The Colonial Legacy in India: How Persistent are the Effects of Historical Institutions?*

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Using updated data, we analyze the long-run effects of two British colonial institutions established in India. Iyer (2010) showed that areas under direct colonial rule had fewer schools, health centers, and roads than areas under indirect colonial rule. Two decades later, we find that these differences have been eliminated. Banerjee and Iyer (2005) found lower agricultural investments and productivity in areas with landlord-based colonial land tenure systems. Our updated data finds that only some of these differences have been eliminated, while others have remained constant and even widened. We conclude that the impact of colonial institutions can eventually fade away under the influence of targeted policies.

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1. Introduction

How persistent are the effects of historical institutions on societies? Can post-colonial policies overcome the legacies left behind by colonial institutions? This paper examines the long-run impact of two historical institutions in India, extending the datasets used in two previous papers. Iyer (2010) compared areas in India that were under indirect colonial rule to those that were under direct colonial rule. Using an instrumental variables strategy to account for the selectivity in British annexation policy, she finds that directly ruled areas have lower levels of access to schools, health centers, and roads. Banerjee and Iyer (2005) examine the effect of land tenure systems implemented in different parts of (directly ruled) British India. They find that areas that had landlord-based systems had lower agricultural investments and productivity in the post-colonial period. Interestingly, these differences arise during the Green Revolution of the late 1960s, when the Green Revolution brought new agricultural technologies to India: landlord areas, despite being more productive in the colonial period, fell behind in the adoption of these new technologies.

The data sets used in Iyer (2010) and Banerjee and Iyer (2005) end in 1991 and 1987, respectively. After this period, India experienced higher economic growth following structural reforms and liberalization in 1991, and the political landscape also became more competitive after 1988. Additionally, the post-colonial Indian state made investments in many types of infrastructure and public service delivery over several decades. Have these developments eliminated the differences caused by historical institutions?

In contrast to studies that use different outcome variables, we are the first to revisit these historical institutions using the same outcome variables as in the original papers. We extend the data in Banerjee and Iyer (2005) and Iyer (2010) by 24 and 20 years respectively, allowing for a direct comparison with the earlier results to examine the evolution of the legacy of these historical institutions. For the impact of direct British rule, we use the 2001 and 2011 Population Censuses in India, which is the same data source used in Iyer (2010). In 1991, directly ruled districts had lower access to middle schools, primary health centers, primary health subcenters, and paved roads. By 2001, the difference in access to these public goods was zero, and the gap remained closed in 2011 as well. This suggests that post-colonial policies that were targeted at equalizing access to infrastructure, such as the Minimum Needs Program of the 1970s and the National Rural Health Mission of 2005, were successful in erasing the legacy of direct colonial rule.

To examine the effects of land tenure systems, we use updated agriculture data until 2011 from the Village Dynamics in South Asia (VDSA) dataset. These data show very similar results to those in Banerjee and Iyer (2005): Over the period 1966-1987, areas under landlord-based historical land tenure had lower agricultural investments and productivity. Extending the data until 2011 shows that the gaps in irrigation, as well as the use of high yielding varieties (HYV) of rice and wheat are much smaller and statistically insignificant. However, the gap in other investments such as fertilizer consumption and HYV of other cereals has grown. This is consistent with the nature of some post-colonial public policies. For instance, the Accelerated Irrigation Benefit Program prioritized the completion of last mile distribution networks in rural areas which had not previously been completed due to colonial budgetary constraints and local topography (Pant, 1981; Shah, 2011; Stone, 2002). Fertilizer subsidies were available for all farmers rather than being specifically targeted towards under-served areas (Iyer et al., 2010). Consistent with this partial closing of investment gaps, we find that crop yields continue to be significantly higher in non-landlord areas more than 60 years after the end of colonial rule. Overall, our findings suggest some gaps can be narrowed or completely eliminated by later policies; however, those policies have to be specifically targeted towards equalizing access.

Our study is related to the literature on the long run effects of historical circumstances and colonial institutions. Several theoretical models describe mechanisms of policy persistence that include considerations of uncertainty, information asymmetry, endogenous investments by agents or path dependence dynamics (Alesina & Drazen, 1991; Coate & Morris, 1999; Fernandez & Rodrik, 1991; Nunn, 2007). Some empirical studies have documented the persistence of historical advantages and patterns of economic activity (Bleakley & Lin, 2012; Bruhn & Gallego, 2012; Castelló-Climent et al., 2018; Donaldson, 2018; Huillery, 2009; Jedwab et al., 2017; Jedwab & Moradi, 2016). Despite these studies of persistence, there are also instances of convergence in human development outcomes across the world (Kenny, 2005).

The vast majority of studies on the long run effects of colonial institutions are cross-sectional comparisons across places with different historical circumstances (see the reviews by Nunn (2009) and Fenske et al. (2024)). The institutions studied have included property rights, slavery, labor coercion, and the presence of large corporate interests (Acemoglu et al., 2001; Dell, 2010; Dell et al., 2018; Dell & Olken, 2020; Lowes & Montero, 2021; Méndez & Van Patten, 2022; Michalopoulos & Papaioannou, 2016; Nunn, 2008; Sokoloff & Engerman, 2000). Both Iyer

(2010) and Banerjee and Iyer (2005) conduct such cross-sectional comparisons across different regions of India. We contribute to the literature on historical persistence by examining the evolution of such cross-sectional comparisons over time in the post-colonial period. Only a handfule of studies have conducted such over-time analyses. Agüero and Campanario (2023), who reexamine Dell (2010) and find that gaps in per capita consumption across areas with different historical institutions remain equally large 20 years later. In India, studies find that education investments have counteracted educational gaps caused by colonial institutions (Chaudhary & Garg, 2015; Lehner, 2025).

The historical variation explored in Banerjee and Iyer (2005) and Iyer (2010) have influenced many future studies, usually examining different outcomes and some employing spatial regression discontinuity designs. Most follow-up studies confirm the Banerjee and Iyer (2005) result of non-landlord areas having better development and policy outcomes (Batra, 2024; Misra, 2019; Ratnoo, 2024; Verghese, 2019). The follow-up studies on indirect colonial rule have yielded mixed results. Jha & Talathi (2023) find higher economic growth in indirectly ruled areas (as measured by night light intensity), consistent with Iyer (2010)'s finding of better public goods provision. But other studies document that directly ruled areas have more private investment, higher citizen cooperation, greater empowerment of women, lower cross-caste and land inequality (Chaudhary et al., 2020; Colleoni, 2024; Kapoor, 2024; Nandwani & Roychowdhury, 2024); studies differ on the relationship between indirect colonial rule and post-colonial left-wing violence (Mukherjee, 2018a, 2018b; Verghese & Teitelbaum, 2019). In contrast to studies that use different outcome variables, we are the first to revisit these historical institutions using the same outcome variables as in the original papers.

The paper is structured as follows: Section 2 dives into the historical background and Section 3 explains the new datasets. Section 4 documents the results on indirect colonial rule from our updated dataset, while Section 5 does the same for historical land tenure systems. Section 6 concludes.

2. Historical Background

2.1. British Annexation Policy

The British empire's influence and colonization of the Indian subcontinent lasted almost 200 years. Nearly all of modern-day India, Pakistan, Burma, and Bangladesh were under British political

control. Beginning in 1757, and continuing through the Sikh wars of 1846 and 1849, the English East India Company waged several battles against Indian kings and successfully annexed many areas. Agreements for tribute or other payments were made with many rulers, with the East India Company acquiring territory when rulers failed in their payments. Further territorial annexations were made by accusing local rulers of "misrule" and by the controversial policy of "lapse" whereby Lord Dalhousie (Governor-General from 1848 to 1856) annexed states where the Indian ruler died without a natural heir, in contrast to previous administrators who had frequently recognized adopted heirs.

In 1857, Indian soldiers in the British army mutinied against their officers. Many native states assisted the British by providing soldiers and equipment during the mutiny and protected British subjects within their territories. After the mutiny was suppressed at the end of 1858, the British Crown took over the administration of the East India Company's territories. Further annexation was halted, with Queen Victoria's 1858 proclamation stating that, "We desire no extension of our present territorial possessions." Further, all Indian rulers were guaranteed British recognition of adopted heirs. Thus, substantial parts of the Indian subcontinent (45% of area and 23% of population) continued to be ruled by Indian kings, being known as "native states" or "princely states." We consider these areas to have experienced indirect colonial rule, as compared to direct colonial rule in the areas annexed into British India.

2.2. Direct versus Indirect Colonial Rule

About 680 native states were recognized by the British Foreign Office in 1910. The British Crown controlled the foreign and defense policies of these states (e.g. setting limits on when and how they could communicate with each other or with other European power, or limiting the size of their armies), but they had considerable autonomy in matters of internal administration including the provision of public services and the building of infrastructure. Native states varied considerably in size, with some consisting of only a few villages, and others consisting of almost 100,000 square miles of land. As Iyer (2010) has documented, British policy was focused on annexing areas that were agriculturally superior: areas under direct British rule had significantly higher rainfall and a significantly lower proportion of barren or rocky areas, compared to areas that were part of native states.

Iyer (2010) compares districts that were part of native states to those that were under direct British rule. A simple OLS comparison shows that directly ruled areas have higher agricultural yields in the post-colonial period and similar access to public goods such as schools, health centers and roads. To overcome the bias caused by selective British annexation, she constructs an instrumental variables (IV) strategy based on Dalhousie's policy of "lapse." The instrument equals one if a native state ruler died without a natural heir during the period 1848-1856. This is a strong predictor of direct British rule during this specific period, but not during other periods. The IV results are very different from the OLS results: directly ruled areas do not have any agricultural advantage, and have significantly lower access to middle schools, health centers and roads.

Iyer (2010) uses public goods availability data from the 1981 and 1991 population censuses. We examine whether the documented disadvantage of directly ruled areas continues to be present in later years using data from the 2001 and 2011 population censuses.

2.3. Colonial Land Tenure Systems

In 1765, the British were formally granted the right to collect revenue in modern-day Bengal and Bihar. Land tax constituted almost 60 percent of total tax revenue in 1841, and the collection of land revenue was a major policy decision. The British implemented one of three land revenue systems on approximately all of the cultivatable land in directly ruled areas. One of the systems was a landlord-based system, also called *zamindari* or *malguzari*, where a single landlord was responsible for paying taxes (to the British) for a village or a group of villages. In turn, the landlord was able to tax tenants or land cultivators within their jurisdiction. This system was mainly implemented in the colonial provinces of Bengal, Bihar, Central Provinces and parts of Madras.

The second system was an individual cultivator-based system, also known as *raiyatwari.* In this land tenure system, the government surveyed the land, and cultivators were given a record of rights which served as a legal title to the land. The individual cultivators were individually responsible for paying their tax liability to the government. This was implemented in the provinces of Bombay, Assam and much of Madras. The last land tenure system was the village-based system, also called *mahalwari,* prevalent in the provinces of Panjab and the North-West Provinces. Under this system, villages were jointly responsible for collecting tax revenue. The village bodies could be composed of a single person, family, or a large number of individuals.

Banerjee and Iyer (2005) compared measures of agricultural investments (irrigation, fertilizer use, adoption of high-yielding varieties of seeds) and agricultural productivity (crop yields) across districts with higher and lower proportion of area under historical non-landlord tenure. They find that landlord-dominated areas lag behind non-landlord areas in these metrics during the post-colonial period, despite the facts that they were agriculturally more productive in the colonial period. Agriculture taxation was abolished after independence, and many land reform measures were enacted to reduce land inequality. In fact, Banerjee and Iyer (2005) document that the agricultural investment and productivity gaps arise in the late 1960s, the period of the Green Revolution when HYV crops were introduced to India, suggesting that landlord areas are unable to successfully adopt the new technology.

2.4. Post-Independence Policies

After the end of colonial rule in 1947, the post-colonial Indian state moved swiftly to dismantle colonial-era institutions. By 1950, all native states with the borders of India had been integrated with directly ruled areas into the new Indian nation, and were subject to the same administrative, legal and political systems. Many states passed land reform legislations in the 1950s and 1960s, including measures to abolish intermediaries (like landlords), land ceiling legislations and land distribution programs (see details in Besley and Burgess, 2000). In addition, the government of independent India enacted many policies towards improving infrastructure and human development. Appendix Table A.12 lists the major programs that were aimed at the outcome variables analyzed in our paper. We see that, in most cases, education and health provision programs have specific equalization goals and target underserved areas. For instance, the Minimum Needs Program (MNP) of the 1970s envisioned a primary school and a safe water source within a mile of every village (Banerjee & Somanathan, 2007), and the 2001 Sarva Shiksha Abhiyan aimed to achieve universal access to schools and universal enrollment. The National Rural Health Mission aimed to help states with weak health indicators. The picture is mixed for investments in roads, irrigation and fertilizer. While the MNP envisioned providing paved roads to all villages with populations over 1000, the Golden Quadrilateral project aimed at connecting the four largest cities through upgraded highways, which would only benefit places close to these planned routes. Fertilizer subsidies were available to all farmers rather than being targeted to poorer regions, resulting in wealthier states receiving more benefits (Iyer et al., 2010).

3. Data on Development Outcomes

3.1. Public Goods Provision

We extend Iyer (2010) by examining the impact of direct British rule on access to public goods through 2011. The original paper uses the village directories from India's population censuses of 1961, 1981, and 1991 to compute the fraction of villages in each district that have the following public goods: primary school, middle school, high school, primary health center, primary health subcenter, canal, or a road. District level data is used because the direct British rule variable is assigned at that level rather than at the village level. We update these data using the village directory data from population census of 2001 and 2011, obtained from the SHRUG database at the Development Data Lab (Asher et al., 2021). Historical variables are obtained from the replication package for Iyer (2010).

The updated data show clear increases in the availability of most of these public goods (Appendix Table A.1), consistent with the post-independence policies described in Section 2.4. For instance, the share of villages that have a primary school increased from 51% in 1961 to 88% in 2011, and the share of villages with a road increased from 21% in 1961 to 70% in 2011. Two important caveats apply to interpreting changes over time. First, the recording of certain public goods changed across censuses. For censuses prior to 2001, we use the presence of canals only, while for 2001 and 2011 we use the presence of operational canals or rivers. For the 2011 census, we use the total of primary health centers and community health centers, since the National Rrural Health Mission advocated upgrading the former into the latter. Since we will be focused on the gap between directly and indirectly ruled areas for a given census year, such changes in definition may not be a major concern. The second caveat refers to missing data: the census was not conducted in the states of Assam in 1981 and Jammu & Kashmir in 1991 due to insurgencies, and the 1961 data is incomplete for many states.

3.2. Agricultural Investments and Productivity

The analysis in Banerjee and Iyer (2005) included district-level data on agricultural investments and productivity from 1956 through 1987 from the World Bank's India Agriculture and Climate Data Set. This database extracts data from five sources: Agricultural Situation in India; Area and Production of Principal Crops in India; Agricultural Prices in India; Fertilizer Statistics (published

by the Fertilizer Association of India); and Statistical Abstracts of India. We update the analysis using the Village Dynamics in South Asia (VDSA) database to obtain agricultural data from 1966 through 2011.[1] The VDSA data uses the same underlying data sources as the World Bank database, as well as season and crop reports, land utilization and use reports, and unpublished reports. Most of the reports and documents come from the national Directorate of Economics and Statistics; the state Directorates of Economics and Statistics; or the state Directorate or Commissionerate of Agriculture. Measures of historical land tenure institutions, as well as geographic variables (soil type, annual rainfall, coastal dummy, latitude, altitude) were obtained from the Banerjee and Iyer (2005) replication package. Henceforth, the data used in Banerjee and Iyer (2005) is referred to as BI data. We restrict our analysis to the 13 Indian states that were included in the original paper.[2] Analysis is conducted at the 1991 district level; data from split districts are aggregated to the original district boundaries.

We use the same measures of agricultural investment as Banerjee and Iyer (2005): the proportion of gross cropped area irrigated; the quantity of nitrogen, phosphorus, and potash fertilizer used per hectare of gross cropped area; and the proportion of crop area sown with high-yielding varieties (HYV) of rice, wheat, and other cereals. We also examine agricultural productivity, measured by the (log) yield of rice, wheat and 13 major crops (crop output divided by total area of crop sown).[3,4]

The VDSA database is mostly consistent with the BI data, with some adjustments. When examining the common years that are covered in both databases (1966-1987), we see that the VDSA dataset has fewer observations than the BI data for several variables, but a larger number of observations for rice and wheat yields (Appendix Table A.2, columns 1 and 2). The gap is particularly pronounced for the proportion of area sown with HYV rice, wheat, and other cereal crops (VDSA has only 47%, 46%, and 34% of the district-year pairs in the BI data) and the yield of 13 major crops (64% of the BI district-year pairs are present in VDSA). To mitigate this issue,

[1] The VDSA was funded by the Bill and Melinda Gates Foundation through a partnership with the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT).
[2] The 13 states include Andhra Pradesh, Bihar, Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal.
[3] Banerjee and Iyer (2005) examined the yield of 15 major crops. However, the VDSA data does not include tobacco or jute. We therefore use the 13 major crops common to both databases. These are rice, wheat, pearl millet, finger millet, maize, barley, groundnut, sesamum, rape seed, mustard seeds, sugarcane, cotton, sunflower and soybean.
[4] As in Banerjee and Iyer (2005), we drop observations where the proportion of irrigated area exceeds 1, or where the proportion of area sown with HYV rice, wheat, and other cereal crops exceeds 1.

we "binned" the data in five-year increments i.e. computed the averages of our key variables over five-year periods (1956-1960, 1961-1965, …, 2006-2011). This greatly reduces the extent of missing data in the VDSA dataset compared to the original dataset (Appendix Table A.2, columns 3 and 4). Using the binned data, we find that the variables in the VDSA and BI data have over 90 percent correlation (column 5), except for area under HYV wheat (89 percent correlation) and HYV cereals (80 percent). Appendix Figure A.1 graphs the data over time from both datasets and shows that the overlap between the two databases is extremely good, except that the VDSA systematically records a lower proportion of area under HYV wheat and HYV cereals, as well as slightly higher wheat yields, than the BI data.

3.3. Human Capital and Economic Development

We use data from the National Family and Health Surveys (NFHS) of 1998-99 and 2015-16 to compute neonatal mortality rates, infant mortality rates, and the mortality rate for children under the age of five. These rates are calculated for each cohort's birth year. The NFHS is a nationally representative survey and records retrospective birth histories for female respondents between ages 15-49. Additionally, we use the National Sample Survey (NSS) round 75, conducted in 2017-18, for information on educational attainment measured as indicators for whether the respondent had completed primary and/or secondary school (grade 8). We examine educational attainment by the year a student would have entered school. For example if we wanted to determine primary school completion between 1990 and 2000, we examine students born between 1984 and 1994 since students enter primary school at six years old. Finally, we also use the NSS rounds of 1983, 1988, 1994 and 2000 to analyze average household expenditure per capita (deflated to the 1980 price level), and poverty as measured by the head count ratio, namely the fraction of households below the national poverty line. There are nationwide gains over this period: infant mortality declined from 12.5% in the 1970s to 4.7% in the 2000s, primary school completion rates increased from 65% to 95%, secondary school completion rates increased from 38% to 48%, and the share of households under the poverty line decreased from 41% in 1983 to 14% in 2000 (Appendix Table A.3).

4. Comparing Areas under Direct versus Indirect Colonial Rule

4.1. Empirical Strategy

To determine the effect of direct versus indirect British colonial rule, we use the following equation, which corresponds to equation (1) of Iyer (2010):

$$y_i = \delta_0 + \delta_1 Brit_i + \boldsymbol{X_i}\Gamma + \nu_i \qquad (1)$$

where y_i is an outcome for district i and $Brit_i$ is an indicator for whether a district was under direct British colonial rule. District characteristics are denoted $\boldsymbol{X_i}$. These controls mainly include the geographic characteristics of the area (latitude, altitude, rainfall, soil type indicators, coastal dummy). The coefficient of interest is δ_1 which captures the average impact of direct British control on the outcome variable. Standard errors are clustered at the native state level to allow for potential correlation in outcomes across districts within the same native state.

The estimated coefficient δ_1 will be biased upwards if the British selectively annexed areas with higher productivity. To account for this endogeneity, Iyer (2010) uses Lord Dalhousie's policy of "lapse" as a quasi-exogenous determinant of direct British rule. As described earlier, this policy allowed the British to annex a native state if the ruler died without a natural heir from 1848 through 1856. The instrumental variable is $Lapse_i$, a dummy that equals one if the ruler of the native state died between 1848 and 1856 without a natural heir. The $Lapse_i$ variable cannot be assigned to native states annexed prior to 1848 as these areas were already directly ruled by the British. The sample for IV estimation is therefore restricted to places that had not been conquered by 1847. For *Lapse* to be a valid instrument, we require that it should be a significant predictor of direct British rule. We find that this is indeed the case: districts whose leader died without a natural heir were almost 70 percent more likely to be annexed by the British (Appendix Table A.4, panel A); the F-statistics for the first stage range are approximately 18-19, suggesting a moderately strong instrumental variable.[5] Our IV estimates are consistent as long as *Lapse* is assigned quasi-randomly i.e. it is uncorrelated with factors that may also shape long-run development outcomes of the area, even if there was some selectivity in British annexation among places where Lapse occurred.[6] Iyer (2010) argues that, since such a policy was not followed before or after Dalhousie's tenure, a ruler death without a natural heir in this specific period was as-if random.

[5] These F-statistics are larger than the critical value of 16.38 in Stock and Yogo (2005).
[6] In this sense, the Lapse variable is akin to the "intent to treat" indicator in a randomized controlled trial setting, while the direct rule variable reflects the actual treatment status. Our IV estimates are thus the impact of treatment

4.2. Do Directly Ruled Areas Catch Up to Indirectly Ruled Areas in Public Goods Provision?

The results from our extension of Iyer (2010) are shown in Table 1. We focus on the IV results that account for the potential endogeneity of British rule. Replicating the results in Iyer (2010), we find that directly ruled British areas are significantly less likely to have middle schools, high schools, primary health centers and subcenters and roads in the 1981 and 1991 censuses (Table 1, columns 2 and 3). Importantly, we see that the gaps in access to schools have already become smaller (in percentage terms), when compared to the gaps estimated using data from the 1961 census (column 1); in particular, the gap in access to primary schools is already closed by 1981.

Our updated data set shows that this narrowing of the gaps continues over time. By 2001, the differences in access to most public goods between directly and indirectly ruled districts are not statistically significant, and the point estimates are close to zero (Table 1, column 4). In particular, the access gaps in primary health centers and subcenters have reduced considerably, and the gap in road access has halved (from 20 percentage points to 10 percentage points) and is statistically insignificant. The exceptions are middle schools and canals, where directly ruled areas have significantly fewer villages with access. The canal result should be interpreted with caution, since the definition changed over time: it was measured as access to a canal (only) in 1991 but as access to a river or canal in 2001 (to be consistent with 2011 data).

Going further forward in time, we see no statistically significant differences in access to any type of infrastructure by 2011 (Table 1, column 5). Note that the definition of the canal variable is similar in 2001 and 2011, and we see a clear narrowing of the gap in this variable as well during this period. There is also no significant difference in access to middle schools across direct and indirect rule areas by 2011, consistent with the implementation of Sarva Shiksha Abhiyan program which aimed to provide universal access to schools for children aged six to 14. By 2011, the gap in road access is less than 1 percentage point, consistent with the implementation of the Pradhan Mantri Gram Sadak Yojana (PMGSY) road building program that began in 2001. Overall, our results suggest that post-colonial policies that are specifically aimed at equalization of

(direct rule) on the treated. The reduced form of the IV estimation, namely the intent-to-treat estimates, are presented in Appendix Table A.4, panel B.

infrastructure access can be successful in overcoming the long-run effects of historical institutions.[7]

[Insert Table 1 here]

4.3. Robustness Checks

We verify that our results on convergence in public goods access is not driven by omitted variables or other econometric concerns. Since directly ruled areas have higher population density, it may have been more cost-effective to provide public goods in those areas. We re-estimate the impact of direct colonial rule, controlling for population density in 2001, and find that our results for the impact of direct colonial rule are extremely similar to the baseline results of Table 1 (see Appendix Table A.8, columns 1 and 2). A second confounding factor may be migration: if people move from indirectly ruled areas to directly ruled ones, that may create greater demand for public goods in those areas. We control for state-level rates of out-migration[8] and find smaller gaps in public good provision than in our Table 1 estimates, suggesting that migration is not the main driving factor in the narrowing gaps we documented (see results in Appendix Table A.9, columns 1 and 2). Finally, we verify that our results are robust to accounting for spatial dependence in our outcome variables. Following Colella et al. (2023), we recompute standard errors to allow for clustering based on spatial dependence of districts, based on cutoffs of 100 kilometers, 200 kilometers, and 500 kilometers. We still find statistically significant gaps in access to public goods until 1991, followed by convergence in most public goods, including middle schools, by 2001 (Appendix Table A.10).

4.4. Do Direct and Indirect Rule Areas Differ in Development Outcomes?

While ensuring universal coverage in access to public goods is an important goal, this may not be enough to ensure that gaps in development outcomes are also covered. For instance, gaps in health outcomes may persist if the health centers deliver poor service, or if other complementary

[7] For completeness, we show the OLS comparisons between direct and indirect rule areas in Appendix Table A.5. Note that these are quite different from the IV results, because they do not control for the selectivity of British annexation policy. In particular, we see no gaps in access to public goods in 1981 and 1991, and an advantage in road access in 2011 (panel A). We also see that direct rule areas have significantly higher agricultural investments and productivity (with little evidence of convergence over time), consistent with selective British annexation of areas with higher agricultural potential (panel B).

[8] We use data from round 64 of the National Sample Survey, which asks about the previous state of residence for each respondent.

investments are not made. To examine whether convergence occurred for other development goals, we examine differences in child mortality, educational attainment, and income and poverty measures for directly and indirectly ruled districts. We find that children born between 1973 and 1981 had 4.2 percentage points higher neonatal mortality and 5.1 percentage point higher infant mortality in directly ruled districts. By 2011, the difference in neonatal mortality rate was 1.1 percentage points, while the gap in infant mortality was a statistically insignificant 0.9 percentage points. For educational attainment, we find that the difference in the primary school completion rate was increasing over the first few decades (even as access to primary school was being equalized). For cohorts entering primary school between 1992 and 2001, directly ruled areas have a statistically significant 6.4 percentage point higher primary school completion rate (Table 2, panel B). This gap decreased to 3 percentage points for students who started primary school in 2002 or later, consistent with the SSA program's goal of equalizing universal enrollment for children aged 6-14. There is no advantage in secondary school completion for districts historically under direct versus indirect British rule. Table 2 Panel C explores differences in income and poverty for directly ruled districts. In 1983, people in districts historically under direct British rule had an average household expenditure that was 17.2 rupees less than households in indirectly ruled districts (Table 2, panel C). This gap decreased to a statistically insignificant 11.9 rupees by 2000. Similarly, the poverty rate was 14.1 percentage points higher in directly ruled districts in 1983, and only 6.4 percentage points higher by 2000.

[Insert Table 2 here]

5. Do the Effects of Colonial Land Tenure Attenuate Over Time?

5.1. Empirical Strategy

We examine the long run effects of colonial land tenure systems by comparing outcomes across districts that have more versus less area under non-landlord systems. The regression specification is similar to equation (1) of Banerjee and Iyer (2005):

$$y_{it} = \alpha_t + \beta NL_i + Z_{it}\gamma + \varepsilon_{it} \qquad (2)$$

where the dependent variable y_{it} includes measures of agricultural investment and productivity in district i in (five-year) period t. NL_i denotes the extent of non-landlord land tenure systems in district *i*, measured by the fraction of area or fraction of villages in the district that were not under *zamindari* land tenure.[9] The coefficient of interest is β, which measures the average difference in the outcome variable between non-landlord and landlord districts post-independence. Period fixed effects are denoted α_t, and Z_{it} are control variables, including altitude, latitude, mean annual rainfall, indicators for soil type, dummies for coastal regions, and the date of British land revenue control. The sample is restricted to districts where the British authorities determined the land tenure systems.[10] Standard errors are clustered at the 1991 district level to account for within-district correlation since the data contains observations for each district from 1966 through 2011.

The main endogeneity concern is that the British chose land tenure systems based on expected future agricultural productivity of the area. To overcome this, we follow Banerjee and Iyer's instrumental variables (IV) strategy that relies on quasi-exogenous historical changes in British land policy. Owing to a series of historical events that set important precedents, as well as changes in prevailing British ideology, policymakers in the period 1820-1856 were significantly more likely to choose non-landlord systems.[11] The most important of these historical events were a switch to individual cultivator systems in previously conquered Madras province in 1820, an 1819 letter from the Secretary of the United Provinces Board of Revenue stating that every village historically was led by a village body, and decreased rivalry with France after 1815. However, the mutiny of 1857 led to a rethinking of this policy stance, with the British wanting to retain support from large landlords. Our instrument is a dummy variable that equals one if the British assumed land revenue control of the district between 1820 and 1856, and zero otherwise. To avoid confounding with other effects of longer British policymaking, we control linearly for the date of

[9] This classification is based upon several historical sources, including district-level land settlement reports. See Banerjee and Iyer (2005) for details. *Mahalwari* systems were classified as "landlord" if the village body consisted of only one person.

[10] This is the same as districts that were under direct British rule, with the exception of the princely state of Mysore where the British regent chose the land tenure system during a period where the king was a minor.

[11] Guha (1963) and Stokes (1959, 1978) discuss the role of ideology and economic doctrine in shaping decisions on land tenure systems.

British land revenue control. We focus on the OLS estimates in the next section; the results from the IV regressions are shown as a robustness check in the Appendix.

5.2. Do Landlord Areas Catch Up in Agricultural Investments and Productivity?

We first verify that the VDSA data are able to closely replicate the results from Banerjee and Iyer (2005). We show that the five-year binned data yield very similar results to using annual data for the BI data set (Table 3, columns 1 and 2). We see that areas with non-landlord land tenure systems have significantly higher levels of irrigation and fertilizer usage, higher proportions of land sown with high-yielding varieties (HYV) crops (marginally significant) and significantly higher crop yields. We next show that the VDSA data shows gaps in agricultural investments and productivity between landlord and non-landlord areas that are very similar to those from the BI data for the overlapping time period of 1966-1987 (column 3). All the coefficients are of similar magnitude and significance as in the BI data; in fact, the VDSA data show larger differences between landlord and non-landlord areas for some of these outcomes, particularly the area under HYV cereals.

[Insert Table 3 here]

We now use the VDSA data to examine whether the gap is higher or lower in the later years, 1988-2011. We see that there is no longer a statistically significant difference in the proportion of irrigated area between landlord and non-landlord districts in the later period; the gaps in the proportion of area under HYV of rice and wheat have also narrowed, though the gap in the proportion of area under HYV of cereals other than rice and wheat has increased over time (Table 3, column 4). The closing of the irrigation gap is consistent with the 1997 Accelerated Irrigation Benefit program which constructed last mile irrigation networks to connect rural farmers to the existing irrigation networks. Additionally, the non-landlord advantage in fertilizer consumption per hectare has more than doubled since the 1980's despite the government of India providing fertilizer subsidies, perhaps because these subsidies were available to all farmers and therefore benefited those with initially higher levels of investment.

Consistent with the fact that only some of the agricultural investment gaps have narrowed, while others have widened, we see that the agricultural yield differences remain large and statistically significant in the 1988-2011 period. The combined yield of 13 major crops remains

approximately 20 percent higher in non-landlord districts (Table 3, column 5); the rice yield is 20.9% higher and the wheat yield is 18.5% higher. While the difference in the overall yield and rice yield has remained constant over time, the gap in wheat yield has decreased by 40%. Figure 1 depicts the gaps between landlord and non-landlord districts for each of the agricultural productivity and investment variables, with each point represents the regression estimate of the impact of colonial land tenure in the five-year period. We see the irrigation gap closing in the early 1990s, and the gap in HYV rice and wheat becoming insignificant in the early 1980s. The figure also shows that the fertilizer consumption gap has consistently increased over time, as has the gap in HYV of cereals other than rice and wheat.

[Insert Figure 1 here]

5.3 Robustness Checks

We subject our estimates of Table 3 to a range of robustness checks. First, since a few districts in the VDSA data are missing data for all years for specific variables, [12] we re-run our regressions by excluding these districts from the estimation for all agricultural outcomes. The results remain similar to our results from Table 3, namely that the gaps in irrigation and HYV area of rice and wheat have dissipated over time, the gaps in fertilizer use and HYV area of other cereals has grown larger, and the gaps in crop yields are still present in the later period (Appendix Table A.6, columns 1 and 2).

Second, as outlined in Section 5.1, we verify that our results are not biased due to endogeneity of the land tenure system by computing IV estimates, using the fact of being conquered between 1820 and 1856 as an instrument. The IV estimates from the VDSA data show large and statistically significant advantages to non-landlord tenure in the period 1966-1987, for all agricultural outcomes except for irrigation and total yields (Appendix Table A.6, column 3). For the updated years 1988-2011, the IV estimates confirm our conclusions from the OLS estimates: non-landlord areas continue to have higher fertilizer usage and a higher share of area under HYV of cereals, resulting in significantly higher wheat yields even in the later period (column 4). In contrast to the OLS, the IV results do not show significantly higher rice or total yields in the later period.

[12] VDSA data on HYV cereals is missing for the state of Karnataka and the districts of Kendujhar, Madurai, and Thanjavur. VDSA data on HYV wheat and wheat yields is missing for Kendujhar district.

Third, as in Banerjee and Iyer (2005), we do a neighboring district analysis by restricting our sample to districts that were next to each other but had different land tenure systems. Note that such a comparison is based on the fact that different colonial administrators made different choices for their areas that were brought under British revenue control at different times, resulting in tenure systems differing across colonial province boundaries. However, such a restriction results in a small sample of only 35 districts. For this restricted sample of 35 districts, we find statistically significant gaps in irrigation, HYV area of cereals, total yield and wheat yield for the 1966-1987 period (Appendix Table A.6, column 5). For the later period 1988-2011, we see no significant gaps in irrigation or total yield, while the gaps in HYV cereal adoption and wheat yields are persistent (column 6). In contrast to Table 3, we find that the restricted sample also shows convergence in fertilizer usage as well as total and rice yields (comparing the magnitude of coefficients between columns 5 and 6). Given that this sample is geographically similar across landlord and non-landlord areas, it is reasonable to expect greater convergence in this restricted sample.

Fourth, we verify that our results are not driven by potential omitted variables such as population density or migration. While higher population densities may make it easier to invest in new technologies such as irrigation and HYV seeds, we should note that it was landlord areas which have (on average) higher population densities than non-landlord areas. Controlling for district population density, we still observe convergence in irrigation and utilization of HYV rice and wheat. The non-landlord advantages in fertilizer consumption and crop yields are higher when accounting for population density, consistent with the idea that it was the landlord areas that held an initial advantage (Appendix Table A.8, panel B). Our main conclusion of only partial convergence in agricultural outcomes remains unchanged.

Another possibility is that better tenure security under non-landlord systems may lead to greater out-migration and consequently less investment in agriculture, thereby accounting for the partial convergence we do observe. We re-run our estimations controlling for state-level out-migration rates, and find slightly smaller gaps than in Table 3 (Appendix Table A.9, panel B). This suggests that out-migration is not a major determinant of the convergence we observe: if it were, we would expect to see larger gaps after controlling for it.

Finally, to address concerns about spatial dependence in our outcome variables, we follow Colella et al. (2023) to allow for arbitrary clustering of standard errors, just as we did for direct rule. Our Table 3 results are robust when using 100 kilometers, 200 kilometers, and 500 kilometers

as cutoffs for the spatial dependence of districts, in that we still see convergence in irrigation and HYV adoption of rice and wheat (Appendix Table A.11). Gaps still exist in fertilizer consumption and rice and wheat yields. The only slight difference with Table 3 is that, for cutoffs of 200 kilometers and 500 kilometers, the yield of 13 major crops converges. Overall, the results in Table 3 are robust to correcting for spatial dependence.

5.4. Do Landlord Areas Catch Up on Other Development Outcomes?

We have shown that there has been partial convergence in agricultural productivity and investments between historically landlord and non-landlord districts. What does that mean for other development outcomes? Previous studies have found conflicting evidence on the health consequences of the Green Revolution in India; Bharadwaj et al. (2020) find lower infant mortality while Singh (2024) finds worse adult health. We examine whether public goods availability also converges across landlord and non-landlord areas, as we observed for direct versus indirect ruel areas. We find that landlord areas had significantly less access to schools (primary, middle, high), health centers and subcenters, canals and roads in 1981 (Appendix Table A.7, column 1). By 2011, these gaps are greatly reduced though not fully eliminated; non-landlord areas continue to have significantly better access to high schools, health subcenters and roads (column 4).

Turning to health outcomes, we find that the child mortality gap between landlord and non-landlord areas was not as large as the gap between direct and indirect rule areas: neonatal mortality, infant mortality and under-5 mortality were 0.7, 1.8 and 2.9 percentage points lower in non-landlord areas compared to landlord areas for children born in 1973-1981 (Table 4, panel A). For those born in 2002-2011, these gaps were 0.8, 1 and 1.3 percentage points, similar to this end-period gap between direct and indirect rule areas (shown in Table 2).

By 1991, non-landlord districts had a 7.5 percentage point higher primary school completion rate than landlord districts (Table 4, panel B). The gap has since shrunk: students entering school in 2002 or later show a completion rate only 1.9 percentage points higher. Interestingly, the difference in secondary school completion between non-landlord and landlord districts has remained relatively constant over time, with non-landlord districts having an approximately 10 percentage point higher secondary school completion rate. This is consistent with the persistent advantage in high school access enjoyed by these areas. Interestingly, the differences in average household expenditure and poverty between landlord and non-landlord

districts are not statistically significant from 1983 through 2000 (Table 4, panel C). These gaps are also small in magnitude: average household expenditure per capita was 2 rupees higher in non-landlord areas in 1983 and 7 rupees higher in 2000.

[Insert Table 4 here]

6. Conclusion

Extending the data sets used in Iyer (2010) and Banerjee and Iyer (2005), we document two important facts about the persistent effects of historical institutions. Comparing areas that were under direct versus indirect colonial rule, we find that, by 2011, there were no significant differences in access to middle schools, primary health centers, primary health subcenters and paved roadways between historically directly and indirectly ruled districts. We attribute these results to post-colonial policies that were specifically targeted towards places with initially lower levels of infrastructure. However, when extending the analysis on land tenure systems, we find that some of the agricultural investment gaps have dissipated while others have persisted and even widened. Consequently, non-landlord districts still experience higher crop yields more than 60 years after the end of colonial rule and the official dismantling of colonial land tenure institutions. We conclude that colonial institutions can have lasting impacts on populations long after the independence of a nation. However, it is possible to mitigate these long-run effects through targeted public policy and infrastructure investment.

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Table 1: How Long Do the Effects of Direct Colonial Rule Persist?

	(1) 1961 IV	(2) 1981 IV	(3) 1991 IV	(4) 2001 IV	(5) 2011 IV
Primary School	-0.127*	-0.007	-0.000	0.033	0.054
	(0.067)	(0.045)	(0.036)	(0.032)	(0.033)
Middle School	-0.068*	-0.087**	-0.088**	-0.080*	-0.006
	(0.035)	(0.039)	(0.037)	(0.047)	(0.053)
High School	-0.037	-0.064	-0.068*	-0.042	-0.081
	(0.022)	(0.043)	(0.040)	(0.057)	(0.061)
Primary Health Center		-0.024**	-0.039***	-0.007	-0.032
		(0.011)	(0.015)	(0.051)	(0.058)
Primary Health Subcenter		-0.041**	-0.063**	-0.050	-0.029
		(0.016)	(0.032)	(0.056)	(0.058)
Canals	-0.000	-0.047	-0.042	-0.306***	0.166
	(0.000)	(0.030)	(0.027)	(0.107)	(0.144)
Roads	-0.077	-0.189***	-0.204***	-0.104	0.006
	(0.092)	(0.068)	(0.066)	(0.082)	(0.057)

Note: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors clustered at the native state level are reported in parentheses. Each cell represents the coefficient from an IV regression of the dependent variable on the indicator of direct British rule, using the *Lapse* indicator as an instrument. *Lapse* = 1 if the ruler of a native state died without a natural heir between 1848 and 1856. Sample restricted to areas that were not annexed in or before 1847. All regressions control for altitude, latitude, mean annual rainfall, dummies for soil type, and a dummy for coastal region. Data from population censuses of years indicated. The 1961 census has the following missing data: canals for Uttar Pradesh, Tamil Nadu, Rajasthan, Orissa, and Maharashtra; primary and middle schools for Uttar Pradesh; middle schools, roads, and canals for West Bengal; and roads for Punjab and Rajasthan. The 1981 and 1991 have the following missing data: middle schools in Gujarat, high schools in Madhya Pradesh, and primary health subcenters in Karnataka. The census was not conducted in Assam in 1981, and Jammu and Kashmir in 1991. Primary health centers includes community health centers in 2011. Canals refers to access to canal or river in 2001 and 2011.

Table 2: Direct Colonial Rule and Development Outcomes Over Time

	(1)	(2)	(3)	(4)
Birth Years	1973-1981	1982-1991	1992-2001	2002-2011
Panel A: Health (NFHS 1998-99 and 2015-16)				
Neonatal Mortality	0.042**	0.020*	0.010*	0.011**
	(0.020)	(0.011)	(0.006)	(0.004)
Infant Mortality	0.051*	0.020	0.011	0.009
	(0.031)	(0.017)	(0.011)	(0.007)
Under 5 Mortality	0.057	0.018	0.011	0.012
	(0.035)	(0.021)	(0.012)	(0.009)
Began Attending School	1972-1981	1982-1991	1992-2001	2002-2011
Panel B: Education (NSS 75th round, 2017)				
Completed Primary School	0.036	0.044	0.064**	0.030***
	(0.049)	(0.057)	(0.025)	(0.011)
Completed Secondary School	0.042	0.001	-0.019	0.002
	(0.040)	(0.048)	(0.067)	(0.041)
Year	1983	1988	1994	2000
Panel C: Income and Poverty (NSS rounds 38, 43, 50 and 55)				
Average Household Expenditure	-17.177*	-2.643	-16.638**	-11.908
Per Capita	(9.448)	(6.332)	(6.808)	(8.942)
Poverty Rate (Head Count Ratio)	0.141**	0.024	0.014	0.064
	(0.071)	(0.058)	(0.035)	(0.050)

Note: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors clustered at the native state level are reported in parentheses. Each cell represents the coefficient from an IV regression of the dependent variable on the measure of direct British rule, using the *Lapse* indicator as an instrument. *Lapse* = 1 if the ruler of a native state died without a natural heir between 1848 and 1856. Sample restricted to areas that were not annexed in or before 1847. All regressions control for altitude, latitude, mean annual rainfall, dummies for soil type, and a dummy for coastal region. Each column in panel B restricts the sample to students who started the either primary or secondary schooling in the listed years. In Panel C, the average household expenditure per capita is deflated to the 1980 price level.

Table 3: How Long Do the Effects of Colonial Land Tenure Persist?

	(1) B&I 2005 Annual, 1956-1987	(2) B&I 2005 Binned, 1966-1987	(3) VDSA Binned, 1966-1987	(4) VDSA Binned, 1988-2011
Irrigated Land	0.065*	0.077**	0.074**	0.009
	(0.034)	(0.036)	(0.037)	(0.043)
Fertilizer Consumption	10.708***	16.053***	17.067***	26.692**
	(3.345)	(5.303)	(4.932)	(11.172)
HYV Rice	0.079*	0.072	0.067	0.064
	(0.044)	(0.049)	(0.045)	(0.059)
HYV Wheat	0.092**	0.085*	0.070	0.039
	(0.046)	(0.049)	(0.047)	(0.056)
HYV Cereals	0.057*	0.053	0.096**	0.253***
	(0.031)	(0.036)	(0.037)	(0.065)
Yield of 13 major crops	0.202**	0.239**	0.214**	0.188*
	(0.092)	(0.094)	(0.088)	(0.098)
Rice yield	0.171**	0.197**	0.181**	0.189**
	(0.081)	(0.091)	(0.091)	(0.091)
Wheat yield	0.229***	0.259***	0.279***	0.171***
	(0.067)	(0.080)	(0.065)	(0.063)

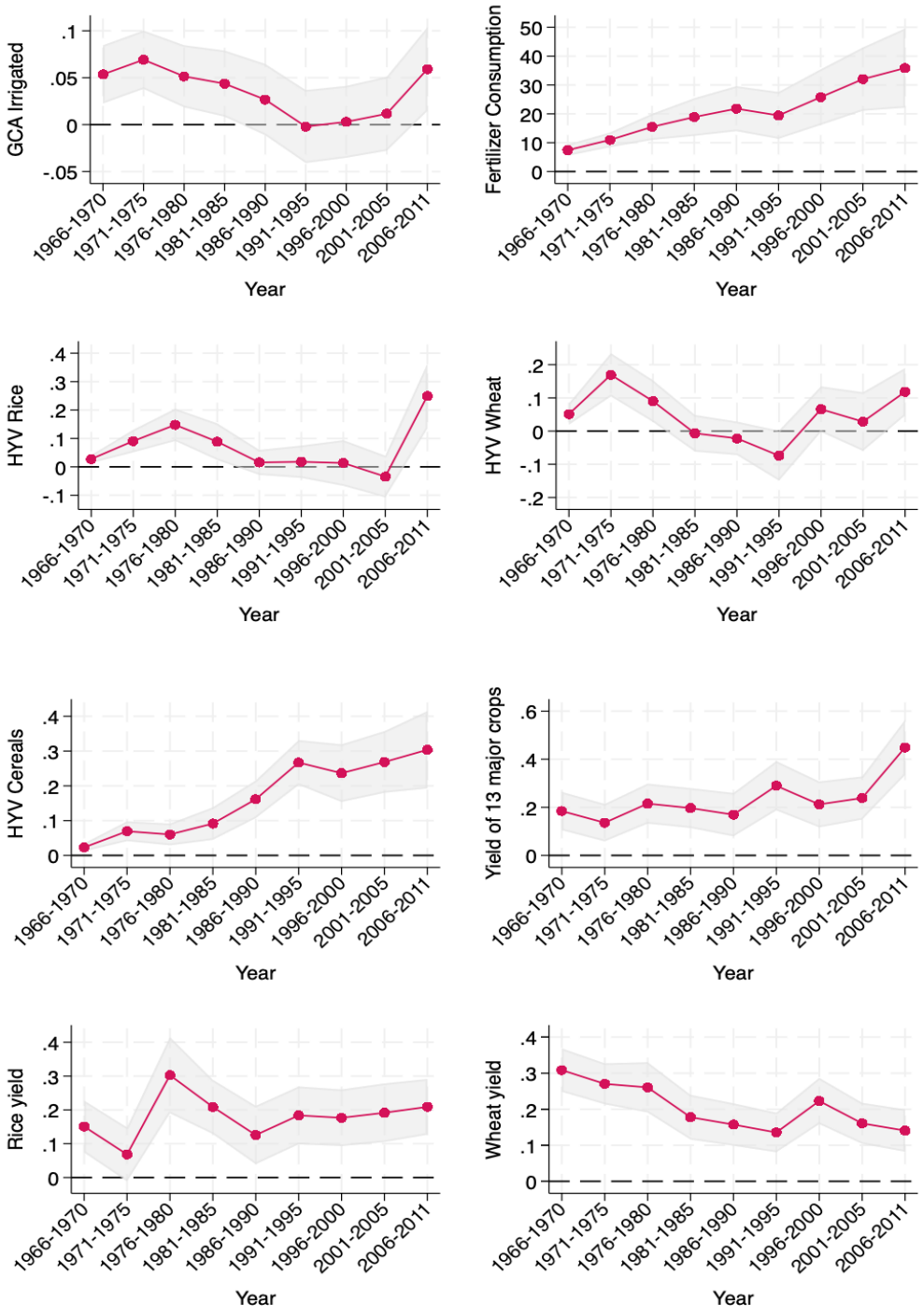
Note: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors clustered at the 1991 district level are reported in parentheses. Each cell represents the coefficient from a regression of the dependent variable on the measure of non-landlord tenure, controlling for period fixed effects, geographic controls, and the date of British land revenue control. The geographic controls include altitude, latitude, mean annual rainfall, dummies for soil type, and a dummy for coastal region.

Table 4: Colonial Land Tenure and Development Outcomes Over Time

	(1)	(2)	(3)	(4)
Birth Years	1973-1981	1982-1991	1992-2001	2002-2011
Panel A: Health (NFHS 1998-99 and 2015-16)				
Neonatal Mortality	-0.007	-0.007	-0.011***	-0.008***
	(0.010)	(0.005)	(0.003)	(0.002)
Infant Mortality	-0.018	-0.016**	-0.016***	-0.010***
	(0.012)	(0.007)	(0.004)	(0.004)
Under 5 Mortality	-0.029**	-0.023***	-0.019***	-0.013***
	(0.014)	(0.009)	(0.005)	(0.004)
Began Attending School	1972-1981	1982-1991	1992-2001	2002-2011
Panel B: Education (NSS 75th round, 2017)				
Completed Primary School	0.053	0.075**	0.029	0.019**
	(0.036)	(0.034)	(0.022)	(0.010)
Completed Secondary School	0.056	0.107***	0.100***	0.095***
	(0.035)	(0.032)	(0.033)	(0.026)
Year(s)	1983	1988	1994	2000
Panel C: Income and Poverty (NSS rounds 38, 43, 50 and 55)				
Average Household Expenditure	2.010	2.243	6.941	6.716
Per Capita	(3.858)	(5.652)	(4.539)	(5.070)
Poverty Rate (Head Count Ratio)	-0.015	-0.007	-0.019	-0.011
	(0.026)	(0.031)	(0.020)	(0.024)

Note: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors clustered at the 1981 district level are reported in parentheses for Panel A. Robust standard errors clustered at the 1991 district level are reported in parentheses for Panels B and C. Each cell represents the coefficient from a regression of the dependent variable on the measure of non-landlord tenure, controlling for geographic variables and the date of British land revenue control. Each column in panel B restricts the sample to students who started the either primary or secondary schooling in the listed years. In Panel C, the average household expenditure per capita is deflated to the 1980 price level.

Figure 1: Impact of Colonial Land Tenure Systems Over Time



Note: Each point on the graph represents the coefficient from a regression of the outcome variable (listed on the y-axis) on the measure of non-landlord land tenure. The shaded area is the 95 percent confidence interval for the regression coefficient. The black, dashed, horizontal line is at zero. GCA stands for "gross cropped area." HYV stands for "high yielding varieties." All regressions use data from the VDSA data set, and control for altitude, latitude, mean annual rainfall, dummies for soil type, a dummy for coastal region and the date of British land revenue control.

The Colonial Legacy in India: How Persistent are the Effects of Historical Institutions?

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Appendix Tables and Figures

Table A.1: Trends in Public Good Availability

	(1) 1961	(2) 1981	(3) 1991	(4) 2001	(5) 2011
Primary School	0.513	0.747	0.794	0.870	0.879
Middle School	0.097	0.225	0.267	0.411	0.510
High School	0.030	0.112	0.141	0.239	0.272
Primary Health Center		0.030	0.052	0.146	0.280
Primary Health Subcenter		0.039	0.101	0.248	0.275
Canals	0.002	0.053	0.042	0.498	0.575
Roads	0.212	0.406	0.461	0.665	0.703

Note: Data from village directories of population censuses of years indicated. Each entry represents the average fraction of villages in the district with a certain public good. The 1961 census has the following missing data: canals for Uttar Pradesh, Tamil Nadu, Rajasthan, Orissa, and Maharashtra; primary and middle schools for Uttar Pradesh; middle schools, roads, and canals for West Bengal; and roads for Punjab and Rajasthan. The 1981 and 1991 have the following missing data: middle schools in Gujarat, high schools in Madhya Pradesh, and primary health subcenters in Karnataka. The census was not conducted in Assam in 1981, and Jammu and Kashmir in 1991. Primary health centers includes community health centers in 2011. Canals refers to access to canal or river in 2001 and 2011.

Table A.2: Comparing the Banerjee & Iyer (BI) and VDSA datasets

	# observations over 1966-1987				
	(1)	(2)	(3)	(4)	(5)
Outcome	BI Annual	VDSA Annual	BI Binned	VDSA Binned	Correlation
Irrigation	2,805	2,574	496	488	0.996
Fertilizer	3,634	3,594	826	828	0.919
HYV Rice	3,542	1,667	793	808	0.976
HYV Wheat	3,375	1,556	755	749	0.893
HYV Cereals	3,453	1,179	717	710	0.799
Yield of 13 Major Crops	3,652	2,354	830	830	0.979
Rice Yield	3,642	3,652	828	830	0.991
Wheat Yield	3,124	3,652	744	785	0.911

Note: Each entry of Columns 1 through 4 is the number of observations. "Binned" refers to five-year averages of outcome variables. Correlation coefficients are computed for the binned data from 1966 through 1987.

Table A.3: Trends in Development Outcomes

	(1)	(2)	(3)	(4)
Birth Years	1973-1981	1982-1991	1992-2001	2002-2011
Panel A: Health (NFHS 1998-99 and 2015-16)				
Neonatal Mortality	0.084	0.070	0.042	0.034
Infant Mortality	0.125	0.103	0.060	0.047
Under 5 Mortality	0.147	0.121	0.071	0.056
Began Attending School	1972-1981	1982-1991	1992-2001	2002-2011
Panel B: Education (NSS 75th round, 2017)				
Completed Primary School	0.653	0.724	0.863	0.947
Completed Secondary School	0.383	0.401	0.606	0.476
Year	1983	1988	1994	2000
Panel C: Income and Poverty (NSS rounds 38, 43, 50 and 55)				
Average Household Expenditure Per Capita	116.95	114.45	124.18	89.75
Poverty Rate (Head Count Ratio)	0.412	0.231	0.181	0.137

Note: Each cell represents the mean of each development outcome in the given year or set of years. Each column in panel B restricts the sample to students who started the either primary or secondary schooling in the listed years. In Panel C, the average household expenditure per capita is deflated to the 1980 price level.

Table A.4: Long Run Effects of Direct Colonial Rule: Reduced Form and First Stage

	(1)	(2)	(3)	(4)
	1981	1991	2001	2011
Panel A: First Stage				
Ruler died without a	0.663***	0.673***	0.673***	0.673***
natural heir in 1848-1856	(0.157)	(0.155)	(0.155)	(0.155)
First Stage F stat	17.79	18.84	18.84	18.84
Panel B: Reduced Form				
Primary School	-0.005	-0.000	0.022	0.037*
	(0.031)	(0.025)	(0.021)	(0.020)
Middle School	-0.057**	-0.059**	-0.054*	-0.004
	(0.025)	(0.027)	(0.031)	(0.037)
High School	-0.048	-0.052	-0.028	-0.055
	(0.034)	(0.032)	(0.038)	(0.037)
Primary Health Center	-0.016**	-0.027***	-0.005	-0.021
	(0.007)	(0.008)	(0.035)	(0.039)
Primary Health Subcenter	-0.027***	-0.042**	-0.034	-0.020
	(0.008)	(0.021)	(0.039)	(0.039)
Canals	-0.031*	-0.028*	-0.206**	0.112
	(0.016)	(0.015)	(0.083)	(0.111)
Roads	-0.126***	-0.138***	-0.070	0.004
	(0.033)	(0.034)	(0.046)	(0.039)
Number of Districts	157	163	163	163
Number of Native States	70	71	71	71

Note: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors clustered at the native state level are reported in parentheses. Sample restricted to areas that were not annexed in or before 1847. In Panel A, each cell represents the coefficient from a first stage regression of the measure of direct British rule on the *Lapse* indicator which equals 1 if the ruler of a native state died without a natural heir between 1848 and 1856. For Panel B, each cell represents the coefficient from a reduced form regression of the dependent variable on the Lapse indicator. All regressions control for altitude, latitude, mean annual rainfall, dummies for soil type, and a dummy for coastal region.

Table A.5: Long-run Effects of Direct Colonial Rule: OLS Results

	(1)	(2)	(3)	(4)
	1981 census	1991 census	2001 census	2011 census
Panel A: Public good provision				
Primary School	-0.011	-0.021	-0.049**	-0.021
	(0.034)	(0.029)	(0.024)	(0.023)
Middle School	-0.030	-0.054	-0.041	-0.020
	(0.034)	(0.035)	(0.040)	(0.042)
High School	-0.061	-0.068*	-0.035	-0.055
	(0.038)	(0.041)	(0.034)	(0.043)
Primary Health Center	-0.016	-0.028	-0.029	-0.027
	(0.010)	(0.017)	(0.029)	(0.034)
Primary Health Subcenter	-0.009	0.003	-0.005	-0.022
	(0.012)	(0.022)	(0.032)	(0.033)
Canals	0.019	-0.032*	-0.149**	-0.011
	(0.016)	(0.016)	(0.067)	(0.061)
Roads	0.061	0.036	0.039	0.091**
	(0.065)	(0.065)	(0.058)	(0.046)

	(5)	(6)
	1966-1987	1988-2011
Panel B: Agricultural investments and productivity		
Irrigated Land	0.115**	0.171***
	(0.049)	(0.051)
Fertilizer Consumption	11.016*	30.932**
	(5.581)	(11.858)
HYV Rice	0.033	0.221***
	(0.044)	(0.072)
HYV Wheat	0.015	0.070
	(0.043)	(0.048)
HYV Cereals	-0.055	-0.060
	(0.043)	(0.072)
Yield of 13 major crops	0.239*	0.331**
	(0.132)	(0.128)
Rice yield	0.187	0.328**
	(0.118)	(0.127)
Wheat yield	-0.007	0.019
	(0.109)	(0.078)

Note: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors clustered at the native state level are reported in parentheses. Each cell represents the coefficient from an OLS regression of the dependent variable on the indicator of direct British rule. All regressions control for altitude, latitude, mean annual rainfall, dummies for soil type, and a dummy for coastal region.

Table A.6: Long-run Effects of Land Tenure Systems: Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)
	Drop districts with missing data		IV estimates		Neighboring districts sample	
	1966-1987	1988-2011	1966-1987	1988-2011	1966-1987	1988-2011
Irrigated Land	0.079**	0.043	0.186	-0.056	0.098**	-0.038
	(0.037)	(0.045)	(0.139)	(0.122)	(0.042)	(0.055)
Fertilizer Consumption	17.847***	33.182***	31.878*	66.903*	9.962	1.079
	(5.043)	(11.631)	(16.541)	(34.923)	(6.849)	(15.593)
HYV Rice	0.076*	0.058	0.461***	0.627*	-0.048	0.056
	(0.042)	(0.053)	(0.171)	(0.323)	(0.083)	(0.068)
HYV Wheat	0.060	0.036	0.979***	0.597	0.015	-0.008
	(0.048)	(0.054)	(0.247)	(0.392)	(0.034)	(0.061)
HYV Cereals	0.107***	0.298***	0.321***	2.358*	0.090**	0.348***
	(0.037)	(0.062)	(0.092)	(1.241)	(0.044)	(0.042)
Yield of 13 major crops	0.211**	0.234**	-0.078	-0.172	0.232***	0.010
	(0.088)	(0.098)	(0.383)	(0.384)	(0.082)	(0.094)
Rice yield	0.186**	0.196**	0.573*	0.391	0.081	-0.014
	(0.090)	(0.097)	(0.313)	(0.342)	(0.108)	(0.082)
Wheat yield	0.289***	0.221***	0.988***	0.366**	0.212**	0.184**
	(0.068)	(0.070)	(0.285)	(0.184)	(0.081)	(0.076)

Note: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors clustered at the 1991 district level are reported in parentheses. Each cell represents the coefficient from a regression of the dependent variable on the measure of non-landlord control. Columns (3) and (4) use an indicator for British land revenue control between 1820 and 1856 as an instrument for the non-landlord proportion. Each regression includes year fixed effects, geographic controls, and the date of British land revenue control. The geographic controls include altitude, latitude, mean annual rainfall, dummies for soil type, and a dummy for coastal regions. All regressions are computed for the VDSA binned data.

Table A.7: Long-run Effects of Colonial Land Tenure on Public Goods

	(1)	(2)	(3)	(4)
	1981 census	1991 census	2001 census	2011 census
Primary School	0.182***	0.108***	0.024	0.007
	(0.036)	(0.033)	(0.026)	(0.031)
Middle School	0.136***	0.132***	0.076*	0.057
	(0.024)	(0.027)	(0.044)	(0.037)
High School	0.050**	0.068***	0.063	0.103***
	(0.020)	(0.024)	(0.045)	(0.033)
Primary Health Center	0.012**	0.027***	-0.027	0.025
	(0.005)	(0.009)	(0.039)	(0.024)
Primary Health Subcenter	0.031**	0.062***	0.023	0.085**
	(0.013)	(0.021)	(0.044)	(0.035)
Canals	0.052**	-0.008	0.108	-0.014
	(0.024)	(0.010)	(0.072)	(0.036)
Roads	0.238***	0.263***	0.214***	0.155***
	(0.047)	(0.043)	(0.048)	(0.049)

Note: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors clustered at the 1991 district level in parentheses. Each cell represents the coefficient from a regression of the dependent variable on the measure of non-landlord tenure, controlling for period fixed effects, geographic controls, and the date of British land revenue control. The geographic controls include altitude, latitude, mean annual rainfall, dummies for soil type, and a dummy for coastal regions.

Table A.8: Long Run Effects of Direct Rule and Colonial Land Tenure, Controlling for Population Density

	(1)	(2)		(3)
	Coefficient on direct rule indicator			Coefficient on non-landlord proportion
	Census 2001	Census 2011		VDSA Binned, 1988-2011
Panel A: Public good provision			*Panel B: Agricultural investments and productivity*	
Primary School	0.021	0.038	Irrigated Land	0.031
	(0.027)	(0.027)		(0.040)
Middle School	-0.075*	-0.004	Fertilizer Consumption	32.635***
	(0.042)	(0.048)		(10.006)
High School	-0.041	-0.067	HYV Rice	0.050
	(0.051)	(0.054)		(0.059)
Primary Health Center	-0.009	-0.034	HYV Wheat	0.028
	(0.048)	(0.053)		(0.056)
Primary Health Subcenter	-0.058	-0.032	HYV Cereals	0.257***
	(0.052)	(0.053)		(0.064)
Canals	-0.305***	0.153	Yield of 13 major crops	0.241**
	(0.100)	(0.133)		(0.096)
Roads	-0.069	0.041	Rice yield	0.216**
	(0.071)	(0.048)		(0.096)
			Wheat yield	0.188***
				(0.066)

Note: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors clustered at the native state level in columns (1) and (2), and clustered at the 1991 district level in column (3). Columns (1) and (2) report the coefficient from an IV regression of the dependent variable on the indicator of direct British rule, using the *Lapse* indicator as an instrument, controlling for geographic controls. *Lapse* = 1 if the ruler of a native state died without a natural heir between 1848 and 1856. Sample restricted to areas that were not annexed in or before 1847. Column (3) shows the coefficients from a regression of the dependent variable on the measure of non-landlord tenure, controlling for geographic controls and the date of British land revenue control. The geographic controls include altitude, latitude, mean annual rainfall, dummies for soil type, and dummies for coastal regions. Column (1) controls for district-level population density in 2001, columns (2) and (3) control for population density in 2011.

Table A.9: Long Run Effects of Direct Rule and Colonial Land Tenure, Controlling for Migration

	(1)	(2)	(3)
	Coefficient on direct rule indicator		Coefficient on non-landlord proportion
	Census 2001	Census 2011	VDSA Binned, 1988-2011
Panel A: Public good provision			*Panel B: Agricultural investments and productivity*
Primary School	0.017	0.019	Irrigated Land	-0.022
	(0.023)	(0.021)		(0.039)
Middle School	-0.031	-0.018	Fertilizer Consumption	21.337**
	(0.047)	(0.047)		(10.389)
High School	-0.012	-0.062	HYV Rice	0.066
	(0.050)	(0.059)		(0.058)
Primary Health Center	0.023	-0.023	HYV Wheat	0.008
	(0.042)	(0.053)		(0.057)
Primary Health Subcenter	-0.024	-0.021	HYV Cereals	0.236***
	(0.049)	(0.053)		(0.063)
Canals	-0.223**	0.211	Yield of 13 major crops	0.117
	(0.094)	(0.157)		(0.089)
Roads	-0.031	0.013	Rice yield	0.135*
	(0.093)	(0.052)		(0.078)
			Wheat yield	0.131**
				(0.055)

Note: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors clustered at the native state level in columns (1) and (2), and clustered at the district level in column (3). Columns (1) and (2) report the coefficient from an IV regression of the dependent variable on the indicator of direct British rule, using the *Lapse* indicator as an instrument, controlling for geographic controls. *Lapse* = 1 if the ruler of a native state died without a natural heir between 1848 and 1856. Sample restricted to areas that were not annexed in or before 1847. Column (3) shows the coefficients from a regression of the dependent variable on the measure of non-landlord tenure, controlling for geographic controls and the date of British land revenue control. The geographic controls include altitude, latitude, mean annual rainfall, dummies for soil type, and a dummy for coastal region. All regressions control for state-level rates of out-migration, computed from the National Sample Survey 64th round.

Table A.10: Long-run Effects of Direct Rule on Public Good Availablilty, Corrected for Spatial Dependence

	(1) 1981 IV	(2) 1991 IV	(3) 2001 IV	(4) 2011 IV
Primary School	-0.007	-0.000	0.033	0.054
	(0.041)	(0.031)	(0.032)	(0.033)
	{0.042}	{0.032}	{0.038}	{0.034}
	[0.043]	[0.034]	[0.036]	[0.031]*
Middle School	-0.087	-0.088	-0.080	-0.006
	(0.041)**	(0.044)**	(0.075)	(0.058)
	{0.041}**	{0.039}**	{0.063}	{0.067}
	[0.036]**	[0.036]**	[0.054]	[0.067]
High School	-0.064	-0.068	-0.042	-0.081
	(0.033)*	(0.030)**	(0.085)	(0.073)
	{0.040}	{0.037}*	{0.068}	{0.073}
	[0.037]*	[0.035]**	[0.061]	[0.062]
Primary Health Center	-0.024	-0.039	-0.007	-0.032
	(0.010)**	(0.013)***	(0.085)	(0.071)
	{0.012}**	{0.014}***	{0.066}	{0.071}
	[0.011]**	[0.014]***	[0.060]	[0.057]
Primary Health Subcenter	-0.041	-0.063	-0.050	-0.029
	(0.014)***	(0.029)**	(0.086)	(0.071)
	{0.017}**	{0.028}**	{0.087}	{0.072}
	[0.017]**	[0.029]**	[0.073]	[0.057]
Canals	-0.047	-0.042	-0.306	0.166
	(0.026)*	(0.022)*	(0.129)**	(0.172)
	{0.031}	{0.025}*	{0.136}**	{0.167}
	[0.033]	[0.026]	[0.117]***	[0.154]
Roads	-0.189	-0.204	-0.104	0.006
	(0.074)**	(0.066)***	(0.108)	(0.070)
	{0.070}***	{0.069}***	{0.101}	{0.058}
	[0.074]**	[0.071]***	[0.077]	[0.063]

Note: *** p<0.01, ** p<0.05, * p<0.1. Each cell represents the coefficient from a regression of the dependent variable on the indicator of direct British colonial rule, instrumented by the *Lapse* indicator where *Lapse* = 1 if the ruler of a native state died without a natural heir between 1848 and 1856. Sample includes areas that were not annexed in or before 1847. All regressions control for altitude, latitude, mean annual rainfall, dummies for soil type, and a dummy for coastal region. Standard errors corrected for spatial dependence of districts within 100km (parantheses); 200km {curly brackets} and 500km with a linear decay [square brackets].

Table A.11: Long-run Effects of Colonial Land Tenure on Agricultural Productivity and Investment, Corrected for Spatial Dependence

	(1) VDSA Binned, 1966-1987	(2) VDSA Binned, 1988-2011
Irrigated Land	0.071	0.009
	(0.048)	(0.046)
	{0.051}	{0.038}
	[0.047]	[0.041]
Fertilizer Consumption	14.777	26.692
	(6.239)**	(12.042)**
	{6.843}**	{12.764}**
	[6.241]**	[12.914]**
HYV Rice	0.056	0.064
	(0.046)	(0.065)
	{0.049}	{0.074}
	[0.050]	[0.053]
HYV Wheat	0.072	0.039
	(0.061)	(0.065)
	{0.073}	{0.076}
	[0.054]	[0.054]
HYV Cereals	0.096	0.253
	(0.053)*	(0.082)***
	{0.067}	{0.073}***
	[0.069]	[0.066]***
Yield of 13 major crops	0.193	0.188
	(0.090)**	(0.108)*
	{0.084}**	{0.115}
	[0.089]**	[0.117]
Rice yield	0.156	0.189
	(0.107)	(0.105)*
	{0.116}	{0.111}*
	[0.107]	[0.106]*
Wheat yield	0.249	0.171
	(0.078)***	(0.058)***
	{0.090}***	{0.056}***
	[0.079]***	[0.050]***

Note: *** p<0.01, ** p<0.05, * p<0.1. Each cell represents the coefficient from an OLS regression of the dependent variable on the measure of non-landlord tenure, controlling for period fixed effects, the date of British land revenue control, and geographic controls (altitude, latitude, mean annual rainfall, dummies for soil type, and dummy for coastal region). Standard errors corrected for spatial dependence of districts within 100km (parantheses); 200km {curly brackets} and 500km with a linear decay [square brackets].

Table A.12: Post-Independence Development Programs in India

Scheme	Time	Target	Details	Citations
Panel A: Education and Health				
Minimum Needs Programme (MNP)	1974-1978	Areas without access to education, health centers, roads, electricity, housing	Raise the living standards and reduce regional disparities. Provide equal access to elementary and adult education. Provide rural health; rural roads and electrification; and rural housing. Environmental improvement of urban slums. Improve nutrition.	Banerjee & Somanathan (2007); Government of Maharashtra (2011)
Integrated Child Development Services (ICDS)	1975	Young children and pregnant and lactating mothers	Offers nutritional meals, preschool education, primary healthcare, immunizations for children under six years old and pregnant and lactating mothers	Nandi et al. (2020); Sachdev and Dasgupta (2011)
National Policy on Education	Launched 1986, Modified 1992	Historically disadvantaged groups	Provide every student access to quality education regardless of caste, creed, sex, or religion. Aimed to remove disparities and equalize educational opportunities.	Government of India (1992)
Sarva Shiksha Abhiyan (SSA)	Launched 2001	Habitations without schools, Improvement in quality in existing schools	Provide education to all children aged 6 to 14 by 2010. Provide a timeline to complete universal primary education. Achieve universal access, universal enrollment, and universal achievement within the specified timeline. Prioritize upper primary schooling. Partner with local and regional governments to bridge social, regional, and gender gaps.	Government of India (2018); Kainth (2006); Ward (2011)

National Rural Health Mission (NRHM)	Launched 2005	Rural areas. Vulnerable populations	Improve public health delivery system. Upgrade primary health subcenters to primary health centers. Provide rural primary health subcentres with grants for operating expenses and facility improvements.	Government of India (2005); Nandan (2010)
Panel B: Infrastructure				
Fertilizer Subsidy	Launched in 1977 for nitrogenous fertilizer; other fertilizers added in 1979.	All farmers	Subsidies provided for all types of fertilizer to all farmers across the entire country	Government of India (2025); Iyer et al. (2010)
Accelerated Irrigation Benefit Program	Launched 1997	Last mile irrigation networks	Provide state governments with funds to complete construction on last mile irrigation networks. Monitoring of projects was done by the Central Water Commission. Satellite data used for monitoring also helped identify areas needing irrigation infrastructure and canals.	Government of India (2010)
Pradhan Mantri Gram Sadak Yojana (PMGSY)	Launched 2000	Unconnected habitations	Launched to provide roads and connect unconnected habitations to other towns. Aim to reduce poverty and disparities in rural communities	Asher and Novosad (2020); Government of India (2012)

Golden Quadrilateral	Launched 2001	Towns along highways connecting four major cities	Connect Delhi, Kolkata, Mumbai, and Chennai. Reduce travel time between these four major cities. Cities along the highway were also connected. Intended to provide smaller towns better access to markets and promote economic growth	Ghani et al. (2016)

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Figure A.1: Trends in Agricultural Investments and Productivity, VDSA and BI data