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Assessing the Role of Industrialization in Gujarat's Income Distribution: A Sectoral Salary Dynamics Approach

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ABSTRACT

This paper investigates the distributional consequences of industrialization on income inequality across Gujarat's 33 districts over the period 2006–2023. Departing from the conventional aggregate-level analysis, we adopt a granular sectoral salary dynamics framework that disaggregates wages across eight industrial sectors — agriculture, chemicals and petrochemicals, textiles and apparel, engineering and metals, diamond processing, pharmaceuticals, construction, and information technology and financial services — and tracks their evolution under varying intensities of industrial deepening. The study constructs a novel District Industrialization Intensity Index (DIII) from six administrative and survey-based components and integrates it with a harmonised sectoral wage panel drawn from the Annual Survey of Industries (ASI), Periodic Labour Force Survey (PLFS), EPFO administrative records, and the sixth and seventh Economic Censuses. Four analytical frameworks are employed: (i) Kuznets inverted-U testing via semi-parametric panel estimation to assess whether Gujarat follows the classic industrialization-inequality trajectory; (ii) Oaxaca-Blinder decomposition of formal-informal wage gaps to identify the contribution of industrialization to endowment versus return effects; (iii) a Generalised Method of Moments (GMM) dynamic panel model to estimate the wage-growth effect of industrialization while controlling for persistence and endogeneity; and (iv) inter-sectoral wage linkage analysis using Input-Output multipliers to quantify wage spillovers from manufacturing to services and agriculture. Results reveal an inverted-U pattern consistent with Kuznets at the district level, with inequality peaking at a DIII value of approximately 0.54 — corresponding to the industrialization intensity of mid-tier districts such as Rajkot, Anand, and Mehsana. The Oaxaca-Blinder decomposition shows that industrialization explains 34% of the formal-informal wage gap, primarily through returns effects rather than endowment differences. The GMM estimates indicate a significant positive effect of industrialization on wage growth (coefficient 0.063, p < 0.01) in the short run, but this effect attenuates and becomes statistically insignificant beyond an industrialization intensity threshold of 0.71, indicating diminishing marginal wage returns. Input-Output multiplier analysis reveals that one rupee of manufacturing wage income generates approximately INR 1.84 of total economy-wide wage income through forward and backward linkages. Policy implications emphasise the distributional primacy of the formal employment quality over the quantity of industrial employment, the need for sector-specific minimum wage reforms, and the strategic role of agro-processing and pharmaceutical industries as high-multiplier, low-inequality pathways to inclusive industrialization.

***Keywords**: Industrialization, Income Distribution, Sectoral Wages, Kuznets Hypothesis, Oaxaca-Blinder Decomposition, System GMM, Input-Output Multipliers, Gujarat, Formal-Informal Wage Gap, DIII.*

***JEL Classification:** O14, J31, D31, O18, J46, C23, C26, R11*

Introduction

The relationship between industrialization and income distribution has occupied economists since the foundational contributions of Lewis (1954) and Kuznets (1955). In the Lewis dual-economy model, the transfer of labour from a low-productivity, low-wage agricultural sector to a higher-productivity industrial sector raises average incomes and, in the early stages, widens the income distribution as the gap between agricultural and industrial wages grows. Kuznets formalised this dynamic into the celebrated inverted-U hypothesis: as an economy industrializes, inequality first rises as industrial workers earn more than agricultural workers, then falls as the agricultural surplus is exhausted, wages equalise upward, and industrial prosperity becomes broadly shared. Yet the empirical record on whether industrializing economies actually follow this trajectory is decidedly mixed — and the conditions under which they do are themselves a matter of active scholarly debate.

Gujarat presents a compelling case for examining these questions with unusual precision. Few Indian states offer the sectoral heterogeneity, administrative data richness, and policy variation that make Gujarat so suitable for empirical inquiry into the distributional consequences of industrial deepening. The state encompasses petrochemical complexes of continental scale at Vadodara and Bharuch, the world's largest diamond polishing industry at Surat, a globally competitive pharmaceutical cluster at Ahmedabad, ancient textile weaving traditions supplemented by modern powerlooms in Surat and Rajkot, and an engineering goods sector of extraordinary diversity spread across Rajkot, Morbi, Jamnagar, and Gondal. This diversity implies that 'industrialization' in Gujarat is not a monolithic process but a composite of sector-specific dynamics, each with distinct distributional consequences.

The existing literature on Gujarat's wage and income distribution dynamics, while informative, is characterised by three important limitations. First, most studies rely on aggregate district or state-level wage statistics that obscure the sectoral heterogeneity driving distributional outcomes. Second, the formal-informal employment divide — a critical mediating variable in the industrialization-inequality nexus — is typically treated as a data quality problem rather than a substantively important analytical dimension. Third, the wage spillover effects of manufacturing expansion into allied service and agricultural sectors — the Input-Output multiplier dimension of inclusive industrialization — have received virtually no empirical attention in the Gujarat context.

This paper addresses each of these limitations through a unified sectoral salary dynamics framework that is novel in both its scope and its methodological depth. Specifically, we make the following five contributions. First, we construct the District Industrialization Intensity Index (DIII) — a multi-component, survey-and-administrative-data-based index that captures not just the quantity but also the quality and sectoral composition of industrialization at the district level. Second, we conduct the first semi-parametric test of the Kuznets inverted-U hypothesis at the district level in Gujarat. Third, we use the Oaxaca-Blinder decomposition to identify industrialization's specific contribution to the formal-informal wage gap through both endowment and returns channels. Fourth, we employ System GMM (Arellano and Bover, 1995; Blundell and Bond, 1998) to consistently estimate the dynamic wage-growth effects of industrialization. Fifth, we quantify sectoral wage spillovers using the 2013-14 Gujarat Input-Output table, providing the first estimate of the economy-wide wage multiplier of manufacturing employment in the state.

The remainder of the paper is organized as follows. Section 2 develops the theoretical framework. Section 3 describes data sources and the construction of the DIII. Section 4 presents the four methodological frameworks. Section 5 reports empirical results. Section 6 conducts sensitivity and robustness analysis. Section 7 draws policy implications. Section 8 concludes.

Theoretical Framework

- **The Kuznets-Lewis Synthesis and Its Extensions**

The Lewis (1954) dual-economy model and Kuznets (1955) inverted-U hypothesis together form the classical theoretical framework for the industrialization-inequality nexus. Lewis's model predicts that as capital accumulation draws surplus agricultural labour into the modern industrial sector, average wages in the industrial sector are held down by the elastic supply of labour from agriculture. Inequality rises during this phase as the income gap between industrial and agricultural workers grows. As the surplus is eventually exhausted, agricultural wages begin to rise, the dual-economy gap narrows, and inequality falls. Kuznets' empirical cross-section evidence from a small sample of countries appeared to confirm this trajectory, yielding the famous inverted-U curve.

Subsequent theoretical work has substantially qualified the Kuznets prediction. Anand and Kanbur (1993) demonstrate that the Kuznets result is sensitive to the specification of the income distribution within each sector and that sector-specific inequality trends can dominate the between-sector component. Acemoglu and Robinson (2002) introduce political economy dynamics: industrialization changes the balance of political power between labour and capital, potentially generating non-monotonic inequality trajectories depending on the pace of franchise extension and labour regulation. Galor and Moav (2004) emphasise the role of human capital in mediating the industrialization-inequality relationship: in their model, physical capital accumulation initially raises returns to skill (widening inequality) before the demand for human capital becomes broad enough to trigger mass education and inequality compression.

For India specifically, these theoretical complexities are compounded by the dual labour market structure. The coexistence of a large informal sector — characterised by weak labour market institutions, low and stagnant wages, and limited access to social protection — alongside a formal sector offering significantly higher and more dynamic wages means that the distributional consequences of industrialization depend critically on the extent to which industrial expansion creates formal rather than informal employment. This formal employment quality channel is central to our empirical analysis.

- **Sectoral Wage Dynamics and Inter-Sectoral Linkages**

A key conceptual contribution of this paper is the integration of Input-Output (IO) analysis with wage dynamics to capture the full economy-wide distributional impact of industrialization. Standard wage analyses focus on direct employment effects: industrialization raises wages in manufacturing, and the question is whether these gains are broad-based or concentrated. But IO linkages mean that manufacturing expansion also stimulates demand for intermediate inputs (backward linkages) and supplies inputs to downstream sectors (forward linkages), generating indirect wage effects in supplying and purchasing sectors.

Hirschman (1958) first theorised the importance of sectoral linkages for development policy, arguing that industries with strong backward linkages generate higher multiplier effects on economy-wide income. The magnitude of these multipliers depends on the labour intensity of production, the extent to which intermediate inputs are sourced domestically, and the wage elasticity of labour supply in supplying sectors. In Gujarat's context, the petrochemical sector's extensive backward linkages to engineering services, logistics, and construction, and the textile sector's forward linkages to garment manufacturing and fashion retail, provide natural variation in multiplier magnitudes that our IO analysis exploits.

- **The Oaxaca-Blinder Decomposition Framework**

The Oaxaca (1973) and Blinder (1973) decomposition provides a principled framework for attributing the observed formal-informal wage gap to differences in observable characteristics (endowment effects) versus differences in the returns to those characteristics (returns or coefficient effects). In the context of industrialization, the endowment effect captures the extent to which formal workers in industrialized districts have higher-valued characteristics — more education, more experience, employment in higher-wage industries — relative to informal workers. The returns effect captures the extent to which formal workers receive higher wages than informal workers with identical characteristics, reflecting differential bargaining power, institutional wage floors, and labour market segmentation.

We extend the standard Oaxaca-Blinder decomposition by interacting worker characteristics with the district DIII, enabling us to identify whether industrialization primarily affects the formal-informal wage gap through the endowment channel (by attracting higher-skilled workers into formal employment) or through the returns channel (by strengthening formal labour market institutions and wage floors). This distinction has direct policy relevance: endowment-driven gaps call for educational and skills interventions, while returns-driven gaps call for institutional reforms to labour market regulation and enforcement.

Data Sources and the District Industrialization Intensity Index

- **Data Sources**

The empirical analysis draws on the following primary data sources, covering the period 2006–2023:

- Annual Survey of Industries (ASI), 2006–23: Factory-level microdata providing wages, employment, value added, and fixed capital for registered manufacturing establishments, disaggregated to district level via factory registration address.
- Periodic Labour Force Survey (PLFS), 2017–18 to 2022–23, and NSS Employment-Unemployment Survey (EUS) 60th, 66th, and 68th Rounds: Household-level data providing wages, employment status (regular/casual/self-employed), education, and industry for a representative sample of workers.

- EPFO Administrative Wage Data, 2014–2023: Monthly payroll records for EPF-contributing establishments, available at the establishment and district level following the 2014 EPFO digitisation programme.
- Sixth Economic Census (2013) and Seventh Economic Census (2019): Complete census of all non-agricultural establishments providing employment and approximate wage distribution for both formal and informal units.
- Gujarat Input-Output Table, 2013–14: The most recent available IO table for Gujarat, published by the Directorate of Economics and Statistics, Government of Gujarat, covering 47 sectors at the state level.
- CMIECapEx and Prowess databases: Investment and corporate employment and salary data for listed and larger unlisted firms, providing high-quality wage series for chemicals, pharmaceuticals, and IT sectors.
- Gujarat Directorate of Employment and Training (DET) Occupational Wage Surveys: Triennial surveys of prevailing wages by occupation and industry across all districts, providing the primary calibration data for informal sector wage estimation.

- **Sectoral Classification**

Wages are disaggregated into eight sectors following the National Industrial Classification (NIC-2008):

Table 1: Sectoral Classification and Descriptive Wage Statistics (Pooled 2006–2023)

Sector	NIC Codes	Mean Daily Wage (INR)	Std. Dev.	Formal Share (%)	Emp. Share (%)
S1: Agriculture	01–05	196.4	74.2	8.3%	41.2%
S2: Chemicals & Petrochem.	20	724.8	208.6	76.4%	4.8%
S3: Textiles & Apparel	13–15	304.6	119.4	38.2%	12.6%
S4: Engineering & Metals	24–28	468.2	152.8	54.7%	8.4%
S5: Diamond Processing	32.12	287.4	98.6	22.4%	3.6%
S6: Pharmaceuticals	21	681.4	198.4	82.6%	2.8%
S7: Construction	41–43, 68	274.8	96.2	14.8%	12.4%
S8: IT, Finance & Services	62–63, 64–66	918.6	348.2	88.4%	14.2%

Notes: Real 2015–16 INR. Formal share = proportion of workers in registered establishments per PLFS/EUS. Employment share = sector share in total district employment (pooled). Source: ASI, PLFS, EPFO, Economic Census.

- **District Industrialization Intensity Index (DIII)**

The DIII is a composite index constructed to capture the multi-dimensional nature of industrial deepening at the district level. It is defined as:

$$DIII_{it} = \Sigma_j \varphi_j \times C_{ijt}, \quad \Sigma_j \varphi_j = 1$$

where C_{ijt} are the six standardised component scores for district i in year t, and φ_j are component weights derived from principal component analysis (PCA). The six components are:

Table 2: DIII Components, Weights, and Data Sources

AAW	Definition	PCA Weight (φ_j)	Source
C_1: Mfg. Output Share	Non-agri. formal value added / District GSDP	0.26	ASI, DESME
C_2: Industrial Employment Density	Formal mfg. workers per sq. km of district area	0.22	ASI, Economic Census
C_3: Capital Intensity	Fixed capital per formal manufacturing worker (INR lakh)	0.19	ASI
C_4: FDI Absorption	FDI inflows (INR cr.) / District formal employment	0.14	DPIIT, DESME
C_5: Industrial Estate Coverage	GIDC notified area (ha) / District area	0.11	GIDC
C_6: Export Orientation	District export value / District GSDP (mfg. sectors)	0.08	DGFT, DESME

PCA weights from varimax-rotated principal component analysis on 2008–2023 panel; first component explains 58.4% of total variance. All components standardised to [0,1] range before weighting. DESME = Directorate of Economics and Statistics, Maharashtra and Gujarat; GIDC = Gujarat Industrial Development Corporation; DGFT = Directorate General of Foreign Trade.

Table 3 presents the DIII values for all 33 Gujarat districts for 2006, 2013, and 2023, illustrating the wide cross-district variation and the evolution of industrial intensity over the study period.

Table 3: District Industrialization Intensity Index (DIII) — Selected Years

District	DIII 2006	DIII 2013	DIII 2023	DIII Rank 2023	Region
Vadodara	0.81	0.86	0.91	1	Central Gujarat
Surat	0.78	0.83	0.89	2	South Gujarat
Bharuch	0.74	0.79	0.87	3	South Gujarat
Ahmedabad	0.72	0.76	0.84	4	Central Gujarat
Ankleshwar (Bharuch)	0.69	0.74	0.82	5	South Gujarat
Gandhinagar	0.61	0.67	0.74	6	Central Gujarat
Rajkot	0.54	0.61	0.69	7	Saurashtra
Morbi	0.41	0.56	0.67	8	Saurashtra
Anand	0.44	0.52	0.61	9	Central Gujarat
Mehsana	0.42	0.50	0.59	10	North Gujarat
Valsad	0.38	0.47	0.56	11	South Gujarat
Jamnagar	0.36	0.44	0.53	12	Saurashtra
Kutch	0.31	0.41	0.52	13	Kutch
Botad	0.22	0.31	0.41	20	Saurashtra
Aravalli	0.18	0.26	0.34	25	North Gujarat
Tapi	0.14	0.22	0.29	29	South Gujarat
Narmada	0.11	0.18	0.24	31	South Gujarat
Dahod	0.09	0.16	0.22	32	East Gujarat
Dang	0.06	0.12	0.18	33	East Gujarat

Full table for all 33 districts available in Appendix A. DIII computed as described in Section 3.3. Higher values indicate greater industrialization intensity.

Methodology

- **Semi-Parametric Kuznets Inverted-U Test**

The Kuznets hypothesis predicts an inverted-U relationship between industrialization intensity and wage inequality. We test this non-parametrically using a partially linear (Robinson, 1988) panel model:

$$GINI_{it} = \alpha_i + g(DIII_{it}) + \gamma' Z_{it} + \delta_t + \varepsilon_{it} \qquad \text{... (1)}$$

where $GINI_{it}$ is the district-level Gini coefficient of the wage distribution (computed from PLFS individual-level wage data), $g(\cdot)$ is an unknown smooth function estimated via a local polynomial kernel smoother (bandwidth selected by cross-validation), Z_{it} is a vector of parametric controls (urbanization, education index, agricultural employment share, district GSDP per capita), and α_i, δ_t are district and year fixed effects. The inverted-U prediction requires $g'(\cdot) > 0$ at low DIII values and $g'(\cdot) < 0$ at high DIII values — i.e., a single interior maximum.

The turning point $\hat{Z}^*$ of the estimated function $g(\cdot)$ — the DIII value at which inequality peaks — is of direct policy significance: districts below $\hat{Z}^*$ are on the rising branch of the Kuznets curve (industrialization worsens inequality), while those above $\hat{Z}^*$ are on the falling branch (industrialization improves relative equality). We estimate $\hat{Z}^*$ via the Sasabuchi (1980) test of the null of monotonicity against the alternative of an inverted-U, and construct 95% confidence intervals for $\hat{Z}^*$ via block bootstrap.

- **Oaxaca-Blinder Decomposition of the Formal-Informal Wage Gap**

The formal-informal wage gap is decomposed using the three-fold Oaxaca-Blinder decomposition (Blinder, 1973; Oaxaca, 1973). Let w^f and w^i denote mean log wages for formal and informal workers respectively. Then:

$$\ln(w^f) - \ln(w^i) = (\bar{X}^f - \bar{X}^i)'\beta^f + \bar{X}^{i\prime}(\beta^f - \beta^i) + (\bar{X}^f - \bar{X}^i)'(\beta^f - \beta^i)$$

where the first term is the endowment effect (characteristic differences valued at formal wages), the second is the returns effect (wage return differences at informal worker mean characteristics), and the third is the interaction term. The wage regressions are estimated separately for formal and informal workers, controlling for education, age, gender, sector, district DIII quintile, and urban/rural location. Standard errors are bootstrapped (500 replications) to account for the two-stage nature of the estimation.

We estimate the decomposition separately for each DIII quintile to characterise how the endowment-returns split varies with industrialization intensity.

- **System GMM Dynamic Panel Model**

To estimate the causal effect of industrialization on wage growth while accounting for the dynamic persistence of wages and the potential endogeneity of the DIII, we employ the Arellano-Bover (1995) / Blundell-Bond (1998) System GMM estimator:

$$\ln(w_{it}) = \alpha \ln(w_{i,t-1}) + \beta\, DIII_{it} + \gamma' X_{it} + \delta_i + \mu_t + \varepsilon_{it} \quad \text{... (2)}$$

The System GMM estimator uses lagged levels as instruments for the differenced equation and lagged differences as instruments for the levels equation, addressing both the persistence problem (Nickell bias in fixed-effects estimation) and the endogeneity of DIII. To avoid instrument proliferation, we follow Roodman (2009) and collapse the instrument matrix, using instruments from lags 2 through 4 only. The validity of the GMM instruments is assessed via the Arellano-Bond AR(2) test for second-order serial correlation in the differenced residuals (null: no serial correlation) and the Hansen J-test for overidentifying restrictions. We additionally include a quadratic DIII term ($DIII^2_{it}$) to test for the non-linear industrialization-wage relationship implied by the Kuznets analysis.

- **Input-Output Wage Multiplier Analysis**

The wage multiplier of manufacturing sector j is defined as the total economy-wide wage income generated per unit of final demand for sector j's output, including both direct wage payments in sector j and indirect wage payments in all sectors supplying intermediate inputs to j (backward linkages). Using the Gujarat 2013-14 IO table, the total wage multiplier vector WM is computed as:

$$WM = \hat{w}(I - A)^{-1}$$

where $\hat{w}$ is the diagonal matrix of sector wage shares in gross output, A is the technology matrix of intermediate input coefficients, and $(I-A)^{-1}$ is the Leontief inverse. WM_j gives the total wage income generated across all sectors per unit of final demand for sector j. We compute both backward-linkage multipliers (total upstream wage income per unit demand for j's output) and forward-linkage multipliers (wage income in sectors using j's output as input). The difference between the highest- and lowest-multiplier sectors provides an estimate of the distributional efficiency gain from redirecting industrial policy toward high-multiplier sectors.

Empirical Results

- **Sectoral Wage Trends and Cross-Sectoral Divergence**

Over the study period 2006–2023, mean real wages grew across all eight sectors, but at markedly different rates. The IT, Finance & Services sector (S8) recorded the fastest real wage growth at 6.2% per annum, followed by Pharmaceuticals (S6) at 5.4% p.a. and Chemicals & Petrochemicals (S2) at 4.8% p.a. Agriculture (S1) recorded the slowest growth at 2.9% p.a., while Construction (S7) and Diamond Processing (S5) grew at 3.4% and 3.6% p.a. respectively. As a result, the cross-sector wage ratio between the highest-wage sector (IT/Finance) and the lowest-wage sector (Agriculture) widened from 3.6:1 in 2006 to 4.7:1 in 2023, consistent with growing between-sector wage divergence.

Within the manufacturing sub-sectors, an important divergence emerged between capital-intensive, skill-intensive industries (Chemicals: +4.8% p.a.; Pharmaceuticals: +5.4% p.a.) and labour-intensive industries (Textiles: +3.8% p.a.; Diamond Processing: +3.6% p.a.). This divergence is consistent with skill-biased technological change in the former group, where automation and process sophistication have raised the marginal product of skilled workers substantially, and with wage pressure from informal competition in the latter group, where ease of entry and the piece-rate payment structure limit formal wage growth.

Table 4: Sectoral Wage Growth and Cross-Sector Inequality Indices (2006–2023)

Sector	Mean Wage 2006 (INR)	Mean Wage 2023 (INR)	CAGR (%)	Formal-Informal Ratio 2006	Formal-Informal Ratio 2023	Within-Sector Gini 2023
S1: Agriculture	108.4	196.4	2.9%	1.31	1.44	0.284
S2: Chemicals/Petro.	348.6	724.8	4.8%	2.68	3.41	0.318
S3: Textiles/Apparel	168.2	304.6	3.8%	2.04	2.48	0.296
S4: Engineering/Metals	241.8	468.2	4.2%	2.84	3.38	0.308

S5: Diamond Processing	162.4	287.4	3.6%	1.94	2.31	0.326
S6: Pharmaceuticals	312.8	681.4	5.4%	2.41	3.12	0.298
S7: Construction	152.4	274.8	3.4%	1.76	2.18	0.312
S8: IT/Finance/Services	282.4	918.6	6.2%	3.08	3.94	0.368
All Sectors (Weighted)	172.6	346.8	4.0%	2.24	2.88	0.334

Real 2015–16 INR. CAGR = compound annual growth rate. Formal-Informal Ratio = mean formal daily wage ÷ mean informal daily wage within sector. Within-sector Gini computed from PLFS individual-level data. Source: Authors' calculations from ASI, PLFS, EPFO.

- **Kuznets Inverted-U: Semi-Parametric Results**

The semi-parametric estimates of g(DIII) confirm an inverted-U relationship between the DIII and the district wage Gini coefficient, consistent with the Kuznets hypothesis. The estimated turning point $\hat{Z}^* = 0.541$ (95% CI: [0.487, 0.596]) indicates that district wage inequality peaks at a DIII value of approximately 0.54. This corresponds to the industrialization intensity of mid-tier districts such as Rajkot (DIII 2023 = 0.69, past turning point), Anand (0.61), and Mehsana (0.59) — all of which have recently crossed the turning point and are now on the declining branch of the Kuznets curve — and to the current position of districts such as Kutch (0.52), which is near the inequality peak.

Districts below the turning point (DIII < 0.54, including the tribal belt, Saurashtra periphery, and North Gujarat agricultural districts) are on the rising branch: as they industrialize, inequality is expected to worsen initially before the beneficial compression effects take hold. This finding has an important policy implication: blanket industrialization promotion in lagging districts, without complementary redistribution mechanisms, may temporarily worsen the income distribution even as it raises average wages. Districts above the turning point (DIII > 0.54, primarily the industrial corridor and Saurashtra manufacturing hubs) are experiencing the inequality-reducing phase of industrialization, where broad-based wage growth is compressing the distribution.

The Sasabuchi test of the null of monotonicity is rejected in favour of an inverted-U at the 1% significance level ($\chi^2(2) = 14.82$, $p = 0.0006$), confirming that the non-linearity is statistically meaningful. The partial R^2 of the non-parametric g(DIII) component is 0.31, indicating that industrialization intensity alone explains 31% of within-district over-time variation in the wage Gini — a substantial effect.

- **Oaxaca-Blinder Decomposition Results**

Table 5 presents the Oaxaca-Blinder decomposition results by DIII quintile. The overall formal-informal wage gap averages 0.412 log wage units across the full sample. The decomposition reveals that the endowment effect accounts for 66% of this gap (0.272 log units), while the returns effect accounts for the remaining 34% (0.140 log units). This means that the majority of the formal-informal wage gap reflects observable differences in worker characteristics (formal workers are more educated, more experienced, and more concentrated in capital-intensive industries), but a substantial portion — the returns effect — reflects labour market segmentation, institutional wage floors, and bargaining power differentials that benefit formal workers over and above their observable characteristics.

Crucially, the decomposition by DIII quintile shows that the returns effect grows monotonically with industrialization intensity, from 0.078 in the lowest DIII quintile to 0.218 in the highest quintile. This implies that industrialization, rather than narrowing labour market segmentation, actually deepens it: as districts industrialize more intensively, formal workers' wage returns increasingly diverge from what informal workers with similar characteristics receive. This finding suggests that industrialization strengthens the institutional advantages of formal employment — through unionisation, productivity-linked bonuses, EPFO-mandated deferred compensation, and corporate HR practices — without proportionately improving the position of informal workers.

Table 5: Oaxaca-Blinder Decomposition by DIII Quintile — Formal-Informal Log Wage Gap

DIII Quintile	DIII Range	Total Gap (log pts)	Endowment Effect	Returns Effect	Interaction Term	Returns Share (%)
Q1 (Lowest)	0.06–0.24	0.282	0.191	0.078	0.013	27.7%
Q2	0.25–0.41	0.341	0.224	0.104	0.013	30.5%
Q3 (Mid)	0.42–0.58	0.408	0.264	0.131	0.013	32.1%
Q4	0.59–0.74	0.471	0.294	0.164	0.013	34.8%
Q5 (Highest)	0.75–0.91	0.548	0.317	0.218	0.013	39.8%
Full Sample	0.06–0.91	0.412	0.272	0.140	0.000	34.0%

Bootstrapped standard errors (500 replications). All gap components are statistically significant at the 1% level. DIII quintile boundaries based on the 2023 DIII distribution across 33 districts. Source: PLFS 2017–18 to 2022–23.

- **System GMM: Dynamic Wage-Growth Effects of Industrialization**

Table 6 presents the System GMM results. The lagged log wage coefficient ($\alpha = 0.674$, $p < 0.001$) confirms strong wage persistence across districts and over time, consistent with the literature on wage rigidity and labour market adjustment costs. The DIII coefficient ($\beta = 0.063$, $p < 0.01$) indicates that a one-unit increase in the DIII raises the contemporaneous log wage level by 6.3%, a substantial effect. The quadratic term DIII² has a negative coefficient ($\beta_2 = -0.044$, $p < 0.05$), confirming diminishing marginal wage returns to industrialization. The implied threshold beyond which additional industrialization no longer significantly raises wages is $DIII^* = -\beta_1/(2\beta_2) = 0.063/(2\times0.044) = 0.716$, consistent with the Kuznets turning point and the observation that the most heavily industrialized districts (Vadodara, Surat, Bharuch, Ahmedabad) have effectively plateaued in terms of marginal wage growth.

The AR(2) test p-value of 0.384 does not reject the null of no second-order serial correlation in the differenced residuals, and the Hansen J test p-value of 0.291 does not reject instrument validity, providing standard diagnostics in favour of the GMM specification. The number of instruments (31) is well below the number of districts (33), mitigating the Roodman (2009) concern about instrument proliferation. The coefficient on the Education Index (0.041, $p < 0.05$) confirms the human capital channel, while the Infrastructure Index (0.062, $p < 0.01$) again emerges as a significant predictor of wages.

Table 6: System GMM Estimates — Dynamic Effect of Industrialization on District Log Wages

Variable	Coeff.	Std. Err.	t-stat	p-value
Lagged Log Wage ($\ln w_{i,t-1}$)	0.674	0.048	14.04	< 0.001
DIII	0.063	0.019	3.32	0.001
DIII² (non-linearity)	-0.044	0.021	-2.10	0.036
Infrastructure Index	0.062	0.018	3.44	0.001
Education Index	0.041	0.019	2.16	0.031
Urban Population Share	0.024	0.021	1.14	0.254
FDI Intensity	0.038	0.016	2.38	0.017
Agriculture Employment Share	-0.047	0.022	-2.14	0.033
Implied DIII Wage Threshold (DIII*)	0.716	—	—	—
Year FE	Yes	—	—	—
No. of Instruments	31	—	—	—
AR(2) Test (p-value)	0.384	—	—	—
Hansen J Test (p-value)	0.291	—	—	—
Observations	462	—	—	—
No. of Districts	33	—	—	—

System GMM (Arellano-Bover/Blundell-Bond). Instruments: lags 2–4 of log wage and DIII in the differenced equation; lag 1 differences in the levels equation. Instrument matrix collapsed following Roodman (2009). Clustered standard errors at the district level.

- **Input-Output Wage Multiplier Analysis**

Table 7 presents the total wage multipliers (backward linkage + direct effect) for the eight sectors computed from the Gujarat 2013-14 IO table. The Pharmaceuticals sector (S6) has the highest wage multiplier at 2.41, meaning that one rupee of final demand for pharmaceutical output generates INR 2.41 of total economy-wide wage income — INR 1.00 directly in pharmaceuticals plus INR 1.41 in supplying sectors (chemicals, glass, packaging, logistics, business services). The IT/Finance/Services sector (S8) ranks second with a multiplier of 2.28, reflecting extensive procurement of hardware, software support, and professional services. Agriculture (S1) has the lowest wage multiplier at 1.12, reflecting limited inter-sectoral linkages and the dominance of own-account farming.

The difference between the highest-multiplier (Pharmaceuticals: 2.41) and lowest-multiplier (Agriculture: 1.12) sectors implies that shifting one unit of final demand from agriculture to pharmaceuticals generates INR 1.29 of additional wage income through economy-wide multiplier effects. This has a direct implication for the distributional efficiency of industrial policy: directing investment toward high-multiplier sectors not only raises wages in the targeted sector but generates substantially greater economy-wide wage income, including in supplying agricultural and service sectors. The agro-processing sector (a sub-sector within S1/S3) has an intermediate multiplier of 1.74, suggesting that agro-processing investment in tribal districts — which would leverage both the agricultural base and the labour surplus — could generate significant economy-wide wage multiplier effects.

Table 7: Input-Output Wage Multipliers by Sector — Gujarat 2013-14

Sector	Direct Wage Effect	Backward Linkage Effect	Total Wage Multiplier	Forward Linkage Effect	Ranking by Multiplier
S6: Pharmaceuticals	1.00	1.41	2.41	0.84	1
S8: IT/Finance/Services	1.00	1.28	2.28	1.12	2
S2: Chemicals/Petrochem.	1.00	1.18	2.18	1.68	3
S4: Engineering/Metals	1.00	1.06	2.06	0.94	4
S3: Textiles/Apparel	1.00	0.94	1.94	0.72	5
S5: Diamond Processing	1.00	0.87	1.87	0.46	6
S7: Construction	1.00	0.81	1.81	0.28	7
S1: Agriculture	1.00	0.12	1.12	1.84	8
All-Sector Average	1.00	0.96	1.96	0.86	—

Computed from Gujarat Input-Output Table 2013-14 (47-sector, Directorate of Economics and Statistics, GoG). Sectors aggregated from 47-sector to 8-sector classification. Direct wage effect = 1.00 by construction. Backward linkage = wage income in all supplying sectors per unit final demand. Forward linkage = wage income in all purchasing sectors per unit output supplied. Total multiplier = direct + backward linkage.

Robustness and Sensitivity Analysis

- **Alternative DIII Specifications**

To assess whether the empirical results are sensitive to the construction of the DIII, we test three alternative index specifications: (i) DIII-EW, using equal weights ($\varphi_j = 1/6$) rather than PCA-derived weights; (ii) DIII-3C, using only the three highest-loading components (Mfg. Output Share, Industrial Employment Density, and Capital Intensity); and (iii) DIII-NF, excluding the FDI and export orientation components to focus on purely domestic industrialization. In all three cases, the Kuznets turning point estimate remains in the range [0.506, 0.571], and the System GMM DIII coefficient and non-linearity are qualitatively identical to the baseline results. The Oaxaca-Blinder decomposition results are also robust to alternative DIII specifications, with the returns effect share remaining in the 30–40% range across all alternative indices.

- **Controlling for Migration and Structural Change**

A potential confound in the wage analysis is inter-district migration: if industrialization attracts high-skill migrants from other districts, the apparent wage-raising effect of industrialization may partly reflect compositional change in the workforce rather than true wage growth for incumbent workers. We address this by estimating the System GMM model on a sub-sample that excludes districts with above-median net in-migration rates (identified from Census 2001-2011 and 2011-2021 migration data). The DIII coefficient in this sub-sample is 0.057 ($p < 0.01$), slightly smaller than the full-sample estimate of 0.063, suggesting that compositional effects from migration account for approximately 10% of the measured wage effect. The qualitative results are unchanged.

- **Pre-Trends Test**

To assess whether pre-existing wage trends drive the convergence and industrialization results, we conduct a pre-trends test by estimating the System GMM specification on the pre-2013 sub-period (2006-2012) and examining whether the DIII coefficient is smaller and less significant than in the post-2013 sub-period. The DIII coefficient in 2006-2012 is 0.041 ($p = 0.08$), compared to 0.071 ($p < 0.001$) in 2013-2023. This acceleration in the industrialization-wage effect post-2013 is consistent with the catalysing role of the DMIC and PCPIR infrastructure investments that came on-stream after 2013, and does not suggest spurious pre-trend confounding.

Policy Implications

- **Managing the Kuznets Transition for Lagging Districts**

The Kuznets inverted-U result implies that districts currently below the turning point (DIII < 0.54) face a distributional trade-off as they industrialize: average wages will rise, but the wage distribution will initially widen before eventually compressing. For the tribal belt and peripheral Saurashtra districts where this transition lies ahead, proactive redistribution mechanisms are essential to prevent the rising-branch phase from entrenching durable inequality. Specific instruments include: district-level conditional cash transfer top-ups for households below the 30th percentile of the income distribution during the industrialization transition phase; enhanced MGNREGS wage rates (currently set at the State Schedule of Rates) benchmarked to the prevailing informal manufacturing wage in each district; and district-specific minimum wage schedules that are adjusted more frequently in industrializing districts to prevent the formal-informal gap from widening beyond the observed returns effect.

- **Formalisation as the Highest-Return Intervention**

The Oaxaca-Blinder results demonstrate that the returns effect of the formal-informal wage gap grows from 28% to 40% of the total gap as districts industrialize more intensively. This implies that in highly industrialized districts, where labour market segmentation is most pronounced, formalisation of informal workers yields the highest distributional dividend. The returns effect is not attributable to unobservable worker quality (which is captured in the endowment term) but to the institutional advantages of formal employment — union coverage, EPFO contributions, statutory bonus entitlements, and corporate wage-setting practices. Policies that extend these institutional advantages to informal workers — including portable EPFO accounts under the e-Shram portal, extension of the Employees' State Insurance (ESI) scheme to informal construction workers, and mandatory written employment contracts for workers engaged for more than 90 days — would directly reduce the returns component of the formal-informal gap.

- **Prioritising High-Multiplier Sectors for Industrial Policy**

The IO multiplier analysis reveals that pharmaceuticals and IT/financial services generate the highest economy-wide wage multipliers per unit of final demand, substantially exceeding the multipliers of the traditionally dominant chemicals/petrochemicals and textiles sectors. This finding supports a reorientation of Gujarat's industrial promotion strategy toward knowledge-intensive, high-multiplier sectors that generate broader wage income diffusion. The Bulk Drug Park established at Bharuch under the PLI scheme, the semiconductor fabrication investment announced for Dholera SIR, and the GIFT City financial services cluster at Gandhinagar are consistent with this strategic direction. Ensuring that supplier development programmes — including MSME vendor development initiatives under GVS and SIDBI Gujarat — actively link lagging district enterprises into the supply chains of these high-multiplier anchor industries would maximise the economy-wide wage spillover effects.

- **Agricultural Wage Floor Reform**

The low wage multiplier of agriculture (1.12) compared to manufacturing (1.81–2.41) reflects the sector's weak inter-sectoral linkages rather than the absence of policy levers for improving agricultural wages. The MGNREGS programme provides a de facto wage floor for unskilled agricultural labour, and our analysis suggests that calibrating MGNREGS wages to the prevailing local manufacturing casual wage — rather than to the State Schedule of Rates, which updates only annually — would generate a direct compression of the agriculture-manufacturing wage gap. Additionally, promoting agro-processing industries (which exhibit an intermediate wage multiplier of 1.74) in the tribal belt would convert low-multiplier agricultural employment into medium-multiplier industrial employment, raising both the wage floor and the economy-wide multiplier benefits of labour in these districts.

Conclusion

This paper has examined the distributional consequences of industrialization in Gujarat through a multi-method sectoral salary dynamics framework, deploying four complementary analytical tools — semi-parametric Kuznets testing, Oaxaca-Blinder decomposition, System GMM dynamic panel estimation, and Input-Output wage multiplier analysis — on a rich panel dataset covering all 33 Gujarat districts over 2006–2023.

The central empirical findings are as follows. First, the Kuznets inverted-U hypothesis is confirmed at the district level in Gujarat, with wage inequality peaking at a DIII turning point of approximately 0.54. Districts below this threshold are on the inequality-rising branch of industrialization; those above it are on the inequality-compressing branch. Second, the Oaxaca-Blinder decomposition reveals that industrialization deepens labour market segmentation: as districts industrialize more intensively, the returns component of the formal-informal wage gap grows from 28% to 40% of the total gap, reflecting the strengthening institutional advantages of formal employment. Third, System GMM estimates confirm a significant positive effect of industrialization on wage levels (coefficient 0.063), but this effect diminishes and becomes economically negligible beyond a DIII threshold of 0.716. Fourth, Input-Output multiplier analysis reveals that pharmaceuticals (multiplier 2.41) and IT/financial services (2.28) generate substantially greater economy-wide wage income per unit of final demand than traditional industrial sectors, with agriculture recording the lowest multiplier at 1.12.

Together, these findings paint a nuanced picture of industrialization's role in Gujarat's income distribution: it is a powerful but double-edged process that raises average wages while simultaneously deepening distributional asymmetries in the short-to-medium run. The policy architecture required to harness industrialization for inclusive income growth must therefore address three simultaneous imperatives: (i) managing the distributional transition for districts currently on the rising branch of the Kuznets curve; (ii) extending the institutional advantages of formal employment to informal workers in already-industrialized districts; and (iii) strategically directing industrial promotion toward high-multiplier sectors that generate the broadest economy-wide wage spillovers.

Future research should extend the analysis in three directions. First, the IO multiplier analysis is based on the 2013-14 Gujarat IO table; an updated table incorporating the structural shifts of the post-2014 period — including the growth of gig economy services, the pharmaceutical PLI programme, and the semiconductor investment — would substantially enrich the multiplier estimates. Second, a decomposition of the within-sector Gini by worker skill level would identify whether the distributional consequences of industrialization are more pronounced for low-skill or high-skill workers within each sector. Third, a microsimulation model linking the DIII-inequality relationship to household survey data would enable quantification of the welfare effects of alternative industrialization pathways, providing a more direct input to policy design.

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