Journal of Social Economics Research
2021 Vol. 8, No. 2 pp. 135-154.
ISSN(e): 2312-6264
ISSN(p): 2312-6329
DOI: 10.18488/journal.35.2021.82.135.154

ASSESSING THE PERFORMANCE AND FACTORS AFFECTING INDUSTRIAL DEVELOPMENT IN INDIAN STATES: AN EMPIRICAL ANALYSIS

Ajay K. Singh[1+]
Sanjeev Kumar[2]

[1]*Assistant Professor (Economics), School of Liberal Arts & Management, DIT University, Dehradun, Uttarakhand-248009, India.*
Email: a.k.seeku@gmail.com Tel: +917566569201
[2]*Assistant Professor (Economics), School of Liberal Arts & Management, DIT University, Dehradun, Uttarakhand India.*
Email: vashishtsanjeev147@gmail.com

(+ Corresponding author)

Article History
Received: 4 October 2021
Revised: 2 November 2021
Accepted: 23 November 2021
Published: 6 December 2021

Keywords
Industrial growth
Industrial development
Economic development
Gross value-added
India.

JEL Classification:
F63; I52; L16; O14; O15.

ABSTRACT

This study measures the industrial performance of Indian states using secondary data. It uses value of gross output, gross value added, invested capital, number of factories, gross capital formation, total inputs, total persons engaged, and total emoluments of industries. Next, it examines the factors affecting the gross value added of industries, using state-wise panel data for the period 2003–2018. Linear, log-linear and non-linear regression models are considered to estimate the regression coefficients of total persons engaged, gross capital formation, total inputs, labor productivity, per person emoluments, capital intensity, and credit to industry by scheduled commercial banks, annual population growth, and literacy rate with the gross value added of industries. Among the Indian states, Gujarat, Maharashtra, Tamil Nadu and Karnataka make the greatest contributions to industrial development. Labor productivity, annual population growth, literacy rate, total person engaged, credit to industries by scheduled commercial banks, per person emoluments, and gross capital formation positively influence gross value added. Literacy rate, per person emoluments, capital intensity and total inputs display a hill-shaped association with gross value added. Labor productivity, annual population growth, credit to industries by scheduled commercial banks, total persons engaged, and gross capital formation display a linear association with the gross value added of industries in India.

Contribution/Originality: This study makes a valuable contribution to the existing literature by examining the factors affecting industrial development in Indian states using a concrete empirical model. It provides practical policy implications to increase the industrial growth by strengthening labor productivity, capital intensity, financial support, capital formation and human skills across Indian sates.

1. INTRODUCTION

Industrial development supports the creation of jobs for skilled and unskilled laborers, increases the production scale of industries, generates physical and capital assets, creates new markets, increases the capacity of enterprises to absorb raw materials produced by the agricultural sector, develops infrastructure, generates tax revenue for the government, generates foreign currency through exports of goods and services produced by industries, promotes foreign trade, increases per capita gross domestic product (GDP) and income, and reduces the poverty and income inequality in a country (Maroof, Hussain, Jawad, & Naz, 2019). The growth of the industrial sector also contributes to increasing mechanization, technological development, technology transfer, commercialization, innovation and competition (Singh, Ashraf, & Ashish, 2019; Singh & Jyoti, 2020). Consequently, industrial development contributes to increasing the socio-economic development and inclusive growth of a nation (Franck, 2021; Ndiaya & Lv, 2018; Sankaran, Vadivel, & Jamal, 2020).

In India, industrial development serves to increase per capita income and the socio-economic development of people in several ways. The industrial sector provides jobs to around 25.1% of the population and contributes 24.8% to India's GDP. The industrial sector helps to develop goods and services that satisfy human needs. As industrial development increases, exports of goods and services increase under foreign trade. The industrial sector contributes significantly to the generation of foreign currency and foreign exchange reserves for the Indian government through foreign trade. The industrial sector is expected to provide more foreign currency through increasing exports of goods produced by the manufacturing industries in India. Industrial development is highly effective in creating infrastructure development (i.e., roads, transport, buildings, markets). It also provides the way in which available resources (e.g., human, capital, financial, natural) can be used to produce goods and services. Thus, the sector is essential in generating capital and sustaining financial stability in India.

Furthermore, India is the second-largest agricultural intensive economy with a high potential for meeting the industry's requirements for raw materials. Therefore, the industrial sector has significant opportunities to expand further in India. Also, a large proportion of the population is engaged in the agricultural sector; thus, it is essential to increase the industrial development in India to reduce the unlimited supply of labor in this sector and to absorb the additional labor into the industrial sector. Consequently, it would be helpful to create jobs for skilled and unskilled laborers who get seasonal employment in the agricultural sector. Later, industrial development could help to reduce poverty, income inequality, regional imbalances, and disparity in socio-economic structure across Indian states.[1] Also, it could increase the transformation of the Indian economy from the agricultural to the industrial. Due to industrialization, India has become an innovation-driven economy.[2] Furthermore, India is the second most populated country, with a high potential for absorbing the goods and services produced by industries.

In India, the history of industrial development can be observed in five phases: industrial development during the British regime, 1950–1965, 1965–1980, 1980–1991, and industrial development since the economic reforms. Since its independence, India has achieved remarkable growth in industrial development as the share of the industrial sector in India's GDP has increased from 20.8% in 1960 to 31.10% in 2019. Furthermore, it can also be observed that the annual growth of industry value-added was positive during 1961–2019. Accordingly, employment in the industrial sector has increased in the period 1990–2019. Per capita GDP and industry value-added per worker have also increased during 1991–2019. The national-level figure indicates that industrial development is on a growth path in India. However, Indian states display a high diversity in industrial development levels which is apparent in the variation in infrastructural development, number of factories, number of industrial workers, capital investment, the banking sector, number of branches of commercial banks, geographical location, agricultural production, educational and research institutions, government policies, population growth, business ecosystem, technological skills and education level of the workers, demand for goods and services, inflation, workforce availability, ecosystem services, capital formation, market structure, saving and investment patterns, technological development, government policies and others.

Previous studies have assessed different aspects of industrial performance in India. For instance, Mazumdar, Rajeev, and Ray (2009); Kumar and Arora (2012); Pattnayak and Chadha (2013); Debnath and Sebastian (2014); Mahajan, Nauriyal, and Singh (2014); Sahu and Narayanan (2015); Mitra, Sharma, and Véganzonès-Varoudakis

[1] https://www.un.org/esa/sustdev/publications/industrial_development/3_1.pdf.

[2] https://economictimes.indiatimes.com/news/economy/policy/how-indias-is-leading-digital-revolution-with-speed-and-scale/articleshow/67906932.cms?from=mdr.

(2016); Sen and Das (2016); Chaudhuri (2016); Singh et al. (2019) have examined the technical efficiency of different industries in India, such as pharmaceutical, sugar, steel, and electronics, using primary and secondary data. Tyagi and Nauriyal (2016); Satpathy, Chatterjee, and Mahakud (2017); Ranajee (2018). Kumar and Paul (2019) have investigated the production structure, profitability, and productivity of various industries in the manufacturing sector in India. Goldar and Sharma (2015); Mehta and Rajan (2017); Soni, Mittal, and Kapshe (2017); Singh, Narayanan, and Sharma (2017); Singh and Jyoti (2020) have measured the determinants and factors affecting industries in the Indian manufacturing sector. Sahu and Narayanan (2011) have observed the energy intensity of manufacturing firms. Daharwal and Mishra (2021) have examined the role of wages, salaries, emoluments and human resource management in the production of Indian manufacturing industries. Mishra (2019) has investigated the impact of mergers and acquisition on the financial progress of firms in the manufacturing sector. Chawla and Manrai (2019) have analyzed the reasons for the low growth of the manufacturing sector in India. Vinodh and Joy (2012) have assessed the significance of sustainable manufacturing practices in the success of companies. Basu, Ghosh, and Dan (2018) have explored the importance of human resources and the internal practices of the manufacturing firms in India. Thampy and Tiwary (2021) have examined the association of the local banking sector and human capital with the development of the manufacturing sector. Sankaran et al. (2020) have identified the impact of macro-economic variables on manufacturing output in India using national-level data. Finally, taking a broader view, Maroof et al. (2019) have assessed the determinants of industrial development in South Asian countries, and Singh, Singh, and Ashraf (2020) have examined the impact of STDI, IPPI and SEDI on manufacturing value added in 41 developed and developing countries.

From this very brief review of the literature, it can be observed that previous studies have not assessed the factors affecting industrial development across Indian states. Therefore, this study examines the factors affecting industrial development in India using state-wise panel data. This study addresses the following research questions:

- How and why does industrial development vary across Indian states?
- Which Indian states display a better performance in industrial development?
- What are the crucial determinants of industrial development in India?
- How can India create a conducive ecosystem for industrial development in the long term?

With regards to the abovementioned research questions, the present study aims to achieve the following objectives:

- To measure the performance of each Indian state in terms of industrial development.
- To examine the factors affecting the gross value added of industries in Indian states.

2. INDUSTRIAL DEVELOPMENT PERFORMANCE OF INDIAN STATES

The percentage share of Indian states of various indicators, such as value of gross output, gross value added, invested capital, number of factories, gross capital formation, total inputs, total persons engaged, and total emoluments of industrial development, is given in Table 1. It shows that Gujarat state has the highest contribution in value of gross output, invested capital, gross capital formation, and total inputs of industries in India. Maharashtra state has the highest contribution in gross value added and total emoluments in the industrial sector. Tamil Nadu has the highest number of factories in the industrial sector. Secondary data also indicates that Gujarat, Maharashtra, Tamil Nadu, and Karnataka occupy the 1st, 2nd, 3rd, and 4th position, respectively, in terms of industrial development among the Indian states. Uttar Pradesh, Haryana, West Bengal, Andhra Pradesh, Rajasthan, Madhya Pradesh also contribute a significant share of the industrial activities in India. Uttarakhand, Odisha, Telangana, Punjab, Kerala, Jharkhand, Chhattisgarh, Himachal Pradesh, Dadra & Nagar Haveli, and Assam have a low share in industrial development among the Indian states. Thus, these states need to formulate effective industrial policies to increase industrial development in India.

Table-1. The percentage share of states in the industrial development of India in 2017-2018.

State/Region/India	Value of Gross Output	Gross Value Added	Invested Capital	Number of Factories
Gujarat	16.85	15.05	19.35	11.19
Maharashtra	14.86	17.63	12.04	11.10
Tamil Nadu	10.70	11.19	9.07	15.90
Karnataka	6.55	6.97	6.02	5.69
Uttar Pradesh	6.38	5.75	4.86	6.66
Haryana	6.24	4.92	4.03	3.74
West Bengal	3.95	3.08	3.79	4.01
Andhra Pradesh	3.86	3.15	5.38	6.86
Rajasthan	3.68	3.53	3.43	3.88
Madhya Pradesh	3.19	3.34	4.32	1.91
Uttarakhand	2.93	3.39	1.81	1.26
Odisha	2.85	2.80	8.45	1.29
Telangana	2.76	3.22	2.72	6.42
Punjab	2.63	2.15	1.94	5.35
Kerala	2.03	1.49	1.38	3.22
Jharkhand	1.75	2.06	2.84	1.21
Chhattisgarh	1.56	1.33	2.97	1.41
Himachal Pradesh	1.40	2.27	1.31	1.12
Dadra & Nagar Haveli	1.34	1.15	0.90	0.57
Assam	0.83	1.08	0.82	1.91
Other States	3.68	4.47	2.56	5.31
All India	100	100	100	100

Source: Annual Survey of Industries (ASI), Ministry of Statistics and Programme Implementation (GoI).

Table-1. The percentage share of states in the industrial development of India **Continued…**

State/Region/India	Gross Capital Formation	Total Inputs	Total Persons Engaged	Total Emoluments
Gujarat	19.17	17.25	11.70	12.15
Maharashtra	16.03	14.25	12.86	18.01
Tamil Nadu	9.35	10.59	16.16	13.75
Karnataka	7.13	6.46	6.82	7.95
Uttar Pradesh	4.50	6.51	6.86	6.35
Haryana	5.29	6.53	5.50	6.02
West Bengal	4.61	4.15	4.25	3.66
Andhra Pradesh	4.81	4.01	3.83	3.38
Rajasthan	4.59	3.72	3.56	3.53
Madhya Pradesh	4.30	3.15	2.42	2.41
Uttarakhand	1.25	2.82	2.73	2.30
Odisha	2.91	2.86	1.79	2.21
Telangana	4.16	2.65	5.09	3.78
Punjab	2.44	2.73	4.54	3.08
Kerala	1.57	2.15	1.99	1.74
Jharkhand	0.40	1.69	1.23	1.80
Chhattisgarh	2.76	1.61	1.19	1.44
Himachal Pradesh	0.81	1.21	1.32	1.49
Dadra & Nagar Haveli	0.17	1.38	0.77	0.72
Assam	0.68	0.78	1.39	0.69
Other States	3.09	3.50	4.02	3.55
All India	100	100	100	100

Source: Annual Survey of Industries (ASI), Ministry of Statistics and Programme Implementation (GoI).

The cross-comparison of Indian states based on mean values of the value of gross output, gross value added, number of factories, gross capital formation, total inputs, total person engaged, total emoluments and invested capital during 2011-2018, 2001-2010, 1991-2000 is given in Figures 1, 2, 3, 4, 5, 6, 7 and 8, respectively. These figures show that Gujarat, Maharashtra, Tamil Nadu, and Karnataka have a significant share in India's industrial activities. Thus, these can be considered the highly industrialized states of India. However, the progress of industrial development of all the states has improved during the period 2011-2018 as compared to earlier periods. Despite that, Gujarat, Maharashtra, Tamil Nadu and Karnataka have maintained a better position in industrial development in India. These states show a higher position in terms of the entrepreneurship ecosystem, literacy rate, research institutions, infrastructure, banking facilities, technological advancement, and skills and research & development (R&D) ecosystem, which all have a significant influence on industrial development. Therefore, these states are achieving a better industrial development performance among the Indian states.

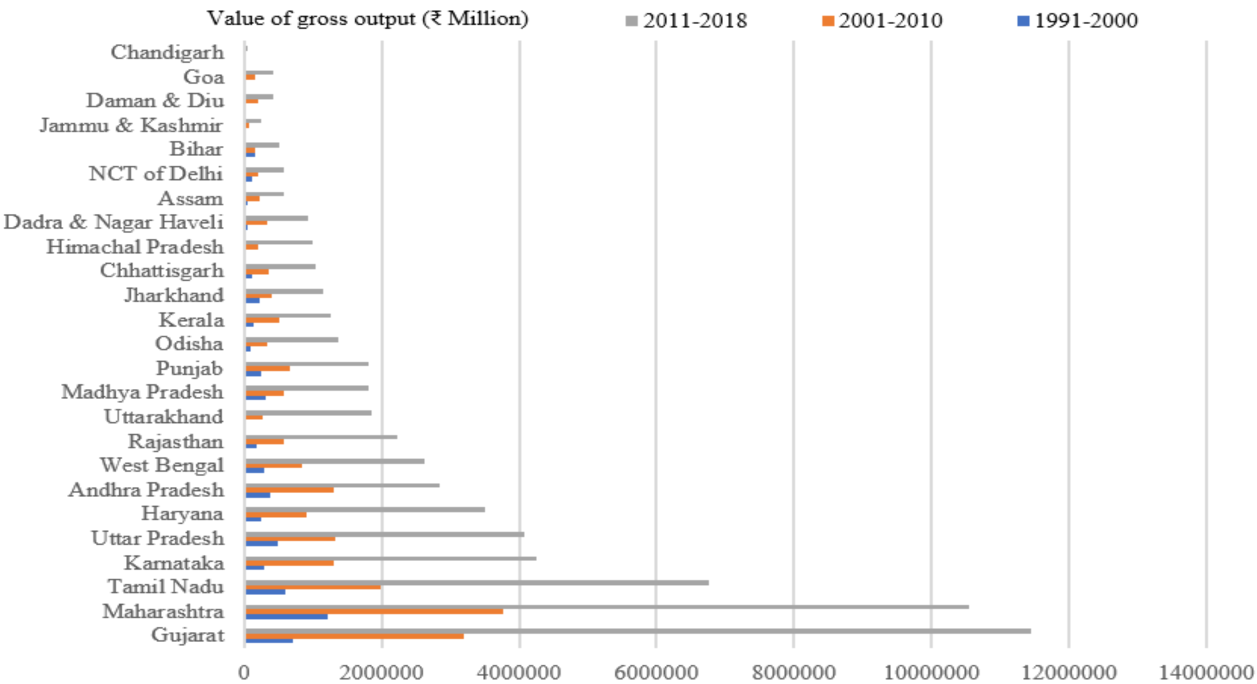

Figure-1. Cross comparison of Indian states in value of gross output during 2011-2018, 2001-2010, 1991-2000.

Source: Annual Survey of Industries (ASI), Ministry of Statistics and Programme Implementation (GoI).

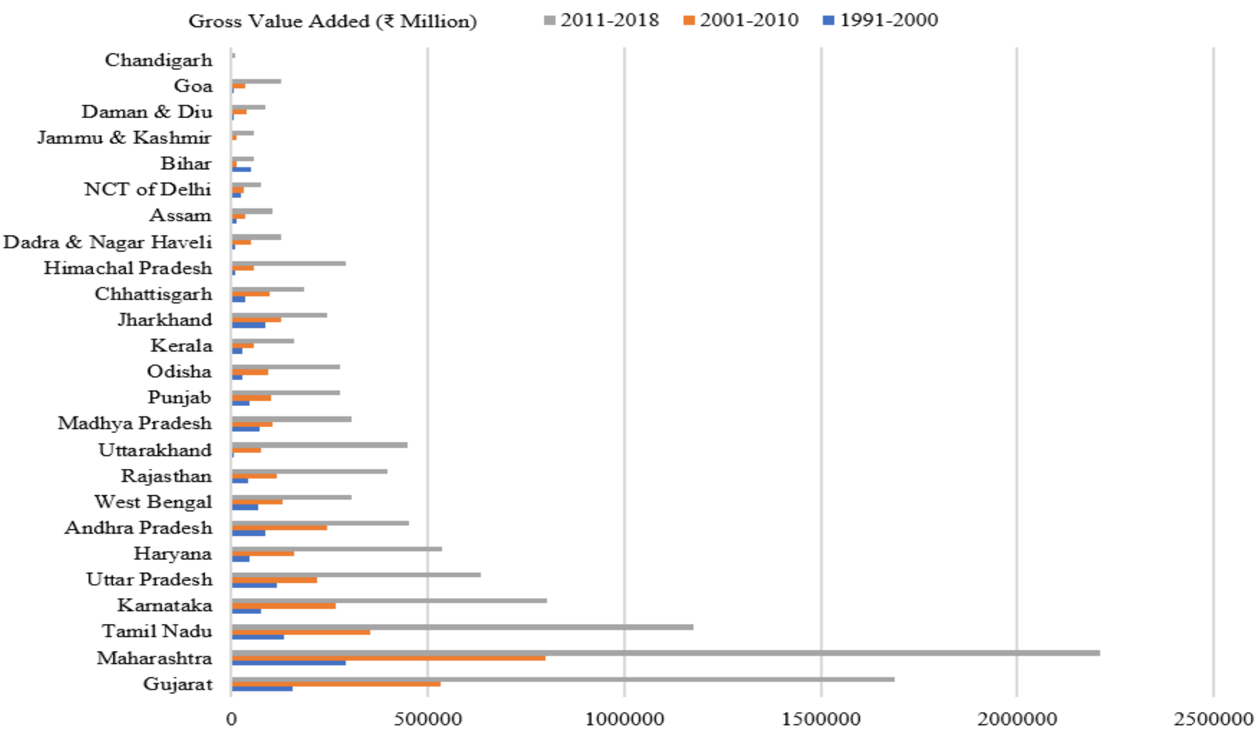

Figure-2. Cross comparison of Indian states in value of gross added during 2011-2018, 2001-2010, 1991-2000.

Source: Annual Survey of Industries (ASI), Ministry of Statistics and Programme Implementation (GoI).

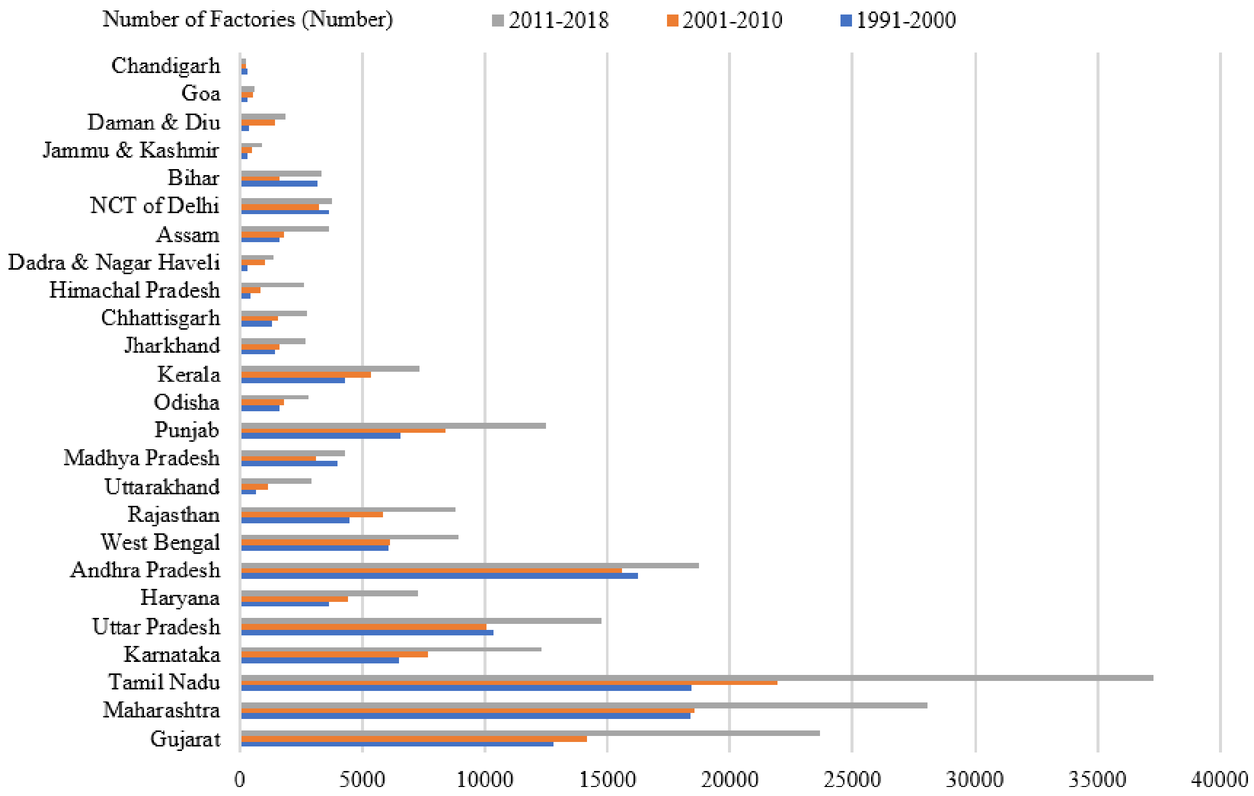

Figure-3. Cross comparison of Indian states in number of factories during 2011-2018, 2001-2010, 1991-2000.

Source: Annual Survey of Industries (ASI), Ministry of Statistics and Programme Implementation (GoI).

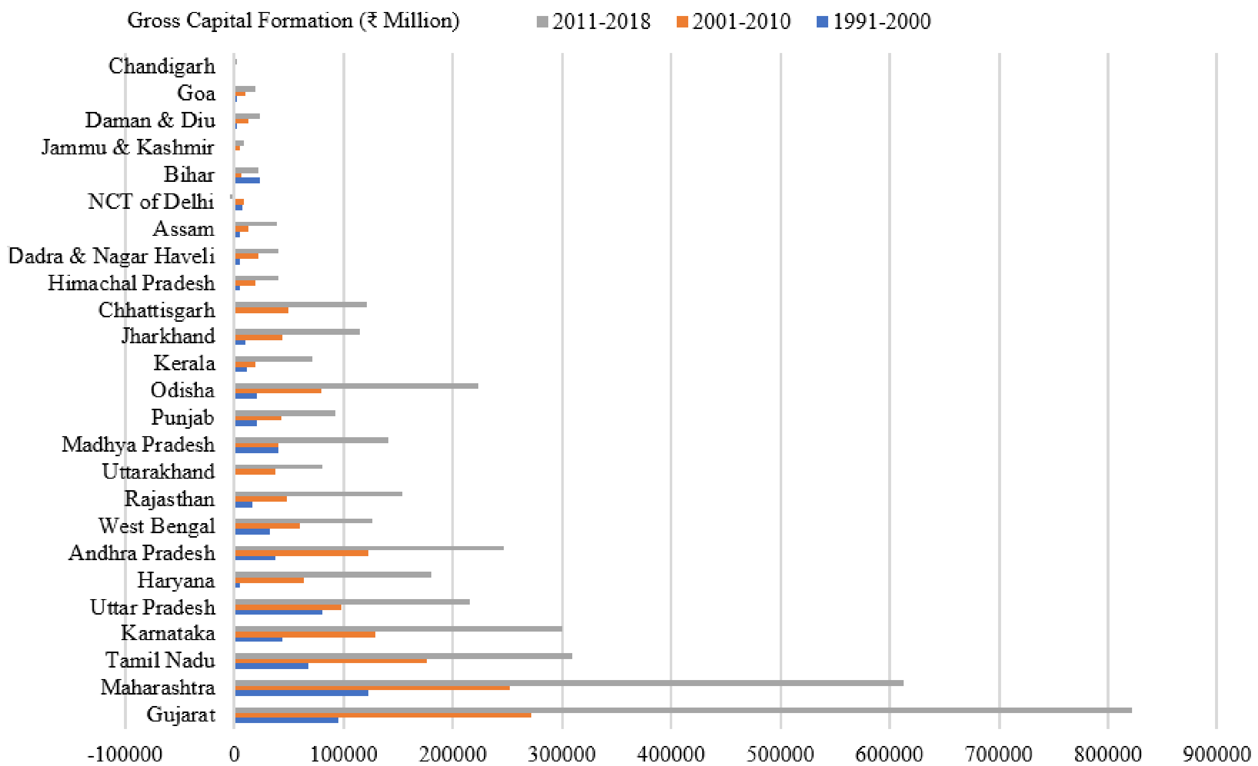

Figure-4. Cross comparison of Indian states in gross capital formation during 2011-2018, 2001-2010, 1991-2000.

Source: Annual Survey of Industries (ASI), Ministry of Statistics and Programme Implementation (GoI).

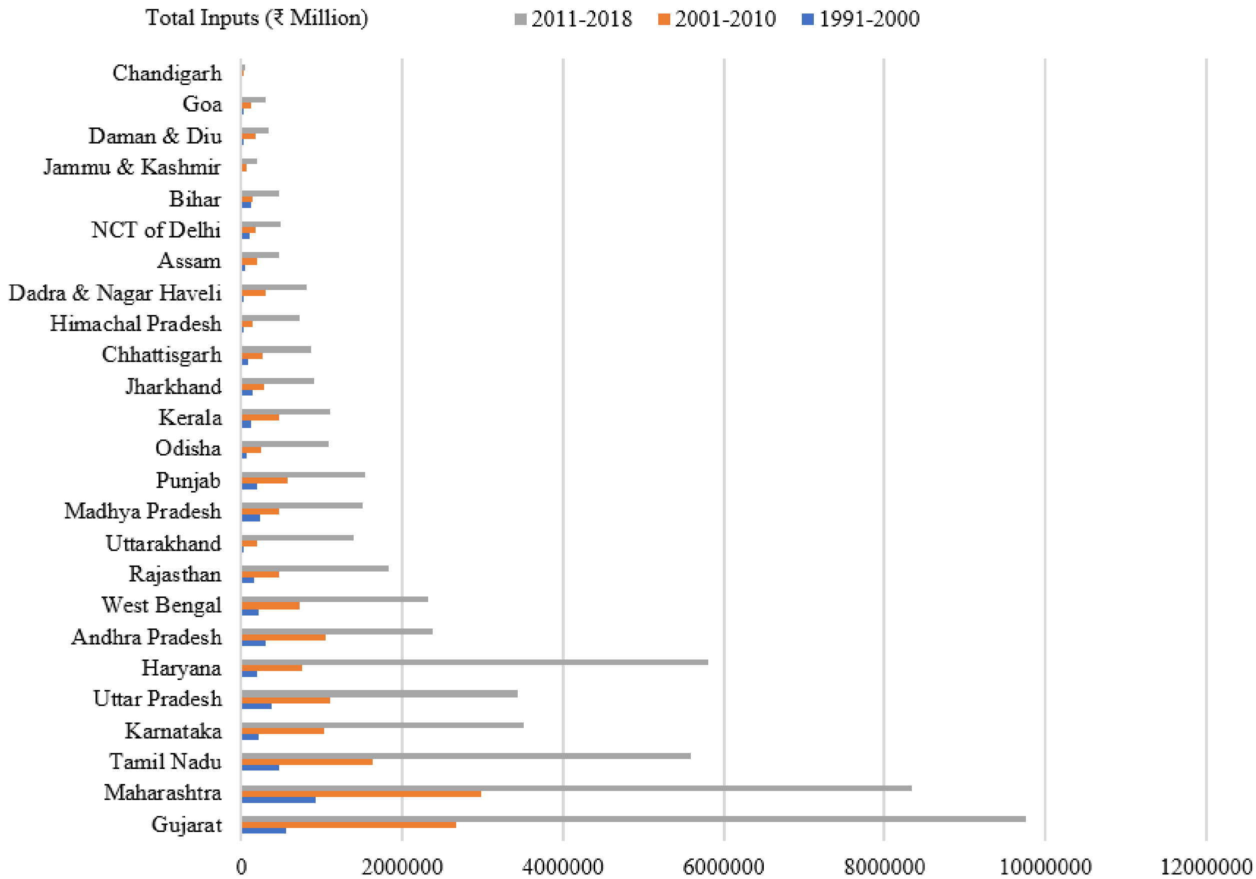

Figure-5. Cross comparison of Indian states in total inputs during 2011-2018, 2001-2010, 1991-2000.
Source: Annual Survey of Industries (ASI), Ministry of Statistics and Programme Implementation (GoI).

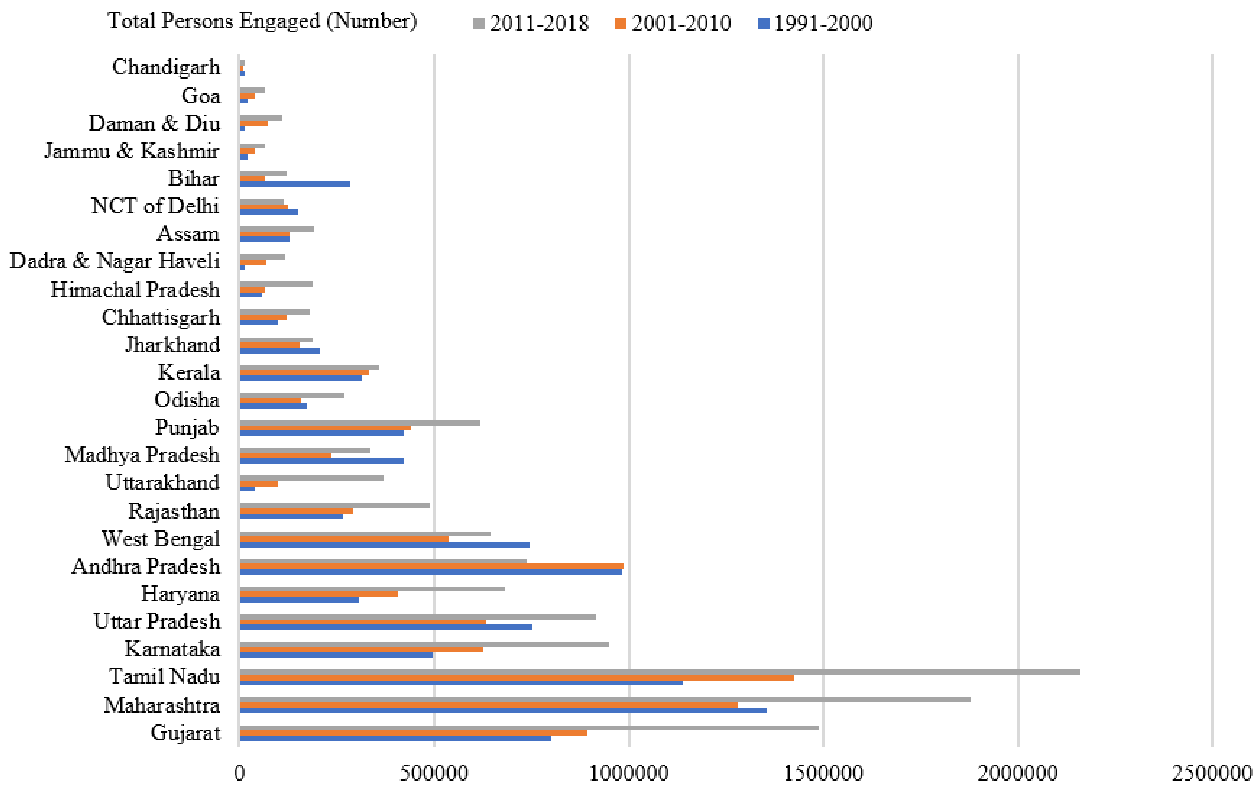

Figure-6. Cross comparison of Indian states in total person engaged during 2011-2018, 2001-2010, 1991-2000.
Source: Annual Survey of Industries (ASI), Ministry of Statistics and Programme Implementation (GoI).

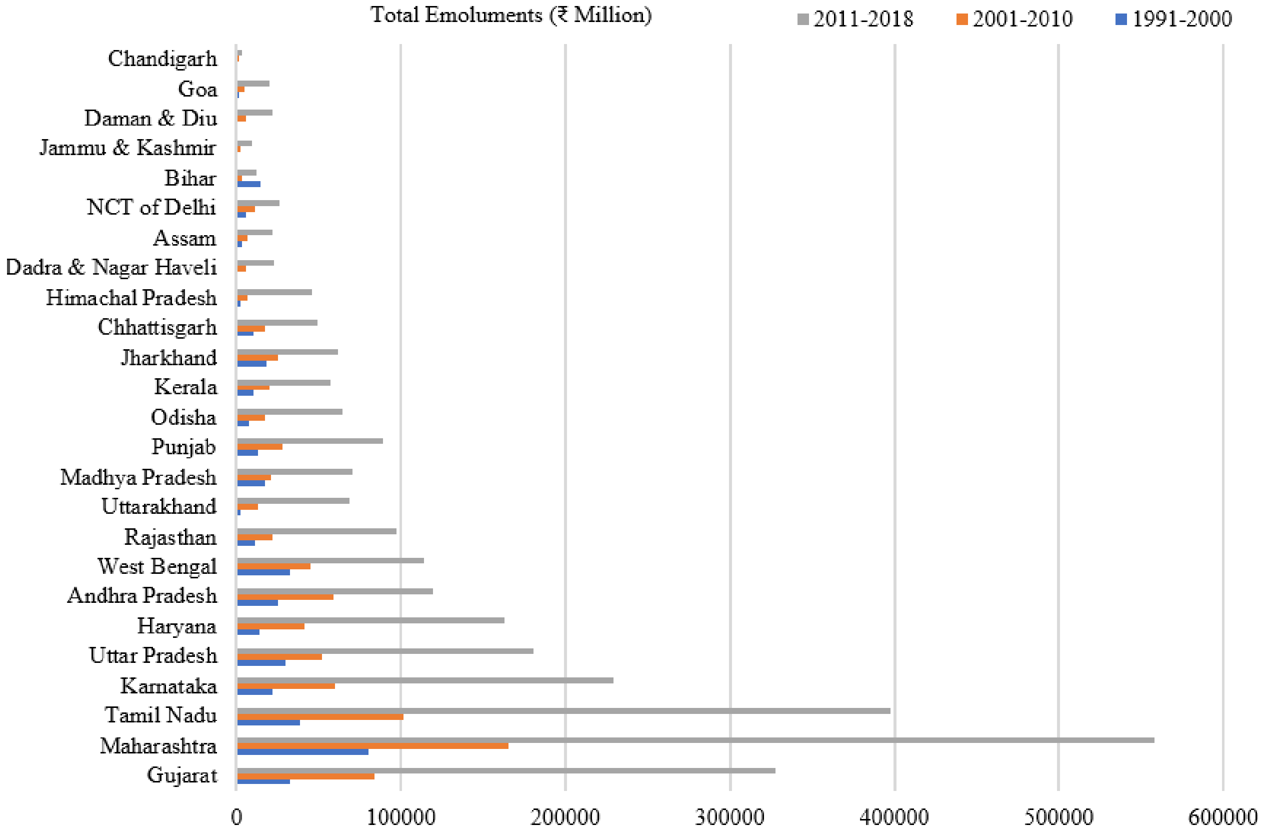

Figure-7. Cross comparison of Indian states in total emoluments during 2011-2018, 2001-2010, 1991-2000.
Source: Annual Survey of Industries (ASI), Ministry of Statistics and Programme Implementation (GoI).

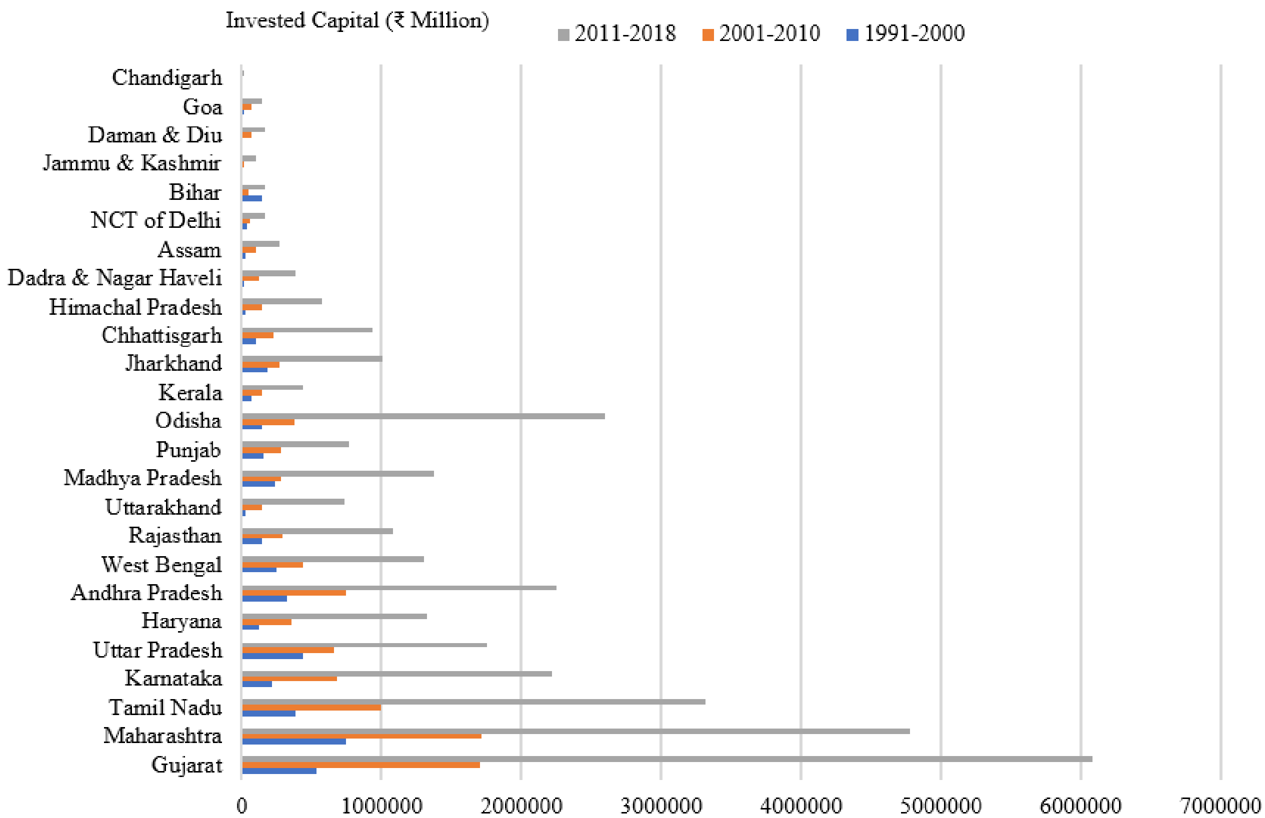

Figure-8. Cross comparison of Indian states in invested capital during 2011-2018, 2001-2010, 1991-2000.
Source: Annual Survey of Industries (ASI), Ministry of Statistics and Programme Implementation (GoI).

3. EMPIRICAL ANALYSIS

3.1. Source of Data and Study Area

The study used state-wise panel data of gross value added, total persons engaged, gross capital formation, total inputs, ratio of gross value added to total persons engaged, ratio of total emolument to total persons engaged, capital intensity (ratio of fixed capital to total persons engaged), credit to industry by scheduled commercial banks, annual population growth, and literacy rate during 2003–2018. The information on the above-mentioned indicators was derived from the Annual Survey of Industries (ASI), Ministry of Statistics and Programme Implementation, Government of India (GoI); Basic Statistical Returns of Scheduled Commercial Banks in India, RBI (GoI); Policy Commission (GoI); and Reserve Bank of India (RBI) (GoI). Accordingly, the selection of states was based on the availability of data on the aforementioned indicators. The following states were considered in this study: Andaman & Nicobar Islands, Andhra Pradesh, Assam, Bihar, Chandigarh, Chhattisgarh, Dadra & Nagar Haveli, Daman & Diu, Goa, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Delhi, Odisha, Puducherry, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh, Uttarakhand, and West Bengal.

3.2. Formulation of Empirical Model

Existing studies have used different variables, such as gross output, gross value added, employment and share of industrial sector in GDP, to define the industrial development of a country (Maroof et al., 2019; Mohsen, Chua, & Sab, 2015; Sankaran et al., 2020). Industrial output is significantly associated with the number of factories, number of industrial workers, education level of workers, skills and knowledge of workers, number of start-ups, infrastructure development, financial development, credit to industries, research & development (R&D) activities, science & technological development, oil price, inflation, exchange rate, exports and imports, government policies, availability of raw materials, foreign direct investment, foreign trade, and intellectual property rights (Maroof et al., 2019; Mohsen et al., 2015; Sankaran et al., 2020; Singh et al., 2019; Singh & Jyoti, 2020; Singh et al., 2020). The agricultural sector meets the industries' requirements for raw materials; thus, industrial output is also positively associated with growth of the agricultural sector (Mohsen et al., 2015). Previous studies have explored the factors affecting industrial development from different perspectives. For instance, Lahiri, Madhur, Purkayastha, and Roy (1984) examined the influence of price, wages and raw material costs on the output of the factory sector in India. Ndiaya and Lv (2018) assessed the effect of industrial output, inflation rate, FDI, and foreign exchange rate on economic growth in Senegal. Mohsen et al. (2015) examined the determinants of industrial output in Syria. Their study used industrial output as the dependent variable, while capital, manufacturing exports, population, agricultural output, and oil price were independent variables. Jelilov and Iheoma (2016) also examined the impact of industrial output, foreign direct investment, interest rate, foreign exchange rate, and inflation rate on economic growth in ten selected economies. Sankaran et al. (2020) identified the impact of agricultural output, gross capital formation and gross fixed capital formation on industrial output in India. Singh et al. (2020) examined the impact of factors associated with science & technological development, socio-economic development, and intellectual property protection on manufacturing value added, in 41 developed and developing countries. Maroof et al. (2019) assessed the determinants of industry gross value added, which was used to measure industrial development in South Asian countries. Thampy and Tiwary (2021) applied the GMM model to assess the influence of the banking sector and human capital on the growth of the manufacturing sector in India. They considered per capita growth in manufacturing value added as the dependent variable, while credit to manufacturing sector divided by value added in manufacturing, population density, literacy, infrastructure, per capita gross domestic product were independent variables.

Previous studies have thus used various methods to assess the factors affecting industrial performance in India and other countries using different variables. This study used state-wise panel data from the years 2003–2018.

Therefore, in this study, gross value added was used as the dependent variable, while total persons engaged, gross capital formation, total inputs, labor productivity (i.e., the ratio of gross value added to total persons engaged), per person emoluments (i.e., the ratio of total emolument to total persons engaged), capital intensity, credit to industry by scheduled commercial banks, annual population growth, and literacy rate were considered the independent variables. Mohsen et al. (2015); Maroof et al. (2019); Sankaran et al. (2020); Kołodziejczak (2020); Thampy and Tiwary (2021); Daharwal and Mishra (2021) also used a similar set of variables to examine their association with industrial development and the manufacturing sector in different countries. A summary of the studied variables is provided in Table 2.

Table-2. Summary of the variables.

Factors	Symbol	Unit	Source of Data
Gross value added	*GVA*	□ Million	Annual Survey of Industries (ASI), Ministry of Statistics and Programme Implementation, Government of India.
Total persons engaged	*TPE*	Number	
Gross capital formation	*GCF*	□ Million	
Total inputs	*TI*	□ Million	
Labor productivity (i.e., ratio of gross value added to total persons engaged)	*RGVATPE*	□/Person	Author's estimation
Per person emoluments (i.e., ratio of total emolument to total persons engaged)	*RTETPE*	□	
Capital intensity (i.e., fixed capital/total persons engaged)	*CI*	Number	
Credit to industry by scheduled commercial banks	*CISCB*	□ Billion	Basic Statistical Returns of Scheduled Commercial Banks in India, RBI (GoI)
Annual population growth	*APG*	%	Policy Commission (GoI)
Literacy rate – total (rural +urban)	*LR*	%	RBI (GoI)

The investigation, linear, log-linear and log-linear regression models were used to assess the influence of specific explanatory variables on the industries' value of gross value added. The study assumes that gross value added is a function of total persons engaged, gross capital formation, total inputs, labor productivity, per person emoluments, capital intensity, credit to industry by scheduled commercial banks, annual population growth, and literacy rate. The functional relationship of the value of gross output with the aforesaid factors is explained as:

$$(GVA) = f((GVATPE), (APG), (LR), (CISCB), (TPE), (RTETPE), (GCF), (CI), (TI)) \quad (1)$$

In Equation 1, *GVA* is gross value added, *GVATPE* is labor productivity, *APG* is annual population growth, *LR* is literacy rate, *CISCB* is credit to industry by scheduled commercial banks, *TPE* is total persons engaged, *RTETPE* is per person emoluments, *GCF* is gross capital formation, *CI* is capital intensity and *TI* is total inputs. The aforesaid function is used as a linear regression model in the following form:

$$(GVA)_{st} = \alpha_0 + \alpha_1 (GVATPE)_{st} + \alpha_2 (APG)_{st} + \alpha_3 (LR)_{st} + \alpha_4 (CISCB)_{st} + \alpha_5 (TPE)_{st} + \alpha_6 (RTETPE)_{st} + \alpha_7 (GCF)_{st} + \alpha_8 (CI)_{st} + \alpha_9 (TI)_{st} + \lambda_{st} \quad (2)$$

In Equation 2, α_0 is a constant term; α_1, α_2, … α_9 are the regression coefficients of associated explanatory variables; *s* is cross-sectional state (1 to 31), *t* is time period (i.e., 2003–2018) and λ_{st} is the error term. The equation shows the linear relationship of gross value added of industries with the explanatory variables. For the log-linear regression model, the aforementioned equation is adapted as:

$$log(GVA)_{st} = \beta_0 + \beta_1\ log(GVATPE)_{st} + \beta_2\ log(APG)_{st} + \beta_3\ log(LR)_{st} + \beta_4\ log(CISCB)_{st} + \beta_5\ log(TPE)_{st} + \beta_6\ log(RTETPE)_{st} + \beta_7\ log(GCF)_{st} + \beta_8\ log(CI)_{st} + \beta_9\ log(TI)_{st} + \epsilon_{st} \quad (3)$$

In Equation 3, *log* is the natural logarithm of associated variables, β_0 is the constant coefficient, β_1, β_2, … β_9 are the regression coefficients of associated explanatory variables, and ϵ_{st} is the error term. A non-linear regression model was also used to examine the long-term association of the gross value added of industries with the explanatory variables. For this, original and square terms of explanatory variables are considered in the following empirical form:

$$(GVA)_{st} = \theta_0 + \theta_1\,(GVATPE)_{st} + \theta_2\,(Sq.\text{ of }GVATPE)_{st} + \theta_3\,(APG)_{st} + \theta_4\,(Sq.\text{ of }APG)_{st} + \theta_5\,(LR)_{st} + \theta_6\,(Sq.\text{ of }LR)_{st} + \theta_7\,(CISCB)_{st} + \theta_8\,(Sq.\text{ of }CISCB)_{st} + \theta_9\,(TPE)_{st} + \theta_{10}\,(Sq.\text{ of }TPE)_{st} + \theta_{11}\,(RTETPE)_{st} + \theta_{12}\,(Sq.\text{ of }RTETPE)_{st} + \theta_{13}\,(GCF)_{st} + \theta_{14}\,(Sq.\text{ of }GCF)_{st} + \theta_{15}\,(CI)_{st} + \theta_{16}\,(Sq.\text{ of }CI)_{st} + \theta_{17}\,(TI)_{st} + \theta_{18}\,(Sq.\text{ of }TI)_{st} + ¥_{st} \quad (4)$$

Here, in Equation 4, θ_0 is a constant term, θ_1, θ_2, … θ_{18} are the regression coefficients of associated explanatory variables, *Sq.* is the square term of respective variables, and $¥_{st}$ is the error term. The equation shows the non-linear relationship between the gross value added of industries and the explanatory variables.

3.3. Selection of Appropriate Models

This study used state-wise panel data of the value added of industries with its associated variables during the period 2003–2018. Since Indian states display a high diversity in various dimensions, it was therefore essential to use a scientific process to select an appropriate form of empirical model to resolve all statistical issues, including non-stationarity, panel root, multi-correlation, auto-correlation, serial correlation, heteroskedasticity, and cross-sectional independence in panel data. Thus, the following process was used to select a consistent empirical model. The skewness and kurtosis values were estimated to check the normality of each variable. Since the statistical values of skewness and kurtosis did not lie between -1 and + 1 for most variables in their original form (see Table 3), the shape of all variables therefore seemed to have an abnormal form. Therefore, the *log* of all variables was considered to make the data assume a normal form. However, the values of skewness and kurtosis did not lie between – 1 and + 1 for these variables after taking the *log*. The other statistical properties, such as minimum (*Min*), maximum (*Max*), mean, standard deviation (*SD*), and standard error (*SE*) values of the studied variables are provided in Table 3.

Table-3. Descriptive results for dependent and explanatory variables.

Variables	Min	Max	Mean	SD	SE	Skewness	Kurtosis
GVA	29.40	2586311	247504	408329	18335	3.22	14.77
logGVA	3.38	14.77	10.94	2.38	0.11	-1.11	3.73
RGVATPE	32331.44	2344425	619805	402718	18083	1.04	4.51
logRGVATPE	10.38	14.67	13.08	0.80	0.04	-0.90	3.72
APG	0.16	5.26	1.67	0.75	0.03	1.73	7.84
logAPG	-1.86	1.66	0.42	0.44	0.02	-0.52	5.72
LR	50.36	98.23	77.50	9.46	0.42	-0.29	2.49
logLR	3.92	4.59	4.34	0.13	0.01	-0.57	2.85
CISCB	1.00	8940	510	1186	53	4.40	25.38
logCISCB	0.00	9.10	4.28	2.31	0.10	-0.18	2.18
TPE	251.00	2523483	371211	485175	21785	1.95	6.62
logTPE	5.53	14.74	11.68	1.98	0.09	-1.00	3.74
RTETPE	17709.20	403144	138075	82548	3707	0.85	3.14
logRTETPE	9.78	12.91	11.64	0.66	0.03	-0.49	2.96
GCF	0.50	1158119	96740	153815	6906	2.91	13.46
logGCF	-0.69	13.96	9.76	2.75	0.12	-1.27	4.26
CI	34229.40	124000000	11900000	14300000	642234	3.67	23.10
logCI	10.44	18.64	15.63	1.38	0.06	-1.02	4.05
TI	89.50	25200000	1190839	2158172	96905	4.69	38.10
logTI	4.49	17.04	12.45	2.40	0.11	-1.05	3.59

The existence of the panel root test was observed using the Im-Pesaran-Shin test (Asteriou, Pilbeam, & Pratiwi, 2021). Most variables in their original and logarithm forms were found to be non-stationary (see Table 4).

Therefore, the first difference of these variables was considered to convert them to a stationary form (Kumar, Ahmad, & Sharma, 2017). Hence, the first co-integration of gross value added, labor productivity, annual population growth, literacy rate, credit to industry by scheduled commercial banks, total persons engaged, per person emoluments, gross capital formation, capital intensity, and total inputs were considered in the empirical models.

Table-4. Results of panel unit root test.

Variables	t-bar	t-tilde-bar	Z-t-tilde-bar	p-value	Critical values at 1%
GVA	-0.6282	-0.5756	5.7695	1.0000	-1.820
ΔGVA	-4.5872	-2.7601	-10.4524	0.0000	-1.830
logGVA	-1.7348	-1.5047	-1.0797	0.1401	-1.820
ΔlogGVA	-4.6515	-2.7781	-10.5858	0.0000	-1.830
RGVATPE	-1.2604	-1.1167	1.7803	0.9625	-1.820
ΔRGVATPE	-4.8738	-2.8300	-10.9703	0.0000	-1.830
logRGVATPE	-1.8430	-1.5719	-1.5753	0.0576	-1.820
APG	-1.0940	-1.0249	2.4572	0.9930	-1.820
ΔAPG	-3.7900	-2.6391	-9.5560	0.0000	-1.830
logAPG	0.9819	-0.9064	3.3306	0.9996	-1.820
ΔlogAPG	-3.8059	-2.6446	-9.5966	0.0000	-1.830
LR	0.1838	0.1673	11.2461	1.0000	-1.820
ΔLR	-3.5910	-2.5657	-9.0124	0.0000	-1.830
logLR	-0.4115	-0.3387	7.5162	1.0000	-1.820
ΔlogLR	-3.5927	-2.5688	-9.0352	0.0000	-1.830
CISCB	-0.5592	-0.5153	6.2136	1.0000	-1.820
ΔCISCB	-3.7524	-2.4968	-8.5019	0.0000	-1.830
logCISCB	-1.9058	-1.6560	-2.1952	0.0141	-1.820
ΔlogCISCB	-3.7816	-2.4650	-8.2667	0.0000	-1.830
TPE	-0.9553	-0.9027	3.3581	0.9996	-1.820
ΔTPE	-4.3580	-2.7356	-10.2707	0.0000	-1.830
logTPE	-1.5028	-1.3686	-0.0765	0.4695	-1.820
ΔlogTPE	-4.0940	-2.6634	-9.7364	0.0000	-1.830
RTETPE	1.0637	0.9481	17.0020	1.0000	-1.820
ΔRTETPE	-3.8604	-2.5630	-8.9927	0.0000	-1.830
logRTETPE	-0.2582	-0.2591	8.1024	1.0000	-1.820
ΔlogRTETPE	-4.4692	-2.7443	-10.3355	0.0000	-1.830
GCF	-2.3151	-1.9271	-4.1937	0.0000	-1.820
logGCF	-2.8131	-2.1628	-5.9316	0.0000	-1.820
CI	-1.2377	-1.1374	1.6280	0.9482	-1.820
ΔCI	-4.7459	-2.8708	-11.2724	0.0000	-1.830
logCI	-2.9265	-2.3403	-7.2399	0.0000	-1.820
TI	-0.6211	-0.5714	5.8001	1.0000	-1.820
ΔTI	-3.7452	-2.5441	-8.8527	0.0000	-1.830
logTI	-2.3115	-1.8790	-3.8395	0.0001	-1.820

Note: Critical values are at 1% significance level.

As the *Ramsey* regression equation error test (*RESET*) is useful to check the appropriate form of empirical model (Singh, 2017), this test was therefore conducted to check the reliability of the functional form of the proposed regression models. As the *F–values* of this test for dependent and independent variables were found to be statistically significant (see Table 5), the estimates therefore provide positive proof that the functional forms of the linear, log-linear and non-linear regression models were correctly defined. The variance inflation factor (*VIF*) was estimated to identify the presence of multi-correlation among the explanatory variables (Kumar et al., 2017; Singh, 2017). The values of *VIF* were under 10. Thus, the explanatory variables do not display multi-correlation.

Table-5. Results of hypothesis testing.

Model	Linear Model	Log linear model	Non-linear model
Ramsey RESET test using powers of the dependent variables (F – Value)	14.49*	0.48*	205.89*
Ramsey RESET test using powers of the independent variables (F – Value)	5.19*	4.61*	13.13*
Variance Inflation Factor (VIF)	1.11	3.86	2.01
Akaike's information criterion (AIC)	- 11432.05	- 271.7889	- 11423.45
Bayesian information criterion (BIC)	- 11473.47	- 313.2093	- 11493.86
Breusch-Pagan Lagrange multiplier (LM) test for random effects (Chibar^2)	0.00	0.000	0.00
Hausman test for fixed or random effects (Chi^2)	0.00*	240.57*	0.00*
Pesaran's test of cross-sectional independence	1.167	2.215**	1.177
Breusch-Pagan LM test of independence (Chi^2)	577.398*	-	559.157*
Modified Wald test for heteroskedasticity (Chi^2)	3.3e+05*	2934.75*	3.2e+05*
Wooldridge test for serial-correlation and autocorrelation (F - Value)	11.715*	18.909*	14.467*

Note: *, **, and *** indicates the significance level at 1%, 5%, and 10%, respectively.

A random effect model was also used to estimate the regression coefficient of the explanatory variables. The model accepts that the state's error term does not correlate with gross value added (Kumar et al., 2017). A Breusch-Pagan Lagrange multiplier test was used to check the viability of a simple or random-effect model. Subsequently, a fixed-effect model was also used to estimate the regression coefficient of the explanatory variables. The suitability of the random-effect and fixed-effect models was verified through a Hausman test (Kumar et al., 2017). Since the *Chi*^{2} values under the Hausman test were found to be statistically significant, the estimates therefore suggested that the random-effect and fixed-effect models may not be effective in assessing the regression coefficient of the explanatory variable in the proposed models. Thus, a Pesaran test was used to check the presence of cross-sectional dependency across states (Asteriou et al., 2021). Furthermore, a Modified Wald test was used to identify the presence of heteroskedasticity in the panel data. A Wooldridge test was applied to recognize the existence of serial-correlation and autocorrelation. As the panel data displays auto-correlation, serial correlation, heteroskedasticity and cross-sectional dependence, the random-effect and fixed-effect models may therefore be ineffective to produce consistent coefficients of the explanatory variables. Hence, the panel corrected standard estimation model was used to estimate the regression coefficient of the explanatory variables for the proposed regression model (Jyoti & Singh, 2020; Kumar et al., 2017). Meanwhile, the Akaike information criterion (*AIC*) and Bayesian information criterion (*BIC*) were applied to select the appropriate model among the linear, log-linear and non-linear regression models (Jyoti & Singh, 2020; Kumar et al., 2017).

4. RESULTS AND DISCUSSION

4.1. Correlation Coefficients between Variables

The correlation coefficients among the studied variables are given in Table 6. The estimates indicate that gross value added was positively correlated with total persons engaged, gross capital formation, total inputs, labor productivity, per person emoluments, capital intensity, credit to industry by scheduled commercial banks, and literacy rate. Hence, the results indicate that industrial development depends upon the aforementioned activities of industries in India. Gross capital formation and capital intensity are essential to increase the innovation capability of industries. Hence, the estimates clearly indicate that innovation may be effective to boost the overall growth of industries in India. The estimates also show that total persons engaged is positively associated with gross value added, literacy rate is positively associated with gross value added, and per person emoluments is also positively correlated with gross value added. The estimate suggests that appropriate wages provide workers incentive to increase their contribution to the production activities of industries. Subsequently, gross value added is likely to be improved as an increase in total emoluments in industries. Availability of credit makes an important contribution in maintaining the production activities of industries. Thus, credit to industry by scheduled commercial banks is positively associated with the gross value added of industries.

Table-6. Correlation coefficients of the among the variables.

Variables	GVA	Rgvatpe	APG	LR	CISCB	TPE	Rtetpe	GCF	CI	TI
GVA	1									
Rgvatpe	0.350**	1								
APG	-0.230**	-0.039	1							
LR	0.178**	0.214**	-0.302**	1						
CISCB	0.743**	0.173**	-0.201**	0.240**	1					
TPE	0.857**	0.089*	-0.273**	0.068	0.614**	1				
Rtetpe	0.437**	0.778**	-0.168**	0.400**	0.381**	0.229**	1			
GCF	0.902**	0.286**	-0.233**	0.103*	0.600**	0.812**	0.358**	1		
CI	0.233**	0.557**	-0.095*	0.099*	0.065	0.077*	0.597**	0.316**	1	
TI	0.843**	0.250**	-0.218**	0.167**	0.587**	0.754**	0.378**	0.811**	0.200**	1

Note: **. Correlation is significant at the 0.01 level and *. Correlation is significant at the 0.05 level.

4.2. Regression Results

This study used linear, log-linear and non-linear regression models to estimate the regression coefficients of the explanatory variables with the gross value added of industries (see Tables 7, 8 and 9). The regression coefficients were estimated using panel corrected standard estimation to reduce the influence of autocorrelation, serial correlation, heteroskedasticity and cross-sectional dependence on estimators. Accordingly, *AIC* and *BIC* values were estimated to select the better model among the aforesaid estimations. As the log linear regression model produced the lower values of *AIC* and *BIC*, this model could therefore provide more consistent results as compared to the linear and non-linear regression models. Accordingly, the statistical explanation of the results based on the log-linear regression model is provided in this study. The regression coefficient of labor productivity with gross value added was positive and statistically significant. The estimate shows that labor productivity is crucial to increasing the gross value added of industries (Kołodziejczak, 2020). Previous studies, such as Singh et al. (2019); Singh and Jyoti (2020), have also argued that labor productivity is an essential driver to increase the production scale of manufacturing industries in India. Daharwal and Mishra (2021) also claimed that workforce productivity is necessary to increase the growth of the manufacturing sector in India. The average population growth rate and literacy rate both have a positive impact on industries' gross value added. However, the regression coefficients of population growth and literacy rate with gross value added were statistically insignificant. Nonetheless, the estimates do suggest that workers' education level effectively increases the productivity and efficiency of available resources in industries. Also, literate workers have higher technical skills and understanding of the usage of various technologies in industries. Consequently, workers' literacy rate can contribute to improving the gross value added of industries (Singh et al., 2019; Singh & Jyoti, 2020).

The demand for the goods and services produce by industries may increase due to an increase in population growth. Accordingly, industries will have more incentive to increase their production scale in response to rising population growth. Thus, population growth may have a positive impact on the gross value added of industries. However, it also seems that population growth has a positive impact on industrial growth up to a certain level. The regression coefficient of credit to industries by scheduled commercial banks with the gross value added of industries was observed to be positive and statistically significant. The result suggests that the availability of banking credit facilities for industries will increase the affordability of buying new technologies and raw materials and setting up new plants. Consequently, banking credit facilities support industries in maintaining their production scale in the long run. Thampy and Tiwary (2021) have also argued that the local banking sector plays a crucial role in increasing the development of the manufacturing sector in India. The regression coefficient of the total persons engaged with gross value added of industries was also positive and statistically significant. Thus, the result indicates that human resources are also an important determinant for increasing industrial development in India. Furthermore, the regression coefficient of gross capital formation with gross value added was positive and statistically insignificant. The result suggests that gross capital formation is helpful in increasing the gross value added of industries in India. Sankaran et al. (2020) also observed the significant contribution of gross fixed capital formation to industrial development in India.

Table-7. Regression results based on the linear regression model.

Model	Random Effect Model		Fixed Effect Model		PCSEs Model	
Number of obs.	465		465		465	
Number of groups	31		31		31	
R-sq overall	0.5533		0.5471		0.5533	
Wald Chi²	563.65				366.37	
Prob > Chi²	0.000				0.000	
F-Value			37.98			
Prob > F			0.000			
ΔGVA	Reg. Coef.	P>|z|	Reg. Coef.	P>|t|	Reg. Coef.	P>|z|
GVATPE	0.2033	0.000	0.2024	0.000	0.2033	0.000
ΔAPG	-3029.4240	0.688	-3227.2430	0.681	-3029.4240	0.434
ΔLR	977.2903	0.642	1402.5510	0.526	977.2903	0.446
ΔCISCB	17.2178	0.284	-2.9408	0.886	17.2178	0.339
ΔTPE	0.4556	0.000	0.4504	0.000	0.4556	0.000
ΔRTETPE	-0.1539	0.313	-0.1238	0.446	-0.1539	0.189
GCF	0.1674	0.000	0.1355	0.000	0.1674	0.000
CI	-0.0013	0.045	-0.0010	0.167	-0.0013	0.000
TI	-0.0017	0.292	-0.0018	0.285	-0.0017	0.141
Con. Coef.	-4855.5470	0.214	-1614.9670	0.740	-4855.5470	0.094
sigma_u	0.000		10384.7840			
sigma_e	53468.345		53468.3450			
Rho	0.000		0.0364			

The regression coefficient of per person emoluments with gross value added of industries was positive and statistically significant. Hence, the role of total emoluments in industrial production was found to be positive. The result can be explained by the fact that appropriate remuneration of workers will incentivize them to increase their contribution to the production activities of industries. Thus, it is noted that industrial development will improve following an increase in the total emoluments of workers in industries. Daharwal and Mishra (2021) also suggested that increasing workers' wages and salaries would be an effective way to achieve the desired output in manufacturing industries in India. The regression coefficients of capital intensity and total inputs with gross value added were observed to be negative and statistically significant. Hence, the results suggest that industrial development does not achieve significant benefits from capital intensity and inputs in India. As capital intensity is representative of innovation, which makes a positive contribution to industrial development, previous studies have claimed that innovation may be useful and effective in increasing industrial development. Since most industries use traditional technologies and workers have low skills and knowledge to apply new technologies and innovation in the production activities of Indian industries, it is evident that capital intensity makes an insignificant contribution to increasing the gross value added of industries in India. The negative association of inputs with gross value added may be due to either the law of diminishing returns or the use of traditional techniques in the production activities of industries in India.

Table-8. Regression results based on log-linear regression model.

Model	Random Effect Model		Fixed Effect Model		PCSEs Model	
Number of obs.	465		465		465	
Number of groups	31		31		31	
R-sq overall	0.2426		0.0896		0.2426	
Wald Chi²	145.72				80.04	
Prob > Chi²	0.000				0.000	
F-Value			36.4			
Prob > F			0.000			
ΔlogGVA	Reg. Coef.	P>|z|	Reg. Coef.	P>|t|	Reg. Coef.	P>|z|
logRGVATPE	0.2535	0.000	0.7369	0.000	0.2535	0.000
ΔlogAPG	0.0307	0.552	-0.0054	0.906	0.0307	0.510
ΔlogLR	0.5800	0.530	0.1669	0.844	0.5800	0.678
ΔlogCISCB	0.1408	0.019	0.1741	0.002	0.1408	0.020
ΔlogTPE	1.0315	0.000	1.1722	0.000	1.0315	0.000
ΔlogRTETPE	0.5385	0.000	0.5060	0.000	0.5385	0.000
logGCF	0.0325	0.085	0.0164	0.463	0.0325	0.138
logCI	-0.1228	0.000	-0.1157	0.000	-0.1228	0.000
logTI	-0.0555	0.011	-0.2901	0.000	-0.0555	0.019
Con. Coef.	-1.0026	0.000	-4.3654	0.000	-1.0026	0.019
sigma_u	0.0000		0.5315			
sigma_e	0.2842		0.2842			
rho	0.0000		0.7776			

Note: *, **, and *** indicates the significance level at 1%, 5%, and 10%, respectively.

Table-9. Regression results based on non-linear regression model.

Model	Random Effect Model		Fixed Effect Model		PCSEs Model	
Number of obs.	465		465		465	
Number of groups	31		31		31	
R-sq overall	0.5745		0.5471		0.5745	
Wald Chi²	463.65				507.63	
Prob > Chi²	0.000				0.000	
F-Value			37.98			
Prob > F			0.000			
ΔGVA	Reg. Coef.	P>|z|	Reg. Coef.	P>|t|	Reg. Coef.	P>|z|
ΔRGVATPE	0.2074	0.000	0.2073	0.000	0.2074	0.000
(ΔRGVATPE)^2	0.0000	0.503	0.0000	0.500	0.0000	0.557
ΔAPG	-5579.7270	0.471	-5295.4090	0.508	-5579.7270	0.191
(ΔAPG)^2	-2237.6530	0.397	-2635.2120	0.369	-2237.6530	0.130
ΔLR	-43.2667	0.990	967.3902	0.803	-43.2667	0.984
(ΔLR)^2	66.7360	0.865	-38.1118	0.934	66.7360	0.759
ΔCISCB	11.7739	0.465	-1.2834	0.951	11.7739	0.496
(ΔCISCB)^2	0.0209	0.184	0.0127	0.488	0.0209	0.210
ΔTPE	0.3702	0.000	0.3599	0.000	0.3702	0.000
(DTPE)^2	0.0000	0.001	0.0000	0.001	0.0000	0.004
ΔRTETPE	-0.1934	0.253	-0.1430	0.428	-0.1934	0.095
(ΔRTETPE)^2	0.0000	0.712	0.0000	0.559	0.0000	0.441
GCF	0.2794	0.000	0.3060	0.000	0.2794	0.000
(GCF)^2	0.0000	0.003	0.0000	0.006	0.0000	0.183
ΔCI	-0.0020	0.025	-0.0015	0.104	-0.0020	0.001
(ΔCI)^2	0.0000	0.431	0.0000	0.460	0.0000	0.230
ΔTI	-0.0021	0.202	-0.0022	0.193	-0.0021	0.087
(ΔTI)^2	0.0000	0.885	0.0000	0.829	0.0000	0.842
Con. Coef.	-6541.9490	0.133	-7740.1160	0.205	-6541.9490	0.034
sigma_u	0.000		9063.0222			
sigma_e	52708.522		52708.522			

rho	0.000	0.0287		

The regression results based on the non-linear regression model indicate that the ratio of gross value added to total persons engaged, annual population growth, credit to industries by scheduled commercial banks, total persons engaged, and gross capital formation have a non-linear relationship with gross value added (see Table 8). Literacy rate, per person emoluments, capital intensity, and total inputs also have a non-linear relationship with gross value added. Furthermore, the aforementioned variables have a hill-shaped association with the gross value added of industries. The results indicate that the impact of these variables on industrial development will be positive up to a certain extent, but thereafter will have a negative impact on the gross value added of industries.

4.3. Rationality of Regression Coefficient

Previous studies have claimed that the regression coefficients of independent variables with the dependent variable must be validated to provide a scientific justification for their relationship (Jyoti & Singh, 2020; Maity & Chatterjee, 2012; Singh. et al., 2017). For instance, suppose the residual term and its first two lags are positively and negatively correlated with each other in a model. In that case, it may be concluded that the regression coefficients of the independent variables display consistency in the model. Accordingly, the correlation coefficients of the residual term with its various lags under linear, log-linear, and non-linear regression models were estimated to check the validity of the regression coefficients. The correlation coefficients of the residual term and its various lags are given in Table 10. The results suggests that the auto-correlation coefficients and partial auto-correlation coefficients of the residual term and its first two lags were statistically significant. Thus, the regression coefficients of the independent variables were found to be consistent.

Table-10. Correlation coefficients of the error term and its various lags.

No. of Lags	Log-linear regression model		Linear regression model		Non-linear regression model	
	Auto-correlation coefficients	Partial auto-correlations	Auto-correlation coefficients	Partial auto-correlations	Auto-correlation coefficients	Partial auto-correlations
1	-0.2931*	-0.2679*	-0.3132*	-0.4222*	-0.3234*	-0.3778*
2	-0.0210*	-0.0320*	-0.1351*	-0.4021*	-0.1168*	-0.2848*
3	0.1536*	0.2842*	0.1135*	-0.2076*	0.1209*	-0.1045
4	0.0667	0.2469*	-0.1625*	-0.2836*	-0.1609*	-0.2229*
5	-0.0500	0.0498	0.1327*	0.0281	0.1454*	0.0572
6	0.1043**	0.0784	-0.0773	0.0637	-0.0995	0.0562
7	0.1144	0.1153	0.0895	0.2281*	0.0949	0.2107*
8	0.0347	0.0847	0.0765	0.1455*	0.0724	0.1606*
9	-0.0824	-0.0768	-0.1514*	-0.0140	-0.1450*	-0.0068

Note: *, **, and *** values are statistically significant at the 1%, 5% and 10% significance level respectively.

5. CONCLUSION AND POLICY SUGGESTIONS

The descriptive results based on time trend analysis show that industrial development is on a growing path in India. However, there still exists a high diversity in industrial development between the different Indian states, due to variation in infrastructural development, number of factories and industrial workers, capital investment, the banking sector, credit support to industries by scheduled commercial banks, branches of scheduled commercial banks, geographical location, agricultural production, educational level of workers, per capita income, social inclusion, business ecosystem, research institutions, government policies, population growth, demand for goods and services, inflation, availability of skilled manpower, ecosystem services, capital formation, market structure, saving and investment patterns of people, and technological development. It has been reported that Gujarat, Maharashtra, Tamil Nadu and Karnataka hold the 1st, 2nd, 3rd, and 4th position, respectively, in industrial development among the Indian states. Furthermore, Gujarat, Maharashtra, and Tamil Nadu contribute around 40% of the value of gross output, gross value added, invested capital, number of factories, gross capital formation, total inputs, total persons engaged, and total number of emoluments in Indian industries at the national level. Therefore, these states make a greater contribution to the industrial development of India. Thus, it is suggested that other Indian states should implement effective and conducive industrial policies to create a business ecosystem that will increase their share in the industrial development of India.

The descriptive results based on the correlation coefficients of gross value added with total persons engaged, gross capital formation, total inputs, labor productivity, per person emoluments, capital intensity, credit to industry by scheduled commercial banks, and literacy rate were observed to be positive and statistically significant. Hence, these variables have been identified as crucial drivers of industrial development in India. The regression results based on the log-linear regression model also suggest that labor productivity, annual population growth, literacy rate, credit to industries by scheduled commercial banks, total persons engaged, per person emoluments, and gross capital formation have a positive impact on the gross value added of industries. Thus, these variables may be effective in sustaining industrial development in India. The results of the non-linear regression model indicate that labor productivity, annual population growth, credit to industries by scheduled commercial banks, total persons engaged, and gross capital formation display a linear association with the gross value added of industries. Meanwhile, literacy rate, per person emoluments, capital intensity, and total inputs display a hill-shaped association with industrial development in India.

The following suggestions may be considered when formulating industrial policies in India. India needs to increase its labor productivity and the efficiency of available resources to increase industrial development. To achieve this, regular training and skills development programs must be organized for industrial workers in India. Provision must be made to provide the appropriate remuneration and benefits (in term of social, job, and health security) for industrial workers, to increase their contribution to the production activities of industries. Technological advancement and innovation are crucial drivers for increasing the production of innovative goods and services in industries. Hence, it is advisable to create an innovative ecosystem in Indian factories to increase industrial development. Since the agricultural sector is required to meets the requirement for raw materials in most industries, the farming community should therefore cultivate crops in accordance with the current requirements of industries to increase industrial development in India. Indian industries should also focus on increasing their exports of goods and services to earn foreign currency and increase their production scale in the long run. The banking sector should also provide credit facilities to the industries at affordable interest rates to increase India's industrial development. India needs to control inflation, the prices of goods and services, and the tax rate to increase the demand for goods which are produced by Indian industries. Indian policy makers should monitor the demand and supply components of the economy on a regular basis to maintain the equilibrium between the demand and supply of industrial goods and services in the domestic market to increase industrial development in India.

Funding: This study received no specific financial support.
Competing Interests: The authors declare that they have no competing interests.
Acknowledgement: Both authors contributed equally to the conception and design of the study.

REFERENCES

Asteriou, D., Pilbeam, K., & Pratiwi, C. E. (2021). Public debt and economic growth: Panel data evidence for Asian countries. *Journal of Economics and Finance*, *45*(2), 270-287. Available at: https://doi.org/10.1007/s12197-020-09515-7.

Basu, P., Ghosh, I., & Dan, P. (2018). Using structural equation modelling to integrate human resources with internal practices for lean manufacturing implementation. *Management Science Letters*, *8*(1), 51-68.

Chaudhuri, D. D. (2016). Impact of economic liberalization on technical efficiency of firms: Evidence from India's electronics industry. *Theoretical Economics Letters*, *6*(3), 549-560. Available at: https://doi.org/10.4236/tel.2016.63061.

Chawla, R., & Manrai, R. (2019). Determinants of financial performance of selected listed manufacturing firms in India. *Journal of General Management Research, 6*(1), 78-89.

Daharwal, S., & Mishra, P. (2021). Workforce compensation and productivity growth in the Indian manufacturing sector: Lessons for human resource management. Pal, M.K. (Ed.) Productivity Growth in the Manufacturing Sector (pp. 121-135). Bingley: Emerald Publishing Limited.

Debnath, R. M., & Sebastian, V. (2014). Efficiency in the Indian iron and steel industry–an application of data envelopment analysis. *Journal of Advances in Management Research, 11*(1), 4-19. Available at: https://doi.org/10.1108/jamr-01-2013-0005.

Franck, R. (2021). Flowers of evils: Industrialization and long run development. *Journal of Monetary Economics, 117*(1), 108-128.

Goldar, B., & Sharma, A. K. (2015). Foreign investment in Indian industrial firms and impact on firm performance. *The Journal of Industrial Statistics, 4*(1), 1-18.

Jelilov, G., & Iheoma, E. H. (2016). *Impact of industrialization on economic growth: Experience of ten countries in ECOWAS (2000-2013)*. Paper presented at the 2nd International Conference Social Science and Law, Nigeria.

Jyoti, B., & Singh, A. K. (2020). Projected sugarcane yield in different climate change scenarios in Indian states: A state-wise panel data exploration. *International Journal of Food and Agricultural Economics (IJFAEC), 8*(4), 343-365.

Kołodziejczak, W. (2020). Employment and gross value added in agriculture versus other sector of the European Union economy. *Sustainability, 12*(14), 5518. Available at: https://doi.org/10.3390/su12145518.

Kumar, S., & Arora, N. (2012). Evaluation of technical efficiency in Indian sugar industry: An application of full cumulative data envelopment analysis. *Eurasian Journal of Business and Economics, 5*(9), 57-78.

Kumar, A., Ahmad, M. M., & Sharma, P. (2017). Influence of climatic and non-climatic factors on sustainable food security in India: A statistical investigation. *International Journal of Sustainable Agricultural Management and Informatics, 3*(1), 1-30. Available at: https://doi.org/10.1504/ijsami.2017.082917.

Kumar, R. A., & Paul, M. (2019). Industry level analysis of productivity growth under market imperfections. Working Paper, NO. 207, Institute for Studies in Industrial Development, New Delhi.

Lahiri, A. K., Madhur, S., Purkayastha, D., & Roy, P. (1984). The industrial sector in India: A quantitative analysis. *Economic and Political Weekly, 19*(31/33), 1285-1306.

Mahajan, V., Nauriyal, D., & Singh, S. (2014). Efficiency and ranking of Indian pharmaceutical industry: Does type of ownership matter? *Eurasian Journal of Business and Economics, 7*(14), 29-50. Available at: https://doi.org/10.17015/ejbe.2014.014.02.

Maity, B., & Chatterjee, B. (2012). Forecasting GDP growth rates of India: An empirical study. *International Journal of Economics and Management Sciences, 1*(9), 52-58.

Maroof, Z., Hussain, S., Jawad, M., & Naz, M. (2019). Determinants of industrial development: A panel analysis of South Asian economies. *Quality & Quantity, 53*(3), 1391-1419. Available at: https://doi.org/10.1007/s11135-018-0820-8.

Mazumdar, M., Rajeev, M., & Ray, S. C. (2009). Output and input efficiency of manufacturing firms in India: A case of the Indian pharmaceutical sector. Working Paper No. 219, The Institute for Social and Economic Change, Bangalore, India.

Mehta, Y., & Rajan, A. J. (2017). Manufacturing sectors in India: Outlook and challenges. *Procedia Engineering, 174*(1), 90-104. Available at: https://doi.org/10.1016/j.proeng.2017.01.173.

Mishra, P. (2019). How have mergers and acquisitions affected financial performance of firms in Indian manufacturing sector? *Eurasian Journal of Business and Economics, 12*(23), 79-96. Available at: https://doi.org/10.17015/ejbe.2019.023.05.

Mitra, A., Sharma, C., & Véganzonès-Varoudakis, M. A. (2016). Infrastructure, ICT and firms' productivity and efficiency: An application to the Indian manufacturing (Chapter 2). F. De Beule and K. Narayanan (eds.), Globalization of Indian Industries, India Studies in Business and Economics (pp. 17-41). Singapore: Springer.

Mohsen, A. S., Chua, S. Y., & Sab, C. N. C. (2015). Determinants of industrial output in Syria. *Journal of Economic Structures, 4*(1), 1-12. Available at: https://doi.org/10.1186/s40008-015-0030-7.

Ndiaya, C., & Lv, K. (2018). Role of industrialization on economic growth: The experience of Senegal (1960-2017). *American Journal of Industrial and Business Management, 8*(10), 2072-2085.

Pattnayak, S. S., & Chadha, A. (2013). Technical efficiency of Indian pharmaceutical firms: A stochastic frontier function approach. *Productivity, 54*(1), 54.

Ranajee, B. B. (2018). Factor influencing profitability of banks in India. *Theoretical Economics Letters, 8*(14), 3406-3061.

Sahu, S. K., & Narayanan, K. (2011). Determinants of energy intensity in Indian manufacturing industries: A firm level analysis. *Eurasian Journal of Business and Economics, 4*(8), 13-30.

Sahu, S. K., & Narayanan, K. (2015). Environmental certification and technical efficiency: A study of manufacturing firms in India. *Journal of Industry Competition and Trade, 16*(2), 1-17. Available at: https://doi.org/10.1007/s10842-015-0213-9.

Sankaran, A., Vadivel, A., & Jamal, M. A. (2020). Effects of dynamic variables on industrial output in one of the world's fastest-growing countries: Case evidence from India. *Future Business Journal, 6*(1), 1-8. Available at: https://doi.org/10.1186/s43093-020-00023-y.

Satpathy, L. D., Chatterjee, B., & Mahakud, J. (2017). Firm characteristics and total factor productivity: Evidence from Indian manufacturing firms. *Margin: The Journal of Applied Economic Research, 11*(1), 77-98. Available at: https://doi.org/10.1177/0973801016676013.

Sen, J., & Das, D. (2016). Technical efficiency in India's unorganized manufacturing sector: A non-parametric analysis. *International Journal of Business and Management, 4*(4), 92-101.

Singh, A. K., Narayanan, K., & Sharma, P. (2017). Effect of climatic factors on cash crop farming in India: An application of Cobb-Douglas production function model. *International Journal of Agricultural Resources, Governance and Ecology, 13*(2), 175-210. Available at: https://doi.org/10.1504/ijarge.2017.10007474.

Singh, A. K. (2017). An empirical analysis to assess the GDP projection of Gujarat state of India. *JNNCE Journal of Engineering and Management, 1*(2), 51-58.

Singh, A. K., Ashraf, S. N., & Ashish, A. (2019). Estimating factors affecting technical efficiency in Indian manufacturing sector. *Eurasian Journal of Business and Economics, 12*(24), 65-86. Available at: https://doi.org/10.17015/ejbe.2019.024.04.

Singh, A. K., & Jyoti, B. (2020). Factors affecting firm's annual turnover in selected manufacturing industries of India: An empirical study. *Business Perspective Review, 2*(3), 33-59. Available at: https://doi.org/10.38157/business-perspective-review.v2i3.206.

Singh, A. K., Singh, B. J., & Ashraf, S. N. (2020). Implications of intellectual property protection, and science and technological development in the manufacturing sector in selected economies. *Journal of Advocacy, Research and Education, 7*(1), 16-35.

Soni, A., Mittal, A., & Kapshe, M. (2017). Energy Intensity analysis of Indian manufacturing industries. *Resource-Efficient Technologies, 3*(3), 353-357. Available at: https://doi.org/10.1016/j.reffit.2017.04.009.

Thampy, A., & Tiwary, M. K. (2021). Local banking and manufacturing growth: Evidence from India. *IIMB Management Review, 33*(2), 95-104. Available at: https://doi.org/10.1016/j.iimb.2021.03.013.

Tyagi, S., & Nauriyal, D. (2016). Profitability determinants in Indian drugs and pharmaceutical industry: An analysis of pre and post TRIPS period. *Eurasian Journal of Business and Economics, 9*(17), 1-21. Available at: https://doi.org/10.17015/ejbe.2016.017.01.

Vinodh, S., & Joy, D. (2012). Structural equation modeling of sustainable manufacturing practices. *Clean Technologies and Environmental Policy, 14*(1), 79-84. Available at: https://doi.org/10.1007/s10098-011-0379-8.