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Persistent effects of colonial land tenure institutions: Village-level evidence from India

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ABSTRACT

This paper estimates the causal impact of land revenue institutions on long run rural development using a Spatial Regression Discontinuity framework on a new village level data set from colonial India. An early 19th century historical quirk meant that villages in close geographical proximity were assigned to different property rights systems — some falling under landlords and others under the government. Villages that were assigned to landlords in the colonial era have a higher poverty rate and lower consumption per capita in 2012. Village census data from 1961 to 2011 shows that historically rooted characteristics in landlord villages prevented them from accessing Green Revolution technologies. Analysis demonstrates that non-landlord, cultivator villages secured preferential access to public investment in the early decades. Despite some convergence in public goods availability, lower private wealth and investment in landlord villages causes continuing spatial inequalities.

1. Introduction

Policies implemented during periods of colonization are known to have striking effects on contemporary economic outcomes. The allocation of property rights to landlords instead of cultivators in colonial India in the 19th century is considered to have determined agricultural investments and incomes late into the 20th century (Banerjee and Iyer, 2005). I test this hypothesis with a new methodology, newly digitized more granular data, and provide fresh evidence on how public and private investments explain the evolution of historically rooted inequalities in the decades since Indian independence.

Specifically, this paper links colonial era village level records to georeferenced data from village censuses between 1961 and 2011. The focus is on a single district in the state of Andhra Pradesh in India, where villages were assigned to different land tenure systems at the beginning of the 19th century. This happened due to an exogenous quirk around a historical boundary during a period of colonial expansion and policy experimentation. Villages on the eastern side of this boundary were handed over to a pre-existing landlord for revenue administration as per colonial policy in 1801, becoming *zamindari* or 'landlord' villages. The administrator on the western side went against official policy at the time to settle villages under his control directly with cultivators, creating *raiyatwari* or 'government' villages. This historical accident creates a setting for a natural experiment, in that villages with identical geographical conditions are led down different institutional paths.

A spatial regression discontinuity (SRD) design is employed. The results indicate that villages that were on the landlord side of the colonial boundary have higher poverty and lower consumption in 2012 compared to villages on the government side. These economically significant impacts are robust to alternate specifications that vary the bandwidth, the geographic control function or kernel in the RD estimation. Further tests with sub-samples of the data and Conley standard errors confirm unequal outcomes around this historical boundary. Similar differences are not observed when other administrative or simulated boundaries are used instead.

Next, villages in the study area are digitized and linked across all decadal censuses from 1961 to 2011. This data shows lower land inequality and higher literacy in government villages by 1971, indicating the formation of a class of medium cultivators. With this as a starting point, subsequent analysis examines how government villages harnessed their position to secure preferential access to both public and private irrigation in the following decades. The analysis finds that some developmental gaps between government and landlord villages narrow in the 1980s and 1990s but reemerge in the following decades, a pattern for which lasting differences in private household assets and investment are likely responsible.

The current study adds to a substantial literature that investigates the historical origins of development (for recent reviews, see Nunn (2020) and Cirone and Pepinsky (2021)). Previous work has also used

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natural experiment like settings to investigate the impacts of historical colonial policies (Dell, 2010; Mattingly, 2017; Dell et al., 2018; Oto-Peralías, 2020). The adverse effects of indirect rule and capture of political institutions have also received significant attention across different colonial settings (Acemoglu et al., 2014; Lowes and Montero, 2021).

This paper contributes directly to debates on colonial origins of Indian development (Banerjee and Iyer, 2005; Iversen et al., 2013; Banerjee and Iyer, 2013). It is the first to test relevant hypotheses quantitatively using village level data from India. The methodological approach is able to isolate the effect of institutions from other explanations such as the role of the extreme seasonality across the Indian subcontinent (Roy, 2021). Previous research attributed economic inequalities to conflict and its impacts on politics and expenditures at the state level. The results here show how institutional divergence can lead to long run economic divergence in villages exposed to the same provincial and district level policies.

This study also relates to an important literature on the development of the agricultural sector and its impacts on incomes and poverty (Ligon and Sadoulet, 2018; Datt et al., 2020). There is a large body of work that investigates the adoption and diffusion of Green Revolution technologies in India (Binswanger et al., 1993; Das, 1999; Mittal and Kumar, 2000; Foster and Rosenzweig, 2004; Chinnappa, 2019; Vasudevan, 2023) and their multifaceted impacts on yields, income, health, education and democratization (Pingali, 2012; Foster and Rosenzweig, 2004; Dasgupta, 2018; Bharadwaj et al., 2020). The results here provide quantitative evidence on the impact of historical, social and political factors that determine the allocation of, and access to, large scale public investments in education, irrigation, and electrification (Wade, 1982, 1984; Nikku, 2006; Kale, 2014; Mollinga, 2018).

The paper is organized as follows. Section 2 lays out the historical circumstances that created a meaningful discontinuity and the historical evidence on the subsequent impacts during the colonial period. Section 3 covers the data and Section 4 discusses the empirical strategy. The results and channels are explored in Sections 5 and 6 respectively, and Section 7 concludes.

2. Historical background

2.1. The making of a historical accident

There were three broad systems under which the British administration defined the liability for land revenue. Under the landlord based system (*zamindari*), the liability was fixed, often in perpetuity, with individual landlords who were broadly free to decide revenue terms in villages under their jurisdiction. The cultivator based system (*raiyatwari*), on the other hand, entailed that there was an annual settlement process through which individual cultivators paid revenue directly to the government, based on the value of their crop and the local geographical conditions. The third and final system (*mahalwari*) put the liability for land revenue jointly on village bodies, which could differ considerably in nature. The first two systems are the focus of the present study.

There was a distinct chronological pattern in the implementation of these land tenures. In the territories that the British first acquired in the 18th century, such as Bengal, they implemented a landlord based system formalized by the Permanent Settlement of 1793. The stated rationale was that allowing landlords or local chiefs to retain control over estates would maintain pre-existing agrarian relations and stable revenue while incentivizing productivity. Crucially, this policy also required little administrative work from the state. Within a few decades, as state capacity grew, the default position had changed such that the whole of the newly expanded province of Bombay was placed under the cultivator based system instead. Authorities now argued that it was this arrangement that better incentivized productivity, while also protecting smaller peasants. This transformation did not take place on the merits of such arguments, but rather due to an intervening period of experimentation on the ground by committed administrators going against official policy. The site for this experimentation was the Madras province, leading to arbitrary divisions in tenure type within small regions of the province.

The study area of this paper lies in one such region. The neighbouring lands comprising the districts of Cuddapah and Nellore were acquired from Mughal governors almost simultaneously, in 1800 and 1801 respectively. Both districts were populated by small chiefs (known as *poligars*) who held legal and revenue authority in villages under their control. In 1799, the Governor-General of India had instructed the Madras government to extend the Bengal landlord based system across the *poligar* territories.[1] The administrator on the Nellore side completed the implementation of this policy by 1802: all the local chiefs were relieved of their military obligations and converted into landlords, liable for a permanently fixed sum of land revenue from their estates.

The administrator in charge a few kilometres across the boundary in Cuddapah was Thomas Munro, a strong proponent of alternative revenue arrangements. He devised a plan to get rid of the landlords, while maintaining a pretence of following orders. Munro raised the revenue demanded of the *poligars* to the theoretical maximum based on previous records. When a *poligar* invariably failed to pay he was ordered to present himself in Munro's court — in itself an insult to *poligars* who saw themselves as kings. The absconding *poligars* were then hunted down and pensioned off. At the start of this process Munro stated, "I am convinced that it is possible to expel them all and to hang the great part of them."[2] By the time he left Cuddapah for Britain in 1807, "there was not a single... unpensioned, unimprisoned, or unhanged Poligar in the district".[3] Instead of landlords, Munro assigned property rights to over 200,000 cultivators during his stint. This was the making of the *raiyatwari* system. The British government in India was initially angry at what was clearly as a disobeyal of orders,[4] but the success of the system in terms of revenue collected, a general shift in ideology, and lobbying in London, had changed official policy by 1820. Munro himself returned in 1821 as the Governor of the Madras province to supervise the extension of revenue settlements under a cultivator based system.

The result of these circumstances meant that villages within a few kilometres of one another were assigned to different land revenue arrangements as shown in Fig. 1. Villages under the landlord based *zamindari* system became 'landlord' villages and those under the cultivator based *raiyatwari* system became 'government' villages. These villages were otherwise very similar. It is hard to find historical records at this level of disaggregation but there is some evidence from the *Imperial Gazetteer of India*[5] published in 1908 and 1909 that the geographical conditions on both sides of this historical boundary were almost identical. The gazetteer reports rocky hills, red and gravelly soil, small and seasonal rivers, and around 25 inches of rainfall annually in the vicinity of the border. Villages on both sides were relatively isolated and far from cities of any importance. All districts in the study area came under Mughal rule under Aurangzeb's reign. The Historical Atlas of South Asia shows that there were no important religious or cultural sites in the sample area either from the Mughal or pre-Mughal period.[6].

[1] *The Fifth Report, v. 3, pg 336* as cited in Stein (1989)

[2] Wellesley papers as cited in Stein (1989, pg 88)

[3] *Manual of the Cuddapah District in the Presidency of Madras, 1875, pg 136*

[4] The Court of Directors said Munro's actions were "not only disingenuous, but harsh and ill-considered" and his conduct based on "violent and mistaken principles" *Manual of the Cuddapah District in the Presidency of Madras, 1875, pg 108*

[5] Available in digital form at https://dsal.uchicago.edu/reference/gazetteer/

[6] *Historical Atlas of South Asia pg 22,34,41 and 47*, accessed at https://dsal.uchicago.edu/reference/schwartzberg/

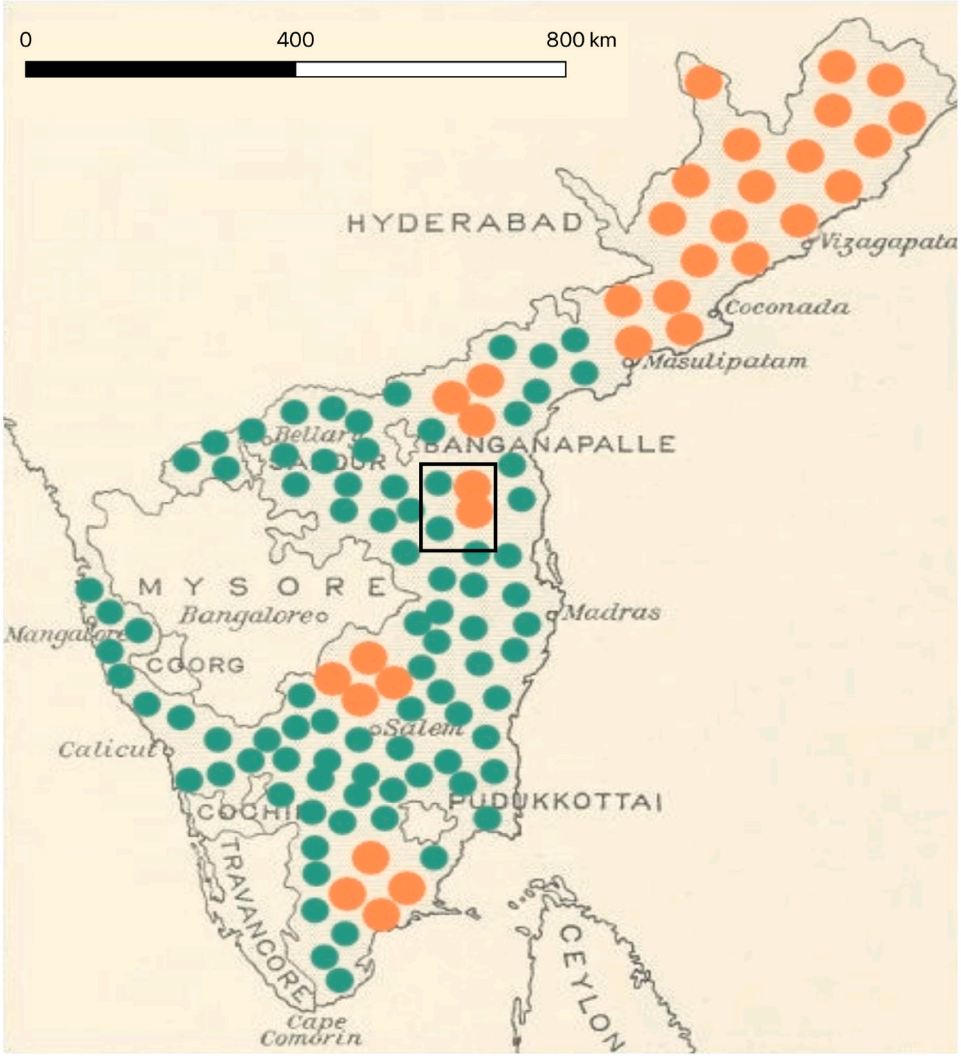

Fig. 1. Land revenue systems in colonial Madras.
Notes: Approximate extent of landlord regions (larger orange dots) and government regions (smaller green dots) in the 19th century Madras. Revenue settlements were made directly with landlords in one-third of the province, while the remaining was settled under the new cultivator based system. Location of study area is highlighted. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

In terms of previous history, the landlord side witnessed less warfare and depopulation. The Nellore manual states "... the districts of Nellore and Ongole... entirely escaped the effects of the last two wars, the population has suffered no violent decrease, and the population have not been deprived of means of cultivation" (*Nellore manual, pg. 471*). In contrast, it is remarked that the neighbouring areas of Cuddapah suffered depopulation and the country was in "poor condition" (*Kurnool manual, pg. 53)*.[7]

One-third of the province of Madras was settled permanently under landlords by the early 19th century in a legally irreversible way. Even once its weaknesses became clear courts maintained that the administration had no legal right to subsequently take over these estates except in very specific conditions of mismanagement. The rest of the Madras province as well as almost all of Bombay province was settled under a cultivator based system that was continuously refined over the rest of the century.

The success of revenue collections in the study area was replicated over time across directly settled areas. This was largely due to the possibility of benefiting from expansions in acreage or any increases in agricultural productivity. Revenue numbers available from the turn of the 20th century show that land revenue per acre was approximately 1 rupee in directly settled areas of Kurnool and Cuddpah which places it below the mean incidence of 2 rupees per acre across Madras districts. However, revenue per acre in the landlord villages in the study area was four times lower at 0.25 rupees per acre. The incidence of land revenue in landlord areas across the province varied from as little as 0.15 rupees to 0.9 rupees, with an average of 0.7 rupees.[8]. Taking a broader view of colonial India land revenue per acre was 0.4 rupees in the landlord province of Bengal and just over 1 rupee in the cultivator based province of Bombay.[9]. The eventual turn towards a cultivator based revenue system reflected shifting ideologies, increasing state

[7] For the purposes of the empirical strategy employed here, it is important to show that conditions were similar on both sides of the boundary *before* the arrival of the British. It is reassuring that differences in prior history imply that future government villages started from being worse off in terms of population, which would be a bias against our finding a result in favour of their future success, which is the hypothesis explored later in this paper.

[8] All numbers belong to the 1903-04 season from *Agricultural Statistics of India, 1899-1903, pg 265, 293.*

[9] *Agricultural Statistics of India, 1899-1903, pg 261, 264.*

capacity but also belief in the system's ability to ensure steady and relatively higher land revenues.

2.2. Describing the institutional divergence

The historical accident described in the previous section led to distinct features in these sets of neighbouring villages. This section will briefly outline historical evidence on four elements in particular that characterized the different conditions prevalent in landlord and government villages. I return to the long term consequences of these differences when discussing the channels later in the paper.

Firstly, there was historically higher revenue extraction from the actual cultivators in landlord villages. When the revenue demand due from landlords was fixed permanently in 1801, the amount the landlords could demand of their tenants was not, leading to the possibility of severe over-extraction of revenue. Indeed, the revenue extracted from tenants on comparable pieces of land could be 4 to 5 times higher in landlord villages compared to government ones (Sayana, 1949, pg 106). The existence of a sub-tenant class at the village level often meant that the actual cultivators worked under even harsher conditions (Driver, 1949, pg 66). Although the landlords were liable for persecution if there was 'undue exaction', in practice this rarely ever happened for two major reasons. The diversity in collection methods (cash or kind) and the plethora of additional customary charges imposed, made it impossible for the government to accurately measure the levels of exaction (Raychaudhuri et al., 1983, pg 218). For example, in various estates (including the one in the study area), a traditional system continued to be used, which meant that revenue was to be paid on a crop by crop basis. Higher rates were charged for more productive crops, and cultivators were forced to cultivate inferior lands alongside higher quality ones (Sayana, 1949). Additionally, the village headmen and accountants were appointed by the landlord and they were able to modify revenue arrangements from village to village in a variety of ways, often to the advantage of the village elite (Baker, 1984, pg 431). Weaker tenants were more heavily assessed but could not get legal recourse given the lack of proper accounts and their disadvantaged position in the village hierarchy. In contrast, the revenues in government villages were often reduced at the start to encourage cultivation — in Cuddapah for example, Munro recommended a 25% decrease in revenue demanded which was implemented in 1821. Once fully established, the annual revenue settlement process in government villages ensured that cultivators paid only for the land cultivated in any given year, with further procedures in place for revenue remission after poor agricultural seasons.

Secondly, land concentration was higher and wages were lower in landlord areas. Lack of village level data means we need to rely on India wide province and district level estimates here. The allocation of property rights to landlords concentrated ownership within a landed elite. This is shown by a strong positive relationship between the land Gini and proportion of landlords in a colonial province (Banerjee and Iyer, 2005). The concentration of land also led to collusion in labour markets and lower bargaining power for wage labour in colonial India, resulting in lower wage incomes (Caum-Julio, 2023).

Thirdly, there was a stark difference in clarity and implementation of property and other associated rights between landlord and government villages. The settlements made in 1801 were vague on what the rights of tenants and sub-tenants were "leaving the courts the impossible task of discovering them" (Washbrook, 1981, pg 656). Subsequent legislation made attempts to define these rights further, but even clearly defined rights were almost impossible to implement in court due to a lack of well maintained land records and limited state capacity in landlord areas. For the landlords it was hard to "convince the court that a particular ryot occupied a certain tract of land, was supposed to pay a certain rent, and indeed had not paid it" (Baker, 1984, pg 430). Landlords more often than not relied on traditional methods to maintain revenue collections, and they resisted economic and social change that could potentially threaten traditional power structures (Baker, 1981). At the same time, landlords increasingly ignored their customary obligations. When the government legislated to define the legal responsibility of the landlords in their estates, to provide irrigation facilities for example, it realized in court that it had no way to enforce this. The legal confusion created by the settlement even extended to water from government canals passing through landlord villages which landlords refused to pay for. Railways often navigated around landlord estates due to such legal difficulties (Baker, 1984). In government villages, comprehensive land surveys were carried out and title deeds were created and assigned for each piece of land, specifying the revenue obligations that came with it. The judicial authority to oversee disputes regarding such deeds was moved out of the village into the district courts. This resulted in the creation of a vibrant market in land, and also the expansion in credit, as the deeds could be used as collateral.

Finally, the level of historical conflict reported in landlord villages was much higher relative to government villages. The peasants complained about the poor state of irrigation and the erosion of their historical rights to common forest lands. These disputes were often "conducted with greater bitterness and in some estates ryots and estate officials murdered one another with monotonous regularity" (Baker, 1984, pg 436). The violence was strong in the Telugu areas in the study region, where peasants launched a protest to restore traditional rights to fodder and timber (Sarkar, 1989). The conflict between landlords and peasants was sustained also by the economic and political developments in the early 20th century. As the railways were built and commercialization of agriculture proceeded at pace, landlords found their traditional role in the centre of the economy was being diluted. The landlords' lackadaisical attitude towards irrigation, transport and general infrastructure can be substantially explained by their perception of these developments as a threat to their social position, which drove further tenant protests (Baker, 1981).

3. Data

I use historical and modern data for my analysis. This is the first study to digitize and link the 1901 village census to post-independent censuses from 1961 onwards.

I use colonial censuses to identify and classify villages based on the revenue system historically applicable.[10] I obtain and merge data on rural consumption, poverty and other village level data from The Socioeconomic High-resolution Rural-Urban Geographic Platform for India (Asher et al., 2021; Ministry of Rural Development, Government of India, 2011). The consumption data has been estimated at a per capita level using household level data collected via the Socio-Economic and Caste Census conducted in 2012 and the 2011-12 India Human Development Survey (IHDS-II). The poverty data uses a threshhold of 2$ per person per day in PPP terms based on 2012. In addition, the digitized population census data for 2001 and 2011 provides information on literacy, irrigation and public good provision (Asher et al., 2021; Office of the Census Commissioner India, 2011). For an exploration of channels, I digitize and then merge data from village censuses from 1961, 1971, 1981, and 1991 to previously digitized 2001 and 2011 data, using a string matching algorithm implemented sequentially in R.

I supplement this data with altitude variables estimated using satellite data from the National Remote Sensing Centre, through their open data portal *Bhuvan*.[11] I use FAO Global Agro-Ecological Zones (GAEZ)

[10] I exclude *inam* villages which were granted a more favourable tax status and also leave out a small set of villages that were brought under government control on the landlord side of the boundary. Results do not change if these are included in the sample.

[11] Available at https://bhuvan-app3.nrsc.gov.in/data/download/index.php

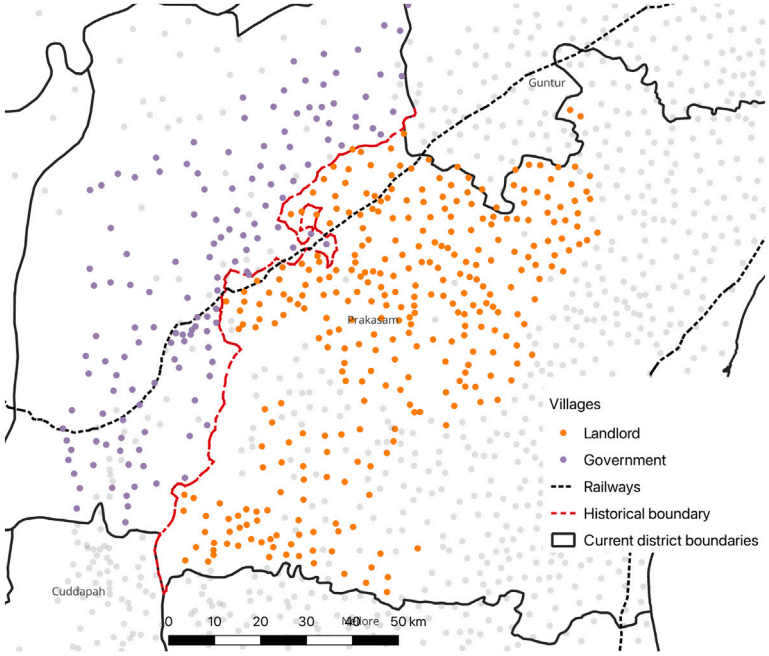

Fig. 2. Map of study area.
Notes: Map showing historical boundary around which villages were allocated to government or landlord villages in the 19th century. Also shows current district boundaries and railway lines in the study area. Villages coloured grey within 50 km of the boundary were allocated to a third type of land tenure (*inam*) or cannot be reliably linked to their historical land tenure.

Table 1
Balancing tests for covariates.

Variable	MSE Optimal Bw	RD Coeff	*p*-value	95% CI values		Effective N
Altitude	17.86723	27.04691	.4410469	−42.05746	96.53609	224
Ruggedness	10.81253	2.540042	.1657253	−1.301195	7.586503	139
Potential rice production	14.71784	−.0285764	.8979458	−.7663013	.6721702	192
Potential gram production	13.96823	.0181916	.9771721	−.2220722	.2156812	186
Distance to (colonial) rail station	7.467391	3.336593	.093975	−.7202324	9.179973	99
Distance to town	10.78914	4.751515	.1779231	−2.146014	11.5818	138
Distance to canal	14.97273	1.726122	.1968126	−.8589659	4.171955	193
Distance to river	12.74909	3.494976	.3555917	−3.496791	9.731943	172
Proportion of Lower Castes	7.660099	−.0947224	.0465174	−.234851	−.0018252	101
Proportion of Agricultural Labourers	9.869401	−.0019676	.8394579	−.1177668	.0957021	131

Notes: Balancing tests for all observable variables using MSE-optimal bandwidth and p-values based on robust standard errors. See section 3 for details on data construction.

as composite measures for crop suitability that capture relevant agro-climatic, soil and terrain conditions determining crop yields.[12] I identify historically important towns and calculate the distance to the nearest town from each village. Finally, I plot the railway line and use colonial military records to identify railway stations in the 19th century. Fig. 2 shows the final set of sample villages on either side of the historical boundary alongside current district boundaries and the railway line in the area.

4. Empirical strategy

A Spatial Regression Discontinuity (SRD) design is employed to estimate the long run causal effect of historical institutions on contemporary economic outcomes across the boundary. The model estimated is:

$$Outcome_i = \alpha + \tau Z_i + \mathbf{G}\gamma + \mathbf{X}\beta + f(location)_i + \phi_d + u_i \qquad for\ i\ \epsilon\ b$$

where outcome in village i is the outcome of interest, Z indicates if a village is on the landlord side of the boundary, G is a selection of geographical controls, X is a set of other covariates, ϕ_d is a set of border segment dummies and $f(location)_i$ is a polynomial function that captures the geographical location of each village. My baseline specifications use distance to the historical boundary in local linear polynomials estimated separately on either side of the discontinuity following Cattaneo et al. (2019). The default specifications employ a triangular kernel and an optimal bandwidth b that minimizes the Mean Squared Error given the choice of polynomial and weighting scheme (Cattaneo et al., 2019).

The use of a SRD needs to satisfy two main criteria to be viable. The first identifying condition is that all other relevant, pre-determined factors varied smoothly across the historical boundary. The historical factors that determined the allocation of land revenue rights suggest

[12] FAO Global Agro Ecological Zones http://www.fao.org/gaez/. Soil quality classifications based on the World Harmonized Soil Database are used in robustness checks.

Table 2
Balancing tests for covariates with fixed bandwidth.

Variable	Bandwidth	RD Coeff	*p*-value	95% CI values		Effective N
Altitude	30	30.65828	.422788	−37.18222	88.64252	344
Ruggedness	30	.8956746	.2394744	−1.309085	5.239039	344
Potential rice production	30	−.038626	.7836264	−.7093563	.5350164	344
Potential gram production	30	.0364975	.8649892	−.1709292	.2034024	344
Distance to (colonial) rail station	30	−1.924675	.9479464	−3.692492	3.45443	344
Distance to town	30	7.097093	.1221676	−1.056379	8.940433	344
Distance to canal	30	1.914669	.1438181	−.5726562	3.932703	344
Distance to river	30	6.269285	.2733598	−2.401865	8.487651	344
Proportion of Lower Castes	30	.0015932	.3741757	−.1156071	.0434762	344
Proportion of Agricultural Labourers	30	−.0045143	.8465146	−.0676424	.0824673	344

Notes: Balancing tests for all observable variables using 30 km bandwidth and p-values based on robust standard errors. See section 3 for details on data construction.

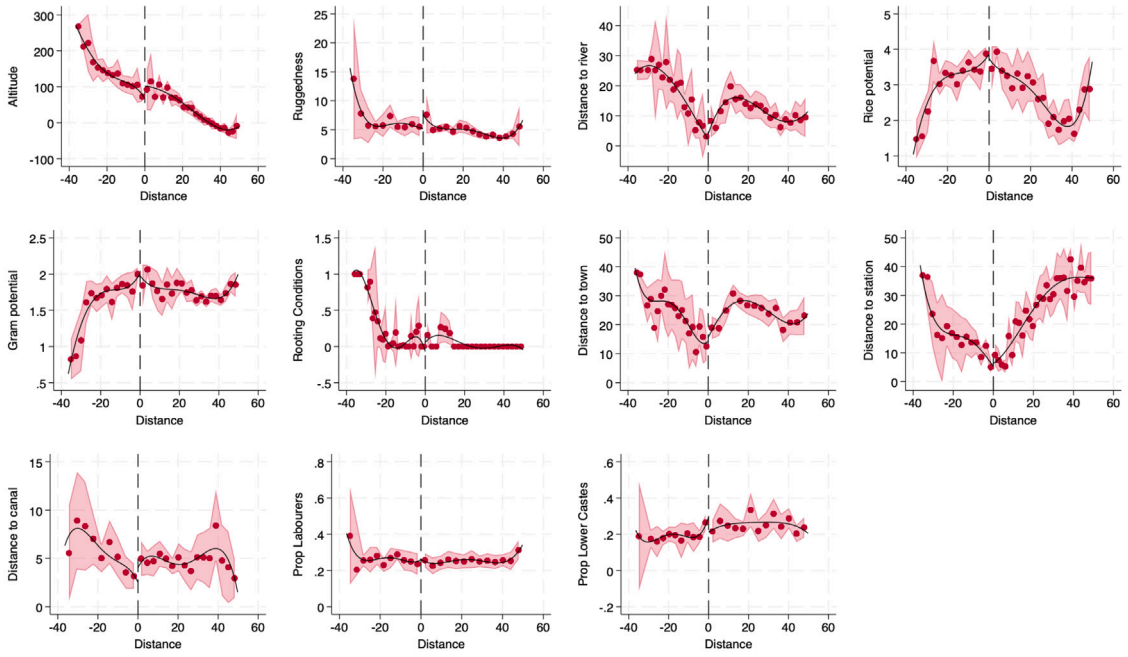

Fig. 3. RD plots for all covariates.
Notes: Constructed using the **rdrobust** package using full sample of villages in the study period. Default options used i.e. IMSE-optimal evenly-spaced bins with number of bins chosen to mimic variability in underlying data. See Cattaneo et al. (2019) for details. Shaded area represents 95% confidence intervals.

that this allocation was arbitrary rather than strategic, and took place in a geographically and culturally contiguous area. I test this more formally now.

Table 1 presents balancing tests for geographical and other variables. Geographical variables related to altitude, ruggedness, distance to nearest river, and measures for soil quality and agricultural suitability are similar across the historical boundary.[13] The timing of assignment at the start of the 19th century makes it possible that the growth of towns and construction of railway lines was endogenous. Major historical towns lie on the boundary and the railway line – built as a 'famine relief line' in the late 19th century – cuts diagonally across the study area. Balancing tests show that there is no statistically significant difference in distance to the nearest town as per the 1901 census. The distance to a colonial railway station is slightly higher on the landlord side (*p*-value 0.09) for villages within 7.5 km of the boundary but there is no statistically significant difference at wider bandwidths (Table 2). The placement of canals may be considered endogenous (Asher et al., 2022): in the sample however the distance to the contemporary canals is similar across the villages. Variables on the proportion of lower castes and agricultural labourers in 2001 are included as additional controls for robustness, and to evaluate whether any of them were channels through which any effects of the different revenue systems have persisted over time.

Fig. 3 presents RD plots for all village characteristics with shaded confidence intervals that shows there are no jumps in these variables across the boundary. Histograms and chrolopeth maps for all controls can be seen in Online Appendix C (Figure C2–Figure C14). Since the MSE optimal bandwidth is often narrower, Table 2 shows that villages up to 30 km of the boundary are also balanced on all chosen variables.

The second identifying assumption is that villages should not be able to opt out of treatment i.e. there should be no selective sorting across the boundary. The circumstances of the historical assignment makes it impossible for individual villages to choose the implemented tenure

[13] I opt for the 'intermediate input' versions of the potential yield measures as they are more suited to a developing country context, but results are identical for 'high input' estimates.

Table 3
Main results.

	Poverty	Consumption	Poverty	Consumption	Poverty	Consumption
RD Coeff	0.153***	−4630.277***	0.115***	−4140.551***	0.128***	−4634.295***
Robust SE	0.045	1260.226	0.032	1147.051	0.034	1074.900
Optimal Bandwidth (km)	13.22	11.50	12.75	10.30	10.79	9.32
Effective Observations	178	150	172	135	138	124
Total Observations	454	454	454	454	454	454
Geographical Controls	No	No	Yes	Yes	Yes	Yes
All Controls	No	No	No	No	Yes	Yes

Notes: All columns report results for the two outcome variables based on a local linear model estimated separately on either side of the discontinuity, with bandwidths that minimize the Mean Squared Error, a triangular kernel and robust standard errors as outlined in Cattaneo et al. (2019). The dependent variables are measured as the poverty rate and consumption per capita at the village level. Border segment fixed effects are included. The baseline specification with pre-determined geographical covariates includes altitude, slope, distance to the nearest river and potential rice yield. Additional controls include distance to the nearest town and railway station, distance to nearest canal, and controls for proportion of lower castes and proportion of agricultural labourers in 2001. * $p < .10$, ** $p < .05$, *** $p < .01$.

type. All villages on the left hand side of the historical boundary were settled under direct governmental control, while almost all villages on the right hand side were allocated to the pre-existing landlord.[14] It is likely that part of any estimated landlord effect can be attributed to selective, historical out-migration from landlord villages, however a lack of relevant data prevents a detailed analysis of this channel.[15]

An additional challenge in such a setting is that of compound treatment. If there are multiple treatments across the discontinuity, then τ no longer measures just the treatment of interest. It is reassuring that all the villages in the sample were placed together within a single newly created district in post-independence India. However, during the colonial period district boundaries were drawn around this discontinuity, which is what led to the differential land tenure assignment. This is clearly not ideal as there could theoretically be other overlapping treatments. There are some good reasons to think this issue would be of limited concern in this instance. Firstly, per capita development spending in colonial India was low. Secondly, the spending on developmental outcomes in colonial India was decentralized such that development expenditures were largely financed by local revenues controlled by district boards. The landlords had a strong presence on such boards in their districts, so insofar as there were differences in public good provision across historical districts in this area, these are likely to have themselves been a function of the different land tenure types. Thirdly, since 1970, all of these villages have been in the same district and have been treated to exactly the same state and district level policy interventions. Many of the large poverty reduction and mass literacy programmes picked up pace in the 1980s when all these villages were in the same district.[16]

5. RD results

What is the long run effect of this institutional divergence 200 years ago? RD plots in Fig. 4 and Fig. 5 (as well as spatial RD plots in Figure B3) visually confirm a significant discontinuity in the poverty rate and consumption data from 2012.

The poverty rate is significantly higher and consumption per capita significantly lower in erstwhile landlord villages. The results from the baseline specification with a linear fit, triangular weights and MSE-optimal bandwidth are shown in Table 3. Taking the specification with all covariates included shows that the poverty rate is approximately 12.5 percentage points higher and consumption for individuals in ex-landlord villages around 4500 rupees lower than in the government villages across the boundary. All results are statistically significant at the 1% level. The magnitude is substantial — approximately one standard deviation for poverty and around one and a half standard deviations for consumption. The historical legacy of colonial institutions on modern economic outcomes for these villages is sizeable.

5.1. Robustness

These results are robust to a variety of alternative specifications that are reported in Online Appendix A. Figure A1 shows this effect exists across alternative, fixed bandwidths of 15, 30 and 50 km. Table A1 uses a quadratic fit instead of a linear one with identical results. Table A2 and Table A3 report results with uniform and epanechnikov kernel options instead. In a geographical setting the location of villages may be better captured by polynomials containing latitude and longitude, instead of simple distance to the boundary. Table A4 shows that results are robust to controlling for latitude, longitude and an interaction term of latitude and longitude. Table A5 further supplements the geographic polynomial by including latitude and longitude in quadratic form. In the model with all controls, the size of the estimated coefficients reduces to 11.5 percentage points higher poverty and 4000 rupees lower consumption per capita in landlord villages. The statistical significance of the results is unchanged.

To address the possibility that the detected effect is due to a larger east–west gradient, Figure A2 and Figure A3 show what happens if the boundary is artificially shifted up to 6 km to either side of the true discontinuity. In these alternate constructions, villages with the same tenure type are compared to each other so that the anticipated treatment effect is zero by construction as per (Cattaneo et al., 2019). The results of these placebo tests show that we can reject the null hypothesis of no treatment effect only at the true cutoff.

Taking this idea further, the real boundary is replaced with alternate boundaries that do not have historical-institutional significance. Figure A4 shows the boundaries used. The first three are randomly drawn within the study area with similar orientations as the historical boundary while boundary 4 and 5 use real administrative boundaries where villages on both sides were historically settled directly with cultivators. Table A8 confirms that similar discontinuities do not exist around fake or real alternate boundaries.

It could be that the results are driven by historical conflict or other boundary specific characteristics in close proximity of the historical border. Table A6 and Table A7 show the results of 'donut' RDDs

[14] The few exceptions were because villages that had been previously granted by landlords further onward to other subjects on favourable terms were brought under direct governmental control.

[15] The caste estimates on 'lower castes' available show some evidence in the opposite direction in Table 1 but no statistical difference with wider bandwidths (Table 2).

[16] In Section 5, I also perform a test that indicates district boundaries do not drive results for villages in the vicinity.

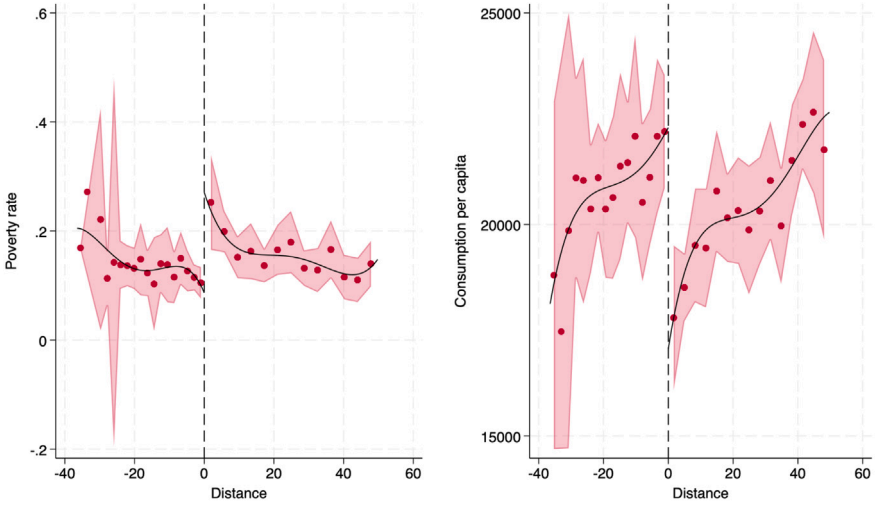

Fig. 4. RD plots with polynomial fit.
Notes: RD plots for poverty rate and consumption per capita for full sample of villages in the study period. Default options used i.e. IMSE-optimal evenly-spaced bins with number of bins chosen to mimic variability in underlying data. See Cattaneo et al. (2019) for details. Shaded area represents 95% confidence intervals.

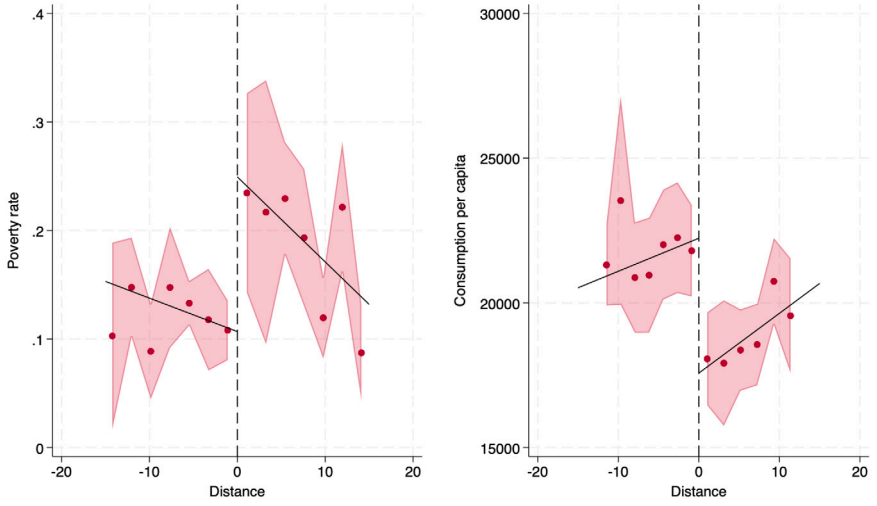

Fig. 5. RD plots with local linear fit.
Notes: RD plots for poverty rate and consumption per capita for villages within the MSE-optimal bandwidth as per Cattaneo et al. (2019). Shaded area represents 95% confidence intervals.

where villages very close to the boundary are excluded in a step-wise manner. The estimated treatment effects remain stable and significant. These results are shown graphically in Figure A5. Table A9 and Table A10 employ Conley standard errors to correct for spatial dependence between neighbouring observations, with the model estimated across different bandwidths and cutoffs (Conley, 1999). The results are robust to the exclusion of very small villages (Table A11), larger villages (Table A12) and a sub-sample of villages in the south that lie close to a hill range (Table A13). Finally, using more general FAO quality indicators that capture nutrient, oxygen and rooting conditions instead of GAEZ estimates, or including the villages with the third tenure type ('inam'), also leave the results unchanged (Table A14 and Table A15).

6. Channels

The previous section established persistent long run adverse effects in villages historically assigned to landlords. Do colonial institutions generate difference in outcomes that persist, or do historical policies create pre-conditions for future divergence? There is evidence for impact of the Green Revolution on a wide range of outcomes in India, ranging from increased calorie and protein intake to lower fertility, higher human capital investment, greater demand and supply for schooling, and lower infant mortality (Pinstrup-Andersen and Jaramillo, 1991; Ryan and Asokan, 1977; Foster and Rosenzweig, 2004, 2007; Bharadwaj et al., 2018).

Previous studies have suggested that historical presence of a landlord class led to lower state capacity and greater conflict, which in turn explains differing investment in Green Revolution technologies (Banerjee and Iyer, 2005; Lee, 2019). Das (1999) has argued that the key causal link between colonial institutions and Green Revolution technologies hinges on the presence of a class of small to medium cultivators. The presence of this class was stronger in regions that were historically not under landlords. Structural differences in land ownership between landlord and non-landlord areas have been shown to persist at the district level. For example, data up to 1990 India shows small to medium holdings constituted 48% of all holdings in formerly non-landlord areas, while the corresponding figure for formerly landlord areas was 35% (Banerjee and Iyer, 2005).

This class of small to medium cultivators evolved and gathered strength after the end of the colonial period. In non-landlord areas the larger number of small to medium cultivators were able to consolidate power in the countryside and gain political influence at the state

level (Dasgupta, 1977; Byres, 1981). In the immediate aftermath of independence, the cultivating castes of 'Reddy' and 'Kama' formed 6% and 4% of the total population but up to 25% and 12% of the state parliament in the 1960s (Srinivasulu, 2002). These groups were able to expand their influence into political arenas, campaigning for and obtaining state support as their agricultural yields and surplus increased (Srinivasulu, 2002). The incentives of the state, particularly in the early phases of the Green Revolution, aligned with these dominant groups. The state strategy was based on a "selective approach" that targeted "progressive farmers" via an allocation system that worked through pre-existing village level institutions (Dasgupta, 1977; Byres, 1981). Control of village political and water bodies by the dominant castes created an important political economy channel determining the allocation of public investment.

I now test whether the such a causal chain can be supported using village level data.

6.1. Landowning structure

The presence of a rural class of small to medium cultivators is an appropriate starting point. Specifically, the average land per cultivator in a government village is approximately 4 hectares, with a minimum of 2 hectares and a maximum of 10 hectares. In contrast, the average land per cultivator in a landlord village is above 7 hectares with a maximum of almost 60 hectares per cultivator. Figure B1 in Appendix B shows the distributions of this variable in the two sub-samples. This analysis is limited as we do not have information about the distribution of landownership within villages. We can still conclude that (i) government villages are relatively more homogeneous in the semi-medium (2-4 hectares) and medium (4-10 hectares) categories, and (ii) larger landlords continue to have presence in landlord areas in the early 1960s. Figure B2 shows that there is a significant difference, and a discontinuous jump at the boundary, in land per cultivator in 1961.[17]

The importance of a rural class of small to medium landholders was that they were historically more literate, had greater access to information and credit, higher capital accumulation and employed more wage labour (Byres, 1981). The market-oriented outlook and higher historical levels of commercialization has been hypothesized to have created favourable pre-conditions for the Green Revolution in such regions (Das, 1999). I now turn to providing the first village level quantitative evidence on these historical channels.

6.2. Literacy

Historical roots of higher human capital are important as literacy has been shown to be an important determinant of the adoption of High Yielding Varieties (HYVs) in India (Mittal and Kumar, 2000). I use village literacy data from 1961 to 2011 to identify the timing and magnitude of any divergence in human capital outcomes.

The RD model described in Section 4 is estimated including the set of pre-determined geographical variables as covariates.[18] The results are presented in Fig. 6 and Table B1. Villages that were historically on the landlord side of the boundary have significant lower literacy in the post-colonial period in 1971 and 1981.[19] This gap is no longer statistically significant in 1991 and 2001, but reemerges strongly in 2011.

Poorer rural development outcomes in landlord villages – in the early decades of Indian independence and prior to the Green Revolution – is a new finding. This indicates the long run effects of under-provision of public goods historically, while confirming the consolidation of a cultivating elite in non-landlord areas. The narrowing of educational outcomes between 1981 and 2001 supports previous studies demonstrating the success of national education programmes in targeting historical inequalities (Chaudhary and Garg, 2015; Banerjee and Somanathan, 2007). Relevant state and district level statistics suggest rapid progress in literacy rates between 1981 and 2001, with a subsequent slowdown in the next decade (Dev et al., 2009). The increase in private provision of education and the persistence of gender gaps in education in particular may explain the re-emergence of the literacy gap in the most recent decade (Manji et al., 2015; Maitra et al., 2011).

6.3. Irrigation

High Yielding Varieties of crops introduced as part of the Green Revolution required intensive use of inputs such as water and fertilizer to successfully increase yields (Evenson and Gollin, 2003; Hazell, 2009). Existing literature argues that the link between colonial institutions and higher agricultural incomes is driven by greater conflict and lower state per capita investment (Banerjee and Iyer, 2005). I am able to disentangle the roles of public and private investment in explaining variations in within-state development outcomes.

A straightforward division between public and private irrigation sources is made. The construction and more importantly the maintenance of tanks was an important topic in pre-colonial and colonial India, with evidence that the landlord estates had a poor record in this regard (Mosse, 1999). Both colonial and post-colonial India (between 1950 and 1970) invested heavily in the construction of canals (Shah, 2011; Mukherji, 2016). In the 1970s and 1980s groundwater pumped via electric tube-wells became the dominant mode of irrigation in the country (Shah, 2011). Significant complementarities exist between the presence of tanks and canals, but it has been shown that there are no spillovers between canal access and tube-wells (Asher et al., 2022). Data on irrigated area is available starting in 1971. I examine how erstwhile landlord and government villages fared across this period.

Fig. 7 gives an overview of the trends in irrigation across the two sets of villages. The total irrigated area is similar in landlord villages and government villages in the early decades until the adoption of tube-wells post-1981 puts government villages significantly ahead. Government villages have greater access to tank irrigation, then benefit more from an expansion in canal irrigation in the 1980s, and subsequently are far ahead of landlord villages in their use of private tube-wells. Landlord villages rely more on (non-electric) private wells in the 1970s but once government villages begin to substitute tube-well irrigation for canal irrigation in the 1990s, they obtain increasing access to canal water.

These trends suggest that erstwhile government villages were advantaged in each phase: first, by access to canals over older wells, and then by the use of tube-wells that allowed the flooding of individual rice fields. Estimating the full model further supports this hypothesis. Fig. 8 shows that landlord villages have significantly poorer access to public irrigation in 1971 and 1981, but there is no significant difference in subsequent decades. Fig. 9 shows that government villages are first movers in the utilization of tube-well irrigation starting in the 1990s, with evidence of the gap narrowing in the most recent decade. Full results from these models are presented in Table B2 and Table B3.

The placement of canals was itself likely influenced both by historical presence of permanently settled landlord estates and by the presence of an endowed dominant village elite (Nikku, 2006). Despite the impressive pace of construction of canals, their actual performance suffered from reports of unequal access due to corruption in the allocation of canal water via secondary canals and outlets for specific villages (Wade, 1982, 1984). These results provide local, village-level evidence on outcomes of a historically determined cultivating elite influenced the allocation of scarce canal water below the 'outlet', via

[17] Data on cultivable land per village is not available so calculations use a ratio of total village area to number of cultivators.

[18] I set a bandwidth of 50 km to use the entire sample of matched villages and to support comparability of results over time.

[19] The estimated coefficient for the 1961 specification is negative and close to significant at the 10% level.

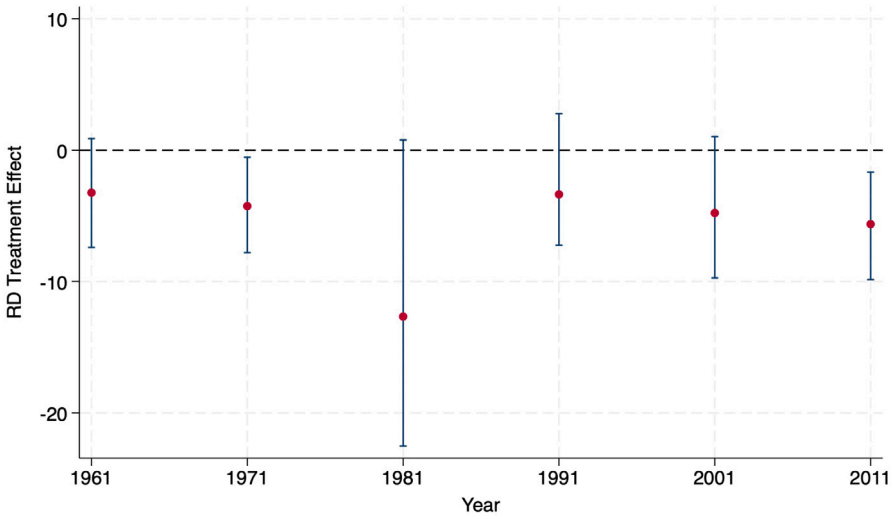

Fig. 6. RD results for literacy rate in post-independence India.
Notes: Estimated coefficients of RDD regressions with village level literacy rate as the dependent variable in all available census periods. Robust 95% confidence intervals around point estimates. Full results available in Table B1 of online appendix.

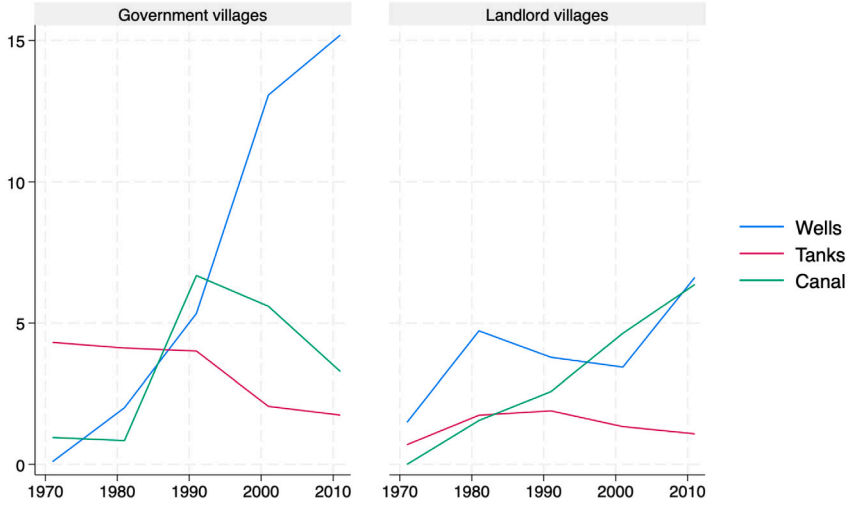

Fig. 7. Proportion of irrigated area in government and landlord villages by source. *Notes:* Data from linked village censuses for matched villages from 1971 to 2011.

lobbying, a dominant position in local water management bodies, and stronger political connections (Mollinga, 2018).

The relative lack of reliability of canal water for irrigation – due to allocation issues above and below the local outlet as well as maintenance problems – meant that by the 1980s canals were being neglected in favour of groundwater extraction (Shah, 2011). Apart from ensuring regular water for intensive rice cultivation, access to groundwater opened up the possibility of extending cultivation to the dry season (Asher et al., 2022). Earlier access to credit and infrastructure, combined with returns to the adoption of HYVs, also placed these villages in a better position to bear the larger private upfront cost involved in the installation of tube wells (Sekhri, 2014). The momentum from early adoption and higher yields likely led to cementing the favourable political status for cultivators in government villages (Dasgupta, 2018). Fig. 10 shows how the trajectory of 'electric populism' on the back of a farmers movement in Andhra Pradesh led to prioritization of government villages for electrification (Kale, 2014).

6.4. Summary

Why have not narrowing gaps in public investment over time eliminated differences in poverty and consumption? There is no data on land distribution within villages, which may continue to be important missing variable. Available data does offer some key suggestions.

Table 4 presents results from village level data from 2011-12. To start, the proportion of landowning households or the proportion of households whose main source of income is cultivation is not statistically different across landlord and government villages in 2012 (columns 1 and 2). However, landlord villages in the sample have a significantly lower share of households that own agricultural and irrigation equipment (columns 3 and 4), a lower share of households who own their house (as opposed to rent, column 5) and fewer households that own a vehicle (column 6). These results show that private investments and assets continue to be more equitably distributed in erstwhile government villages, evidence of the enduring presence of an advantaged cultivating class.

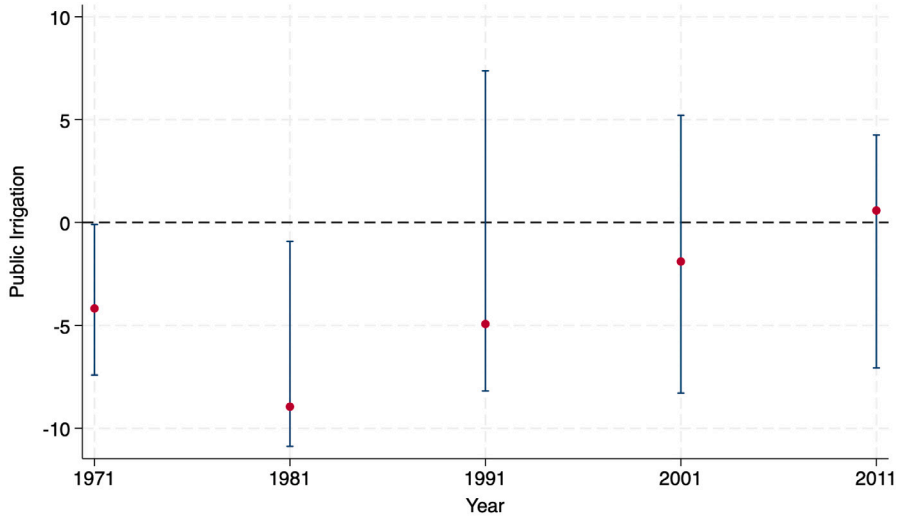

Fig. 8. RD results for public irrigation in post-independence India.
Notes: Estimated coefficients of RDD regressions with percentage area under public irrigation by village as the dependent variable in all available census periods. Robust 95% confidence intervals around point estimates. Full results available in Table B2 of online appendix.

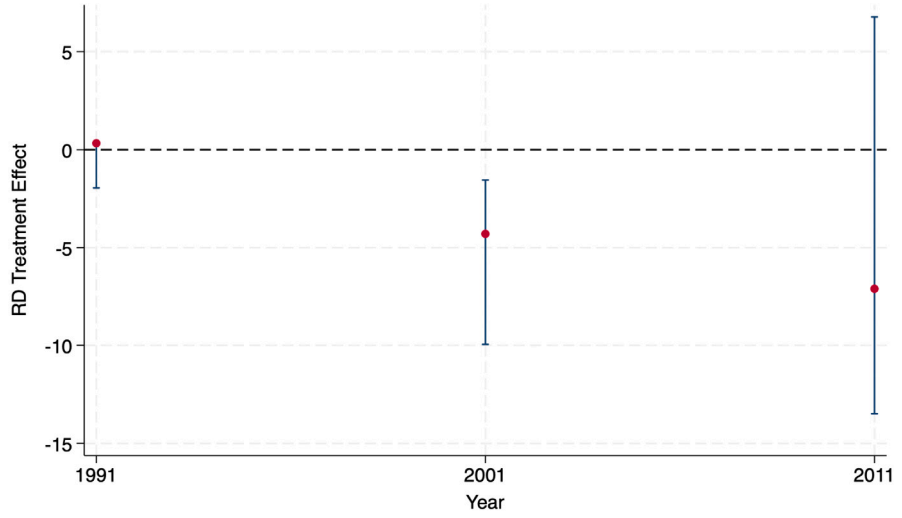

Fig. 9. RD results for private irrigation in post-independence India.
Notes: Estimated coefficients of RDD regressions with percentage area under private tube-well irrigation by village as the dependent variable in all available census periods. Robust 95% confidence intervals around point estimates. Full results available in Table B3 of online appendix.

Table 4
RD results for household assets in 2011-12.

	(1)	(2)	(3)	(4)	(5)	(6)
RD Coeff	−0.108	−0.076	−0.104**	−0.093*	−0.053***	−0.104***
Robust SE	0.119	0.097	0.056	0.056	0.023	0.030
Optimal Bandwidth (km)	7.63	9.96	12.61	12.19	7.68	10.38
Effective Observations	101	131	168	161	101	135
Total Observations	454	454	454	454	454	454
Geographical Controls	Yes	Yes	Yes	Yes	Yes	Yes
All Controls	Yes	Yes	Yes	Yes	Yes	Yes

Notes: All columns report results for outcome variables based on a local linear model estimated separately on either side of the discontinuity, with bandwidths that minimize the Mean Squared Error, a triangular kernel and robust standard errors as outlined in Cattaneo et al. (2019). All geographical and additional variables as in the main specification are included, along with border segment fixed effects. The dependent variables are: (1) share of village households that own land (2) share of households whose main source of income is cultivation (3) share of households that own agricultural equipment (4) share of households that own irrigation equipment (5) share of households who own a house and (6) share of households that own a vehicle. * p < .10, ** p < .05, *** p < .01.

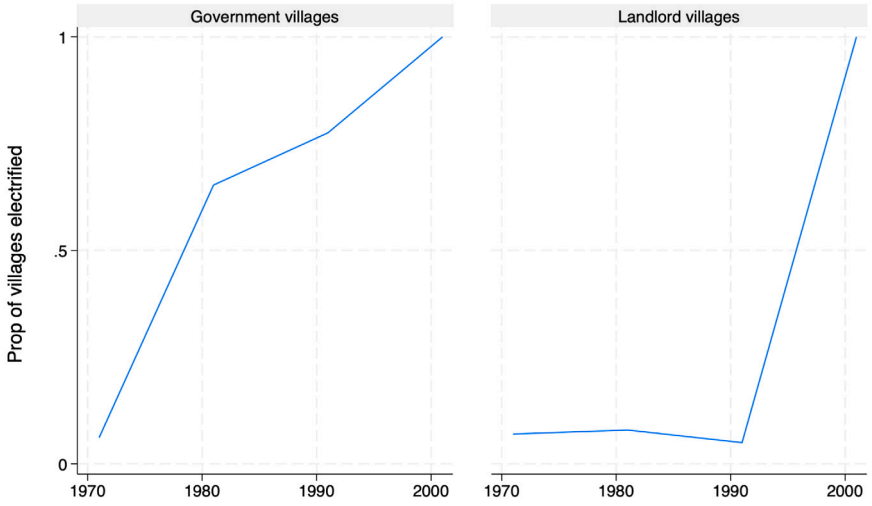

Fig. 10. Proportion of sample villages electrified in post-independence India.
Notes: Based on village censuses from 1971 until 2000, when the district achieves 100% electrification. The slight drop in landlord villages between 1981 and 1991 likely caused by a restricted sample of villages that were matched in 1981.

7. Conclusions

This paper uses the historically contingent and idiosyncratic expansion of British rule in India to trace the impact of colonial institutions. The assignment of villages to different land tenure systems in the 19th century India had substantial impacts that have widened and persisted well past the colonial period.

This study identifies the impact of colonial institutions on Indian long term development at the village level. It shows that the 'arbitrary' allocation of villages to distinct land revenue systems had substantial long run consequences for rural poverty and consumption. The historical roots of inequality in India continue to matter through decades of a region being nominally treated to the same district and provincial level policies.

These results support earlier findings of persistent impacts of colonial institutions in India but provide evidence on new outcomes at a more granular level. They are relevant to understanding patterns of rural inequalities across other parts of the India where villages show heterogeneity in the historical structure of property rights — something that occurred across, but also within, the three broad types of colonial land tenure systems implemented in colonial Asia.

The unfavourable climate and historically poor access to infrastructure and communications in large parts of rural India – similar to conditions in the sample area – makes the results applicable more widely in studies on long run Indian development. At the same time, the minority of colonial districts with reliable rainfall and/or access to stable irrigation may present different long run dynamics that require further investigation.

The analysis of channels shows that the structure of landholdings and endowments of human capital were already significantly different just after the colonial period. The historical creation of a rural class of medium cultivators with capital and human capital endowments made the faster adoption of new technologies possible. Villages with a more homogeneous composition of medium cultivators were able to leverage their initial advantages to benefit most from canal irrigation in the first phase of the Green Revolution, and subsequently harness economic and political power to reap the benefits of groundwater fuelled agricultural advances.

The paper highlights that it is possible for state investments to target backward regions and reduce human capital and infrastructural inequalities. However, a shift from public to private investments (in both education and irrigation) can lead to the re-emergence, and persistence, of gaps based on the historically advantaged position of certain cultivating classes. Further research is required to explore how village political and social institutions adapt and respond in different regions and across different phases of growth in post-independence India.

CRediT authorship contribution statement

Vigyan D. Ratnoo: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation, Visualization, Writing.

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Appendix A. Supplementary tables and figures

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.jdeveco.2023.103247.

References

Acemoglu, D., Reed, T., Robinson, J.A., 2014. Chiefs: Economic development and elite control of civil society in Sierra Leone. J. Polit. Econ. 122 (2), 319–368.
Asher, S., Campion, A., Gollin, D., Novosad, P., 2022. The Long-Run Development Impacts of Agricultural Productivity Gains: Evidence from Irrigation Canals in India. Centre for Economic Policy Research London.
Asher, S., Lunt, T., Matsuura, R., Novosad, P., 2021. Development research at high geographic resolution: an analysis of night-lights, firms, and poverty in India using the shrug open data platform. World Bank Econ. Rev. 35 (4).
Baker, C., 1981. Colonial rule and the internal economy in twentieth-century madras. Mod. Asian Stud. 15 (3), 575–602.
Baker, C.J., 1984. An Indian Rural Economy, 1880-1955: The Tamilnad Countryside. Oxford University Press, USA.
Banerjee, A., Iyer, L., 2005. History, institutions, and economic performance: the legacy of colonial land tenure systems in India. Am. Econ. Rev. 95 (4), 1190–1213.
Banerjee, A., Iyer, L., 2013. Response to 'A re-examination of Banerjee and Iyer'by Iversen, Palmer-Jones and Sen. J. Dev. Stud. 49 (12), 1647–1650.

Banerjee, A., Somanathan, R., 2007. The political economy of public goods: Some evidence from India. J. Dev. Econ. 82 (2), 287–314.
Bharadwaj, P., Fenske, J., Kala, N., Mirza, R.A., 2020. The green revolution and infant mortality in India. J. Health Econ. 71, 102314.
Bharadwaj, P., Fenske, J., Mirza, R.A., Kala, N., et al., 2018. The Green Revolution and Infant Mortality in India. Technical Report, University of Warwick, Department of Economics.
Binswanger, H.P., Khandker, S.R., Rosenzweig, M.R., 1993. How infrastructure and financial institutions affect agricultural output and investment in India. J. Dev. Econ. 41 (2), 337–366.
Byres, T.J., 1981. The new technology, class formation and class action in the Indian countryside. J. Peasant Stud. 8 (4), 405–454.
Cattaneo, M.D., Idrobo, N., Titiunik, R., 2019. A Practical Introduction To Regression Discontinuity Designs: Foundations. Cambridge University Press.
Caum-Julio, J., 2023. Can colonial institutions explain differences in labour returns? Evidence from rural colonial India. Econ. History Rev.
Chaudhary, L., Garg, M., 2015. Does history matter? Colonial education investments in India. Econ. History Rev. 68 (3), 937–961.
Chinnappa, B.N., 2019. Adoption of the new technology in North Arcot district. In: Green Revolution?. Routledge, pp. 92–123.
Cirone, A., Pepinsky, T.B., 2021. Historical persistence. Annu. Rev. Political Sci. 25.
Conley, T.G., 1999. GMM estimation with cross sectional dependence. J. Econometrics 92 (1), 1–45.
Das, R.J., 1999. Geographical unevenness of India's green revolution. J. Contemp. Asia 29 (2), 167–186.
Dasgupta, B., 1977. India's green revolution. Econ. Political Wkly. 241–260.
Dasgupta, A., 2018. Technological change and political turnover: The democratizing effects of the green revolution in india. Am. Political Sci. Rev. 112 (4), 918–938.
Datt, G., Ravallion, M., Murgai, R., 2020. Poverty and growth in India over six decades. Am. J. Agric. Econ. 102 (1), 4–27.
Dell, M., 2010. The persistent effects of Peru's mining mita. Econometrica 78 (6), 1863–1903.
Dell, M., Lane, N., Querubin, P., 2018. The historical state, local collective action, and economic development in Vietnam. Econometrica 86 (6), 2083–2121.
Dev, S.M., Ravi, C., Venkatanarayana, M., 2009. Human Development in Andhra Pradesh: Experiences, Issues, and Challenges. Centre for Economic and Social Studies.
Driver, P.N., 1949. Problems of Zamindari and Land Tenure Reconstruction in India. New Book Co.
Evenson, R.E., Gollin, D., 2003. Assessing the impact of the green revolution, 1960 to 2000. Science 300 (5620), 758–762.
Foster, A.D., Rosenzweig, M.R., 2004. Technological change and the distribution of schooling: evidence from green-revolution India. J. Dev. Econ. 74 (1), 87–111.
Foster, A., Rosenzweig, M., 2007. Does economic growth reduce fertility? Rural India 1971-99. In: India Policy Forum, Vol. 3, No. 1. National Council of Applied Economic Research, pp. 179–213.
Hazell, P.B., 2009. The Asian Green Revolution, Vol. 911. Intl Food Policy Res Inst.
Iversen, V., Palmer-Jones, R., Sen, K., 2013. On the colonial origins of agricultural development in India: a re-examination of Banerjee and Iyer,'History, institutions and economic performance'. J. Dev. Stud. 49 (12), 1631–1646.
Kale, S.S., 2014. Electrifying India: Regional Political Economies of Development. Stanford University Press.
Lee, A., 2019. Land, state capacity, and colonialism: Evidence from India. Comparative Political Stud. 52 (3), 412–444.
Ligon, E., Sadoulet, E., 2018. Estimating the relative benefits of agricultural growth on the distribution of expenditures. World Dev. 109, 417–428.
Lowes, S., Montero, E., 2021. Concessions, violence, and indirect rule: evidence from the Congo free state. Q. J. Econ. 136 (4), 2047–2091.
Maitra, P., Pal, S., Sharma, A., 2011. Reforms, Growth and Persistence of Gender Gap: Recent Evidence from Private School Enrollment in India. IZA Discussion Paper.
Manji, S., Arnold, C., Gowani, S., Bartlett, K., Kaul, V., Sharma, S., Chaudhary, A.B., Sharma, S., 2015. How are we doing and how do we get it right for children. In: Evolution of the Roles of the Public and Private Sector in Early Childhood Care and Education in Efforts to Achieve EFA Goal, Vol. 1, No. 1.3.
Mattingly, D.C., 2017. Colonial legacies and state institutions in China: Evidence from a natural experiment. Comparative Political Stud. 50 (4), 434–463.
Ministry of Rural Development, Government of India, 2011. Socio economic and caste census.
Mittal, S., Kumar, P., 2000. Literacy, technology adoption, factor demand and productivity: An econometric analysis. Indian J. Agric. Econ. 55 (3), 490–499.
Mollinga, P.P., 2018. Secure rights and non-credibility: the paradoxical dynamics of canal irrigation in India. In: An Endogenous Theory of Property Rights. Routledge, pp. 190–211.
Mosse, D., 1999. Colonial and contemporary ideologies of 'community management': the case of tank irrigation development in south India. Mod. Asian Stud. 33 (2), 303–338.
Mukherji, A., 2016. Evolution of irrigation sector. Econ. Political Wkly. 44–47.
Nikku, B.R., 2006. The Politics of Policy: Participatory Irrigation Management in Andhra Pradesh. Wageningen University and Research.
Nunn, N., 2020. The historical roots of economic development. Science 367 (6485).
Office of the Census Commissioner India, 2011. Census of India. https://censusindia.gov.in/census.website/data/census-tables.
Oto-Peralías, D., 2020. Frontiers, warfare and economic geography: The case of Spain. J. Dev. Econ. 146, 102511.
Pingali, P.L., 2012. Green revolution: impacts, limits, and the path ahead. Proc. Natl. Acad. Sci. 109 (31), 12302–12308.
Pinstrup-Andersen, P., Jaramillo, M., 1991. The impact of technological change in rice production on food consumption and nutrition. The Green revolution reconsidered: The impact of the high yielding rice varieties in South India.
Raychaudhuri, T., Kumar, D., Desai, M., Habib, I., 1983. The Cambridge Economic History of India: Volume 2, C.1751-C.1970. In: Cambridge histories online, Cambridge University Press, ISBN: 9780521228022, URL: https://books.google.co.uk/books?id=9ew8AAAAIAAJ.
Roy, T., 2021. Why geography matters to the economic history of India. Aust. Econ. Hist. Rev. 61 (3), 273–289.
Ryan, J.G., Asokan, M., 1977. Effect of green revolution in wheat on production of pulses and nutrients in India. Indian J. Agric. Econ. 32 (3), 8–15.
Sarkar, S., 1989. Modern India 1885–1947. Springer.
Sayana, V., 1949. Agrarian Problems of Madras Province. Business Week Press.
Sekhri, S., 2014. Wells, water, and welfare: the impact of access to groundwater on rural poverty and conflict. Am. Econ. J. Appl. Econ. 6 (3), 76–102.
Shah, T., 2011. Past, present, and the future of canal irrigation in India. In: India infrastructure report. pp. 70–87.
Srinivasulu, K., 2002. Caste, Class and Social Articulation in Andhra Pradesh: Mapping Differential Regional Trajectories. ODI Working paper.
Stein, B., 1989. Thomas Munro: The Origins of the Colonial State and His Vision of Empire. Oxford University Press, USA.
Vasudevan, S., 2023. Radio and technology adoption during India's green revolution: Evidence from a natural experiment. World Dev. 161, 106069.
Wade, R., 1982. The system of administrative and political corruption: Canal irrigation in south India. J. Dev. Stud. 18 (3), 287–328.
Wade, R., 1984. Irrigation reform in conditions of populist anarchy: an Indian case. J. Dev. Econ. 14 (3), 285–303.
Washbrook, D.A., 1981. Law, state and agrarian society in colonial India. Mod. Asian Stud. 15 (3), 649–721.