



## RESEARCH ARTICLE

### STRUCTURAL TRANSFORMATION, SPATIAL POLARIZATION, AND THE SUB-NATIONAL RESOURCE CURSE: A DIAGNOSTIC AND SPATIAL TRADE ANALYSIS OF CHHATTISGARH, INDIA

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#### ABSTRACT

This study investigates the structural, commercial, and spatial dynamics of Chhattisgarh—a landlocked, natural-resource-abundant province in Central India—using harmonized macroeconomic, banking, and trade records across the 2011–12 constant series. Despite accounting for a major share (approximately 13.4% based on recent Indian Bureau of Mines and state economic surveys) of India's total mineral production value and maintaining base load electricity surpluses, the state exhibits classic sub-national resource enclave dynamics. Analysis of Gross Value Added reveals an industrial sector generating over 50% of real output, while modern commercial services—specifically Trade, Repair, and Hospitality (LQ = 0.67) and Financial Intermediation (LQ = 0.60)—exhibit persistent structural deficits. Outbound merchandise trade displays high commodity concentration (longitudinal mean HHI\* = 0.294), with over 81% of export value concentrated in primary metals and bulk rice. Spatially, commercial bank credit is heavily polarized along the central urban spine (absorbing 68.4% of credit with a Credit-Deposit ratio of 88.6%), while peripheral agrarian and forested belts register ratios between 42.5% and 48.2%. The analysis clarifies that while decentralized public grain procurement cushions farm receipts, low credit deployment in peripheral belts reflects statutory collateral constraints under Fifth Schedule (PESA) land protections in tribal areas, alongside agricultural crop-financing dynamics in rural plains, rather than simple capital flight. We conclude by outlining targeted non-distortionary policy interventions in multi-modal logistics and non-timber forest produce supply chains to support regional economic diversification.

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## INTRODUCTION

Economic development theory posits that structural transformation proceeds via the reallocation of labor and capital from low-productivity agriculture to industrial manufacturing, followed by the expansion of modern, high-value commercial services (Clark, 1940; Kuznets, 1966). Many contemporary developing economies have diverged from this trajectory through "premature deindustrialization," wherein the employment and output shares of manufacturing peak at lower income thresholds, shifting labor directly into informal tertiary activities (Rodrik, 2016). Sub-national jurisdictions rich in natural resources frequently follow an alternate, resource-concentrated trajectory. When regional output becomes dominated by point-source mineral extraction and primary metallurgy, regions often encounter sub-national variants of the "resource curse" (Auty, 1993; Sachs & Warner, 2001; van der Ploeg, 2011). Within a federal customs and monetary union, the mechanisms of the resource curse operate through distinct channels. Because sub-national governments cannot adjust nominal exchange rates or set external tariffs, resource windfalls reallocate factors internally (Venables, 2016). Capital and skilled labor flow into resource extraction and basic intermediate processing, driving up local wages and

urban land rents. This bids away productive inputs from non-resource manufacturing and market-intermediated services (Allcott & Keniston, 2018; Cust & Poelhekke, 2015). In India, these spatial patterns were historically reinforced by the Freight Equalization Scheme (operational between 1952 and 1993). By subsidizing the rail freight costs of iron ore and coal across long distances, this policy neutralized the spatial comparative advantage of mineral-bearing eastern and central states, discouraging the geographic clustering of finished consumer-goods manufacturing near raw extraction sites (Datta, 2001; World Bank, 2009). Formed from eastern Madhya Pradesh in November 2000, Chhattisgarh provides an empirical setting to evaluate these structural dynamics. The state accounts for approximately 13.4% of India's total mineral production value, possesses major reserves of coal, iron ore, and bauxite, and generates a consistent baseload electricity surplus. Despite these resource endowments, official secondary data point to three structural patterns:

1. A Depressed Tertiary Share: While services generate approximately 54% of national Indian Gross Domestic Product (GDP), they contribute only 32% to 34% of Chhattisgarh's Gross State Domestic Product (GSDP).

- Real economic output remains concentrated in capital-intensive extraction and intermediate metallurgy.
- High Export Concentration: Merchandise exports consist largely of raw and semi-finished commodities (iron ore, sponge iron, non-alloy steel billets, raw aluminum, and bulk non-basmati rice), exposing state export receipts to global commodity cycles and national tariff shifts.
  - Spatial Polarization and Transport Frictions: Formal commercial activity, institutional bank lending, and logistics infrastructure are clustered along the central transport corridor (Raipur, Durg, Bilaspur), whereas peripheral forested and agricultural districts rely predominantly on informal markets. Furthermore, as an inland state located 550 to 800 km from maritime gateways, export-oriented firms incur substantial overland freight costs and container-repositioning surcharges (analogous to the cross-country transport penalties documented by Limao & Venables, 2001).

To evaluate these patterns, this study uses secondary administrative time series and district-level administrative data spanning FY2015 to FY2024 (April 1, 2014 to March 31, 2024), addressing two core research questions:

- Research Question 1: To what extent do structural composition and Location Quotients reveal a commercial services deficit across Chhattisgarh's districts relative to primary extraction and heavy industrial agglomeration?
- Research Question 2: How do spatial credit polarization, trade logistics, and institutional land-tenure frameworks influence regional export concentration and banking intermediation depth?

**Theoretical Framework and Hypotheses:** Figure 1 outlines the transmission channels linking sub-national natural resource endowments, intermediate production, and regional economic imbalances.

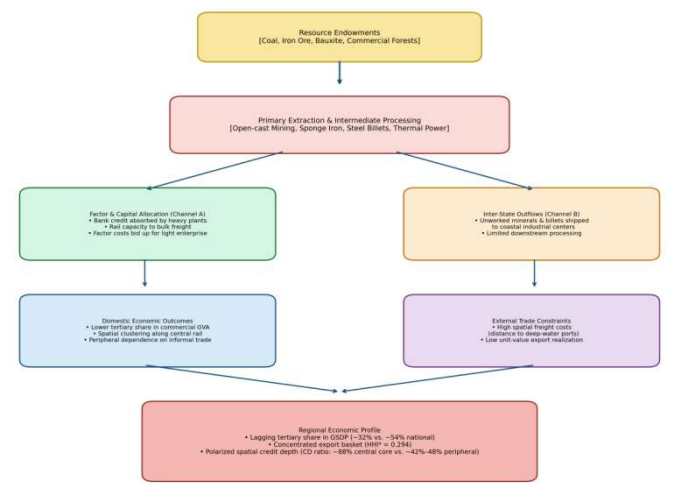


Figure 1. Conceptual Framework of Sub-National Enclave Dynamics

The resource movement effect reallocates capital, specialized labor, and infrastructure investments toward primary extraction and basic metallurgy (Corden & Neary, 1982). Because these facilities produce basic intermediate commodities for external manufacturing supply chains, they generate limited forward production linkages within the state to finished consumer goods, technology, or business services (Hirschman, 1958; Hausmann et al., 2007). In addition, public and private capital

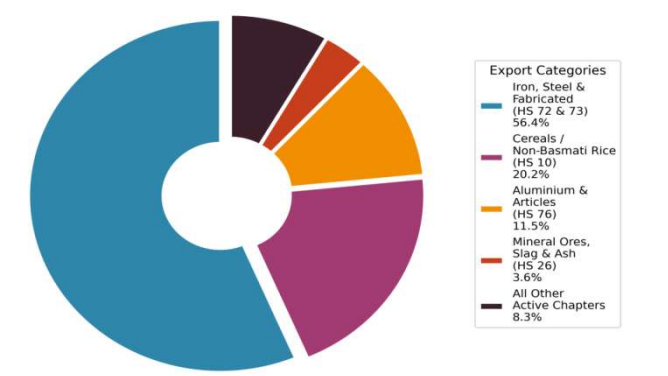


Figure 2. Chhattisgarh Export Basket Concentration by Value (FY2018–FY2024)

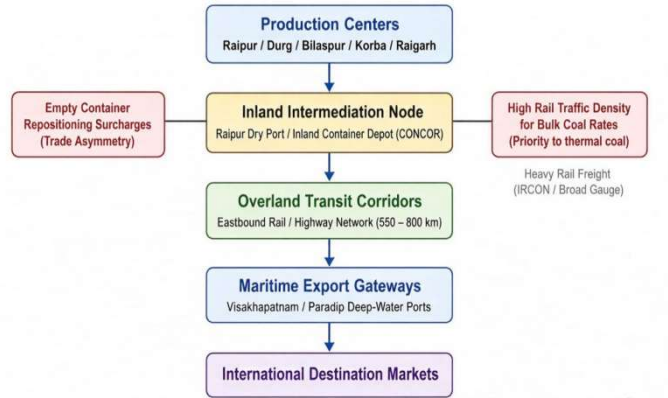


Figure 3. Outbound Intermodal Freight Flow and Bottleneck Nodes

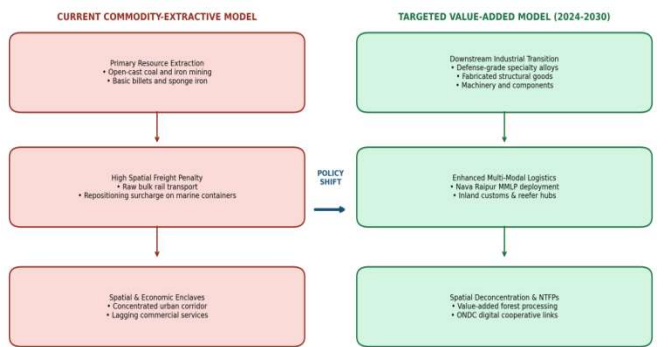


Figure 4. Strategic Interventions for Regional Diversification (2024–2030)

investments concentrate along bulk mineral rail networks, reinforcing spatial disparities between extraction corridors and the surrounding rural periphery.

To evaluate these structural mechanisms empirically while avoiding mechanical accounting dependencies, we formulate two testable analytical propositions:

**Proposition 1:** Primary mineral extraction and heavy intermediate manufacturing exhibit high regional concentration ( $LQ > 1.25$ ), whereas market-intermediated commercial services exhibit structural deficits ( $LQ < 0.75$ ), indicating limited intra-regional service spillovers from industrial enclaves.

**Proposition 2:** District-level banking credit deployment and export receipts are highly concentrated along the central urban spine, with peripheral credit-to-deposit disparities governed by

statutory land-mortgage non-alienability under PESA in tribal areas, alongside agricultural crop-credit structures in rural plains.

Data Sources and Methodological Design

**Data Harmonization and Spatial Concordance Protocol:** The empirical analysis examines annual administrative data across the 16 base parent districts of Chhattisgarh from FY2015 to FY2024 (N = 16, T = 10). To address administrative redistricting—wherein the state expanded from 16 districts in 2001 to 18 in 2007, 27 in 2012, and 33 by 2022—all economic, financial, and infrastructural indicators were aggregated back to the 16 parent-district boundaries defined in Census 2011.

For child districts carved entirely from a single parent district, observations were summed directly. For jurisdictions partitioned across multiple parent boundaries (specifically Sarangarh-Bilaigarh, created from portions of Raigarh and Baloda Bazar/Raipur), fixed apportionment weights ( $w_k$ ) were calculated using sub-district (tehsil-level) population and area shares from Census 2011.

Operational Definitions and Measurement Protocols

To evaluate structural transformation and spatial polarization:

**State Macroeconomic GVA:** Sourced from official National Accounts Statistics (NAS) published by MoSPI and DES Raipur at constant 2011–12 basic prices, using sector-specific implicit deflators.

**Location Quotients (LQ):** Calculated as  $LQ_i = (\text{Sector GVA Share in Chhattisgarh}_i) / (\text{Sector GVA Share in All India}_i)$ . Thresholds:  $LQ > 1.25$  indicates marked regional specialization;  $0.75 \leq LQ \leq 1.25$  indicates baseline parity;  $LQ < 0.75$  indicates a structural deficit.

**Normalized Herfindahl-Hirschman Index (HHI\*):**  $HHI = \sum s_j^2$ ,  $HHI^* = [HHI - (1/N)] / [1 - (1/N)]$ , where  $s_j$  is the value share of export chapter  $j$ , and  $N = 98$  (or active set  $N_{\text{active}} = 26$ ). Values above 0.25 indicate high export concentration.

**Institutional Governance Variables:** Binary statutory indicators for Fifth Schedule PESA tribal land-alienability restrictions and Ministry of Home Affairs Security-Related Expenditure (SRE) Left-Wing Extremism (LWE) conflict monitoring.

Empirical Results and Discussion

**Structural Composition of Real Gross Value Added:** Table 1 presents the sectoral distribution of Gross Value Added at constant (2011–12) prices for Chhattisgarh relative to the all-India baseline across the FY2016–FY2024 period. The secondary sector generates over 50% of real GVA in Chhattisgarh, compared to roughly 30% nationwide. Location quotients confirm regional specialization in Mining and Quarrying ( $LQ = 5.25$ ), Utilities ( $LQ = 3.46$ ), and Manufacturing ( $LQ = 1.40$ ).

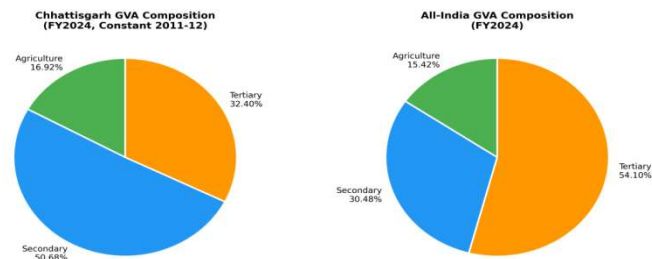


Figure 5. Comparative Sectoral Composition of Real GVA (FY2024)

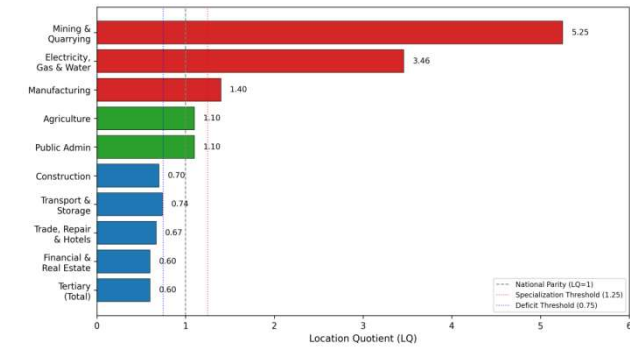


Figure 6. Location Quotients by Sector (FY2024) Relative to All-India Baseline

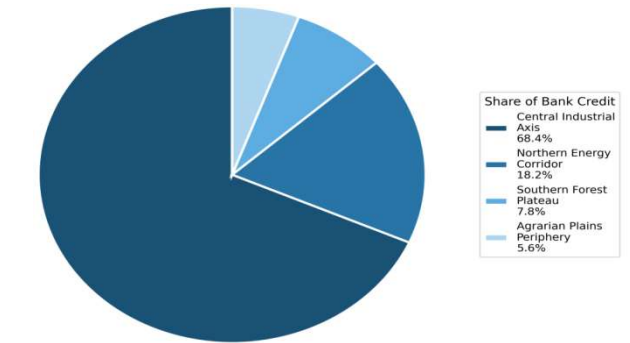


Figure 7. Spatial Distribution of Commercial Bank Credit (FY2024)

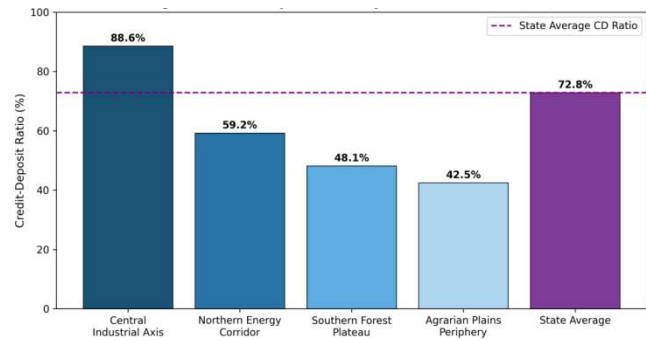


Figure 8. Credit-Deposit Ratios by Economic Zone (FY2024)

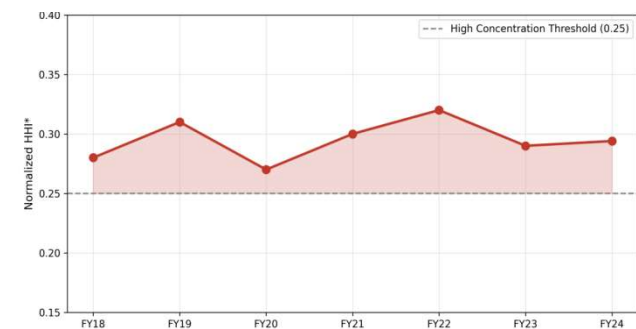


Figure 9. Longitudinal Export Concentration (Normalized HHI\*; Mean = 0.294)

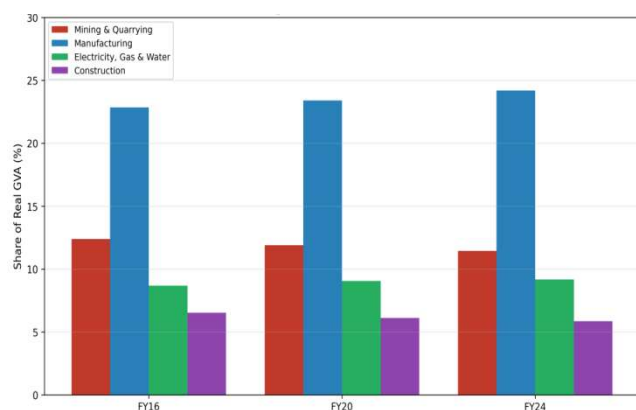


Figure 10. Evolution of Secondary Sector Components (Chhattisgarh, Constant 2011–12 Prices)

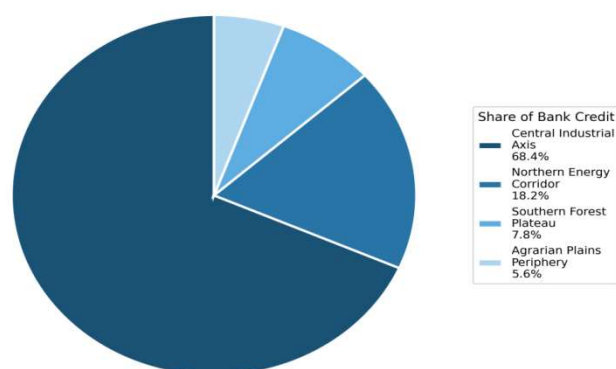


Figure 11. Spatial Distribution of Registered MSMEs (FY2024)

In contrast, the services deficit is concentrated in market commercial activities: Trade, Repair, and Hospitality has an LQ of 0.67, while Financial and Real Estate Services records an LQ of 0.60. Conversely, non-market Public Administration (LQ = 1.10) operates at parity with national averages. Across the ten-year period, the tertiary sector's share of real GVA expanded by less than one percentage point (from 31.43% to 32.40%), remaining over 21 percentage points below the national baseline.

**Export Basket Composition, Unit Values, and Volatility:** Figure 2 and Table 2 report merchandise export concentration using transaction microdata from DGCI&S. The normalized Herfindahl-Hirschman Index ( $HHI^* = 0.294$  under  $N=98$ ;  $HHI^* = 0.312$  under active chapters  $N_{active}=26$ ) confirms high commodity export concentration. Over 81% of export value comes from primary metals and non-basmati rice.

**Spatial Distribution, Financial Intermediation, and Institutional Frameworks:** Table 3 reports district-level banking indicators and enterprise registrations across four economic zones. Commercial banking activity exhibits substantial spatial concentration: the Central Industrial Axis absorbs 68.40% of total commercial bank credit and accounts for 62.10% of registered MSME units, with a Credit-Deposit ratio of 88.62%. The Southern Forest Plateau and Agrarian Plains Periphery record CD ratios of 48.15% and 42.45%, respectively.

These disparities stem from two distinct structural mechanisms: (1) In the Tribal Forest Corridor, statutory protections under PESA and the Fifth Schedule prohibit the alienation of tribal land, preventing commercial banks from

securing real property mortgages; (2) In the Agrarian Plains Periphery, low CD ratios reflect agrarian financial flows where liquidity from MSP paddy sales accumulates as deposits while short-term agricultural credit is intermediated primarily through cooperative societies (PACS).

**Logistical Frictions and the Landlocked Penalty:** Figure 3 illustrates the logistics and freight corridors linking production centers in Chhattisgarh to maritime export gateways. Official data from the DPIIT Logistics Ease Across Different States (LEADS) reports highlight three main transport constraints: trade flow imbalances and container repositioning surcharges; rail network bottlenecks prioritizing thermal coal rakes; and post-harvest handling constraints for agricultural and forest produce.

**Industrial Policy Analysis (2024–2030):** Figure 4 illustrates the structural transition outlined in the Chhattisgarh Industrial Development Policy 2024–2030, contrasting the existing resource-extractive model with a diversified, value-added model. The state's industrial policy framework targets three primary interventions: downstream industrial incentives toward fabrication and specialty alloys; multi-modal logistics infrastructure under PM Gati Shakti (Nava Raipur MMLP); and value-added forest produce processing via CGMFPP and ONDC linkages.

**Methodological Limitations:** This study relies on secondary institutional data and is subject to four main methodological boundaries: (1) Unorganized and informal sector data gaps; (2) Revisions in sub-national accounts and series splicing; (3) Internal trade accounting discontinuity post-GST 2017; and (4) Boundary adjustments requiring re-aggregation to parent-district boundaries using Census 2011 population keys.

## Conclusions and Analytical Takeaways

**Empirical Findings and Core Contribution:** The empirical analysis yields three primary findings: (1) Structural Sectoral Skew—secondary sector >50% of real GVA with persistent commercial services deficits (LQ 0.60–0.67); (2) Export Vulnerability and Low Unit Complexity— $HHI^* = 0.294$  with >81% of revenues from primary metals and bulk rice; (3) Spatial Polarization and Institutional Credit Sorting—central axis 68.4% of credit (CD 88.6%) versus peripheral CD ratios of 42.5–48.2%, driven by PESA land non-alienability and agrarian crop-credit structures rather than pure capital flight.

**Theoretical and Practical Implications:** These findings demonstrate that point-source natural resource wealth inside a sub-national federation does not automatically induce broad structural diversification. Policy should target binding spatial and institutional constraints: multi-modal logistics to reduce non-tariff friction; alternative underwriting (warehouse-receipt financing, cash-flow lending to cooperatives) that respect PESA protections; and downstream integration into specialty alloys and scientific NTFP handling.

**Generalizability and Future Research Scope:** While anchored in Chhattisgarh, the patterns provide an empirical baseline for other mineral-rich, landlocked jurisdictions in eastern and central India (Jharkhand, interior Odisha) and, more broadly, resource-dependent provincial economies in emerging federations. Future research should incorporate firm-level ASI microdata and post-2017 GSTN E-Way bill

**Table 1. Sectoral Composition of Real GVA and Location Quotients (Constant 2011–12 Prices)**

| Economic Activity / Sector      | CG % FY16    | CG % FY20    | CG % FY24    | India % FY24 | LQ FY24     | Assessment                       |
|---------------------------------|--------------|--------------|--------------|--------------|-------------|----------------------------------|
| Agriculture, Forestry & Fishing | 18.15        | 17.84        | 16.92        | 15.42        | 1.10        | Baseline Parity                  |
| Mining and Quarrying            | 12.38        | 11.90        | 11.45        | 2.18         | <b>5.25</b> | <b>Marked Specialization</b>     |
| Manufacturing                   | 22.84        | 23.40        | 24.20        | 17.25        | <b>1.40</b> | Heavy Industrial Conc.           |
| Electricity, Gas & Water        | 8.68         | 9.05         | 9.18         | 2.65         | <b>3.46</b> | Energy Surplus Core              |
| Construction                    | 6.52         | 6.12         | 5.85         | 8.40         | 0.70        | Sub-National Deficit             |
| <b>Secondary Sector (Total)</b> | <b>50.42</b> | <b>50.47</b> | <b>50.68</b> | <b>30.48</b> | <b>1.66</b> | <b>Industrial Specialization</b> |
| Trade, Repair, Hotels & Rest.   | 7.92         | 8.15         | 8.35         | 12.40        | <b>0.67</b> | Commercial Services Deficit      |
| Transport, Storage & Comm.      | 4.60         | 4.70         | 4.82         | 6.55         | 0.74        | Infrastructure Deficit           |
| Financial & Real Estate         | 9.42         | 9.75         | 10.05        | 16.80        | <b>0.60</b> | Low Intermediation Density       |
| Public Admin. & Other           | 9.49         | 9.09         | 9.18         | 8.35         | 1.10        | Public Sector Parity             |
| <b>Tertiary Sector (Total)</b>  | <b>31.43</b> | <b>31.69</b> | <b>32.40</b> | <b>54.10</b> | <b>0.60</b> | <b>Tertiary Deficit</b>          |

Notes: Secondary Sector Total = Mining + Manufacturing + Electricity/Gas/Water + Construction. Sources: Author's calculations using MoSPI National Accounts Statistics and DES Raipur (2011–12 series).

**Table 2. Concentration, Unit Values, and Volatility in Major Export Categories (FY2018–FY2024)**

| HS Product Category              | Mean Share % | Volatility ( $\sigma/\mu$ ) | Primary Destinations        | Processing Tier     |
|----------------------------------|--------------|-----------------------------|-----------------------------|---------------------|
| 72 Iron and Steel                | 49.80        | 0.36                        | SE Asia, Middle East, EU    | Intermediate        |
| 10 Cereals (Non-Basmati Rice)    | 20.20        | 0.45                        | West Africa, Bangladesh, ME | Primary Agrarian    |
| 76 Aluminium and Articles        | 11.50        | 0.29                        | USA, East Asia, EU          | Intermediate        |
| 73 Articles of Iron or Steel     | 6.60         | 0.24                        | Middle East, N. Africa      | Fabricated          |
| 26 Ores, Slag, and Ash           | 3.60         | 0.58                        | China, East Asia            | Raw Minerals        |
| — <b>Top 3 Chapters Combined</b> | <b>81.50</b> | —                           | —                           | Commodity-Dependent |
| — <b>Normalized HHI* (N=98)</b>  | <b>0.294</b> | 0.08                        | High Concentration          | HHI* > 0.25         |

Sources: Derived from DGCI&S State-wise Export Statistics and Ministry of Commerce EXIM Bank (FY2018–FY2024).

**Table 3. Spatial Distribution of Bank Deposits, Credit Deployment, and Enterprise Density (FY2024)**

| Geographic Zone                | Base Districts                      | Dep. %        | Credit %      | CD Ratio %   | MSME %        | PESA / LWE                |
|--------------------------------|-------------------------------------|---------------|---------------|--------------|---------------|---------------------------|
| <b>Central Industrial Axis</b> | Raipur, Durg, Bilaspur, Rajnandgaon | 56.20         | <b>68.40</b>  | <b>88.62</b> | 62.10         | Non-Sched. / Non-LWE      |
| Northern Energy Corridor       | Korba, Raigarh, Surguja, Koriya     | 22.40         | 18.20         | 59.25        | 21.40         | Partial Sch.V / Minor SRE |
| Southern Forest Plateau        | Bastar, Dantewada, Kanker           | 11.80         | 7.80          | 48.15        | 9.70          | Full Sch.V / High LWE     |
| Agrarian Plains Periphery      | Dhamtari, Mahasamund, Janjgir       | 9.60          | 5.60          | 42.45        | 6.80          | Non-Sched. / Non-LWE      |
| <b>State Baseline / Total</b>  | All 16 Base Districts               | <b>100.00</b> | <b>100.00</b> | <b>72.85</b> | <b>100.00</b> | —                         |

Notes: Data aggregated to 16 parent units using Census 2011 concordance. Sources: RBI BSR-1/BSR-2 (March 2024), Ministry of MSME Udyam Portal, MHA SRE Notifications.

registries to measure cross-district trade flows and factor-crowding elasticities directly.

### Declarations and Open Science Statements

**Data Availability Statement:** Secondary data were collected from official public archives: DES Raipur Economic Surveys; MoSPI National Accounts; RBI BSR-1/BSR-2; DGCI&S State-wise Export Statistics. Aggregated parent-district panel data, concordance tables, and estimation code will be archived in an open-access OSF repository upon publication.

**Ethical Compliance and Conflict of Interest:** This study relies on aggregated secondary public records; no human subjects or confidential identifiers were involved. The authors declare no commercial or financial conflicts of interest.

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Additional sources: DGCIS (2018–2024); DES Raipur (2018–2024); Government of Chhattisgarh (2024) Industrial Development Policy 2024–2030; MoSPI (2015–2024); RBI BSR (2018–2024); NABARD (2018); and other official statistical releases cited in the text.

**Appendix Note:** Full methodological protocols for sectoral data harmonization, Location Quotient thresholds, and Normalized Herfindahl Index construction are provided in the original working-paper appendix and will be included in the online supplementary materials upon journal acceptance.

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