31 March).

Sources of data: Standalone audited financial results (Statement of Profit and Loss) of Tata Steel Limited as filed with BSE and NSE under Regulation 33/52 of the SEBI (LODR) Regulations, 2015, cross-verified with data reported on Moneycontrol, Screener.in and the company's own investor-relations filings (tatasteel.com). All figures are in ₹ crore and pertain to the standalone entity, Tata Steel Limited (India operations).

- **Variables used:** Output: Net Sales / Revenue from operations. Input 1 – Materials: Cost of materials consumed, adjusted for purchases of stock-in-trade and change in inventories (i.e.,

total material cost charged to the Statement of Profit and Loss for the year). Input 2 – Labour: Employee benefits expense.

Input 3 – Overheads: Other expenses (manufacturing, administration, selling and distribution expenses, excluding finance cost and depreciation). Total Input: Sum of Materials + Labour + Overheads.

Tools of analysis: (i) Productivity ratio = Output ÷ Input; (ii) Actual Index (2016-17 = 100); (iii) Trend line fitted by the least-squares method, $Y = a + bX$, where X is coded as 1, 2, 3 ... 10 for the ten years and Y is the productivity ratio (the trend index is then computed on the same 2016-17 = 100 base as the actual index); (iv) Chi-square test, $\chi^2 = \sum [(O - E)^2 / E]$, applied to the actual index (O) against the trend index (E) for each ratio, with 9 degrees of freedom, to test whether the year-to-year fluctuations of the actual index around its own trend are statistically significant at the 5 per cent level.

Hypothesis: H_0 — There is no significant difference between the actual productivity index and the trend productivity index (i.e., the productivity ratio has moved in line with its long-term linear trend). H_1 — There is a significant difference between the actual and trend productivity indices.

- **Limitations:** (a) The study is confined to the standalone (India) operations of Tata Steel Limited and does not cover the consolidated group, which includes Tata Steel Europe and other subsidiaries. (b) Figures for 2016-17 have been adjusted to a post-GST-equivalent (net-of-excise-duty) basis to make them comparable with later years, since excise duty was replaced by GST with effect from 1 July 2017; this involves a reasonable estimate for that one year. (c) With effect from 2022-23, several Tata Group companies were amalgamated into Tata Steel Limited, which enlarges the scale of materials, labour and overheads reported from that year onward and is a structural, not merely operational, break in the series. (d) Figures have been rounded to the nearest ₹ crore and compiled from secondary sources; very minor rounding differences (well under 1 per cent) may exist between figures reported by different financial-data platforms for the same year.

Data Presentation

Table 1 presents the basic data — output and the three categories of input — for Tata Steel Limited (standalone) for the ten years under study.

Table 1: Output and Input Data of Tata Steel Limited, 2016-17 to 2025-26 (₹ crore, standalone)

Year (FY)	Output – Sales (₹ Cr)	Materials (₹ Cr)	Labour (₹ Cr)	Overheads (₹ Cr)	Total Input (₹ Cr)
2016-17	48,144	12,048	4,605	19,614	36,267
2017-18	59,617	18,070	4,829	20,939	43,838
2018-19	70,611	21,094	5,131	23,823	50,048
2019-20	60,436	18,406	5,037	22,132	45,575
2020-21	64,869	16,479	5,199	21,426	43,104
2021-22	1,29,021	37,525	6,366	34,001	77,892
2022-23	1,42,913	66,043	7,221	41,379	1,14,643
2023-24	1,40,987	58,091	7,402	45,661	1,11,154
2024-25	1,32,517	54,245	8,010	42,396	1,04,651
2025-26	1,39,720	52,690	7,756	46,803	1,07,249

Source: Compiled by the author from standalone audited financial results of Tata Steel Limited filed with BSE/NSE and reported on Moneycontrol and Screener.in.

Material Productivity (Sales ÷ Materials)

Material productivity measures the sales generated per rupee of material consumed. Table 2 presents the actual ratio, actual index, trend value and Chi-square contribution for each year.

Table 2: Material Productivity of Tata Steel Limited

Year	Output (₹Cr)	Materials (₹Cr)	Ratio (O/I)	Actual Index	Trend $Y=a+bX$	Trend Index	$(O-E)^2/E$
2016-17	48,144	12,048	3.996	100.00	3.823	100.00	0.000
2017-18	59,617	18,070	3.299	82.56	3.662	95.79	1.827
2018-19	70,611	21,094	3.347	83.77	3.501	91.58	0.666
2019-20	60,436	18,406	3.283	82.17	3.340	87.37	0.310
2020-21	64,869	16,479	3.936	98.51	3.179	83.16	2.832
2021-22	1,29,021	37,525	3.438	86.04	3.018	78.95	0.637

2022-23	1,42,913	66,043	2.164	54.15	2.857	74.74	5.673
2023-24	1,40,987	58,091	2.427	60.74	2.696	70.53	1.361
2024-25	1,32,517	54,245	2.443	61.13	2.535	66.32	0.406
2025-26	1,39,720	52,690	2.652	66.36	2.375	62.11	0.290

Trend equation: $Y = 3.9837 - 0.1609X$ | Chi-square (calculated) = 14.002, d.f. = 9, table value at 5% = 16.92

Interpretation: Material productivity declined from 4.00 in 2016-17 to a low of 2.16 in 2022-23, recovering only marginally to 2.65 by 2025-26; the actual index fell to about 54–66 per cent of the base-year level in the last four years. The negative slope of the trend line ($b = -0.16$) confirms a consistent long-term decline. The calculated Chi-square value (14.00) is lower than the table value (16.92) at 9 degrees of freedom and 5 per cent significance, so the null hypothesis cannot be rejected: the year-to-year movement, though large in magnitude, is not statistically significant from its own declining trend — i.e., the decline itself is the dominant and fairly steady pattern rather than random fluctuation around a flat line. The decline is attributable to a sharp rise in raw-material costs (iron ore royalty, coking-coal prices) and, from 2022-23, to the amalgamation of several group companies into Tata Steel Limited, which enlarged the materials base disproportionately relative to sales in the amalgamated years.

Labour Productivity (Sales ÷ Employee Cost)

Table 3: Labour Productivity of Tata Steel Limited

Year	Output (₹Cr)	Labour (₹Cr)	Ratio (O/I)	Actual Index	Trend $Y=a+bX$	Trend Index	(O-E) ² /E
2016-17	48,144	4,605	10.455	100.00	11.242	100.00	0.000
2017-18	59,617	4,829	12.346	118.09	12.182	108.36	0.874
2018-19	70,611	5,131	13.762	131.63	13.121	116.71	1.906
2019-20	60,436	5,037	11.998	114.77	14.061	125.07	0.849
2020-21	64,869	5,199	12.477	119.35	15.000	133.43	1.486
2021-22	1,29,021	6,366	20.267	193.86	15.940	141.79	19.124
2022-23	1,42,913	7,221	19.791	189.30	16.879	150.14	10.215
2023-24	1,40,987	7,402	19.047	182.19	17.819	158.50	3.540
2024-25	1,32,517	8,010	16.544	158.24	18.759	166.86	0.445
2025-26	1,39,720	7,756	18.014	172.31	19.698	175.21	0.048

Trend equation: $Y = 10.3028 + 0.9395X$ | Chi-square (calculated) = 38.487, d.f. = 9, table value at 5% = 16.92

Interpretation: Labour productivity nearly doubled over the decade, rising from an index of 100 in 2016-17 to a peak of about 194 in 2021-22, before easing to around 172 by 2025-26 as the amalgamated entity's employee base expanded. The strongly positive slope ($b = 0.94$) indicates a clear and sustained improvement. Here the calculated Chi-square value (38.49) exceeds the table value (16.92), so the null hypothesis is rejected: the deviations of the actual index from its own trend are statistically significant, reflecting the sharp, event-driven jump in 2021-22 (record steel prices and post-COVID demand recovery) followed by a partial correction — i.e., labour productivity has improved, but not smoothly, and the improvement has been punctuated by sizeable cyclical swings.

Overhead Productivity (Sales ÷ Overheads)

Table 4: Overhead Productivity of Tata Steel Limited

Year	Output (₹Cr)	Overheads (₹Cr)	Ratio (O/I)	Actual Index	Trend $Y=a+bX$	Trend Index	(O-E) ² /E
2016-17	48,144	19,614	2.455	100.00	2.767	100.00	0.000
2017-18	59,617	20,939	2.847	115.99	2.829	102.25	1.847
2018-19	70,611	23,823	2.964	120.75	2.891	104.50	2.527
2019-20	60,436	22,132	2.731	111.25	2.954	106.76	0.189
2020-21	64,869	21,426	3.028	123.34	3.016	109.01	1.886
2021-22	1,29,021	34,001	3.795	154.59	3.078	111.26	16.878
2022-23	1,42,913	41,379	3.454	140.71	3.141	113.51	6.515
2023-24	1,40,987	45,661	3.088	125.79	3.203	115.76	0.869
2024-25	1,32,517	42,396	3.126	127.34	3.265	118.02	0.737
2025-26	1,39,720	46,803	2.985	121.62	3.327	120.27	0.015

Trend equation: $Y = 2.7044 + 0.0623X$ | Chi-square (calculated) = 31.462, d.f. = 9, table value at 5% = 16.92

Interpretation: Overhead productivity improved steadily, with the index rising from 100 to a peak of about 155 in 2021-22 and settling around 122–127 in the most recent years, and the trend slope is mildly positive ($b = 0.06$). As with labour productivity, the calculated Chi-square value (31.46) exceeds the table value (16.92), so the null hypothesis is rejected — the actual index deviates significantly from a smooth trend, again on account of the exceptional 2021-22 peak followed by moderation, rather than a steady linear improvement.

Total Productivity (Sales ÷ Total Input)

Table 5: Total Productivity of Tata Steel Limited

Year	Output (₹Cr)	Total Input (₹Cr)	Ratio (O/I)	Actual Index	Trend $Y=a+bX$	Trend Index	(O-E) ² /E
2016-17	48,144	36,267	1.327	100.00	1.413	100.00	0.000
2017-18	59,617	43,838	1.360	102.44	1.403	99.28	0.101
2018-19	70,611	50,048	1.411	106.28	1.392	98.56	0.605
2019-20	60,436	45,575	1.326	99.89	1.382	97.84	0.043
2020-21	64,869	43,104	1.505	113.37	1.372	97.12	2.718
2021-22	1,29,021	77,892	1.656	124.78	1.362	96.40	8.353
2022-23	1,42,913	1,14,643	1.247	93.91	1.352	95.68	0.033
2023-24	1,40,987	1,11,154	1.268	95.55	1.342	94.96	0.004
2024-25	1,32,517	1,04,651	1.266	95.39	1.331	94.24	0.014
2025-26	1,39,720	1,07,249	1.303	98.14	1.321	93.52	0.228

Trend equation: $Y = 1.4229 - 0.0102X$ | Chi-square (calculated) = 12.097, d.f. = 9, table value at 5% = 16.92

Interpretation: Total productivity has been broadly stable, moving in a narrow band around the base-year level (index between roughly 94 and 125), with a mildly negative trend slope ($b = -0.01$) — indicating the improvements in labour and overhead productivity have been almost entirely offset by the decline in material productivity, since materials constitute the largest share of total input. The calculated Chi-square value (12.10) is below the table value (16.92), so the null hypothesis cannot be rejected: total productivity has moved in line with its (near-flat) trend without a statistically significant departure.

Results and Findings

- Material productivity of Tata Steel Limited declined consistently over the study period (index falling from 100 to about 54–66 in recent years); the decline follows its trend closely and is not a random fluctuation ($\chi^2 = 14.00 < 16.92$).
- Labour productivity improved substantially (index rising to 158–194 in the later years) but with statistically significant year-to-year volatility around its rising trend ($\chi^2 = 38.49 > 16.92$), driven mainly by the record profitability cycle of 2021-22.
- Overhead productivity also improved (index up to about 121–155) with a similarly significant departure from a smooth trend ($\chi^2 = 31.46 > 16.92$), again linked to the 2021-22 price cycle.
- Total productivity — the combined effect of all three inputs — has remained broadly range-bound and close to its own near-flat trend ($\chi^2 = 12.10 < 16.92$), because the material-productivity decline has largely neutralised the labour- and overhead-productivity gains.
- The amalgamation of group companies into Tata Steel Limited effective 1 April 2022 is a structural break that enlarged the base of all three inputs from 2022-23 onward and should be kept in mind while interpreting the year-on-year figures for the last four years of the study.

Conclusion

The ten-year productivity analysis of Tata Steel Limited shows a company that has been able to substantially improve the efficiency with which it converts labour and overhead expenditure into sales, but has struggled to improve — and has in fact lost ground on — material productivity, the input category that carries the heaviest weight in the cost structure of an integrated steel producer. Because materials dominate total input, the net effect on total productivity has been broadly neutral rather than positive. The statistically significant Chi-square results for labour and overhead productivity indicate that these gains, while real, have been achieved unevenly across the cycle rather than through steady year-on-year efficiency improvement, and are therefore vulnerable to reversal when the steel-price cycle turns down, as was seen in 2022-23 to 2024-25. Sustained improvement in total productivity will depend primarily on

the company's ability to manage material productivity — through raw-material security, cost-efficient sourcing and yield improvement — rather than through further labour or overhead rationalisation alone.

Suggestions to Improve Productivity

- Strengthen raw-material security by further expanding captive iron-ore and coking-coal linkages and long-term supply contracts, to reduce the exposure of material cost to global price volatility, which is the single largest driver of the observed decline in material productivity.
- Improve material yield and reduce wastage through better process control, higher-grade beneficiation of iron ore, and continued investment in energy- and material-efficient technologies such as pellet plants and coke-oven modernisation.
- Pursue value-added, higher-realisation product mix (branded and downstream products) so that a given tonne of material input generates higher sales realisation, thereby improving material productivity even when input volumes do not fall.
- Institutionalise a formal productivity-measurement and target-setting system (of the kind proposed by Sumanth's Total Productivity Model) covering material, labour, overhead and total productivity ratios on a quarterly basis, so that adverse movements are identified and corrected early rather than only at the end of the financial year.
- Smoothen the cyclicalities evident in labour and overhead productivity by hedging exposure to steel-price cycles (where feasible) and by keeping fixed employee and overhead cost growth more closely aligned to the company's medium-term, rather than peak-cycle, revenue expectations.
- Carry out a post-merger integration review of the amalgamated entities (Tata Steel Long Products, Tata Metaliks, Tinplate, TRF, ISWP, Tata Steel Mining and S&T Mining) specifically from a productivity standpoint, to identify and eliminate duplicated overheads and to realise the operational synergies that were cited as a rationale for the amalgamation scheme.

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