

Regional growth, convergence, and spatial spillovers in India: A view from outer space

Using satellite nighttime light data as proxy for economic activity, Chanda and Kabiraj (2020, World Development) studied regional growth and convergence across 520 districts in India. This article builds on their work by confirming and extending their main findings in three fronts. First, we illustrate regional convergence patterns using an interactive web-based tool for satellite image visualization. Second, we assess the degree of spatial dependence in their main econometric specification. Third, we employ a spatial Durbin model to measure the role of spatial spillovers in the convergence process. Our results indicate that spatial spillovers significantly increase the speed of regional convergence. Overall, the results emphasize the role of spatial dependence in regional convergence through the lens of satellite imagery, interactive visualizations, and spillover modeling.

Introduction

Regional economic growth and convergence are key concerns in developing countries, particularly in large federal states like India where spatial inequalities can threaten social cohesion and political stability. However, studying regional convergence patterns in developing countries has been historically challenging due to limited availability of consistent economic data at subnational administrative levels. The emergence of satellite nighttime light data as a proxy for economic activity has created new opportunities to analyze regional growth dynamics at granular geographic scales.

In an important contribution, Chanda and Kabiraj (2020) leveraged nighttime light data to document evidence of regional convergence across 520 districts in India between 1996 and 2010. Their analysis showed that poorer districts grew faster than richer ones during this period, suggesting a gradual reduction in spatial inequalities. However, their econometric approach did not account for potential spatial spillovers in the convergence process—the possibility that a district's growth trajectory might be influenced not only by its own initial conditions but also by those of its neighbors.

In this context, this paper confirms and extends the study of Chanda and Kabiraj (2020) in three key methodological directions. First, we develop an interactive web-based visualization tool that allows researchers to dynamically explore spatial and temporal patterns in the nighttime light data. This tool facilitates the identification of converging regions and growth hotspots that may be difficult to detect in static representations. Second, we formally test for spatial dependence in both the dependent and independent variables of the convergence equations, highlighting that spatial autocorrelation is an inherent feature of satellite data and the regional convergence process. Third, we employ a spatial Durbin model that explicitly accounts for spatial spillovers, quantifying how neighborhood effects influence the speed of regional convergence.

Our results yield three main findings that advance our understanding of regional convergence in India. First, interactive visualization tools reveal clear spatial patterns in both the initial distribution and subsequent growth of nighttime lights. Second, formal tests of spatial dependence indicate that district-level economic trajectories are not independent of their neighbors. Third, accounting for spatial spillovers through the spatial Durbin model shows that the total convergence effect is substantially larger than previous non-spatial estimates would suggest. Specifically, spatial spillovers appear to accelerate the convergence process by creating additional channels through which lagging regions can catch up.

These findings have important implications for both research methodology and policy design. Methodologically, they demonstrate that conventional non-spatial approaches may significantly underestimate the speed of regional convergence by failing to account for inter-district spillovers. From a policy perspective, they suggest that the benefits of place-based development interventions may extend beyond target districts through spatial multiplier effects, potentially increasing their cost-effectiveness. The results also highlight the value of new data sources and methodological tools in advancing our understanding of regional economic dynamics in developing countries.

The rest of this article is organized as follows. Section 2 provides an overview of the data and methods, describing our use of nighttime light data as a proxy for economic activity and introducing the spatial Durbin model that forms the basis of our empirical strategy. We also detail our methodological extensions related to interactive visualizations, spatial dependence testing, and spillover modeling. Section 3 presents our empirical results, beginning with an interactive exploration of regional convergence patterns, followed by formal tests of spatial dependence, and concluding with estimates of direct and indirect convergence effects from the spatial Durbin model. Finally, Section 4 offers some concluding remarks.

Concluding remarks

This article examines regional convergence patterns across Indian districts using satellite nighttime light data, interactive visualizations, and spatial econometric modeling. Expanding on the work of Chanda and Kabiraj (2020), we developed an interactive web-based visualization

tool that illustrates spatial and convergence patterns across Indian districts. Spatial autocorrelation tests confirm that spatial dependence is a fundamental characteristic of satellite data and the regional convergence process in India. Estimates from our spatial Durbin model indicate that incorporating spatial spillovers significantly increases the estimated speed of regional convergence. The total convergence effect in our fully specified model is approximately 36% larger than conventional non-spatial estimates of (Chanda and Kabiraj 2020). This finding implies that non-spatial convergence models may considerably underestimate the speed of regional convergence. Additionally, it suggests that place-based development interventions may have broader impacts, as their benefits can extend to neighboring districts through spatial spillover effects.

These results have important implications for both research methodology and policy design in developing countries. From a methodological perspective, they highlight the value of combining new data sources, interactive geospatial visualization tools, and spatial econometric methods to better understand regional economic dynamics. From a policy standpoint, they suggest that regional convergence operates not just through district-specific factors, but through complex spatial interactions that create additional channels for catch-up growth. This spatial perspective is crucial for the analysis and design of policies aimed at reducing regional inequalities in developing countries.

Chanda, Areendam, and Sujana Kabiraj. 2020. “Shedding Light on Regional Growth and Convergence in India.” *World Development* 133: 104961.