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District-wise Industrial Infrastructure Development and Regional Disparities in Haryana: A Longitudinal Analysis (1990–2019)

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Abstract:

This study constructs district-wise composite indices to analyze the patterns and disparities of industrial infrastructure development in Haryana across four benchmark years: 1990-91, 1999-2000, 2009-10, and 2018-19. Utilizing Principal Component Analysis (PCA) and Coefficient of Variation (C.V.), the research highlights increasing industrial infrastructure availability while revealing widening inter-district disparities. Key infrastructure indicators such as road density, railway density, banking penetration, credit-deposit ratio, industrial electricity connections, and transport facilities are examined. The findings confirm significant spatial concentration of industrial infrastructure in districts bordering the National Capital Region, particularly Gurgaon and Faridabad, while many districts lag behind. The study underscores the need for policy focus on balanced regional growth to harness Haryana's full industrial potential.

Keywords: Regional Disparities, Infrastructure Development, Transport, Industrial, Haryana

1. Introduction:

Haryana, since its separation from Punjab in 1966, has witnessed remarkable progress in industrialization, contributing substantially to India's economy. The state's industrial infrastructure has evolved significantly, driven by policy reforms, liberalization, and its proximity to the national capital. This paper examines district-level industrial infrastructure development in Haryana over nearly three decades, exploring spatial disparities and growth

patterns. Understanding these trends is crucial for targeted regional planning and sustainable industrial growth.

2. Scope of the Study:

The study covers all districts of Haryana over the period from 1990-91 to 2018-19. It focuses on ten key indicators representing multiple dimensions of industrial infrastructure, including transportation, energy, banking, and communication facilities. The scope encompasses constructing composite indices to measure infrastructure development and analyzing inter-district disparities and their evolution over time.

3. Objectives:

- To construct district-wise industrial infrastructure development indices (IID) for Haryana at four points in time.
- To analyze the spatial and temporal patterns of industrial infrastructure growth in Haryana.
- To assess inter-district disparities and their trends using the Coefficient of Variation.
- To classify districts into development categories based on IID scores.
- To provide policy recommendations to reduce regional disparities and promote balanced industrial growth.

4. Statement of the Problem:

Despite Haryana's overall industrial growth, the distribution of industrial infrastructure remains uneven, with significant concentration near the National Capital Region. This spatial imbalance potentially limits inclusive economic growth and constrains industrial expansion in less developed districts. The problem lies in identifying these disparities, understanding their progression, and formulating strategies to ensure equitable infrastructure development across all districts.

5. Review of Literature:

The relationship between infrastructure development and regional economic performance has been a significant focus in economic research. Eisner (1991) emphasizes that infrastructure is a fundamental determinant of regional economic growth, facilitating productivity improvements and market integration. The study underscores that regions with better infrastructure tend to exhibit superior economic outcomes. Anand (2001) examines development planning in India, tracing the evolution of past policies and highlighting the critical role of infrastructure in achieving balanced regional growth. The work points to the

necessity of efficient infrastructure provisioning to support sustainable economic development and reduce regional disparities. Health and social disparities linked to infrastructure and socio-economic factors are explored by Adelson (2015) and Asada et al. (2013). Adelson's research on Aboriginal Canada highlights how inequitable infrastructure and service access contribute to persistent health disparities. Similarly, Asada and colleagues summarize social disparities in health, illustrating how infrastructure deficits reinforce broader inequalities. Focusing specifically on India, Bajar (2013) investigates the infrastructure-output nexus, demonstrating a strong positive correlation between infrastructure investments and regional economic outputs. The study reveals that infrastructure development is uneven across Indian regions, contributing to persistent economic inequalities. Furthering this line of inquiry, Bajar and Rajeev (2015) analyze the impact of infrastructure provisioning on inequality in India. Their findings suggest that improved infrastructure access reduces economic inequality by enhancing opportunities in lagging regions, though disparities may persist if infrastructure growth remains concentrated in already developed areas. Collectively, these studies affirm that infrastructure is a vital driver for regional economic performance and equity. They highlight the importance of policy interventions aimed at equitable infrastructure distribution to foster inclusive growth and mitigate disparities.

6. Research Methodology

Research Design: Research design refers to the systematic plan and procedures chosen by researchers to collect and analyze data effectively. It guides the selection of appropriate methods to ensure that the study objectives are met accurately. Research designs can be qualitative, quantitative, or mixed-method approaches. Depending on the research problem, investigators may choose exploratory, descriptive, correlation, or experimental designs. Key components of a research design include data collection strategies, measurement tools, and data analysis techniques. A well-designed study minimizes bias and error, enhancing the validity and reliability of findings. This study adopts a quantitative approach, utilizing secondary data from various sources to analyze industrial infrastructure development and economic growth in Haryana. Quantitative research allows precise measurement and statistical evaluation of variables related to infrastructure and economic indicators.

Variables: In research, variables represent characteristics or properties that can take different values and are essential for explaining variation in phenomena. Variables are classified as independent or dependent. The independent variable is the cause or predictor that influences changes in the dependent variable, which is the observed outcome. For example, in an

experimental context, if a treatment (independent variable) is applied to a group, the resulting effect on a condition (dependent variable) is measured. Variables have attributes; for instance, if "location" is a variable, its attributes might be urban, semi-urban, or rural. Proper identification and classification of variables help clarify relationships and enable accurate data analysis.

Independent and Dependent Variables: The independent variable is manipulated or categorized to examine its effect on the dependent variable. In the context of this study, independent variables could include various infrastructure components such as transport facilities or energy availability, while the dependent variables represent measures of industrial growth or economic performance.

Data Collection: The study primarily relies on secondary data collected from multiple authoritative sources, including:

- Statistical Handbook of Haryana, Economic and Statistical Organization, Government of Haryana
- Economic Survey of Haryana, various issues
- Census of India reports (1991–2011)
- Economic Survey of India

Additional data were drawn from journals, magazines, government reports, unpublished theses, seminars, conferences, newspapers, and credible internet sources.

Tools and Techniques Used: To analyze the contribution of economic growth to industrial infrastructure development, this study focuses on key sectors such as communication, transport, and railways. Data were sourced from official publications like the Economic Survey of India and Haryana's Economic Review.

Sampling Method: Sampling involves selecting a subset of individuals or units from a population to make inferences about the whole. It is a cost-effective and time-efficient approach for data collection. Sampling methods can be broadly classified into:

Probability Sampling: Every member of the population has a known and equal chance of selection, enabling generalizable results.

Non-Probability Sampling: Selection is based on non-random criteria, making it less representative but useful for exploratory studies.

7. Data Analysis and Results:

Ten district-level indicators reflecting industrial infrastructure were selected, including road density, railway density, industrial workforce, banking penetration, credit-deposit ratio, post office density, transport facilities, industrial electricity connections, and commercial vehicle numbers. Principal Component Analysis (PCA) was applied to construct composite IID indices. Coefficient of Variation was used to assess inter-district disparities. This paper construct the district wise development composite indices for industrial infrastructure development of the state of Haryana at four points of time 1990-91, 1999-2000, 2009-10, 2018-19 and to conduct regional analysis by the classification of districts on the basis of constructed indices. It is expected to help in investigating the pattern of sectoral and overall economic development and inter-districts variations/disparities in Haryana. The industrial infrastructure index is erected by applying the Principal Component Analysis (PCA) and further Co-efficient of Variation (C.V) is used to estimate the inter-districts variations with respect of industrial infrastructure development. Based on the literature and availability of data at district level ten indicators are selected and while selecting the indicator of industrial infrastructure development all dimension such as energy, transportation, roads, railway, banking, commercial vehicle etc., are taken care of. The following indicators are used to construct the industrial infrastructure development index (IID) for the districts of the Haryana.

IID 1: Length of surfaced road per 100 SQ KM in Haryana (Road density)

IID 2: Surfaced road length per lakh of population in Haryana

IID 3: Workers employed in working factories in Haryana (in percentage)

IID 4: Density of Railway in Haryana

IID 5: Number of bank branches per lakh of population in Haryana

IID 6: Credit-Deposit Ratio

IID 7: Number of post offices per lakh population in Haryana

IID 8: Facility of transportation per lakh of population in Haryana

IID 9: Number of industrial Electricity connections in Haryana

IID 10: Number of transport vehicle in Haryana

As discuss and observed earlier in paper 4, after the bifurcation from the parent state i.e., Punjab, the state has been perceived a remarkable progress in the country. The state is better known for its success in ushering in the Green Revolution in agriculture. The gains of Green Revolution in agricultural productivity are evenly distributed in almost all parts of Haryana. The state has done equally well on the front of industrial development. The industries in Haryana contribute approximately 28 percent of total GSDP. In comparison, the contribution of industries in national income of the country is only 21 per cent. Before 1991, industries were

highly regulated by the government. The industrial policy of Haryana after liberalization can be regarded as successful in that the growth of industry in Haryana at 8 per cent per annum is higher than the growth of industry in India at 7 per cent post liberalization. Haryana presently accounts for 66% of passenger car production, 50% of tractor manufacturing, 60% of motorcycle production, and 50% of refrigerator manufacturing in India. Haryana contributes about a quarter (25%) of India's total sanitary-ware production. Additionally, one fourth of bicycles produced in India originate from Haryana. Haryana has successfully attracted significant investments from multinational corporations, large corporate entities, foreign investors, and non-resident Indians.

Haryana strategically promotes its advantageous location on the outskirts of the national capital. Gurgaon has emerged as a prime destination for IT, ITES, and shopping complexes. It has essentially evolved into an extension of national capital. This increasing industrial activity has also augmented the industrial infrastructure in the state and it is well visible from the increasing industrial activities. As majority of industrial activities in Haryana are concentrated in few districts particularly national capital region, the industrial infrastructure development is also seems unequal in the state. Prima-facie, this can be said that industrial infrastructure variations among the districts of the state not only exits but also seems to be increasing over the time. To establish this observation in scientific way, districts wise industrial infrastructure development index was constructed.

Average and Co-efficient of Variation of Selected indicators: To summarize the general trend of industrial infrastructure development in Haryana, district average of all the indicators and co-efficient of variation of each indicator are measured as shown in the table 1. It is pertinent to mentioned here that few newly established districts are considered in their parent district only. An analysis of district-wise average values of indicators suggests that average values of all indicators is increasing excluding the number of bank branches (IID5). The increasing trend of almost all the selected indicators indicates the increasing industrial infrastructural availability in the state. Road infrastructure (IID1 and IID2) has been witnessed the significant improvement and in plain surface of Haryana the surfaced roads are serving as bone of industrial development in the state. In Haryana 64 percent industrial freight is carried by roads only (FICCI, 2019). Increasing rail density is also complement the infrastructure growth in the state (IID4). The right side of the table 1 depicts the variations of industrial infrastructure development among the districts of the Haryana. The values of coefficient of variation indicate that except the surfaced road length per 100 sq km (IID2). The district wise regional variations are increasing in the state. The rising value of CV of indicators is

statistically significant only of 6 indicators out of total 10 indicators (Table 1). Therefore, it is decided to explore the phenomenon more rigorously.

Table 1: Industrial Infrastructure Development Indicators in Haryana (Averages and Coefficient of Variation)

Average

Indicator	1990-91	1999-00	2009-10	2018-19
IID1	52.949	55.179	56.197	59.081
IID2	134	138.438	143.947	145.421
IID3	6.31	6.25	7.15	8.09
IID4	4.8	5.7	6.4	7.1
IID5	7.804	7.654	7.879	7.795
IID6	62.436	50.274	60.295	72.554
IID7	14	14.688	13.684	14.94
IID8	3039.812	4651.608	6377.702	10733.334
IID9	3108	4590	7122	9340
IID10	2640	2980	3265	3580

Coefficient of Variation

Indicator	1990-91	1999-00	2009-10	2018-19
IID1	94.57	92.22	86.64	86.63
IID2*	106.29	121.55	118.22	116.91
IID3	143.17	152.15	146.99	151.88
IID4*	89.16	113.1	160.11	163.47
IID5*	60.71	84.81	81.64	77.52
IID6	105.16	106.64	95.97	109.11
IID7*	125.69	105.92	159.45	159.45
IID8	44	48.38	48.18	47.83
IID9*	71.438	78.016	81.703	86.009
IID10*	40.866	48.299	48.361	48.361

Source: Calculations by Researcher

Overall Industrial Infrastructure Development Index: The constructed composite index based on all ten indicators has been shown in table 2. The table highlight that industrial infrastructure development in Haryana is rising continuously. This can be evident with score of IID index. The Over the years, the industrial infrastructure development is increasing in the

Haryana this can be evident from increasing value of composite score. The score was 0.3181 in the year 1990-91 which has increased to 0.6143 in the year 2018-19. The score indicates that the industrial infrastructure has been developed over the time in Haryana. Here the first hypothesis of the study i.e., the overall industrial infrastructure development in Haryana is increasing over the time as the composite score of industrial; infrastructure development has risen over the time.

Table 2: Year-wise Industrial Infrastructure Development Index for Haryana

Year	IID*	Year	IID*	Year	IID*
1990-91	0.3182	2000-2001	0.4356	2010-11	0.5215
1991-92	0.3882	2001-2002	0.4182	2011-12	0.5181
1992-93	0.3641	2002-2003	0.4412	2012-13	0.5509
1993-94	0.3804	2003-2004	0.4478	2013-14	0.5527
1994-95	0.4117	2004-2005	0.4813	2014-15	0.5813
1995-96	0.3987	2005-2006	0.4719	2015-16	0.5983
1996-97	0.4201	2006-2007	0.4873	2016-17	0.6172
1997-98	0.4285	2007-2008	0.4901	2017-18	0.6216
1998-99	0.4311	2008-2009	0.4884	2018-19	0.6143
1999-2000	0.4107	2009-2010	0.4916		

Source: Calculation by researcher by using Principal Component Analysis.

IID = Industrial Infrastructure Development

District-wise Industrial Infrastructure Development Index: Further. Table 3 shows the district-wise industrial infrastructure development. A quick perusal on the results indicates that districts of Haryana are diverging in industrial infrastructural development. This can also be interpreted as that the IID is confined with few districts only over the years. The districts are categorized into infrastructural highly developed district (HDD), infrastructural developed district (DD), infrastructural medium developed district (MDD), infrastructural low developed district (LDD) depending upon their index score. The classification score value was obtained through normal distribution cutoff of the score based on their mean and standard deviation. The table 3 shows highest industrial infrastructure was enjoyed by Faridabad trailed by Gurgaon and Yamunanagar in 1990-91. Faridabad falls in high infrastructural development category while Gurgoan and Yamunanagar in developed infrastructural category. While seven districts viz. Ambala, Rohtak, Hisar, Panipat, Sonepat, Rewari and Karnal are medium developed in industrial infrastructural development and remaining six districts are in low developed category. The study reveals that, geographically, the industrial infrastructural development is

concentrated in northern part of Haryana. A look at the table 3 shows that all high developed

Table 3: District wise Industrial Infrastructure Development Index in Haryana

Districts	1990-91			1999-2000			2008-09			2018-2019			Change in ranks
	IID	Ranking	Category	IID	Ranking	Category	IID	Ranking	Category	IID	Ranking	Category	
Ambala	0.3654	10	MD	0.422	7	MD	0.5145	7	MD	0.4643	9	MD	1
Bhiwani	0.3504	11	LD	0.331	13	LD	0.3745	13	MD	0.3303	15	LD	-4
Faridabad	0.8083	1	HD	0.8143	1	HD	0.8856	1	HD	0.8625	2	HD	-1
Fatehabad	-	-	-	0.205	18	LD	0.3125	19	LD	0.3063	17	LD	1
Gurgaon	0.6234	2	D	0.759	2	D	0.8495	2	HD	0.9384	1	HD	1
Hisar	0.3854	9	MD	0.454	6	MD	0.5245	6	MD	0.5013	6	MD	3
Jhajjar	-	-	-	0.392	11	MD	0.4065	12	MD	0.4533	10	MD	1
Jind	0.3034	13	LD	0.243	15	LD	0.3605	15	MD	0.3543	13	MD	0
Kaithal	0.2144	16	LD	0.212	17	LD	0.3425	16	LD	0.3013	18	LD	-2
Karnal	0.4244	8	MD	0.396	9	MD	0.4955	10	MD	0.4663	8	MD	0
Kurukshetra	0.3354	12	LD	0.275	14	LD	0.3645	14	MD	0.3433	14	LD	-2
Mahendergarh	0.2304	15	LD	0.203	19	LD	0.3135	18	LD	0.2883	19	LD	-4
Panchkula	-	-	-	0.414	8	MD	0.4465	11	MD	0.4033	12	MD	-4
Panipat	0.5894	4	MD	0.501	5	MD	0.6315	5	D	0.5743	5	MD	-1
Rewari	0.4684	6	MD	0.54	4	MD	0.6985	3	D	0.6803	3	D	3
Rohtak	0.4244	7	MD	0.382	12	MD	0.5095	8	MD	0.4313	11	MD	-4
Sirsa	0.2584	14	LD	0.223	16	LD	0.3255	17	LD	0.3063	16	LD	-2
Sonepat	0.4754	5	MD	0.395	10	MD	0.5025	9	MD	0.4893	7	MD	-2
Yamunanagar	0.6184	3	D	0.582	3	D	0.6795	4	D	0.6513	4	D	-1
CV*	52.72%			58.09%			74.35%			81.11%			

Souce: Calculations by Researcher, - district were not existing, 8 Significant at 5 percent

and developed districts lies on outskirt of national capital.

Table 4: District-wise Industrial Infrastructure Development Index

Composite Score	Category	Abbreviation
< 0.350	Low developed District	LDD
0.350 to 0.599	Medium developed District	MDD
0.600 to 0.799	Developed District	DD
>0.800	High Developed District	HDD

Key Findings:

- The overall industrial infrastructure in Haryana improved steadily from an IID score of 0.3181 in 1990-91 to 0.6143 in 2018-19.

- District-wise disparities widened, with the Coefficient of Variation increasing from 52.72% in 1990-91 to 81.11% in 2018-19.
- Industrial infrastructure is concentrated in districts adjacent to the National Capital Region, notably Gurgaon and Faridabad, classified as High Developed Districts (HDD).
- Several districts remained in the Low Developed District (LDD) category throughout the period, showing minimal infrastructure growth.
- Gurgaon and Rewari exhibited consistent upward trends in IID scores, reflecting successful industrial attraction policies.
- Other key industrial hubs such as Panipat, Hisar, and Yamunanagar showed stagnation or marginal changes in infrastructure development.
- The data confirms a spatial divergence in infrastructure, suggesting that policy measures have not sufficiently addressed regional imbalances.

8. Conclusion:

The study concludes that while Haryana has made commendable progress in industrial infrastructure development overall, significant inter-district disparities persist and have intensified over time. Industrial infrastructure is heavily concentrated near the National Capital Region, reinforcing spatial inequalities. To sustain industrial growth and ensure inclusive development, balanced infrastructure investment across all districts is imperative. Strengthening infrastructure in lagging districts will foster equitable economic opportunities and regional integration.

9. Limitations:

- The study relies on secondary data, which might have reporting inconsistencies across years and districts.
- Newly created districts were merged with parent districts for some years, potentially affecting time-series comparability.
- The study focuses on quantitative infrastructure indicators and does not account for qualitative aspects such as infrastructure reliability or service quality.

10. Future Scope:

- Conduct primary field surveys to assess infrastructure quality and industrial stakeholders' perceptions.
- Explore qualitative factors influencing industrial infrastructure effectiveness.

- Examine the impact of recent government initiatives on infrastructure and industrial growth beyond 2019.
- Comparative studies with other states to identify best practices in reducing regional disparities.
- Investigate socio-economic outcomes of infrastructure disparities on employment and income distribution.

11. Recommendations:

- Prioritize infrastructure development in lagging districts through targeted investments and incentives.
- Promote decentralized industrial growth by establishing industrial clusters outside the National Capital Region.
- Enhance transport linkages and power supply reliability in underserved districts.
- Strengthen financial inclusion and credit availability to support industrial expansion in backward areas.
- Encourage public-private partnerships for sustainable infrastructure development.
- Continuous monitoring and evaluation of infrastructure projects to ensure equitable distribution and impact.

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