



WRI INDIA

REPORT

Morphology of Delhi National Capital Region's economic geography and its implications for planning

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Foreword

Cities and their interconnected regions are the engines of economic growth in states and countries. The economies of mega city-regions, with their large concentrations of employment and GDP, are comparable in size to those of some large countries. The example of the New York Tri-State region, which accounted for approximately 10 percent of the U.S. GDP and generated \$1.9 trillion in 2017—more than Canada or Russia—is often quoted.

Although national- and state-level policies are important for economic development, they are inadequate to cater to the dynamic needs of city-regions. Megacities such as Delhi, whose extended urban agglomeration cuts across multiple states and city jurisdictions (such as Gurugram, Faridabad, Noida, and Ghaziabad), are often not recognized as one agglomeration because they are statistically categorized and computed separately in the economic and population censuses of India. Only when the data are spatio-economically collated and assessed do such extended megacities get recognized as one agglomeration, one labor pool, and one economy.

This report studies the Delhi National Capital Region, which accommodates India's foremost economic agglomeration, through an economic geography lens that closely synergizes with urban and regional planning and governance. This region, which has the highest concentration of jobs and people at the national scale and generated a GDP of US\$370 billion in 2015, grapples with increasing land and infrastructure costs; widening income gaps; air, land, and water pollution; natural resource deficiencies; and institutional coordination barriers. This report studies the region's morphology by tracking the sector-wise evolution of jobs from the liberalization in 1991 up to 2013–14.

Unique place-based assessments, done for the first time in India, revealed features of the economy such as the nature, location, density, and diversity of jobs by core, periphery, and region. Proximity to the national capital, extensive metro rail networks from the core to the periphery, proactive investments by the adjoining states, and the affinity of manufacturing firms to arterial corridors all illustrate where economic activity takes place and why, and that no two places are alike. The rise of the peripheries

and the decline of the core also confirm literature findings that all places do not rise or fall at the same time across neighborhoods, cities, and regions and contrasting processes happen at the same time.

Complementarities were found across the region, but what stands out is that the peripheries contiguous to core Delhi attracted jobs and educated migrants, witnessed increased per capita income and consumption, while the core saw a decline in employment growth rates. Further impacts associated with the economic transformation of the region are falling poverty rates, increasing unemployment rates, and decreasing female participation rates. These findings among others can support strategies to rebalance and accelerate the expected transition to a knowledge-based, high-wage economy at the core and further policies to distribute benefits more equally and enhance equitable participation in the region's economy.

An economic geography approach interfaces with multiple disciplines and is therefore well equipped to inform policy. It has the potential to explain where and why economic activity occurs, where industrial clusters develop, why urban agglomerations are significant, and how they impact people. Informing planning processes at the regional and local scales, guiding investment decisions, being cognizant of environmental impacts, and including marginalized groups in the economy are vital.

Sustainable, well-planned urban economic growth offers a path to reducing poverty, improving inclusion, and supporting a higher quality of life while respecting planetary boundaries.



ROGIER VAN DEN BERG

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Executive summary

Through an economic geography lens, this report investigates whether Delhi National Capital Region's industrial structure, demography, and spatial interdependencies achieved the benefits of efficiency, equity, and energy resource conservation after the liberalization in 1991. This report provides a starting point for a framework for other Indian and global south mega city-regions to better understand their economic realities. It will help spatially target investments and enable the economic benefits of regional growth to be distributed widely to all types of businesses and population segments in comparable mega city-regions.

HIGHLIGHTS

- India's leading urban agglomeration economy is located within the Delhi National Capital Region (NCR) and cuts across multiple city and state jurisdictions, but functions as one economy and one labor pool.
- Delhi NCR's core-periphery spatial system is in transition. The Core National Capital Territory (Core NCT) has decentralized without the expected movement to a knowledge-based, high-wage economy, and informality persists despite higher infrastructure provision levels.
- The peripheries are not conventional political backyards; rather, they attract investment by the adjoining state governments. Spatially contiguous Gurugram (in Haryana) and Gautam Buddha Nagar (in Uttar Pradesh) districts have the highest per capita incomes among districts in their respective states.
- Rapid urbanization, peripheralization of jobs, and migration tripled the region's per capita income and increased consumption levels. Declining poverty rates coexisted with increasing unemployment rates. Women's workforce participation remained abysmal, with marginalized groups concentrated in elementary occupations.
- Employment contribution from industrial sectors that experienced growth in industrial output and labour productivity, were higher than those in industrial sectors that experienced growth in technical and energy efficiency.
- Place-specific, dynamic, and targeted economic and infrastructure development strategies must be prioritized, including revitalization of Core NCT. Employing such frameworks could ensure that economic benefits of regional growth are widely distributed to all types of businesses and population segments in comparable mega city-regions.

BACKGROUND

Mega city-regions such as the Delhi National Capital Region (NCR) are often politically diverse, jurisdictionally separated, and socially disparate, but are economically connected through complex core, periphery, and rural region interrelationships. Concerted efforts toward spatio-economic assessments and strategic planning for the coordinated economic development of these powerhouses, though, has not been mainstreamed in the Indian context.

India's foremost economic activity hub and the seat of national government is housed in Delhi NCR. It covers a vast area of over 55,000 sq. km, is spread across four different states and had an estimated population of 71.8 million in 2021. The extended urban agglomeration of Delhi (which includes the contiguous cities of Gurugram, Faridabad, and Ghaziabad) is set to become the most populous in the world by 2030 according to UN estimates (UNDESA 2019). It overtook the Mumbai agglomeration to become the economic capital of the country in 2015. A forward-thinking economic move in the mid-1980s secured the agreement of the adjoining states of Haryana, Rajasthan, and Uttar Pradesh (and the Union Territory of Delhi) and led to the constitution of the National Capital Region Planning Board (NCRPB). This body prepares the NCR Regional Plan, which broadly recommends policy zones, land uses, and sectoral policies.

Delhi NCR faces planning and socioeconomic development challenges such as increasing land and infrastructure costs, widening income gaps, increasing unemployment rates, and coordination barriers between different states in the region. Though regional plans, subregional plans, and functional plans are prepared for Delhi NCR, planning for its economic development is prescriptive and done once in 20 years. The region lacks a dedicated economic development agency despite being the nation's economic powerhouse, does not provide a platform for consistent interaction with industry and non-state actors, and does not employ a spatio-economic/economic geography approach.

This report applies an economic geography lens to explore the transformation of Delhi NCR. It investigates whether this dynamic region's industrial structure, demography, and spatial interdependencies achieved the benefits of efficiency, equity, and energy resource conservation after the liberalization in 1991. It presents the findings on the region's industrial structure, diversification, and competitiveness and how the subregions within Delhi NCR underwent a unique transformation involving associated demographic impacts without affecting the economic prominence of the overall region.

KEY FINDINGS

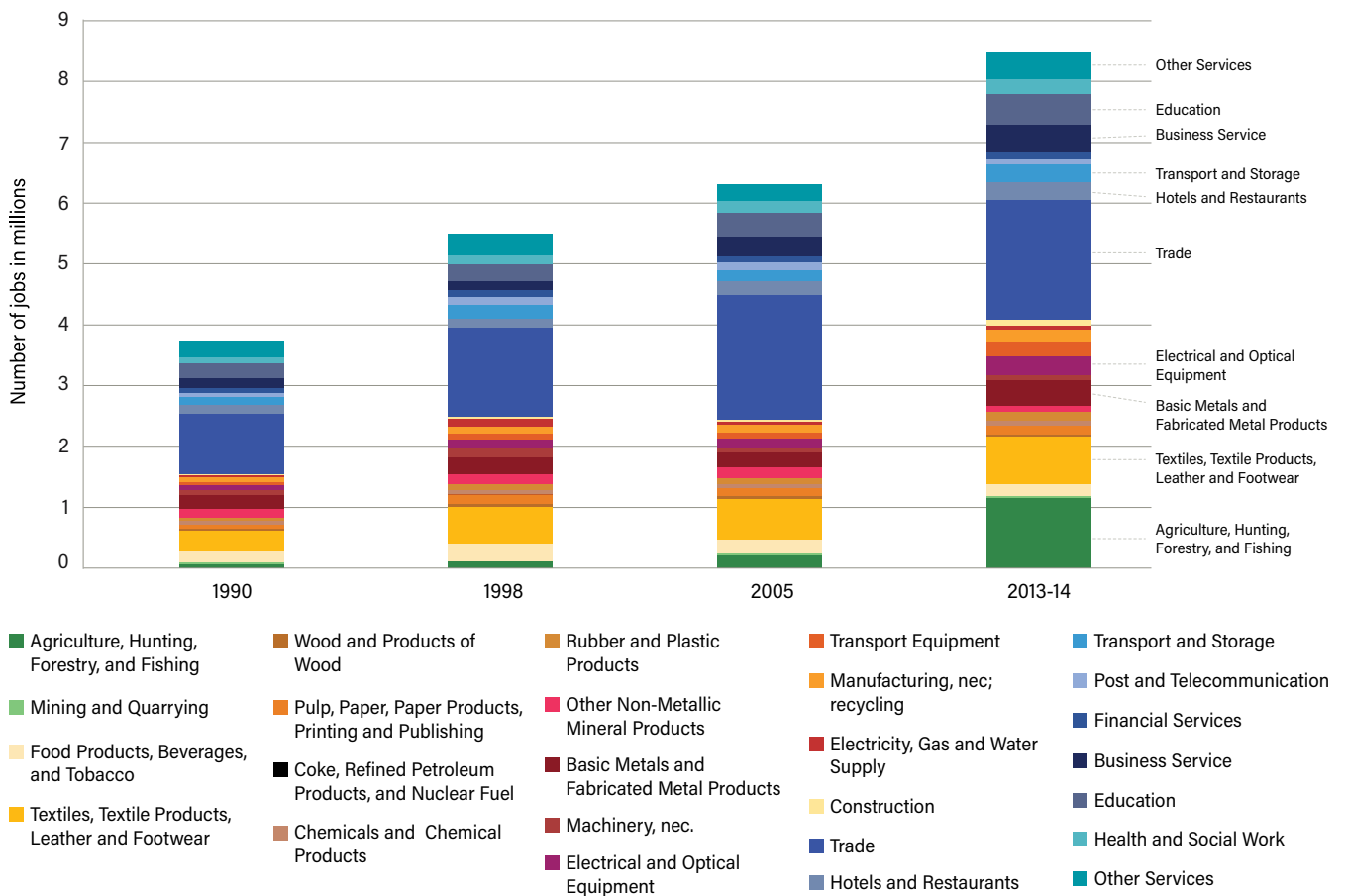
At the scale of Delhi NCR, the industrial structure has largely followed a predictable historical trajectory and presented a diverse mix where traditional sectors such as “Trade,” and “Textiles, textile products, leather and footwear,” continued their dominance from the liberalization in 1991 to 2013–14. Although the tertiary sector’s growth is boosting the region’s gross domestic product (GDP), employment-intensive growth in the secondary and tertiary sectors has been low.

Sectoral decomposition of the primary sector indicated that establishments in the subsectors of “Agriculture, forestry, and fishing” and “Mining and quarrying” employed about 1.18 million people, which was about 14 percent of the total employment in Delhi NCR in 2013–14. Employment in livestock establishments, which meet the increasing urban consumption demand, grew

sharply between 2005 and 2013–14 from 3.6 percent to 13.6 percent, making Agriculture, forestry, and fishing” subsector the second-highest contributor to Delhi NCR’s total employment after “Trade.” However, despite increasing employment shares, the primary sector’s contribution to the GDP in Delhi NCR declined by 4 percentage points between 2005–06 and 2013–14.

The secondary sector, which comprises manufacturing and construction, employed about 2.9 million people in Delhi NCR, which was about 34 percent of the total employment in 2013–14. Major employment subsectors included “Textiles, textile products, leather and footwear,” “Basic metals and fabricated metals products,” and “Electrical and optical equipment” (see Figure ES-1). Although employment in the manufacturing sector increased marginally by 2 percentage points, its contribution to the GDP in Delhi NCR declined by 4 percentage points between 2005–06 and 2013–14.

FIGURE ES-1 | Employment in industrial sectors in Delhi NCR from 1990 to 2013–14



Notes: Top 10 employment-generating industrial sectors of 2013–14 are highlighted in the chart; nec = Not Elsewhere Classified.

Source: Authors’ analysis using data from Central Statistics Office (a) (n.d.).

The tertiary sector was the dominant economic driver of Delhi NCR, contributing about 52 percent of the total employment in Delhi NCR in 2013–14. Sectors such as trade, business services, and education did not contribute significantly to employment growth, but, overall, the tertiary sector's GDP growth was high, at 12 percent annually between 2005–06 and 2013–14. This low-job growth trend has been associated with a rise in unemployment rates and declining workforce participation rates despite GDP growth.

Although comparable and comprehensive data on the informal sector are not available, estimates by the NCRPB suggest that there were about 5.87 million informal workers in the region, who strongly complemented the formal sector. They were employed in micro and small units located in the vicinity of organized large industries, or in units that produced specialized and artisanal products (such as handicrafts, leather products, and wood products) or were service providers such as construction workers, street vendors, and home workers.

Delhi NCR specialized locationally in the manufacturing sectors of transport equipment, electrical and optical equipment, and rubber and plastic products when compared to the rest of India. However, a location quotient analysis established that it did not enjoy a competitive edge in sectors such as business services (which includes information technology and financial services), whose primacy decreased. This was indicated by a reduction in the location quotient from 1.8 to 1.34 between 2005 and 2013–14.

Industrial efficiency assessments from 1991–92 to 2017–18 show that Delhi NCR's overall employment structure has improved to include more industries with high levels of industrial output and improved labor productivity. Growth of technically efficient and energy-efficient industries, however, declined, implying that Delhi NCR's industrial transformation has not included substantial gains in terms of sustainable development.

Spatial mapping of jobs by distance from the center of Delhi NCT moving outward showed that economic activity peaked at about 5,000 jobs per sq. km for a radial distance of 10 km, while remaining significant with over 2,000 jobs per sq. km up to a 20 km radial distance and completely tapering off after a 40 km distance. Most jobs were within and at the periphery of major urban centers, and others were located along regional transport arteries. Transport-corridor-linked economic activity such as warehousing facilities was evident. An assessment of the built-up area growth from 1990 to 2015 and growth in

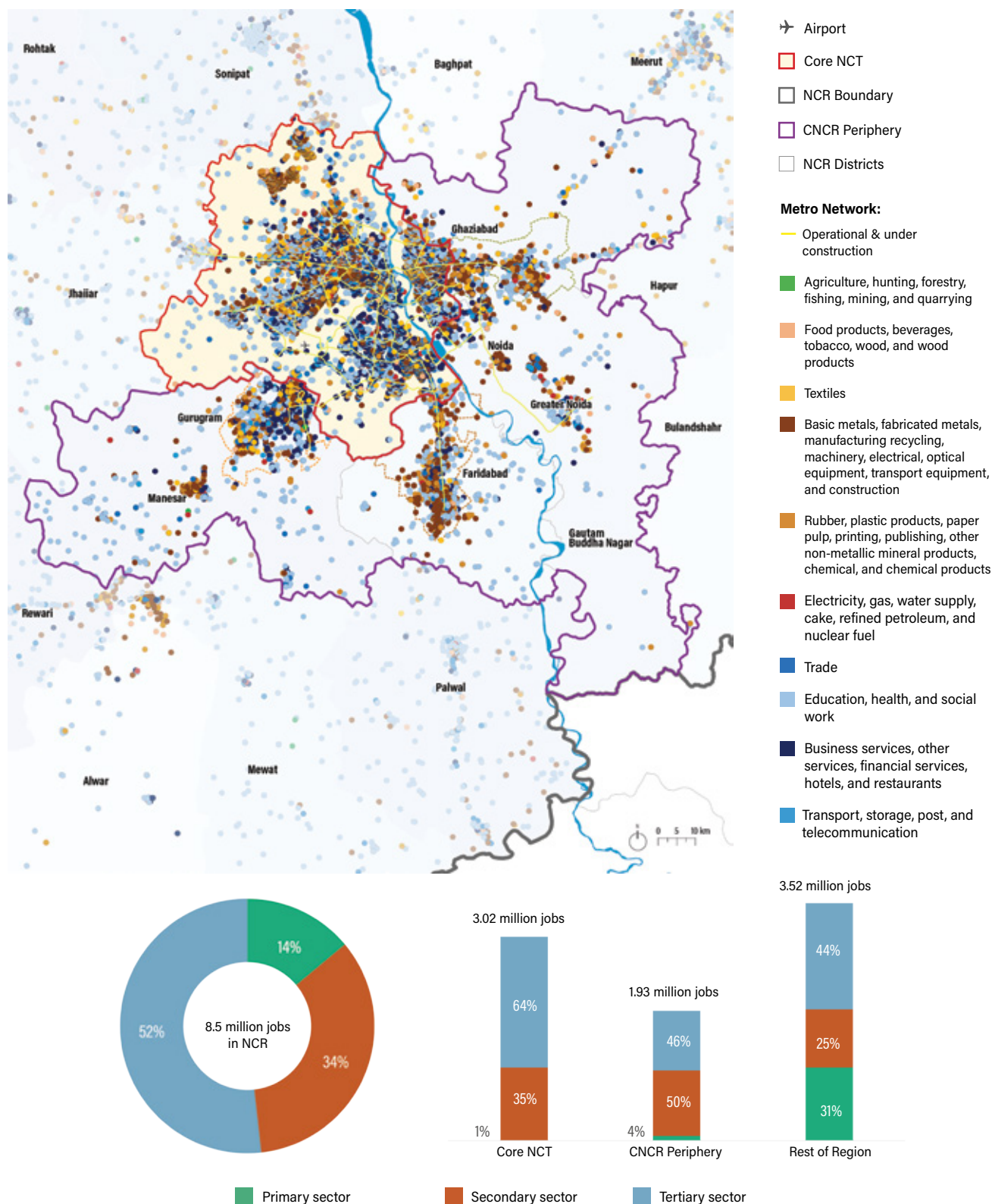
night-lights from 1992 to 2018 further indicated a clear peripheralization of growth toward Gurugram (near the international airport), Faridabad, New Okhla Industrial Development Authority (NOIDA), Greater Noida, and Ghaziabad. The southern and eastern arcs around the center of Delhi NCT witnessed a doubling of built-up area growth, while night-light intensity (which is often used as a proxy for economic activity) increased three times in the districts adjoining Delhi NCT.

The unevenness of the urban and economic growth, the distribution of jobs, and the industrial transformation after liberalization across the region requires a spatially differentiated approach to understand the transformations within Delhi NCR. From a theoretical standpoint, core-periphery models as discussed by Friedmann (1967) and (Klimczuk and Klimczuk-Kochańska 2019) with general reference to the core and periphery from a geographical perspective (varying from the regional to the continental scale) suggest that cores become centers of innovation, and are involved in producing knowledge-intensive jobs and value-added products, whereas peripheries are social, economic, and political backyards and even undergo degradation. Such regional inequalities are a characteristic theme of the core-periphery model, though there is variation in the case of Delhi NCR.

An assessment of Delhi NCR by the delineated subregions of NCT Core, CNCR Periphery (that is, Central NCR Periphery), and the Rest of Region showed that the core consistently lost employment share to its periphery and to its larger rural region, both of which made significant employment gains. Core NCT, along with a declining decadal growth rate of population over two time periods (1991–2001 and 2001–2011), experienced a further reduction in its share of employment from 50 percent in 1990 to 36 percent in 2013–14. This implied decentralization of jobs and population, which was also noted by Jain et al. (2013): the Delhi region has been in an absolute decentralization stage since 1981. In CNCR Periphery and in the Rest of Region, the percentage share of employment increased from 12 to 23 percent and from 37 to 42 percent, respectively, from 1990 to 2013–14.

Although the historical growth trajectory of the industrial structure of the whole of Delhi NCR did not reveal any unexpected changes, a stark and substantial transformation was noted within it; that is, across Core NCT, CNCR Periphery, and the Rest of Region. Employment in high-value sectors such as business services reduced in Core NCT from 0.21 million jobs in 2005 to 0.16 million jobs in 2013–14, while in CNCR Periphery, the number

FIGURE ES-2 | Establishments and employment in agricultural and non-agricultural activities in Delhi NCR in 2013–14



Note: Establishments and total employment in agricultural and non-agricultural activities exclude "Crop production and plantation" and "Public administration, defense and compulsory social security activities," respectively.

Source: Authors' analysis using data from Central Statistics Office (a) (n.d.); map prepared by WRI India.

of such jobs increased from 0.06 million to 0.18 million between 2005 and 2013–14. CNCR Periphery specialized in textiles, chemicals and chemical products, machinery, electrical and optical equipment, and transport equipment, and had higher location quotient values than Core NCT and the Rest of Region in 2013–14. The Rest of Region is predominantly rural, with about 52 percent of its workforce engaged as agricultural laborers and cultivators. It has also gained manufacturing jobs, which increased from 0.6 million to 0.8 million between 2005 and 2013–14.

The core–periphery spatial system of Delhi NCR is transitioning, and the Core NCT has undergone decentralization without moving up toward becoming a highly specialized, high-wage, high-technology economy. The peripheral CNCR districts attracted more investments and had a higher per capita income than Core NCT. They are not conventional political backyards, but instead serve as the focus of their respective states. Taking advantage of their proximity to Delhi, the national capital, the adjoining state governments in CNCR Periphery invested in land and infrastructure developments through public-private partnerships that triggered industrial and residential developments. This has resulted in higher per capita incomes in the districts of Gurugram (in Haryana) and Gautam Buddha Nagar (Noida in Uttar Pradesh) than any in other districts in their respective states. Being rapidly urbanizing suburbs, however, they are yet to catch up with Core NCT in terms of infrastructure provision levels.

Delhi NCR presents a case of complementarity between its subregions, because the jobs that moved out from the Core NCT were captured by the CNCR periphery and Rest of Region without getting expelled from the region. An analysis of the diversity of the economy using the Herfindahl Hirschman Index (HHI) calculated for the subregions revealed that CNCR Periphery had more diversified industrial sectors than Core NCT and the Rest of Region. This subregion has also diversified more into unrelated industrial sectors than the other two subregions. Overall, however, the unrelated variety measures of the three subregions are not significantly different, indicating that the dynamics of the region supported complementary movement of industries between the regions. Decentralization policies, which were emphasized as far back as in Delhi's first master plan in 1962, coupled with land use and building control restrictions, pollution control norms, and inefficient large-scale land acquisition and disposal policies have resulted in fragmented development driven by speculation beyond the boundaries of Delhi state.

This expansion of development has been greatly aided by infrastructure investments such as the metro rail.

The industrial transformation at the overall Delhi NCR scale and across the delineated subregions has been associated with changes in demographic indicators such as improved main workforce participation, higher per capita incomes, and lower poverty rates. However, unemployment persisted, workforce participation rates of women have declined despite higher education levels and lower fertility rates, and marginalized groups remain concentrated in elementary occupations.

The economic strength of the overall Delhi NCR is evident from the increase in the number of main workers (those who have worked for more than six months in the reference period) by three percentage points between 2001 and 2011. They constituted over 82 percent of the total working population (in contrast to the national average of 75 percent in 2011), with the number of marginal workers decreasing correspondingly. However, unemployment rates, calculated as the ratio of the number of people seeking work or who are available for work to the total labor force, shot up by 8 percentage points between 2004–05 and 2018–19, reflecting the national trend. Women's participation in the workforce remained at 17 percent in 2011 despite literacy rates in the region recording an increase of 26 percentage points between 1991 and 2011, which correlated with a reduction in household/family size. Scheduled Castes and Scheduled Tribes' (SCs and STs) establishments were concentrated in the manufacturing sector, whereas Other Backward Castes' (OBCs) establishments were concentrated in agriculture. SCs were employed mostly in construction; petroleum products; textiles and leather products; and agriculture, fishing, and forestry. STs were employed mostly in electricity, gas, and water supply and in mining and quarrying.

Delhi NCR's economic primacy is reflected in its credit-deposit ratio (0.86), which was higher than that of the country (0.76) in 2019–20, enabling banks in this region to make better use of their resources. The per capita credit advanced increased from Rs 0.4 million in 2001–02 to Rs 2.5 million in 2011–12 to Rs 3.4 million in 2019–20, which is an established sign of economic prosperity. The per capita income of Delhi NCR tripled in the years between 2004–05 and 2016–17 and was twice the national per capita income in 2016–17, while poverty rates plummeted. Consumption levels too were much higher in Delhi NCR, with the monthly per capita expenditure being 50 percent more than the national monthly per capita expenditure in 2011–12.

At the subregional scale, the bulk of the population has always been concentrated in Core NCT since 1991. The growth rate of population across the three subregions, however, has declined steadily, with Core NCT showing the highest decline during the last three census decades. In terms of per capita income, too, Core NCT remained the highest from 2004–05 to 2011–12, but the adjoining CNCR Periphery moved ahead in 2016–17. Poverty rates declined steeply in CNCR Periphery, while Core NCT experienced only a marginal decrease in poverty between 2004–05 and 2011–12. The migrant population of CNCR Periphery grew dramatically and attracted more skilled migrants (graduates or higher in qualification) than Core NCT, whose migrant population remained largely stable between 2001 and 2011. The migrant population in the Rest of Region grew marginally over the three decades and attracted more unskilled workers because of its predominantly agricultural economic base.

CONCLUSION

Economic development planning for the dynamic spatial system of Delhi NCR across Core NCT, CNCR Periphery, and the Rest of Region is insufficient and prescriptive. Despite being the economic powerhouse of the country, strategic intent to plan its economic development does not compare with that in other global city-regions. Despite higher infrastructure provisions for Core NCT than for the other two delineated subregions, it is still hollowing out with an outward movement of people and jobs. Differentiated strategies must be employed for the development of Delhi NCR's subregions. Place-specific rethinking of its competitive advantages and strategies to retain and enhance industrial diversity must go hand in hand with environmental efficiencies. Women and marginalized groups, who face barriers to workforce entry and are therefore concentrated in elementary jobs, must have access to better opportunities.

RECOMMENDATIONS AND THE WAY FORWARD

An economic geography approach will better inform the planning process of the dynamic spatial system of Delhi NCR across Core NCT, CNCR Periphery, and the Rest of Region. It would enable place-specific strategies and processes that consider firm locations and clustering, their transformation over time, and the impact it will have on people's lives and natural resource use. Recommendations include the following:

- **NCR Economic Development Corporation (NCR-EDC) to be set up to build Regional Economic Development Strategy:** The one economy and one labor pool phenomenon of the agglomeration requires regional economic development strategies to cut across jurisdictional and policy barriers. To do this, the NCRPB may constitute an NCR Economic Development Corporation (NCR-EDC) on the lines of the NCR Transport Corporation (NCRTC).
 - Regional economic development strategy plan: Leverage the existing frameworks of interstate coordination to set up economic development strategies that are place specific and part of a continuously updated process.
 - Multi-stakeholder platform: Bring together the government, private sector, industrial associations, academia, and civil society representatives on one platform to address economic development needs.
 - Fostering healthy competition between the participating states and cities: The NCR Economic Development Corporation (NCR-EDC) should help attract investments and businesses to their respective regions through healthy competition.
- **Delhi Economic Development Corporation (Delhi EDC) to be set up to revitalize Core NCT:** Global cities have revitalized their cores through targeted economic development strategies, and Core NCT has several strengths that it can leverage toward this end. A city-level Economic Development Corporation (Delhi EDC) may be set up that works closely with state departments and is led by the chief minister as the chairperson.
 - City economic development strategy plan: Delhi EDC must provide flexibilities in land management and revise its industrial policy to interact with and attract newer businesses and retain its highly skilled talent pool.
 - Core city revitalization plan: Strategies are needed to upgrade Core NCT's industrial infrastructure, refurbish derelict industrial areas, incentivize inner city redevelopment, and improve its fiber-optic and telecommunication networks.
 - Improving Core NCT's business environment: Partnerships with private players will help raise funds for the revitalization of the core through well-structured incentives and transparent terms of engagement.

- Spatio-economic assessments for large infrastructure provision agencies to improve investment decisions: Spatio-economic assessments will spatially target infrastructure investments and foreign direct investments to economically dynamic locations to provide better returns on investment, job growth, and crowding in of private investment for economic development.
- Strategies to ensure the participation of marginalized groups in the economy: Safe and accessible work and travel conditions, and child and elderly care facilities would encourage more women to join the workforce. Better access to education, healthcare, basic services, social security benefits, skilling programs and jobs for marginalized groups are to be provided.

Although further research is required, the economic-geography-based assessment framework for mega city-regions used in this study could form an initial starting point for other mega city-regions located in India and the Global South to improve their planning and target infrastructure investment decisions.

LAYOUT OF THE REPORT

This report uses an economic geography approach to explore the transformation of the Delhi NCR. It investigates whether the industrial structure, demography, and spatial interdependencies in the decades after the liberalization in 1991 secured the benefits of economic efficiency, equity, and energy resource conservation. The report is structured as follows:

- The section titled “Introduction: Delhi NCR, India’s economic capital” presents the prominent economic positioning of Delhi NCR in the country, its geographic constituents, and the current planning practices followed.
- The section titled “Method, scope, and limitations of the study” raises three key research questions around industrial structure, locational advantages and efficiencies, and a geographic disaggregation-based assessment of transformation across the urban core, periphery, and rural region of Delhi NCR. Details of the data used, and the methodology employed are explained.
- The section titled “Sectoral decomposition of Delhi NCR’s economic growth and contribution to GDP” breaks down the nature and growth of jobs in the primary, secondary, and tertiary sectors across the entire Delhi NCR and comments on the informality of the economy. The sector-wise contribution of establishments to the employment share and GDP discusses which sectors drive economic growth and which sectors drive employment growth.
- After assessing the sectoral trends of jobs in the entire Delhi NCR, a further assessment of its locational advantages and efficiencies (in terms of energy, labor productivity, real value added, and total factor productivity) is conducted in the section titled “Growth, specialization, and industrial efficiency trends in Delhi NCR.”
- Once the entire Delhi NCR’s industrial structure, sectoral jobs, efficiencies, and transformation trends at the macro scale are understood, the focus then shifts to what happens within; that is, across its urban core, periphery, and rural region. The section titled “Structural transformation across Core NCT, CNCR Periphery, and Rest of Region” forms the crux of the report’s analysis, where spatial mapping pins down the variation in Delhi NCR’s jobs by density, diversity, and geographic distribution. Key theories in economic geography are employed to understand this morphology and the intra-regional movements of jobs, and subregional locational preferences and complementarities are assessed.
- The section titled “Economic transformation and its association with subregional demographic trends” looks at the change in people’s lives associated with the changes in industrial structure across its subregions over time in terms of population growth, migration, educational attainment, income increases, and effects on women and marginalized groups.
- The brief section titled “Economic development approaches adopted by global city-regions” looks at the strategies employed by other city-regions to gauge learnings, processes, and structures that may inform Delhi NCR’s strategies.
- The section titled “Findings, conclusions, recommendations and the way forward” brings together the various trends and findings that make Delhi NCR and its subregions unique, and suggests ways in which it could leverage its inherent strengths and ground realities to better inform other similar regions in India and the Global South.

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CHAPTER 1

Introduction

Delhi National Capital Region, which house the nation's leading agglomeration of Delhi National Capital Territory, emerged as the leading employment hub among the metropolitan regions of the country. Although there are planning frameworks for the National Capital Region, planning for its economic development is prescriptive and does not employ an economic geography approach.

DELHI NCR, INDIA'S ECONOMIC CAPITAL

The need to plan Delhi, the national capital of India, in a regional context was understood by policymakers as far back as the early 1960s, as evidenced in the first Delhi Master Plan, 1962 (DDA 1962). Rapid suburban growth, with consequent housing and land shortages and constraints in infrastructure and amenities, led to the NCRPB being constituted in 1985 by an Act of the Union Parliament. This forward-thinking economic move in the mid-1980s had the agreement of the participating states of Haryana, Rajasthan, and Uttar Pradesh. The National Capital Region (NCR), constituted under the provisions of the NCRPB Act, 1985, is today spread over 55,000 sq. km and had an estimated population of 71.8 million¹ in 2021. According to the provisions of the Act, the board is tasked with the preparation of the NCR Regional Plan and related policy documents once every 20 years, with recommendations for various sectors through functional plans such as for transport and economic development. Subregional plans and projects are prepared by the participating states.

Delhi NCR comprises the National Capital Territory (NCT) of Delhi at its core. It includes 14 districts from the state of Haryana, 8 from Uttar Pradesh, and 2 from Rajasthan (Table 1), and is an example of cooperative federalism backed by a Central Statute (NCRPB 2021).

Data released by Oxford Economics in 2015 indicate that the agglomeration of Delhi (which includes Delhi NCT, Gurugram, Faridabad, New Okhla Industrial Development Authority [NOIDA], and Ghaziabad) had overtaken the agglomeration of Mumbai to become the economic capital of India. Delhi's agglomeration had a GDP at purchasing power parity of US\$370 billion, against Mumbai's \$368 billion (*The Financial Express* 2016). Delhi NCR as a whole generated about 8 percent of the national GDP in 2016, received about 20 percent of all foreign direct investment from 2010 to 2015, and contained about 5 percent of the country's population in just 2 percent of its geographical area in 2011 (KPMG 2017; NCRPB 2021).

Delhi NCR had 342 cities of various sizes and 11,169 villages, which accommodated 58 million people, according to the Census of India 2011. Urbanization in the region, which was recorded as 55 percent in 2011, is skewed toward its large urban centers (those having a population of a million and above), which accommodate close to 50 percent of the urban population, with the rest of the Class 1 cities accommodating another 28 percent of the urban population. Five of India's 50 largest cities by population are present in Delhi NCR; namely, Delhi, Ghaziabad, Faridabad, Gurugram, and Meerut. Delhi (the seat of the national government) together with its extended urban agglomeration is set to become the most populous city in the world by 2030 according to UN estimates, overtaking Tokyo, which houses over 37 million people (UNDESA 2019).

TABLE 1 | Geographical area of administrative units within Delhi NCR

SUBREGION	NAME OF THE DISTRICTS	AREA (IN SQ. KM)
Haryana	Faridabad, Gurugram, Mewat, Rohtak, Sonipat, Rewari, Jhajjar, Panipat, Palwal, Bhiwani, Charkhi Dadri, Mahendragarh, Jind, and Karnal (14 districts)	25,327
Uttar Pradesh	Meerut, Ghaziabad, Gautam Buddha Nagar, Bulandshahr, Baghpat, Hapur, Shamli, and Muzaffarnagar (8 districts)	14,826
Rajasthan	Alwar and Bharatpur (2 districts)	13,447
Delhi	Whole of NCT Delhi (9 districts)	1,483
Total		55,083

Notes: NCR = National Capital Region; NCT = National Capital Territory.
Source: Census of India 2011; NCRPB 2021.

Delhi NCR plans have over time sought to deflect the growth of Delhi NCT outward to reduce the pressure on its infrastructure, while creating high-speed transport networks connecting Delhi NCT with the region. The maximum amount of funding for Delhi NCR plan has been for transport projects, for which a dedicated National Capital Region Transport Corporation (NCRTC), a joint venture company of the Government of India and the four participating states of Delhi NCR, was created. Delhi NCR has benefited from immense connective infrastructure investments over time, such as the country's most extensive metro rail network (which covers over 389 km and was built with an investment of INR 810,000 million) (DMRCL n.d.) and the busiest airport (Indira Gandhi International Airport). Mega projects are underway within the region, such as the Delhi-Mumbai Industrial Corridor (DMIC), the Orbital Rail Corridor, and the Regional Rapid Transit System (RRTS). Further strategic investment projects such as the upcoming Jewar Airport located south of Greater Noida, the Eastern Dedicated Freight Corridor, Special Economic Zones in Noida and Greater Noida in Uttar Pradesh, and industrial townships in Haryana are either under development or have been proposed in the region.

This region has emerged as the largest employment hub of the country among metropolitan regions, providing 8.5 million jobs (6 percent of the nationally recorded employment) in 2013–14. With over 7,000 start-ups and 10 unicorns, Delhi NCR overtook Bengaluru, Mumbai,

and Hyderabad in the start-up economy space in 2019 (*Money Control* 2019). Since 2015, the participating states have actively engaged in facilitating a start-up ecosystem through start-up policies.²

The continued national ambition of becoming a \$5 trillion economy by 2024–25 and a \$10 trillion economy by 2030 (*The Hindu* 2021) will further direct national and global attention to the dynamic Delhi NCR, which will have to contribute significantly to this target. However, similar to other comparable mega city-regions such as Kolkata, Mumbai, Chennai, Hyderabad, and Bengaluru, in India, the Delhi NCR is subject to several constraints. These constraints include increasing land and infrastructure costs; widening income gaps; natural resource insufficiencies; air, land, and water pollution; increasing unemployment rates; decreasing female workforce participation rates; coordination barriers between regions; and technological and institutional capacity limitations.

Knowledge of Delhi NCR's economic geography will provide valuable lessons that will help spatially target policies, projects, and investments to mitigate problems for its urban future. It could be considered an initial step in developing an assessment framework for other mega city-regions in India and in the Global South to make progress on the Sustainable Development Goals (SDGs) by bringing wider economic benefits to all classes of workers and businesses.





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CHAPTER 2

Methodology, scope, and limitations of the study

This report employs an economic geography approach to analyze the large and complex region constituting Delhi NCR, which is the national and economic capital of India. Economic growth trajectories were analyzed using the time series data published by the government of India and several published secondary literature.



This study applies an economic geography lens to explore how India's leading economic agglomeration, the Delhi NCR, has transformed after the liberalization in 1991 in terms of its industrial structure, demographic trends, and spatial interdependencies.

RESEARCH QUESTIONS

The following three research questions will be addressed to understand Delhi NCR's economic geography:

- What is the industrial structure of Delhi NCR and what spatio-economic changes occurred after the liberalization in 1991?
- Which industries have enjoyed locational advantages in Delhi NCR and has their growth been efficient in terms of industrial output, productivity, and energy?
- What has been the industrial transformation in Delhi NCR's Core NCT, CNCR Periphery (that is, Central NCR Periphery), and the Rest of Region and what is its association with demographic changes?

DATA SOURCES AND LIMITATIONS

The best and latest data sets available at the most granular levels were collated from a variety of sources and across multiple time periods for this study as follows:

- Economic census (EC) data—EC 3, 4, 5, and 6 for the years 1990, 1998, 2005, and 2013–14, respectively, published by Central Statistics Office, Ministry of Statistics & Programme Implementation (CSO-MoSPI)—were collated across 26 categories of

industries to understand the transformation of the industrial structure, sectors, and employment over time for both Delhi NCR and India. The EC provides data on the number of establishments categorized by the number of employees and by ownership type (by social group and gender), distinguishing it from the Population Census data.

- Data on informal sector employment are provided in a report published by Delhi NCRPB in 2016. The report describes a functional plan for the economic development of Delhi NCR. According to the National Commission for Enterprises in the Unorganized Sector (NCEUS), the informal sector comprises all unincorporated private enterprises owned by individuals or households engaged in the sale and production of goods and services operated on a proprietary or partnership basis and employing fewer than 10 workers. Informal workers comprise those working in the informal sector or households, excluding regular workers with social security benefits provided by the employers and the workers in the formal sector without any employment and social security benefits provided by the employers (NCEUS 2008).
- Directory of Establishments data (2013–14) based on the 6th EC were spatially mapped at granular street address levels to gauge the geographical distribution and distance between establishments in Delhi NCR.
- GDP data were extracted from tables released by the Ministry of Statistics and Programme Implementation (MoSPI), economic survey reports of the participating states, and the Functional Plan for Economic Development of NCR released by Delhi NCR Planning Board.

- Data from the KLEMS (K, capital; L, labor; E, energy; M, materials; S, purchased services) India Database (released by Reserve Bank of India [RBI]) for the years 1991–92, 2001–02, 2011–12, and 2017–18 were extracted at the national level to gauge the efficiency of Delhi NCR’s leading industrial sectors across selected parameters.
- The Population Census (1991, 2001, and 2011) was accessed from the Office of the Registrar General and Census Commissioner, India, to gauge various demographic indicators pertaining to population growth, migration, gender-disaggregated movement of migrants, work participation rates, the occupational classification and education levels of workers and non-workers, and literacy levels by gender.
- National Sample Survey Office (NSSO) data rounds, Periodic Labour Force Surveys (PLFSs), and state economic survey reports were accessed to gauge demographic impacts such as unemployment rates, the credit-deposit ratio, per capita credits, the monthly per capita expenditure (MPCE), and the number of regular wage employees.
- Built-up data were extracted from the Global Human Settlement Layer (EU-JRC) and night-lights data from the Defense Meteorological Satellite Program, National Oceanic and Atmospheric Administration, and the Visible Infrared Imaging Radiometer Suite (VIIRS; NASA). This harmonized global night-time light dataset 1992–2018 was released through Sci Data 7, 168 (Li. et al 2020).

The collation and standardization performed on the above data sets for comparability and parameter derivation are explained in the “Methodology” section, with further details and assumptions provided in Appendix B. Data and findings from Delhi NCR regional plans, functional plans, and master plans of Delhi that supplement the analysis of this paper were also referred to extensively.

The 6th EC does not provide information on the number of establishments and the number of persons employed in crop production, plantation, public administration, defense, and compulsory social security. The agriculture category in the EC relates largely to livestock, poultry, and milk production. Hence, data from the economic tables of the Directorate of Census of India, which were released for 2001 and 2011 and provide the number of workers by industrial classification, were extracted. The EC does not cover informal sector workers such as laborers on casual

wages; household members engaged as domestic servants, drivers, and so on, who undertake jobs for others on wages; household members engaged in household chores; persons doing different type of jobs, such as loading, unloading, and helping a mason or carpenter; households depending on remittances, rent, interest, or pension; and establishments run by nomads.

The impacts of COVID on Delhi NCR’s economic structure have not been addressed by this study because although the data used were the latest available, they pre-date the pandemic and its effects. One of the limitations of the study is the non-availability of latest data from the Office of the Registrar General & Census Commissioner, India and Central Statistics Office, Ministry of Statistics & Programme Implementation.

Detailed literature reviews were also conducted using secondary sources such as articles in peer-reviewed journals, websites, newspaper articles, reports of multilateral and bilateral agencies, and reports by private, nonprofit, and multilateral organizations, as documented in the References.



METHODOLOGY

Employing an economic geography/spatio-economic approach closely synergizes with urban planning because it is the interface of multiple disciplines such as geography, economics, urban and regional planning, management sciences, and public policy. All places do not rise or fall at the same time, because contrasting processes often occur across contiguous neighborhoods, cities, regions, and countries (Feldman and Storper 2018). The economic geography approach was hence chosen to analyze the large and complex region constituting Delhi NCR, which is the national and economic capital of India.

Delhi NCR comprises 30 districts according to the Census of India 2011, and all other data sets have been made comparable to this spatial unit for district-level analysis. Out of the 30 districts, 3 districts were split to form 3 new districts after the release of the Census of India 2011 data. This study has hence conducted assessments at the district boundary (administrative) scale in accordance with the Census of India 2011; this scale constitutes one of the primary units of disaggregated analysis in this research.

Time series employment data available from the EC have been used to assess employment contribution and percentage changes over the years in the primary, secondary, and tertiary sectors of the economy. Employment data from the Economic Census have been categorized into 26 key industries to maintain uniformity across the four databases (EC 3, 4, 5, and 6). “Public administration, defence and compulsory social security” and “Crop production and plantation” were dropped as categories from EC 6 due to data collection issues and hence were dropped as categories in this analysis due to non-comparability across time. However, GDP data released by government departments include these missing categories, and the employment data on “Public administration, defence and compulsory social security” and “Crop production and plantation” provided by the Population Census have been aggregated with the EC data to match the GDP sectors at the India and NCR levels.

These data have also been assessed separately in the section titled “Sectoral decomposition of Delhi NCR’s economic growth and contribution to GDP,” which discusses the composition of industrial sectors in Delhi NCR. Industrial categories falling under the primary, secondary, and tertiary sectors (given in Appendix B) were vital to achieving an understanding of how employment was transitioning across industries and where jobs were being created. From

an equity point of view, women’s participation over time in these sectors as well as ownership of establishments by the SC/ST and OBC communities were tabulated from the EC data.

Spatial analysis using geographic information system (GIS) and remote sensing techniques was conducted using time-series-based open source satellite imagery from various organizations to understand the spatial spread of built-up area and the spatial distribution of jobs. Data for this analysis were taken from the EC and the Directory of Establishments. Further, remote-sensing-based indicators such as night-lights and built-up area were computed for multiple time epochs roughly corresponding to the census years and for the most recent year for which the data were available to assess growth trends.

A location quotient (LQ) analysis was conducted. This analysis is a way of quantifying how concentrated a particular industry, cluster, occupation, or demographic group is in a geographic unit (such as a region) compared to the larger geographical area (such as the nation). LQ as a tool was used to measure Delhi NCR’s industrial specialization relative to a larger geographic unit (India) and later was applied to the delineated subregions within Delhi NCR relative to the whole NCR. LQ analysis is one of the ways of understanding the region’s competitive advantage in a particular industrial sector (Baer and Brown 2006; Niyimbanira 2018). In the Indian context, this tool has been used by several researchers such as Saikia (2011), Chandrasekhar and Sharma (2014), and Sridhar (2017) to assess industrial specialization. Further, the Herfindahl Hirschman Index (HHI) and unrelated variety (UV) measures using EC data were assessed to measure diversification and the extent of unrelated variation of the industrial sectors.

The India KLEMS Database is constructed at the national level with the support of the RBI to analyze productivity performance in the Indian economy at a disaggregate industry level. KLEMS refers to broad categories of intermediate inputs that are consumed by industries in their production of goods and services. This industrial classification is constructed by building concordance with the National Industrial Classification (NIC) Codes given by RBI, which hence allows KLEMS and EC data to be compared. This has allowed an efficiency assessment of NCR’s industries in this study across four indicators of growth: real value added, total factor productivity, labor productiv-

ity, and energy efficiency. Because the Agriculture sector in the KLEMS database and the EC database cannot be compared, it was dropped from the industrial efficiency assessments in this report.

Although a detailed analysis was conducted at the overall scale of Delhi NCR (which is over 55,000 sq. km in area) and comparisons of the region's specialization and efficiency were made with those at the national level, they were insufficient to understand the region's true dynamism as manifested by the economic changes within it. An assessment of what was transpiring within—that is, between the region's urban core (Core NCT), immediate periphery (CNCR Periphery), and rural hinterland (Rest of Region)—was therefore necessary.

Cores (in core-periphery theory) are often described as the central region in an economy. They have an advanced and diverse economic base, high levels of economic vitality, are usually metropolitan in character, and are pioneering and innovative with good information flows (Friedmann 1967). They are associated with high wages and high technology, and dominate the periphery in the economic sphere. Peripheries, on the other hand, are understood as being subordinate to the core and are often the social, economic, and political backyards of the region (Klimczuk and Klimczuk-Kochańska 2019). As the distance from the core increases, the level of economic interaction and networking as well as the level of infrastructure services are expected to decrease, implying a negative correlation between development and distance. To understand and explain such economic exchanges better, further assessments were conducted of the three delineated subregions within Delhi NCR.

The three subregions were delineated for analysis keeping in mind the policy zones presented in the NCRPB's Regional Plans. Delhi NCT and its surrounding ring towns were initially part of the Delhi Metropolitan Area. Later, due to intense levels of interaction and interdependence and the stark distinction in terms of population size, density, and infrastructure provisions, the two areas became two different policy zones: Delhi NCT and the Central National Capital Region (CNCR). A third policy zone, which was predominantly rural and relatively backward in terms of industrial development, was also identified in the Regional Plan 2001. Subsequent regional plans also identified such policy zones, where Delhi NCT continued to be one defined policy zone, and the spatial extents of the other policy zones were expanded based on the development trends. Additional policy zones such as highway

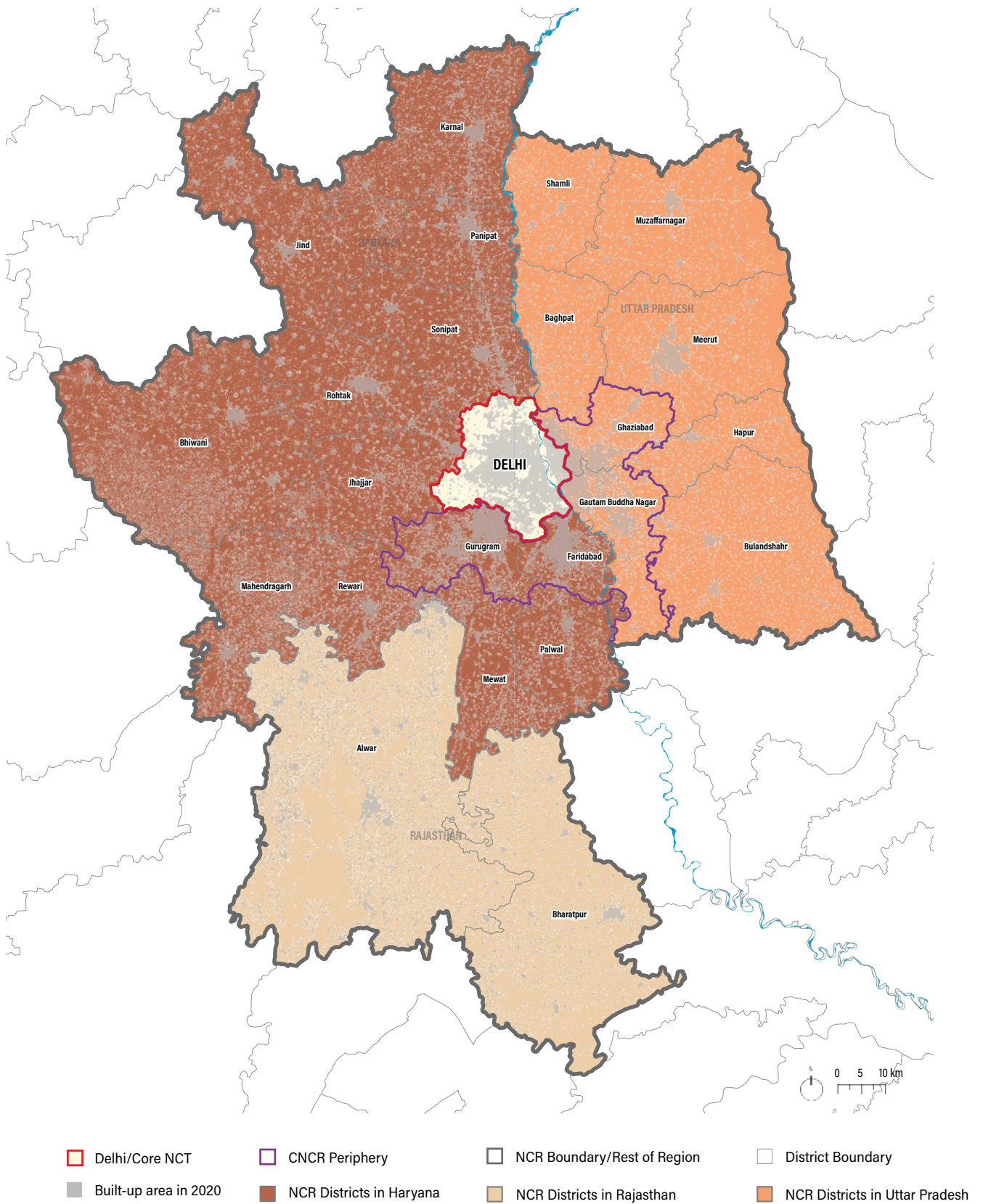
corridor zones and conservation zones were also identified in the subsequent regional plans. The NCRPB's policy zones largely follow the NCT, CNCR, and Rest of NCR classification, with various policy moves and decentralization agendas made over time reflecting these divisions (see Table A-2, Appendix A).

Considering factors such as the proximity to Delhi city; connectivity by metro rail, which significantly influences the level of economic interaction between the regions; and the percentage of urban population, this study delineates the following three subregions, which are defined by district administration boundaries (see Figure 1):

- **Core NCT:** This is Delhi NCT, which has the highest percentage of urban population (over 98 percent urban in 2011) and is the seat of the national government.
- **CNCR Periphery:** This is the CNCR, which includes the districts of Gurugram and Faridabad in Haryana, and Ghaziabad and Gautam Buddha Nagar districts in Uttar Pradesh. The districts fall within a 50 km radius of the Core and were 69 percent urbanized in 2011. These districts accommodate the contiguous growth of Delhi's urban agglomeration and are connected by Delhi's Metro Rail service; hence, they are categorized as the Periphery.
- **Rest of Region:** The remaining districts of Delhi NCR, which fall in the participating states of Haryana, Uttar Pradesh, and Rajasthan and are largely rural, are considered as the Rest of Region. These districts are Karnal, Sonapat, Panipat, Rewari, Palwal, Mewat, Mahendragarh, Bhiwani, Rohtak, Jind, and Jhajjar in Haryana state; Baghpat, Meerut, Muzaffarnagar, and Bulandshahr in Uttar Pradesh; and Alwar and Bharatpur in Rajasthan. Panipat, Rohtak, and Meerut are larger urban centers but fall beyond the 50 km radius of influence. They are not connected by metro rail and are not contiguous to the Core; hence, they fall in the Rest of Region.

Other studies too, such as Morya and Ram (2020), support this delineation. They note that Delhi's urbanization process had highly influenced the growth of the towns located within a radius of 50 km from the core of Delhi, whereas the urban influence³ decreases as the distance from the Core increases. A World Bank study (World Bank 2013) indicated that the area within a 50 km radius of the city center, which is the distance that can be traveled in two hours or less, is approximated as the extent of economic interactions within an urban area. However, this "2-hour

FIGURE 1 | Subregions in Delhi NCR delineated for the study



Note: NCR = National Capital Region
 Source: Data from NCRPB (2021).



distance” could increase with better transport networks or decrease with worse congestion. The study also suggests that it is in the 50 km economic shadow of seven cities (Mumbai, Delhi, Bangalore, Kolkata, Chennai, Hyderabad, and Ahmedabad) that a quarter of the urban population and 18 percent of the national employment is concentrated (World Bank 2013). Although the size of a labor market and how labor markets function are important contributors to economic growth (represented, for instance, by employment rates), it is the location of the labor pool and the distribution of job density across the region that determines the spatial extent of economic interactions in a region.

Demographic indicators are assessed to understand the relationship between industrial transformation and the demographic profile of the region. Assessments have been carried out at the regional scale as well as across Core NCT, CNCR Periphery, and the Rest of Region. Changes in the growth rate of the urban population, literacy rates, work participation rates, and the percentages of main and marginal workers (main workers are those who have worked for more than six months in a year, and marginal workers are those who have worked for less than six months in a year) are assessed using the primary census abstract data tables of 1991, 2001, and 2011. A detailed description of the formulas used and data sources are given in Table B-2 of Appendix B.

Using scatter plots, the relationship between various demographic indicators is interpreted and analyzed across Core NCT, CNCR Periphery, and the Rest of Region. Using data from the occupation classification tables, the types of jobs, such as professional, technical, and elementary jobs, are analyzed for 2001 and 2011. The migration pattern across three time periods, the reasons for migration, and the educational level of the migrants are assessed using the data sets from various migration tables released by the Census of India for 1991, 2001, and 2011. The educational level of workers and non-workers is analyzed for 2001 and 2011, using the data tables on industrial classification by educational level of the main workers released by the Census of India. To derive data for the newly created districts, an apportionment method is followed that is described in detail in Appendix B.

This section described the objective of the study and its methodology. The next section examines Delhi NCR’s economic growth by industrial sector and its contribution to the GDP.





CHAPTER 3

Sectoral decomposition of Delhi NCR's economic growth and contribution to GDP

At Delhi NCR scale, the industrial structure has largely followed a predictable historical trajectory, where the traditional subsectors such as "Trade" and "Textiles, textile products, leather and footwear," continued their dominance from the liberalization in 1991 to 2013–14. Although the tertiary sector's growth is boosting the region's gross domestic product (GDP), employment-intensive growth in the secondary and tertiary sectors has been low.

The vast region of Delhi NCR (over 55,000 sq. km) houses one of the most populous agglomerations in the world, and it is also India's leading economic activity hub. The total population residing in Delhi NCR was recorded as 58 million people in the Census of India 2011 and is estimated to have reached 71.8 million in 2021 (NCRPB 2021). The compounded annual growth rate (CAGR) of Delhi NCR population reduced from 2.9 percent between 1991 and 2001 to 2 percent between 2001 and 2011, which was lower than that of the country. Although the natural growth of the population has decelerated, migration into the large cities in the region has also declined, including into Delhi NCT. Whereas the population growth rate declined, the share of the urban population surged from 44 percent in 1991 to 55 percent in 2011 and is estimated to have reached 59 percent in 2021 according to the NCR Draft Regional Plan 2041. This section describes the nature of employment of this population in Delhi NCR and its contribution to the GDP.

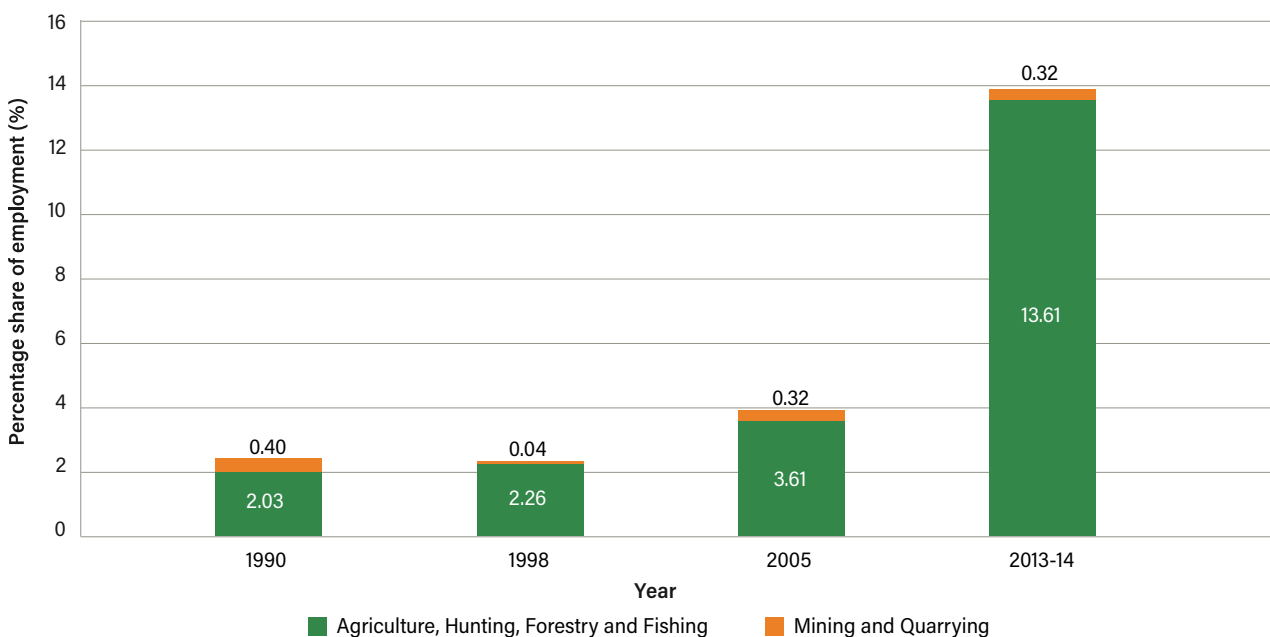
PRIMARY SECTOR: LIVESTOCK SECTOR BOOM

The primary sector, which broadly includes “Agriculture, forestry, and fishing” and “Mining and quarrying,” employed about 1.18 million people, which was about

14 percent of the total employment in Delhi NCR as recorded in the EC 2013–14 (see Figure 2). Out of this, 1.15 million were employed in the agriculture, forestry, and fishing subsectors, and less than 0.03 million were employed in mining and quarrying. Among the three sectors, the primary sector experienced the highest CAGR of employment, which was about 21 percent between 2005 and 2013–14. The employment share of the “Agriculture, forestry, and fishing subsector,” which is largely limited to the rural peripheries and meets the increasing urban consumption demands, was the second highest in the region in 2013–14 (see Table A-2 in Appendix A for the CAGR and employment shares of the leading industrial sectors in Delhi NCR).

The employment share in the primary sector shot up remarkably due to the increase in employment generation in the livestock sector (such as milk and meat production), whereas the hunting, forestry, fishing, and mining sectors experienced negligible growth between 1990 and 2013–14. A plausible explanation for the sharp increase in the livestock sector is the contributions made by Haryana and Uttar Pradesh to the country's livestock sector. For instance, Haryana, with 60 percent of its rural population living in Delhi NCR, is among the three leading states⁴ in poultry and meat production in the country (Ministry of

FIGURE 2 | Percentage share of employment in the primary sector of Delhi NCR



Note: NCR = National Capital Region.

Source: Authors' analysis using data from Central Statistics Office (a) (n.d.).

Food Processing Industries (a) n.d.). Uttar Pradesh, on the other hand, is the largest producer of meat and milk in the country (Ministry of Food Processing Industries (b) n.d.).

During the period between 2005 and 2013–14, at the national level, non-agricultural establishments grew at the rate of 28.97 percent while agricultural establishments grew at the rate of 115.98 percent, within which the livestock sector was the major center of economic activity, contributing about 15 percent of the national employment in 2013–14 (Central Statistics Office 2016). However, one would expect to see a similar dominance of the livestock sector since the 1990s, which is not reflected in the EC data here and may be attributed to the limitations in the quality of the surveyed data.

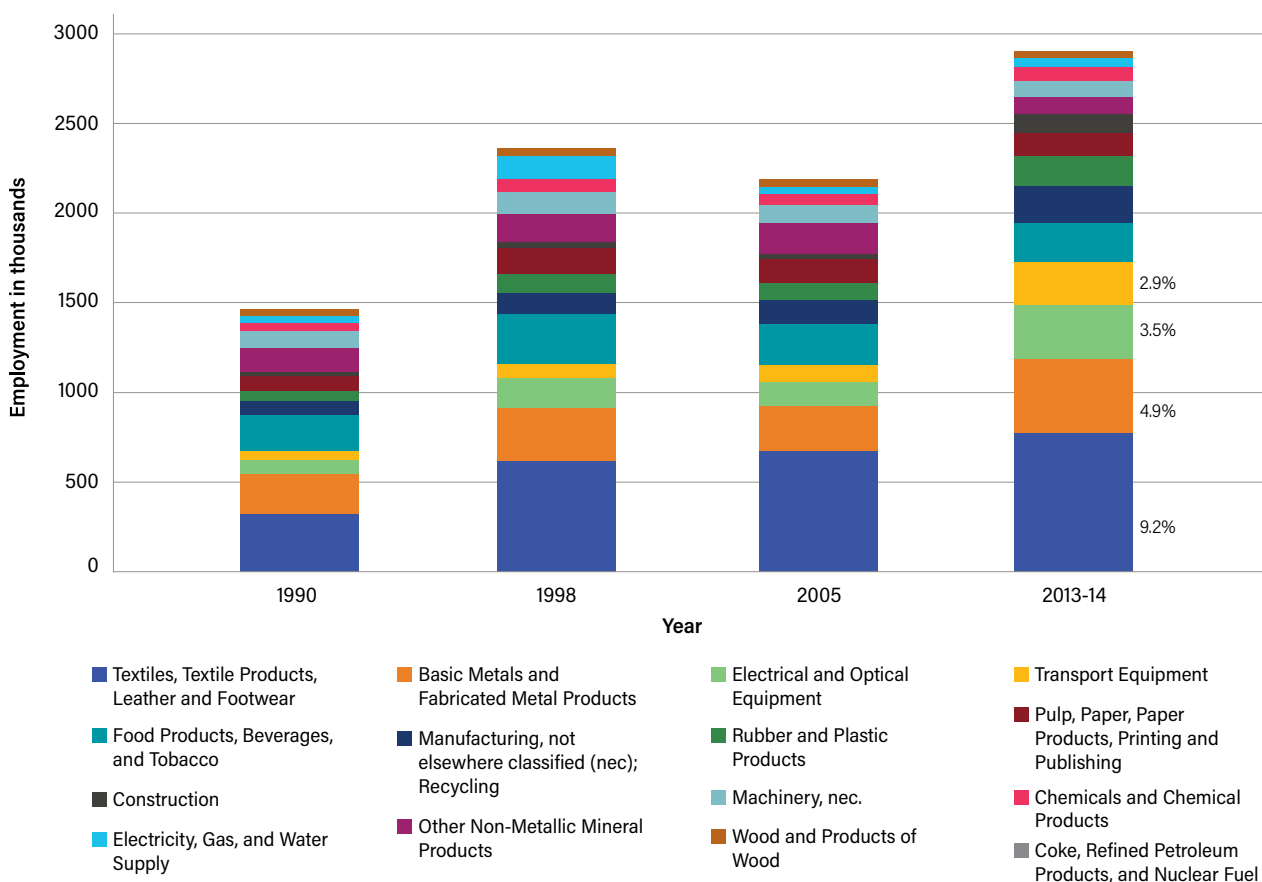
Although many positive social and economic outcomes are associated with increased livestock production, the sector is also responsible for negative environmental impacts

(Salman et al. 2019). The study noted that approximately 5 percent of the annual global greenhouse gas emissions is caused by direct emission from livestock production.

SECONDARY SECTOR: STEADY PRESENCE OF TEXTILES AND METALS

The secondary sector, which comprises the manufacturing and construction subsectors, employed about 2.9 million people in Delhi NCR, which was about 34 percent of the total employment in Delhi NCR as recorded in the EC 2013–14. The manufacturing subsector of the region is dominated by the textile industry followed by basic metals and fabricated metals production, electrical and optical equipment, and transport equipment, which together contributed about 21 percent of the total employment share of the region, as shown in Figure 3.

FIGURE 3 | Employment in the secondary sector (in absolute numbers) in Delhi NCR from 1990 to 2013–14



Note: nec = Not Elsewhere Classified.

Percentages specified in the graph give the share of the total employment in the region in the four major secondary sectors in 2013–14.

Source: Authors' analysis using data from Central Statistics Office (a) (n.d.).



The percentage share of employment of the relatively faster-growing sectors such as construction, transport equipment, and electrical and optical equipment, put together was less than 8 percent in 2013–14. Despite the lack of affordable shelter provision in the region (NCRPB 2021), the region has attracted many construction workers (for which official numbers are unavailable), who are mostly migrant laborers.

The region's industrial clusters are mainly in the textiles, automotive components, general engineering, and power loom subsectors in Meerut, Ghaziabad, Gautam Buddha Nagar, Bulandshahr, Gurugram, Faridabad, Panipat, and Alwar districts (NCRPB 2021). The functional plan on household enterprises in Delhi NCR⁵ noted that micro, small, and medium enterprises (MSMEs), especially the micro and small enterprises, provide employment to lakhs of workers including artisans and rural people in the region.

MSMEs in the manufacturing sector employed about 1.54 million workers in Delhi NCR in 2009 (NCRPB 2015). In the absence of data for the MSME sector in earlier time periods, it is difficult to assess its growth trends for Delhi NCR. The NCR Draft Regional Plan 2041 noted that high logistic costs, the high cost of land assembling, and the time-consuming land acquisition process are responsible for fewer investments from large manufacturing facilities in the region (NCRPB 2021). MSMEs in Delhi NCR face several hurdles such as delays on the part of the government in allotting land for industrial plots, lack of access to skilled laborers, lack of access to finance, and inadequate skilling programs for students to improve their employment prospects (Vasudevan 2020).

The prominence of the manufacturing sector in the economy did not get diluted in terms of its employment generation capacity. The ratio of the employment share in

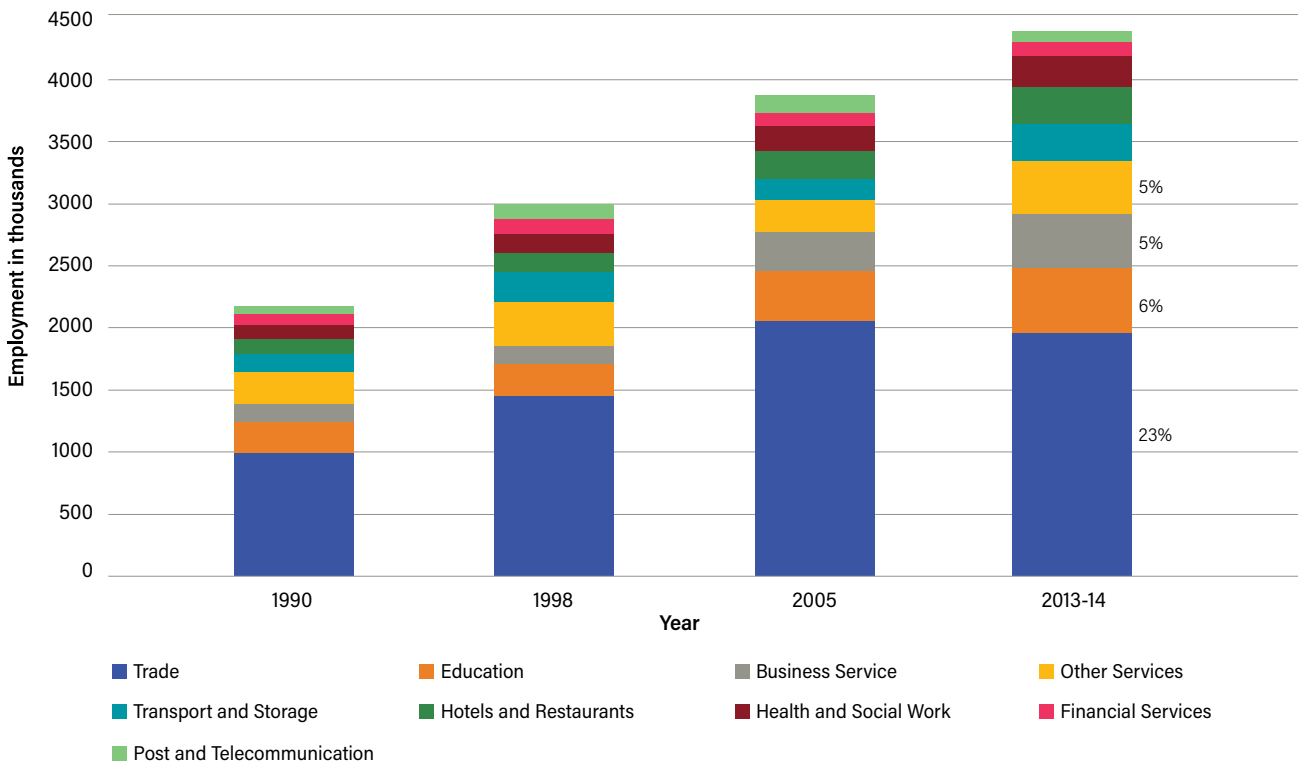
the manufacturing sector to that in all the non-agricultural sectors remained constant at about 0.33 in 2013–14, implying that a large share of employment continued to be generated by the secondary sector.

TERTIARY SECTOR: TRADE'S DOMINANT POSITION

The tertiary sector, the main economic driver of the region, employed about 4.38 million people, which was about 52 percent of the total employment in Delhi NCR as recorded in the EC 2013–14. The tertiary sector experienced a CAGR of only 1 percent between 2005 and 2013–14. The ratio of the employment share in the tertiary sector to that in all the non-agricultural sectors declined from 0.6 to 0.5 between 2005 and 2013–14; however, it has remained above 0.5 since the 1990s. Trade has been the dominant employment generator within the formal as well as the informal economy after Independence, one of the contributory factors being the political and administrative power of Delhi as the capital city. Trade contributed about 23.3 percent of the total employment in Delhi NCR in 2013–14. However, its employment share (both in absolute numbers and as a percentage share of the total employment) declined slightly after 2005.

Education, business service,^{6,7} other services,⁸ and transportation and storage were the other prominent employment sectors in the region, as indicated in Figure 4. Among the knowledge-based industries⁹ such as education, business services, financial services, and other services, education and business services were among the leading industrial sectors in terms of their employment share in 2013–14. Education and business services contributed about 6 percent and 5 percent, respectively, of

FIGURE 4 | Employment in the tertiary sector in Delhi NCR (in absolute numbers) from 1990 to 2013–14



Note: Numbers in the chart are the percentage share of employment of the trade sector to the total employment in Delhi NCR. Other services include real estate, libraries, archives and other cultural activities, sports activities, activities of membership organizations, and so on.

Source: Authors' analysis using data from Central Statistics Office (a) (n.d.).

the total employment in Delhi NCR in 2013–14. However, these sectors experienced a declining trend in their CAGR between 1998 and 2005 and between 2005 and 2013–14. Several warehousing facilities emerged along the major transport corridors in Delhi NCR, and phenomenal growth in employment in the transport and storage sector occurred between 2005 and 2013–14 (see Table A-2 in Appendix A).

The region has several prominent industrial parks, such as the Software Technology Park of India in Noida, Shastri Park in Delhi NCT, and Delhi Land and Finance (DLF) Cyber City and World Tech Park in Gurugram, that cater to the knowledge-based industrial sectors in the region (NCRPB 2016). Among all the states in the country, Delhi is reported to have the largest share of skilled workforce qualified for knowledge-based economic activities such as IT/Information Technology Enabled Services (ITES), designing, R&D, and financial services (IBEF 2022), contributing significantly to the labor pool of the region. Delhi NCR has about 14 percent of the Global Inhouse

Centers (GICs) in the Engineering, Research and Development (ER&D) ecosystem and houses about 12 percent of the country's GIC talent pool (NASSCOM 2019). In the tertiary sector, according to the Census of India 2011, workers in the "Public administration and defense and compulsory social security" sector constituted about 6.32 percent of the total workforce of Delhi NCR in 2011.

INFORMAL SECTOR: STRONG COMPLEMENTARITY

A strong complementarity exists between high-wage and low-wage workers; the latter often fall in the informal segment of the labor market (Storper and Scott 2009). Storper and Scott (2009) noted that low-wage workers, who are often immigrants and an undocumented segment of the labor markets, are the critical foundation of urban life, especially in large, economically dynamic metropolitan

areas, because they are involved not only in basic production activities but also in work as caretakers, security guards, transport workers, short-order cooks, and child minders. It is these workers who maintain the networks, infrastructures, and services that help run the entire urban system (Storper and Scott 2009).

The informal sector in Delhi NCR can be classified into three types, based on either the size/type of the unit or the type of employment the sector provides. The first type consists of micro and small units located in the vicinity of organized large industries, for whom they primarily serve as subcontractors. The second type consists of units that produce specialized products such as artisanal pottery and ceramics in places such as Khurja in Uttar Pradesh (NCRPB 2016). The third type consists of service sector workers such as construction workers, petty traders, street vendors, and other home-based service providers. Within the region, Delhi NCT has the highest concentration of informal sector enterprises, followed by the Uttar Pradesh, Haryana, and Rajasthan subregions, which provided employment to about 5.87 million workers in the region in 2005 (NCRPB 2016). Meerut, Ghaziabad, Bulandshahr, and Delhi have several informal artisanal clusters producing leather footwear products, handmade rugs, zari work, hand-printed textiles, and lead-based articles such as lead hand gloves, lead alloys, lead-tin anodes, and so on (NCRPB 2016). Informal sector clusters in the districts of Jhajjar, Faridabad, Palwal, Rohtak, and Rewari are engaged in grass, leaf, reed, stone inlay and wood inlay, and metal work. Such informal sector enterprises have been providing abundant opportunities for self-employment to the migrants of the region. However, in the absence of comparable and comprehensive data on the informal sector, it is difficult to link employment growth in the informal sector with the evolution or transformation of the economic structure of Delhi NCR.

A World Resources Institute (WRI) paper noted that city officials often fail to recognize informal workers as key contributors to the urban economy; instead, they are stigmatized as tax defaulters and contributors to congestion and crime (Chen and Beard 2018). The World Bank noted that informality remains a major development issue because of its association with low labor productivity and limited access to capital and advanced technologies, poor working conditions and vulnerability, and a small tax base (World Bank 2022).

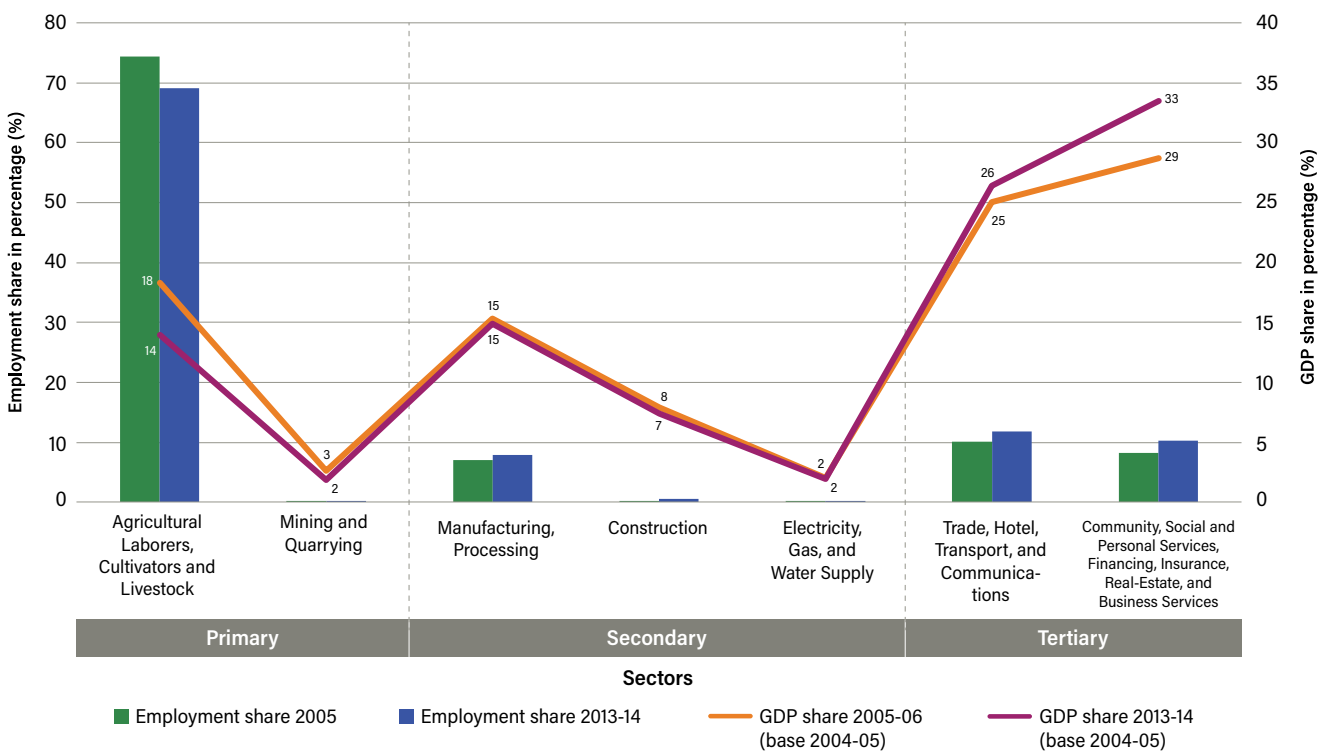
SECTOR-WISE CONTRIBUTION TO GDP: HIGH GROWTH WITH LOW EMPLOYMENT GENERATION

The approximated/projected GDP levels show that Delhi NCR mimics the Indian economy scenario when one considers the elements of employment as well as GDP across the key industry categories. At the national level, the total employment grew by 0.3 percent annually between 2005 and 2013–14, while the GDP grew at 7 percent annually between 2005–06 and 2013–14. In Delhi NCR, the total employment grew at 2 percent annually between 2005 and 2013–14, while the GDP grew by 11 percent annually between 2005–06 and 2013–14.

The primary sector's GDP contribution to the Indian economy remained the lowest (16 percent of the total GDP) among the three sectors, whereas its employment share was recorded as close to 70 percent of the total employment of the country in the 2013–14 period (see Figure 5). The primary sector's GDP contribution to the Indian economy declined over time, although its employment share remained significant over the same period. Delhi NCR's economy also showed a similar trend, wherein the primary sector's GDP contribution continued to fall over time (it declined from 9 percent to 5 percent), yet it continued to generate a significant share of employment (49 percent in 2013–14) despite showing a declining trend between 2005–06 and 2013–14, as shown in Figure 6.

The secondary sector's GDP contribution to the Indian economy was recorded as 24 percent, and its employment share was 9 percent in 2013–14. Within the secondary sector, the manufacturing sector's GDP share to the Indian economy remained at 15 percent between 2005–06 and 2013–14, and the corresponding employment share marginally increased by 1 percent (from 7 percent to 7.97 percent) during this period (see Figure 5). Delhi NCR's manufacturing sector's GDP contribution declined from 17 percent to 13 percent between 2005–06 and 2013–14, whereas its share of the total employment increased by 2 percentage points (from 15 percent to 17 percent) from 2005 to 2013–14 (see Figure 6).

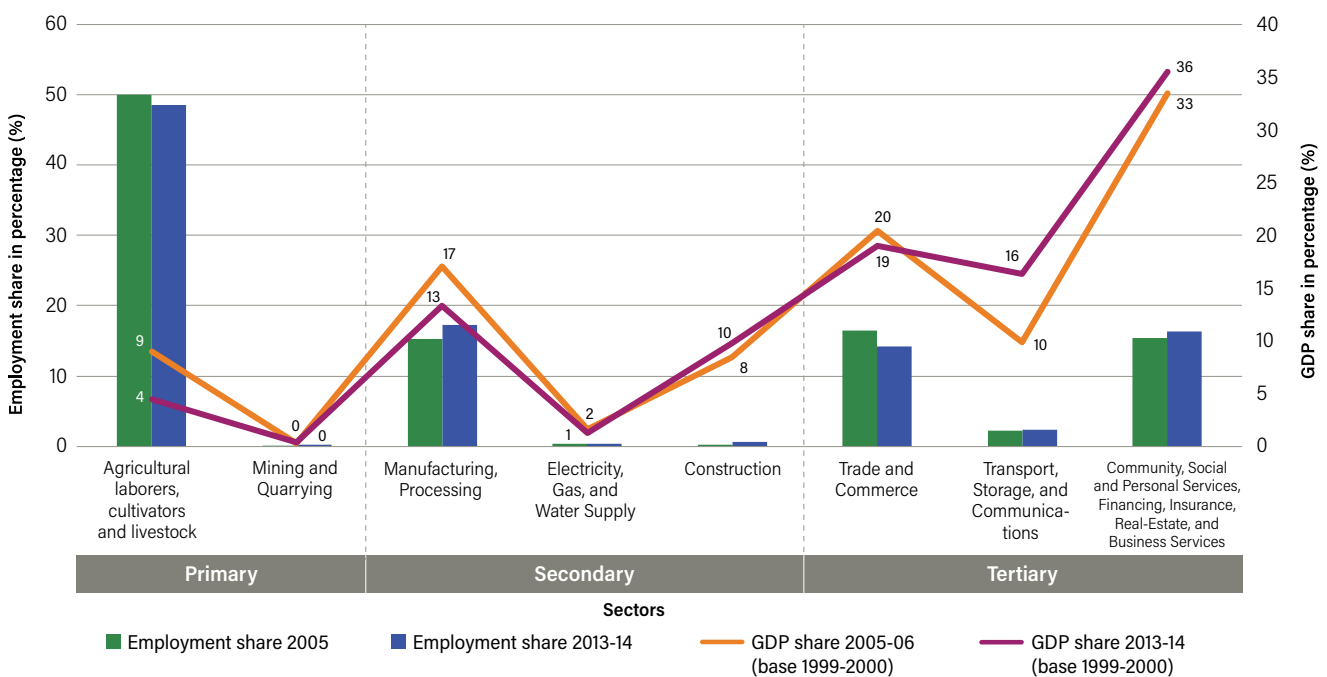
FIGURE 5 | Percentage share of employment and GDP contribution of various industries in India



Note: GDP = gross domestic product.

Source: Authors' analysis using data from Central Statistics Office (a) (n.d.) and Central Statistics Office (b) (n.d.).

FIGURE 6 | Percentage share of employment and GDP contribution of various industries in Delhi NCR



Note: GDP = gross domestic product; NCR = National Capital Region.

Source: Authors' analysis using data from Central Statistics Office (a) (n.d.); NCRPB (2016).

The tertiary sector's GDP contribution to the Indian economy was recorded as 22 percent in 2013–14, and its employment share was about 60 percent. Its employment share increased from 18 percent to 22 percent between 2005 and 2013–14, and its GDP contribution increased by 6 percentage points between 2005–06 and 2013–14. The tertiary sector's employment share (including “Public administration jobs” from the 2011 Census of India) in Delhi NCR, which was 34 percent in 2005, declined by 1 percentage point in 2013–14, whereas its GDP contribution increased by 7 percentage points, recording 71 percent in 2013–14. The employment growth in the tertiary sector in Delhi NCR was estimated as 1.24 percent (CAGR) between 2005 and 2013–14, while the growth in the GDP was estimated as 12 percent (CAGR) during this period (see Figure 6).

From the sector-wise composition assessment, the tertiary sector is the dominant economic driver of the NCR, while the primary and secondary sectors within the region continue to play pivotal roles in enhancing its economy. After liberalization, the traditional tertiary subsectors such as trade continued to dominate in the region, whereas knowledge-based economies within the tertiary sector—other than business services and education—did not contribute significantly to employment or growth from 1990 to 2013–14.

From the assessments of the employment and GDP growth trends, it is evident that the economy of Delhi NCR is moving toward a services-driven economy where output growth is exceeding employment generation, confirming a slow job growth pattern in the region. This low-job growth trend has been associated with a rise in unemployment rates and declining workforce participation rates in the region and across the subregions, which is discussed in detail in the later section titled “Employment and income levels.” Such trends in job growth are evident in the case of the economic growth of the country as well, where the change in production structure from agriculture to services has not translated into a proportionate change in the occupation structure (Mukherjee 2013). Joblessness, which is the state of being unemployed, was reported to be about 8 percent in 2021 in the country (S. Biswas 2021).

This section examined the industrial sectors' contribution to economic growth and employment growth. The next section assesses the locational advantage of the industries in Delhi NCR with reference to India and efficiencies in terms of energy, productivity, and real value added.



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CHAPTER 4

Growth, specialization, and industrial efficiency trends in Delhi NCR

Delhi NCR specialized locationally in the manufacturing sectors of transport equipment, electrical and optical equipment, and rubber and plastic products when compared to the rest of India. Over the years, NCR's overall employment structure has improved to include more industries with high levels of industrial output and improved labor productivity.

Developing economies such as India have undergone an atypical structural transformation in which the manufacturing sector's contribution to the GDP has remained more or less stagnant over the past three decades, whereas services and trade have expanded rapidly. In fact, the declining contribution of agriculture to the economy has been compensated by the increasing contribution of the tertiary sector/services rather than that of manufacturing (Dougherty et al. 2009; Goel and Echavarría 2015). Lin and Treichel (2014) note that when economies expand into modern manufacturing industries, firms need highly skilled workers and large funds for investments in equipment. Working capital and new marketing arrangements are required, such as subsidizing activities for industrial upgradation, coordinating investments in related industries, and catalyzing the development of new industries by incubating them. To overcome the coordination and externality issues that are inherent to the development of new activities and sectors, governments must play a proactive and facilitating role to enable an economy to transition from one stage to another (Lin and Treichel 2014).

ECONOMIC GROWTH AND REGIONAL SPECIALIZATION

LQ analysis is a way to check whether a particular industry has a competitive advantage in that specific regional economy. An LQ higher than 1 implies regional specialization, whereas a number lower than 1 implies the lack of regional specialization. The LQs for Delhi NCR for the years 2005 and 2013–14 were assessed to understand the regional specialization across 26 industrial categories for Delhi NCR against the reference area of India (see Table 2).

The LQ analysis reveals that the dominant manufacturing industries of Delhi NCR that have high employment shares are transport equipment, electrical and optical equipment, basic metals, and rubber and plastic, and they also remained locationally specialized when compared to the rest of India. There was an upward movement in regional specialization for the manufacturing sector because it was also complemented by high job growth. The NCR Draft Regional Plan 2041 noted that industrialization is concentrated as follows: general manufacturing in the Uttar Pradesh subregion; automobile, electronics, and handloom manufacturing in the Haryana subregion; marble, leather, and textile sectors in the Rajasthan subregion; and the textile sector in Delhi NCT.

In the tertiary sector, the primacy of business services, which includes information technology and information-service-related activities as well as financial services, decreased in the region from 1.8 to 1.34 between the two reference periods (see Table 2). NCR Functional Plan 2016 notes that though the software industry started slowly, it has been catching up with other software hubs in the country. Start-up ecosystems have also received a policy boost in this region. “Post and telecommunication” and “Other services” gained more locational prominence, but it was still low compared to the manufacturing sector's dominance.

Between the two reference periods, while all the industries that had high LQ (>1) in the region experienced growth in their annual employment, the “Machinery, nec” and “Post and telecommunication” sectors experienced a negative CAGR, implying a reduction in the absolute number of jobs between 2005 and 2013–14. The region's LQ value in “Transport equipment,” which was the highest among all sectors and experienced a high CAGR of 11.46 percent between 2005 and 2013–14, reflected the prominence of the automobile and ancillary facilities in the region. After liberalization, when Maruti Suzuki's first manufacturing unit was established in Gurgaon, Delhi NCR evolved to occupy a prominent space in the automobile sector and has become a destination of choice for both vehicle and component manufacturers (Business Today 2011). Sectors that were not locationally prime to the region such as “Agriculture, hunting, forestry, and fishing” and “Construction” were the two leading industrial sectors in terms of CAGR between 2005 and 2013–14 and outperformed the national growth rates.

INDUSTRIAL EFFICIENCY INDICATORS

In this study, Delhi NCR's economic structure has been assessed from the points of view of employment growth, contribution to the GDP, and regional specialization over time. A further assessment is required to gauge whether Delhi NCR's industrial transformation and growth have been efficient in terms of various productivity factors and energy efficiency. Using the India KLEMS Database (RBI), which analyzes productivity performance in the Indian economy by disaggregating industry level, the top 10 employment sectors of Delhi NCR are gauged through four parameters.

TABLE 2 | Location quotient computed for 26 categories of industries and CAGR of India and Delhi NCR between 2005 and 2013-14

CATEGORIES	LQ 2005 NCR-INDIA	LQ 2013-14 NCR-INDIA	INDIA CAGR (2005 TO 2013-14) %	NCR CAGR (2005 TO 2013-14) %
Agriculture, hunting, forestry, and fishing	0.33	0.78	9.60	21.03
Mining and quarrying	0.52	0.75	-0.50	3.77
Food products, beverages, and tobacco	0.51	0.48	0.28	-0.83
Textiles, textile products, leather and footwear	1.29	1.25	2.38	1.66
Wood and products of wood	0.36	0.36	-0.72	-0.96
Pulp, paper, paper products, printing, and publishing	2.44	2.26	1.41	0.20
Coke, refined petroleum products, and nuclear fuel	0.94	0.57	5.43	-1.01
Chemicals and chemical products	1.14	1.15	2.89	2.62
Rubber and plastic products	3.21	3.78	4.88	6.55
Other non-metallic mineral products	1.34	0.83	-0.99	-6.97
Basic metals and fabricated metal products	2.07	2.24	5.66	6.29
Machinery, nec	2	3.07	-5.38	-0.80
Electrical and optical equipment	3.47	4	8.11	9.56
Transport equipment	3.48	5.33	6.38	11.46
Manufacturing, nec; recycling	0.97	1.15	3.67	5.37
Electricity, gas, and water supply	1.54	1.06	7.27	2.33
Construction	0.52	0.67	14.37	17.52
Trade	1.06	0.91	1.62	-0.55
Hotels and restaurants	0.89	0.75	5.76	3.31
Transport and storage	0.89	0.95	3.61	2.41
Post and telecommunication	1.43	1.48	-6.73	-6.60
Financial services	0.96	0.65	6.73	1.62
Business services	1.8	1.34	8.06	4.05
Education	0.81	0.78	3.72	2.94
Health and social work	1.13	1.06	3.61	2.41
Other Services	0.75	0.91	4.04	6.09

Notes: CAGR = compound annual growth rate; LQ = location quotient; nec = Not Elsewhere Classified.

Source: Authors' analysis using data from Central Statistics Office (a) (n.d.).

These parameters are:

- **Growth in real value added:** Real value added is considered an industry's output, whereas only primary inputs such as labor and capital are considered industry inputs. It reflects productivity and an industry's capacity to contribute to national income and final demand. Broadly, growth in real valued added indicates the growth in industrial output.
- **Growth in total factor productivity:** Total factor productivity, or multi-factor productivity, is used to measure the productivity that relates the aggregate output index to the aggregate input index, where the inputs are capital, labor, material, energy, and services. The service inputs include 14 input items: water supply, railway transport services, other transport services, storage and warehousing, communication, trade, hotels and restaurants, banking, insurance, ownership of dwellings, education and research, medical and health, other services, and public administration. This parameter shows how much of the observed rate of change of an industry's output can be explained by the rate of change of the combined inputs. It is a tool used to measure technical change by an industry. It shows the time profile of how productively combined inputs are used to generate the gross output. Growth in total factor productivity, or multi-factor productivity, is indicative of technically efficient industries and can be achieved through technological progress, change in costs, cyclical effects and so on.
- **Growth in labor productivity:** Labor productivity refers to the value added per person employed. Labor productivity changes reflect the joint influence of changes in capital and technical, organizational, and efficiency changes within and between firms; the influence of economies of scale; varying degrees of capacity utilization; and measurement errors. Growth in labor productivity implies labor efficiency. According to the International Labour Organization (ILO), the labor productivity of a country is a measure of the economic growth, competitiveness, and living standards within a country (International Labour Organization n.d.).
- **Growth in energy efficiency:** The share of energy input is the energy cost share of the gross output, where energy is considered an intermediate input, which includes coal and lignite, petroleum products, electricity, natural gas, and LPG. Growth in energy efficiency implies growth in the low-cost share on energy relative

to the output. Improvement in energy efficiency indicates improvement in the sustainable development of the region. One of the targets of the United Nation's SDGs is to double the global rate of improvement in energy efficiency by 2030 (United Nations n.d.).

The growth rate for the efficiency indicators in the KLEMS India database pertains to the reference period from 2011 to 2017–18, whereas the growth rates of employment for different periods have been computed annually.

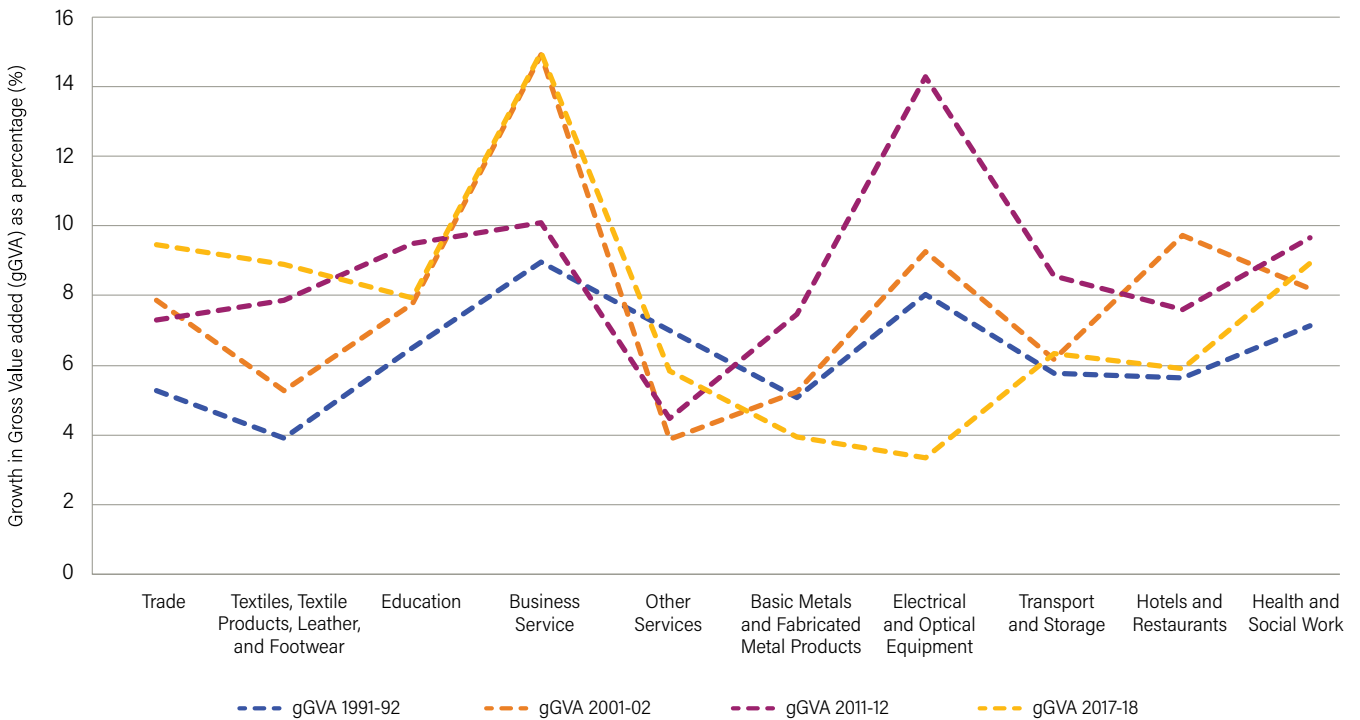
EFFICIENCY OF NCR'S LEADING INDUSTRIAL SECTORS

The interlinkages between employment and the various efficiency parameters are indicated in the next four graphs (see Figures 7 to 10) linking the top 10 non-agricultural-employment-generating sectors in Delhi NCR to the different efficiency parameters.

Trade has been the leading employment sector in Delhi NCR and has grown nationally in terms of industrial output/gross value added. However, the technical efficiency of the sector, represented by the growth in total factor productivity, has been declining over time and has become negative in 2011–12 and 2017–18. The growth in energy efficiency, which was previously negative, has improved slightly in 2017–18, implying a slow shift by the highest-employment-generating sector toward a sustainable path of economic growth.

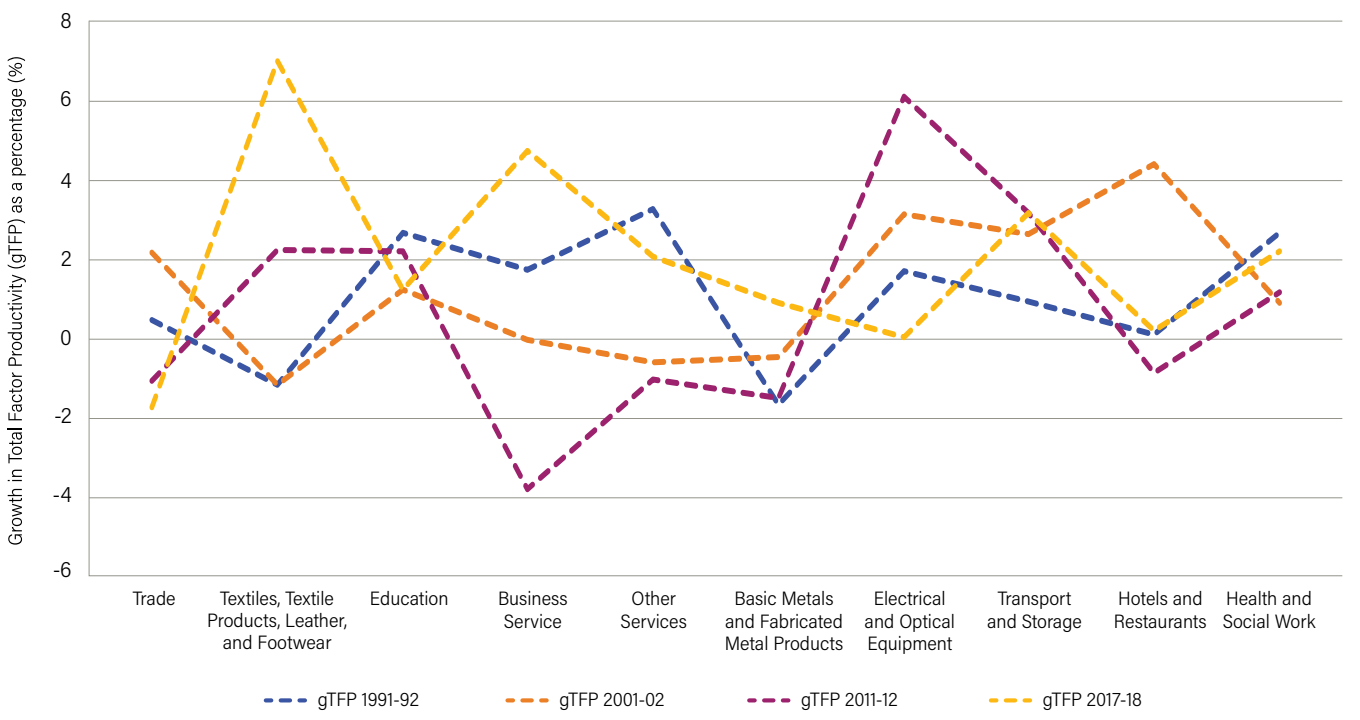
The textile industry, the second-largest employment generator in the non-agricultural sectors in Delhi NCR, is also a highly polluting industry.¹⁰ From an environmental point of view, the growth in energy efficiency of the textile sector improved relative to previous years from negative levels to positive levels of energy cost share. This sector showed a growth in value added, which increased from 4 percent to 9 percent between 1992–93 and 2017–18. The growth in industrial output to 9 percent in 2017–18, which is higher than the industry average (7.28 percent) in recent years, reflects its growing importance in the economy. This is complemented by an increased growth in labor productivity as well as high technical efficiency, which is higher than the average of all the other industries for India. The growth in labor productivity of the textile industry increased from 3 percent to 10 percent, and its growth in energy efficiency improved from –0.2 percent to 3 percent between 1992–93 to 2017–18.

FIGURE 7 | Top 10 employment sectors based on the growth in gross value added (1990 to 2013–14)



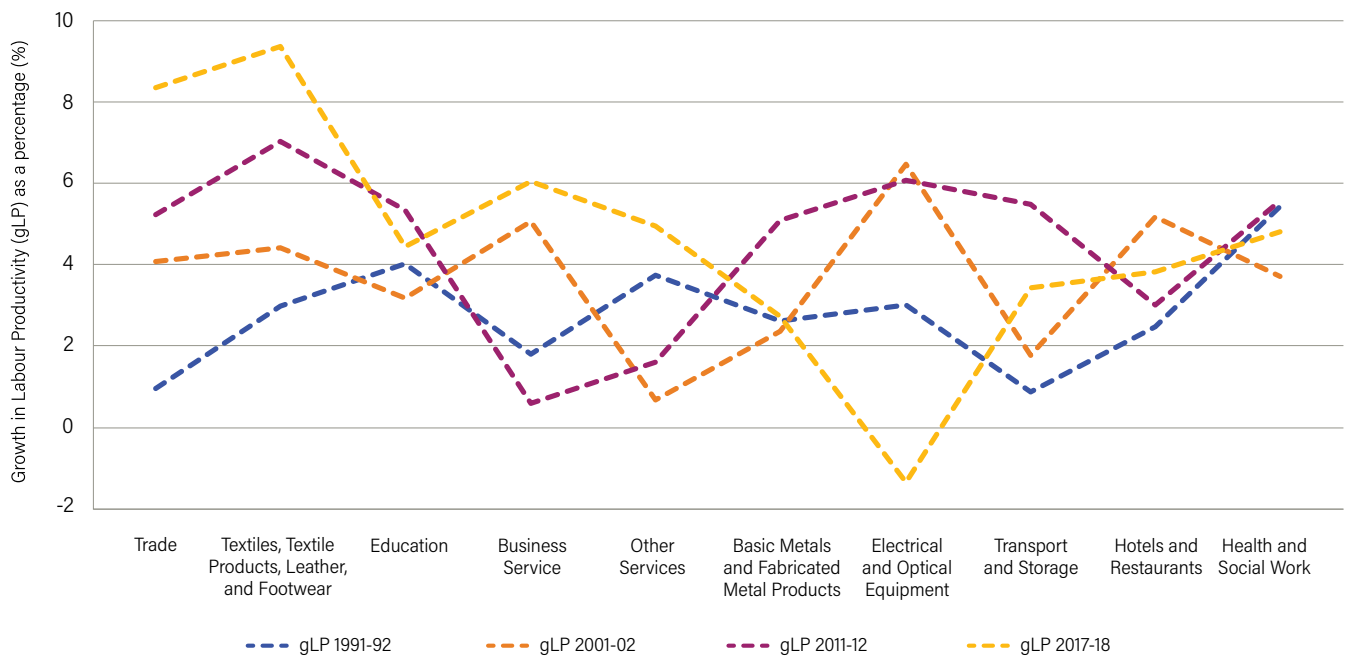
Source: Authors' analysis using data from Central Statistics Office (a) (n.d.) and Reserve Bank of India (2019).

FIGURE 8 | Top 10 employment sectors based on the growth in total factor productivity (1990 to 2013–14)



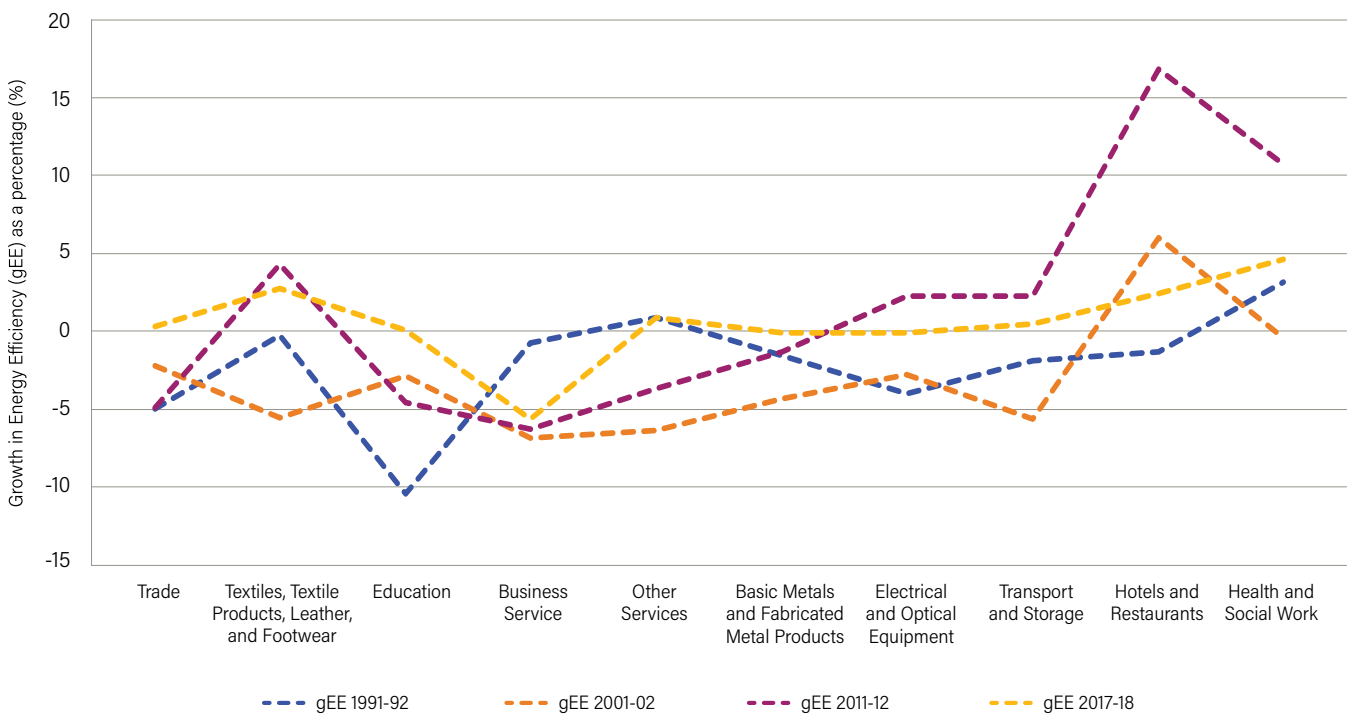
Source: Authors' analysis using data from Central Statistics Office (a) (n.d.) and Reserve Bank of India (2019).

FIGURE 9 | Top 10 employment sectors based on the growth in total labor productivity (1990 to 2013-14)



Source: Authors' analysis using data from Central Statistics Office (a) (n.d.) and Reserve Bank of India (2019).

FIGURE 10 | Top 10 employment sectors based on the growth in energy efficiency (1990 to 2013-14)



Source: Authors' analysis using data from Central Statistics Office (a) (n.d.) and Reserve Bank of India (2019).

The textile industry continues to remain important for the national economy, because this industrial sector meets the domestic demand and creates export linkages. The textile industry is a cause of concern for environmental reasons and due to its low wages and poor working conditions (International Labour Organization 2015). However, it is evidently an efficient sector nationally, responsible for more than 9 percent of the employment in Delhi NCR and 10 percent of the employment in Delhi NCT.

In the services sector, that is, in “Education,” “Business services,” and “Other services,” the increase in energy efficiency is nominal relative to that in the other industries. However, it important to note that the service sector’s energy cost share would be considerably low to begin with; therefore, an increase in energy efficiency to a level that is close to the national average indicates a movement toward environment-friendly process adoption in generating the services. The “Business services” sector experienced high growth in industrial output and exhibited high technical efficiency, but its energy efficiency decreased. “Education” and “Other services” showed some improvement across most of the efficiency indicators.

The output of the “Basic metals and fabricated metals products” sector has been increasing nationally; however, its technical efficiency and labor efficiency remained low. Within the basic metals industry, productivity and capital intensity vary across the size of enterprises and the type of metal industry. Therefore, although the overall industry exhibited a below-average trend in efficiency aspects, the inherent productivity of the sector remained high. Despite obstacles, the sector managed to improve its performance over the decade from 1999–2000 to 2009–10. At India scale, labor productivity was high in the micro, small, and large size classes of the metals sector, but not in the medium-size class, which showed a negative trend (P. K. Biswas et al. 2014).

The “Electrical and optical equipment” sector has been generating significant employment in Delhi NCR, but the growth in industrial output, which was initially high, dipped in recent years. Growth in real value added, technical efficiency, and labor efficiency also dipped. A report on Mission 2021–22 for this sector states that even though the productivity of this sector has been high, it remains relatively lower than that of the global players, making it less globally competitive (Department of Heavy Industry 2013). The report notes that although the electrical equipment industry requires almost 90,000 skilled workers every year, the large number of trained workers coming out of



technical institutes do not possess the required skills and are not employable in the industry. Although the sector’s energy efficiency improved over the years, there is a need to enhance industry–institute interaction to improve its labor efficiency.

The tertiary subsectors comprising “Hotels and restaurants” and “Health and social work” showed an upward trend in their value added/industrial output, energy efficiency, and labor efficiency from 1991–92 to 2017–18 at the national level. Hotels and restaurants improved marginally from 0.11 percent to 0.20 percent, and the health and social sector declined from 2.69 percent to 2.3 percent in technical efficiency during same period. The energy efficiency growth of these sectors rose steeply for a brief period in 2011–12, but declined thereafter. However, the reason for such peaks in values could not be understood using the methodology adopted in this study; this would require a detailed analysis of the KLEMS database, which is at the national level. This analysis could be included in any future study taken up for Delhi NCR.

The “Transport and storage” sector showed an upward trend in the overall growth in value added, total factor productivity, labor productivity, and energy efficiency between 1991–92 and 2017–18, though all the four indicators dipped between 2011–12 and 2017–18.

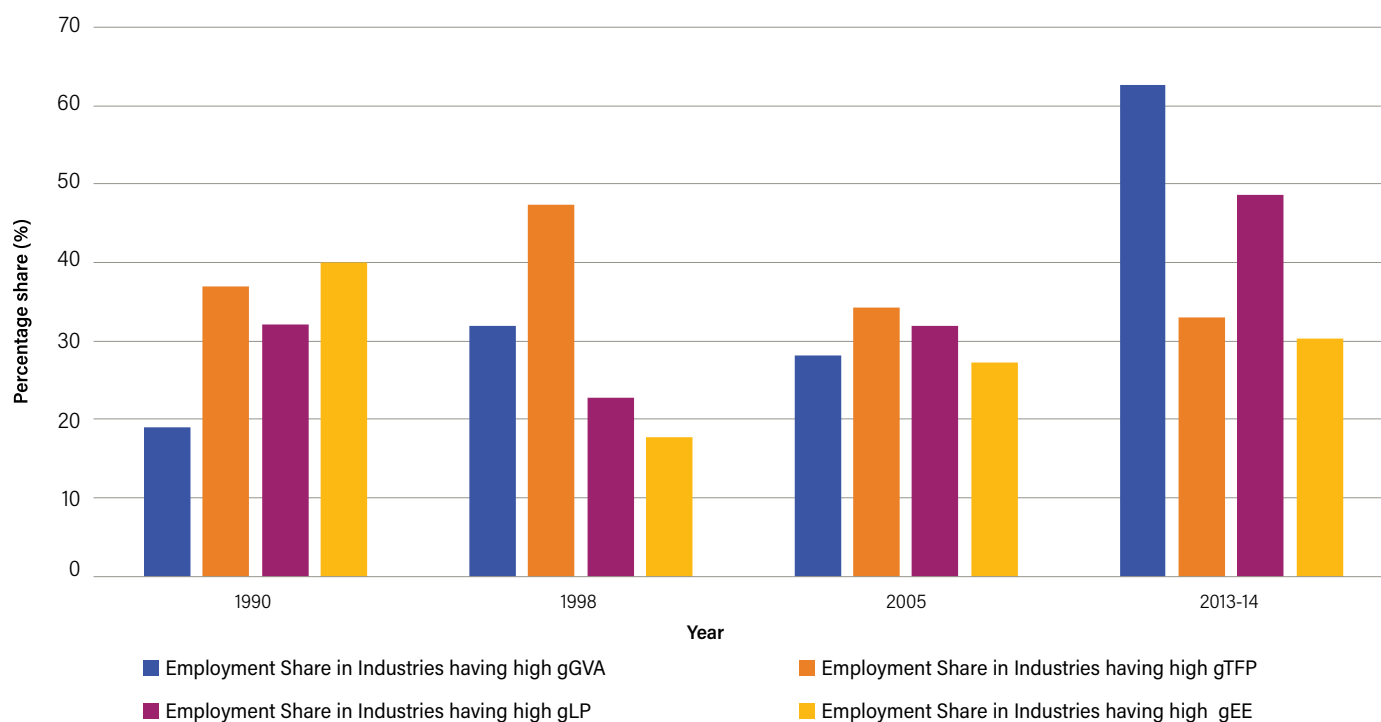
DELHI NCR'S OVERALL INDUSTRIAL EFFICIENCY TRENDS

In the 1990s, nine industrial sectors from the secondary sector and one industrial sector from the tertiary sector were among the 10 most efficient industries according to the composite efficiency measure. However, in 2013–14, “Health and social work” and “Hotel and restaurants” from the tertiary sector were among the 10 most efficient industries. In the 1990s, the tertiary sector had only a 1.65 percent employment share in the 10 most efficient industries, which increased to a 7 percent share in 2013–14. Employment generation in efficient industries, identified

based on the growth in the total factor productivity and labor productivity, was higher for Delhi NCR than for India in 2013–14, although the difference is not very large.

From the composite efficiency measure, the trend of the percentage share of employment indicates that 25 percent of employment in 1990 was contributed by the top 10 industries; this share rose to 34 percent in 2005, but dropped back to 27 percent in 2013–14. In 2013–14, about 30 percent of Delhi NCR’s employment was in industries that showed an improvement in energy efficiency (see Figure 11), which is lower than the national figure of 35.14 percent. Improvement in energy efficiency translates into benefits such as reduction in primary energy consumption, energy demand, energy costs, environmental pollution, and dependence on energy imports (Ziolo et al. 2020). Between 1990 and 1998, the percentage share of employment in industries that showed improved energy efficiency declined, but showed an increasing trend from 1998 to 2013–14. Growth in energy efficiency improved across

FIGURE 11 | Percentage share of employment in top 10 industrial sectors based on the four efficiency parameters (1990 to 2013–14)



Notes: gGVA = growth in Gross Valued Added; gTFP = growth in Total Factor Productivity; gLP = growth in Labor Productivity; gEE = growth in Energy Efficiency. The top 10 industrial sectors exhibiting high growth in GVA, TFP, LP, and EE for each year are used to show the employment shares in the graph.

Source: Authors' analysis using data from Central Statistics Office (a) (n.d.) and Reserve Bank of India (2019).



industrial sectors to some extent after 1998, although not in sectors such as “Business services,” which is concerning given its high output growth and contribution to the GDP. NCRPB noted that the manufacturing sector in Delhi NCT is small scale and low skilled, and does not invest sufficiently in technology upgradation and pollution control equipment. According to the Economic Survey Report of Delhi (Planning Department 2020), with the introduction of various environmental norms by the Central Pollution Control Board and Delhi Pollution Control Committee, industries not meeting with the safety standards would shut down or shift to neighboring states. Improvement in energy efficiency can be attributed to the policy instruments that have been devised in the Delhi Master plans and in Delhi NCR plans, which prohibit heavy and large manufacturing sectors in Delhi NCT. A list of 99 prohibited/negative polluting industries has been included in Delhi’s master plan to promote cleaner industries in the subregion.

Among the top 10 industrial sectors that showed high growth in technical efficiency, “Business services,” “Textiles, textile products, leather and footwear,” and “Transport and storage” were the leading industrial sectors, providing about 20 percent of the employment in 2013–14. Employment generation in efficient industries, identified from the growth in the total factor productivity and labor productivity, was higher for Delhi NCR than for India, although the difference is not very large. About one-third of the employment was in technically efficient industries. Similarly, about half of Delhi NCR’s employment in

2013–14 were in industries showing high growth rates in labor productivity, implying that industries relying on technology employed about half of Delhi NCR.

Industrial efficiency assessments from 1991–92 to 2017–18 show that Delhi NCR’s overall employment structure improved to include more industries with high levels of industrial output and improved labor productivity. Growth in technical efficiency and energy efficiency of industries in Delhi NCR, however, declined, implying that Delhi NCR’s industrial transformation did not make substantial gains in terms of sustainable development. NCR cities, including Noida, Ghaziabad, and Faridabad, have been listed in the world’s 10 most polluted cities, primarily due to industrial and vehicular pollution (Anand 2021). It is reported that most of the industries in Noida and Ghaziabad have not shifted to alternative fuels such as solar power or compressed natural gas (CNG) and continue to run on traditional diesel gensets (Anand 2021).

This section described Delhi NCR’s industrial transformation trends at the macro scale. The next section focuses on the growth trends of the built-up area and spatial distribution pattern of jobs and assesses the industrial transformation trends across the three subregions of Delhi NCR.





CHAPTER 5

Structural transformation across Core NCT, CNCR Periphery, and Rest of Region

Delhi NCR presents a case of complementarity between its subregions, because the jobs that moved out from the Core NCT were captured by the CNCR periphery and Rest of Region without getting expelled from the region.



SUBURBANIZATION TRENDS OF BUILT-UP AREA AND NIGHT-LIGHTS

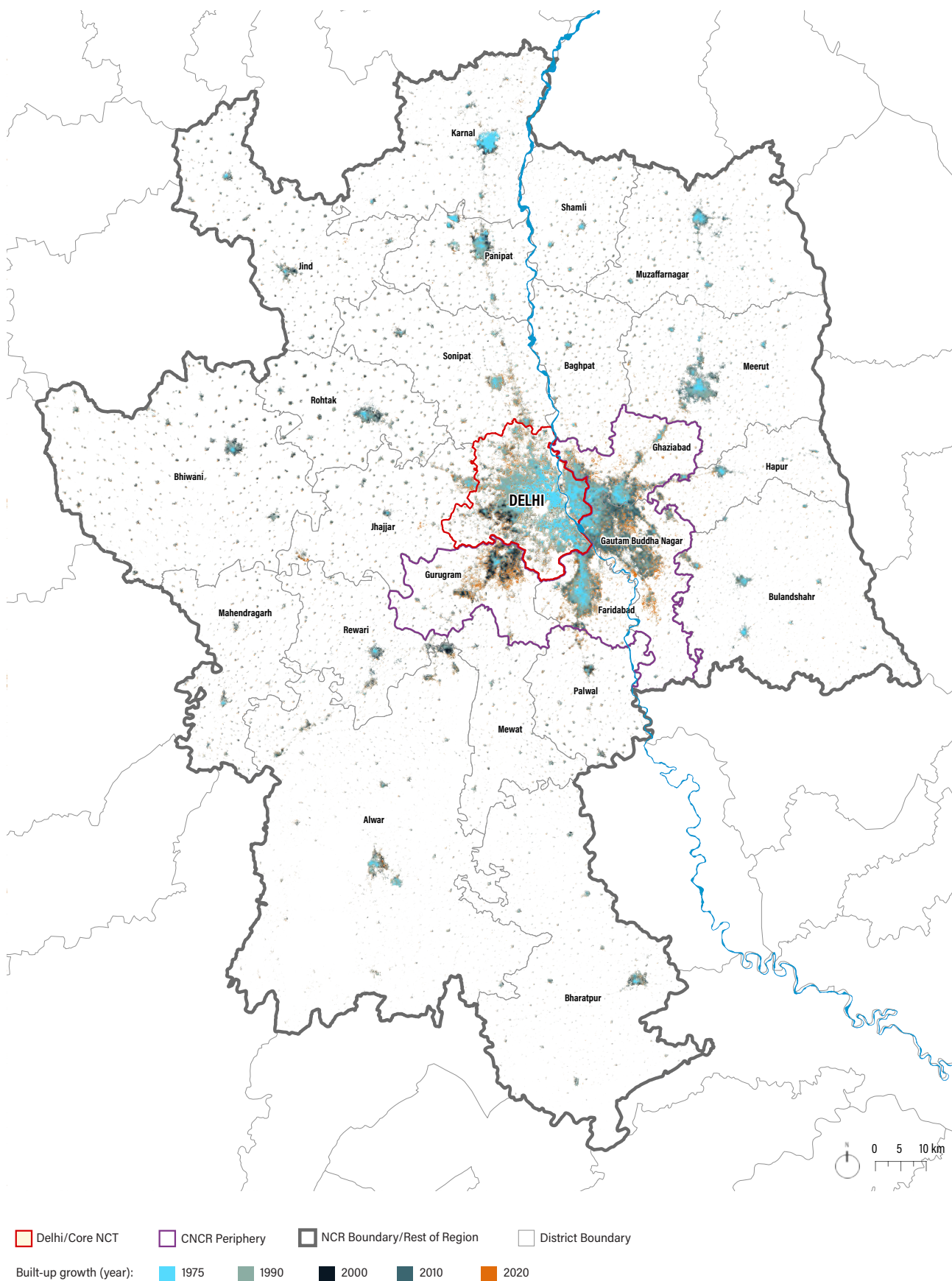
The growth dynamics in Delhi have unleashed a strong process of suburbanization in the hinterland (Kundu 2006). According to Jain et al. (2013), the spatial spread of NCT Delhi beyond its jurisdictional boundary has been due to factors such as restricted land use zoning and control regulations as well as the inefficient large-scale land acquisition and disposal policy, confirming the findings of a World Bank study. This study noted that the metropolitan suburbanization phenomenon in India is partly due to land management practices that impose stringent regulations on urban development densities, which have pushed firms and workers out of the cores (World Bank 2013). Newer developments proliferated on the city's peripheries that were part of the other participating states, Haryana and Uttar Pradesh. The operationalization of Delhi metro lines beyond the state boundaries triggered the outward expansion of the built-up area and reinforced the strong interlinkage with the peripheral towns for economic activities, housing, and other services.

A to-be-published WRI study, a comparative analysis of the employment density along the metro rail alignments of major metropolitan regions in India, found that about 70 percent of all jobs are located within a 1 km buffer along the Delhi metro transit line.¹¹ Spatial growth patterns along the Delhi metro corridor reveal that peripheral areas experienced an explosion of built-up area around the Delhi metro corridors (at a distance ranging from 1 to 5 km of a metro line) from 2010 to 2018 (Rana et al. 2022). A study of the impact of the Delhi metro on commercial property values noted that the metro induced a noticeable increase in commercial property prices within an impact zone of ½ km radius from the metro rail stations (Singhal and Tyagi 2021). The Delhi metro has improved the connectivity of peripheral towns and plays a significant role in transporting people across this region. Roads providing regional connectivity within Delhi NCR have experienced high levels of congestion, high traffic flow, and excessive delay and queuing on roads (DDA 2021). Taking note of the intensive development that transport networks trigger along their corridors, the NCR Draft Regional Plan 2041 recommended transit-oriented development zones extending from 800 m to 1 km on both sides of all rail transit corridors, expressways, and national highways, with their transit nodes serving as axes of urban densification.

As is visually evident from Figures 12 and 13, the horizontal expansion of Delhi NCT slowed down after the 1990s, whereas the peripheries witnessed a spurt in development. A plausible explanation for this slow horizontal expansion, as noted in the Delhi Master Plan's baseline report on shelter, was the prohibitive land costs in Delhi NCT and restrictions on land use zoning that allowed only single land use, which led to the suboptimal utilization of land in Delhi NCT (National Institute of Urban Affairs 2020). Contrary to core-periphery theories, which suggest that metropolitan suburbs have low political presence and hence low priority, these areas are the most attractive land for the adjoining states. Haryana adopted a public private partnership policy that boosted land development in Gurugram and Faridabad, which fall in the areas adjoining Delhi's state boundary. Uttar Pradesh developed Noida and Greater Noida as planned industrial townships, which triggered built-up area expansion outside the core toward the south-east. From 1990 to 2015, the built-up area of Delhi NCT grew by 32 percent, thus increasing the 1990 built-up area 1.3 times, while its adjoining peripheral areas, which fall in Gurugram, Faridabad, Gautam Buddha Nagar, and Ghaziabad districts, experienced a growth rate of 157 percent; that is, a 2.6 times increase in the 1990 built-up area. Gurugram, for example, witnessed a growth spurt between the years 1990 and 2000. The vertical expansion of built-up area in Delhi NCT would have been affected by single land use zoning and restrictions on the number of floors imposed by the master plans of Delhi from 1962 to 2013 (Vats 2022). However, the draft Master Plan for Delhi 2041 now allows vertical mixing of compatible uses and regeneration of building stock in Delhi NCT. In the absence of published data on the vertical extent of the built-up area over years, it is difficult to analyze the vertical growth trends, which would have given a different picture of the built-up area growth in both Delhi NCT and CNCR Periphery.

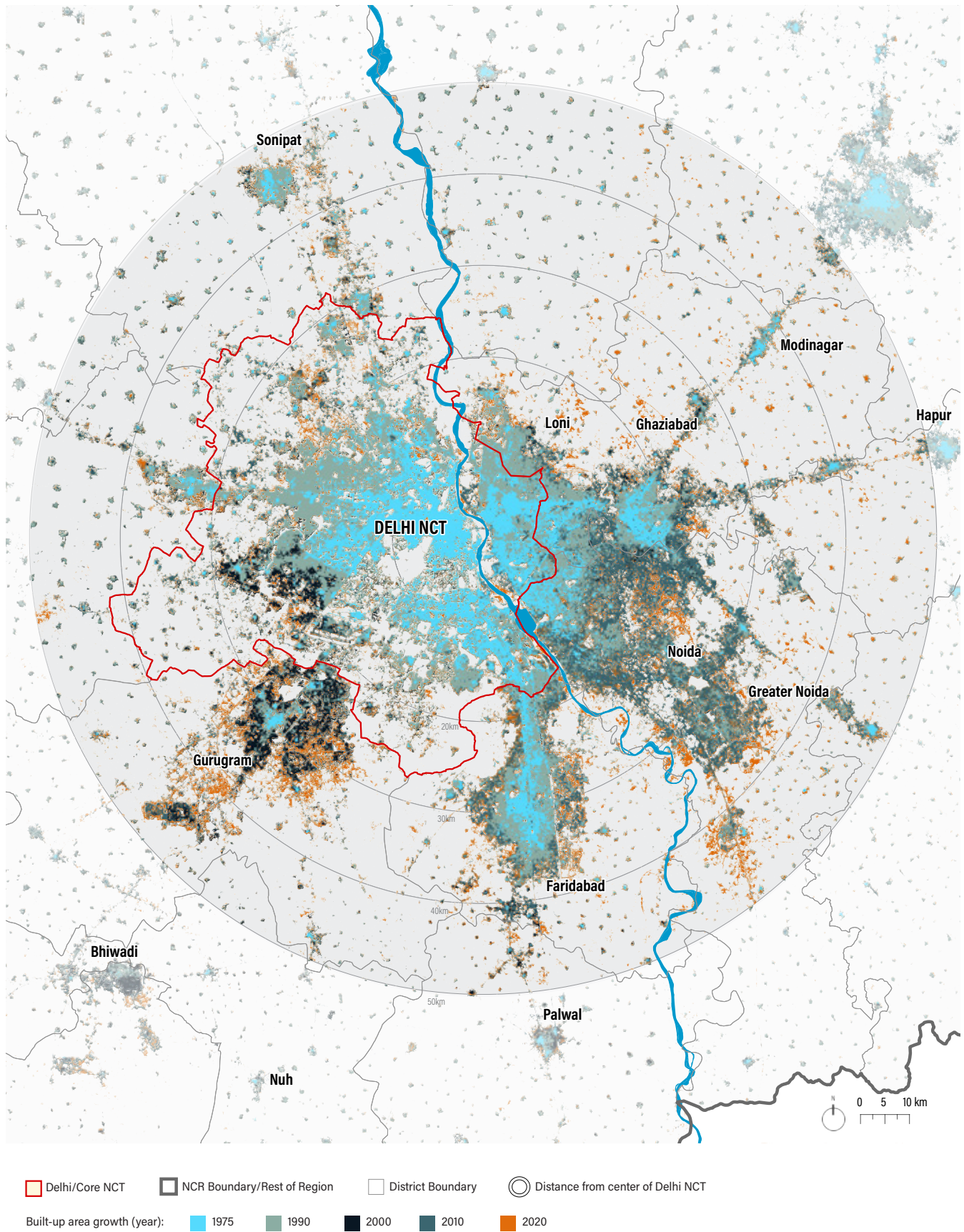
Satellite towns, which were concentrated growth nodes, transformed into corridors with development along the transport network, especially along national highways and regional railway lines (Jain et al. 2013). This suburbanization trend is confirmed by the night-light data of the region (Figure 14), which is used in several studies as a proxy for economic activity at the state or district level (Prakash et al. 2019). It is also used as a proxy to identify whether a piece of land is urbanized (Tewari et al. 2016).

FIGURE 12 | Built-up area growth in Delhi NCR (1975–2020)



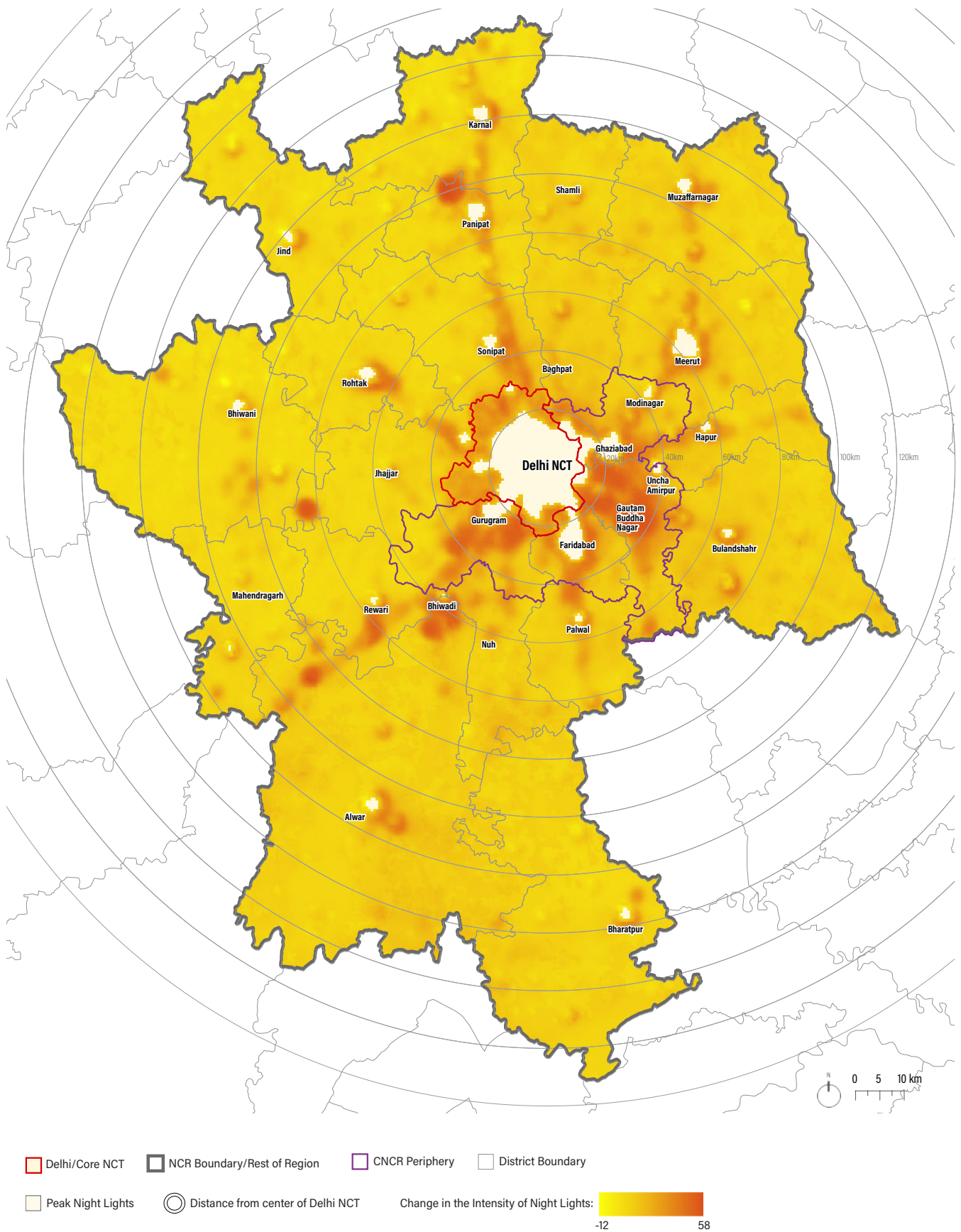
Source: Author's analysis using data from the Global Human Settlement Layer (EU-JRC) and OpenStreetMap (OSM); map prepared by WRI India.

FIGURE 13 | Built-up area growth in a 50 km radius around Delhi (1975–2020)



Source: Author's analysis using data from the Global Human Settlement Layer (EU-JRC) and OpenStreetMap (OSM); map prepared by WRI India.

FIGURE 14 | Variation in night-light intensity by distance from the center of Delhi NCT



Note: NCT = National Capital Territory.

Source: Author's analysis, using night-light data from Li et al. (2020); map prepared by WRI India.

Luminosity, which is measured by a digital number on a linear scale between 0 and 63, has the limitation that its upper limit is 63; this means that if an area is assigned a luminosity of 63, any further growth in the light would not be captured (Prakash et al. 2019). From the night-light mapping, it is evident that Core NCT, which is the urbanized core of Delhi NCR, has reached maximum luminosity; it has not exhibited any variation in night-light intensity over a 10 km distance from the center of Delhi since the 1990s. However, as one moves outward from the center of Delhi, variation in the night-light intensity is evident. Urban centers and their peripheries, nodes, and transport corridors have shown the maximum growth and change in luminosity, indicating a suburbanization of both urban and economic growth. Remote rural areas within Delhi NCR showed the least change.

DENSITY AND DIVERSITY OF JOBS BY DISTANCE FROM THE CORE

Using highly granular street-address-level data from the Directory of Establishments (2013–14), employment was mapped spatially across Delhi NCR (Figure 15). The tertiary sector establishments (bluish hues) are concentrated in Delhi NCT, with a clear outward presence in the peripheral towns (see Figures 16a and 16b). Manufacturing sector establishments (brown/yellow hues) are present across Delhi and its larger urban agglomeration with concentrations along the arterial corridors. This was also noted in the Economic Survey Report of Delhi, where retail trade, except that of motor vehicles and motorcycles before the COVID-19 pandemic, employed the highest number of persons in Delhi state (Planning Department 2020).

The other top five sectors in terms of providing employment in Delhi state were construction of buildings, land transport and transport via pipes and specialized construction activities, manufacturing of apparel, services to buildings and landscape activities, and education (Centre for Market Research & Social Development 2020). An audit report released in 2022 by the Comptroller and Auditor General of India gives an estimate of 10 lakh construction workers in Delhi state (Office of the CAG 2022). Sectors such as basic metals, machinery, electrical and optical equipment, and transport equipment, which are predominantly along transport corridors such as the Delhi–Gurugram–Manesar corridor, signifies the need for access and proximity to Delhi NCT.

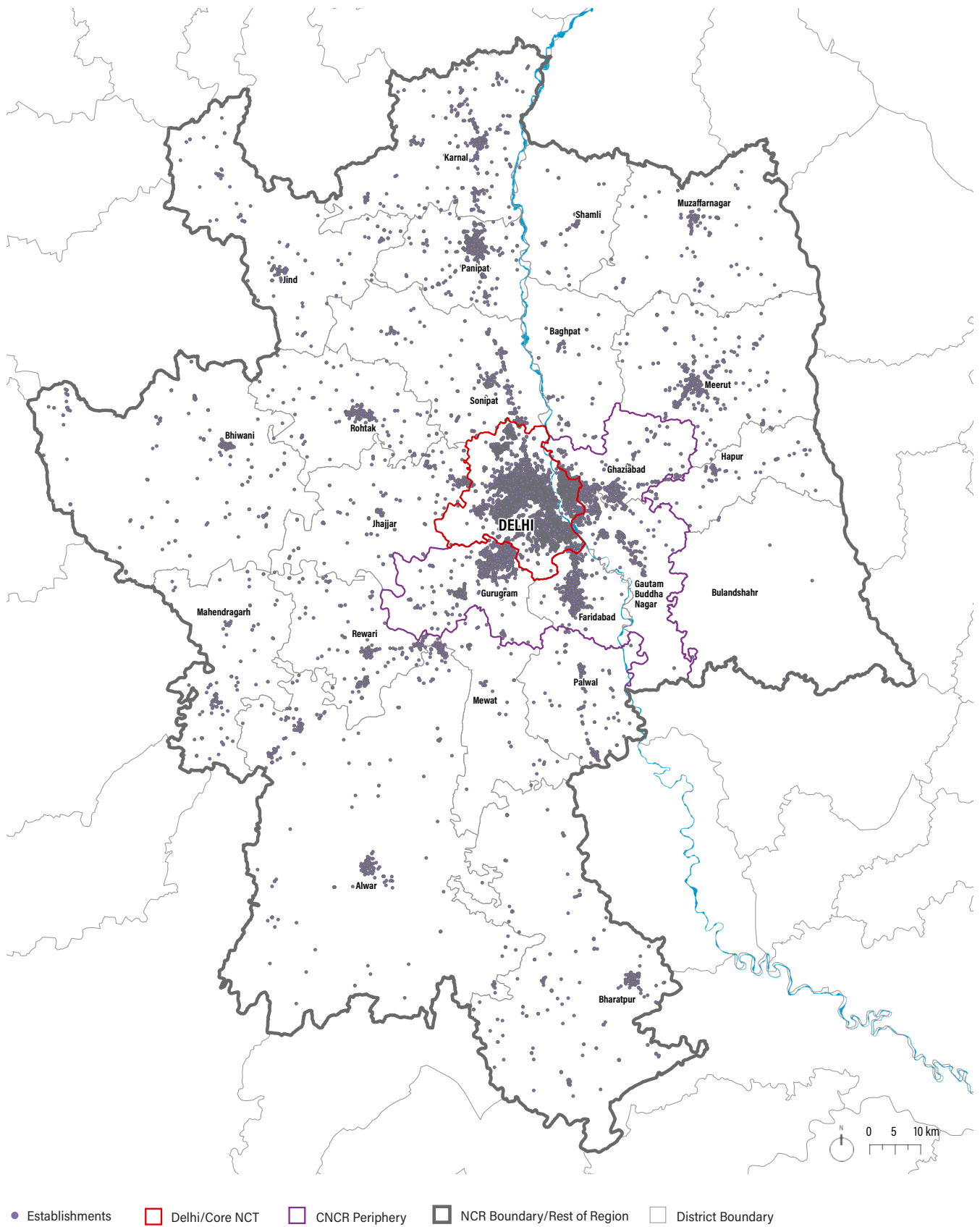
Granular data from the Directory of Establishments (2013–14) were then plotted by radial distance from the urban core (see Figures 15, 16a and 16b) to analyze the density and extent of diversification of jobs in the region. Within Delhi NCR, the highest density of jobs recorded was 5,000 jobs per sq. km in the first 10 km radius from the urban core of Delhi NCT. The number of jobs in the next 40 km radius is also significant, as it houses close to 3,200 jobs per sq. km. However, as the radial distance increases beyond 50 km, there is a reduction in the number of jobs per sq. km, as shown in Figure 16b.

Unevenness is evident in the type of industrial sectors present across the region. Tertiary sector establishments (blue hues) are concentrated in Delhi NCT with clusters in Gurugram and Noida. With the onset of globalization, Delhi NCT restructured its central and subcentral districts, which resulted in the transformation of many of its residential areas into commercial spaces to accommodate branch offices of multinationals, domestic companies, and financial institutions (Jain et al. 2011). The number of jobs represented per sq. km across the various industrial sectors (Figure 16a and 16b) shows that trade, which is considered one of the most centralized employment sectors (Sridhar 2004), dominates; other service sector jobs such as business services, financial services, and commercial services are concentrated within a 10 km distance from the center of Delhi.

Such diversity in industrial sectors is further noted at 20, 30, and 40 km distances from the center of Delhi NCT. It is observed that as the distance from Core NCT increases, the diversity of industries is reduced, with most of the jobs concentrated in agricultural sectors beyond 80 km from Delhi NCT.

A World Bank report noted that irrespective of the geographic scale, the geographic distribution of economic activity is uneven, and a hierarchy of density¹² exists that is constituted by a primary city at the top and agricultural land or rural areas at the bottom with a continuum of settlements of varying density between the top and the bottom regions (World Bank 2009). These settlements of different sizes are all linked through their complementary functions, and mutually beneficial links exist between these settlements. Proximity to density—that is, distance—affects the spatial movements of goods, services, information, knowledge, and people between two locations, and areas that are closer to the economic density enjoy easier access to beneficial interactions and exchanges.

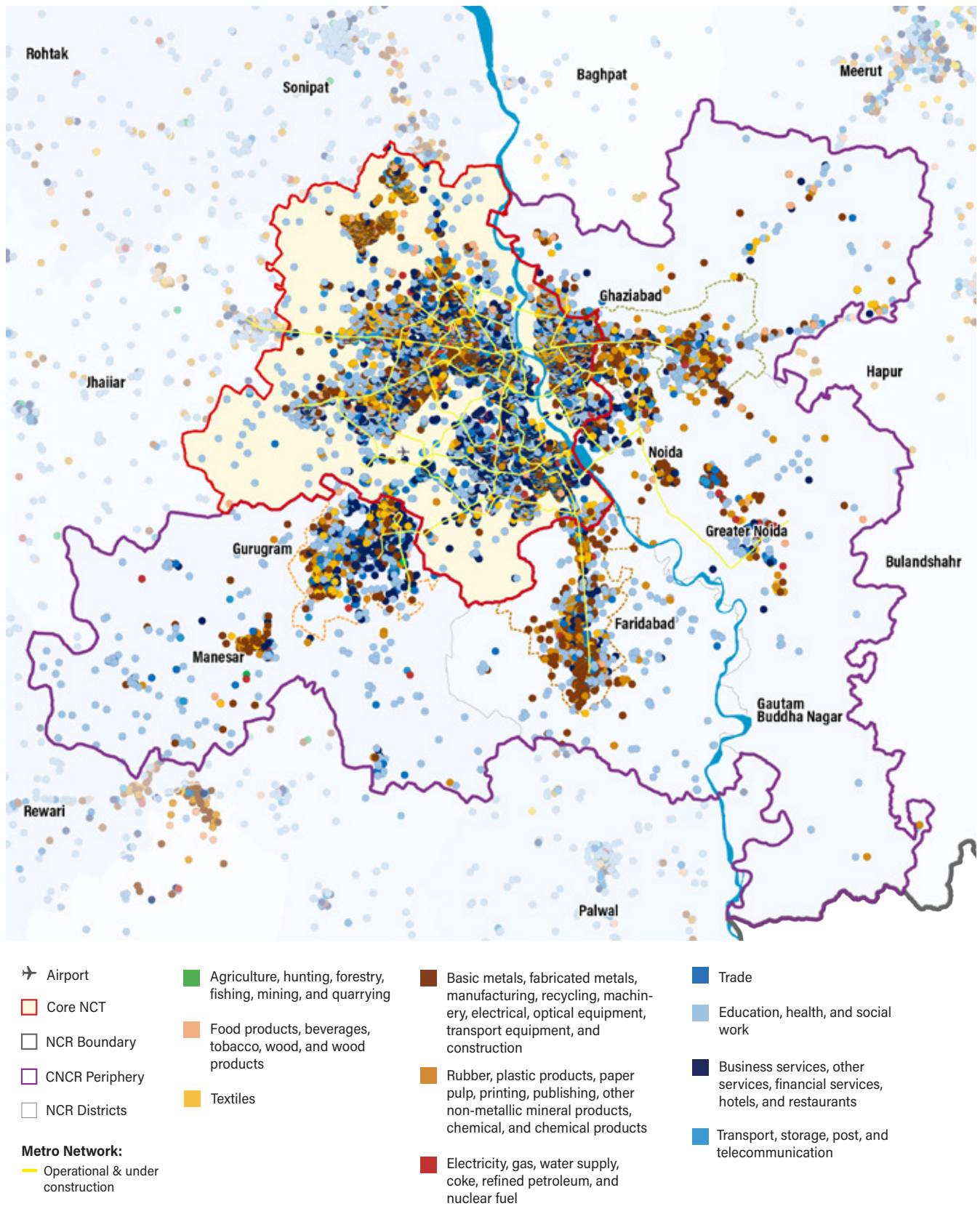
FIGURE 15 | Spatial distribution of establishments in Delhi NCR



Note: NCR = National Capital Region.

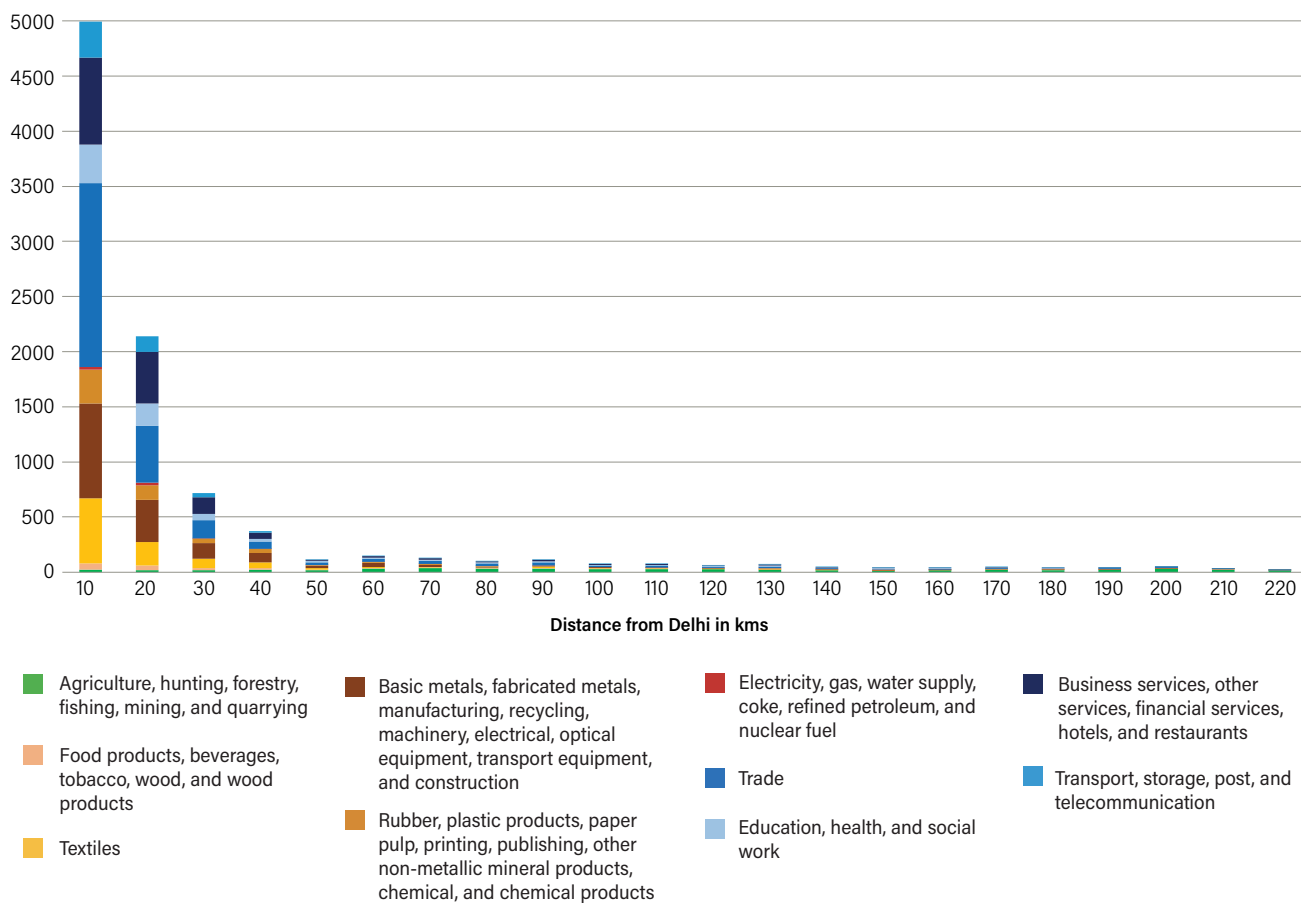
Source: Authors' analysis using data from (Central Statistics Office (c) n.d.); map prepared by WRI India.

FIGURE 16A | Job distribution by establishment type and location in Delhi NCT and its adjoining districts



Source: Authors' analysis using data from Central Statistics Office (c) (n.d.); map prepared by WRI India.

FIGURE 16B | Density of jobs moving outward from center of Delhi NCT



Notes: sq. km = square kilometer.

Source: Authors' analysis using data from Central Statistics Office (a) (n.d.) and Reserve Bank of India (2019).

EXAMINING THE CORE-PERIPHERY MORPHOLOGY OF DELHI NCR

The unevenness of the urban and economic growth, the distribution of jobs, and the industrial transformation after liberalization across the whole of Delhi NCR will be better revealed by assessing what transpired within the following subregions:

- Core NCT (the region's urban core or Delhi National Capital Territory)
- CNCR Periphery (the immediate periphery, which includes the adjoining districts of Gurugram and Faridabad in Haryana, and Ghaziabad and Gautam Buddha Nagar districts in Uttar Pradesh)

- Rest of Region (which includes the remaining districts of Delhi NCR, which fall among the participating states of Haryana, Uttar Pradesh, and Rajasthan, and are largely rural)

The delineation of these three subregions is explained in detail in the earlier section titled "Methodology."

Theoretical underpinning of core-periphery structures

Development, viewed as a process of innovation, originates in a relatively small number of centers of change located at points of high potential interaction within a communication field; development tends to spread outward from these centers to areas where the probability of potential interaction is lower. Major centers of change are called core regions; all other areas within a given spatial system are called peripheral regions. The periphery is defined by

its relation to dependency on the core. Core and periphery together constitute a complete spatial system or subsystem (Friedmann 1967).

Core regions from a geographic perspective (continents, countries, or even regions within countries) tend to induce a higher rate of innovation because of population growth, production and income, and transfer of human and capital resources to the core from the periphery (Friedmann 1967). Klimczuk and Klimczuk-Kochańska (2019) note that in terms of spatial dimension (space and place), a core–periphery structure indicates an uneven socioeconomic development pattern (Klimczuk and Klimczuk-Kochańska 2019). Although the core regions are often involved in producing knowledge-intensive jobs and value-added products, areas described as the periphery often serve as social, economic, and political backyards and supply sources and in certain cases are even subject to degradation and decline.

Hence, regional inequalities and injustices have emerged as the main themes of the core–periphery model as economic activities tend to concentrate around some pivotal points (Klimczuk and Klimczuk-Kochańska 2019). In the core–periphery model examined in a case study on Finland, a metropolis (the core) accumulates economic surplus from the surrounding satellites (the periphery) and utilizes that surplus for its own development (Kauppila 2011). Kauppila (2011) notes that as the core strengthens, the peripheral satellites are unable to benefit from the overall growth and become increasingly dependent on the core, resulting in a polarization process.

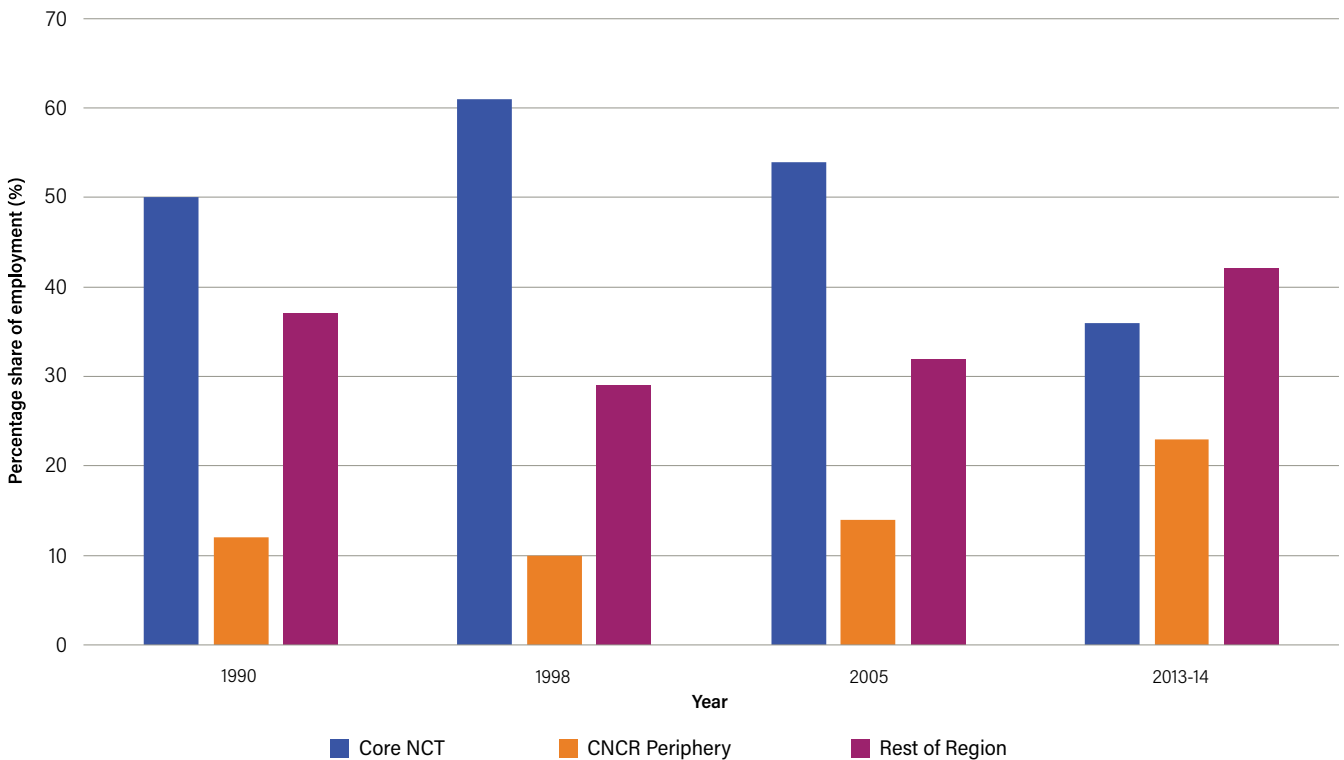
To identify the “urban development stage” of Delhi NCR, Jain et al. (2013) divided the region into several segments, designating a “core” and a set of four concentric “rings” within and around Delhi NCT. They found evidence of spatial variations in density, employment, and population among the designated rings, noting that the density gradient indicated a “compact core and sprawling outer periphery” and that the “Delhi region was in the stage of absolute decentralization since 1981 with the core losing on both population and employment whereas the agglomeration was gaining.” The analysis in this paper also reveals decentralization of the core, where the decadal growth rate of population was 47 percent in 1991–2001, which declined to 21 percent in 2001–11. The employment contribution of the core to the whole region reduced by 14 percentage points between 1990 and 2013–14.

When the conventional core–periphery model of development tries to represent the emergence of regional urban systems in various stages of transition, it keeps pace with the development of the regional transport system (Rodrigue 2020). Whereas in the first two stages of the transition the economy of the core gets concentrated as a result of innovation and capital accumulation, in the third stage of the transition, other growth centers emerge in the region because of the increasing cost of labor and land in the core area (Rodrigue 2020). This diffusion or expansion of growth is linked with the construction of transport infrastructure. In the fourth stage, which is the final stage of the transition, the urban system is envisaged to become fully integrated, with a significant reduction in spatial inequalities (Rodrigue 2020). At this stage, each area specializes in a specific function because of the division of labor linked with the strong flows along the transport corridors. With the expansion of transport infrastructure networks, the core–periphery regional spatial system of Delhi NCR is in the third stage of transition, as noted by Rodrigue (2020). Duranton noted that cities in the urban system of a developing economy are far less functionally specialized than those of the advanced economies and are often burdened by congestion and crowding of all ancillary activities such as basic manufacturing and call centers (Duranton 2015). This is very much true of Core NCT, which has not evolved to become a highly specialized, high-wage, high-technology-based economy. Instead, low-value manufacturing and labor-intensive industries continue their domination in this subregion.

Employment shifts and decentralization trends of the core

An analysis using the three delineated subregions (Core NCT, CNCR Periphery, and the Rest of Region) (Figure 17) reveals that from 1990 onward, Core NCT witnessed a downward-tapering employment growth trend whereas CNCR Periphery and the Rest of Region witnessed an upward trend. With the NCRPB’s and Delhi state’s planning policy pushes over time, large-scale economic activity generators established themselves outside Delhi state despite the peripheries being relatively less planned and less serviced for residential and commercial activity. The employment contribution of Core NCT to the whole of NCR recorded a loss of 14 percentage points between 1990 and 2013–14 (Figure 17). During the same period, the percentage share of employment in CNCR Periphery and the Rest of Region increased by 11 and 5

FIGURE 17 | Changes in percentage share of employment across Delhi NCR's three subregions from 1990 to 2013-14



Notes: CNCR = Central NCR; NCR = National Capital Region; NCT = National Capital Territory.

Source: Authors' analysis using data from Central Statistics Office (a) (n.d.).

percentage points, respectively. In absolute terms, total employment in Core NCT reduced from 3.4 million to 3.01 million between 2005 and 2013-14, while in CNCR Periphery and the Rest of Region, it increased from 0.90 million to 1.91 million and from 1.99 million to 3.5 million, respectively.

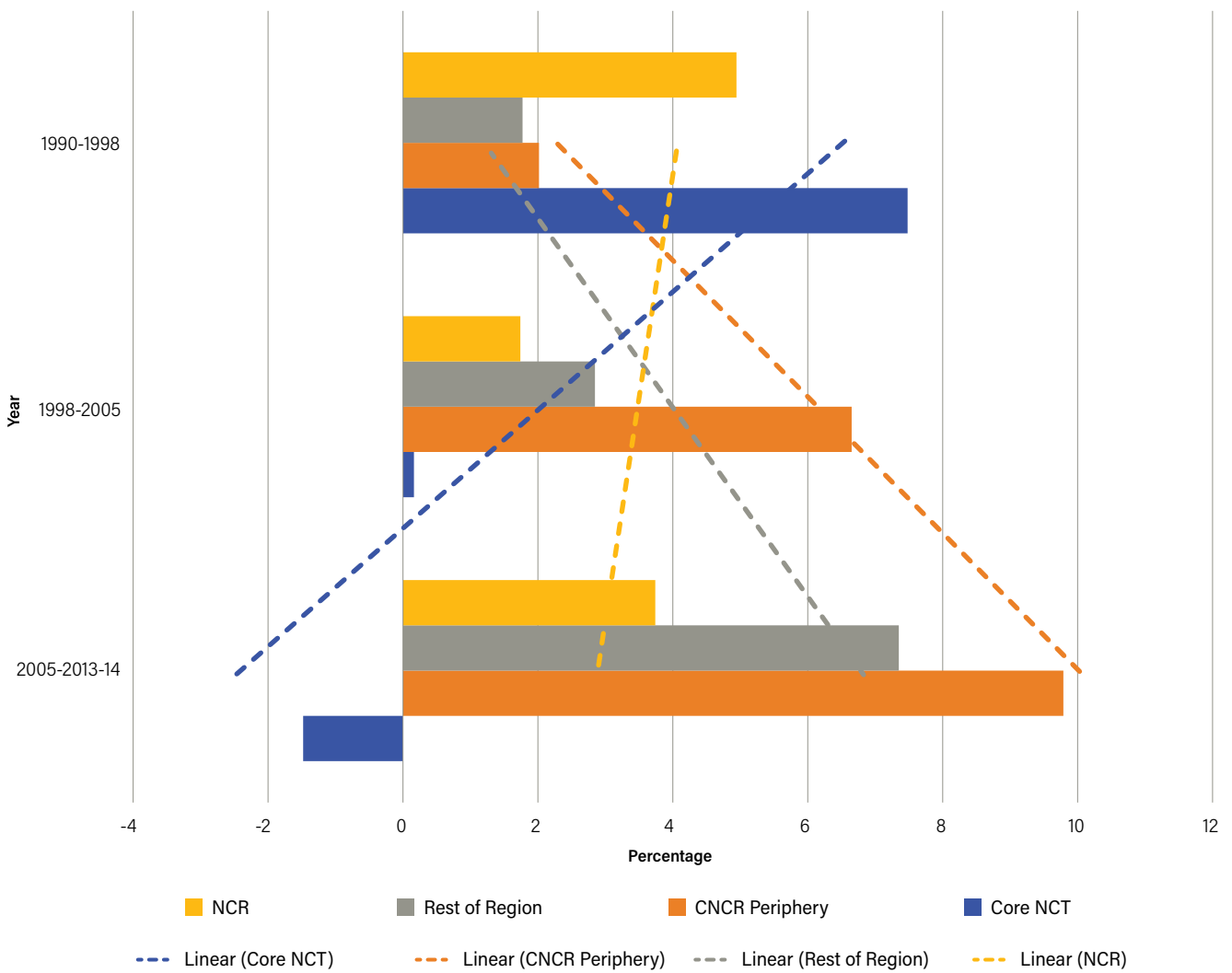
When the CAGR for the three subregions is assessed, the divergent trend continues: Core NCT experienced a decline of 1.4 percent, whereas CNCR Periphery and the Rest of Region experienced a rise in employment of 9.2 percent and 6.9 percent, respectively, for the period 2005 to 2013-14, as shown in Figure 18. The urban influence remains concentrated in Core NCT (Morya and Ram 2020), which retained the highest density of jobs. Core NCT is composed of old and new business districts that continue to dominate as the regional employment center, but it was slowly losing its importance (Morya and Ram 2020). The formation of a decentralized core has been complemented by an increase in the share of jobs in CNCR Periphery and the Rest of Region. Hence, the decentralized core has included CNCR Periphery.

Employment diversification and specialization

The diversity of the economy is analyzed by subregion using the Herfindahl Hirschman Index (HHI), which is calculated using the EC data from 1990 to 2013-14. The HHI is calculated from the relative employment shares of individual industries covered by the EC data. A higher HHI value signifies specialization, and low values indicate regional industrial diversity.

The results indicate that among the three subregions, CNCR Periphery was more diversified than Core NCT and the Rest of Region. However, the industries in Core NCT and the Rest of Region closely followed CNCR Periphery by also exhibiting a high level of diversification. The industrial diversification of Core NCT marginally reduced between 1990 and 2013-14, which can be attributed to the shifting of several manufacturing industries from Core NCT to CNCR Periphery (see Table 3).

FIGURE 18 | CAGR of employment across Delhi NCR's three subregions from 1990 to 2013-14



Notes: CAGR = compound annual growth rate; CNCR = Central NCR; NCR = National Capital Region; NCT = National Capital Territory.
 Source: Authors' analysis using data from Central Statistics Office (a) (n.d.).

TABLE 3 | Herfindahl Hirschman Index and unrelated variety of industries in Delhi NCR's three subregions

HERFINDAHL HIRSCHMAN INDEX AREA (IN SQ. KM)					UNRELATED VARIETY OF INDUSTRIES
Year	1990	1998	2005	2013-14	2013-14
Core NCT	0.10	0.11	0.15	0.12	3.72
CNCR Periphery	0.10	0.10	0.11	0.09	3.96
Rest of Region	0.12	0.12	0.14	0.15	3.50

Notes: CNCR = Central NCR; NCR = National Capital Region; NCT = National Capital Territory.
 Source: Authors' analysis using data from Central Statistics Office (a) (n.d.).

Boschma et al. (2018) noted that diversification into related activities is much more common than unrelated diversification and that the uncertainties associated with diversification can be reduced by relying on existing local capabilities. However, unrelated diversification occurs when a region develops a new activity that requires very different capabilities than existing local activities and hence tends to be driven by external factors such as migrants and multinationals; in some cases, such diversification was supported by state policies (Boschma et al. 2018).

The UV of industrial sectors was measured using employment shares by industry groups at the two-digit level of the National Industrial Classification (NIC) to understand to what extent Core NCT, CNCR Periphery, and the Rest of Region have diversified into unrelated sectors. The formula for the UV measure is given in Appendix B. The results show that CNCR Periphery has a marginally higher UV than the other regions, However, the unrelated variation is not very high among the three subregions, indicating that the dynamics of the subregions supported the complementary movement of industries between them.

Through policy changes that relaxed the restriction on land acquisition by private players, the Haryana state government allowed land development that triggered the growth of real estate and industrial development in the districts adjoining Delhi. Delhi NCR has been flexible in accommodating newer industries on whatever land was available. These industries were developed by the adjoining states to capture the outward development of Core NCT, though in an unplanned and spatially fragmented manner. In the case of Delhi NCR, although most of the industrial diversification is related and emerges from local capabilities, some levels of unrelated diversification have also occurred, specifically in the districts of CNCR Periphery. For instance, Gurugram, which was farmland two decades ago, now has a diversity of companies ranging from telecom and automobile manufacturing companies to banking and IT companies (Kannan 2013).

After the economic liberalization in 1991, mega investment projects by DLF attracted institutional and retail investors to Gurugram and attracted large populations as well, because of the shrinking land supply and rising real estate prices in Delhi (Malik 2017). The ability of the participating state governments to take advantage of the availability of large parcels of urbanizable land lying close to Delhi and support economic development through favorable industrial and urban development policies attracted industrial investments in the peripheral districts.

In Haryana, for instance, in the 1970s, the Haryana Urban Development Authority relaxed its restriction on land acquisition of designated urban areas and allowed private developers to carry out large-scale land development in designated urban area in collaboration with the Authority (Mathews et al. 2018). This relaxation resulted in a massive increase in residential, commercial, and office buildings, particularly in Gurugram, which has become the preferred IT destination in the state.

Sector-wise spatial movement of employment across the three subregions

Employment redistribution across the three subregions enabled the retention of jobs within the larger region and at the same time moved jobs outward to the peripheries of Core NCT. This redistribution is further analyzed to understand the nature of the jobs that were retained in the core, which sectors moved out, and the employment-generating potential of these sectors.

The primary sector did not see much change since the 1990s; its dominance remained in the Rest of Region (see Table 4) with little or no spatial transformation, including for the Agriculture sector (livestock), which showed a high growth rate. Core NCT was 98 percent urban according to the Census of India 2011, and its share of agricultural employment was only 0.55 percent in 2013–14.

The secondary sector continued to remain dominant within Core NCT, with high growth rates in sectors such as “Rubber and plastic products” and “Basic metals and fabricated metal products” (see Table 5). Products such as “Food products, beverages, and tobacco” moved out of the core and maintained growth rates and dominance in the Rest of Region, which retained more than 50 percent of the employment.

The textile sector was a pivotal employment-generating sector for Delhi NCR. In the 1990s, more than 50 percent of the employment share of textiles was in Core NCT, which declined to 37 percent in 2013–14, whereas CNCR Periphery made major employment gains, growing from 11 percent in 1990 to 36 percent in 2013–14, with a CAGR of 12.90 percent, indicating a shift from Core NCT to CNCR Periphery.

The wood manufacturing industry remained limited to the Rest of Region, and its employment share further decreased. The wood industry has seen a movement toward

TABLE 4 | Movement of primary sector employment share across Delhi NCR's three subregions

PRIMARY SECTOR		
Within the primary sector, industries showed the following kinds of movement from 1990 to 2013-14 (based on % share of employment in each region relative to Delhi NCR):		
Yellow – Less than 5% CAGR 2005-13 for NCR (>0)	Green – Greater than 5% CAGR 2005-13 for NCR	Red – Negative CAGR 2005-13 for NCR
Continued dominant share in Core NCT		Continued dominant share in Rest of Region
n/a (Primary sector is not a dominant sector in Core NCT)		Mining and quarrying
		Agriculture, hunting, forestry, and fishing
Movement from Core NCT to CNCR:		Movement from Rest of Region to CNCR Periphery and Core NCT:
n/a		n/a

Notes: CAGR = compound annual growth rate; CNCR = Central NCR; n/a = not applicable; NCR = National Capital Region; NCT = National Capital Territory.
Source: Authors' analysis using data from Central Statistics Office (a) (n.d.).

TABLE 5 | Movement of secondary sector employment share across Delhi NCR's three subregions

SECONDARY SECTOR		
Within the secondary sector, industries showed the following kinds of movement from 1990 to 2013-14 (based on % share of employment in each region relative to Delhi NCR):		
Yellow – Less than 5% CAGR 2005-13 for NCR (>0)	Green – Greater than 5% CAGR 2005-13 for NCR	Red – Negative CAGR 2005-13 for NCR
Continued dominant share in Core NCT		Continued dominant share in Rest of Region
Pulp, paper, paper products, printing, and publishing		Food products, beverages, and tobacco
Rubber and plastic products		Agriculture, hunting, forestry, and fishing
Basic metals and fabricated metal products		Other non-metallic mineral products
Textiles and textile products, leather and footwear (but declining over time)		-
Movement from Core NCT to CNCR Periphery:		Movement from Rest of Region to CNCR Periphery and Core NCT:
Textiles and textile products, leather and footwear		Coke, refined petroleum products, and nuclear fuel
Electrical and optical equipment		Machinery, nec
Transport equipment		-
Chemicals and chemical products		-

Notes: CAGR = compound annual growth rate; CNCR = Central NCR; NCR = National Capital Region; NCT = National Capital Territory.
Source: Authors' analysis using data from Central Statistics Office (a) (n.d.).

CNCR Periphery, while it continued to remain dominant in the Rest of Region. Core NCT employment halved (in absolute terms from 10,000 jobs to 4,000 jobs) in this sector. The pulp-making industry remained concentrated in

Core NCT, with relatively lower shares in CNCR Periphery and the Rest of Region. The absolute numbers for Delhi NCR were as low as 2,600; therefore, even a slight change is reflected in the figures. This industry too was

moving out to the Rest of Region. “Other non-metallic mineral products” continued their dominance in the Rest of Region, with an overall decline for Delhi NCR.

The dominant sectors under the secondary sector, which have a regional specialization for Delhi NCR, show differing patterns. “Basic metals and fabricated metal products” continued to dominate Core NCT and showed high growth rates with increasing share in CNCR Periphery. On the other hand, even though the overall growth rate of “Machinery, nec” declined in Delhi NCR, the sector showed a high growth rate in CNCR Periphery with movement from the Rest of Region to CNCR Periphery, and an overall decline for Delhi NCR. “Electrical and optical equipment” also showed movement from Core NCT to CNCR Periphery, with high growth rates for CNCR Periphery as well as for the Rest of Region. “Transport equipment” had the highest share and growth in CNCR Periphery, implying a decentralized transport equipment industry for Delhi NCR. These trends could be attributed in part to the various government policies over the past few decades that focused on relocating polluting industries outside Core NCT.

Most of the industries in the manufacturing sector, in addition to the three that are dominant in Core NCT, showed movement toward CNCR Periphery, whereas the textiles, electrical and optical equipment, transport equipment, and chemicals and chemical products industries completely decentralized. The rest of the manufacturing sector too showed movement out of Core NCT toward CNCR Periphery and the Rest of Region. Employment in the manufacturing sector in the Rest of Region increased from 0.6 million jobs in 2005 to 0.8 million jobs in 2013–14. CNCR Periphery as a region draws the maximum attention in the understanding of the economic evolution and shows the highest growth rate in most industries in terms of employment in the manufacturing sector.

The tertiary sector (see Table 6) remained most concentrated in Core NCT, with CNCR Periphery catching up rapidly in terms of the decentralized employment share, but growth rates in Core NCT declined. Trade remained a regionally specialized activity, but this too was moving out along with business services and education to CNCR Periphery and the Rest of Region, respectively, with

TABLE 6 | Movement of tertiary sector employment share across Delhi NCR’s three subregions

TERTIARY SECTOR	
Within the tertiary sector, industries showed the following kinds of movement from 1990 to 2013–14 (based on % share of employment in each region relative to NCR):	
Yellow – Less than 5% CAGR 2005–13 for NCR (>0)	Green – Greater than 5% CAGR 2005–13 for NCR
Red – Negative CAGR 2005–13 for NCR	
Continued dominant share in Core NCT	Continued dominant share in Rest of Region
Trade	Education
Hotels and restaurants	-
Transport and storage	-
Post and telecommunication	-
Financial services	-
Health and social work	-
Other services	-
Movement from Core NCT to CNCR Periphery:	Movement from Rest of Region to CNCR Periphery and Core NCT:
Business Services	n/a

Notes: CNCR = Central NCR; n/a = not applicable; NCR = National Capital Region; NCT = National Capital Territory.

Source: WRI India analysis based on data from Central Statistics Office (a) (n.d.).

education seeing a surge in the Rest of Region. Although the trade sector showed a declining growth trend, the Delhi Economic Survey Report 2021 noted that trade and commerce have been playing a pivotal role in promoting Delhi's economic growth and providing employment to a large section of the population in Delhi NCT.

The draft Master Plan for Delhi 2041 also emphasizes improving retail and wholesale trade along with other core economic sectors of Delhi NCT. The NCRPB (2021) noted that policies such as lowering customs duties and central excise duties and removing blanket bans on imports have enabled employment generation in the trade sector within the metropolitan city. The implementation of large-scale infrastructure projects, such as the access-controlled Delhi–Mumbai expressways that bypass Delhi, would have a ripple effect on the trade and commerce sector in Delhi NCR, especially in Sohna and Gurugram (Sood 2023). This alignment passes through the industrial hubs in the adjoining states of Delhi, which have several warehousing facilities along their major transport corridors. This direct link would speed up movement of goods to and from the ports, enabling easy access to markets and boosting trade and commerce. Such projects may impact employment in the trade sector of Core NCT, which does not have direct access to the expressway, and cause movement of jobs in the trade sector to CNCR Periphery.

Employment in high-value sectors such as “Business services” fell from 0.21 million jobs in 2005 to 0.16 million jobs in 2013–14 in Core NCT, whereas it increased from 0.06 million jobs to 0.18 million jobs in CNCR Periphery during the same period. Among the other tertiary sector categories that have remained dominant in Core NCT, “Post and telecommunication” also experienced a negative growth rate from 2005 to 2013–14 but continues to remain within Core NCT. Population Census data on the employment share of the “Public administration and defense and compulsory social security” sector show that Core NCT had about 8 percent of the total workers engaged in this sector. CNCR Periphery and the Rest of Region had about 5 percent and 6 percent of workers engaged in this category, respectively, according to the Census of India 2011. A World Bank study observed a movement of high-tech and other emerging manufacturing industries to the immediate suburbs and peripheries of large cities in India.¹³ Because Delhi NCR is a multi-state region, wide variations exist in the statutory tax rates and tax concessions given to manufacturers on purchase of raw materials

and machinery, tariffs on various services such as power, water, and transport, and so on. These factors significantly influence the location of heavy and small-scale industries and diversion of manufacturing activities from one state to another state (NCRPB 2016).

As shown in Table 7, Core NCT, led by the “Trade,” “Hotels and restaurants,” and “Other services” sectors, continues to specialize in the services sector, but a parallel development is the strong growth of manufacturing, allowing this subregion to maintain its traditional strengths and prevent complete tertiarization. CNCR Periphery has seen growth in “Business services” and has a strong manufacturing base, with the “Electrical and optical equipment,” “Transport equipment,” and “Textiles and textile products, leather and footwear” sectors seeing growth between 2005 and 2013–14. The Rest of Region houses an increasing number of educational institutions and is also the hinterland that provides agricultural produce, livestock, food products, and beverages for the growing demands of the agglomeration's population.

There are concerns that the outward movement of employment will result not only in decentralization but also in a hollowing out of Core NCT. New sectors such as “Business services,” which includes management consulting, computer programming, and information-services-related activities, have not thrived in Core NCT as they have in CNCR Periphery.

Industries that contribute significantly to the GDP but without contributing to a corresponding growth in employment continued to concentrate in Core NCT, reinforcing a low-employment growth phenomenon. The employment-generating industries moved to CNCR Periphery; however, the industries that are the biggest contributors to the GDP were concentrated in Core NCT, and hence CNCR Periphery experienced growth-less jobs. Similarly, although the Rest of Region witnessed increased agricultural productivity, it was accompanied by a declining percentage share of agricultural laborers. As the urban core is largely focused on the tertiary sector as well as on manufacturing, there is a need to understand the trajectory of the industries that can sustain and retain the primacy of Core NCT.

TABLE 7 | Summary of changes in the sectoral employment share across Delhi NCR's three subregions

DESCRIPTION	PRIMARY SECTOR	SECONDARY SECTOR	TERTIARY SECTOR
Core NCT	n/a	Pulp, paper, paper products, printing, and publishing	Trade
		Rubber and plastic products	Hotels and restaurants
		Basic metals and fabricated metal products	Transport and storage
		Textiles, textile products, leather and footwear (but declining over time)	Post and telecommunication
		Coke, refined petroleum products, and nuclear fuel	Financial services
			Health and social work
CNCR Periphery	n/a	Machinery, nec.	Business services
		Textiles, textile products, leather and footwear	
		Electrical and optical equipment	
		Transport equipment	
		Chemicals and chemical products	
Rest of Region	Mining and quarrying	Food products, beverages, and tobacco	Education
	Agriculture, hunting, forestry, and fishing	Wood and products of wood	
		Other non-metallic mineral products	

Within the primary, secondary, and tertiary sectors, industries showed the following types of movement from 1990 to 2013-14 (based on % share of employment in each region relative to NCR):

Yellow - Less than 5% CAGR 2005-13 for NCR (>0)	Green - Greater than 5% CAGR 2005-13 for NCR	Red - Negative CAGR 2005-13 for NCR
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Notes: CNCR = Central NCR; n/a = not applicable; NCR = National Capital Region; NCT = National Capital Territory.

Source: Data from Economic Census 3, 4, 5, and 6, Ministry of Statistics and Programme Implementation (MoSPI), and WRI Analysis. Authors' analysis using data from Central Statistics Office (a) (n.d.).

Spatially differentiated competitiveness by core, periphery, and region

The 26 employment sectors present across the three delineated subregions (Core NCT, CNCR Periphery, and the Rest of Region) are assessed using an LQ analysis against the reference area of the whole of Delhi NCR (see Table 8). This exercise is similar to the LQ analysis that was done for the whole of Delhi NCR against the reference area of India in the earlier section titled “Economic growth and

regional specialization.” An LQ higher than 1 implies the presence of subregional specialization, whereas a number lower than 1 implies its absence. For reference, the LQ of the whole of Delhi NCR is retained as well as the CAGR of the employment sectors in Delhi NCR.

Delhi NCR's primacy across various employment sectors when assessed by its constituent subregional delineations revealed which employment sectors were more concentrated in which subregion. Core NCT remained the leading subregion in the manufacturing sectors of “Rubber and plastic products,” “Pulp, paper, paper products, printing,

and publishing,” and “Basic metals and fabricated metal products.” Despite being the national capital and India’s foremost economic agglomeration, Core NCT retained its traditional strengths in low-value polluting industries and did not make the expected shifts toward newer knowledge-based tertiary economies in 2013–14. Polluting industries such as rubber and plastic industries continued to operate

in Core NCT despite the Supreme Court order issued in 1996 directing the closure or relocation of such industries. Core NCT still led the region’s tertiary sector activities such as trade, hotels and restaurants, transport and storage, post and telecommunication, financial services, and health and social work. Policy intent to transform Core NCT into a knowledge economy is present in the Delhi

TABLE 8 | Location quotient of Delhi NCR’s three subregions (NCT Core, CNCR Periphery, Rest of Region)

CATEGORIES YEAR 2013-14	LQ/NCR (REFERENCE AREA: INDIA)	LQ/DELHI NCT CORE (REFERENCE AREA: NCR)	LQ/CNCR PERIPHERY (REFERENCE AREA: NCR)	LQ/REST OF REGION (REFERENCE AREA: NCR)	CAGR NCR (2005 TO 2013-14)
Agriculture, hunting, forestry, and fishing	0.78	0.04	0.29	2.21	21.03
Mining and quarrying	0.75	0.00	0.20	2.30	3.54
Food products, beverages, and tobacco	0.48	0.50	1.06	1.40	-0.83
Textiles, textile products, leather and footwear	1.25	1.05	1.58	0.64	1.66
Wood and products of wood	0.36	0.29	1.09	1.56	-0.96
Pulp, paper, paper products, printing, and publishing	2.26	1.80	0.90	0.37	0.20
Coke, refined petroleum products, and nuclear fuel	0.57	1.25	1.04	0.76	-1.01
Chemicals and chemical products	1.15	0.85	1.59	0.81	2.62
Rubber and plastic products	3.78	1.91	0.89	0.28	6.55
Other non-metallic mineral products	0.83	0.21	0.28	2.08	-6.79
Basic metals and fabricated metal products	2.24	1.45	1.33	0.43	6.29
Machinery, nec.	3.07	0.72	2.16	0.61	-0.80
Electrical and optical equipment	4.00	0.77	1.92	0.70	9.56
Transport equipment	5.33	0.53	2.87	0.38	11.46
Manufacturing, nec; recycling	1.15	1.10	0.86	0.99	5.71
Electricity, gas, and water supply	1.06	1.03	0.98	0.98	2.48
Construction	0.67	1.16	1.04	0.84	17.52
Trade	0.91	1.28	0.75	0.90	-0.55
Hotels and restaurants	0.75	1.35	0.94	0.73	3.31
Transport and storage	0.95	1.74	0.49	0.65	6.92

CATEGORIES YEAR 2013-14	LQ/NCR (REFERENCE AREA: INDIA)	LQ/DELHI NCT CORE (REFERENCE AREA: NCR)	LQ/CNCR PERIPHERY (REFERENCE AREA: NCR)	LQ/REST OF REGION (REFERENCE AREA: NCR)	CAGR NCR (2005 TO 2013-14)
Post and telecommunication	1.48	1.46	1.08	0.56	-6.60
Financial services	0.65	1.46	0.79	0.72	1.62
Business Services	1.34	1.04	1.81	0.52	4.05
Education	0.78	0.76	0.81	1.31	2.94
Health and social work	1.06	1.35	0.77	0.82	2.41
Other Services	0.91	1.20	0.94	0.86	6.09

Notes: CNCR = Central NCR; NCR = National Capital Region; NCT = National Capital Territory.
Source: Authors' analysis using data from Central Statistics Office (a) (n.d.).

Industrial Policy (DIP) 2010-21, which envisions a clean, high-technology hub. The Delhi Start Up Policy envisions a global innovation hub in Core NCT and promotes industry-academia collaborations and an entrepreneurial spirit. However, concerns remain; OECD (2019) notes that although stimulating innovation and technological progress increases productivity, it may increase the demand for skilled workers, thereby leaving behind the low-skilled workers.

CNCR Periphery experienced both employment growth as well as diversification and specialization. It captured the outward movement of jobs from Core NCT. In the manufacturing sector, it specialized in textiles, chemicals and chemical products, machinery, electrical and optical equipment, and transport equipment. This is substantiated by the presence of a large number of MSME units in Ghaziabad, Faridabad, and Gurugram that cater to various manufacturing goods such as plastic products, packaging materials, automotive components, electrical and engineering equipment, and electronic goods. About 60 percent of the MSME units in Faridabad are engaged in manufacturing automobile parts, sheet metal components, and fabrication work (E&Y 2016).

Plants of three automobile giants—Maruti Suzuki, Hero MotoCorp, and Suzuki Motorcycles and Scooters—are located in Haryana's Gurugram—Manesar—Bawal belt, further substantiating the subregional specialization of transport equipment in CNCR Periphery. Gurugram district, for example, experienced phenomenal economic growth, aided by its location on the National Highway, proximity to the Delhi International Airport, as well as its highly advanced infrastructure and communication

networks. In the tertiary sector, it outperformed Core NCT in business services such as management consulting, computer programming, and information-services-related activities. It improved in the education sector as well.

The Rest of Region is predominantly rural, with about 52 percent of its workforce engaged as agricultural laborers and cultivators (Census 2011). Hence, mining, quarrying, agriculture, hunting, and forestry, and fishing, which fall under the primary sector, predominate in this subregion. Further, non-metallic mineral products, wood and products of wood, and food, beverages, and tobacco are the leading products. The education sector leads in this subregion, which could be attributed to the increase in the number of government schools and other institutes and the fact that the Rest of Region covers a very large area.

The next section describes the changes that occurred in people's lives over time, such as population growth, migration, income levels, types of occupation, and consumption patterns.





CHAPTER 6

Demographic trends associated with Delhi NCR's economic transformation

The industrial transformation at the overall Delhi NCR scale and across the delineated subregions has been associated with changes in demographic indicators such as improved main workforce participation, higher per capita incomes, and lower poverty rates. However, unemployment persisted, workforce participation rates of women have declined despite higher education levels and lower fertility rates, and marginalized groups remained concentrated in elementary occupations.

Demographic trends at Delhi NCR scale are first compared with national demographic trends, and then details on the demographic trends are presented at the scale of the delineated subregions. This analysis will give insights into the changes associated with the industrial transformation discussed in the earlier sections.

POPULATION GROWTH AND MIGRATION PATTERNS

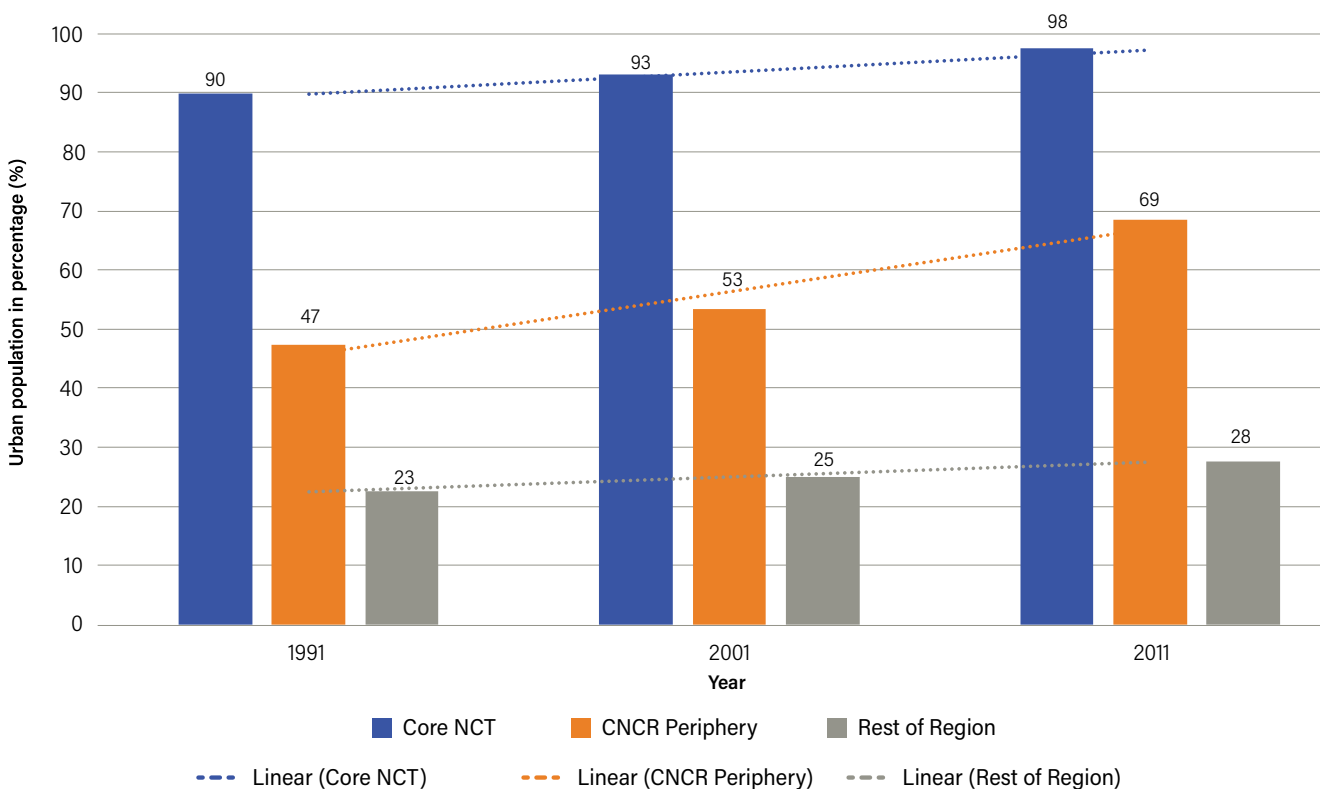
Delhi NCR recorded a population growth much above the national average both in rural as well as urban areas in the decades after Independence. However, this trend slowed down after 1991, with the decennial population growth declining from 23 percent between 1991 and 2001 to 18 percent between 2001 and 2011. Delhi NCR accommodated about 58.2 million people in 2011.

Within the delineated subregions, 16.8 million (29 percent) resided in Core NCT, 9.7 million (17 percent) in CNCR Periphery, and 31.7 million (55 percent) in the

Rest of Region according to the Census of 2011. Delhi NCT was 98 percent urban in 2011 itself, with about 68 percent of the state's area already built up. CNCR Periphery was rapidly becoming more urban and had 47 percent urban population in 1991, 53 percent in 2001, and 68 percent in 2011 (Figure 19). The Rest of Region experienced only a 5-percentage-point increase in urban population between 1991 and 2011. An analysis of the urban population in the three delineated subregions shows that since 1991, the bulk of the urban population remained concentrated in Core NCT. The growth rate of population across the three subregions, however, declined steadily, with Core NCT showing the highest decline during the last three census decades.

The Economic Survey Report (2018–19) of Delhi noted that the development of NCR priority towns—namely, Gurugram, Faridabad, Sonapat, Noida, Ghaziabad, and Meerut—and the implementation of various employment promotion programs such as the National Rural Employment Guarantee Act (NREGA) and other welfare schemes have contributed to the reduction of migration to Delhi (Planning Department 2019). The largest share¹⁴

FIGURE 19 | Percentage of urban population in Delhi NCR's three subregions



Notes: CAGR = compound annual growth rate; CNCR = Central NCR; NCR = National Capital Region; NCT = National Capital Territory.

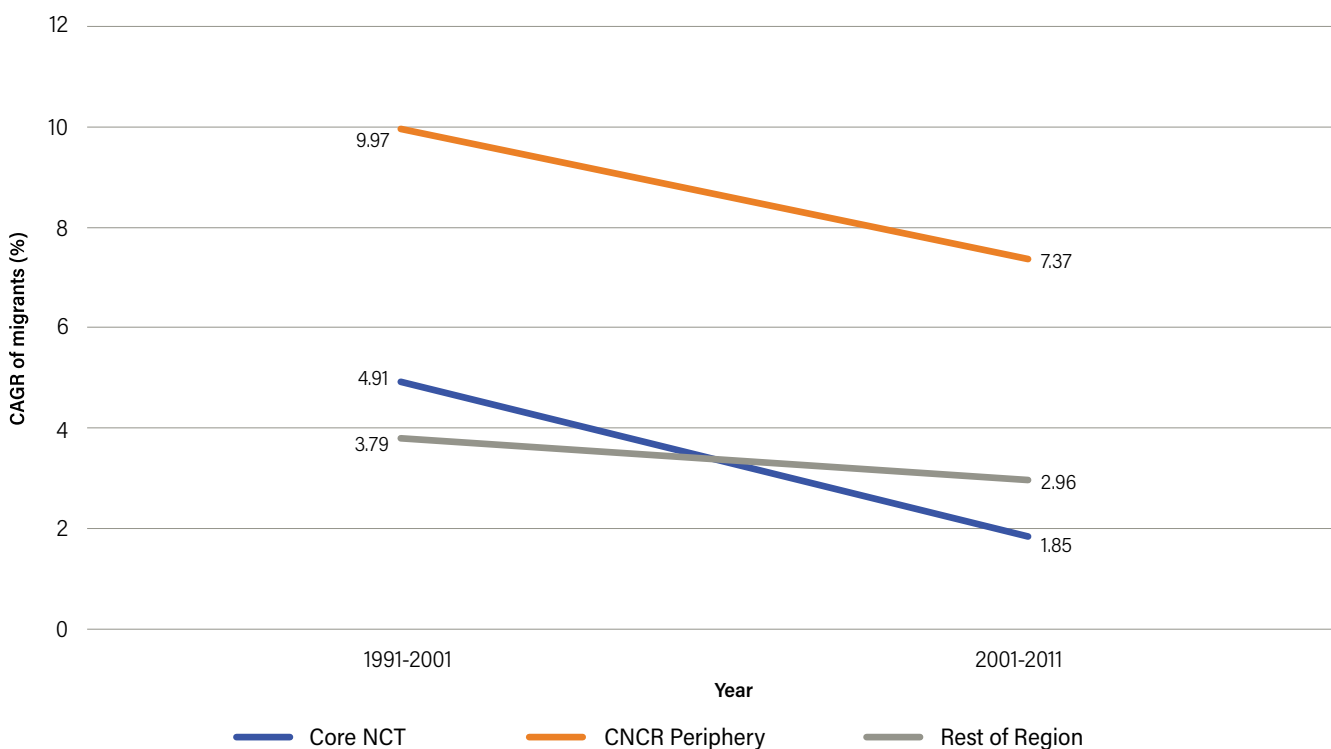
Source: Authors' analysis using data from Census of India (1991, 2001, 2011).

of migrants to Delhi NCR by all durations of residence¹⁵ came from states such as Uttar Pradesh (37 percent), followed by Bihar (16 percent) and Haryana (9 percent). Migrants, whose absolute number was 22.8 million, constituted about 39 percent of the population in 2011, which was 2 percent higher than the national average. The CAGR of migration, however (by all durations of residence), when analyzed for the period between 1991–2001 and 2001–11, declined from 5 percent to 3 percent.

Figure 20 shows that the CAGR of the migrant population by all durations of residence for all the three subregions declined over time, with the highest decline in Core NCT. Delhi NCT had 7.2 million migrants in 2011, and the percentage share of the migrant population to the total population remained stable at 43 percent in 2001 and 2011. The migrant population of CNCR Periphery grew dramatically, with the percentage share of the migrant population increasing from 22 percent in 1991 to 38 percent in 2001 and to 54 percent in 2011. The Rest of Region saw an about 4-percentage-point increase across the three decades. CNCR Periphery became the go-to destination for migration in the decades after 1991 in Delhi NCR.



FIGURE 20 | CAGR of migrant population by all durations of residence in Delhi NCR's three subregions



Notes: CAGR = compound annual growth rate; CNCR = Central NCR; NCR = National Capital Region; NCT = National Capital Territory.
Source: Authors' analysis using data from Census of India (1991, 2001, 2011).

An analysis of the reasons for migration by gender shows that most of the male migrants moved to Delhi NCR for work and business purposes, which contrasts with the reasons given by the women, who moved largely for marriage (other than “moving with household”). This trend is reflected in the subregions as well, with most women moving for marriage (74 percent) in the Rest of Region, which is largely rural (see Figure 21). Job opportunities provided by the region have acted as a significant pull factor for the migration of men into the region.

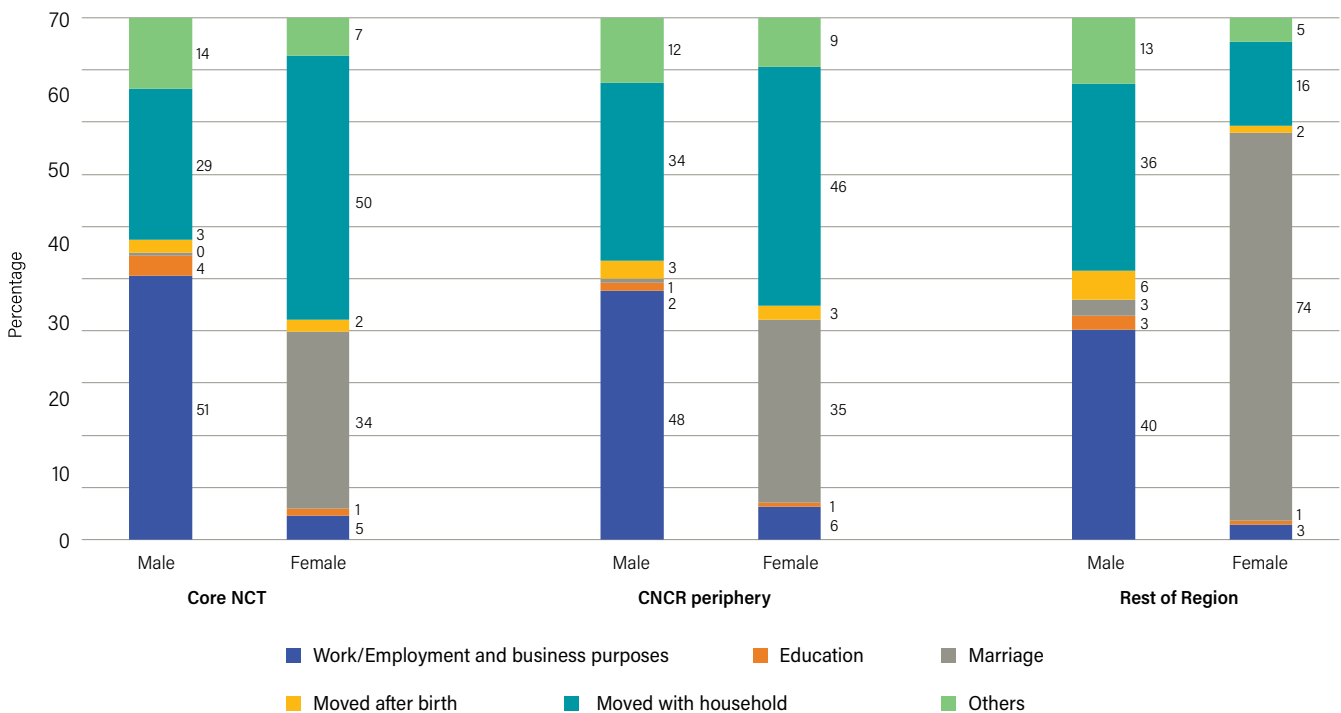
EDUCATION LEVELS AND WORKER PROFILES

The percentage share of educated and technically qualified workers (other than cultivators and agricultural laborers) increased from 13 percent in 2001 to 19 percent in 2011 in Delhi NCR, whereas nationally it was 10 percent in 2011. A quarter of migrants with duration of residence 0 to 9 years who reported work/business as the reason for migration in 2011 were also educated and technically qualified. An “educated and technically qualified” worker is defined

as a person who has earned a graduation or a postgraduation degree from a college or university. In Delhi NCR, 1 in 6 residents above 20 years of age is a migrant, but at the national level, only 1 in 10 residents is a migrant.

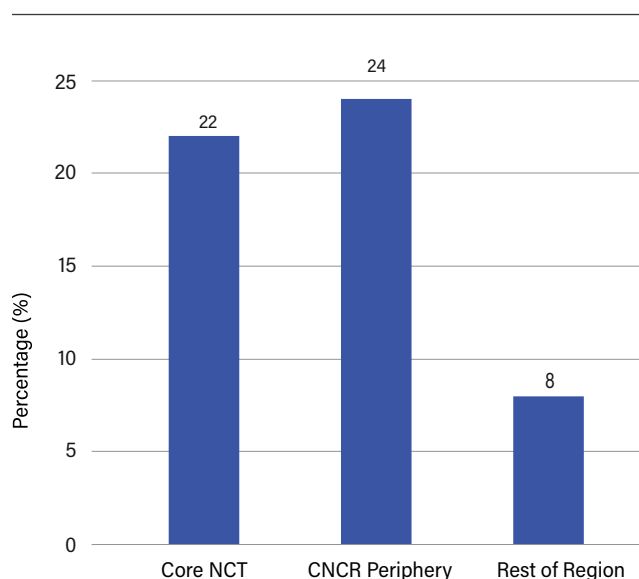
With the increase in urbanization, literacy rates also showed improvement across all the three subregions after 1991. The literacy rates in Delhi NCT, CNCR Periphery, and the Rest of Region were 86 percent, 80 percent, and 72 percent, respectively, in 2011. Delhi NCT, which is the most urbanized subregion of Delhi NCR, accommodated the highest percentage of graduate Main workers in the Other¹⁶ (those engaged in non-agricultural activities) category, followed by CNCR Periphery and the Rest of Region. Delhi NCR’s intra-regional industrial transformation resulted in an increased movement of skilled labor toward the CNCR Periphery, with 24 percent of the migrants here being graduates or higher in qualification (see Figure 22). The share of illiterate migrants (all with duration of residence of 0 to 9 years) was the highest in the Rest of Region, indicating a lower requirement of skilled workers in the rural region, which has a primarily agrarian economy.

FIGURE 21 | Gender disaggregated reasons for migration across Delhi NCR’s three sub regions



Notes: CAGR = compound annual growth rate; CNCR = Central NCR; NCR = National Capital Region; NCT = National Capital Territory.
Source: Authors’ analysis using data from Census of India (1991, 2001, 2011).

FIGURE 22 | Percentage of graduate migrants (all durations of residence) in Delhi NCR in 2011



Notes: CNCR = Central NCR; NCR = National Capital Region; NCT = National Capital Territory.

Source: Authors' analysis using data from Census of India (2011).

In a multiregional open economy where goods and services are traded with other countries, the distribution of knowledgeable people is uneven. Labor migration constantly shapes the map of human capital, because places with better amenities attract workers with higher levels of human capital who will experience rapid growth because of their entrepreneurial, creative, and innovative energies (Storper and Scott 2009).

The occupational classification¹⁷ of worker profiles shows that most workers (other than agricultural laborers and cultivators)—that is, 18 percent—were engaged in elementary occupations (hand tools based)¹⁸ in Delhi NCR in 2001 and 2011. This occupational class also experienced a growth rate of 15 percent between 2001 and 2011. Apart from the workers not reporting any occupation, the region had a substantial share of workers engaged as models, salespersons, and demonstrators, which includes fashion models and shop and market salespersons, closely followed by laborers in mining, construction, and manufacturing jobs.

Elementary occupations in the “Sales and service” category include street vendors, domestic vendors, building caretakers, and similar classes of workers, who at 6 percent constituted the third largest share of workers in the region in 2011. Although there was an increase in legislators,

professionals, and associate professional workers, such as doctors; engineers; teachers; corporate managers; administrative, finance, and business professionals; and other categories of workers, the overall percentage share of these categories remained low when compared to the “elementary occupations” category (see Figure 23).

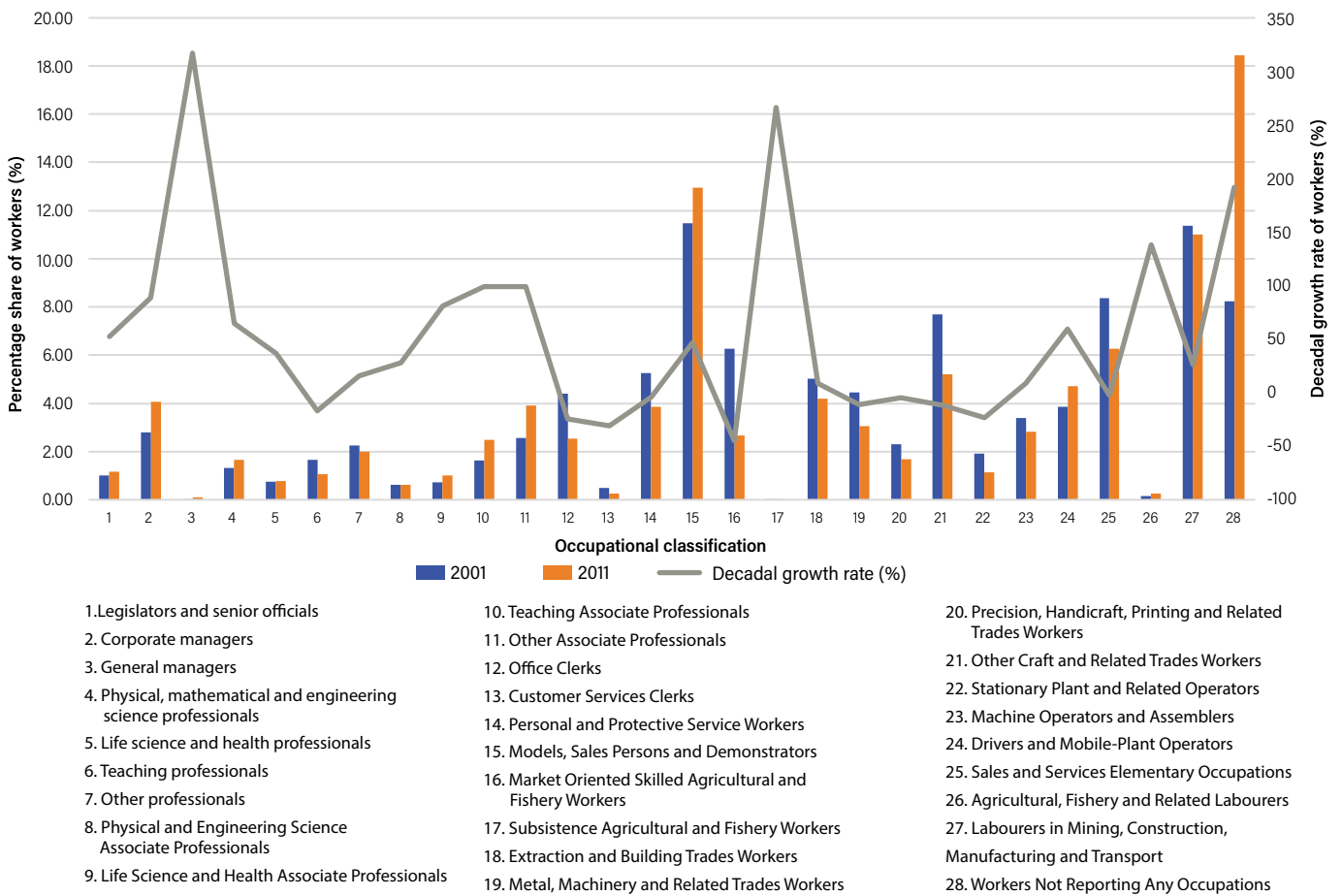
Assessment of worker profiles at the subregional level showed that in 2011 the highest share of workers in Core NCT were engaged as models, salespersons, and demonstrators, whereas in CNCR Periphery and the Rest of Region, the highest share of workers were engaged in mining, construction, and manufacturing jobs (see Table 9). The informal sector constitutes up to 80 percent of the city jobs in India (Raveendran and Vanek 2020). According to the ILO, in low- and middle-income countries, workers in skilled agricultural, forestry, and fishing occupations and elementary occupations are likely to be low-skilled and earn very low incomes; also, they are likely to have irregular or no employment contracts (International Labour Organization 2020). If a region has a high share of workers engaged in elementary occupations, it can be assumed that the region has a large share of workers involved in low-skilled jobs who earn lower incomes when compared to those employed in jobs that fall in the professional and technical categories.

EMPLOYMENT, INCOME, AND EXPENDITURE LEVELS

The employment generation of industries when linked with the work participation rates (WPRs) of the region reveals that there has been no significant improvement in the overall work participation rate or in the female work participation rate. Out of the total number of workers, about 58 percent of the main workers were engaged outside of agriculture, which is 22 percent higher than the national average. Employment from all the sectors increased from 6.3 million in 2005 to 8.5 million in 2013–14. A comparison of the changes in the workforce share of the region revealed that although nationally the percentage share of main workers in the total working population declined between 2001 and 2011, it increased from 79 percent to 82 percent in Delhi NCR during this period. The increase in the share of main workers in Delhi NCR reflects the employment opportunities available for the larger part of the year.

Out of the total number of workers, the percentages of main workers in the Others category who were engaged

FIGURE 23 | Decadal change in the occupational classification of main and marginal workers (other than agricultural laborers and cultivators) in Delhi NCR



Notes: NCR = National Capital Region.

Source: Authors' analysis using data from Census of India 2001 and 2011.

TABLE 9 | Top five worker occupational classes (other than cultivators and agricultural laborers) in Delhi NCR's three subregions

NCT	CNCR	REST OF THE REGION
Models, Salespersons, and Demonstrators	Laborers in Mining, Construction, Manufacturing, and Transport	Laborers in Mining, Construction, Manufacturing, and Transport
Laborers in Mining, Construction, Manufacturing, and Transport	Models, Salespersons and Demonstrators	Models, Salespersons, and Demonstrators
Sales and Services Elementary Occupations	Sales and Services Elementary Occupations	Other Craft and Related Trades Workers
Other Associate Professionals	Other Craft and Related Trades Workers	Drivers and Mobile-Plant Operators
Corporate Managers	Corporate Managers	Market Oriented Skilled Agricultural and Fishery Workers

Notes: CNCR = Central NCR; NCR = National Capital Region; NCT = National Capital Territory.

Source: Authors' analysis using data from Central Statistics Office (a) (n.d.).

largely in non-agricultural activities were recorded as 92 percent, 80 percent, and 39 percent, respectively, in 2011 in Core NCT, CNCR Periphery, and the Rest of Region. The predominantly rural Rest of Region had 36.42 percent of main workers as agricultural laborers and cultivators. It also had a higher share of marginal workers primarily working as agricultural laborers and cultivators than that in Core NCT and CNCR Periphery in 2011.

The economic entities in the region have been able to attract capital from the banking system, with the per capita credit advanced increasing from Rs 0.4 million in 2001–02 to Rs 2.5 million in 2011–12 to Rs 3.4 million in 2019–20. This was much higher than that of the country's per capita credit, as seen in Table 10. The RBI notes that access to financial services, especially credit, is a well-established sign of economic prosperity and that the factors influencing the demand for credit are per capita income, level of industrial activity, and availability of infrastructure such as road networks and power supply (Rajesh and Das 2019). The higher credit-deposit ratio of Delhi NCR (0.86) than that of the country (0.76) in 2019–20 also indicates that banks were able to make better use of their resources in this region.

The per capita income of Delhi NCR tripled in the years between 2004–05 and 2016–17, and was twice the national per capita income in 2016–17 (see Table 10). Importantly, the margin increased over the years for Delhi NCR, with income increasing by 200 percent in just over a decade and the national income increasing by 106 percent during this period. Consumption levels too were much higher in Delhi NCR, with the MPCE being 50 percent more than the national MPCE (see Table 10).

Assessment of per capita income across the three subregions showed that CNCR Periphery overtook Delhi NCT to record the highest per capita income among the three subregions in 2016–17. This occurred around the time that the agglomeration of Delhi (including Delhi NCT, Gurugram, Faridabad, NOIDA, and Ghaziabad) had overtaken the agglomeration of Mumbai to become the leading economic agglomeration in India. CNCR Periphery experienced a phenomenally high growth rate (169 percent) in per capita income during the period 2004–05 to 2011–12. However, during 2011–12 to 2016–17, the growth rate of per capita income declined to 71 percent in CNCR Periphery but remained higher than that of the Core NCT (see Table 11).

TABLE 10 | Income and expenditure levels of India versus NCR

	INDIA			NCR		
Year	2001–02	2011–12	2019–20	2001–02	2011–12	2019–20
Per capita credit (in thousands of rupees)^a	103.60	1,040.50	1,831.10	470.00	2,490.40	3,409.60
Credit-deposit ratio (%)^b	0.30	0.76	0.76	0.73	0.83	0.86
Per capita income (Rs.) calculated at 2004–05 constant prices^c	24,143	38,048	49,764	36,965.21	70,825.21	111,120.49
MPCE (in Rs.)^d	712.20	1,627.10	n/a	971.90	2,469.50	n/a

Notes: n/a = not applicable; MPCE = monthly per capita expenditure; NCR = National Capital Region.

Source: Authors' analysis using data from

a. Credit data source: Reserve Bank of India (RBI), Worker's data source: Census of India (2011).

b. RBI.

c. Department of Economics and Statistics of respective state governments.

d. National Sample Survey Office (NSSO) Consumption Expenditure Rounds. Calculated from unit-level data.

TABLE 11 | Per capita income levels across Delhi NCR's three subregions

PER CAPITA INCOME (IN INR)	2004-05	2011-12	2016-17
Core NCT	60,799	108,635	145,416
CNCR Periphery	37,621	101,203	172,718
Rest of Region	24,393	41,445	71,774

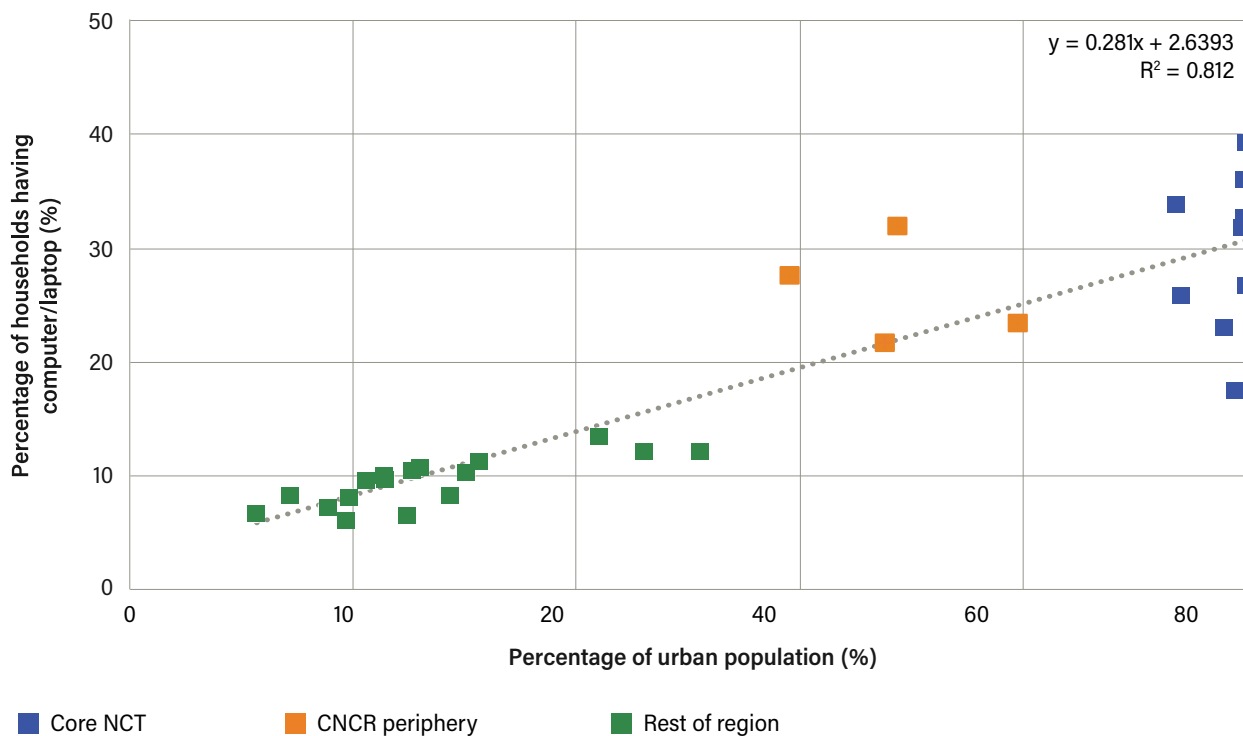
Notes: CNCR = Central NCR; NCR = National Capital Region; NCT = National Capital Territory.
Source: Data from Census of India (2011).

Urbanization and computer/laptop ownership in Delhi NCR were positively correlated. With the increase in urbanization, the number of households having a computer/laptop also increased. Assessment of Internet access and computer/laptop ownership shows that the percentage of households owning a computer and having access to the Internet is high in Delhi NCT and in CNCR Periphery. However, digital penetration remains low in the Rest of Region, which is also the least urbanized region (see Figure 24). With low ownership of computers and hence low Internet penetration in the rest of the districts, this subregion will continue to remain backward in digital

skills and hence will have limited opportunities of gaining the skills needed to advance within the rapidly transforming economy.

The per capita income rise translated into a reduction in poverty rate from 24 percent in 2004–05 to 9 percent in 2011–12 in Delhi NCR, which was lower than the national poverty rate of 22 percent in 2011–12. The poverty rate decreased drastically in CNCR Periphery and the Rest of Region between 2004–05 and 2011–12, whereas it decreased only modestly in Core NCT during the same period (see Table 12).

FIGURE 24 | Access to computers/laptops versus urbanization across Delhi NCR's three subregions



Notes: CNCR = Central NCR; NCR = National Capital Region; NCT = National Capital Territory.
Source: Authors' analysis using data from Census of India (2011).

TABLE 12 | Per capita income levels across Delhi NCR's three subregions

SUBREGIONS IN NCR	POVERTY RATE (%)		PERSONS BELOW POVERTY LINE (IN MILLIONS)	
	2004-05	2011-12	2004-05	2011-2
Core NCT	13	10	2.03	1.69
CNCR periphery	22	4.40	1.70	0.42
Rest of region	29.90	9.90	8.60	3.13

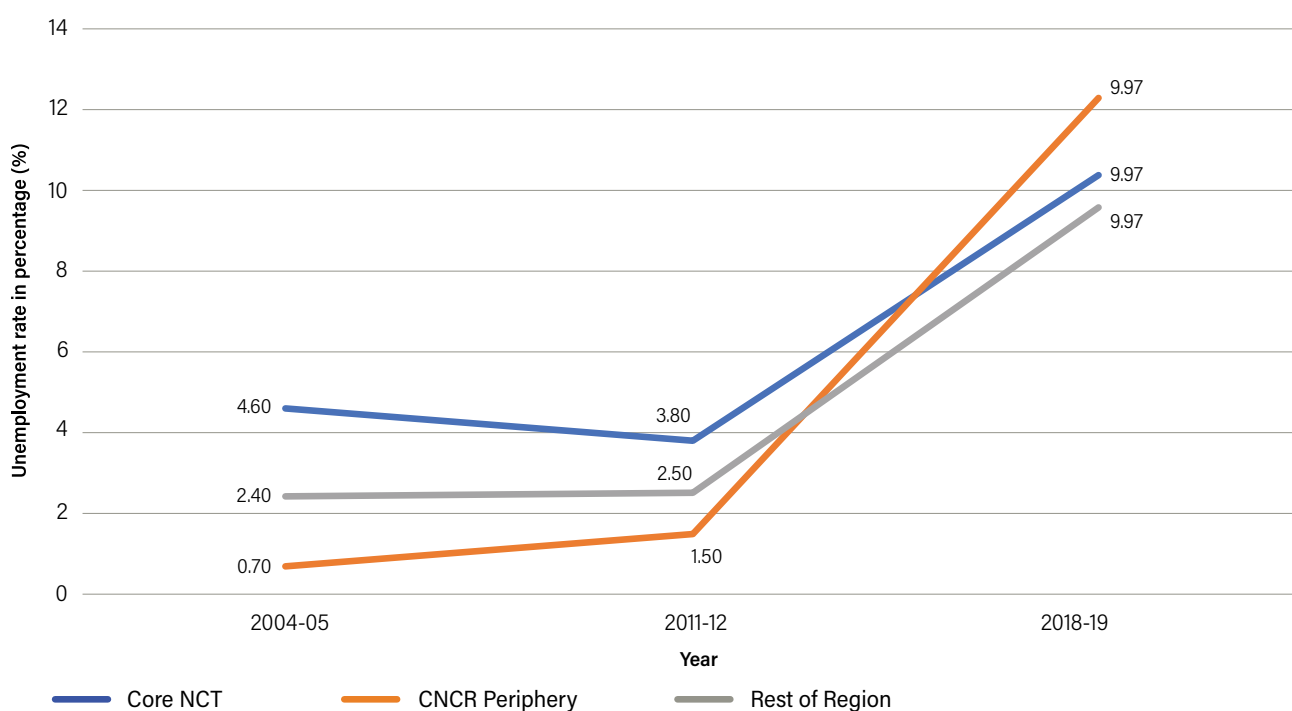
Notes: CNCR = Central NCR; NCR = National Capital Region; NCT = National Capital Territory.
 Source: Authors' analysis using data from Census of India (2011).

An increase in literacy rates, though, did not translate into a proportionate increase in employment access in the region. Although the literacy rate in Core NCT was about 86 percent according to the Census of India 2011, the highest among the three subregions, the number of educated unemployed (graduates and above) also remained substantially high. Core NCT had about 28 percent of the total number of educated unemployed, followed by CNCR Periphery at 19 percent and the Rest of Region at 18 percent, according to the Census of India 2011. In the formal

employment sector in Indian cities, youth unemployment is a mounting challenge despite better education levels, while skill levels remain disconnected from industry needs (*The Financial Express* 2019; Kapoor 2022).

Overall, the unemployment rate showed an increasing trend during the period from 2004-05 to 2018-19, with CNCR Periphery having the highest unemployment rate among the three regions (see Figure 25). The unemployment rate of the region increased from 1.6 percent in 2004-05 to 9.8 percent in 2018-19.

FIGURE 25 | Unemployment rate across Delhi NCR's three subregions



Notes: CNCR = Central NCR; NCR = National Capital Region; NCT = National Capital Territory.
 Source: Data from PLFS 2018-19 and NSS rounds (2011-12 and 2004-05). Authors' analysis using data from NSO (2019) and NSSO (n.d.).

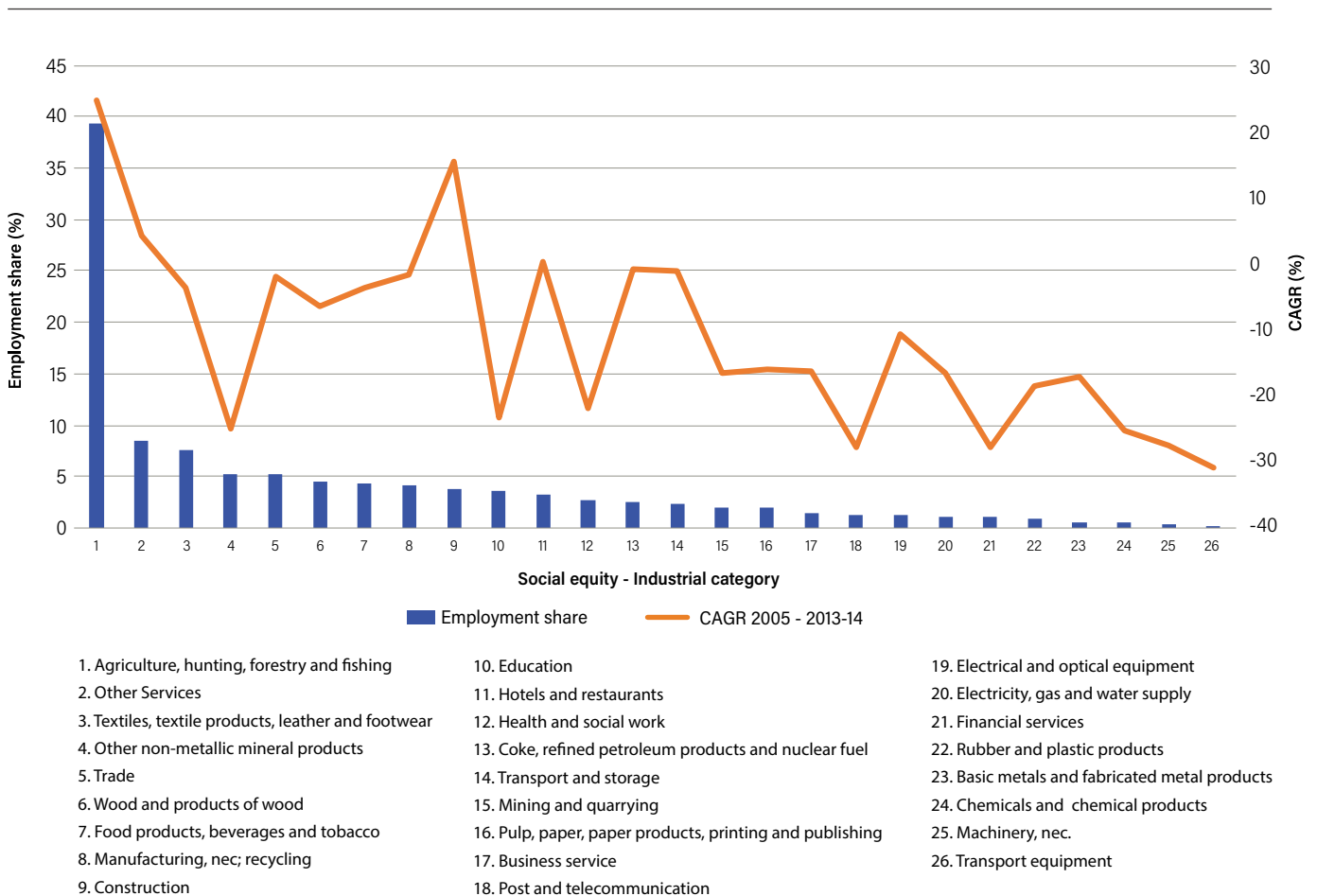
The decline in the WPR from 36 percent in 2001 to 35 percent in 2011, coincided with the rising level of unemployment in the region, which is a matter of serious policy concern. The percentage share of unemployment in Delhi NCR shot up from 2.24 percent in 2011–12 to 9.8 percent in 2018–19, according to NSS and PLFS data. One of the reasons for the rising share of unemployment is the presence of illiterate migrants, who moved to the region in search of a job. Illiterate migrants constituted about one-third of the migrants (with duration of residence 0 to 9 years) in 2011. According to the Census of India 2011, about 5 percent of the migrants (with duration of residence 0 to 9 years) were non-workers seeking jobs. Although Delhi NCR's economy grew, its job creation did not keep pace with the number of job seekers. The number of unemployed educated seeking jobs was as high as 21 percent of the working age population (population above 14 years) in Delhi NCR, which was 7 percentage points higher

than that of India. It is reported that nationally, over 30 percent of youth aged between 15 and 19 years were not in employment, education, or training (NEETs) in 2017 (Jethmalani 2017).

WOMEN AND OTHER MARGINALIZED GROUPS

Female employment in Delhi NCR grew only by a CAGR of 0.6 percent from 2005 to 2013–14. With regard to gender equity, 39 percent of those employed in the agriculture sector were women, which was the highest female percentage across all the sectors under consideration in 2013–14 (see Figure 26). This implies that majority of the women workers in the region are from the rural part of the region and are engaged in the low-wage employment sector. The growth rate of female employment (CAGR) in the region

FIGURE 26 | Percentage share of female employment in Delhi NCR across various industrial categories



Source: Authors' analysis using data from Central Statistics Office (a) (n.d.).

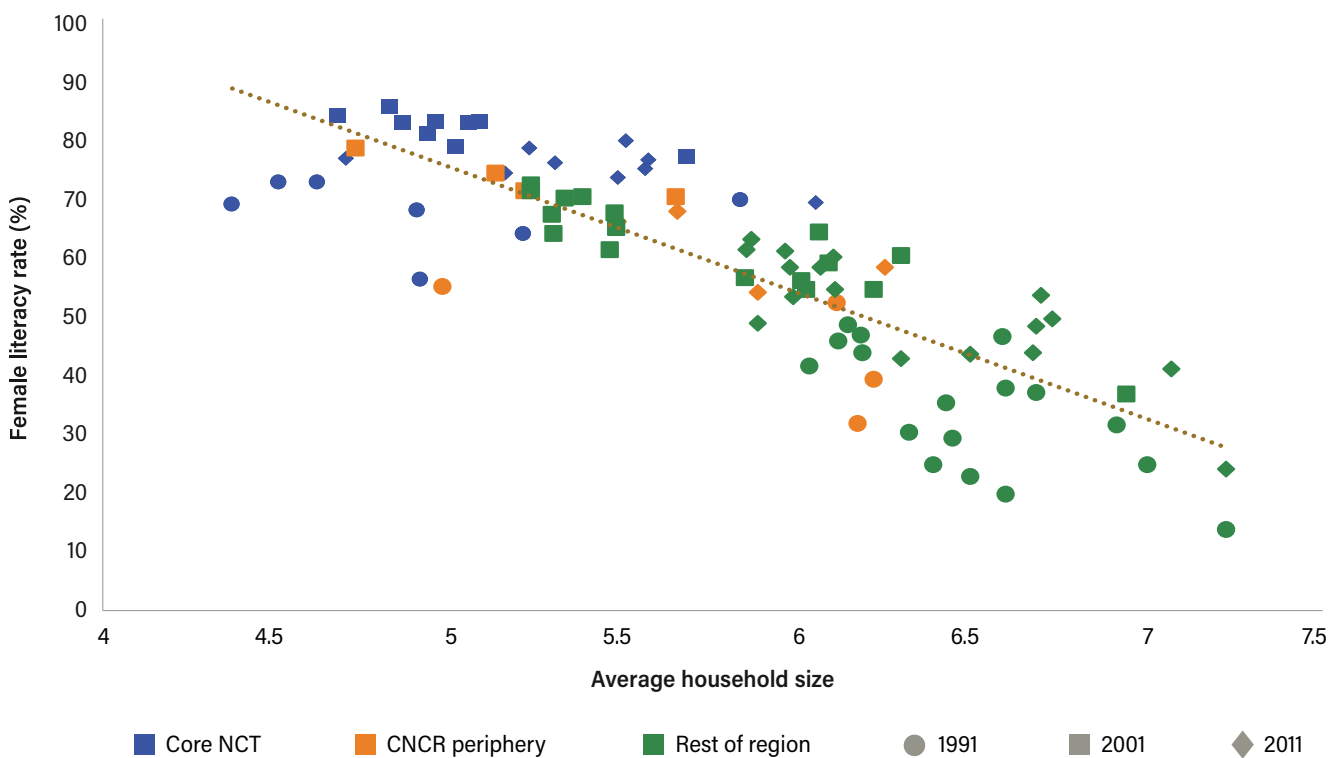
was higher in sectors such as agriculture, construction, trade, other services, textiles, manufacturing and recycling, and hotels and restaurants. Their presence and growth rate were much lower in higher-value sectors such as financial services and business services. The percentage share of female employment in secondary and tertiary sector jobs remained below 10 percent in 2013–14.

The region experienced a decline in female work participation rate from 20 percent in 2001 to 17 percent in 2011, which is 9 percentage points less than the national average. Despite the rise in the female literacy rate in the three regions, in 2011, the female WPR was the lowest in Delhi NCT at 10.58 and the highest in the Rest of Region at 20.49; it was 14.01 in CNCR Periphery. Female migration due to marriage or the need to shift with the household could be one of the reasons for the lower rate of work participation among females in Delhi NCR. An ILO study on women’s work and labor force participation in urban Delhi noted that women workers in Delhi are undercounted in labor force surveys because the work they perform is often home based or subcontracted; they

may also be self-employed (Sudarshan and Bhattacharya 2008). This study also noted women’s reproductive roles, societal cultural sanctions and patriarchal hierarchies, and aspiration-related issues as the likely causes of supply-side constraints of the women’s workforce in Delhi. In addition to this, safety and mobility concerns both inside and outside workplaces also impacted the female employment scenario in Delhi NCT.

Female literacy rates showed an improvement from 42 percent in 1991 to 68 percent in 2011, which had a positive effect on the household size. The improved literacy rates partly reflect better education and lead to better health indicators such as lower infant mortality rate and lower population growth (Saurabh et al. 2013). The percentage of children in the population in the region dropped from 19 percent in 1991 to 13 percent in 2011. When the female literacy rates across the region are plotted against the household sizes, a negative correlation is seen, implying that improved female literacy rates led to smaller household sizes across Delhi NCR subregions (see Figure 27).

FIGURE 27 | Average household size versus female literacy rate across Delhi NCR's three subregions



Notes: CNCR = Central NCR; NCR = National Capital Region; NCT = National Capital Territory.

Source: Authors’ analysis using data from Census of India (1991, 2001, 2011).

Although household size shrank from 6 in 2001 to 5.47 in 2011 for Delhi NCR, it remained higher than that of the country during the same period. Studies have noted that a decline in household size is often associated with higher economic development, which is measured through the rate of urbanization, educational expansion, economic pressure, improvement in infrastructure, level of national income, poverty rate, and other variables (Tripathi 2018). This finding confirms Delhi NCR's experience, where there has been an increase in the rate of urbanization, improvement in educational level, growth in per capita income, and a fall in poverty levels.

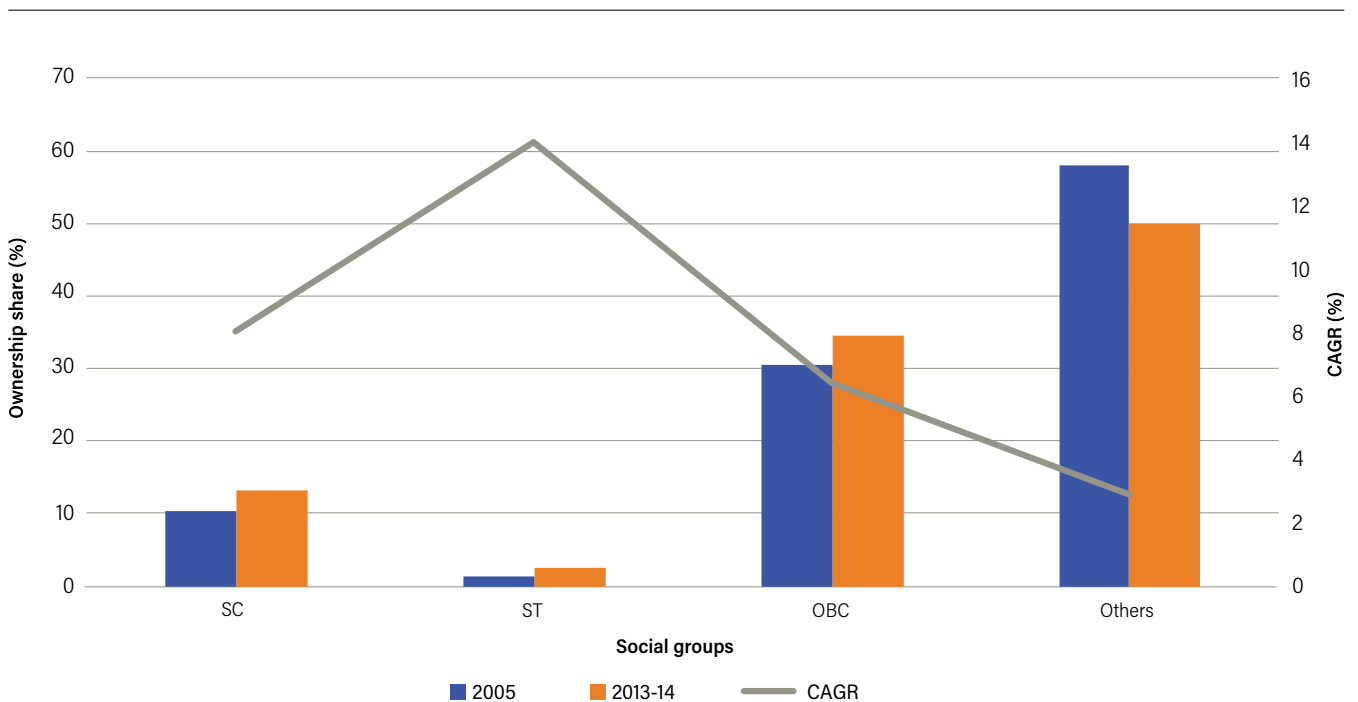
Analysis of data from the ownership of establishments across social groups shows that most of the establishments in the region are owned by those belonging to the Others¹⁹ category (50 percent), followed by Other Backward Classes (OBC)²⁰ (34 percent). SCs constitute 17 percent of Delhi NCR population, and about 13 percent of the establishments are owned by them. STs represent only 1 percent of Delhi NCR population, but they own 2.4 percent of the establishments in the region. There has been an increase in the ownership of establishments by SCs and STs, which grew 2.7 times and 4 times the ownership by those in the

Others category, respectively, as shown in Figure 28. This implies that SCs and STs are fairly represented in the ownership of establishments in Delhi NCR.

Figure 29 shows that SCs were mostly concentrated in construction activities (27 percent) in 2013–14, which was the case in 2005 as well (25 percent) and in petroleum products; textiles and leather products; and agriculture, fishing, and forestry. STs were mostly concentrated in electricity, gas, and water supply (3.9 percent) in 2013–14; they were mostly concentrated in mining and quarrying (2.7 percent) in 2005. OBCs were mostly concentrated in other non-metallic products (59 percent). For the Others category, the concentration of establishments moved from financial services (82 percent) in 2005 to rubber and plastic products (74 percent) in 2013–14. However, within the groups, establishments owned by SCs, STs, and those in the Others category were concentrated in trade, whereas establishments owned by OBCs were concentrated in agriculture.

This section covered the industrial transformation at NCR and subregional scales and its association with demographic trends. The next section briefly discusses the economic development approaches adopted by the global city-regions and the learnings from them for Delhi NCR.

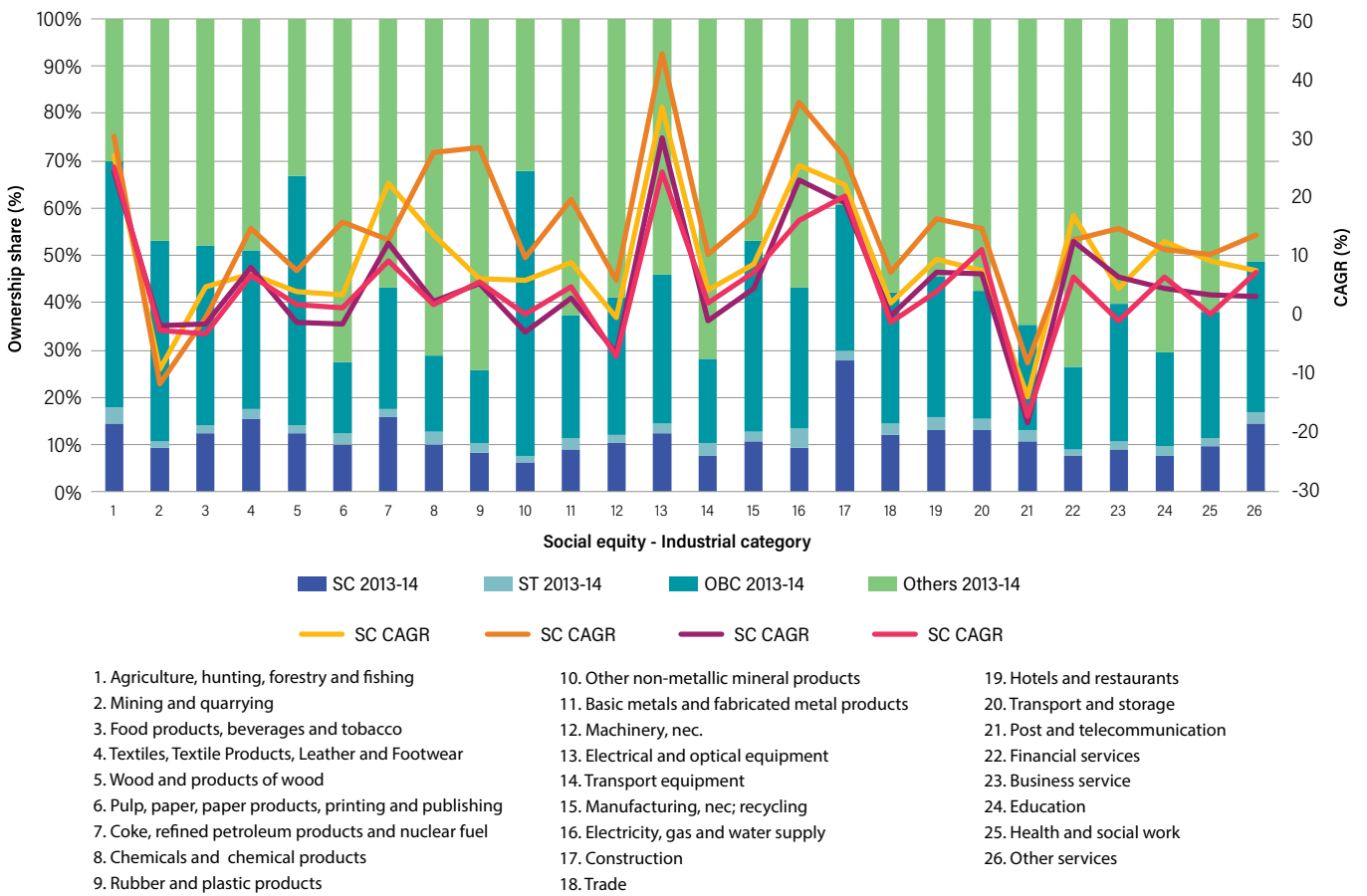
FIGURE 28 | Ownership of establishments by different social groups in Delhi NCR



Note: NCR = National Capital Region.

Source: Authors' analysis using data from Central Statistics Office (a) (n.d.).

FIGURE 29 | Ownership of establishments by different social groups across industrial categories



Notes: CAGR = compound annual growth rate; OBC = Other Backward Class; SC = Scheduled Caste.
 Source: Authors' analysis using data from Central Statistics Office (a) (n.d.).





CHAPTER 7

Economic development approaches adopted by global city-regions

Many of the global city-regions have a permanent economic development council or corporation that constantly works with elected representatives, industry associations, and academia to strategically plan for their economic development. Some of the key metrics of economic development in the global city-regions include job density targets, upgrading skill programs, crowding of public and private finances, and promoting sustainable technologies.



In the globalized world, cities and their region compete to attract both investments and talent. Indian cities have not yet taken the advantage of proactive planning for economic development, whereas many of the global city-regions have consistently adopted such strategic planning approaches.

Tokyo is a world city and a leading economic hub with a diversified and advanced economy in finance, manufacturing, and technology, accounting for about 21 percent of the nation's GDP (Statistica Research Department 2023). Delhi is comparable to Tokyo in population size and is projected to unseat it and become the largest agglomeration by population in the world in this decade. Tokyo had over 37 million people²¹ in 2018. The national government plays a major role in Tokyo's regional policy. The prime minister of Japan led the Urban Renaissance program of Tokyo, which was intended to enhance the attractiveness and international competitiveness of Japanese cities, promote the utilization of funds and know-how from the private sector, and eliminate bad loans through land liquidation (World Bank 2017).

State and non-state actors work in tandem across the state, region, and city in New York to promote economic development, and the city today has a GDP comparable to that of Canada. The New York City Economic Development Corporation (NYCEDC), a not-for-profit organization, works closely with the Department of City Planning to create the City's Strategic Plan led by the mayor. New York is a Global City Region that periodically plans its economic development by facilitating business growth, competitiveness, and job creation (NYC 2022). Through the mayor, a visionary Applied Sciences NYC initiative was launched in 2011 to diversify NY's economy beyond financial services for future growth in technology-related jobs and businesses. This initiative is today among the most

valuable start-up ecosystems in the world and has launched more than 80 start-ups that raised over \$1 billion in funding (NYC EDC n.d.).

China's 14th Five Year Plan (2021–2025) aims to develop and expand its urban agglomeration, metropolitan areas, and cities of various sizes so that they form a spatial pattern of urbanization (clusters) that are dense and divided but coordinated and fully functional. Investments in these clusters are helping develop high-speed railway networks, digital public services, and regional environmental management (Xin 2021). China aims to complete a grid of 16 new high-speed railway lines connecting various clusters.

The City of London too periodically prepares economic development strategies. In December 2018, the mayor committed to channeling investment into key areas to equip Londoners with the skills, education, and training they need to participate in the modern economy (Mayor of London 2018). He offered targeted support to sectors such as tech, life sciences, the night-time economy, and the capital's creative industries. After the pandemic, an immediate economic recovery framework for London was published in November 2021 around the pillars of Jobs, Business, Thriving Neighborhoods, Connected City, and Global London Pillar.

The city government of Barcelona amended its metropolitan master plan for the refurbishment of the derelict industrial area of Poblenou, and the 22@ Plan was adopted. Key strategies employed by the 22@ Barcelona Plan included restoring more than 4,600 derelict houses built during the Industrial Age and shifting to innovative knowledge-based activities. Five specialized clusters were created in the fields of media, energy, medical technologies, information and communication technologies, and design. Public spaces and green spaces were revitalized, and several networks, such as fiber-optic telecommunications, waste collec-



tion, and electricity, were created. This effort successfully revitalized the area, and Poblenuo was ranked as the fourth most economically powerful city by GDP in the European Union in 2018 (Urban Sustainability Exchange n.d.).

Johannesburg adopted economic strategies to revive its core city through inner city redevelopment frameworks that divided the inner city into 10 priority policy intervention zones in the Greater Johannesburg Strategic Metropolitan Development Framework. The Johannesburg City Council (1991–93) and later the Greater Johannesburg Metropolitan Council (1995 onward) evolved local economic development initiatives to reinvent, reimage, and remarket Inner City Johannesburg (Weiss 2001). The first strategic plan laid the foundation for financial restructuring and reorganizing service delivery, and the second one that followed was targeted toward integration of service delivery, human development, and economic growth. The spatially targeted investment program, called “Corridor of Freedom,” pursued by the city of Johannesburg in 2015 demonstrated strong institutional coordination that helped align investment for the program in the city’s strategic planning frameworks (Pieterse and Owens 2018). This program aimed to reduce spatial inequality by increasing the mixed-income density around the city’s bus rapid transit lines.

The Functional Plan for Economic Development of Delhi NCR is a document, issued once in 20 years, that analyzes data across parameters such as GDP and workforce distribution, identifies issues, and proposes a prescriptive list of industries that may be taken up. Contrast this with internationally competitive city-regions, which have a permanent economic development council or corporation that constantly works with elected representatives, industry associations, and academia. Targeted policies, strategies, incentives, and projects (including and beyond transport

infrastructure) are closely coordinated across departments with clear metrics to be achieved. The metrics include job density targets, funding and setting up institutes of technological excellence, strategic project planning and investment to be leveraged, upgrading skill programs, crowding of public and private finances, revitalizing old cores, and promoting sustainable technologies.

The following section concludes the report by presenting key findings, recommendations and way forward to improve the economic planning process of Delhi NCR.





CHAPTER 8

Findings, conclusions, recommendations, and the way forward

The recommendations include constituting an NCR Economic Development Corporation to build regional economic development strategies, setting up of a Delhi Economic Development Corporation to revitalize Core NCT, spatio-economic assessments to improve investment decisions and strategies to improve the participation of marginalized groups in the economy of Delhi NCR.

Delhi NCR has a diverse mix of industrial categories and has retained its historical strength in the trade, manufacturing, and agricultural employment base. Traditional manufacturing industries such as textiles, basic metals, electrical and optical equipment, and transport equipment in the secondary sector and livestock in the primary sector remain significant contributors of employment in the region. Trade is the predominant employer in the tertiary sector, followed by education, business services, and other services.

An assessment of growth trends and industrial competitiveness reveals that industrial sectors with a higher share of employment did not exhibit high annual growth in employment, with the agricultural sector being the only exception. The LQ analysis indicates that it is the manufacturing industries such as transport equipment, electrical and optical equipment, basic metals, and rubber and plastic that remain locationally prime and not the tertiary sector in the region when compared to the rest of India. The region's concentration of manufacturing activities further attracted warehousing activities along the peripheries and national highways.

Knowledge-based industrial sectors such as financial services have not exhibited higher growth rates (1.72 percent CAGR between 2005 and 2013–14) compared to the overall economic growth (4 percent between 2005 and 2013–14) nor have they contributed significantly to employment in the region. NOIDA and Gurugram have emerged as prominent destinations for the IT and ITES sector in the region.

The economic transition of the region mimics the national trend, with the annual employment growth of 2 percent in the region being higher than the national growth rate of 0.3 percent between 2005 and 2013–14. The annual GDP growth rates in the region and at the national level were 11 percent and 7 percent, respectively, between 2005–06 and 2013–14. The GDP from the tertiary sector in Delhi NCR grew at 12 percent annually between 2005 and 2013–14, while its employment grew at 1.24 percent during the same period, confirming low-employment growth in the economy.

The industrial efficiency analysis concluded that industries in prime locations in the region and having high employment shares, such as textiles, rubber, plastics, and metals, have improved in labor productivity, total factor productivity, and real value, but have not improved in energy efficiency. Among the top 10 employment sectors,



industries that have improved their energy efficiency have been experiencing lower employment growth than the employment growth of the region.

Spatial mapping of urban growth and change in night-lights reveals that peripheral urban centers, nodes, and transport corridors beyond Core NCT showed the maximum growth and change in luminosity, indicating a suburbanization of both urban and economic growth. Remote rural areas within Delhi NCR showed the least change in values. The density of jobs in the tertiary sector remained highly centralized up to a 10 km distance from the Core NCT and remained concentrated up to a 20 km distance before tapering off. Manufacturing sector establishments are present in Core NCT and CNCR Periphery and are also prominent along the arterial road corridors in the region. Agriculture is spread across the Rest of Region.

An examination of the structural transformation of the economy across the three subregions of Delhi NCR revealed that intra-regional adjustments occurred in employment distribution, with no accompanying job losses beyond Delhi NCR's boundary. Though clear outward shifts in employment occurred between the three subregions, the secondary and tertiary sectors continued to remain concentrated in Core NCT while the primary sector employment remained concentrated in the Rest of Region. The movement of employment from manufacturing industries such as textile and basic metals and fabricated metal products as well as from business services and education toward CNCR Periphery indicate a decentralized core. The declining growth rate of employment from these sectors in Core NCT further indicates a hollowing out of the Core. Over the years, Core NCT has also become less diversified than CNCR Periphery in terms of industrial sectors, as revealed by the HHI index.



The core–periphery regional spatial system of Delhi NCR, with its expanded transport networks such as the metro rail, is noted to be in the third stage of transition, which is marked by a diffusion or expansion of growth to other growth centers (Rodrigue 2020). Core NCT has not progressed to become a hub of innovation, nor has it attracted enough newer industrial activities to become the knowledge-based economy of the region. CNCR Periphery has been able to attract more business services, which include information technology and related services, than Core NCT and has evolved to become the most dynamic subregion of Delhi NCR, with the highest growth rates of jobs, specialization, migration, and per capita income. The dynamic nature of the core–periphery relationship as noted by Friedmann (1967) is evident in the case of Delhi NCR as well, wherein the CNCR Periphery has become part of the decentralized Core NCT.

With the expansion of the Delhi metro network and other investments in transport that improved the connectivity between Core Delhi NCT, CNCR Periphery, and the Rest of Region, housing and office markets extended beyond the Core to the adjoining districts of Haryana and Uttar Pradesh. As a result, Gurugram (in Haryana) and Gautam Buddha Nagar (Uttar Pradesh) had a higher per capita income than any district in their respective states. Being made up of rapidly urbanizing districts, however, CNCR Periphery was yet to catch up with Core NCT in terms of infrastructure provision levels, basic services, and public transport availability. Core NCT will need to strategically plan its future investments so that it can attract newer, higher-value industrial sectors such as financial services and business services without losing its advantage to the peripheries.

An estimated 72 million people resided in Delhi NCR in 2021. Core NCT was the most urbanized subregion (98 percent), followed by CNCR Periphery (68 percent) and the Rest of Region (27 percent). Migrants constituted about 39 percent of the population in 2011, which was 2 percentage points higher than the national average. The migrant population for all durations of residence in all the three subregions declined over time in 2011, with the highest decline in Core NCT. Analysis of the reasons for migration by gender shows that most of the male migrants moved to Delhi NCR for work and business purposes, unlike the female migrants, who moved largely for marriage-related reasons (other than “moving with household”).

With the increase in urbanization, literacy rates also improved across all the three subregions after 1991. The literacy rates in Delhi NCT, CNCR Periphery, and the Rest of Region were 86 percent, 80 percent, and 72 percent, respectively, in 2011. Analysis of the occupational classification of worker profiles showed that most workers (other than agricultural laborers and cultivators) were engaged in elementary occupations in Delhi NCR in 2011. Despite the high share of workers engaged in elementary jobs, such as salespersons and construction laborers, the region was able to attract a larger share of educated and technically qualified workers (19 percent in 2011) than the country (10 percent in 2011). This indicates that the region has the potential to offer high-skill jobs as well. Delhi NCR’s intra-regional economic transformation resulted in an increased movement of skilled labor toward CNCR Periphery, with 24 percent of the migrants here being graduates or higher.

The economic prosperity of the region is reflected in the ability of its economic entities to attract more per capita credit than entities at the national level. The region's growth in per capita income was 123 percentage points higher than that of the country's per capita income. However, the rising share of unemployment and the region's inability to offer jobs at a pace that matches the number of jobseekers is a concern. The region had 21 percent of educated unemployed (graduates and above), which was 7 percentage points higher than that of the country.

Data analysis revealed that overall literacy levels and the female literacy rate improved between 1991 and 2011. The reviewed literature showed that the improved literacy rate is associated with better education and health indicators and lower population growth. For example, the improvement in the literacy rate in Delhi NCR had a positive effect on the household size, which shrank from 6 to 5.47 between 2001 and 2011. However, the female work participation rate in the region decreased from 20 percent in 2001 to 17 percent in 2011, which is 9 percent lower than the national average. Female employment was concentrated in agriculture followed by the manufacturing and trade sectors, with low presence in higher-value sectors such as financial services and business services, which parallels the experience of other marginalized groups in the region. Ownership shares of establishments in the region was Other/General categories (50 percent), OBC (34 percent), SC (13%), and ST (2.4%). SC and ST establishments were concentrated in the manufacturing sector, whereas OBC establishments were concentrated in agriculture.

CONCLUSIONS

The dynamic spatial system of Delhi NCR across Core NCT, CNCR Periphery, and the Rest of Region is characterized by differing spatial and economic trends and diverse political and administrative jurisdictions. Formulating Delhi NCR Regional Plan and related strategies once in 20 years for the entire region is prescriptive and insufficient to address its dynamism and plan for its economic development needs. Delhi NCR continues to have a multiplicity of laws across the participating states for economic activity with inadequate supporting infrastructure, and regional policy directives remain recommendatory.

Aspects of economic development planning seen in global city-regions such as the presence of dedicated economic development councils, periodic preparation and updating

of strategic economic development plans, and partnerships with the private sector are absent. Strategic intent for economic diversification, competitiveness, investment crowding, job creation, economic recovery post pandemics, and core area revitalization is low despite Delhi NCR being India's prime economic powerhouse.

Core NCT is the nerve center of the fifth largest metro network in the world, with higher infrastructure provision levels than that in CNCR Periphery and Rest of Region; yet the core is hollowing out with an outward movement of people and jobs. CNCR Periphery includes the contiguous cities of Gurgaon, Faridabad, NOIDA, and Ghaziabad, which are not like conventional political backyards but instead attract the attention of their respective states through investments. Differentiated strategies must be employed to enable more compact development, better infrastructure provision in the peripheries, and the formation of planned clusters rather than firms spreading continually as strip development along regional transport corridors. Strategies to bring in higher-value industries such as business services and financial services, which currently have declining LQs in this region, must be understood. The booming livestock sector in the Rest of Region too needs to be examined to reduce its negative environmental impacts.

Locationally significant industries in the manufacturing sector that have high employment shares in the Delhi NCT have received diktats to move further out into the periphery due to concerns regarding pollution. This is in the backdrop of a hollowing core that is losing its jobs to the periphery and has been slow to attract industries in the knowledge sector. A place-specific plan that retains the economic diversity of the region and ensures efficiency and environmental improvements in the backdrop of clean technology improvements is preferable to declaring that such industries are non-conforming.

Women continue to face significant barriers to workforce entry in Delhi NCR, with low WPRs. Women and other marginalized groups are concentrated in elementary occupations that give them few opportunities to escape poverty. The high-growth and low-employment scenario needs to be addressed so that unemployment rates are curbed and wages are improved. Comparable and comprehensive data on the informal economy, which is the predominant employment sector, need to be collected and assessed.

RECOMMENDATIONS AND THE WAY FORWARD

Informing the planning process through an economic geography approach will enable place-specific strategies and processes that take into account job locations and clustering, their transformation over time, and the impact it will have on people and natural resource use. The following are our recommendations:

- NCR Economic Development Corporation (NCR-EDC) to be set up to build a Regional Economic Development Strategy: Delhi's extended urban agglomeration consists of multiple cities and economies of scale that geographically cut across multiple states and urban local body jurisdictions. Because this agglomeration functions as one economy and one labor pool, it requires regional economic development strategies that cut across jurisdictional and policy barriers. Learnings from competitive world city-regions indicate the need for a dedicated economic development agency that works closely with government, the private sector, and research institutes to drive an economic development strategy that delivers on clear impact metrics. The NCRPB could constitute an NCR Economic Development Corporation (NCR-EDC) with the support of the national government on the lines of the NCRTC. The NCRTC is a joint venture company of the Government of India and the states of Delhi, Haryana, Rajasthan, and Uttar Pradesh that focuses on planning and implementing strategic transport projects such as the RRTS. The broad responsibilities of the NCR-EDC could include the following:
 - Regional economic development strategy plan: The NCR-EDC can leverage the existing frameworks of interstate coordination to set up economic development strategies and goals for the region that are place specific and part of a continuously updated process (without being a one-time product). This will require a comprehensive assessment of the region's economic geography, including firm locations and clustering, industrial transformation, differing infrastructural and skilling needs, conceptualizing strategic projects, collaborating with the private sector, linking institutes of higher learning with industry, addressing environmental concerns and circularity, and setting up quality urban spaces to attract both people and investments.
 - Multi-stakeholder platform: A common platform to bring together various economic actors must be enabled through the NCR-EDC. This will bring government, the private sector, academia, and civil society representatives together on one platform to address aspects such as investment complementarity between the government and the private sector, human resource employability and skilling needs, data sharing between departments, common regional infrastructure development and connectivity such as the metro rail and inter-regional vehicle movement, and institutional cooperation.
 - Healthy competition between the participating states and cities: The NCR-EDC must foster healthy competition among the participating states and cities to attract investments and businesses to their regions. This could take the form of organized competitions and the disbursement of funds for regional development projects. The participating states and cities may offer suitable financial incentives, flexibilities in land use regulations for land development, tax exemptions, and simplified procedures for starting businesses. They could also offer better social and physical infrastructure amenities.
- Delhi Economic Development Corporation (Delhi EDC) to be set up to revitalize Core NCT: Core NCT still retains the highest density of jobs in the secondary and tertiary sector but is losing jobs to a dynamic CNCR Periphery that has attracted newer jobs and skilled labor. Global cities have revitalized their cores through targeted economic development strategies, and Core NCT has several strengths that it can leverage to revitalize itself. It has comparatively high infrastructure provision levels, such as the metro rail and the international airport, and a high density of universities of higher learning. Importantly, it is the national capital. A city-level economic development corporation (Delhi EDC) may be set up that works closely with the Delhi State Urban Development Department and the State Industries Department with the chief minister of the city-state as the chairperson to anchor the city economic development strategy.
 - City economic development strategy plan: Delhi EDC can leverage the intent of current industrial policies that seek to transition the city-state into a knowledge-based and high-tech industrial economy.

The strategy must provide flexibilities in land management and land use regulations and revise its industrial policy to interact with and attract newer businesses while retaining its highly skilled talent pool. Targeted and inclusive skill development programs that help the large share of informal sector workers transition to newer economy roles in the city will be vital to reduce job losses and unemployment.

- Core city revitalization plan: To achieve this revitalization, the plan must strategize the upgradation of its industrial infrastructure, refurbish derelict industrial areas, incentivize inner city redevelopment, and improve its fiber-optic and telecommunications networks. The draft Master Plan for Delhi 2041 has taken a positive step forward by allowing vertical mixing of compatible uses within buildings. Public spaces, heritage precincts and green areas, and connective public transport must be revitalized to attract knowledge workers and students to the city. That is, infrastructural revitalization must proceed in tandem with economic revitalization.
- Improving Core NCT's business environment: Partnerships with private players will help raise funds for revitalization of the core through well-structured incentives and transparent terms of engagement. Suitable financial and tax incentives to reduce the cost of doing business and location incentives such as a higher floor area ratio for knowledge-based economies may be provided. Industrial policy should include fiscal measures so that the manufacturing sector, especially small-scale industries catering to the large number of informal workers, can invest in technology upgradation and move up the ladder into efficient industrial sectors.
- Spatio-economic assessments for large infrastructure provisioning agencies to improve investment decisions: Evidence-based spatio-economic assessment studies will help spatially target infrastructure investments and FDI to locations where there is economic dynamism. Such targeted investments will provide the best return on investment and job growth, and lead to crowding in of public and private investment for economic development. Regional infrastructure projects proposed in the regional plan such as freight corridors, rapid rail, and arterial roads can be better planned through spatio-economic assessments. Competing aspirations across the constituent jurisdictions of Delhi NCR must be

managed fairly to ensure that large centrally and state-funded infrastructure investments follow transparent procedures for disbursement of public funds.

- Strategies to ensure the participation of marginalized groups in the economy: A safe and accessible work environment, social and cultural acceptance of women working outside the home, affordable and safe transport modes, safe public spaces, provision of enabling conditions such as childcare support and daycare centers for elderly people would encourage women to join the workforce. Marginalized groups require formal access to education, healthcare, basic services, and jobs. Alongside planning for high-technology-based and knowledge-based economies, the heterogeneity of the demographic needs must be recognized, such as skill development for workers in elementary occupations, access to digital platforms, customized training, and social security benefits. Such skill development may be provided through industrial training institutes, self-help groups, and such other organizations in the region. Platforms will need to be created for the exchange of information and experiences from time to time to ensure that strategies remain relevant and incorporate feedback loops.

The economic geography or spatio-economic approach used in this study could form an initial starting point for other mega city-regions in India and the Global South to improve their planning and target infrastructure investment decisions. The study takes into account the spatial structure of the city-region, the geographical location of firms, industrial efficiencies, job diversification and transformation over time, locational advantages and contributions to employment and GDP growth. This morphological understanding of the NCR's economy and its association with place-specific demographic changes will provide key insights to help decision-makers to ensure that the economic benefits of regional growth are distributed widely to all types of businesses and population segments in comparable mega city-regions. However, more data, research, and analysis are needed to develop a comprehensive spatio-economic assessment framework that can be applied to other mega city-regions in India and the Global South.



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The Brahmacharya Mandir is a religious site in Tikki, Rajasthan, India. It is a white marble structure with a large archway and a golden dome. The building is surrounded by a wall and has a sign that reads "ब्रह्मचर्य मंदिर, टिकी-1".

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Appendices



APPENDIX A: OVERVIEW OF NCR PLANS AND EMPLOYMENT IN LEADING INDUSTRIES IN DELHI NCR

TABLE A-1 | Main thrusts and policy zones of NCR plans

YEAR OF PUBLICATION AND (AREA)	PLAN VISION PERIOD/TITLE	MAIN THRUST	POLICY ZONES
1989 (30,242 sq. km)	National Capital Region Plan 2001	<ul style="list-style-type: none"> Contain Delhi's population within manageable limits. Reduce dependency on Delhi; three-tier policy approach; strict control for creation of employment opportunities within NCT, moderate control in DMA (excluding NCT), and encouragement with incentives for areas beyond DMA. Locate large-scale economic activities outside Delhi to discourage daily interaction with Delhi. 	<ul style="list-style-type: none"> Delhi NCT Delhi Metropolitan Area (including ring towns adjoining NCT) Beyond DMA up to the NCR boundary (predominantly rural and industrially backward)
2005 (34,144 sq. km)	National Capital Region Plan 2021	<ul style="list-style-type: none"> Emphasizes restricted growth and decentralization of activities concentrated in the NCT—only hi-tech industries are allowed within NCT Delhi. Though Delhi may lose some manufacturing activity, the plan envisages that NCT will attract services such as accountancy, law, advertising, finance, research and development, and consultancy for the factories located/relocated in the greenfield sites in the neighboring areas. In Central NCR towns adjacent to Delhi, no hazardous, polluting industries are allowed; the thrust is on hi-tech industries. Modern industrial townships/estates to be developed in the area outside Central NCR. 	<ul style="list-style-type: none"> Delhi NCT Central NCR excluding NCT Delhi (earlier DMA of RP 2001) comprising the controlled/development areas of the contiguous towns of Ghaziabad-Loni and NOIDA in Uttar Pradesh, the Faridabad-Ballabgarh complex, Gurugram, Bahadurgarh, Kundli, and the extension of the Delhi ridge in Haryana). Highway Corridor Zone (minimum width of 500 m inclusive of green buffer on either side of the right of way along the National Highways 1, 2, 8, 10, 24, 58, and 91 converging at Delhi) Rest of NCR



TABLE A-1 | Main thrusts and policy zones of NCR plans (cont'd)

YEAR OF PUBLICATION AND (AREA)	PLAN VISION PERIOD/TITLE	MAIN THRUST	POLICY ZONES
2021 (55,083 sq. km)	National Capital Region Plan 2041 (Draft in discussion)	<ul style="list-style-type: none"> ▪ NCT to continue as the economic hub but led by vertical development. Heavy industries will continue to be banned in NCT. ▪ Belt of Central NCR around NCT Delhi to serve as a Ring of Opportunity for investments outside Delhi: logistic parks, multimodal transport hubs, dry ports, high-value manufacturing sector, etc., are encouraged and permitted in this area. Central NCR to be the focal point to trigger economic development in the rest of the NCR. ▪ Thrust on economic development in the Rest of Region through planning large rural investment zones, special economic zones, and heavy industries. ▪ Proposes development of new clusters such as cleantech innovation clusters; creative enterprise zones; film, fashion, and design clusters; green enterprise clusters; new industrial estates, industrial parks, or industrial areas at strategic industrial locations across the NCR. ▪ Proposes development of growth corridors and opportunity areas based on the existing and proposed industrial corridors and economic hubs (such as DMIC and the international airport at Jewar). 	<p>Five policy zones</p> <ul style="list-style-type: none"> ▪ NCT Delhi ▪ Central National Capital Region (CNCR): Area from the boundary of NCT Delhi to the Eastern Peripheral Expressway and the Kundli–Manesar–Palwal Expressway up to 5 km beyond the outer edge of the right of way of this first ring of expressways ▪ Transit-oriented development zones as highway corridor zones: Zones extending from 800 m to 1 km on both sides of all rail transit corridors, expressways, national highways, and their transit nodes ▪ Conservation zones (natural and artificial) ▪ Rest of Region

Notes: DMA = Delhi Metropolitan Area; DP = Developmental Plan; DMIC = Delhi-Mumbai Industrial Corridor; NCR = National Capital Region; NCT = National Capital Territory.

Source: NCR Plan 2001, 2021, and 2041 (draft); NCRPB (1988, 2005, 2021).

TABLE A-2 | Employment share and annual growth in the leading industries in Delhi NCR

CATEGORY	YEAR	EMPLOYMENT (ABSOLUTE NUMBERS)	% SHARE OF EMPLOYMENT IN NCR	YEAR	CAGR OF EMPLOYMENT (%)
Total employment	2013-14	8,470,395	n/a	2005 to 2013-14	3.53
	2005	6,309,764	n/a	n/a	n/a
Agriculture, hunting, forestry, and fishing	2013-14	1,152,876	13.61	2005 to 2013-14	21.03
	2005	227,629	3.61	1998-2005	9.05
	1998	124,135	2.26	1990-98	6.37
	1990	75,764	2.03	n/a	n/a
Textiles, textile products, leather and footwear	2013-14	777,018	9.17	2005 to 2013-14	1.66
	2005	675,519	10.71	1998-2005	1.23
	1998	620,003	11.28	1990-98	8.39
	1990	325,372	8.71	n/a	n/a
Electrical and optical equipment	2013-14	299,607	3.54	2005 to 2013-14	9.56
	2005	137,876	2.19	1998-2005	-2.31
	1998	162,424	2.96	1990-98	9.52
	1990	78,458	2.1	n/a	n/a
Transport equipment	2013-14	242,679	2.87	2005 to 2013-14	11.46
	2005	96,518	1.53	1998-2005	1.88
	1998	84,703	1.54	1990-98	5.68
	1990	54,457	1.46	n/a	n/a
Construction	2013-14	101,325	1.2	2005 to 2013-14	17.52
	2005	25,685	0.41	1998-2005	-3.94
	1998	34,028	0.62	1990-98	6.41
	1990	20,696	0.55	n/a	n/a
Transport and storage	2013-14	302,696	3.57	2005 to 2013-14	6.92
	2005	171,443	2.72	1998-2005	-4.48
	1998	236,268	4.3	1990-98	6.88
	1990	138,721	3.71	n/a	n/a

TABLE A-2 | Employment share and annual growth in the leading industries in Delhi NCR (cont'd)

CATEGORY	YEAR	EMPLOYMENT (ABSOLUTE NUMBERS)	% SHARE OF EMPLOYMENT IN NCR	YEAR	CAGR OF EMPLOYMENT (%)
Education	2013-14	514,193	6.07	2005 to 2013-14	2.94
	2005	401,980	6.37	1998-2005	6.32
	1998	261,712	4.76	1990-98	0.72
Business Services	2013-14	439,751	5.19	2005 to 2013-14	4.05
	2005	313,706	4.97	1998-2005	11.2
	1998	149,165	2.71	1990-98	0.34
	1990	145,187	3.89	n/a	n/a
Trade	2013-14	1,966,301	23.21	2005 to 2013-14	-0.55
	2005	2,059,907	32.65	1998-2005	5.16
	1998	1,448,549	26.36	1990-98	4.8
	1990	995,626	26.66	n/a	n/a

Notes: n/a = not applicable; CAGR = compound annual growth rate; NCR = National Capital Region.

Source: Authors' analysis using data from Central Statistics Office (a) (n.d.).

APPENDIX B: DETAILED METHODOLOGY

Methodology for deriving indicators from EC and GDP data

Employment data were derived from Economic Census (EC) 3, 4, 5, and 6 for the periods 1990, 1998, 2005, and 2013–14. The data were extracted using raw files and then converted to a usable format before the analysis. The National Capital Region (NCR) datasets were generated using datasets at the state/union territory level after eliminating district-level information. The industry-level information in the economic datasets were categorized according to the National Industrial Classification (NIC). This classification scheme varied across the four datasets: EC 3 and EC 4 were based on NIC 1987, EC 5 was based on NIC 2004, and EC 6 used NIC 2008. The NIC codes for industries have undergone considerable changes. Therefore, before carrying out the analysis, a concordance was established across the four Economic Census (EC) NIC codes using the KLEMS concordance provided by the Reserve Bank of India, with a few adjustments to ensure data compatibility. Twenty-seven industry categories were created; the category "Public Administration and Defence; Compulsory Social Security" was removed because the data were not available in EC 6. The remaining 26 categories were grouped under primary, secondary, and tertiary categories, as shown Table B-1.

The key indicators under consideration were as follows:

- Percentage Share of Employment in industries in Delhi NCR = $(\text{Total Employment in industry} / \text{Total Employment across all industries}) \times 100$
- Compounded Annual Growth Rate (CAGR) = $\left(\frac{\text{Current Year Employment in industry}}{\text{Initial Year Employment in industry}} \right)^{(1/\text{number of years})} - 1 \times 100$
- The CAGR has been used because the time periods across the economic datasets vary, and the CAGR gives the annual growth rate rather than a simple growth rate, which would be affected by the difference in years between the two ECs under consideration.
- Location quotient (LQ) = $\frac{\text{Percentage share of employment in Industry X in Region Y}}{\text{Percentage share of employment in Industry X in the reference area}}$. The LQ was obtained by dividing the percentage share of employment in Industry X in Region Y by the percentage share of employment in Industry X in the larger reference region. In this case, X refers to the 26 industry categories considered in the analysis, Y refers to the NCR, and the reference area is India.

TABLE B-1 | Subcategories under primary, secondary, and tertiary sectors

PRIMARY	SECONDARY	TERTIARY
Agriculture, forestry, and fishing Mining and quarrying	<ul style="list-style-type: none"> ▪ Food and beverages and tobacco ▪ Textiles, textile products and leather and footwear ▪ Wood and products of wood and cork ▪ Pulp, paper and paper products, and printing and publishing ▪ Coke, refined petroleum, and nuclear fuel ▪ Chemicals and chemical products ▪ Rubber and plastics ▪ Other non-metallic minerals ▪ Basic metals and fabricated metal products ▪ Machinery, nec ▪ Electrical and optical equipment ▪ Transport equipment ▪ Manufacturing nec, recycling ▪ Electricity gas and water supply construction 	<ul style="list-style-type: none"> ▪ Trade ▪ Hotels and Restaurants ▪ Transport and Storage ▪ Post and Telecommunications ▪ Financial Intermediation ▪ Business Services ▪ Education ▪ Health and Social Work ▪ Other Services

Note: Economic Census (EC) 3, 4, 5, and 6 do not include crop production and cultivation for the periods under consideration (1990, 1998, 2005, and 2013–14).

Source: Central Statistics Office (a) (n.d.).

GDP

To make employment data comparable with the sectoral composition of GDP, data on agricultural laborers, cultivators, workers in crop production and plantations, and workers in public administration provided by the Census of India for 2001 and 2011 were added to EC 5 and EC 6 employment data.

Sources of GDP data were the following:

- GDP statistics at the India level were extracted from the quarterly GDP estimates at factor cost (at constant prices) New Series (Base 2004-05) released by the Reserve Bank of India.
- GDP data of Delhi NCR were extracted from the Functional Plan for Economic Development of NCR published by the NCRPB.
- Employment data from EC 5 and 6 were combined with Census of India data on agricultural laborers, cultivators and workers in crop production and plantations, and workers in public administration.

GDP data were approximated for 2013–14 using NCRPB GDP data for Delhi NCR metropolitan region, using CAGR projection methods. Using the CAGR of the GDP for each sector from 2003–04 to 2007–08, the GDP was projected for 2013–14 using the following formula:

Projected Value = Current Value \times $\left(\frac{\text{CAGR}}{100} + 1\right)^{\text{number of years}}$.

The 26 categories of employment data under consideration were aggregated to match the GDP sectors both at the India and NCR levels. For the India level, seven categories of employment and GDP were compared because the trade, transport, and communication sectors is treated as one category in the quarterly estimates of GDP released by the RBI. However, for Delhi NCR, there are eight categories of GDP and employment, because GDP data on trade and commerce are provided separately in the NCRPB functional plan on economic development.

To calculate various efficiency indicators, KLEMS data from 1981–82 to 2017–18 are used, wherein the averages across the period 1981–82 to 1991–92 were matched with EC 1990, the period 1992–93 to 2001–02 with EC 1998, the averages from 2002–03 to 2011–12 with EC 2005, and 2012–13 to 2017–18 averages with EC 2013–14. Growth of Energy Efficiency (India) is calculated as $\left(\frac{\text{Current Year Energy Efficiency}}{\text{Initial Year Energy Efficiency}}\right)^{(1/\text{number of years})} - 1 \times 100$, where the output energy cost is the inverse of the share of the energy input in the gross value of the output.

Methodology for deriving demographic and others socioeconomic indicators

Data on the demography, migration, educational level of workers and non-workers, and occupational classification of workers were extracted from various census tables published by the Office of the Registrar General & Census Commissioner, India. Primary Census Abstract (PCA) tables at the district level as well as at the ward and village levels for all the districts of a state were used to derive various demographic data as well as workforce data. The PCA tables of 2011 and 2001 provide workforce data according to the fourfold industrial classification, which gives the numbers of main and marginal workers classified as cultivators, agricultural laborers, household industry (HHI) workers, and other workers (i.e., workers not in the preceding three categories). The PCA 1991, however, followed the ninefold industrial classification of main workers. To make the PCA 1991 data comparable with the data of the later census years, seven categories of main workers, which include livestock, mining, manufacturing in other household industries, construction, trade, and transport, provided in the PCA 1991 were combined to obtain the total number of other main workers. Occupational classification tables, tables on marginal and non-workers seeking work or those available for work along with the educational level were used to understand the profile of non-workers, who by the definition used by the census, are persons who are not engaged in any productive work in Delhi NCR.

The per capita income (PCI) of districts in Haryana for 2004–05 and 2011–12 (2004–05 constant prices) were taken from Functional Plan for Economic Development of National Capital Region 2016, NCRPB, Ministry of Urban Development, Government of India, and Inter Regional Disparities In Haryana (2014), Institute for Development and Communication, Report submitted for Department of Planning, Government of Haryana, respectively. The PCI of districts in Haryana for 2016–17 (at 2004–05 constant prices) was not available. The state economics and statistics departments have income data for 2016–17 (at 2011–12 prices) at the state level. Using the splicing method, this value was converted to 2016–17 (2004–05 series) by using the formula $(\text{PCI } 2011-12 \text{ (old series)} / \text{PCI } 2011-12 \text{ (new series)}) \times 2016-17 \text{ (new series)}$. This figure was distributed among districts using the weights created from graduate workers (0.25), select tertiary sector workers (0.25), and PCI 2011–12 at 2004–05 constant prices (0.5). The district-wise percentage of select tertiary sector workers, percentage of graduate workers, and PCI 2011–12 (2004–05 series) were divided by its corresponding averages to standardize the value. These are then added to

obtain the final weight. Each of these weights was multiplied to the state level 2016–17 (2004–05 prices) to obtain the district level PCI for 2016–17 (2004–05) district figures. PCI 2011–12 at (2004–05) constant price for the districts of Uttar Pradesh (UP) was not available. Hence, it is estimated in two stages. In the first stage, the ratio of 2009–10 to 2004–05 (X) of all UP districts was calculated. Then the value calculated

using $((X - 1) \times 0.2 + 1) + 50$ percent of the average of the ratio of 2011–12 to 2009–10 for Haryana and Rajasthan was multiplied by the 2009–10 figures of UP districts to obtain 2011–12 data.

The indicators used in the demographic assessment are listed in Table B-2.

TABLE B-2 | List of indicators used for demographic assessment of Delhi NCR

	INDICATORS	FORMULA	DATA SOURCE	YEARS
1	Average household size	Total Number of Households/Total Population $\times 100$	Tables on Housing, household amenities and assets (Census of India)	1991, 2001, 2011
2	Percentage of child population	Total child population (0–6 years)/Total population $\times 100$	Primary Census Abstract tables, Census of India	1991, 2001, 2011
3	Population growth rate	(Present Population – Past Population)/ Past Population	Primary Census Abstract tables (Census of India)	2001, 2011
4	Percentage of urban population	(Urban Population/Total Population) $\times 100$	Census of India	1991, 2001, 2011
5	Literacy rate	Number of Literates/Total population of 7 years and above $\times 100$	Primary Census Abstract tables (Census of India)	1991, 2001, 2011
6	Percentage of migrants (all durations of residence)	Number of migrants (all durations of residence)/Total population $\times 100$	Table on migrants classified by place of last residence, sex, and duration of residence in the place of enumeration (Census of India)	1991, 2001, 2011
7	Percentage of migrants (0 to 9 years of duration of residence)	Number of migrants in the last 0 to 9 years of duration of residence/Total number of migrants (all durations of residence) $\times 100$	Table on Migrants classified by place of last residence, sex, and duration of residence in the place of enumeration (Census of India)	1991, 2001, 2011
8	Percentage of migrants who have migrated in the last 0 to 9 years for work/employment and business purposes	Number of migrants (0 to 9 years of duration of residence) with reason as work/employment or business purposes /Total number of migrants in the last 0 to 9 years of duration of residence $\times 100$	Table on Migrants by place of last residence, age, sex, reason for migration, and duration of residence (Census of India)	2011
9	Percentage of migrants who have migrated in the last 0 to 9 years for education	Number of migrants (0 to 9 years of duration of residence) with reason as education/Total number of migrants in the last 0 to 9 years of duration of residence $\times 100$	Table on Migrants by place of last residence, age, sex, reason for migration, and duration of residence (Census of India)	2011
10	Percentage of migrants who have migrated in the last 0 to 9 years due to marriage	Number of migrants (0 to 9 years of duration of residence) with reason as marriage /Total number of migrants in the last 0 to 9 years of duration of residence $\times 100$	Table on Migrants by place of last residence, age, sex, reason for migration, and duration of residence (Census of India)	2011
11	Percentage of graduate workers (this percentage is calculated for Main Other workers who are graduates or who have a technical degree and higher level of education)	(Number of Main Other workers who are graduates + Number of Main Other workers who have a technical degree or diploma equivalent to a bachelor's degree or postgraduate degree)/Total number of Main Other workers $\times 100$	Table on Main workers classified by industrial category, educational level, and sex (Census of India)	1991, 2001, 2011

TABLE B-2 | List of indicators used for demographic assessment of Delhi NCR (Cont'd)

	INDICATORS	FORMULA	DATA SOURCE	YEARS
12	Percentage of Main workers who are graduates or who have a technical degree and higher level of education	(Number of Main workers who are graduates + Number of Main workers who have a technical degree or diploma equivalent to a bachelor's degree or postgraduate degree)/ Total number of main workers × 100	Table on Main workers classified by industrial category, educational level, and sex (Census of India)	1991, 2001, 2011
13	Work Participation Rate	Total (Main + Marginal) Workers/Total Population × 100	Primary Census Abstract tables (Census of India)	1991, 2001, 2011
14	Percentage of main agricultural laborers and cultivators	Total main (agricultural laborers+ cultivators) workers/Total (Main+ Marginal) workers × 100	Primary Census Abstract tables (Census of India)	2001, 2011
15	Credit-deposit ratio (%)	(Credit/Deposit) × 100	Reserve Bank of India	2001-02, 2011-12, 2019-20
16	Per capita credit (in thousands of rupees)	Credit (in thousands of rupees)/ Number of workers in non-household industries (non-HHI) and Other workers	Primary Census Abstract tables (Census of India)	1991, 2001, 2011
17	Per capita income (Rs.)	Gross District Domestic Product (GDP)/ the mid-year population of districts	Department of Economics and Statistics of respective state governments	2004-05, 2011-12, and 2016-17
18	Monthly per capita expenditure (MPCE) (in Rs.)	Weighted average of MPCE	National Sample Survey Office (NSSO) Consumption Expenditure Rounds. Calculated by the research team from unit-level data	2004-05, 2011-12
19	Regular salaried/wage employee (%)	(Number of Regular salaried or wage employees/Total workforce (principal and subsidiary) × 100	NSSO Employment and Unemployment Rounds and Periodic Labour Force Survey. Calculated by the research team from unit-level data	2004-05 (NSSO), 2011-12 (NSSO), and 2018-19 (PLFS)
20	Built-up	Percentage of Built-up Area to the Total Area of the District calculated at 30 m spatial resolution	WRI India, European Commission – Joint Research Centre	1990, 2000, 2010, 2020
21	Percentage of households with laptop or computer	(Number of households with laptop or computer/Total number of households) × 100	Table on Number of households using banking services and number of households having each of the specified assets (Census of India)	2011
22	Percentage of households with Internet access	(Number of households with laptop or computer with Internet/Total number of households with laptop or computer) × 100	Table on Number of households using banking services and number of households having each of the specified assets (Census of India)	2011
23	Poverty (%)	(Number of People below state specific poverty line/Population) × 100	NSSO Consumption Expenditure Rounds. Calculated by the research team from unit-level data	2004-05, 2011-12
24	Unemployment Rate (%)	(Number of People seeking work/ available for work/Total workforce) × 100	NSSO Employment and Unemployment Rounds and Periodic Labour Force Survey. Calculated by the research team from unit-level data	2004-05 (NSSO), 2011-12 (NSSO), and 2018-19 (PLFS)

TABLE B-2 | List of indicators used for demographic assessment of Delhi NCR (Cont'd)

	INDICATORS	FORMULA	DATA SOURCE	YEARS
25	Percentage of illiterate migrants (by all durations of residence)	Number of illiterate migrants (all durations of residence)/Total number of migrants by all durations of residence × 100	Table on Migrants classified by place of last residence, education and duration of residence in the place of enumeration	1991, 2001, 2011
26	Percentage of illiterate migrants migrated in the last 0 to 9 years	Number of illiterate migrants (duration less than 1 year to 10 years)/Total number of migrants with (0 to 9 years of duration of residence) × 100	Table on Migrants classified by place of last residence, education, and duration of residence in the place of enumeration	1991, 2001, 2011
27	Percentage of migrants who are non-workers and seeking work/available for jobs (by all durations of residence)	Number of migrants who are non-workers and seeking work/available for jobs (all durations of residence)/Total number of migrants (by all durations of residence) × 100	Census of India	2011
28	Percentage of migrants who are non-workers and seeking work/available for jobs with duration of residence 0 to 9 years	Number of migrants who are non-workers and seeking work/available for jobs (0 to 9 years of duration of residence)/ Total number of migrants (0 to 9 years of duration of residence) × 100	Census of India	2011

Note: NCR = National Capital Region.

Source: Authors' computation.

Data used to derive the demographic indicators and socioeconomic indicators shown in Table B-2 were aggregated at the district level. For analysis and comparison across the three regions, data extracted at the district levels were aggregated for the three subregions: Core NCT, CNCR Periphery, and the Rest of Region.

Methodology used to apportion EC data for the newly created districts in Delhi NCR

The ECs conducted for the years from 1990 to 2013–14 do not include the newly created districts, as some districts were formed at a later stage. In the NCR, three districts in Haryana, two in Uttar Pradesh (UP), and nine in Delhi state were created after the 1991 census period. For the newly created districts in Haryana and UP, the census year 2011 was considered the base year for creating the primary census abstract (PCA) tables for the new districts. PCA tables were generated for the newly created districts for the earlier census years by matching the village and town names as well as the tehsil names with the PCA tables of the districts from which those districts were created. For instance, for Mewat, all the village and town names along with the tehsil names were matched with the names from the PCA tables of Gurugram for 2001 and 1991. Hence, the actual figures

for the population, sex ratio, child sex ratio, and workforce details were obtained for the newly created districts of UP and Haryana. For the nine districts of Delhi, the PCA data for 1991 were derived by recasting the data of all the variables of Census 1991 in accordance with the latest jurisdiction (as provided by Census 2011). All the administrative boundaries of the year 1991, such as the boundaries of census towns, villages, and wards of the Delhi Municipal Corporation (DMC), New Delhi Municipal Council (NDMC), and Delhi Cantonment boards, were superimposed on the administrative boundaries of 2011 using a geographic information system (GIS). Because ward boundaries of the DMC and NDMC of 1991 were split by the district boundaries into multiple parts, apportioned values based on the proportion of the area of each ward falling in a district were calculated.

However, for data that have been extracted from census tables other than PCA tables, apportionment was carried out for the new districts of UP and Haryana as described in the next section. For EC datasets, because the data used are on employment, the workforce population was apportioned instead of the population or built-up area. The method used to apportion EC data is shown in Table B-3.

From the workforce percentage shares, it is seen that, for example, when the employment figures of Mewat and Gurugram were combined, Mewat had 30 percent of the

TABLE B-3 | Apportionment of EC data for the newly created districts in Delhi NCR

NEW DISTRICT	APPORTIONMENT FORMULA WITH WORKFORCE POPULATION CENSUS 2011	YEAR FOR WHICH DATA WERE APPORTIONED
Rohtak	(Rohtak + Jhajjar +Rewari)×37%	1990
Jhajjar	(Rohtak + Jhajjar +Rewari)×32%	1990
Rewari	(Rohtak + Jhajjar +Rewari)×31%	1990
Gurugram	(Gurugram +Mewat)×70%	1990, 1998, 2005
Mewat	(Gurugram +Mewat)×30%	1990, 1998, 2005
Faridabad	(Faridabad+ Palwal)×70%	1990, 1998, 2005
Palwal	(Faridabad+ Palwal)×30%	1990, 1998, 2005
Meerut	(Meerut +Baghpat)×73%	1990
Baghpat	(Meerut +Baghpat)×77%	1990
Ghaziabad	(Ghaziabad+Gautam Buddha Nagar+Bulandshahr)×48%	1990
Gautam Buddha Nagar	(Ghaziabad+Gautam Buddha Nagar+Bulandshahr)×18%	1990
	(Ghaziabad+Gautam Buddha Nagar+Bulandshahr)×34%	1990

Note: EC = Economic Census.

Source: Authors' computation.

total employment. Therefore, the same percentage shares were used to apportion the employment in the district of Gurugram before Mewat was created, and the data for these shares were counted separately. The apportionment for other districts were done in the same way, depending on the districts they were carved out of.

Method for deriving demographic indicators for the newly created districts in Delhi NCR

To derive indicators that are derived from variables such as the number of migrants and the number of Main Other workers who are graduates and above, it was assumed that the ratio of the population of the newly created districts to that of the population of the parent district (the district from which the new districts were created) will be equal to the ratio of the value of the variable of interest (say, migrant population) of the newly created district to the value of the variable of interest (say, migrant population) of the parent district. Similarly, to get the total number of households (excluding institutional households), it was assumed that the ratio of the number of households (HHs) of the newly

created districts to that of the original district obtained from the PCA table will be equal to the ratio of the number of households of the new districts to that of the original districts obtained from the housing amenities (HH) table. That is,

$$\text{No. of HHs of new district (obtained from PCA) / No. of HHs of original districts (from PCA)} = \text{No. of HHs of new district (excluding institutional HHs) / No. of HHs of original districts (from the HH amenities table)}$$

Hence, the ratio on the left-side hand side of the above equation multiplied by the number of HHs of the original district (from the HH amenities table), which is the denominator of the right-hand side, will give the number of HHs in the newly created districts. If a district was carved out from two other districts, the villages and towns falling in each of the parent districts were added separately to get the share of HHs from each of the parent districts. Using the same assumptions as above, the number of HHs in the new district was calculated by adding the share of HHs in each of the parent districts. For example, in the year 1991, 17 percent of the HHs in Ghaziabad (from PCA) and 10 percent of the HHs

in Bulandshahr district (from PCA) were in Gautam Buddha Nagar. That is,

Number of households in Gautam Buddha Nagar = 10 percent × number of households in Bulandshahr (from the HH amenities table) + 17 percent × number of households in Ghaziabad (from the HH amenities table).

National classification of occupation of workers

Table B-4 presents national occupations as classified by the Ministry of Labour & Employment, Government of India. For additional details on the classification of workers, see National Classification of Occupation-2004, Code Structure (Ministry of Labour & Employment 2004).

TABLE B-4 | National Classification of Occupations of workers

DIVISION	SUBDIVISION
Legislators, Senior Officials, and Managers	Legislators and Senior Officials Corporate Managers General Managers
Professionals	Physical, Mathematical, and Engineering Science Professionals Life Science and Health Professionals Teaching Professionals Other Professionals
Technicians and Associate Professionals	Physical and Engineering Science Associate Professionals Life Science and Health Associate Professionals Teaching Associate Professionals Other Associate Professionals
Clerks	Office Clerks Customer Services Clerks
Service Workers and Shop & Market Sales Workers	Personal and Protective Service Workers Models, Salespersons, and Demonstrators
Skilled Agricultural and Fishery Workers	Market Oriented Skilled Agricultural and Fishery Workers Subsistence Agricultural and Fishery Workers
Craft and Related Trades Workers	Extraction and Building Trades Workers Metal, Machinery, and Related Trades Workers Precision, Handicraft, Printing, and Related Trades Workers Other Craft and Related Trades Workers
Plant and Machine Operators And Assemblers	Stationary Plant and Related Operators Machine Operators and Assemblers Drivers and Mobile-Plant Operators
Elementary Occupations	Sales and Services Elementary Occupations Agricultural, Fishery, and Related Laborers Laborers in Mining, Construction, Manufacturing, and Transport
Workers Not Classified by Occupations	Workers Reporting Unidentifiable or Inadequately Described Occupations

Source: Ministry of Labour & Employment 2004.

Calculation of unrelated variety of industrial sectors

Unrelated variety (UV) measures the extent to which a region is diversified by type of industrial activity. It is calculated using the formula

$$UV = \sum_{g=1}^G P_g \log_2 \left(\frac{1}{P_g} \right)$$

where P_g is the employment share by industrial sector ($g = 1, 2, \dots, G$) at the two-digit level. The values of UV can vary from 0 (when all employment is concentrated in only one two-digit sector) up to $\log_2(G)$ (when all sectors employ an equal number of employees across the 26 industrial categories). In this analysis, the number of two-digit industrial sectors of Delhi NCR is 26; hence, the upper limit of UV, which is $\log_2(G)$, is 4.70. UV has been calculated by industrial sector at the two-digit level across Core NCT, CNCR Periphery, and the Rest of Region using EC data of 2013–14.

ABBREVIATIONS

CAGR	Compounded Annual Growth Rate	NIC	National Industrial Classification
CNCR	Central National Capital Region	NOIDA	New Okhla Industrial Development Authority
DDA	Delhi Development Authority	NSSO	National Sample Survey Office
DMIC	Delhi-Mumbai Industrial Corridor	OBC	Other Backward Castes
EC	Economic Census	PCA	Primary Census Abstract
EDC	Economic Development Corporation	PLFS	Period Labour Force Survey
EE	Energy Efficiency	RBI	Reserve Bank of India
GDP	Gross Domestic Product	RRTS	Regional Rapid Transit System
GIS	Geographic Information System	SC	Scheduled Castes
GVA	Gross Value Added	ST	Scheduled Tribes
HH	Household	TFP	Total Factor Productivity
HHI	Herfindahl Hirschman Index	UN	United Nations
ILO	International Labour Organization	UV	Unrelated Variety
IT	Information Technology	WPR	Work Participation Rate
KLEMS	K, Capital; L, Labor; E, Energy; M, Materials; S, Purchased Services		
LP	Labor Productivity		
LQ	Location Quotient		
MoSPI	Ministry of Statistics and Programme Implementation		
MSME	Micro, Small, and Medium Enterprises		
NCR	National Capital Region		
NCRPB	National Capital Region Planning Board		
NCT	National Capital Territory (Delhi)		

ENDNOTES

1. Population as projected in the Draft Regional Plan for NCR, 2041.
2. Rajasthan Start up Policy 2015, Uttar Pradesh Information Technology & Start-Up Policy 2017-2022, Delhi Start up Policy 2022, and Haryana State Startup Policy 2022 are some of the start-up policy initiatives taken by the participating state governments to promote start-up ecosystems in the region. The start-up ecosystem in Delhi NCR has a healthy mix of sectors such as consumer products and services, e-commerce enterprise products, foodtech, health, fintech, agriculture, logistics, mobility, Industrial Internet of Things (IIoT), and edtech (TIE 2019).
3. The urban influence of NCT Delhi on the towns in Delhi NCR was measured by computing the index of influence using indicators such as the population growth rate, population density, sex ratio, literacy rate, household size, total work participation rate, and the percentage of main workers in non-primary activities for the years 1991, 2001, and 2011 (Morya and Ram 2020).
4. West Bengal and Uttar Pradesh are the two other leading states in poultry meat production in the country.
5. The function plan on micro and household enterprises in Delhi NCR does not cover the newly added districts. These include Bhiwani, Mahendragarh, Jind, and Karnal districts of Haryana state, Bharatpur district of Rajasthan state, and Muzaffarnagar and Shamli districts of Uttar Pradesh state.
6. The ease of doing business report of the World Bank assess the performance of an economy based on 11 parameters: Starting a business, Dealing with construction permits, Trading across borders, Resolving insolvency, Getting electricity, Registering property, Getting access to credit, Protecting minority investors, Paying taxes, Enforcing contracts, and Employing workers.
7. Business services include management consultancies, computer programming, and information-services-related activities.
8. Other services include real estate activities; broadcasting and programming activities; information service activities; libraries, archives, museums, and other cultural activities; sports and recreational activities; building services and landscape activities; activities of households as employers; and activities of membership-based organizations.
9. The paper adopts the industrial categories used in Delhi's industrial Policy 2010-2021 as knowledge-based industries. Information technology and information technology enabled services, educational services, business and financial services, media, research and development, design, and biotechnology are classified as knowledge-based industries in Delhi's Industrial Policy 2010-2021.
10. A survey conducted in Haryana between 2021 and 2022 reported that among the polluting industries operating in Gurugram, Faridabad, Sonapat, Panipat, Jhajjar, and Rohtak that fall in Delhi NCR, the textile sector accounted for 64 percent of the polluting industries that discharge effluents (Pati 2023).
11. Delhi Metro lines assessed in the WRI study include operational, under construction, and proposed alignments.
12. Density as defined in the World Development Report 2009 is the economic mass per unit of land area, or the geographic compactness of economic activity.
13. Mumbai, Delhi, Bangalore, Kolkata, Chennai, Hyderabad, and Ahmedabad are the seven large cities analyzed in the study (World Bank 2013).
14. The share of migrants in Delhi NCR is derived from the aggregated number of migrants who have moved in from a place outside the place of enumeration.
15. "All durations of residence" is the aggregate of durations of residence less than 1 year, 1–4 years, 5–9 years, 10–19 years, 20+ years, and those migrants who have not reported their duration during the census survey.
16. The "Others" category of workers includes government servants; municipal employees; teachers; factory workers; plantation workers; those engaged in trade, commerce, business, transport, banking, mining, construction, and political or social work; priests; and entertainment artists (Census of India 2011).
17. The classification is based on the National Classification of Occupation, which aligns with the corresponding International Standard Classification of Occupation (ISCO) maintained and updated by the Directorate General of Employment, Ministry of Labour and Employment, Government of India. For the detailed occupation classification, see Appendix B.

18. "Elementary occupation" refers to work that mainly requires the use of hand-held tools and some physical effort. Laborers involved in construction fall in this category. Examples of elementary occupations in the "Sales and service" category are door-to-door salespeople and building caretakers. Laborers in the "Agriculture, fishery, and related" and "Mining, construction, manufacturing, and transport" categories also belong to the "Elementary occupations" classification.
19. The Others category includes the general categories of all religions and all other social groups other than Scheduled Caste/Scheduled Tribe (SC/ST) and Other Backward Classes (OBC).
20. OBC (Other Backward Classes): According to the Constitution (105th Amendment) Act 2021, OBCs are the socially and educationally backward classes of the population. A central list of socially and educationally backward classes is prepared and maintained by and for the Central Government.
21. UNDESA 2019.

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ABOUT WRI INDIA

WRI India is a research organization that turns big ideas into action at the nexus of environment, economic opportunity, and human well-being.

OUR CHALLENGE

Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

OUR VISION

We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

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