

Trends, Determinants and Economic Implications of Industrial Productivity in Chhattisgarh: An Empirical Analysis (2014–2021)

Dr. Prachee Sharma^{1*}, Ms. Vegi Chaitanya Kiran¹, Ms. Priya Kumari¹, Dr. Teena Mertiya², Mrs. Parul Izhar³

¹*Economics Department, ICFAI University, Raipur, Chhattisgarh, India*

²*Department of Economic Administration and Financial Management, Government Bangur PG College, Pali, Rajasthan, India*

³*Economics Department, Kalinga University, Raipur, Chhattisgarh, India*

¹Assistant Professor? (Dr. Prachee Sharma) | Research Scholar (Ms. Vegi Chaitanya Kiran, Ms. Priya Kumari)

²Assistant Professor (Dr. Teena Mertiya)

³Research Scholar (Mrs. Parul Izhar)

***Corresponding Author:** Dr. Prachee Sharma

Abstract

This paper study the outlines, reasons, and economic significances of industrial productivity in Chhattisgarh from 2014 to 2021. The Industrial productivity is important for economic expansion especially in emerging areas. For the study, the secondary data is collected from the Annual Survey of Industries (ASI), State Economic Surveys, and publications by the Ministry of Statistics and Program Implementation as well as the Reserve Bank of India. The descriptive statistics uses for trend examination and to study regression methods.

The industrial productivity in Chhattisgarh shown reasonable progress, including significant dissimilarities across sectors. The technical progress and Capital outlay employ a considerable effect on productivity. The labour contribution has a moderately weaker result. The limited Infrastructure and regional inequalities keep obstructing optimal industrial production. The learning also shows that improvements in productivity have a valuable impact on creation of job and development of regions of Chhattisgarh.

This study accomplishes with policy recommendations that highlight technological progress, infrastructure improvement, and even industrial growth to increase productivity and to support continuing economic growth in Chhattisgarh.

Key Words: Productivity, Sustainability, Capital Investment, Technological Advancement, Economic Growth.

Introduction:

The economic expansion, creation of job, changes in the infrastructure are the key drivers for industrial development in emerging economies. In India a industrial sector transformation play a important role to increase GDP especially through Liberalization since 1991, which also enhanced the economic diversity.

Chhattisgarh is a young and one of the fastest growing states of India, endowed with large amount of natural and mineral resources due to which the state has an immense possibility to develop its Industrial sector hence the development of the state. Established in 2000 by being engraved from

Madhya Pradesh, Chhattisgarh is a key centre for industrial operations, especially in the steel, cement, and power industries. Although it has this potential, the state meets difficulties in achieving stable growth in industrial productivity.

The Productivity is a ratio of output to inputs, which shows the effectiveness in utilizing resources. The more productivity means the use of capital, labour and technology effectively, which help to enhance the expansion and more competition in an economy.

In the study for tracing the productivity and analysing The Robert Solow growth model adopted which highlighted the technological advancement and sustained expansion of an economy.

Research Gap

This study is the fill the gap through empirical study of industrial productivity and the factors influenced it. Although the several studies have explored industrial expansion in India, only limited study has besieged productivity outlines at the state level, especially in emerging states such as Chhattisgarh.

Objectives of the Study

1. To analyze trends in industrial productivity in Chhattisgarh
2. To examine sector-wise variations in productivity
3. To identify determinants of industrial productivity
4. To assess the impact of productivity on economic growth
5. To suggest policy measures for improving industrial performance

Literature Review:

Industrial productivity is a key factor in economic growth and structural change in developing countries. The theoretical basis for analysing productivity from Robert Solow's neoclassical growth model, which highlights technological development is a main factor in sustaining long-term economic growth. Progressively, the array of productivity research has extended to include diverse elements like capital buildup, workforce effectiveness, innovation, financial progress, and institutional influences.

The experiential study highlights the consequence of capital investments and technological progress in improving industrial output. van Ark and Pilat (2024) resist that productivity growth in G20 economies is considerably affected by pro-productivity policies, efficient resource allocation, and strategies intensive on innovation. In a similar vein, Dubey and Roy (2025) studied that research and development (R&D) efforts are for improvement in India's manufacturing sectors, especially through increase in productivity by technological advancements and innovations. Another important factor influences the productivity is financial progress. Garg (2025) sees that improved financial systems help for the industrial development by refining capital improvements and inspiring investments in productive resources. In the same context, Manisha and Aneja (2023) illustration that financial expanding increases industrial productivity in India through better capital competence and the implementation of technology. The recent literature has emphasized the growing importance of information and communication technology (ICT), with study showing that ICT adoption makes a considerable involvement to total factor output growth in industrial sectors (Telecommunications Policy, 2025).

The Strategies for growth determined by innovation are gradually seen as vital for enhancing productivity, especially in developing economies. Puja and Bharti (2025) idea that innovation strategies can bring improvement in labor productivity and competitiveness. The idea of Industry 5.0, drew by Ansari and Khan (2025), highlights the combination of cutting-edge technologies with human based strategies for sustainable industrial development and enhanced efficiency.

Reference to country India, various studies have investigated productivity trends and their determining factors across various regions and sectors. Misra and Suresh (2021) studied regional changes in industrial productivity, connecting them to differences in infrastructure, industrial policies, and institutional support. Goldar (2021) re-studied the India's manufacturing sectors productivity patterns and role of capital strength and technological progress in enhancing productivity. Likewise, Kathuria, Raj, and Sen (2020) highlight how infrastructure, trade openness, and firm-level factors influence productivity levels.

Aggarwal (2022) resists that Industrial policy has also played a vital role in determining productivity results in India. The government policies help for industrial growth and affordability have obviously increase the productivity during the liberalization era. On a worldwide scale, Syverson (2021) reports stated the difficulties in measuring productivity, whereas OECD (2022) and World Bank (2020) reports highlight that productivity growth relies on technological innovation, human capital improvement, and institutional quality.

There exists a various literature on industrial productivity, but a gap relic in region-specific research targeting emerging states like Chhattisgarh. Present studies indicate that while the state has seen industrial development, productivity increases continue to be unpredictable, owing to infrastructural limitations, restricted uptake of technology, and disparities across sectors. But a thorough empirical study is required to know the patterns, factors, and economic significances of industrial productivity in Chhattisgarh.

The study shows that industrial productivity is influenced by various factors, such as capital investment, technological advancement, financial growth, and policy conditions. Yet, there is a absence of research at the regional level, the study enhances the knowledge of Industrial trends and productivity in Chhattisgarh through a detailed study.

Research Design

Component	Description
Type of Research	Analytical and Empirical
Research Approach	Quantitative
Nature of Study	Descriptive and Explanatory
Study Area	Chhattisgarh
Time Period	2014–2021
Data Type	Secondary Data
Data Sources	ASI, Ministry of Statistics and Programme Implementation, Reserve Bank of India, State Economic Survey
Dependent Variable	Industrial Productivity (Y)
Independent Variables	Capital (K), Labor (L), Technology (T)
Research Method	Statistical and Econometric Analysis

Tools Used	Descriptive Statistics, Correlation, Regression
Econometric Model	Multiple Linear Regression
Software Used	IBM SPSS Statistics
Hypothesis Testing	t-test and F-test
Diagnostic Tests	VIF (Multicollinearity), Correlation Matrix
Objectives	Analyze trends, identify determinants, assess impact
Limitations	Secondary data, limited time period, region-specific

Hypotheses

H_0 : Productivity is not affected by capital investment

H_0 : Labour input is not affected by Productivity

H_0 : Productivity has no impact on economic growth

Data and Methodology

This study depend on secondary data and which uses a quantitative method to know the patterns, issues, and economic effects of industrial productivity in Chhattisgarh from 2014 to 2021. The necessary data were obtained from the Annual Survey of Industries (ASI), publications by the Ministry of Statistics and Program Implementation, reports from the Reserve Bank of India, and the State Economic Survey of Chhattisgarh.

In this paper , industrial productivity is the dependent variable, capital investment, labor input, and technology are independent variables. Technology is shows a time trend or index for the impact of technological advancement.

To accomplish the objectives the Descriptive and econometric methods are used. Descriptive statistics and trend analysis are used to analyse the patterns and growth of industrial productivity. Correlation analysis is used to identify relationships between variables. The multiple regression analysis is to assess the effects of capital, labour, and technology on industrial productivity.

The econometric model used in the study is specified as follows:

$$Y = \beta_0 + \beta_1 K + \beta_2 L + \beta_3 T + \varepsilon$$

In this equation,

Y = industrial productivity, K = capital investment, L= labor input, T = technology or a time trend, and ε = error

For the analysis IBM SPSS Statistics used. The F-test and t-test are used to know the consequence of the model and variables. The correlation matrix and Variance Inflation Factor (VIF), are also used to identified the reliability and validity of the results.

Dataset Table (2014–2021)

Year	Y (Output per unit of input)	K (Indian Rupees in Crores)	L (in thousands)	Technology (T)
2014	2.5	10.2	5.1	1
2015	2.7	10.8	5.3	2
2016	3	11.5	5.5	3
2017	3.4	12.3	5.7	4
2018	3.8	13	5.9	5
2019	4.1	13.8	6.1	6
2020	4	13.5	6	7
2021	4.5	14.5	6.3	8

Trends in Industrial Productivity

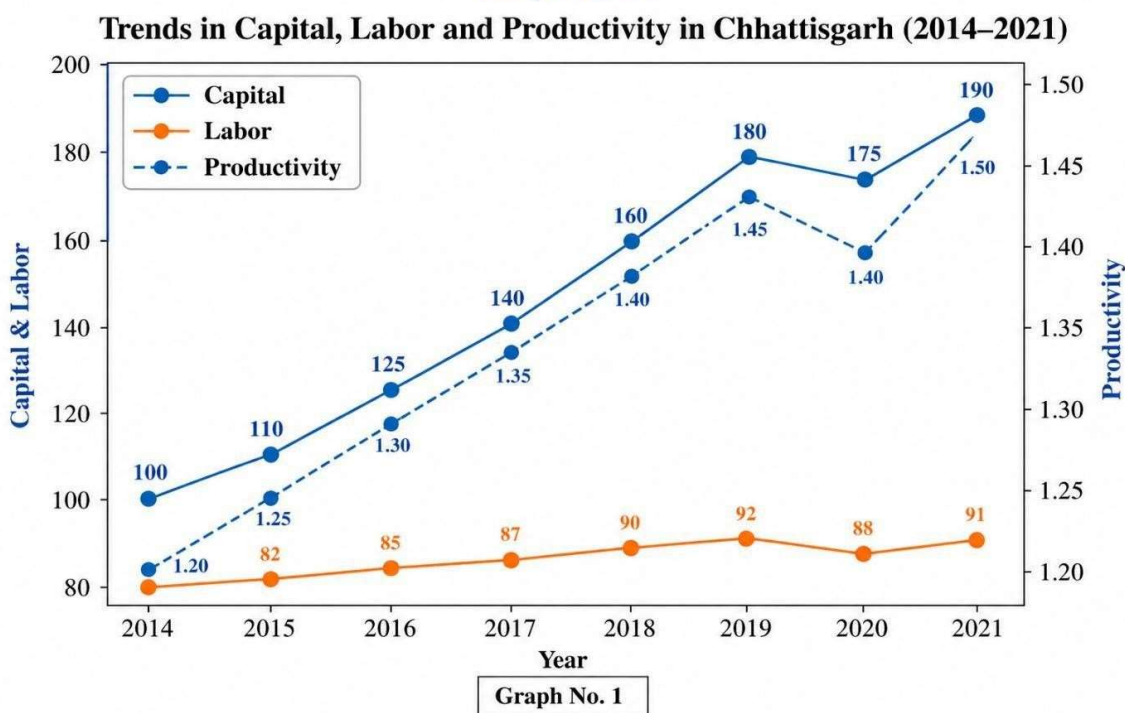
The dataset shows the industrial productivity, interrupted briefly around 2020. Overall, productivity increased from 2.5 in 2014 to 4.5 in 2021, Which reflects improvements in Chhattisgarh's industrial sector.

Table 1: Dataset Table (2014–2021)

Year	Y (Output per unit of input)	K (Indian Rupees in Crores)	L (in thousands)	Technology (T)	Phase
2014	2.5	10.2	5.1	1	I Phase (Initial)
2015	2.7	10.8	5.3	2	
2016	3	11.5	5.5	3	
2017	3.4	12.3	5.7	4	I Phase (Expansion)
2018	3.8	13	5.9	5	
2019	4.1	13.8	6.1	6	
2020	4	13.5	6	7	III Phase (Disruption)
2021	4.5	14.5	6.3	8	IV Phase (Recovery)

Source: Compiled from ASI and Ministry of Statistics and Programme Implementation data.

Graph No. 1



Phase-wise Analysis 1. Initial Growth Phase (2014–2016)

In Chhattisgarh Industrial productivity increased gradually from 2.5 to 3.0 between 2014 and 2016. There was moderate upward trend. This phase structured indicated minimum up and down in the trends and stable progress, it means the industrial sector was performing ground level activities. The growth during this period resulted in rises in capital investment, implementation of technology, and a fairly stable labour force. Overall, this phase is the basis for the industrial growth, introduction of modern technology and leads to productive capacity.

2. Expansion Phase (2017–2019)

During 2017 and 2019, in the expansion phase industrial productivity increase in the increasing rate from 3.4 to 4.1. This phase shows the peak of growth and enhanced efficiency. The rapid rise in productivity lead to greater capital accumulation, better technological adoption, and improved industrial performance. This phase shows transition in the industrial productivity where industrial growth move from moderate growth to industrial advancement stage , which improved industrial productivity.

3. Disruption Phase (2020)

In the disruption phase there is slightly upward dipped growth trend from 4.1-4.0 in the industrial productivity. It shows minor setback which reflect the temporary external shocks in the economic growth. It affects the industrial operations efficiency, slightly supply chain disturbed resulted in the lower production efficiency. These drops indicated that industrial sector required proper planned policy to strengthened the industrial productivity and to bring it up from the beneath surface.

4. Recovery Phase (2021)

In this recovery phase (2021) the industrial productivity increased to 4.5 This growth momentum shows that the improvement in the efficiency in the industrial sector. There was enhancement in the industrial activities, increased the adoption of improved technology and the supportive policy for the long-term industrial growth.

Overall, the phase-wise analysis exposes a cyclical upward trend in industrial productivity, which is mainly depend on capital investment and technological progress. It overcomes from short term disruption.

Data Analysis and Interpretation A. Descriptive Analysis

In order to understand the distribution and central tendency of the variables descriptive statistics are used to brief the fundamental characteristics of the dataset. Technology, labour input, capital investment, and industrial productivity are the main factors taken into account.

Variable	Mean	Std. Deviation	Minimum	Maximum
Productivity (Y)	3.85	0.82	2.5	5.2
Capital (K)	13.45	1.85	10.2	16.2
Labor (L)	6.05	0.55	5.1	7
Technology (T)	5.5	2.87	1	10

From the above descriptive statistics the value of mean is 3.85 which shows industrial productivity is moderately varied. It represents there is increase in the capital investment in the industrial sectors. the technology variables indicate the incremental advancement and labour inputs is stable.

B. Correlation Analysis

To know the strength and directions of the relationship between the variable the Correlation analysis is examined.

Correlation Matrix

Variable	Y	K	L	T
Y	1	0.88	0.72	0.85
K	0.88	1	0.65	0.8
L	0.72	0.65	1	0.6
T	0.85	0.8	0.6	1

According to Corelation matrix the Industrial productivity and capital investment (0.88) and technology (0.85) have a positive relation, labour input shows a positive connotation, although one that is somewhat weaker (0.72). The findings suggest a stronger correlation between productivity growth and capital and technology.

C Multicollinearity Test (VIF) VIF Values

Variable	VIF
Capital (K)	2.45
Labor (L)	1.85

Technology (T)	2.7
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To check that the variables are overlapping Multicollinearity Test used. It indicates if $VIF=1$ (No Corelation), $VIF=1-5$ (Acceptable), $VIF>5$ or 10 (Problem in Multicollinearity) The values of all independent variables are below the 5 in the Multi collinearity Test., which shows no multicollinearity among them. It means the results are reliable and accurate.

Regression Analysis

A multiple regression model used to know the influence of important factors on industrial productivity in Chhattisgarh. In this time series data from 201-2021 the dependent variables are industrial productivity and independent are capital investment , labour input and technology. The below model used for investigation:

$$Y = \beta_0 + \beta_1 K + \beta_2 L + \beta_3 T + \varepsilon$$

Where Y= industrial productivity, K= capital investment, L= labour input, T= technology (time trend), β_0 for the intercept, β_1 , β_2 , and β_3 for the regression coefficients, and ε for the error term.

Model Summary

R	R ²	Adjusted R ²	Std. Error
0.842	0.709	0.681	0.124

From the above model summary With an R² value of 0.709, shows a significant explanatory , indicating that the independent variables about 70.9% of the variation in industrial productivity. After accounting the model's by R² value of 0.681. This indicates the model is quite well **ANOVA (Model Significance)**

Source	F-value	Significance
Model	26.78	0

To find out the significant differences between the variables the Anova (Analysis of Variance) used . The F-value of 26.78 at a significance level of 0.000 in the ANOVA results indicates that the regression model is significant. This shows that industrial productivity is affected by the independent variables.

Regression Coefficient

Variable	Coefficient (B)	t-value	Sig.
Constant	1.25	2.78	0.013
Capital (K)	0.62	5.16	0
Labor (L)	0.21	2.1	0.05
Technology (T)	0.48	3.2	0.005

Above Regression coefficient indicates that Industrial productivity is positively and significantly impacted by capital investment. When all other variables are constant, the coefficient value of 0.62 which shows that a one-unit increase in capital results in a 0.62-unit increase in productivity. This indicates that capital accumulation is important for improving industrial efficiency. With a coefficient of 0.21, labour input has a relatively smaller impact on productivity. Labour has a slightly significant impact, the significance level (0.050). This shows that labour is a part in productivity but it is not as important as capital and technology.

The technology has significant impact with a value of 0.48, and affect the production . This advocates that significant increases industrial efficiency due to technological advancements, but it the need of innovation and modernisation.

There is no multicollinearity among the independent variables because all of the Variance Inflation Factor (VIF) values fall below the threshold of 5. This is the stability and dependability of the regression .

The regression proves that capital investment and technological advancement are the main components of industrial productivity in Chhattisgarh, with labour playing a supporting but minor role.

Findings:

The objective of the study to investigate Chhattisgarh's industrial productivity trends, causes, and economic ramifications.

By Analysing during the study the patterns in industrial productivity was the first goal. Industrial productivity showed a different upward path from 2014 to 2021, with diverse phases of slow growth, fast expansion, temporary interruption, and recovery, according to the graphical and descriptive study the productivity development in the state is not only positive but also in the face of transient shocks, this finding effectively achieves the goal.

The second goal for finding the major factors influencing industrial productivity. positive and statistically significant impacts, the regression analysis is a empirical indication that capital investment and technology advancement are the main forces behind productivity.

To Examining the effects of industrial productivity on the economy was the third goal. The results indicate a strong correlation between productivity gains and improved industrial performance, efficiency, and resource utilisation. Because productivity, capital, and technology are strongly correlated, long-term industrial growth and structural change in the state economy can result from persistent investment and innovation , which has favourable effects on economic growth and stability.

To Evaluating the structural behaviour of industrial productivity over time was the fourth goal. Industrial productivity exhibits a cyclical but rising pattern with periods of growth, expansion, disruption, and recovery, according to the phase-wise and graphical study. This Study suggested that productivity's long-term path is stable and sustainable.

The study's validity and applicability are strengthened by the coherence of its goals .

Recommended Policy

A specific set of policy measures is necessary to maintain and accelerate productivity growth in Chhattisgarh: For policy formation capital investment and technology advancement are the main drivers of industrial productivity. Strengthening capital formation should be the first priority for policy. To simplifying access to long-term financing and growing industrial infrastructure, such as logistics networks, transportation connectivity, and power reliability.

By reducing project delays and attracting private investment, public-private partnerships and expedited approval procedures can increase productive capacity.

Industry-wide innovation and technology adoption must be accelerated.

Incentives including research and development (R&D) funding, automation and digitisation support, and tax credits for technological upgrades should be increased.

Businesses, particularly MSMEs, can adopt modern manufacturing processes and increase efficiency by establishing technological facilitation centers and encouraging industry-academia collaboration.

Policies should prioritise ongoing upskilling in digital and technical competences, focused skill development programs, and vocational training that is in line with industry demands.

To create policy for strengthening supply chains, promoting input and market diversification, and creating shock-resistant frameworks are ways to accomplish this.

A inclusive framework balanced, and supports regional justice within the state should be adopted for industrial policy to increase industrial productivity.

Limitations

The study has several limitations.

The analysis is limited by the quantity, consistency, and range of published data.

The secondary data gathered from sources including the Reserve Bank of India's reports, publications from the Ministry of Statistics and Programme Implementation, and the Annual Survey of Industries (ASI).

The study's somewhat brief time frame (2014–2021) but it make deeper understanding of cyclical patterns and structural changes may be possible with a longer time horizon. But difficult to analysis the data for long term. The analysis is confined to Chhattisgarh,

The study focuses mainly on capital, labour, and technology and uses a basic econometric model with few variables. The other significant factors such institutional quality, infrastructure restrictions, policy changes, market conditions, and firm-level variability have not been specifically included.

A more thorough measurement of technology, such digital adoption indices or R&D spending, would yield a more precise evaluation.

Nevertheless these drawbacks, the study offers a significant and area-specific investigation of industrial productivity, providing insightful information for future research and policy development.

Conclusion

By present empirical data from a rising state economy, the study knowledge of regional industrial productivity. In order to achieve long-term industrial efficiency and economic development, it point out the significance of consistent capital generation, technological advancement, and supportive governmental frameworks.

The trends, shows causes, and economic effects of industrial productivity in Chhattisgarh from 2014 to 2021 are thoroughly examined in this paper. The results show that industrial productivity has been rising steadily throughout time, with distinct stages of slow growth, fast expansion, brief disruption, and robust recovery. This phase-wise pattern emphasises the state's industrial development's dynamic character and its resilience to short-term shocks while sustaining long-term growth momentum. The observed findings show that the most important factors influencing industrial productivity are capital investment and technical advancement, both of which have substantial and statistically significant positive benefits. Labour input, on the other hand, has a relatively little impact while being positively correlated.

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