BRITISH COLONIAL INSTITUTIONS AND ECONOMIC DEVELOPMENT IN INDIA

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ABSTRACT

We explore the impact of British colonial institutions on the economic development of India. In some regions, the British colonial government assigned property rights in land and taxes to landlords whereas in others it assigned them directly to cultivators or non-landlords. Although Banerjee and Iyer (2005) find that agricultural productivity of non-landlord areas diverged and out-performed relative to landlord areas after 1965 with the advent of the Green Revolution, we find evidence of superior economic performance of non-landlord regions in both the pre- and the post-independence periods. We believe that landlord and non-landlord regions diverged because their differing property rights institutions led to differences in incentives for development.

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I. Introduction

Institutions shape the long-run development path of nations because these humanly devised constraints, by structuring the incentives of exchange in the economic, political, and social spheres, influence the accumulation of knowledge and the production of goods and services. Poor institutions are likely to arise when economic resources are concentrated in the hands of a few elites who have incentives to structure institutions for the benefit of the few. Democratic institutions, which are more conducive to economic growth, may arise when economic resources are distributed more equally. However, because institutions and the distribution of economic resources are both endogenously determined, it is difficult to identify the impact of institutions on economic growth.

The European colonization presents an important potential source of exogenous variation in the distribution of institutions around the world. North (1990) and La Porta et. al. (1998a, 1998b) believe that the development paths of colonial economies are explained by the identities of the colonizing European nations. North (1990) and North and Weingast (1989) argue that whereas England, with the triumph of the Parliament, emerged with secure property rights and an impartial judicial system, Spain's centralized bureaucracy led to poor property rights and legal systems. La Porta et. al. (1988a, 1988b) find that nations that adopted British common law rather than civil law, which originates from Roman law, possessed stronger legal rules protecting corporate shareholders and creditors.

Engerman and Sokoloff (1997, 2000) and Acemoglu et. al. (2001, 2002) believe that the distribution of institutions around the world was also significantly influenced by local geographic conditions. For Engerman and Sokoloff, poor institutions arose in the New World colonies in the Caribbean, Brazil and the southern United States where geography and climate were suited for

plantation economies, and in Mexico and Peru, where there were significant indigenous populations and land was granted to few elites. On the other hand, democratic institutions arose in areas, such as in the northern United States and Canada, where geography and climate favored small scale farming.

For Acemoglu et al. (2001, 2002, 2004), the distribution of institutions is determined by initial conditions in settler mortality and native population density. In places where mortality rates were high, the Europeans did not have the incentive to settle in large numbers and establish the more democratic form of institutions developed in Europe. Likewise, in places where Europeans found dense native populations, such as in the Mughal, Aztec, and Inca empires, Acemoglu et al. argue that Europeans simply took over the existing native institutions which favored local elites.

The case of India does not fall neatly into any of our current categories of understanding on the subject of colonial institutions and development. India is endowed with a tropical climate, fertile soil and possessed a large native population. Yet, in India, unlike in the other tropical colonies, the British did not develop extensive plantation economies.[1] Due to its tropical disease environment and the pre-existing dense native population, British immigration to India was limited.[2] Yet, despite the small number of British immigrants, the British government established institutions in India based on private property rights and an English-type judicial system for the native populations. In a land where property rights were informal, complex, overlapping, and

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[1] The British owned or leased plantations in tea, indigo, and coffee. Of the three crops, tea was the most important and it represented about 20% in value of the eight most important non-food grain crops in 1923-1947 (Blyn (1966)). In terms of acreage, however, these crops accounted for a miniscule amount of Indian agriculture (Tomlinson (1993)). British firms were also involved in a variety of manufacturing from the production of jute, cotton, and machinery, but their most important presence was in their control of transportation networks, exports and imports (see Bagchi (1972, p. 183)).

[2] British views of Indians and Indian climate evolved over time with changes in theories of race and disease as well as with the new emerging information from European experiences in Asia (Harrison (1999)). But by the early nineteenth century, the British believed that India's climate was generally incompatible with the European constitution.

locally defined by tradition and village leaders, the British attempted to introduce an impersonal, bureaucratic, modern form of property rights.

Why did the British want to introduce a system of private property rights in India? We believe that there were two important inter-related reasons. First, in India, unlike in the New World, the military costs of taking land from natives were likely to have been prohibitive. As a consequence, the British, like the Mughals before them, focused their energies on extracting land rents from peasant farmers. Second, the focus on land taxes aligned the economic incentives of the British administrators with those of cultivators. A majority of the British administrators believed that private property rights in India would unleash economic development and raise tax revenue for the British government.[3]

Even though the British administrators were unified in their belief that private property rights would increase agricultural productivity, they adopted two very different strategies for assigning property rights and taxes. In some areas (Bengal, Bihar, Orissa, Central Provinces, and some parts of Madras Presidency), property rights to land and taxes were assigned to a few landlords or zamindars who, in turn, set and collected taxes from cultivators or ryotwars. In others (most of Madras, Bombay Presidencies, and Assam), however, property rights to land and taxes were assigned directly to cultivators. Because land ownership was concentrated in the hands of few elites in landlord as compared to non-landlord areas, the landlord elites in these areas had significant interest in structuring the political institutions for their own benefit.[4]

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3 Warren Hastings worked out the first unified British policy in India based on tax-farming. The system auctioned off estates and farmed them out to the highest bidders for short-term leases not extending beyond five years. Most subsequent administrators believed that tax-farming was a failure. They believed that tax-farming led to poor incentives for development because its lack of permanence subverted property rights (Guha (1963, p.8)). The Permanent Settlement of Bengal in 1793, which replaced the tax-farming system, was designed to establish property rights. While administrators held different views on how to govern India, "the greatest common measure of their agreement" was on the importance of private property rights (see Guha (1963), Stokes (1959), Stein (1989)).
4 For example, Cohn (1961) argues that, in the landlord region of Banaras, the eastern end of today's Uttar Pradesh, the British legal system was used by the elites to acquire valuable lands. Elites identified valuable land and then

In this paper, we examine the long-run impact of the two differing assignments of property rights and land taxes in India between 1901 and 1991.[5] We build on the important work of Banerjee and Iyer (2005) who estimate the impact of landlord and non-landlord systems of land tenures on agricultural productivity in post-independence India between 1958 and 1991.[6] We believe that an examination of the period in which these land revenue systems were in effect during the pre-independence period are likely to shed important insights on the impact of these institutions on the Indian economy.

There are several potential causes of divergence in the economies between landlord and non-landlord districts during the pre- and post-independence periods. First, the colonial government was more likely to invest in irrigation and railroads in non-landlord areas where land

made sure that owners of these lands did not pay revenue. Failure of payment led to forced auctions where the land was subsequently purchased by elites. Cohn (1961, 622): "Under the regulations of 1793, it was assumed that by stabilizing landed relations, providing security of property, making peoples' rights explicit through the publication of the laws, and providing an impartial judge making decisions on the basis of evidence and arguments in open court, the happiness and security of the Indian population would be secured. In fact this did not occur. Charles Metcalf in 1815 expressed a view which was held by many English: 'Our Courts of Justice are generally spoken [of] with disgust, with ridicule, or with fear... They [the Indians] abuse the latter [the courts] as scenes of injustice and corruption where nothing is obtained but by bribery." Nakazato (1994) reaches a similar conclusion for Bengal.

5 What type of property rights system emerged in India? Because of differing local political and cultural conditions, the nature of property rights in India varied greatly. Banerjee and Iyer (2005) write that a landlord's property right was one of revenue-collecting rights, which could be bought and sold, rather than proprietary rights. However, this view seems to be based on southern India where property rights of zamindars were least secure (Kumar (1965)). Baker (1976) writes that in Madras a bizarre court judgment in 1870, followed by the Land Act of 1908, changed the legal relationship between landlords and tenants where tenants' rights were restored to "status quo ante" – giving the tenant the right of land ownership and leaving only the right of revenue collection to landlords. Because the landlords could not effectively use the courts to collect rents from tenants, Baker argues that they resorted to other means such as control of credit, water, and marketing to gain leverage over tenants. Scholars of southern India such as Baker (1984) and Frykenberg (1965) generally emphasize the limitations of British power and authority. However, in northern India, many scholars believe that the landlords were able to attain proprietary rights to land. "Owing to the tightening alliance between the British and zamindars during and after the Indian Mutiny, even the Courts had begun to decree that the land itself had also belonged to Zamindars and peasants were only tenants-at-will. (Ranga and Saraswathi (1979, p.50))" Even in some areas of Madras, Reddy (1989, p.275) argues that "jagirdars, zamindars and desmukhs" were able to exploit the courts to turn cultivators to tenants-at-will. Nakazato (1994) provides a detailed examination of the operation of land markets in Bengal. He demonstrates that landlords were able to use their political power in concert with the British to acquire proprietary rights in land and establish a landlord-sharecropping system between 1870 and 1910. Similar views are held by Chatterjee (1984), Chaudhari (1984) and Shukla (1993). The emergence of a land market in India where property was bought and sold in high volume is *prima facie* evidence of a radical change in the conception of property rights in India (see Baker (1976), Chaudhari (1975), and Neale (1962)).

6 There was a bewildering array of land tenure arrangements in India, but scholars generally recognize three major land tenure systems: landlord (zamindari or malguzari), individual cultivator (ryotwari) and village (mahalwari). The non-landlord system is composed of the latter two categories. See Baden-Powell (1892) and Roy (2000).

taxes could be adjusted rather than in landlord areas where tax rates were set permanently.[7]

Second, landlord areas faced greater agency problems in agriculture. In the landlord areas, a

great majority of farms were worked by sharecroppers whereas in the non-landlord areas, it was

farmed by owners and renters.[8] Third, in the landlord districts, tenancy reforms increased the

level of uncertainty of property rights.[9] Finally, local district spending in public goods such as

education or roads may differ between landlord and non-landlord areas. The varying levels of

expenditures may reflect differences in the preferences of local elites or differences in the ability

of local governments to solve collective action problems.[10]

      We estimate the impact of land revenue systems on economic performance by adopting

the empirical approach used in Banerjee and Iyer (2005). We regress measures of economic

performance on geographic control variables, length of British rule, and whether a district was

historically organized as a landlord or a non-landlord district. Whereas Banerjee and Iyer focus

on agricultural productivity and investments, we broaden the investigation to other measures of

development such as urbanization, employment in manufacturing and services, and population

density for the pre- and post-independence periods.[11]

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7 See Whitcombe (1983), Boyce (1987), Hurd (1983), Banerjee and Iyer (2005) and others.

8 Banerjee et. al (2002) provide a useful model of agricultural tenancy in India. While the model is used to investigate tenancy reforms in the post-independence period, we believe that the model applies to the pre-independence period as well. In the base model where tenants cannot be evicted, the first best solution is a rental contract. If the wealth of tenants is too low for a rental contract, then the tenant's effort level is less than first-best and is a positive function of the tenant's outside options. The authors show that agency costs typically lead to less than first-best level of effort from tenants as well as investments from landlord and tenants. If model allows the landlords to evict tenants, then the effort level of tenants is inversely correlated with landlords' bargaining power over tenants. Landlords can use the power of eviction threats to elicit more effort from poor tenants. In this model, tenancy reform lowers the effort level of tenants but increases the share received by tenants. Besley and Burgess (2000) present a different model of tenancy which has essentially the same predictions as those of Banerjee et. al (2002). Also see Bardhan (1984).

9 See Chatterjee (1984), Appu (1975), Besley and Burgess (2000), and Frankel and Rao (1989, 1990).

10 In the colonial period, Chaudhary (2005) finds that local district boards who determined local public expenditures were often controlled by high caste Brahmans. In the post-independence period, Banerjee and Iyer (2005) argue that local public developmental expenditures were determined by the ability of local governments to solve collective action problems.

11 Acemoglu et al. (2001, 2003) argue that urbanization and population densities, to a lesser extent, are useful measures of economic development.

We prefer the ordinary least square (OLS) estimates over those of instrumental variables (IV) based on Banerjee and Iyer's (2005) instrument for a variety of reasons.[12] First, we are able to establish the direction of the omitted variable bias because the landlord districts were likely to have been more productive than non-landlord districts at the time of British annexation.[13] Since our results generally show that non-landlord districts performed better than landlord districts, our OLS estimates are likely to be biased downwards. Second, there is little potential for simultaneity bias or reverse causality. The introduction of a private property rights system enforced by a strong secular state by the British was exogenous.[14] Third, measurement error is likely to involve our dependent rather than our independent variables.[15] Fourth, Banerjee and

12 For the independent variable which measures the impact of land tenures, Banerjee and Iyer's (2005) construct a measure of non-landlord control based on data on the proportion of villages, estates, or land area not under landlord control from the 1870s and 1880s. Banerjee and Iyer (2005) argue that the OLS estimates of this non-landlord variable are unlikely to be systematically biased upwards for a variety of reasons. Nevertheless, they also formulate an instrumental variables strategy. Their instrument is a dummy variable which takes a value of one if the area came under British rule between 1820 and 1856 and zero otherwise. This IV strategy is based on the belief that all districts annexed after 1820 were predominantly designated as non-landlord areas due to Munro's political victory over the Board of Revenue in Madras.

13 Most scholars such as Stokes (1978), Ludden (1984), and Boserup (1965) believe that landlord classes arose in the more fertile regions. In the fertile, densely populated, rain-fed, rice-based areas such as in Bengal, they believe that the conditions were conducive for the emergence of a landlord class whereas in the sparsely populated, drier, millet-based areas such as Madras, agriculture was not sufficiently productive for such a class to arise. While agricultural data on early nineteenth century India are sparse, Banerjee and Iyer (2005) find some evidence that landlord areas were more productive than non-landlord areas during the period of early British rule.

14 The British did not simply adopt the Mughal institutions as described in Habib (1999) and Saran (1973). First, the British possessed superior military strength than those of previous rulers. Frankel (1989, 1) writes that, unlike the British, "Neither the Moslem and Mughal imperia nor the great Hindu empires of ancient and medieval India exercised centralized bureaucratic control through ownership of land and revenue extraction, or wielded a monopoly of force within the territory defined as their dominion." Second, the British were either ignorant of local institutions or could not help but alter the existing property rights institutions. The case of Punjab is illustrative. Under the Mughals, Punjab, a non-landlord province under British rule, was locally ruled by zamindars but its political landscape was altered significantly by the rise of the Sikhs in the last half of the eighteenth century. Even though the British policy under James Thomason, architect of the Ceded and Northwest Provinces, was conservative, Kessinger (1974, p.77-8) argues that "the goal of conserving rural society as the revenue officials found it proved difficult to attain because revenue officials were continually confronted by complexities which forced them to make series of decisions that resulted in innovation and change." One of these innovations was to make the *bhaiachara* (the proprietary group in villages where all landowners are descended from a common ancestor and are treated as a corporate group by the government) collectively responsible for the collection and payment of revenue was new. Even in the British non-landlord areas such as Punjab, by establishing proprietary rights in land, the British fundamentally altered older social relationships based on traditional notions of property.

15 Banerjee and Iyer (2005) address the issue of measurement error in their non-landlord variable which we use in our paper. They argue that this measurement error is likely to bias the OLS estimates downwards but the IV estimates upwards.

Iyer's IV estimates may ignore useful information. The main difference between the OLS and IV estimates stems from the classification of non-landlord districts which were annexed prior to 1820. Because non-landlord districts annexed prior to 1820 are treated as if they are landlord districts in the IV specification, we believe that the IV estimates lose relevant variations in the data. Finally, we test for the robustness of our results by restricting our sample to a subset of neighboring districts which share borders and by clustering our standard errors by provinces and by districts.

Banerjee and Iyer (2005) find that the divergence in economic performance between non-landlord and landlord regions began after 1965 with the advent of the Green Revolution. After 1965, the government of India increased its efforts to disseminate new high-yielding varieties of crops and to build public infrastructure in rural areas. The authors believe, however, that landlord areas failed to take advantage of these new opportunities as class-based antagonism in these areas, created by the historical inequity in the distribution of land, increased the collective action costs for the provision of local public goods investments in health, education and agricultural technologies.

In this paper, we find that relative agricultural productivities of landlord and non-landlord districts varied over time. In 1901, there were no discernible differences in productivity between landlord and non-landlord areas, but in 1931 there is evidence of higher productivity in non-landlord districts.[16] In the post-independence period, agricultural productivities of these regions seem to have converged in the period 1958-1961, but then diverged again after 1961 as non-landlord regions became much more productive than landlord areas and the degree of divergence widened even more after 1965 with the implementation of the Green Revolution.

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16 There is extensive debate on the quality of agricultural data from the British colonial period. We address this issue in the data section and in the appendix.

For other proxy measures of productivity or development, however, we find that non-landlord and landlord regions diverged during the British colonial period and continued to diverge after independence. Because data on acreage are likely to be much more reliable than those on yields for the colonial period, we examine the distribution of acreage between non-food and food crops. In the pre-independence period, Blyn (1966) finds that non-food crops were 2 to 3 times more productive than food crops and that these differences widened over time in most British provinces. We find that non-landlord areas were significantly more specialized in non-food crops and that these patterns continued through the post-independence period. We believe that our finding lends credence to the idea that non-landlord areas were more responsive to market opportunities and were more likely to shift into the more productive non-food crops.

We also find that non-landlord districts were more urbanized for every decade between 1901 and 1941 and that they continued to be more urbanized through the post-independence period. In the pre-independence period, the lack of industrial data precludes us to examine the causes of urbanization, but we find clear evidence in the post-independence period that non-landlord districts were more urbanized because they were centers of manufacturing and service employment. Finally, despite the fact that non-landlord districts seem to have diverged from landlord districts, we find that population densities of non-landlord and landlord districts were no different after controlling for other factors.

While it is extremely difficult to establish the causes of divergence in the economic performances between landlord and non-landlord districts, we believe that the divergence was caused by differing institutional developments in these two regions. In the pre-independence period, agricultural investments and productivity in landlord areas were more likely to suffer from agency costs and greater uncertainty in property rights. The ability of landlords to extract

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effort and rents from tenants was likely to be functions of land tenancy reforms. When landlords

possessed considerable power, they were likely to extract a significant level of effort from

tenants through threats of eviction or extra-legal coercion and maintain high levels of

productivity. However, when tenancy reforms reduced the landlord's bargaining power,

agricultural productivity likely fell as the effort levels of tenants declined.

Because the bargaining power of landlord elites increased when the economic

alternatives of their tenants were more limited, landlords had incentives to limit the economic

and geographic mobility of tenants and laborers. Landed elites who controlled district boards

were less likely to promote spending on public education. They were also less likely to promote

infrastructural investments for urbanization. Even in the post-independence period, while other

factors such as collective action costs may have become important over time, we believe that

agency costs and property rights uncertainty continued to depress investments and productivity

in the historically landlord areas.

II. Data and Empirical Strategy

We use district level data from 9 provinces of British India.[17] Data at the district level are

constructed for the period between 1901 to 1991 using various *decadal censuses*, *District*

Gazetteers, National Sample Survey, *World Bank data*, and other census reports. The

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17 A district in India is an administrative unit below the state level. These districts are also a part of present-day
India with minor changes in district boundaries for some of them. Present day and older district boundaries have
been matched to account for these changes. The Provinces of India were those portions of India that were ruled
directly by officials of the British East India Company until the middle of the 19th century and were under the direct
control of the British crown from 1858 until Indian Independence in 1947. During the years 1947-1950, Independent
India was divided into 19 provinces and hundreds of princely states, which were replaced with states and union
territories in 1950 when the Indian Constitution came into effect. We have included districts from 9 provinces. The
included provinces are Madras, Bombay, Ajmer, North-West Province, Panjab, Central Provinces, Berar, Oudh, and
Bengal. Most of the excluded provinces are now a part of Pakistan, Burma, Bangladesh, and Yemen and thus no
longer belong to the Indian territory and for few others, there is major lack in availability of data. We have also
included a few of the princely states in our data sample for some of the regressions. Since some districts of British
India became parts of Pakistan and Bangladesh, data on these districts are omitted for the post-independence India.

Agricultural Statistics of India and various provinces' *Season & Crops Reports* for different years were the major source of pre-independence period agriculture-related data. The India Database Project by Vanneman, Reeve and Barnes (2000) proved an important source of post-independence period census data. Some of the geographic control variables and post-independence period agricultural data are taken from the India Agriculture and Climate Data Set (compiled by the World Bank using official government publications) and the Maps of India website.[18]

Following Banerjee and Iyer (2005), we estimate the regression of the form:

(1) $Y_i = a + b\ NL_i + c\ BR_i + d\ X_i + \varepsilon_i$

where Y_i is the dependent variable in district i and the independent variables are - NL_i, the share of the land under a non-landlord land revenue system, BR_i, the length of British rule in district i, and, X_i, the geographic control variables. Since district level measures of output or income are unavailable, we use agricultural productivity, urbanization, shares of workforce in manufacturing and services, and population density as dependent variables. NL_i and BR_i are Banerjee and Iyer's (2005) 'proportion of non-landlords' variable and the 'length of British control' variable.[19] Geographic controls include altitude, latitude, rainfall, and various soil types (alluvial, black, and red) and whether a district was located on a coast. Although rainfall and soil conditions fluctuate with time, we assume that these geographic characteristics remained constant over time. Soil data are based on a visual inspection of maps from Raychaudhuri et. al. (1963); rainfall data are based on a 30-year norm between 1930 and 1961.

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18 The Indian district database combines district-level data from census and agricultural sources between 1961 and 1991 and also adjusts the district boundaries to create comparable units across the three decades.
19 For areas where information was available, Banerjee and Iyer (2005) define the 'proportion of non-landlord' as the proportion of villages or estates or land area which was not under the revenue liability of landlords. For all other areas, they assign the non-landlord measure as either zero or one depending on the dominant form of land revenue system.

We present descriptive statistics of our data in Tables 1-3.[20] Table 1 indicates that landlord districts accounted for about 57% of total cultivated land area. Table 2 shows that India is a vast country with considerable variations in geographic characteristics in latitude, altitude, rainfall and soil conditions. In general, superior agricultural conditions exist in locations with lower altitudes, higher latitudes, greater rainfall, and soil in the form of alluvial and red soil rather than black soil. The data suggest that landlord districts possessed better geographic conditions for agriculture than non-landlord districts.

Despite the fact that non-landlord districts possessed inferior geographic conditions than landlord districts, summary statistics of our dependent variables in Table 3 reveal that the non-landlord districts had higher agricultural productivity and higher shares of land allocated to the cultivation of non-food crops. Non-landlord districts were also more urbanized throughout and had greater shares of employment in manufacturing and services in the post-independence period. Population density, however, was higher in landlord districts for both the pre- and post-independence periods.

III. Empirical Results

In this section, we present a series of empirical evidence. First, we report in Tables 4-11 the OLS and IV estimates for agricultural productivity, food grain productivity, non-food grain acreage share, urbanization, employment shares in manufacturing and services, and population densities for various years. Durban-Wu-Hauseman test could not reject the hypothesis that our OLS estimates are consistent.[21] Due to the potential presence of heteroskedasticity, we use t-

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20 For Tables 2 and 3, we define landlord districts as those districts with a greater proportion (> 0.5) of the area under landlordism. In our sample, this classification led to about 50% of districts falling under the category of landlord districts.
21 See Davidson and MacKinnon (1993).

statistics based on Hubert/White standard errors. Second, we report in Tables 12-13 panel

regressions where standard errors are clustered by district and by province. Finally, in Table 14,

we report panel regression for a sub-sample of districts which share borders.[22]

A. Agricultural Productivity: Yield per Acre

Although comprehensive agricultural data exist for the British colonial period, there has

been considerable debate on their quality. Scholars generally believe that data on acreage are

likely to be more reliable than that on output; they also believe that the quality of data is superior

in non-landlord than in landlord areas, especially where tax rates were set on a permanent

basis.[23] Unfortunately, it is extremely difficult, if not impossible, to assess whether the colonial

data are flawed and to what extent they are flawed. Guha's (1992) introduction provides an

excellent summary of the debate.[24]

Blyn's (1969) construction of the agricultural trends for the period 1891-1941 remains

the most important work to date. Blyn finds that agricultural productivity in British India

declined modestly between 1891 and 1941, but on closer examination, the data reveal that the

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22 For a list of neighboring districts, see Table 5 of Banerjee and Iyer's (2005) web appendix. Due to data availability, our sample consists of 32 out of 35 districts in Banerjee and Iyer's sample.

23 In non-landlord areas, acreage data were collected by field-to-field inspections of villages by a trained village revenue officer (patwari). By contrast, in permanently settled landlord areas, the returns were made by a village policeman (chowkidar) who is thought to have been ill-equipped and untrained for field-to-field inspection. From the acreage data, agricultural output was calculated using information on standard yield and seasonal factor. Standard yield was obtained from crop-cutting experiments to be updated every five years; seasonal factors were provided by village revenue officers or policemen but were subject to revision by district and provincial officials. Incentives for under-reporting yields and acreage were likely to have been higher in non-landlord rather than in landlord areas, especially in places where tax rates were set on a permanent basis.

24 Heston (1973, 1979) questions the reliability of Blyn's (1966) estimates based on his work in Bombay. In that province, official standard yield estimates remained constant between 1897 and 1947 so that the only variation in overall yield came from changes in its seasonal factor. Heston argues that the decline in Bombay's seasonal factor over time is not correlated with that region's rainfall trends. On the other hand, Desai (1953), Mishra (1983), Dasgupta (1981), and Sivasubramonian (2000) generally find evidence in favor of Blyn's estimates. McAlpin (1983), based on her extensive research on Bombay Presidency, believes that agricultural statistics in this province are generally of high quality. Yanagisawa (1996) finds that yields reported in *Season and Crop Reports* for Tamil districts accord well with yield estimates derived from various crop-cutting experiments. Islam (1978) finds official yields reported in Bengal differed modestly from the plot-to-plot enumeration and survey estimates conducted in 1944/45. Unlike our study, however, none of these studies examines whether agricultural productivity at the district level correlates well with climate and geographic attributes.

overall decline is caused by a sharp decline in the productivity of food crops and that the productivity of non-food crops actually rose over this period. Yet, data indicate only a minor substitution in acreage from food to non-food crops. At the provincial level, Blyn finds that agricultural productivity declined in Greater Bengal, rose in places like Punjab, and remained constant in most other provinces.

We use the official statistics to construct similar data on agricultural productivity but at the district rather than at the provincial level for 1901 and 1931.[25] Because data reported at the district level are less systematic and comprehensive than at the provincial level, our district level productivity estimates are likely to be less accurate than Blyn's provincial estimates. District acreage data are most comprehensive; yield data on non-food crops are least comprehensive due to numerous missing data. In general, when we aggregate our district level productivity and acreage estimates to the provincial level, our estimates compare reasonably well with those of Blyn (see Appendix I).

Regression estimates for total agricultural productivity presented in Tables 4 and 5 indicate that productivity between non-landlord and landlord districts was similar in 1901 but may have diverged in 1931. In 1931, agricultural productivity was 22% higher in non-landlord districts.[26] In the post-independence period, there is considerable evidence that agricultural productivity between non-landlord and landlord districts converged again in the period between 1958 and 1961. The annual regressions reported in Table 5 indicate that agricultural productivity

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25 We construct data on agricultural productivity (yield per acre) using the following crops. For food grains, crops include rice, wheat, barley, jowar (sorghum), bajra (pearl millet), maize, ragi (finger millet), gram (chickpea), and other food grains including pulses; for non-food grains, they include linseed, sesamum, rape, mustard, groundnut, sugarcane, tea, coffee, tobacco, cotton, and jute. For the pre-independence period, we use 1924/25-1928/29 crop prices from Blyn (1966) to obtain the value of aggregate agricultural output; for the post-independence period, we use contemporaneous prices. See Appendix I for more detail.
26 Blyn (1966) discusses of the various determinants colonial agricultural productivity such as the composition of crops, water supply - irrigation and rainfall, double cropping, soil conditions, technology - improved seeds, education, implements, and labor.

in non-landlord districts began to diverge between 1961 and 1965 and that their divergence

seems to have accelerated after 1965 with the advent of the Green Revolution. In 1961, non-

landlord districts had 13% higher agricultural productivity whereas, in 1981, the figure rose to

26%. Table 6 shows that similar results are obtained when we examine productivity of food

grains.

Table 7 reports the regression estimates on the share of acreage devoted to non-food

grain crops. In the pre-independence period, we find that non-landlord areas had about 33%

higher proportion of their area cultivated under non-food grains in 1901-02 and that this

difference increased to 57% in 1931-32.[27] Thus, there seems to be considerable evidence that

non-landlord areas were responding faster to the commercialization of agriculture and shifting

their production toward non-food cash crops which were generally more productive.[28] In the

post-independence period, however, the differences in acreage devoted to non-food grain

between landlord and non-landlord districts seem to have narrowed over time.

Geography was very important for agricultural productivity in both the pre- and post-

independence periods. We find that districts with alluvial or red soils were more productive than

those with black soil; districts with higher rainfall were also more productive in food crops,

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27 Blyn (1966, p.180-181) addresses the impact of crop composition on overall productivity: "Since nonfoodgrain yield per acre is generally higher in value than that of food-grains, a progressive increase in the proportion of cropland in nonfoodgrains would tend to raise all-crop yield per acre."

28 Due to differing geographic conditions, the share of non-food crops grown in non-landlord and landlord regions may differ. If the composition of crops differs, then the variations in acreage devoted to non-food grain may be accounted for by differences in the prices of these crops. We believe that the price variations are unlikely to explain the concentration of food crops in landlord areas. Islam (1978) finds that in Bengal, where most districts were landlord based, the price elasticity of acreage under cultivation was extremely low. A more interesting case study is presented by Baker's (1984) study of Tamilnad. In this region, the valleys were controlled by mirasidars whereas the plains were inhabited by both landlords (zamindars) and non-landlords (ryotwars). The expansion in acreage towards non-food cash crops was most extensive in the plains whereas the valleys continued to concentrate their cultivation in paddy rice. These trends persisted even when the price of rice fell and prices of non-food crops increased. Baker argues that the zamindars lost considerable power over their tenants with the shift in cultivation into cash crops as transactions moved from zamindar's estate office to cash-crop markets. Baker (1984, p. 219) writes: "Those large landholders who were excessively distanced from cultivation were unable to profit; 'estate mirasidars' in the valleys and zamindars in the plains actively resented the growth of commercial cropping because it loosened their remaining grip on their prospering subordinates and on the products of agriculture."

especially in the pre-independence period. Latitude and altitude were negatively correlated, but statistically insignificant. Districts located near the coast were more productive perhaps because higher moisture levels in coastal districts facilitate the breakdown of organic soil matter into minerals that support plant growth.

Geographic factors also influenced the distribution of acreage between food and non-food crops. The share of non-grain acreage was higher in districts with lower rainfall and higher altitude throughout; it was also higher in districts with great black and red soils in the pre-independence period. Food grains rather than non-food grains are grown in high rainfall areas and non-food crops such as tea are grown in higher altitude locations. Moreover, important non-food crops like cotton are intensive in black soil.

B. Urbanization

The definition of an urban area changed markedly between the pre- and the post-independence periods.[29] But, unlike the agricultural data, there seems to be little controversy concerning the quality of the urban data. In the pre-independence period, urbanization levels were low but rose slightly over time; in the post-independence period, urbanization rates rose more significantly. In 1901 and 1941, the shares of urban population in India were 9.4% and

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29 In the pre-independence period between 1901-1951, an urban area was defined as a town if it met one of the following criteria: (1) every municipality regardless of size, (2) a civil line not within municipal limits, (3) places 5,000 persons or more which the Provincial Superintendent decides to treat as a town, or (4) places under 5,000 persons which the Provincial Superintendent decides to treat as a town. However, Davis (1951) argues that towns with population less than 5,000 accounted for no more than 4-7% of the total urban population. In post-independence India, the definition of an urban area changed from decade to decade making comparisons of aggregate urban levels over time very difficult. However the new definition was more uniformly applied across the Indian provinces and conformed more closely to the definition of an urban area. In general, an area was considered a town if it met the following conditions: (1) a density of not less than 1000 per square mile, (2) population of at least 5000, (3) three-fourths of the occupations of the working population should be outside of agriculture, and (4) at the discretion of the Superintendent of the State, the place should have a few pronounced urban characteristics and amenities such as newly founded industrial areas, large housing settlements, or places of tourist importance, and other civic amenities. See Bose (1973).

12.8% respectively; 1961 and 1991, using the revised urban definition, they were 14.0 and

22.1%, respectively.[30]

We find that non-landlord districts were significantly more urbanized between 1901 and

1941 (Table 8). In 1921, non-landlord districts were 47% more urbanized than landlord districts;

in 1941, the figure was 40%. Despite the major changes in the definition of an urban area

between the two periods, the regression estimates for the post-independence period are very

similar to those of the pre-independence period. The OLS estimates indicate that the non-

landlord districts have a 28% higher proportion of urban population in 1961 and 1981 and about

24% higher in 1991. We also find that districts with higher rainfall were less likely to be urban

whereas districts with alluvial soil were more likely to be urban.[31] Districts in coastal locations

were not significantly more urban since, despite possessing extensive miles of sea coasts, India is

not endowed with good natural harbors.[32]

The regression results presented in Tables 9 and 10 suggest that, at least for the post-

independence period, non-landlord areas were more urbanized than landlord areas because they

have higher shares of employment in manufacturing and services than landlord districts. In

manufacturing employment, non-landlord districts had 57%, 45%, and 50% in 1961, 1971, and

1981 respectively, but the figure dropped to 9% in 1991. Also, non-landlord regions had 22-27%

higher share of service employment than landlord districts for the period between 1961-1991.

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30 For all of India, urbanization rates for 1901, 1941, 1961, and 1991 were 10.8, 13.8, 18.0, and 25.7%, respectively (www.censusindia.net). In Tamilnad, Baker (1984) believes that urban data became more reliable after 1901. He finds four different patterns of urban development during the colonial period: in 1871-1891, the most important factor for town development was the government; in 1891-1911, they were cash-cropping and marketing; in 1911-1931, commercial cropping; and in 1931-1951, industrial growth.

31 The potential negative influence of rain on urbanization was mentioned in the 1931 census report (see Bose (1973, p.52)).

32 Davis (1951, 12) writes: "These coasts, lying mostly in the torrid zone, are practically devoid of natural harbors. For much of their distance they are blocked by coastal islands and mangrove swamps. 'The whole is storm-swept and scourged by fierce currents; there are hundreds of miles of bare rock-wall in the western half and of mangrove-swamp in the eastern; the river harbours are amongst the most dangerous and expensive in the world..."

C. Population Density

For both the pre- and post-independence periods, the data exhibit little systematic relationship between population density and land tenures (Table 11). Even though non-landlord districts exhibited stronger economic outcomes, especially in the post-independence period, population density was no greater for non-landlord districts for the entire period between 1901 and 1991. On the other hand, the data indicate that geographic factors were very important determinants of population density. Population density was higher in districts with lower altitudes, higher latitudes, alluvial and black soil. However, rainfall and coastal locations were not correlated with population density.[33]

D. Length of British Rule

The length of the British rule is negatively correlated with all our dependent variables indicating that the longevity of British rule in a district had a negative impact on its economic performance. While the coefficient on the length of British rule is statistically insignificant in many specifications, it is significant for population density, employment shares in services, agricultural productivity and food grain productivity. Since institutional stability is likely to be correlated with longevity of rule, this negative correlation suggests that British institutions did not have their intended effects. Indeed, agricultural productivity and industrial development remained stagnant during the British colonial period (Blyn (1966), Gadgil (1972), Roy (2000)). Despite the introduction of private property rights and a formal judicial system in India, differences in the race and culture of government officials and their subjects may have created poor incentives for the implementation of policies favorable for long-run development.[34]

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33 It is interesting to note that many scholars such as Blyn (1966, p.134) attribute the geographic variation in population density to variations in rainfall. Surprisingly, at least by the twentieth century, we find little evidence that higher rainfall contributed to higher population density in India.
34 Iyer (2004) finds that the "native states" which were under the administration of Indian rulers during the British

E. OLS Versus IV Estimates

In a majority of cases, the OLS and IV estimates generally give similar results. In a number of instances, however, the two estimates differ. The differences are most notable for pre-independence regressions of agricultural productivity, food-grain productivity, and urbanization. Why do these estimates differ? We investigate the causes of these differences by comparing the non-landlord variable with Banerjee and Iyer's instrument. In our sample, as seen in Appendix II, there are 49 non-landlord districts that are assigned as landlord in the IV specification because these districts were annexed prior to 1820; there is one landlord district that is assigned as non-landlord because it was annexed after 1820.

Are the non-landlord districts annexed prior to 1820 a likely source of endogeneity bias? We do not believe so. What is striking is that most of these districts are from Madras and Bombay. In Madras, we believe that the non-landlord system developed by Read in 1792 and extended by Munro was not indigenous. Under the native Tipu Sultan, the land revenue system was based on tax-farming. Tipu Sultan leased extensive tracts of land to amildars who employed patels or headman to collect revenue preferably in shares (half of the produce). Mukherjee (1962) believes that Read invented the ryotwari system to eliminate the abuses of amildars and patels. Tax-farming based on share-cropping was likely to have been highly inefficient and Read and Munro probably realized that direct assessment of taxes on cultivators would improve both

colonial period had significantly higher investments in public goods such as schools, roads, and health centers than those annexed by the British in the post-independence period. She attributes these differences to the differences in the incentives faced by British administrators and native rulers. British colonial public investments in India were very low as well. Davis and Huttenback (1988, p. 101) write: "When all is said and done, [British] India spent on public works at a lower rate than the underdeveloped countries, and at a level similar to the Princely States. Moreover, unlike the other sectors, where expenditures rose over time, in India they peaked in the early 1880s and declined thereafter. As a percentage of the government's budget, the Indian average was one-quarter higher than the figure for the underdeveloped countries, but only two-thirds of the average of the Princely States. Inclusion of railroads raises the Indian levels substantially. The same adjustment, however, pushes the foreign underdeveloped indices upward as well, and India's relative position changes but little." See Clark and Wolcott (2003) and Wolcott and Clark (1999) for a different perspective on the causes of Indian under-development.

the incentives and conditions of cultivators. However, the development of the ryotwari system faced great resistance from other administrators. Read's territory was converted to a zamindari system when he was forced to resign and return to England; Munro's territory was re-organized under a village-lease system when he also returned to England. In the end, the decision to restore the ryotwari system in Madras came from the Court of Directors in England. The Directors, greatly impressed by Munro's opinion and knowledge, pressed local administrators to restore the ryotwari system over their objections between 1814 and 1827 (Mukherjee (1962)). In Bombay, Stokes (1959) and Kumar (1968) argue that the ryotwari system spread as a product of a change in official British ideology, but Charlesworth (1985) suggests that local conditions also played an important role.

F. Robustness

Table 12 presents OLS panel regressions with year fixed-effects and standard errors adjusted for within-district correlation. We find that the non-landlord coefficient is positively significant for every dependent variable except for population density. When we cluster the standard errors by province, however, the level of significance declines somewhat (Table 13). Finally, when we examine the restricted sample of districts which share borders, the non-landlord coefficient is no longer significant except for food grain productivity which is significant at the 13% level (Table 14). While the results of the restricted sample are troubling, we believe that the neighboring district sample is not randomly generated. Because tenants' bargaining power increases with greater outside options, tenants in landlord districts that border non-landlord districts are likely to have greater bargaining power. Thus, landlord districts that border non-landlord districts may exhibit less systematic variation in their economies.

IV. Conclusion

In this paper, we examine the impact of British colonial institutions on the economic development of pre- and post-independence India. In particular, we study the impact of two differing types of land tax revenue systems imposed in colonial India. In landlord areas, property rights in land and taxes were assigned to landlords who, in turn, set and collected taxes from cultivators; in non-landlord areas, the property rights and taxes were assigned directly to those who cultivated the land. Whereas Banerjee and Iyer (2005) examine the impact of what they call "institutional overhang" for the post-independence period, we investigate the impact of these institutions for the pre- and post-independence periods using a variety of measures of development.

Except for agricultural productivity and population density, we find that non-landlord areas seem to have outperformed landlord areas between 1901 and 1991. Non-landlord areas were more specialized in non-food crops which were likely to be more productive; non-landlord areas were also more urbanized than landlord areas. For the post-independence period for which the data are available, we find that non-landlord areas had greater shares of employment in manufacturing and services. In agricultural productivity, the patterns fluctuated over time. In 1901, agricultural productivities of these areas were similar, but diverged in 1931. There is evidence of convergence between 1958-1961, but of divergence after 1961, and as shown in Banerjee and Iyer (2005), the divergence became more pronounced after 1965 with the advent of the Green Revolution. On the other hand, after controlling for geographic characteristics, land tenure systems had little impact on population density.

Due to the limitations of data, it is extremely difficult to determine the causes of divergence between landlord and non-landlord districts. However, because the political and

economic conditions differed considerably between the pre- and post-independence periods, the examination of these two periods is likely to shed additional insights on the causes of divergence between these regions. In particular, Banerjee and Iyer's (2005) emphasis on the role of collective action costs and the importance of investments caused by the Green Revolution are unlikely to be important for the pre-independence period.

Among the potential causes of divergence outlined in our introduction, we believe that the most likely cause of divergence in the economies of landlord and non-landlord areas are likely to be related to agency costs and uncertainty in property rights. The fluctuations in agricultural productivities between landlord and non-landlord regions may, in part, be explained by the changing bargaining power of landlords and tenants. In the early years of the colonial period, when the British government typically intervened in favor of landlords, agricultural productivity of landlord areas may have been similar to non-landlord areas as landlords extracted significant levels of effort and rents from tenants through close monitoring, threat of eviction and extra-legal physical coercion.[35] As reforms were implemented to protect the rights of tenants, however, agency costs may have risen toward the latter period of British colonial rule leading to a relative decline in agricultural productivity in landlord areas.[36] Ironically, in the early years of the post-independence period, agricultural productivity of these regions may have converged as landlords re-acquired significant bargaining power over tenants in the new national government.[37] But as land reforms became more binding over time, the agricultural productivity

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[35] See Chatterjee (1984), Chaudhari (1984), Bose (1987), Shukla (1993), and Nakazato (1994). For differing views, see Ray (1979) and Panda (1996). Also see Stokes (1978) and Ludden (1984).

[36] Chaudhuri (1984) argues that rent reforms in Bengal, which restricted the ability of landlords to increase rents, contributed to lower levels of investments in the 1930s. Baker (1984) argues that landlords lost considerable bargaining power over their tenants during the first half of the twentieth century in Tamilnad. Yanagisawa (1996) also finds a gradual deterioration in the dominance of land ownership by members of higher castes in this region over time.

[37] Appu (1975) examines the post-independence tenancy legislations in detail. The First Plan of the Indian National Congress proposed ceiling limits on ownership by landlords with the idea that surplus land be given to tenants. The

of landlord districts may have fallen relative to non-landlord districts as the increased bargaining position of tenants led to their reduced efforts.[38]

We also believe that greater uncertainty in property rights in landlord areas contributed to lower levels of agricultural investments and were likely factors responsible for the concentration of their agriculture in food crops, especially in paddy rice. Since a switch from food to non-food crops involves significant new investments in technology and a change in the organization of production, landlords may have been less willing to take on such a venture when their property rights status was more uncertain. In addition, a switch from traditional paddy rice to non-food crops probably increased the monitoring costs of tenants.[39] While it is difficult to assess the importance of property rights uncertainty, peasant revolts and tenancy reforms are testaments to the perceived illegitimacy of landlord property rights. Because the proprietary rights given to landlords by the British colonial government differed markedly from tradition and history, these rights never attained full social legitimacy.

enactment of these reforms, however, was left to state discretion and was voluntary. Subsequent Second and Third Five Year Plans attempted to improve on the first plan, but these reforms were generally seen as failures. During this period, it appears that landlords had great discretion in their ability to evict tenants at will. Insecurity of property rights, however, probably contributed to the failure to invest in new crop varieties. Fourth Five Year Plan reports: "It has been observed that under the present arrangement of informal tenancy and share-cropping, the landlord considers it unwise to invest in improving his land; likewise, the share-cropper or the tenant is either unable or reluctant to invest in inputs like fertilisers. The insecurity of tenancy has not only impeded the widespread adoption of the high-yielding varieties but in some cases led to social and agrarian tensions (Appu (1975, p. 1347))." Also see Frankel and Rao (1989, 1990), Brass (1994), Brown (1994) and Frankel (2005).

38 Besley and Burgess (2000) find that tenancy reforms in post-independence India between 1958 and 1992 lowered poverty levels but did so at the expense of efficiency. They find that land reforms lowered agricultural productivity and they believe that this decline was likely caused by a fall in bargaining power of landlords over tenants due to tenancy reforms. Boyce (1987) argues that tenancy reforms also lowered landlord investments in irrigation. Because irrigation was an important complement to investments in new technology, he believes that tenancy reforms hindered the adoption of new agricultural technologies in the historically landlord areas. On the other hand, Banerjee et. al. (2002) find that tenancy reform implemented in West Bengal in the late 1970s were associated with an increase in rice yields between 1984 and 1993.

39 The valleys in Tamilnad, according to Baker (1984, 170-172), were concentrated in paddy rice and were controlled by landlords who used sharecropping or a system of tied labor (indenture) arrangements to cultivate the land. Baker argues that the optimal scale of paddy rice under flush irrigation was about 1-4 acres involving one plough-team consisting of two men and two buffaloes or cattle. Landlords carefully controlled and monitored the growing of crops and restricted the cultivation of crops which depleted the soil. Because paddy rice involved the inundation of fields, it was difficult to complement paddy rice with other crops, especially those requiring good drainage conditions.

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Economic development in landlord areas was likely to have been hindered as landlords had incentives to reduce the economic mobility of tenants and laborers in landlord regions. As shown in Banerjee et. al. (2002), a landlord's bargaining power over tenants increased as outside options of tenants declined. Given these incentives, it is not surprising that landlord regions were much less urbanized than non-landlord regions as cities often provided alternative forms of employment for tenants. Landlords also had little incentives to foster the geographic mobility of tenants and laborers as their immobility lowered their bargaining position. While reasons as to why geographic mobility remained extremely low in India are complex, our findings on population density indicate little geographic movement from poorly performing landlord districts to the more productive non-landlord districts.[40]

The British colonial institutions imposed in India have had a profound impact on its development. In landlord areas, where the British government gave proprietary rights to few landlords, political and legal institutions were used for the benefit of the few as compared to non-landlord areas where property rights were given to cultivators. These differences led to a significant divergence in their economies. Yet, the impact of British colonial institutions in India goes beyond the important issue of land tenures. Even in non-landlord areas, where property rights were granted to cultivators and were enforced by a formal judicial system, the record of economic progress remained bleak for centuries. Why the introduction of western institutions in India, which eventually led to the adoption of democratic institutions after its independence, did not contribute to economic development for such a long time remains a puzzle to be explored.[41]

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40 Collins (1999) finds little evidence of labor mobility in late nineteenth century India. Despite the fact that transportation improvements may have led to regional convergence in prices, Collins finds little evidence of corresponding regional wage convergence at the district level. Also see Munshi and Rosenzweig (2005).
41 It is beyond the scope of this paper to review the enormous literature on the impact of British colonialism on Indian economic development. We refer the reader to Roy (2000, 2002) for references and perspectives on this subject.

Appendix I: Pre-independence Agricultural Productivity and Acreage Estimates

We construct data on agricultural productivity and acreage at the district level for the pre-independence period (1901-1902, 1931-1932) using official published government documents: *Agricultural Statistics of India* and *Season & Crop Reports*.

We consider a major subset of crops produced in India. This subset currently occupies more than two thirds of the total output value from the crop sector and more than a half of the total output from agriculture. In terms of acreage, these crops account for almost 80-90% of total cultivation. As in Blyn (1966), the crops are divided into two categories: *food grains and non-food grains*. The food grain crops include rice wheat, barley, jowar (sorghum), bajra (pearl millet), maize, ragi (finger millet), gram (chickpea), other food grains including pulses; non-food grains include linseed, sesamum, rape and mustard, groundnut, sugarcane, tea, coffee, tobacco, cotton, and jute. For most of these crops, sufficient and continuous data are available for our period of study.

Prices in pounds per acre for various crops were derived from prices per ton figures from Blyn (1966). These prices are weighted averages of the provincial harvest prices during 1924/25-28/29 for different crops with weights proportional to the area under the crop in the individual provinces. Prices during this period were fairly stable and free from unusual influence of wars or foreign trade conditions. District level crop prices are difficult to construct due to numerous missing and unreported data.

A   Agricultural Productivity

Agricultural productivity (rupees per acre) is measured as total output in rupees divided by total cultivated area in acres. The calculation for a given district of aggregate agricultural productivity is based on the following formula: *Agricultural Productivity = Σ_j* (Yield in pounds per acre of crop j)*(Price in pounds per acre of crop j) * (Area sown under the crop j/ Total area sown in the district aggregated over all crops in the district).

Although yield information is available for most crops, we encountered many challenges in constructing district level agricultural productivity. We refer the reader to Blyn (1966) who faced similar challenges for the construction of output and productivity data at the provincial level. We outline some of the problems: (1) In aggregating the yield of irrigated and un-irrigated areas, the corresponding proportion of irrigated and un-irrigated acreage data for some of the crops were not reported. In these cases, we used the proportion of the total irrigated and un-irrigated sown area in the district as weights. (2) In aggregating the yield of broadcast and transplanted rice, the corresponding acreage shares under the two kinds of rice were not reported. We used a simple arithmetic average of the two kinds of rice yields to get an average yield of rice. (3) In aggregating the yield for crops classified as Bhadoi, Kharif and Rabi crops (autumn, winter and summer crops), we used the acreage share under each category from the *Season and Crop Report*; (4) For some of the crops such as tea, coffee, tobacco and groundnut, where many yield figures at the district level were missing, we used the respective national averages calculated by Sivasubramonian (1960); (5) In a small number of cases, the yield values were approximated using information from neighboring years and districts.

For 1931, we provide a comparison of our agricultural productivity estimates with those of Blyn. To make the comparison comparable, we aggregated our values from the district to the provincial level. It is important to note, however, that our province definition does not match completely with those of Blyn. For Bengal, Blyn's definition also includes present day Bangladesh; for Bombay, Blyn's definition includes Sind; for Punjab, Blyn includes Delhi and the Northwest Frontier province. For Madras, Central Province, and Bombay, our definition overlaps closely with those of Blyn's. In addition, there are a few differences in our coverage of crops from that of Blyn. Unlike Blyn, we include coffee and other food-grains but exclude indigo. Data are in rupees per acre.

Agricultural Productivity, 1931

Province	Our's	Blyn's
Bengal	73.1	64.5
Bombay	37.2	50.0
Central Provinces	32.2	32.8
Madras	66.2	65.3
Punjab	39.3	51.7
United Province	50.9	59.5

B.   *Agricultural Acreage*

Whereas agricultural productivity estimates are based on 18 major crops, data on acreage are based on all crops and are much more comprehensive and reliable. We compare our acreage data with those of Blyn in the table below. Data are in million acres.

Acreage, 1901	All Crops		Food Crops		Non-Food Crops	
Province	Our's	Blyn's	Our's	Blyn's	Our's	Blyn's
Bengal	41.1	49.0	34.6	41.9	6.5	7.1
Bombay	19.7	22.8	18.4	18.7	1.2	4.1
Central Provinces	20.0	19.0	15.0	13.6	5.0	5.4
Madras	28.2	26.1	23.3	22.5	4.9	3.6
Punjab	7.1	17.2	4.1	14.8	3.1	2.4
United Province	41.8	36.2	30.2	36.5	5.3	5.8

Acreage, 1931	All Crops		Food Crops		Non-Food Crops	
Province	Our's	Blyn's	Our's	Blyn's	Our's	Blyn's
Bengal	36.5	48.9	32.0	43.3	4.5	5.6
Bombay	29.1	26.5	19.9	20.4	9.2	6.1
Central Provinces	24.2	21.2	17.8	14.9	6.4	6.3
Madras	32.0	27.6	24.6	21.6	7.4	6.0
Punjab	10.5	26.9	7.6	22.7	2.9	4.2
United Province	42.0	38.7	37.2	31.2	4.9	7.5

Appendix II: Differences in Land Tenure Status Between the OLS and IV Specifications

A. List of non-landlord districts that are assigned as landlord by Banerjee and Iyer's instrument

Bombay Province
Ahmadabad, Ahmadnagar, Belgaum, Bijapur, Broach, Dharwar, Kaira, Kanara, Khandesh, Kolaba, Nasik, Pancha Mahals, Poona, Ratnagiri, Satara, Sholapur, Surat, Thana

Madras Province
Anantapur, Bellary, Chingleput, Coimbatore, Cuddapah, Godavari, Kistna, Nellore, Nilgiris, North Arcot, Pudukottai, Salem, South Arcot, South Kanara, Tanjore, Tinnevelly, Trichinopoly

Northwest Province
Agra, Azamgarh, Ballia, Basti, Farukhabad, Gorakhpur, Hamirpur, Kumaon, Mainpuri, Mathura, Muzaffarnagar, Saharanpur

Punjab Province
Hisar

B. List of landlord districts that are assigned as non-landlord by Banerjee and Iyer's instrument

Punjab Province
Firozpur

Note: For this table, a district was defined as a non-landlord district if more than half of the district came non-landlord organization. Banerjee and Iyer's (2005) instrument takes on a value of 1 (non-landlord) if the area came under British rule between 1820 and 1856 and zero (landlord) otherwise.

Table 1

Geographic Distribution of Land-Tenure Systems in Colonial India

Type of Tenure	Percentage	Province where it was prevalent
Landlord		
zamindari	57%	Bengal, Bihar & Orissa, parts of Madras and United Province
Non-landlord		
ryotwari	38%	Madras, Bombay & Assam, parts of Central Province
mahalwari	5%	Punjab, parts of Central Province and Orissa

Sources: Banerjee and Iyer (2005); Baden-Powell (1892).

Table 2

Summary Statistics of Geographic Variables: Mean values (standard deviation)

	All Districts	Landlord	Non-Landlord	Differences
Latitude	21.99 (5.9)	23.80	20.44	3.28*
Altitude	433.77 (522.3)	327.7	523.58	-161.37*
Rainfall (mm)	1225.35 (436.8)	1346.0	1123.1	191.42*
Coastal dummy	0.18 (0.39)	0.13	0.24	-0.17*
Black soil dummy	0.21 (0.41)	0.13	0.27	-0.16*
Alluvial soil dummy	0.57 (0.50)	0.58	0.56	0.05
Red soil dummy	0.17 (0.38)	0.24	0.12	0.08

Note: *Difference in means between landlord and non-landlord districts significant at 5% level. Latitude is degrees North; altitude is meters above sea level; rainfall is the 30 year average of mean annual rainfall between 1930 and 1961. For this table, a district is considered as landlord if the percentage of land tenures in the district organized as landlord was greater than 50%.

Table 3

Summary Statistics of Dependent Variables: Mean values

	1901	1911	1921	1931	1941	1961	1971	1981	1991
Agricultural Productivity									
All Districts	54.76	-	-	56.57	-	147.44	-	844.72	-
Landlord	51.97	-	-	54.35	-	146.97	-	831.48	-
Non-landlord	57.12	-	-	58.37	-	147.57	-	848.29	-
Difference	*-5.13*	*-*	*-*	*-4.02*	*-*	*-19.47*	*-*	*160.44**	*-*
Non-Food Acreage (%)									
All Districts	18.7	-	-	19.7	-	19.0	-	20.0	-
Landlord	15.0	-	-	14.0	-	14.0	-	15.0	-
Non-landlord	22.0	-	-	24.0	-	22.0	-	24.0	-
Difference	*-7.0**	*-*	*-*	*-10.5**	*-*	*-8.0 **	*-*	*9.0**	*-*
Urbanization (%)									
All Districts	9.7	11.5	11.2	13.6	14.0	16.0	17.4	20.3	22.1
Landlord	5.0	9.0	8.0	9.0	13.0	13.0	14.0	20.0	19.0
Non-landlord	13.3	14.0	13.8	14.0	17.0	19.0	17.0	23.0	25.0
Difference	*-8.0**	*-5.0**	*-5.8**	*-5.0**	*-4.0**	*-6.0**	*-6.0**	*-5.8**	*-6.0**
Manufacturing Empl. (%)									
All Districts	-	-	-	-	-	3.5	4.4	6.0	10.7
Landlord	-	-	-	-	-	3.0	3.0	4.0	9.0
Non-landlord	-	-	-	-	-	4.0	5.0	7.0	11.0
Difference	*-*	*-*	*-*	*-*	*-*	*-1.4**	*-2.3**	*-2.3**	*-2.3**
Services Empl. (%)									
All Districts	-	-	-	-	-	15.6	14.5	14.8	18.6
Landlord	-	-	-	-	-	15.0	13.0	13.0	17.0
Non-landlord	-	-	-	-	-	17.0	16.0	16.0	20.0
Difference	*-*	*-*	*-*	*-*	*-*	*-1.9*	*-2.7**	*-2.7**	*-3.4**
Population Density									
All Districts	402.7	351.8	343.5	385.4	441.3	569.1	693.1	858.0	1141.1
Landlord	407.2	404.0	387.2	409.9	491.4	627.8	765.6	950.7	1296.9
Non-landlord	395.3	304.1	302.5	357.3	394.3	507.5	617.0	760.7	968.3
Difference	*11.6**	*100.0 **	*84.7*	*52.6*	*97.1*	*120.2**	*148.5**	*189.0**	*328.6**

Note: *Difference in means between landlord and non-landlord districts significant at 5% level. Agricultural productivity is measured in rupees per acre. Population density is persons per square miles. The number of observations generally ranged from 124 to 141 districts, except for the 1901 urbanization data which contain only 32 observations.

Table 4

Agricultural Productivity, 1901-1981

	1901 (OLS)	1901 (IV)	1931 (OLS)	1931 (IV)	1961 (OLS)	1961 (IV)	1971 (OLS)	1971 (IV)	1981 (OLS)	1981 (IV)
Non-landlord	8.42	-10.82	12.81*	-7.92	12.14	50.54	69.50*	242.9*	223.2*	495.47
	(1.44)	(0.55)	(2.40)	(0.93)	(1.08)	(1.55)	(2.06)	(2.10)	(2.45)	(1.89)
Length of British Rule	-0.15	-0.12	-0.11	-0.06	-0.60*	-0.71*	-1.70*	-2.19*	-3.16*	-3.93*
	(1.78)	(1.57)	(1.69)	(0.89)	(2.86)	(2.68)	(2.80)	(2.82)	(2.12)	(2.33)
Altitude	-0.01	0.00	0.00	0.02	0.10*	0.07	0.04*	0.29	1.04*	0.84
	(0.76)	(0.05)	(0.03)	(0.82)	(2.45)	(1.36)	(3.16)	(1.65)	(2.96)	(1.96)
Latitude	2.38	1.89	-0.29	-0.90	-2.84	-1.71	-0.19	3.21	-3.85	4.15
	(1.27)	(1.22)	(0.31)	(0.78)	(1.65)	(0.90)	(0.46)	(0.62)	(0.40)	(0.36)
Coastal	38.06	10.27	-0.57	2.22	36.30	32.95	102.1	86.96	178.9	155.17
	(1.62)	(1.55)	(0.06)	(0.24)	(1.71)	(1.43)	(1.84)	(1.38)	(1.45)	(1.12)
Rainfall	-0.00	-0.01	0.01*	0.01*	0.04*	0.04*	0.05	0.08	0.06	0.11
	(0.24)	(0.40)	(3.20)	(2.22)	(2.08)	(2.25)	(1.36)	(1.73)	(0.76)	(1.11)
Black soil	25.23	26.68	-16.44	-15.44	-43.65*	-43.49*	-94.11*	-93.37	-258.59*	-257.43*
	(0.94)	(0.92)	(1.51)	(1.36)	(2.49)	(2.33)	(2.39)	(1.94)	(2.48)	(2.29)
Alluvial soil	11.48	14.59	1.86	4.96	13.06	7.56	35.01	10.16	104.21	65.20
	(0.96)	(0.98)	(0.33)	(0.93)	(0.74)	(0.43)	(0.91)	(0.26)	(1.13)	(0.69)
Red soil	27.23*	24.55*	8.58	6.27	50.90*	52.28*	111.46	117.67	281.08*	290.84*
	(2.52)	(2.65)	(1.14)	(0.84)	(2.40)	(2.45)	(1.98)	(1.97)	(2.26)	(2.26)
Constant	255.09	216.69	239.92	170.67	1199.9*	1357.4*	3216.8*	3927.9*	6093.2*	7209.9*
	(1.88)	(1.69)	(1.93)	(1.39)	(3.18)	(2.95)	(2.89)	(2.87)	(2.29)	(2.42)
Observations	115	115	118	118	105	105	105	105	105	105
R-squared	0.224	0.190	0.278	0.178	0.477	0.437	0.388	0.262	0.392	0.337

Note: * significant at 5%. Heteroskedasticity-robust t-statistics are in parentheses. Agricultural productivity is in rupees per acre. For 1901-1931, we use 1924-25 and 1928-1929 prices from Blyn (1966); for 1961-1981, we use contemporaneous prices.

Table 5

Annual Post-Independence Agricultural Productivity, 1958-1965

	1958 (OLS)	1958 (IV)	1959 (OLS)	1959 (IV)	1960 (OLS)	1960 (IV)	1961 (OLS)	1961 (IV)	1962 (OLS)	1962 (IV)
Non-landlord	4.30	32.69	11.04	62.19*	15.65	44.12	12.15	50.54	17.40	77.75*
	(0.45)	(1.17)	(1.05)	(2.26)	(1.28)	(1.34)	(1.08)	(1.55)	(1.38)	(2.11)
Observations	105	105	105	105	105	105	105	105	105	105
R-squared	0.393	0.356	0.488	0.393	0.401	0.378	0.477	0.437	0.438	0.347

	1963 (OLS)	1963 (IV)	1964 (OLS)	1964 (IV)	1965 (OLS)	1965 (IV)
Non-landlord	33.61	114.75*	33.98	31.11	49.63*	87.26
	(1.94)	(2.22)	(1.63)	(0.55)	(2.43)	(1.29)
Observations	105	105	105	105	105	105
R-squared	0.419	0.319	0.334	0.334	0.485	0.471

Note: * significant at 5%. Heteroskedasticity-robust t-statistics are in parentheses. These regressions contain the same set of independent variables as Table 4.

Table 6

Food Grain Productivity, 1901-1981

	1901 (OLS)	1901 (IV)	1931 (OLS)	1931 (IV)	1961 (OLS)	1961 (IV)	1971 (OLS)	1971 (IV)	1981 (OLS)	1981 (IV)
Non-landlord	0.48	0.96	4.34	-6.22	9.07	111.53*	39.49	340.72*	131.7	777.62*
	(0.14)	(0.09)	(1.74)	(1.11)	(0.94)	(2.81)	(1.27)	(2.47)	(1.83)	(2.61)
Length of British Rule	-0.12	-0.12	-0.01	0.02	-0.30	-0.59*	-0.90	-1.76*	-1.07	-2.91
	(1.74)	(1.86)	(0.25)	(0.31)	(1.66)	(2.32)	(1.61)	(2.28)	(0.82)	(1.65)
Altitude	-0.02	-0.02	-0.02*	-0.01	0.06	-0.01	0.29*	0.07	0.61*	0.14
	(1.74)	(1.33)	(2.84)	(1.38)	(1.81)	(0.22)	(2.56)	(0.39)	(2.30)	(0.36)
Latitude	0.70	0.71	0.56	0.25	-4.06*	-1.05	-5.77	3.09	-12.05	6.94
	(1.88)	(1.52)	(1.83)	(0.71)	(2.37)	(0.48)	(1.39)	(0.50)	(1.27)	(0.53)
Coastal	15.04*	14.99*	12.19*	13.61*	47.96*	39.02	81.07	54.78	142.47	86.11
	(3.94)	(3.70)	(3.38)	(3.36)	(2.32)	(1.55)	(1.52)	(0.83)	(1.15)	(0.57)
Rainfall	0.011*	0.011*	0.01*	0.01*	0.02	0.04	0.01	0.07	-0.01	0.12
	(3.40)	(2.91)	(3.61)	(2.88)	(1.16)	(1.76)	(0.18)	(1.25)	(0.07)	(1.05)
Black soil	1.98	1.95	-1.25	-0.74	-34.20	-33.76	-100.33*	-99.04	-234.92*	-232.15
	(0.54)	(0.50)	(0.41)	(0.23)	(1.96)	(1.46)	(2.62)	(1.66)	(2.38)	(1.67)
Alluvial soil	3.22	3.15	7.82*	9.40*	9.87	-4.81	46.93	3.77	171.89	79.32
	(0.77)	(0.67)	(2.48)	(2.92)	(0.61)	(0.26)	(1.25)	(0.09)	(1.84)	(0.76)
Red soil	12.48*	12.53*	8.31*	7.14*	63.26*	66.93*	126.51*	137.31*	341.51*	364.66*
	(2.22)	(2.06)	(2.58)	(2.10)	(3.06)	(2.90)	(2.32)	(2.16)	(2.58)	(2.45)
Constant	227.16	228.64*	41.39	6.09	703.60*	1123.9*	1923.8	3159.4*	2608.3	5257.8
	(1.91)	(2.03)	(0.53)	(0.07)	(2.11)	(2.50)	(1.82)	(2.32)	(1.07)	(1.68)
Observations	116	116	118	118	105	105	105	105	105	105
R-squared	0.436	0.435	0.521	0.456	0.508	0.212	0.342	-	0.370	0.004

Note: * significant at 5%. Heteroskedasticity-robust t-statistics are in parentheses. Food grain productivity is in rupees per acre. For 1901-1931, we use 1924-25 and 1928-1929 prices from Blyn (1966); for 1961-1981, we use contemporaneous prices.

Table 7

Non-Food Grain Acreage Share, 1901-1981

	1901 (OLS)	1901 (IV)	1931 (OLS)	1931 (IV)	1961 (OLS)	1961 (IV)	1971 (OLS)	1971 (IV)	1981 (OLS)	1981 (IV)
Non-landlord	6.06*	34.0*	11.26*	23.47*	7.13*	15.76	5.88	15.22	4.99	7.08
	(2.21)	(3.21)	(3.58)	(3.28)	(2.47)	(1.73)	(1.94)	(1.66)	(1.61)	(0.74)
Length of	-0.02	-0.09	-0.02	-0.15	-0.02	-0.05	-0.02	-0.05	-0.05	-0.06
British Rule	(0.61)	(1.75)	(0.48)	(1.20)	(0.53)	(1.04)	(0.56)	(1.11)	(1.24)	(1.51)
Altitude	0.03*	0.008	0.03*	0.02*	0.02*	0.001	0.02*	0.01	0.02*	0.02
	(4.00)	(0.60)	(3.73)	(2.10)	(2.17)	(0.94)	(2.12)	(0.97)	(2.03)	(1.45)
Latitude	0.57	1.35*	-0.09	0.26	0.05	0.30	-0.21	0.06	-0.15	-0.09
	(1.57)	(2.88)	(0.25)	(0.63)	(0.14)	(0.73)	(0.58)	(0.14)	(0.44)	(0.21)
Coastal	4.64	1.06	2.52	0.91	4.31	3.56	4.11	3.29	5.29	5.11
	(1.20)	(0.22)	(0.66)	(0.24)	(1.09)	(0.88)	(0.99)	(0.79)	(1.40)	(1.33)
Rainfall	-0.009*	-0.004	-0.008*	-0.006*	-0.013*	-0.011*	-0.014*	-0.012*	-0.011*	-0.011*
	(3.54)	(0.99)	(3.98)	(2.49)	(4.56)	(3.18)	(4.99)	(3.51)	(4.10)	(3.29)
Black soil	6.84	5.42	7.70	7.06	7.96	8.00	5.59	5.63	1.38	1.39
	(1.53)	(1.09)	(1.63)	(1.54)	(1.87)	(1.94)	(1.15)	(1.20)	(0.32)	(0.32)
Alluvial soil	1.84	-2.33	0.44	-1.29	3.72	2.48	2.09	0.75	-1.24	-1.54
	(0.81)	(0.71)	(0.18)	(0.47)	(1.37)	(0.82)	(0.76)	(0.25)	(0.49)	(0.55)
Red soil	8.07*	11.01*	5.10	6.31	2.99	3.30	2.01	2.34	2.02	2.09
	(2.65)	(2.49)	(1.61)	(1.76)	(0.94)	(0.94)	(0.62)	(0.66)	(0.64)	(0.65)
Constant	35.10	126.57	42.48	85.26	51.51	86.93	64.41	102.71	116.07	124.64
	(0.59)	(1.46)	(0.71)	(1.24)	(0.72)	(1.13)	(0.88)	(1.31)	(1.51)	(1.80)
Observations	117	117	116	116	105	105	105	105	105	105
R-squared	0.331	-	0.487	0.392	0.385	0.329	0.378	0.316	0.293	0.290

Note: * significant at 5%. Heteroskedasticity-robust t-statistics are in parentheses.

Table 8

Urbanization, 1901-1991

	1901 (OLS)	1901 (IV)	1911 (OLS)	1911 (IV)	1921 (OLS)	1921 (IV)	1931 (OLS)	1931 (IV)	1941 (OLS)	1941 (IV)
Non-landlord	10.64*	105.8	8.00*	-9.13	5.31*	-0.98	3.02	-1.50	5.53*	1.60
	(2.28)	(0.66)	(2.98)	(0.82)	(2.96)	(0.22)	(1.21)	(0.31)	(2.26)	(0.28)
Length of British Rule	-0.03	-0.40	0.007	0.05	-0.04	-0.03	-0.02	-0.01	-0.03	-0.03
	(0.59)	(0.65)	(0.12)	(0.55)	(1.46)	(0.74)	(0.67)	(0.23)	(0.95)	(0.69)
Altitude	-0.02	-0.20	-0.004*	-0.0002	-0.002	-0.0003	-0.001	-0.0001	-0.003	-0.002
	(1.45)	(0.65)	(2.11)	(0.10)	(1.58)	(0.21)	(0.79)	(0.07)	(1.72)	(0.93)
Latitude	-0.78	0.44	0.32	-0.15	0.11	-0.06	-0.12	-0.25	0.24	0.14
	(2.07)	(0.19)	(1.09)	(0.44)	(0.51)	(0.23)	(0.50)	(0.89)	(2.48)	(0.43)
Coastal	-5.22*	-9.21	-0.52	0.95	0.01	0.70	-2.04	-1.54	-0.65	-0.28
	(2.24)	(0.67)	(0.22)	(0.26)	(0.00)	(0.26)	(0.83)	(0.59)	(0.20)	(0.08)
Rainfall	0.002	0.021	-0.005*	-0.007*	-0.005*	-0.006*	-0.007*	-0.007*	-0.008*	-0.008*
	(0.49)	(0.59)	(2.90)	(3.01)	(3.12)	(3.11)	(3.54)	(3.57)	(2.92)	(2.80)
Black soil	-1.12	-3.42	4.47	6.18	3.27	3.70	2.53	2.83	4.85	5.31
	(0.39)	(0.24)	(1.23)	(1.15)	(1.39)	(1.48)	(1.10)	(1.17)	(1.67)	(1.73)
Alluvial soil	0.32	-13.49	3.17	6.07*	2.97	3.92*	5.14*	5.82*	3.65	4.27
	(0.15)	(0.55)	(1.59)	(2.28)	(1.71)	(2.06)	(2.55)	(2.78)	(1.72)	(1.87)
Red soil	-2.05	15.69	3.55	-0.19	-1.89	-3.11	-2.04	-2.92	0.83	-0.11
	(1.01)	(0.49)	(0.95)	(0.05)	(1.11)	(1.69)	(1.14)	(1.54)	(0.43)	(0.05)
Constant	86.26	693.60	-6.90	-62.83	88.09	63.96	57.61	40.29	74.43	66.10
	(0.87)	(0.43)	(0.07)	(0.42)	(1.69)	(1.10)	(1.05)	(0.64)	(1.18)	(0.99)
Observations	31	31	122	122	121	121	121	121	113	113
R-squared	0.581	-	0.141	-	0.235	0.153	0.198	0.164	0.223	0.201

Note: * significant at 5%. Heteroskedasticity-robust t-statistics are in parentheses.

Table 8 - continued

Urbanization, 1901-1991

	1961 (OLS)	1961 (IV)	1971 (OLS)	1971 (IV)	1981 (OLS)	1981 (IV)	1991 (OLS)	1991 (IV)
Non-landlord	4.46 (1.56)	6.86 (1.14)	4.87 (1.61)	7.51 (1.22)	5.46 (1.74)	7.20 (1.11)	5.54 (1.66)	7.20 (0.98)
Length of British Rule	-0.02 (0.51)	-0.03 (0.63)	-0.03 (0.75)	-0.04 (0.85)	-0.04 (0.99)	-0.05 (0.99)	-0.03 (0.58)	-0.04 (0.60)
Altitude	-0.002 (1.13)	-0.003 (1.35)	-0.002 (1.08)	-0.003 (1.34)	-0.003 (1.28)	-0.003 (1.39)	-0.003 (1.45)	-0.004 (1.50)
Latitude	-0.03 (0.09)	0.04 (0.13)	-0.11 (0.34)	-0.04 (0.11)	-0.11 (0.31)	-0.06 (0.16)	-0.06 (0.17)	-0.01 (0.03)
Coastal	0.01 (0.00)	-0.20 (0.06)	-0.09 (0.02)	-0.32 (0.08)	-0.98 (0.24)	-1.14 (0.27)	-0.71 (0.16)	-0.56 (0.12)
Rainfall	-0.008* (2.92)	-0.008* (2.70)	-0.009* (2.93)	-0.008* (2.71)	-0.009* (2.72)	-0.009* (2.55)	-0.009* (2.75)	-0.009* (2.55)
Black soil	5.29 (1.61)	5.23 (1.58)	5.10 (1.47)	5.03 (1.44)	3.37 (0.94)	3.33 (0.92)	2.29 (0.62)	2.22 (0.60)
Alluvial soil	4.75 (1.92)	4.41 (1.73)	5.10 (1.97)	4.73 (1.79)	4.72 (1.81)	4.48 (1.67)	4.63 (1.65)	4.40 (1.50)
Red soil	0.63 (0.28)	1.05 (0.42)	0.30 (0.13)	0.76 (0.29)	-1.68 (0.64)	-1.38 (0.49)	-1.47 (0.52)	-1.17 (0.38)
Constant	60.87 (0.81)	73.04 (0.89)	84.72 (1.08)	98.08 (1.15)	110.20 (1.37)	119.02 (1.35)	85.73 (0.92)	95.54 (0.90)
Observations	124	124	124	124	124	124	125	125
R-squared	0.188	0.182	0.201	0.194	0.183	0.180	0.162	0.160

Note: * significant at 5%. Heteroskedasticity-robust t-statistics are in parentheses.

Table 9

Manufacturing Employment Share, 1961-1991

	1961 (OLS)	1961 (IV)	1971 (OLS)	1971 (IV)	1981 (OLS)	1981 (IV)	1991 (OLS)	1991 (IV)
Non-landlord	1.76*	4.15*	2.47*	4.54	3.03*	5.29*	2.06	5.31
	(2.05)	(2.10)	(2.57)	(1.94)	(2.76)	(2.05)	(1.24)	(1.55)
Length of British Rule	-0.02	-0.02	-0.01	-0.02	-0.03	-0.03	-0.03	-0.04
	(1.07)	(1.30)	(0.92)	(1.17)	(1.52)	(1.73)	(1.26)	(1.55)
Altitude	-0.001	-0.001*	-0.001	-0.001*	-0.001	-0.002*	0.001	0.000
	(1.55)	(2.45)	(1.53)	(2.06)	(1.54)	(2.07)	(1.15)	(0.39)
Latitude	-0.14	0.21*	0.09	0.15	0.16	0.22	0.00	0.09
	(1.31)	(2.05)	(0.80)	(1.26)	(1.26)	(1.69)	(0.00)	(0.45)
Coastal	1.28	1.08	1.68	1.50	1.86	1.67	1.90	1.62
	(0.82)	(0.65)	(1.03)	(0.87)	(1.07)	(0.91)	(0.90)	(0.73)
Rainfall	-0.002	-0.001	-0.002	-0.002	-0.002	-0.001	-0.001	-0.001
	(1.34)	(1.08)	(1.60)	(1.34)	(1.14)	(0.93)	(0.41)	(0.25)
Black soil	1.16	1.06	0.79	0.70	1.00	0.90	1.33	1.19
	(1.57)	(1.24)	(0.83)	(0.68)	(1.00)	(0.82)	(0.93)	(0.78)
Alluvial soil	2.16*	1.83*	2.20*	1.92*	2.40*	2.09*	3.66*	3.21*
	(3.64)	(2.64)	(1.97)	(2.50)	(2.87)	(2.31)	(2.84)	(2.39)
Red soil	0.77	1.21	0.86	1.23	0.94	1.35	2.77	3.36
	(0.87)	(1.28)	(0.94)	(1.21)	(0.90)	(1.15)	(1.54)	(1.76)
Constant	28.71	39.91	26.93	36.59	46.69	57.27	61.79	77.03
	(1.05)	(1.24)	(0.98)	(1.19)	(1.54)	(1.72)	(1.44)	(1.69)
Observations	125	125	125	125	125	125	125	125
R-squared	0.157	0.104	0.188	0.155	0.185	0.154	0.141	0.110

Note: * significant at 5%. Heteroskedasticity-robust t-statistics are in parentheses.

Table 10

Service Employment Share, 1961-1991

	1961 (OLS)	1961 (IV)	1971 (OLS)	1971 (IV)	1981 (OLS)	1981 (IV)	1991 (OLS)	1991 (IV)
Non-landlord	4.17*	11.00*	3.63*	8.93	3.93*	9.74*	4.40*	11.09*
	(2.33)	(2.48)	(2.10)	(1.98)	(2.42)	(2.26)	(2.33)	(2.24)
Length of British Rule	-0.05	-0.07*	-0.03	-0.05	-0.02	-0.04	-0.02	-0.04
	(1.61)	(2.23)	(0.97)	(1.39)	(0.82)	(1.28)	(0.59)	(1.11)
Altitude	-0.002	-0.003*	0.0001	-0.001	-0.001	-0.002	0.001	-0.000
	(1.10)	(2.16)	(0.08)	(0.76)	(0.53)	(1.61)	(0.78)	(0.31)
Latitude	0.52*	0.71*	0.38	0.53*	0.45*	0.62*	0.52*	0.71*
	(2.50)	(3.08)	(1.98)	(2.59)	(2.69)	(3.25)	(2.66)	(3.22)
Coastal	2.86	2.26	3.34	2.88	4.37*	3.86	5.51*	4.93*
	(1.42)	(1.00)	(1.83)	(1.42)	(2.44)	(1.92)	(2.59)	(2.05)
Rainfall	-0.003*	-0.003	-0.003*	-0.003	-0.003	-0.002	-0.002	-0.002
	(2.44)	(1.64)	(2.06)	(1.54)	(1.88)	(1.30)	(1.43)	(0.88)
Black soil	-0.39	-0.69	0.54	0.32	0.70	0.45	-0.06	-0.35
	(0.20)	(0.31)	(0.29)	(0.15)	(0.42)	(0.24)	(0.03)	(0.16)
Alluvial soil	2.02	1.07	1.84	1.11	1.59	0.79	0.97	0.05
	(1.17)	(0.54)	(0.94)	(0.54)	(0.94)	(0.41)	(0.52)	(0.02)
Red soil	3.86*	5.10*	2.36	3.32	1.92	2.98	1.72	2.93
	(2.46)	(2.63)	(1.63)	(1.80)	(1.38)	(1.65)	(1.04)	(1.39)
Constant	88.44	120.5*	57.57	82.38	47.37	74.56	39.98	71.32
	(1.72)	(2.26)	(1.08)	(1.43)	(0.90)	(1.29)	(0.68)	(1.11)
Observations	125	125	125	125	125	125	125	125
R-squared	0.185	0.078	0.136	0.065	0.159	0.064	0.174	0.077

Note: * significant at 5%. Heteroskedasticity-robust t-statistics are in parentheses.

Table 11

Population Density, 1901-1991

	1901 (OLS)	1901 (IV)	1911 (OLS)	1911 (IV)	1921 (OLS)	1921 (IV)	1931 (OLS)	1931 (IV)	1941 (OLS)	1941 (IV)
Non-landlord	87.35	80.77	-10.71	-46.54	8.50	-25.35	61.73	47.63	26.34	30.94
	(1.70)	(0.78)	(0.26)	(0.57)	(0.20)	(0.34)	(1.40)	(0.58)	(0.50)	(0.28)
Length of British Rule	-0.28	-0.28	-0.67	-0.60	-0.45	-0.39	-0.16	-0.15	-0.83	-0.83
	(0.40)	(0.39)	(0.93)	(0.76)	(0.62)	(0.50)	(0.24)	(0.21)	(0.97)	(0.91)
Altitude	-0.45*	-0.45*	-0.09*	-0.08*	-0.09*	-0.08*	-0.35*	-0.34*	-0.11*	-0.11*
	(4.04)	(3.46)	(2.88)	(2.56)	(2.92)	(2.69)	(3.24)	(2.64)	(3.40)	(3.08)
Latitude	13.94*	13.75*	10.79*	9.78*	9.91*	9.05*	12.22*	11.79*	14.06*	14.17*
	(2.33)	(2.09)	(2.52)	(2.20)	(2.19)	(1.98)	(2.36)	(2.12)	(2.48)	(2.38)
Coastal	19.76	20.23	31.55	33.58	33.32	36.79	18.25	19.66	-24.59	-25.01
	(0.29)	(0.29)	(0.61)	(0.65)	(0.61)	(0.67)	(0.29)	(0.31)	(0.40)	(0.40)
Rainfall	0.05	0.05	0.03	0.03	0.03	0.03	0.05	0.05	0.00	0.00
	(0.98)	(0.97)	(0.77)	(0.67)	(0.63)	(0.53)	(1.24)	(1.20)	(0.07)	(0.08)
Black soil	-13.88	-14.46	-17.87	-14.22	-4.67	-1.63	11.19	10.57	17.09	16.55
	(0.22)	(0.23)	(0.40)	(0.31)	(0.10)	(0.04)	(0.22)	(0.21)	(0.32)	(0.30)
Alluvial soil	159.47*	160.39*	140.82*	146.89*	151.85*	157.25*	184.30*	185.87*	226.70*	225.97*
	(3.09)	(3.15)	(3.14)	(3.30)	(3.36)	(3.58)	(3.93)	(4.05)	(4.22)	(4.24)
Red soil	0.89	-0.24	77.34	69.15	88.88	80.77	70.88	68.58	135.36*	136.46*
	(0.01)	(0.00)	(1.56)	(1.41)	(1.71)	(1.64)	(1.29)	(1.28)	(2.05)	(2.06)
Constant	556.74	557.17	1246.7	1145.9	842.15	772.13	324.85	307.44	1501.3	1511.0
	(0.43)	(0.43)	(0.97)	(0.85)	(0.64)	(0.56)	(0.27)	(0.25)	(0.98)	(0.94)
Observations	93	93	120	120	115	115	106	106	113	113
R-squared	0.457	0.457	0.398	0.394	0.388	0.384	0.443	0.443	0.434	0.434

Note: * significant at 5%. Heteroskedasticity-robust t-statistics are in parentheses.

Table 11 - continued

Population Density, 1901-1991

	1961 (OLS)	1961 (IV)	1971 (OLS)	1971 (IV)	1981 (OLS)	1981 (IV)	1991 (OLS)	1991 (IV)
Non-landlord	28.38	18.43	34.92	49.12	50.98	36.03	61.47	189.77
	(0.47)	(0.16)	(0.49)	(0.34)	(0.58)	(0.20)	(0.51)	(0.76)
Length of	-2.12	-2.08	-2.97*	-3.02	-3.77*	-3.72	-7.17*	-7.58*
British Rule	(1.84)	(1.51)	(2.14)	(1.78)	(2.19)	(1.79)	(2.53)	(2.17)
Altitude	-0.16*	0.16*	-0.19*	-0.20*	-0.24*	-0.24*	-0.34*	-0.38*
	(3.62)	(3.40)	(3.71)	(3.48)	(3.80)	(3.52)	(3.75)	(3.67)
Latitude	16.01*	15.73*	20.56*	20.96*	27.93*	27.51*	39.45*	43.30*
	(2.56)	(2.49)	(2.69)	(2.78)	(3.01)	(3.00)	(2.89)	(3.30)
Coastal	-55.48	-54.61	-67.61	-68.84	-99.87	-98.57	-125.81	-142.88
	(0.76)	(0.71)	(0.74)	(0.71)	(0.88)	(0.82)	(0.71)	(0.72)
Rainfall	0.04	0.03	0.05	0.05	0.06	0.06	0.02	0.04
	(0.63)	(0.59)	(0.75)	(0.75)	(0.79)	(0.74)	(0.21)	(0.31)
Black soil	-13.74	-13.31	-2.90	-3.50	-5.26	-4.62	45.10	35.99
	(0.21)	(0.21)	(0.04)	(0.04)	(0.06)	(0.05)	(0.35)	(0.27)
Alluvial soil	267.21*	268.59*	320.81*	318.84*	398.90*	400.96*	543.71*	525.80*
	(4.24)	(4.31)	(4.22)	(4.22)	(4.31)	(4.39)	(3.99)	(3.89)
Red soil	153.04*	151.24*	202.94*	205.52*	253.37*	250.66*	498.80*	525.35*
	(2.06)	(2.15)	(2.23)	(2.39)	(2.22)	(2.33)	(2.87)	(3.34)
Constant	3878.3	3831.7	5403.5*	5470.0	6797.1*	6727.0	12942*	13554*
	(1.87)	(1.60)	(2.15)	(1.85)	(2.18)	(1.84)	(2.18)	(2.20)
Observations	125	125	125	125	125	125	116	116
R-squared	0.454	0.454	0.470	0.470	0.484	0.484	0.490	0.486

Note: * significant at 5%. Heteroskedasticity-robust t-statistics are in parentheses.

Table 12

OLS Panel Data Regression with Standard Errors Clustered by District, 1901-1991

	Agri Prod.	Food-Grain Prod.	NFG Acreage Share	Urbanization	Mfg. Emp. Share	Service Emp. Share	Population Density
	1901-1981	1901-1981	1901-1981	1901-1991	1961-1991	1961-1991	1901-1991
Non-landlord	65.61*	39.06*	7.41*	4.43*	2.33*	4.03*	22.53
	(2.65)	(1.97)	(3.04)	(1.95)	(2.44)	(2.42)	(0.38)
Length of British Rule	-0.86*	-0.29	-0.03	-0.02	-0.02	-0.03	-2.12
	(2.14)	(0.83)	(0.93)	(0.65)	(1.30)	(1.03)	(1.88)
Altitude	0.27*	0.15*	0.02*	-0.002	-0.00	-0.00	-0.17*
	(2.87)	(2.09)	(3.88)	(1.31)	(0.60)	(0.24)	(3.55)
Latitude	-1.32	-3.58	0.07	-0.06	0.97	0.46*	17.63*
	(0.48)	(1.32)	(0.30)	(0.23)	(0.80)	(2.60)	(2.78)
Coastal	58.29	51.35	3.67	-0.60	1.68	4.02*	-28.17
	(1.73)	(1.50)	(1.31)	(0.22)	(1.02)	(2.22)	(0.37)
Rainfall	0.02	0.01	-0.10*	-0.01*	-0.001	-0.002*	0.04
	(1.02)	(0.38)	(5.39)	(3.17)	(1.09)	(2.05)	(0.64)
Black soil	-77.57*	-70.21*	6.43	3.91	-1.07	0.19	-6.16
	(2.73)	(2.48)	(1.85)	(1.51)	(1.15)	(0.11)	(0.10)
Alluvial soil	29.78	44.66	1.42	4.39*	2.60*	1.60	269.4*
	(1.14)	(1.70)	(0.72)	(2.31)	(3.40)	(0.93)	(4.27)
Red soil	89.31*	101.54*	4.38	-0.82	1.33*	2.46	162.48*
	(2.60)	(2.88)	(1.85)	(0.46)	(2.40)	(1.76)	(2.18)
Constant	1460.9*	527.33	62.85	54.45	38.38	58.08	3646.41
	(2.02)	(0.81)	(1.18)	(0.92)	(1.28)	(1.12)	(1.78)
Observations	443	444	443	987	500	500	1038
R-squared	0.785	0.762	0.373	0.246	0.342	0.191	0.563

Note: * significant at 5%. The regressions include year fixed-effects and standard errors are clustered by districts. Heteroskedasticity-robust t-statistics are in parentheses. Agricultural productivity is in rupees per acre. For 1901-1931, we use 1924-25 and 1928-1929 prices from Blyn (1966); for 1961-1981, we use contemporaneous prices.

Table 13

OLS Panel Data Regression with Standard Errors Clustered by Province, 1901-1991

	Agri Prod.	Food-Grain Prod.	NFG Acreage Share	Urbanization	Mfg. Emp. Share	Service Emp. Share	Population Density
	1901-1981	1901-1981	1901-1981	1901-1991	1961-1991	1961-1991	1901-1991
Non-landlord	65.61	39.1	7.41*	4.43	2.33	4.03	22.53
	(1.68)	(1.52)	(2.98)	(1.74)	(1.47)	(1.66)	(0.17)
Length of British Rule	-0.86	-0.29	-0.03	-0.02	-0.02	-0.03	-2.12
	(1.86)	(0.47)	(0.69)	(0.61)	(0.82)	(0.81)	(1.15)
Altitude	0.27	0.15	0.02*	-0.002	-0.00	-0.00	-0.17*
	(1.47)	(1.35)	(2.95)	(1.09)	(0.49)	(0.17)	(2.89)
Latitude	-1.32	-3.58	0.07	-0.06	0.97	0.46	17.63*
	(0.36)	(0.86)	(0.25)	(0.26)	(0.83)	(1.64)	(2.07)
Coastal	58.29	51.35	3.67	-0.60	1.68	4.02	-28.17
	(1.33)	(1.22)	(1.01)	(-0.22)	(0.90)	(1.54)	(0.37)
Rainfall	0.02	0.01	-0.10*	-0.01*	-0.001	-0.002*	0.04
	(1.43)	(0.34)	(2.87)	(3.83)	(1.00)	(2.12)	(0.56)
Black soil	-77.57*	-70.21*	6.43	3.91	-1.07	0.19	-6.16
	(3.05)	(2.11)	(1.19)	(1.46)	(1.49)	(0.09)	(0.07)
Alluvial soil	29.78	44.66	1.42	4.39*	2.60*	1.60	269.4*
	(1.05)	(1.18)	(0.68)	(2.41)	(3.09)	(0.99)	(5.35)
Red soil	89.31*	101.54*	4.38*	-0.82	1.33	2.46*	162.48
	(4.13)	(3.33)	(2.85)	(0.66)	(1.57)	(2.38)	(1.51)
Constant	1460.9	527.33	62.85	54.45	38.38	58.08	3646.41
	(1.70)	(0.47)	(0.88)	(0.85)	(0.80)	(0.87)	(1.12)
Observations	443	444	443	987	500	500	1038
R-squared	0.785	0.762	0.373	0.246	0.342	0.191	0.563

Note: * significant at 5%. The regressions include year fixed-effects and standard errors are clustered by provinces. Heteroskedasticity-robust t-statistics are in parentheses. Agricultural productivity is in rupees per acre. For 1901-1931, we use 1924-25 and 1928-1929 prices from Blyn (1966); for 1961-1981, we use contemporaneous prices.

Table 14

OLS Panel Data Regression for Neighboring Districts, 1901-1991

	Agri Prod.	Food-Grain Prod.	NFG Acreage Share	Urbanization	Mfg Emp. Share	Service Emp. Share	Population Density
	1901-1981	1901-1981	1901-1981	1901-1991	1961-1991	1961-1991	1901-1991
Non-landlord	35.62	45.87	-4.74	-2.52	-0.26	-1.00	55.29
	(0.81)	(1.57)	(0.93)	(0.98)	(0.29)	(0.67)	(0.74)
Length of British Rule	0.48	0.43	-0.03	-0.06*	-0.02*	-0.04*	-0.68
	(1.13)	(1.54)	(0.76)	(2.18)	(2.88)	(3.01)	(0.53)
Altitude	0.15	0.11	0.01	0.01	0.004	-0.00	-1.09*
	(1.05)	(1.08)	(0.34)	(1.04)	(1.04)	(0.17)	(4.50)
Latitude	-12.0	-28.2*	0.79	-0.17	-0.40	0.31	-6.55
	(1.47)	(5.02)	(0.54)	(0.30)	(1.61)	(1.14)	(0.35)
Coastal	-51.79	47.42	7.93	5.96	0.50	4.99	6.86
	(0.58)	(0.63)	(0.59)	(1.14)	(0.25)	(1.75)	(0.04)
Rainfall	-0.09	-0.06	-0.008	-0.006	-0.00	-0.002	0.35*
	(1.43)	(1.42)	(1.48)	(1.36)	(0.48)	(0.63)	(3.46)
Black soil	-80.01	-51.30	7.67	3.65	-0.86	4.98*	476.57*
	(1.11)	(1.02)	(0.42)	(0.55)	(0.34)	(2.33)	(3.66)
Alluvial soil	80.67*	52.48*	3.84	2.01	0.68	0.92	197.49
	(2.58)	(2.12)	(1.20)	(1.04)	(0.95)	(1.11)	(1.71)
Red soil	-54.04	-47.03	5.85	7.10*	2.11*	5.99*	51.80
	(1.45)	(1.96)	(0.73)	(3.43)	(2.48)	(5.75)	(0.55)
Constant	-482.0	-268.45	50.58	107.0*	38.57*	75.82*	1300.8
	(0.59)	(0.51)	(0.92)	(2.30)	(3.56)	(3.31)	(0.52)
Observations	109	110	110	210	120	120	255
R-squared	0.864	0.831	0.399	0.733	0.759	0.759	0.815

Note: * significant at 5%. The regressions include year fixed-effects and standard errors are clustered by districts. This sample of neighboring districts consists of 32 districts out of our sample of 148 districts. Heteroskedasticity-robust t-statistics are in parentheses. Agricultural productivity is in rupees per acre. For 1901-1931, we use 1924-25 and 1928-1929 prices from Blyn (1966); for 1961-1981, we use contemporaneous prices.

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