Convergence across Sub-national Regions of India: A Study of State Bifurcation Policy using Night-lights Data

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Abstract

India has experienced tremendous growth since the liberalization of 1991. Although the per-capita income (in PPP terms) has increased nearly sevenfold for the country as a whole, studies have found significant divergence in incomes across various subnational regions, such as states and districts. This income divergence, and the resulting income inequality, presents a growing challenge to inclusive growth policies. A survey of the convergence literature in India raises the following questions: 1) Is income convergence across subregions in India influenced by historical and geographical factors, suggesting that these differences are inherent? 2) Do policies play a role in determining the pattern of income convergence? This paper addresses the second question by analysing the impact of an exogenous policy shock in India resulting from the bifurcation of the state of Bihar in 2000. We employ high-resolution night-light data as a proxy for economic activity to examine whether regions near the state borders of the newly formed state of Jharkhand which shared a geographical, historical and policy continnum with Bihar before bifurcation exhibit significantly different economic outcomes post-bifurcation. We find that the night light intensity growth rate was 22% higher in Jharkhand border areas as compared to Bihar after 2000.

JEL Classification: O4 , O5

Keywords: Convergence , India , Economic Growth , State Bifurcation

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1 Introduction

Can policy impact income convergence trajectories across regions overcoming the historical, geographic, and cultural determinants? This question becomes important as income inequalities have economic consequences including loss in productivity, inefficiencies in labor and capital markets and resource allocations, and on economic growth itself. Murphy, Shleifer, and Vishny (1989) argue that high levels of inequality can limit domestic market expansion, discourage industrialization, and constrain economic diversification, thereby slowing down the structural transformation necessary for sustained development. Designing policies to address unbalanced growth and income divergence is therefore a key to sustain long-term growth.

In addition of economic consequences, income disparities also have social and political implications. Severe income inequalities can lead to unrest among people and jeopardize the functioning of democratic institution in a country. In India, the experiences of income inequalities have led people to advocate for policy of state bifurcation. While political and cultural factors also play a role, the economic rationale for bifurcation is rooted in the belief that smaller administrative units can lead to better governance, improved resource allocation, and higher regional growth allowing the regions lagging behind to "catch-up".

Subsequently, states like Bihar, Uttar Pradesh, Madhya Pradesh and Andhra Pradesh were bifurcated to form Jharkhand, Uttarakhand, Chhattisgarh and Telangana respectively. The central theme of this paper is to study the impact of this bifurcation policy in the state of Bihar on the economic outcomes of the newly formed region. We further look at how the income convergence pattern have shaped differently as a result of separation of administrative units and governance structure.

In this paper, we use the event of separation of Bihar and Jharkhand as a natural experiment setting to identify the impact of bifurcation policy on the economic outcomes proxied by night-light data. We do the analysis using difference-in-difference

approach and analyse how the annual growth in night lights intensity differed across the bordering regions of Jharkhand as compared to Bihar. We then look at the sub-district level convergence pattern before and after bifurcation in Bihar, Jharkhand and both states together to check if there was any structural shift in it.

We find that the growth rate of night-time light intensity in Jharkhand bordering regions was approximately 22% higher than that of bordering regions of Bihar. This indicates that the policy of bifurcation had an impact on economic growth. On convergence at sub-district level, we find that convergence pattern strengthened within Bihar and Jharkhand and in the region as a whole post bifurcation.

This paper is structured as follows: Section 2 discusses the literature overview, section 3 describes the data and summary statistics, section 4 outlines the identification strategy, section 5 contains the pre-trend analysis for identifying assumptions, section 6 produces the result of main empirical specification, sections 7 gives the robustness check, section 8 gives the results for β-convergence and section 9 concludes.

(a) Undivided Bihar (before 2000) (b) Bifurcation of Bihar (2000)

Fig. 1: Separation of Bihar-Jharkhand

2 Literature Review

The concept of convergence has been central to growth economics, particularly in understanding whether poorer economies tend to catch up with richer ones over time.

The foundation of convergence theory is based on Solow's (1956) neoclassical growth model, which predicts beta-convergence, where poorer economies grow faster than richer ones due to diminishing returns to capital. If all economies share similar structural characteristics—such as savings rates, population growth, and technology—they should experience absolute convergence, reaching the same steady-state income. The standard equation for beta convergence in terms of growth rates is:

$$g_{i,t} = \alpha + \beta \ln(y_{i,t-1}) + \epsilon_{i,t} \tag{1}$$

where $g_{i,t}$ is the growth rate of income for region i at time t, typically defined as:

$$g_{i,t} = \ln(y_{i,t}) - \ln(y_{i,t-1}) \tag{2}$$

The key parameter of interest is β. A negative and significant β implies beta convergence, meaning initially poorer regions ($y_{i,t-1}$) experience higher growth rates than richer ones, leading to income convergence over time. If the equation is estimated with additional control variables, it represents conditional beta convergence, accounting for structural differences across regions.

Empirical studies by Barro and Sala-i-Martin (1992, 1995) showed that convergence is often conditional, meaning countries or regions converge to their own steady-state levels based on structural differences, such as education, infrastructure, and institutions.

Further empirical work extended the Solow model by incorporating human capital. Mankiw, Romer, and Weil (1992) demonstrated that including human capital improves the model's explanatory power, showing that economies with higher education levels converge more rapidly.

Endogenous growth models by Romer (1986, 1990) and Lucas (1988) challenged the assumption of diminishing returns by introducing knowledge spillovers and human

capital accumulation. These models suggest that economies investing more in innovation and education can sustain long-term growth advantages, potentially leading to divergence rather than convergence.

Later studies emphasized the role of institutions. Acemoglu, Johnson, and Robinson (2001, 2005) found that inclusive institutions promote sustained growth, while extractive institutions hinder convergence. Durlauf and Johnson (1995) provided evidence for multiple convergence clubs, where economies with similar structural characteristics converge among themselves. More recently, Ertur and Koch (2007) highlighted the importance of geographic spillovers in shaping convergence patterns. Overall, while conditional convergence is widely supported, absolute convergence remains elusive due to persistent differences in human capital, institutions, and external economic linkages.

Income convergence has been a topic of significant interest also in the context of India, a country characterized by substantial regional disparities in income levels. Several studies have investigated whether Indian states are experiencing convergence in per capita incomes.

Early studies on Indian states, such as those by Cashin and Sahay (1996) and Rao, Shand, and Kalirajan (1999), found evidence of income convergence among Indian states between 1965-1994. These studies used cross-sectional and panel data techniques to examine the convergence hypothesis.

More recent studies have employed advanced econometric methods to re-examine the convergence process in India. For instance, Ghosh (2012) utilized panel unit root tests and found mixed evidence of convergence, suggesting that while some states are catching up, others are falling behind. Additionally, studies by Nagaraj, Varoudakis, and Véganzonès (2000) highlighted the role of infrastructure, human capital, and policy reforms in facilitating convergence.

The convergence literature on India also explores the impact of economic reforms initiated in the early 1990s. Studies such as those by Sachs, Bajpai, and Ramiah (2002) and Ahluwalia (2000) indicate that reforms have contributed to accelerated growth in certain states, leading to conditional convergence, where states converge to their own steady-state paths determined by structural characteristics and policy environments.

A recent study by ICRIER (2023) titled "Remoteness and Unbalanced Growth: Understanding Divergence Across Indian Districts" provides further insights into the divergence patterns within India, highlighting the role of geographical remoteness and uneven growth in explaining the income disparities across Indian districts.

This paper on the bifurcation of Bihar contributes to the broader convergence literature by examining how political and administrative restructuring affects regional income dynamics. While prior research has largely focused on state-level convergence in India, the division of Bihar into Bihar and Jharkhand in 2000 provides a unique natural experiment to assess whether smaller administrative units experience faster economic convergence due to improved governance, localized policy focus, and more efficient resource allocation. By employing a difference-in-differences framework with border subdistricts in Jharkhand as the treatment group and those in Bihar as the control group, this paper investigates whether the newly created state exhibited faster convergence in income growth relative to its pre-bifurcation trend.

This paper uses Night-time light intensity data which in recent years has emerged as a valuable proxy for economic activity, especially in regions where traditional economic data is scarce or unreliable. Night lights data, derived from satellite imagery, measures the intensity of artificial light emitted from the Earth's surface during nighttime. This data has been used in various studies to estimate economic activity, track regional development, and assess the impact of policies.

Henderson, Storeygard, and Weil (2012) were among the first to systematically use night lights data to estimate economic growth. They demonstrated that night

lights data can serve as a reliable proxy for GDP, particularly in countries with poor data quality. Their methodology has since been adopted and refined by numerous researchers.

In the context of India, night lights data has been used to analyze regional disparities, urbanization patterns, and the impact of infrastructure development. For example, Prakash et al. (2015) used night lights data to study the criminalization of politics in India. They found that regions with higher levels of political violence and criminal activities exhibited lower levels of economic activity as measured by night lights intensity. Asher et al (2021) uses the night-lights data to study firms and poverty in India using the SHRUG open data platform.

3 Data

This paper uses the Night Light Data between 1993-2013 by the National Aeronautics and Space Administration (NASA) Defense Meteorological Satellite Program Operational Linescan System (DMSP-OLS) through a set of military weather satellites and the four rounds (1990, 1998, 2005 and 2013) of data from the Economic Census of India. This data is accessed from the Socioeconomic High-resolution Rural-Urban Geographic Platform for India (SHRUG) platform to take advantage of the common geographic framework of the data set that helps to draw the analysis at the geographic level.

The smallest unit of analysis in this paper is a SHRID which is a unique geographic unit in the SHRUG dataset, designed to ensure consistent mapping throughout the 1990-2013 period despite administrative changes such as village or town mergers and splits. It represents a single village or town in most cases, but when locations have merged or separated over time, SHRIDs are assigned to aggregated units to maintain continuity.

Table 1: Summary Statistics: Bihar and Jharkhand

	Bihar	**Jharkhand**
Panel A: Administrative Units		
Total Shrids	38,124	28,821
Border Shrids	235	258
Total Subdistricts	507	256
Total Districts	38	24
Panel B: Night Lights (IHS Transformed)		
Mean	2.26	2.12
Median	2.62	2.45
Std Deviation	1.63	1.57
Panel C: Non-Farm Employment (IHS Transformed)		
Mean	2.79	2.56
Median	2.77	1.44
Std Deviation	1.75	1.56

Panel A in Table 1 shows the summary of administrative units of Bihar and Jharkhand.

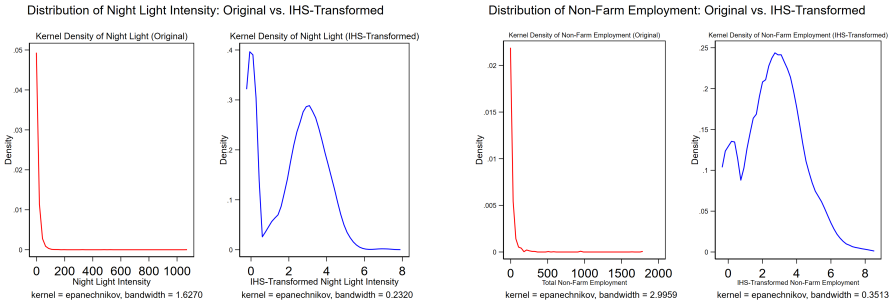
3.1 DMPS-OLS Data

The DMPS-OLS data on night-time light intensity is used as a proxy to measure the primary outcome of economic activity in a region. This approach allows for consistent, annual measurement of economic activity at much more granular level than what is offered by National Income Accounts Statistics or any other large-scale surveys, facilitating a detailed temporal analysis.

While night-time light intensity is not a perfect measure, it serves as a reliable proxy, especially in regions where traditional economic data are scarce or unreliable. Several studies including Henderson et al. (2012) have established a strong correlation between GDP and night-time light intensity at sub-national levels. Further advantage of this approach includes a consistent annual measurements across smaller geographical units.

This paper uses the Inverse Hyperbolic Sine (IHS) transformation of annual nighlight luminosity in a SHRID as a measure of the primary outcome variable to handle

the zeros, smoothen the distribution and reduce skewness. Figure 2 Panel (a) shows the k-density plot of original and transformed annual nights-light luminosity. Panel B in Table 1 shows the summary statistics for Nights-lights (IHS) variable.



(a) (b)

Fig. 2: Distribution (k-density plots) for Night Lights and Non-Farm Employment

3.2 Economic Census of India

The Economic Census of India is a comprehensive dataset that provides detailed information on the structure and distribution of non-agricultural economic activities across the country. It covers all establishments engaged in production and services, including both formal and informal enterprises. The census collects data on variables such as employment, ownership type, sectoral composition, location, and economic activity classification.

The data from 3rd to 6th Economic Census of India is used to corroborate the results further. The fourth round of this census happened in 1998, two years before the bifurcation of Bihar, and the fifth round happened in 2005, five years post-bifurcation. This helps us to analyse the impact of bifurcation policy on the economic outcomes measured as the growth in total non-farm employment in the region. Panel C in Table 1 shows the summary of total non-farm employment across the four rounds of this

census. Panel (b) in Figure 2 shows the distribution of non-farm employment in the data.

4 Identification Strategy

This paper employs a difference-in-differences (DiD) framework to estimate the impact of the Bihar-Jharkhand bifurcation (2000) on income convergence. By focusing on border SHRIDs between the two states, the study aims to isolate the causal effect of the bifurcation on economic performance.

The two main identifying assumptions are as follows:

1. The timing of bifurcation is an exogenous policy shock

   Given that the issue of bifurcation is led by political considerations and entails a massive administrative exercise to implement the policy, timing of the bifurcation is related more to political and administrative factors and are exogenous to economic factors.

2. The areas in Bihar have similar economic outcomes to that of the areas in Jharkhand before the bifurcation.

   As we restrict our analysis to SHRIDs which are on the Jharkhand-Bihar border which shares a geographical, historical, social and cultural continuum as well as policy continuum before 2000, this assumption is likely to hold true. We empirically test this assumption in Section 5.

Given these two assumptions,we can causally identify the impact of bifurcation policy on the economic outcomes of the newly formed state.

Equation 3 gives the main specification which is a DiD regression where the key interaction term captures the differential impact of bifurcation on Jharkhand relative to Bihar. The inclusion of district fixed effects controls for region-specific factors such as terrain, infrastructure, and industrial composition, while time fixed effects account

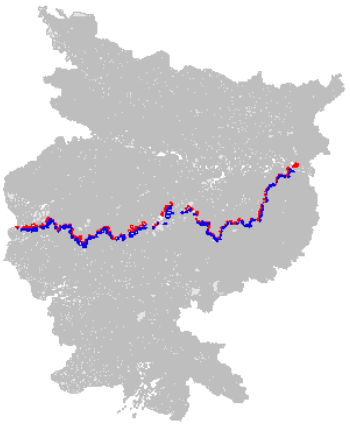


Fig. 3: SHRIDS on Bihar-Jharkhand Border

for macroeconomic trends affecting both states equally. This ensures that the estimated effect is not confounded by broader economic shocks.

$$\begin{aligned} Growth(night\_lights)_{i,t,d} = \beta_0 &+ \beta_1 Growth(night\_lights)_{i,0,d} \\ &+ \beta_2 Treatment_i + \beta_3 Post_t \\ &+ \beta_4 (Treatment_i \times Post_t) \\ &+ \gamma_t + \gamma_d + \epsilon_{i,t,d} \end{aligned} \tag{3}$$

- $Growth(night\_lights)_{i,t,d}$: Growth rate of night light intensity for shrid i in year t and sub-district d.
- $Growth(night\_lights)_{i,0,d}$: Initial growth rate of night light intensity for shrid i in the baseline year 1994 ($t = 0$) within sub-district d.
- $Treatment_i$: Indicator variable equal to 1 if shrid i is in Jharkhand, and 0 otherwise.
- $Post_t$: Indicator variable equal to 1 for years after 2000, and 0 otherwise.
- $Treatment_i \times Post_t$: Interaction term capturing the difference-in-differences effect, measuring the differential change in night light growth for the Jharkhand after the treatment period.
- γ_t: Year fixed effects, controlling for time-specific shocks common to all shrids.

- γ_d: Sub-district fixed effects, accounting for time-invariant characteristics specific to each sub-district.

5 Pre-Trend Analysis

The pre-trend analysis is designed to validate identification assumption 2. It ensures that there were no systematic differences in the economic outcomes of Jharkhand border SHRIDs and Bihar border SHRIDs before the bifurcation in 2000. If the economic trajectories of the two groups were already diverging before the bifurcation, then any observed post-treatment effects might not be attributable to the policy change, undermining causal interpretation.

To check for pre-existing differences in trends, the paper estimates the following equation:

$$Growth(night\_lights)_{i,d,t} = \beta_0 + \sum_{\tau=1994, \tau \neq 2000}^{2013} \beta_1 (Treatment_i \times I[t = \tau]) + \gamma_d + \epsilon_{i,d,t} \tag{4}$$

$Growth(night\_lights)_{i,d,t}$ represents the night-time light intensity for SHRIDs i in sub-district d at time t.

$Treatment_i$ is a dummy variable indicating whether the SHRID belongs to Jharkhand.

$I[t = \tau]$ is an indicator variable for each year τ in the study period (1994-2013, excluding 2000).

β_1 measures the difference in night lights growth between the Jharkhand and Bihar for each year

γ_d controls for district-level fixed effects.

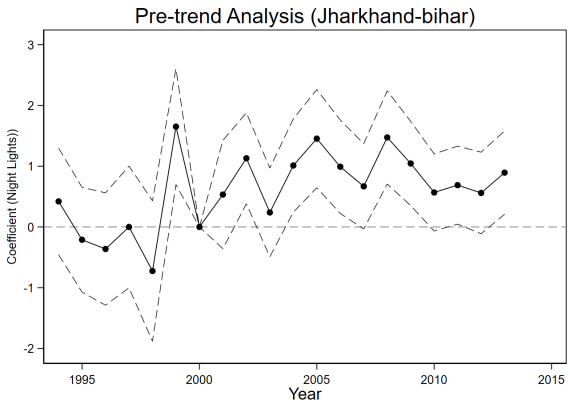


Fig. 4: Pre-trend Analysis (Jharkhand and Bihar: 1994-2013)

By estimating this equation, the paper constructs a series of event-study coefficients (β_1) that show how economic activity in Jharkhand evolved relative to Bihar over time.

If the coefficients β_1 for years before 2000 are statistically insignificant, it suggests that Jharkhand and Bihar had similar night light luminosity before bifurcation. If these coefficients are significantly different from zero before 2000, it would indicate that the Jharkhand and Bihar border SHRIDs were already diverging before the policy change, weakening the identification strategy.

Figure 4 represents these pre-trends analysis by plotting the coefficients we get by estimating equation 4 along with confidence intervals. The coefficients before 2000 remain close to zero and insignificant before indicating that there were no significant differences in night lights luminosity before the bifurcation.

6 Results

Table 2 shows the result of estimating equation 3. Column 3 is the main specification with sub-district and time fixed effects.

Table 2: Diff-in-diff Regression Results

	(1)	(2)	(3)
	g_rate	g_rate	g_rate
post=1	0.485***	0.449***	0.404***
	(0.0434)	(0.0791)	(0.0797)
treatment=1	−0.101	−0.103	−0.174**
	(0.0640)	(0.0633)	(0.0701)
post=1 × treatment=1	0.120*	0.122*	0.198***
	(0.0655)	(0.0639)	(0.0673)
g_rate_0	−0.103	−0.104	−0.0133
	(0.108)	(0.124)	(0.163)
Year Fixed Effects	No	Yes	Yes
Sub-District Fixed Effects	No	No	Yes
Observations	6217	6217	5926

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The coefficient β_3 on (post=1 × treatment=1) is our main coefficient of interest that shows the difference between the night-time light intensity growth in Jharkhand and Bihar. The coefficient remains significant in all three specification as we add more fixed effects. The value also does not change much as we move from model (1) to model (3). Given our identifying assumptions states in Section 4 and the controls introduced in the model for differences in sub-district and time level characteristics, the results indicate that the growth in nigh-time light intensity was significantly different in Bihar and Jharkhand post-bifurcation.

A coefficient of 0.198 implies that post-bifurcation, the growth rate of night-time light intensity in Jharkhand border SHRIDs was approximately: $\left(e^{\beta_4} - 1\right) \times 100 = \left(e^{0.198} - 1\right) \times 100 \approx 21.9\%$ higher than that in Bihar border SHRIDs.

The results thus indicate that the economic activity in Jharkhand bordering SHRIDs grew at significantly higher rate than in Bihar SHRIDs.

7 Robustness Checks

In this section, we run two robustness checks on the model to ensure the validity of the results from Section 6. We will first conduct a placebo time shock test which is a falsification test in which we use an alternative time period of 2002 to construct the post dummy variable and check how the results change. The second robustness check is done by using a different measure of economic activity in place of night-light intensity which are sensitive to some measurement errors. We perform the same diff-in-diff regression approach using this alternative measure of growth in non-farm employment to check how the results change.

7.1 Placebo Time Shocks

The placebo time shock test is conducted to verify whether the observed impact of bifurcation on economic activity in Jharkhand is genuinely caused by the policy change or if similar effects appear even in an arbitrary, unrelated time period. Instead of using 2000 (the actual bifurcation year), a different placebo year of 2002 is chosen, and the same difference-in-differences (DiD) regression is estimated. If the interaction term ($post = 1 \times treatment = 1$) remains significant in this placebo test, it would suggest that the original findings may be driven by spurious correlations, rather than the policy shock itself. However, if the interaction term becomes insignificant, it strengthens the argument that the main results truly reflect the impact of bifurcation, rather than unrelated economic fluctuations.

Table 3: Robustness Check: Placebo Time Shock

	(1)	(2)	(3)
	g_rate	g_rate	g_rate
g_rate_0	−0.699***	−0.112	−0.0483
	(0.144)	(0.122)	(0.159)
post=1	−0.580***	0.534***	0.519***
	(0.0542)	(0.0774)	(0.0781)
treatment=1	0.200**	0.0755	0.0777
	(0.0859)	(0.0606)	(0.0579)
post=1 × treatment=1	−0.197**	−0.0713	−0.0580
	(0.0862)	(0.0609)	(0.0589)
Year Fixed Effects	*No*	*Yes*	*Yes*
Sub-District Fixed Effects	*No*	*No*	*Yes*
Observations	6217	6217	5926

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The results show that in Table 3 Column (1) (without fixed effects), the interaction term is negative and significant, suggesting some divergence between Jharkhand and Bihar in this placebo period. However, when year fixed effects are added in Column (2), the coefficient shrinks and becomes insignificant, and remains so when sub-district fixed effects are introduced in Column (3). This indicates that the apparent divergence in Column (1) was likely driven by omitted factors rather than a true causal effect. The disappearance of the interaction effect after controlling for fixed effects confirms that the observed post-2000 economic divergence in Jharkhand was not due to random

time shocks but was indeed caused by the bifurcation. This indicates that the results produced in Table 2 is robust.

7.2 Impact on Non-Farm Employment

So far, we have used night light data as a proxy for economic activity. With the advantage that this approach has of providing us with a consistent annual measure, it also has some drawbacks. Night lights may reflect non-economic activities, such as public lighting or energy-intensive infrastructure. It may also be a case that post bifurcation Jharkhand had electrification drive and this can confound the results. As we do not have an electrification data at SHRID level, we cannot directly control for it.

To ensure that state bifurcation policy does have an economic impact, we use a more direct and related measure of economic activity–the growth in non-farm employment from the economic census of India 1990 through 2013.

We calculate the growth rate of non-farm employment in the border shrids between 1990-1998 and 2005-2013. Then we use the standard diff-in-diff framework to check if the growth rate post-bifurcation was significantly different for Jharkhand Border shrids relative to Jharkhand border shrids.

Table 4: Two-Sample T-Test with Unequal Variances

Group	Obs	Mean	Std. Err.	Std. Dev.	95% Conf. Interval
0 (Bihar)	50	0.2025	0.1165	0.8234	[-0.0315, 0.4366]
1 (Jharkhand)	71	0.0069	0.0516	0.4346	[-0.0959, 0.1098]
Combined	121	0.0878	0.0572	0.6296	[-0.0256, 0.2011]
Difference		0.1956	0.1274		[-0.0585, 0.4497]
Hypothesis Test:					
Difference (mean(0) - mean(1))			t = 1.5357		
Ho: diff = 0			Welch's degrees of freedom = 69.0335		
P-values:					
H_a: diff < 0			0.9354		
H_a: diff $\neq 0$			0.1292		
H_a: diff > 0			0.0646		

To test for identification assumption, we run t-test for outcome variable and find that there were not significant difference across Jharkhand and Bihar in terms of non-farm employment growth before bifurcation. The t-test result is shown in Table 4. At 5% significance level, we can accept the hypothesis of equal mean across the two groups.

Table 5: Regression Results: Growth in Non-Farm Employment

	(1)	(2)	(3)	(4)
post=1	0.075	0.055	0.025	0.003
	(0.126)	(0.127)	(0.137)	(0.135)
treatment=1	−0.196	−0.219*	−0.238	−0.647**
	(0.127)	(0.129)	(0.238)	(0.288)
post=1 × treatment=1	0.329**	0.347**	0.384**	0.393**
	(0.147)	(0.148)	(0.166)	(0.156)
Public Firms (1990)		0.023	0.030	0.021
		(0.014)	(0.022)	(0.017)
Non-Farm Employment (1990)		−0.001***	−0.002***	−0.001**
		(0.000)	(0.001)	(0.000)
District FE	*No*	*No*	*No*	*Yes*
Sub-district FE	*No*	*No*	*Yes*	*No*
Observations	463	463	439	463

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The results for diff-in-diff regression with non-farm employment growth as the outcome variable is given in Table 5. The DiD interaction term (post=1 × treatment=1),

which captures the differential change in non-farm employment growth in Jharkhand post-bifurcation, is positive and statistically significant across all models. The estimates is also stable across the four models ranging from 0.329 to 0.393. This confirms that non-farm employment in Jharkhand's border SHRIDs grew faster than in Bihar after bifurcation, suggesting that statehood had a positive impact on employment generation outside agriculture.

8 Bifurcation and β-convergence

In Section 6 and 7, we have established the causal impact of bifurcation of Bihar and Jharkhand on the growth of night-light intensity. In this section, we look at the β-convergence at subdistrict levels in Bihar and Jharkhand to check how the intra-state convergence pattern changed, if at all, post bifurcation.

For this, we estimate equation 5 which is a standard β-convergence model with an additional term $(ln(night\_light_{i,t-1}) \times post_t)$ and district and time fixed effects:

$$growth(\text{night\_light}_{i,t}) = \alpha + \beta_1 \ln(\text{night\_light}_{i,t-1}) + \beta_2 \ln(\text{night\_light}_{i,t-1}) \times \text{post}_t + \gamma_t + \delta_d + \epsilon_{i,t,d} \tag{5}$$

- growth(night_light$_{i,t}$): Change in night light luminosity at subdistrict i in year t.
- ln(night_light$_{i,t-1}$): Log of night light intensity in the previous year, capturing initial luminosity at the subdistrict level.
- post$_t$: Indicator variable equal to 1 for post-bifurcation years and 0 otherwise.
- γ_t: Year fixed effects controlling for time-specific shocks.
- δ_d: District fixed effects accounting for time-invariant district characteristics.

The result of estimating equation 5 is shown in Table 6. The coefficient β_2 on $(ln(night\_light_{i,t-1}) \times post_t)$ shows how post bifurcation, the speed of convergence changes. As discussed in Section 4, the identifying assumption 1 asserts that the timing

of bifurcation was an exogenous shock to economic activity. Thus, the variable $post_t$ is exogenous to our model and we can causally identify the impact.

Table 6: Bifurcation and β-Convergence

	(1)	(2)	(3)
	Bihar	Jharkhand	Combined
L.night_light	-0.451^{***}	-0.418^{***}	-0.438^{***}
	(0.00678)	(0.00893)	(0.00541)
L.night_lightXpost	-0.570^{***}	-0.751^{***}	-0.605^{***}
	(0.0191)	(0.0351)	(0.0166)
Year Fixed Effects	Yes	Yes	Yes
District Fixed Effects	Yes	Yes	Yes
Observations	9144	4608	13752

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In all three models, looking at the intra-state convergence between Bihar, Jharkhand and the region as a whole, we find that these regions were on convergence trajectory before bifurcation at the sub-districts level given the negative and significant estimates of β_1.

Post-bifurcation, the conditional convergence speed becomes even more negative indicating that the sub-districts were converging faster after 2000. The coefficient β_2 is higher in absolute term for Jharkhand than Bihar indicating that the speed of conditional convergence was increased more in the former state.

The results conclude that bifurcation benefited both the states by taking them on a faster convergence trajectory than before at subdistrict levels.

9 Conclusion

This paper studies the impact of Bihar's bifurcation on economic growth, using night light intensity as a proxy for economic activity. Using difference-in-differences framework, we find that post-bifurcation, Jharkhand's border SHRIDs experienced approximately 22% higher growth in night light intensity compared to Bihar. This suggests that administrative restructuring and localized governance played a role in accelerating economic activity in the newly formed state.

Robustness checks, including placebo time shocks and an alternative measure of economic activity (non-farm employment growth), reinforce the reliability of our results. The absence of pre-trends further supports the argument that the observed divergence is driven by the bifurcation itself rather than underlying economic differences.

There can be concerns about the potential confounding effects of the change in financial devolution to the states by the central government as a result of bifurcation. There might be a deliberate channeling of funds to Jharkhand region at the cost of Bihar to improve the outcomes of the former less-developed region. Although we do not have a way of dealing with this confounding effect in this paper, it should be noted that any kind of sudden increase in the financial flow towards Jharkhand may not be sustained for a longer period of time and we have estimated the impact of bifurcation policy upto 13 years post the implementation. However, a further investigation into this can be the scope of future policy research.

Beyond the growth effects at the intensive margin on the border SHRIDs, our β-convergence analysis at the subdistrict level shows that income convergence patterns strengthened within Bihar and Jharkhand post-bifurcation. This implies that smaller administrative units may enhance economic catch-up, likely due to improved governance, better-targeted policies, and localized resource allocation. When a new state is formed, it gets a new administrative and institutional setup. More importantly, the

policy regime of the new state also changes as a result of bifurcation that impacts economic outcomes. The experience of Bihar and Jharkhand offers valuable lessons for other regions considering state reorganization as a tool for economic development.

Further research focus could be given on the questions of long-term sustainability of this gains in economic outcomes as a result of bifurcation, the distributional consequences across different population groups and not just across different regions as we studied in this paper, and the broader institutional changes resulting from administrative restructuring. A detailed empirical investigation into the mechanisms driving these results which are qualitatively discussed above can be an important research area to look into for upcoming policy research.

The findings of this paper adds to the broader literature on convergence by establishing the role of policy in shaping regional economic trajectories. The crucial policy implication from these results can be taken as the ability of policies to impact income convergence and thereby income inequalities. Overall, this study contributes to the understanding of how political and administrative changes shape regional economic outcomes. By isolating the impact of an exogenous policy shock, we provide empirical evidence on the role of governance structures in influencing economic growth and convergence.

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