Convergence in Education Infrastructure in India: Evidence from District Level Data

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Abstract

This paper investigates convergence in rural education infrastructure across India's districts between 1971 and 2001. We report two main findings. First, there is strong evidence for cross-district conditional convergence in the number of rural primary schools. By contrast, patterns for convergence in high schools are relatively weak. Second, these national-level patterns hide significant heterogeneity in state-specific convergence rates. We hypothesize that the differences in state-level convergence patterns reflect differences in state-level policies of spatial egalitarianism. Using proxy measures of spatial egalitarianism, we find that more egalitarian states experience greater convergence in the number of rural district primary schools.

Key Words: Convergence, Regional Disparities, Economic Development, Political Economy, Public Goods

JEL Classification Numbers: O1, O43, O53, H52, H75

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1 Introduction

A vast literature documents the importance of infrastructure in determining development outcomes. Investment in infrastructure such as schools, roads, transportation and communication, and health-care facilities can expand the productive capacity of a region by adding new resources and by increasing the productivity of existing resources (Achauer (1989), Munnell (1992), Easterly and Rebelo (1993), Roller and Waverman (2001)). It follows that spatial disparities in infrastructure will be reflected in inter-regional inequalities in development outcomes. Indeed there is an increasing consensus in the existing literature that the disparities in public infrastructure seem to play an important role in explaining regional inequalities in economic outcomes. In the case of China, for instance, Démurger (2001) presents evidence that large infrastructure disparities across provinces has produced large income disparities as well. And Sahn and Stifel (2003) find that in Africa rural-urban inequality in the distribution of public schools and public health facilities is associated with corresponding inequality in school enrollments and neonatal care. For India, Lall and Chakravorty (2005) note that private sector firms tend to locate away from regions with poor infrastructure.

In this paper we document the extent of inter-temporal change in spatial disparities in rural education infrastructure in India. Specifically, we are interested in whether or not there is convergence (and at what rate) in the number of primary and high schools across the districts of rural India. Using census data from 1971 and 2001, we find that there is a trend towards convergence, especially in primary schools. Given that rural education infrastructure in India is mostly publicly provided, it can be argued that this trend is driven by government policies adopted during this period. Furthermore, in the case of rural education infrastructure in India, the key decisions are made by state governments, not the federal government. Since states may differ considerably in underlying spatial preferences and political economy, they may exhibit differing patterns of convergence and divergence. As a result, it is quite possible for all states to have district-level convergence (divergence) and yet for the districts in the nation as a whole to exhibit divergence (convergence). To our knowledge, this is the first attempt in the literature to estimate and compare state-specific patterns of convergence and divergence of publicly-provided infrastructure. We find that the national-level convergence in primary schools masks considerable heterogeneity among states. To establish a causal link between such observed variation and state level policy requires a much richer data set. However, we do find strong association between states' revealed preferences regarding spatial equality and their respective rates of convergence (and in some cases, divergence) in publicly provided rural education infrastructure.

The remainder of the paper is organized as follows. Section 2 discusses two conceptual issues in the analysis of convergence in education infrastructure. Section 3 describes the data and methodology, and Section 4 presents results for conditional convergence for the nation as a whole as well as by state. Section 5 explores the idea that differences in convergence across states seemingly reflect revealed preferences for spatial equality.

2 Development Policy and Convergence: Some Conceptual Issues

In order to investigate the patterns of convergence in economic variables across regions it is important to address two important issues. First, what is the relevant level of government to consider? Second, what is the economic outcome of interest? Below, we discuss these two conceptual issues for analyzing convergence in education infrastructure.

2.1 The State as Locus of Development Policy

In many parts of the developing world the formulation and implementation of development policy rests on the priorities and capabilities of states rather than the center, and there exists a vibrant literature on federalism and decentralization. In the case of India, several previous studies have noted the primacy of state governments in setting and implementing development policy (Besley and Burgess 2002; Kohli 1987). Besides the fact that implementation of most development policies depends on state administration, much of the public spending on the social sector rests with state governments. For instance, 65-75% of public spending on health is by state governments (Deolalikar et al. 2008; Farahani, Subramanian and Canning 2010). On the basis of a large national survey, Chhibber, Shastri and Sisson (2004) report that Indians overwhelmingly look to state governments for local public goods provision, rather than local or national government or non-government organizations.[1]

Not only are states the loci of development policy in many countries, but they also exhibit considerable heterogeneity. In some cases a single province can dominate the national economy and have greater resources than other provinces (Buenos Aires in Argentina, Punjab in Pakistan). In India, states differ considerably in their approach to development policy with potentially different consequences for overall development ((Harriss 2000; Kohli 1987)). To further illustrate this point we use state-level data on expenditure on primary and secondary schools, averaged over

[1] In India, as in several other countries, some aspects of development policy are further decentralized to sub-state jurisdictions. However, such decentralization has been effectively implemented only in the 1990s. Even with the advent of such decentralization (*Panchayati Raj*), decisions regarding provision of village-level public goods such as health and education facilities – the local public goods that I consider – continue to be overwhelmingly dependent on decisions at the state level (Government of India 2007).

1975-2000. The data is sourced from the Analysis of Budget Expenditure from the Analysis of Budget Expenditure, Ministry of Human Resource Development (MHRD). Figure 1 documents the cross-state variation in average per capita education expenditure on primary schools and secondary schools for the period 1975-2000. We observe that there is large variation. For instance, while Bihar and Rajasthan have similar levels of primary education expenditure, in the case of secondary education expenditure Rajasthan spent over five times the amount spent by Bihar. Similarly, while Maharashtra and Gujarat have similar levels of secondary education expenditure, in the case of primary education expenditure Gujarat spent more than double the amount spent by Maharashtra. [2]

Given that the state is the locus of development policy and that there can be considerable heterogeneity between these states, to study the impact of a state's policies on convergence or divergence, the correct regional units are those *within* that state. Since the district is the basic administrative and data collection unit within Indian states, intra-state disparity is often equated with inter-district disparities within a state. [3] In this paper we follow this convention and use the district as our unit of analysis.

[2]This is not to deny the role of national government in influencing country-wide disparities. In several countries national governments do engage in projects that favor 'lagging' regions – for instance, Santopietro (2002, Appalachia in the United States), González (2011, Italy & England), and Boltho, Carlin and Scaramozzino (1997, Germany). In India's case, too, the national government has engaged in specific 'backward areas' programs over the years (Debroy and Bhandari 2003; Government of Karnataka 2002). However, despite such national programs, arguably the impact of state-specific policies (and other state-specific factors such as culture or patterns of social dominance) affect inter-state development outcomes to a greater extent.

[3]For instance see Agnihotri (2001, West Bengal), de Haan and Dubey (2005, Orissa), Chunkath and Athreya (1997, Tamil Nadu), Sekher, Raju and Sivakumar (2001, Karnataka), and Chakraborty (2009, Kerala). Other studies of intra-state disparities for India include Banerjee and Somanathan (2007), Deaton (2003), Diwakar (2009, Uttar Pradesh), and Suryanarayana (2009, Karnataka & Maharashtra).

2.2 Regional Disparity in What? Identifying Appropriate Dependent Variables

District-level studies of village infrastructure in India typically use variables that measure access to public infrastructure such as roads, post offices, healthcare facilities, and schools. For instance Banerjee and Somanathan (2007) use the fraction of villages in a parliamentary constituency with access to each type of facility in their analysis. However, such a a measure is sensitive to village size, which varies greatly within and across districts. Further, villages may have more than one facility, especially in later years, and variables based on fractions do not account for this. Overall, variables to do with the actual number are likely to be better indicators. To see this, consider Figure 2, which presents 1971 primary school data for Orissa and Tamil Nadu districts from information provided by Registrar General of India (1987).[4] As the left graph indicates, the average number of primary schools in the districts of each state was somewhat similar (1968 for Orissa, 1840 for Tamil Nadu). However, on average Tamil Nadu districts had less than half the villages of Orissa districts (3615 for Orissa, 1408 for Tamil Nadu), and over four times the population per village (432 for Orissa, 1898 for Tamil Nadu). Consequently, as the right graph indicates, Tamil Nadu districts had a substantially greater percentage of villages with access to (at least one) primary school. Although the relationship between the number, size, and spread of villages in districts has not been systematically studied in the literature, it seems likely that these parameters would affect the presence of local public goods such as schools. It will not be surprising if there is a fast rate of convergence across districts in the percentage of villages with access to (at least

[4]The figure omits two Tamil Nadu districts which were outliers in terms of village population. However, the points made in this paragraph hold even after inclusion of these districts.

one) primary school, and there is no reason to think that this necessarily implies convergence in the number of schools in districts. In fact, even in 1971, most villages in the state of Kerala had primary schools (the average value of the percentage measure was 96%), but this was partly because its districts had large but few villages (on average, 129 villages per district, with over 15,000 people per village). However, despite the percentage measure being close to 100%, and despite the fact that average district population in Kerala was between that of Orissa and Tamil Nadu, on average Kerala's districts had far fewer primary schools (614 in Kerala, compared to 1968 for Orissa and 1840 for Tamil Nadu). The above examples suggest that the raw number is a better measure than the percentage. Hence, we study convergence / divergence patterns in the number of primary and high schools in each district.

3 Data and Methodology

We compile district-level panel data on village education infrastructure using information from the decennial Census of India. For this study we look at 1971 and 2001 census data. There are two outcome variables of interest. These are number of primary and secondary schools in each district in each census year. The 1971 data were obtained from a census report (Registrar General of India 1987) and the 2001 data are from Census of India CDs. Our sample excludes states that had less than eight districts in 1971.[5] Hence, we have district level data on fifteen major states of India that account for approximately of 95% of total population and 85% of the land area of India, as of

[5]This leads us to focus on the following states: Andhra Pradesh, Assam, Bihar, Gujarat, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Punjab, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal. The state and territories that we exclude are: Jammu and Kashmir, Arunachal Pradesh, Manipur, Tripura, Mizoram, Nagaland, Meghalaya, Sikkim, Delhi, Goa, Dadar and Nagar Havli, Daman and Diu, Pondicherry, Lakshadweep, and Haryana.

Census 2011. Although the focus of the census report for 1971 (Registrar General of India 1987) is on the fraction of villages with specific types of facilities, it also provides information on the average population served by different categories of schools, from which we compute counts for each type of school. The final data set adjusts for district boundary changes in 1971-2001 by using the district mapping created by Kumar and Somanathan (2009), constructing a panel with 1971 district boundaries. We have a total of 278 districts that were matched between 1971 and 2001 census data. Table 1 presents summary statistics for the number of districts and villages in 1971 in each state.

The baseline model is given by

$$\Delta \, \mathrm{I}_d = \alpha + \alpha_s + \beta \, \mathrm{I}_{d,1971} + \sum_i \theta_i \, \mathbf{C}_{i,d,1971} + \varepsilon_d \tag{1}$$

where ΔI_d is the difference in availability of rural infrastructure of each type (primary, middle, & high schools) in district d between the 2001 and 1971 censuses, α_s represent state fixed effects, and I_{1971} is the level of schools in the district at the starting year (1971). β is the parameter of interest. A negative sign for β indicates convergence whereas as positive sign indicates divergence, holding constant the initial conditions in 1971.[6]

The vector $\boldsymbol{C}$ represents control variables measured at the starting year (1971). In the literature on convergence the importance of controlling for initial conditions has been well documented. We include controls that capture the initial levels of factors that may influence the number of rural

[6]We use Stata's *rreg* command to account for outliers in our data. This command performs a robust regression wherein lower weights are given to outlier variables. Instead of dropping all outliers, this method only drops extreme outliers (cases with Cook's $D > 1$).

schools. These include demand conditions, social conditions, and development endowments. For demand conditions, we include rural population, number of villages, and literacy rate. We expect each of these terms to be positively associated with increase in schools (in the case of population, we also include a squared term). For social conditions, we include the population shares of two historically marginalized groups, the Scheduled Castes (SCs) and Scheduled Tribes (STs). We also include the ratio of female to male literacy rate, which is a proxy for gender equality in basic education. For development endowments, we include the urbanization rate and a moisture availability index.[7] Data for population and village counts come directly from the census (Registrar General of India (1987) for 1971, data CDs for 2001). Information for SCs, STs, literacy rate, female-male literacy ratio, and urbanization rate is also derived from census data, but we use the version compiled by ICRISAT, a research institute.[8] Data for the moisture availability index was computed by ICRISAT from meteorological and geographic information for the districts.

In order to investigate patterns of state-specific convergence/divergence, we also estimate a model where we interact the initial infrastructure level with state indicator variables S_s. This model is given by

$$\Delta \mathrm{I}_d = \alpha + \alpha_s + \gamma_s \, \mathrm{S}_s \, \mathrm{I}_{d,1971} + \sum_i \theta_i \, \mathbf{C}_{i,d,1971} + \varepsilon_d \tag{2}$$

[7]We also estimated the model with a larger set of controls for initial conditions. These include geographical variables (latitude and longitude, an indicator for whether a district has a coastline, and the distance from the nearest city), a historical variable (indicator for whether the district was under direct British colonial rule), and additional development endowment variables (road length and type of soil). Inclusion of these additional controls does not change our results qualitatively. However, these additional controls have missing values for several districts, reducing the number of effective observations. Hence, we prefer the set of controls used in the paper, and the results using the additional controls are available upon request.

[8]ICRISAT (International Crops Research Institute for the Semi-Arid Tropics) compiles district information in its *District Level Database Documentation*, and we are grateful to the organization for sharing the data.

We are interested in the estimates for γ_s, which capture state-specific convergence/divergence, holding constant the initial conditions specified in the set of controls, C.[9]

4 Convergence Results

Below, we first estimate convergence / divergence in education infrastructure for districts in the country as a whole (Equation 1), and then proceed to estimate state-specific convergence / divergence (Equation 2).

Overall Conditional Convergence. Table 2 shows estimation results for conditional convergence using Equation 1. Columns (1) and (2) present estimates for the number of rural primary schools and high schools, respectively, where we include controls for initial conditions but not state fixed effects. We find strong evidence for conditional convergence across districts for primary schools. Districts with fewer primary schools in 1971 reduced the gap by a third over the course of the following three decades. By contrast, the coefficient for high schools (Column 2) is positive, implying conditional divergence. These estimates do not account for differences in districts due to differences in state policies and characteristics. To account for fixed unobserved differences across states, we introduce state fixed effects and report the resulting estimates in columns (3) and (4). The estimated convergence coefficients change considerably after inclusion of state fixed effects. The size of the convergence coefficient for primary schools increases; districts with fewer primary schools in 1971 reduced the gap by almost half over the course of the following three decades. Further, we now find convergence for high schools as well, while the model predicted divergence

[9] The full specification would have been to include $\beta\ I_{d,1971}$ as an additional regressor in Equation 2 and then to estimate $\beta + \gamma_s$. However, for ease of presentation of results, we prefer the specification in Equation 2.

in the absence of state fixed effects. The large impact of state fixed effects on estimated coefficients accords with our intuition that to understand patterns of convergence / divergence we must investigate state-specific policies and characteristics. Since the provision of rural infrastructure is overwhelmingly determined by state policies, states may well differ considerably in their patterns of convergence / divergence. Indeed, it is plausible that the overall convergence coefficients in columns (3) and (4) hide divergence in some states. Accordingly, we now turn to an estimation of state-specific patterns of convergence and divergence.

State-Specific Convergence. Table 3 reports estimation results for state-specific convergence using Equation 2. Columns (1) and (2) present convergence coefficients for each state after accounting for initial conditions in 1971. For primary schools, we find evidence for conditional convergence in thirteen of the fifteen states in our sample. Although the estimated coefficients are statistically significant at conventional levels only for about half of the states, the estimates for other states have economically significant magnitudes. The large standard errors in some instances are likely due to small numbers of districts in some states. In other cases, such as Bihar, a large convergence coefficient – 0.8, the highest of all states – masks considerable intra-state differences, producing large standard errors. In the case of high schools, there is conditional convergence in five states of which three are statistically significant. While the coefficients for the remaining ten states suggests divergence in high schools, the results are statistically significant in only two cases.

One of the important findings from Table 3 is the observed differences in convergence patterns across states in our sample. For instance, for primary schools we have Bihar with the highest rate of convergence on one end and Karnataka with the lowest convergence rate on the other. On the other hand Punjab and Andhra Pradesh actually have positive coefficients implying divergence in primary schools across districts in these states. A key question is what can explain these widely varying patterns of convergence and divergence across states. In the next section we address this question and seek an answer in the state level differences in spatial egalitarianism.

5 Egalitarian Policy and Convergence: A Hypothesis

In this section we attempt to explain the observed state level patterns in the convergence of rural education infrastructure. Since we find strong evidence for convergence only for primary schools, we focus on explaining state level differences in primary schools. We propose the hypothesis that states are driven by different notions of spatial egalitarianism. Specifically, where policy is more interested in reducing intra-state regional differences in infrastructure, we would expect greater rates of convergence. We face two challenges in exploring the relationship between egalitarian spatial policy and convergence. First, it is not clear how to measure spatial policy as regards egalitarianism, and to our knowledge there is not much discussion of this in the existing literature. Second, in the absence of a causal research design, even with a proxy measure for spatial egalitarianism our framework can only explore correlation between such a measure and the convergence or divergence rate. Hence, no causal interpretation can be attached to our findings in this section.

We use two proxy measure for spatial egalitarianism. For the first measure, we use the expenditure on primary schools relative to high schools in a state as a measure of preference for providing basic education, as opposed to 'higher' education, in the state's policy-making process. Using data from India's Ministry of Human Resource Development (MHRD), we compute the average ratio of total revenue expenditure on primary schools to high schools for each state for the period 1975-

2000. This produces a measure of relative expenditure on primary schools by state. As Figure1 indicates, there was considerable variation of relative expenditure among states. For the second measure, we use a measure of land ceilings legislation constructed by Besley and Burgess (2000) – specifically, legislation to impose ceilings on landholdings with the objective of redistributing land to the landless.[10] Note that the measure focuses on legislation rather than actual implementation, which can be influenced by several non-policy variables, and it is intent (as captured by legislation) that is more relevant for our argument.

Based on our idea of spatial egalitarianism, we expect that there is faster convergence in states with greater relative expenditure on primary schools. Similarly, to the extent that land ceilings legislation represents intent regarding egalitarian policy, we expect greater convergence rates for states with more land ceilings legislation. Figures 3 & **??** present scatter plots to probe these associations. Figure 3 plots state-wise convergence coefficients for primary schools from Equation 2 against relative education expenditures on primary schools. (Education expenditure as well as land reform data for Himachal Pradesh is unavailable, so we have only have 14 observations.) We find that across states there is a negative correlation between the size of the convergence coefficient and the share of primary school expenditure. That is, convergence for primary schools is greater for states with greater expenditure on primary education relative to secondary education. Figure 4 plots state-wise convergence coefficients against the land reform variable. We find that states with more land ceilings legislation experience greater convergence. We emphasize that these findings are tentative and at best suggest correlation but not causation. Also, egalitarian spatial policy does

[10] In their variable construction, Besley and Burgess (2000) treat Amendments to previous Acts as new pieces of legislation.

not necessarily imply egalitarianism in underlying preferences. It may well be that political economy reasons, rather than preferences, underlie observed policies at the state level.

6 Conclusion

In this paper we use the district level Census data to estimate the patterns of convergence in education infrastructure in rural India. We find strong evidence for convergence in primary schools across districts wherein, by 2001, districts with fewer primary schools in 1971 had bridged the gap by almost half. The convergence is relatively weaker for high schools. The overall convergence in primary schools masks considerably cross-state variation. We find that states that are more egalatarian, as reflected by policy spending and reforms geared toward greater equality, tend to have greater convergence in primary schools.

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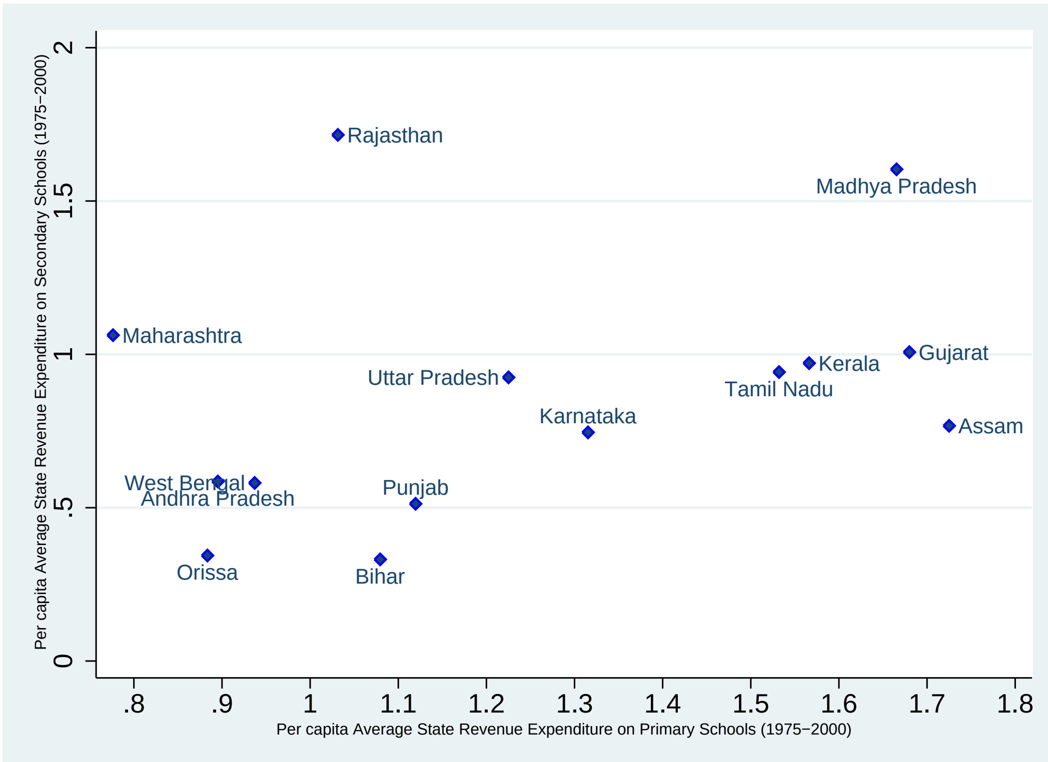
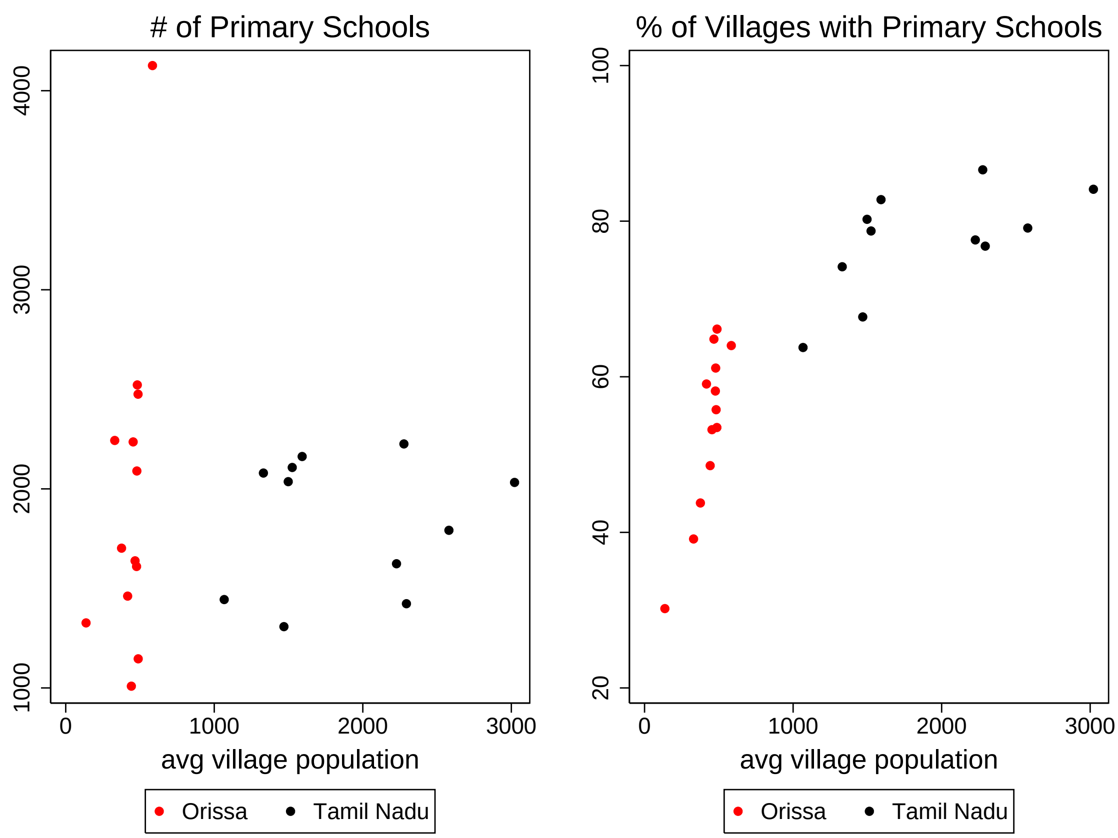
Figure 1: Relative Expenditure on Primary Vs Secondary Education



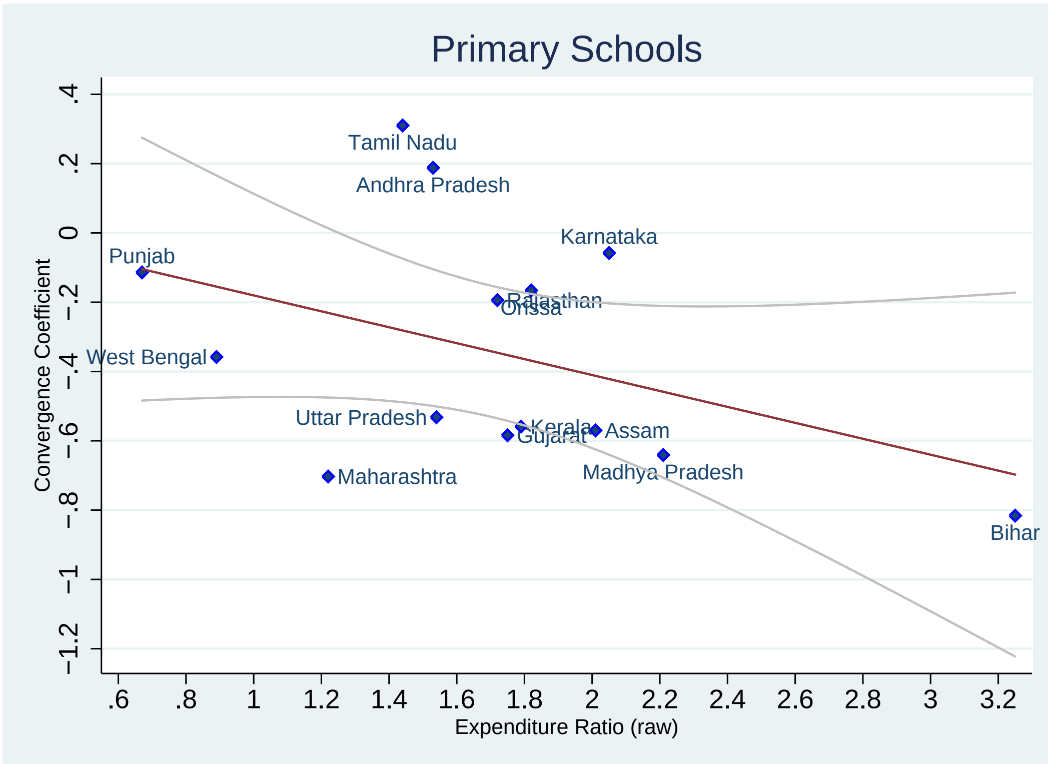
Note: Ratio of Average State Expenditure on Primary and Secondary Schools. *Source: Analysis of Budget Expenditure, MHRD*.

Figure 2: Choice of Infrastructure Variable: Percentage Vs Raw Number



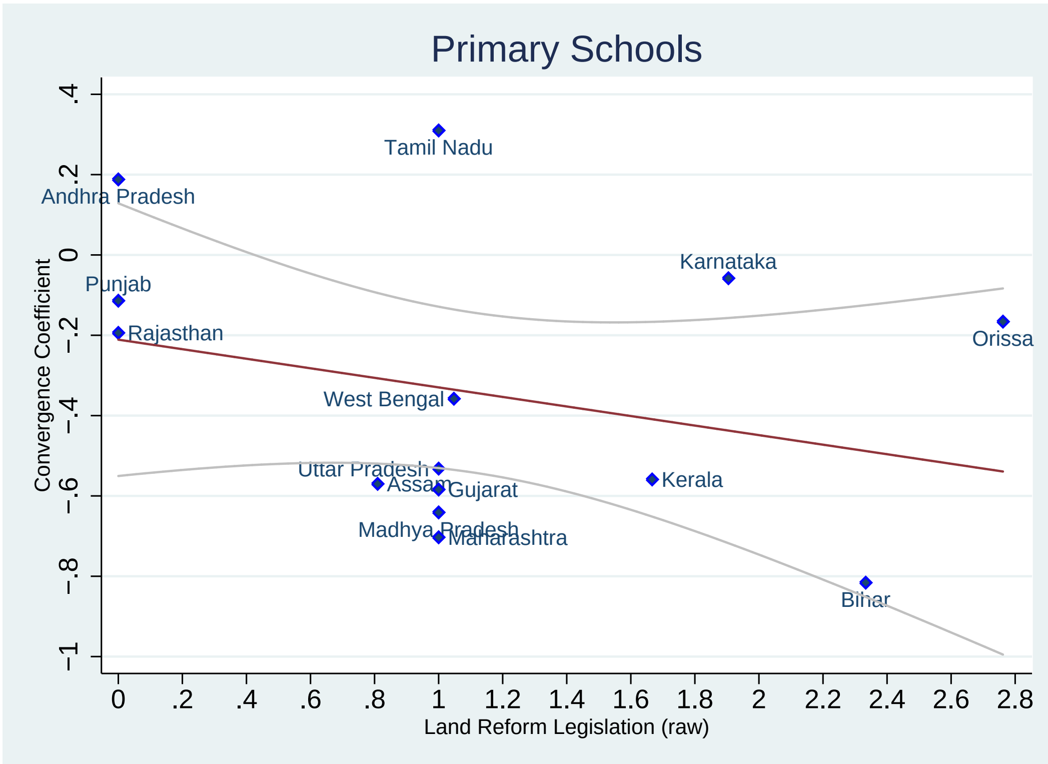
Note: Graphs are for the districts of Orissa and Tamil Nadu in 1971, excluding two Tamil Nadu districts that were outliers because of relatively large village populations. Data source: Registrar General of India (1987).

Figure 3: Convergence Coefficients on Primary Education and Relative Education Expenditure



Note: The graph plots convergence coefficients from Table 3 against relative expenditure on primary versus secondary education.

Figure 4: Convergence Coefficients on Primary Education and Land Reforms



Note: The graph plots convergence coefficients from Table 3 against land ceilings legislation.

Table 1: Descriptive Statistics, 1971-2001

State	Number of Districts	Number of Villages (1971)
Andhra Pradesh	20	27084
Assam	10	22224
Bihar	16	67566
Gujarat	15	18275
Himachal Pradesh	8	16916
Karnataka	19	26826
Kerala	9	1268
Madhya Pradesh	41	70854
Maharashtra	23	35565
Orissa	13	46992
Punjab	8	12188
Rajasthan	24	33303
Tamil Nadu	12	15580
Uttar Pradesh	45	112502
West Bengal	15	37995
Total	**278**	**545138**

Table 2: Convergence, 1971-2001

	(1) Primary Schools b/se	(2) High Schools b/se	(3) Primary Schools b/se	(4) High Schools b/se
Initial value (1971)	-0.319***	0.721***	-0.454***	-0.145**
	(0.046)	(0.090)	(0.037)	(0.056)
Population (m)	-0.020***	-0.005***	-0.007*	-0.000
	(0.005)	(0.001)	(0.004)	(0.001)
Population (sq.)	0.000**	0.000**	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
# of Villages	0.002	0.001***	0.003**	0.000
	(0.001)	(0.000)	(0.001)	(0.000)
Literacy Rate (%)	-0.384	-0.052	0.578**	0.088**
	(0.293)	(0.059)	(0.260)	(0.041)
Female/Male Literacy Rate	8.761	2.852	-20.909	-6.416***
	(18.386)	(3.622)	(16.296)	(2.459)
SC (%)	-0.258	-0.076*	0.150	-0.009
	(0.201)	(0.039)	(0.181)	(0.027)
ST (%)	0.178*	0.006	0.359***	0.003
	(0.103)	(0.019)	(0.074)	(0.011)
Urbanization (%)	-0.078	0.005	-0.167*	-0.021
	(0.132)	(0.026)	(0.089)	(0.014)
Moisture Index	5.407	1.383**	4.829*	1.137***
	(3.353)	(0.659)	(2.672)	(0.407)
State Fixed Effects	No	No	Yes	Yes
Observations	254	254	254	254

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: See text for data description and model specification. Stars show statistical significance at the 10, 5, and 1% levels. Dependent variable is given in column titles (ps, ms, and hs stand for primary, middle, and high schools).

Table 3: State-Wise Convergence, 1971-2001

	(1) Primary Schools b/se	(2) High Schools b/se
Initial Value, Andhra Pradesh	0.188	-1.291***
	(0.195)	(0.277)
Initial Value, Assam	-0.570***	2.608***
	(0.206)	(0.369)
Initial Value, Bihar	-0.816	-0.303
	(0.527)	(0.495)
Initial Value, Madhya Pradesh	-0.641***	0.513
	(0.158)	(0.377)
Initial Value, Uttar Pradesh	-0.532***	0.266
	(0.173)	(0.436)
Initial Value, Rajasthan	-0.194	0.426
	(0.222)	(0.353)
Initial Value, Orissa	-0.166	0.288
	(0.147)	(0.199)
Initial Value, Maharashtra	-0.703***	-0.379*
	(0.123)	(0.212)
Initial Value, West Bengal	-0.358*	-0.270
	(0.182)	(0.273)
Initial Value, Gujarat	-0.584***	-0.855***
	(0.069)	(0.231)
Initial Value, Punjab	-0.114	0.345
	(0.407)	(0.487)
Initial Value, Himachal Pradesh	-0.547***	4.326***
	(0.151)	(0.300)
Initial Value, Karnataka	-0.058	-0.320
	(0.099)	(0.264)
Initial Value, Tamil Nadu	0.310	0.824
	(0.275)	(0.593)
Initial Value, Kerala	-0.559	-0.001
	(0.575)	(0.418)
Controls	Yes	Yes
Observations	253	252

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: See text for data description and model specification. Stars show statistical significance at the 10, 5, and 1% levels. Dependent variable is given in column titles (ps, ms, and hs stand for primary, middle, and high schools). All models include state fixed effects, although coefficients are not reported.