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Sarmistha Pal
University of Surrey and IZA

Prabal Roy Chowdhury
Indian Statistical Institute, Delhi Centre

Zoya Saher
University of Nottingham

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IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

Land Ceiling Legislations, Land Acquisition and De-industrialisation: Theory and Evidence from the Indian States*

We examine the impact of legislated land ceiling size on capital investment and industrialisation in the Indian states. India's land ceiling legislations of 1960s and 1970s imposed a ceiling on maximum land holdings and redistributed above-ceiling lands. These ceiling legislations, effectively implemented or not, had increased land fragmentation and increased transactions costs of acquiring land for both strategic and non-strategic reasons. States with smaller ceiling size are thus likely to have (i) lower capital investment; (ii) less factories and lower industrialisation too. Ceteris paribus, estimates of both relative (post-1971 ceiling legislations relative to pre-1971 ones) and aggregate effects of legislated ceiling size lend support to these hypotheses, after eliminating competing explanations. These results offer insights about how to reduce transactions costs of land acquisition, policies that we claim are also applicable beyond India.

JEL Classification: H70, K11, L38, O14, Q15

Keywords: land reform, land acquisition, land ceiling size, transaction costs of land acquisition, investment in capital, industrialisation, India

Corresponding author:
Sarmistha Pal
Surrey Business School
University of Surrey
Stag Hill
Guildford GU2 7XH
United Kingdom
E-mail: s.pal@surrey.ac.uk

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1 Introduction

Many developing and emerging economies never had their own industrial revolutions - they have experienced falling manufacturing shares in both employment and real value added. Rodrik (2016) labelled this phenomenon premature deindustrialisation and attributed it to globalisation and labour-saving technological progress. While Rodrik (2016) finds that such deindustrialisation was less significant for Asian countries, Amirapu and Subramanian (2015) document that between 1980-2000, the Indian economy also underwent a similar slowdown of the industrial sector.[1] The present paper argues that in the Indian context, such deindustrialisation can be traced, among other reasons, to well-meaning policies like land reforms, land ceiling legislations to be precise, that predate this period. Such ceiling legislations had led to fragmentation of land, which in turn increased transactions costs of land acquisition, thereby slowing down the process of industrialization.

Successive Indian governments have introduced a large body of land reform legislations in the post-independence period. This encompassed (1) the abolition of intermediaries; (2) tenancy reforms; (3) fixing ceilings on land holdings; and (4) consolidation of landholdings. There is a significant literature that examine the efficacy of these land reform legislations. Bardhan (1970) has argued that an unenthusiastic implementation has muted some of the benefits, especially for the poor. Using panel data on the sixteen main Indian states from 1958 to 1992, Besley and Burgess (2000) had, however, documented that states with large volume of legislated land reforms had experienced a significant decline in poverty, attributing this result to land reforms that change the terms of land contracts (especially that relating to security of tenure), rather than actual redistribution of land. However the study also found a negative effect on agricultural productivity. One can possibly attribute this to the gap between legislations and their implementation as highlighted by Bardhan (1970). Studying the case of West Bengal, a state where tenancy reforms were implemented very thoroughly, Banerjee, Gertler and Ghatak (2002) concluded that tenancy reforms had improved agricultural productivity. Without denying any of these beneficial effects of land reforms, the present paper identifies an unintended consequence of land reforms–land ceiling legislations leading to increased transaction costs of land acquisition–that remains unexplored in the literature.

At its extreme, such transactions cost is manifested in the conflicts associated with land acquisition in many countries, especially populous emerging economies like India, Brazil and China (Alston et al., 2000; Deininger and Nagarajan, 2007; Deininger et al. 2011; Ding and Lichtenberg, 2011). As highlighted by the conflict surrounding land acquisition for the Nano project in India, the so-called 1 lakh rupee car, land acquisition can sometimes lead to violence, political interference and even the scrapping of the concerned projects.[2] While the reasons behind such conflicts are complex, anecdotal evidence suggests that the consequences of these conflicts are both sizeable and visible: projects are delayed, relocated, or cancelled. As of 2009, delays in land acquisition for

[1] Both Rodrik (2016) and Amirapu and Subhamanain (2015) find that deindustrialisation was accompanied by a growth of the service sector. Amirapu and Subramanian (2015) argue however that the potential for key service sub-sectors including finance, insurance and real estate to assume the role of manufacturing is limited. This is because these sub-sectors are highly skill intensive where India lacks a comparative advantage. The focus of the present paper however is on deindustrialisation, rather than the service sector growth.

[2] Initiated in 2007 by the Tata group, the project required acquisition of 997 acres (4.03 sq. km) of farmland in Singur (in the Indian state of West Bengal). Following opposition by unwilling farmers (the undervaluation of multi-cropped land playing a large role in this, see Ghatak et al. 2013), opposition parties, and environmental activists, the project was ultimately scrapped, and the factory was relocated.

industrial projects were threatening investments worth USD 100 billion all over India.[3,4]

We argue that in India these transactions costs were quite large to begin with, and the process of land reforms, in particular land ceiling legislations, exacerbated these costs. These legislations typically imposed a ceiling on the maximum amount of land a landowner can hold, with the ceiling size varying across the states and over time as legislations were modified in the 1960s and then again in the 1970s. After 1971, such ceilings were imposed on family land holding and varied with soil fertility so that more fertile land tends to have a lower ceiling size. The excess land over and above the ceiling was then redistributed among the landless though the effectiveness of redistribution varied across states (Appu 1972; Venkatsubramanian 2013). In case the ceiling legislations were implemented well, land was redistributed from a few big owners to numerous small owners, thereby increasing land fragmentation. Even when these legislations were not implemented effectively by the state, the fear of such legislations had led to benami[5] transfers of land to third parties so as to prevent the government from taking possession of excess land (Appu 1972). Using the agricultural census data, we show that states with smaller land ceiling size tend to have lower average cultivable land size (per household, as well as per individual) in a state, indicating greater land fragmentation and therefore higher transaction costs of acquiring land.[6] We elaborate on these issues, in particular that of mala fide transfers, further in Section 3.

One likely though unintended consequence of such increased fragmentation would be an increase in the per unit transaction costs of buying land. This is because with smaller plot sizes, a firm looking to acquire a plot of a given size has to negotiate with a larger number of owners. This can add to land acquisition costs via various channels, both non-strategic, as well as strategic. The non-strategic reasons can be located at the intersection of various legal-bureaucratic factors. In particular, given that there are fixed costs of writing any contract (e.g. stamp duties, as well as registration fees, see Alm et al., 2004), no matter how small the amount of land involved, the aggregate legal costs of buying any given amount of land is increasing in the number of sellers who hold that land. This cost can be even higher in case some of the land owners were recipients of benami transfers, given the legal ramifications of such transfers (Venkatsubramanian, 2013). Such legal-bureaucratic costs are likely to be quite salient in India, given its out-dated land records,[7] improper identification of de facto, as well as de jure owners in land surveys (Lindsay, 2012; Feder and Feeny, 1991; Ghatak amd Mookherjee, 2014), mis-classification of land quality (Ghatak, Mookherjee and Nath, 2013),[8] and a slow moving and expensive legal justice system.

[3] This is from a 2016 report by the Rights and Resources Initiative (RRI), a global coalition of non-profit organizations, and the Indian School of Business (ISB). See, https://rightsandresources.org/wp-content/uploads/2016/11/Land-Disputes-and-Stalled-Investments-in-India-November-2016.pdf. Also see: https://www.constructionweekonline.in/land-acquisition- delays-costing-us100-bln-study which states that according to an assessment report released by the Indian Steel Ministry, 22 major steel projects in the country worth USD 82 billion are being held up because of several reasons, including public protests.

[4] Such delay has sometimes led policy makers to resort to the legal expropriation of agricultural land, converting these to non-agricultural uses under various industrial promotions programmes (Kazmin, 2015).

[5] Benami literally means under someone else's name. In case it is a false name then it is not just benami, but also "farzi", i.e. fraudulent.

[6] At the same time land consolidation was slow because of lack of updated land records, and also because it was resisted by small and marginal landowners, as well as by tenants and sharecroppers (for fear of displacement). Eastwood et al. (2010), among others, discuss how the land reform process might have affected the smallness of plots in India.

[7] Caused, among other reasons, by high stamp duty and registration costs (Mishra and Suhag, 2017), so that buyers often skip registration of land purchase.

[8] Such weak property rights is an important reason why land markets are thin in most LDCs, see Binswanger et

Moreover there can be strategic reasons why fragmentation can increase transactions costs, in particular the holdout problem that arises when one buyer bargains with multiple sellers (Roy Chowdhury (2012); Roy Chowdhury and Sengupta, 2012). For example, Roy Chowdhury (2012) has argued that this problem becomes more serious when land gets more fragmented, developing an argument that is based on the landowners' inability to manage large sums of money (and consequent lack of consumption smoothing following the sale of land). Further, in case of private bargaining, ill-defined property rights force buyers to deal with not just owners, but also non-owners, possibly leading to conflict (Banerjee et al., 2007).[9,10] Finally, in Appendix 2 we develop a theory of holdout that does not depend on any inability on part of the landowners to manage large sums of money. One reduced form way of capturing this aspect would be to say that an increase in fragmentation increases the per unit cost of acquiring land.

We develop a general equilibrium framework with two consumer goods, agricultural and industrial, and two factors of production, capital and land. The industrial sector uses a CES production function, where the elasticity of substitution between land and capital is not too small, capturing the idea that land acts as a constraint on the amount of capital that can be gainfully employed. Further, given that our interest is in less developed economies, we assume that the land market is imperfect. Formally, industrial firms have to pay a premium over and above that paid by agricultural firms, thereby creating a role for transactions costs and consequently land ceiling legislations. We demonstrate that land ceiling legislations can, via an increase in transaction costs, dis-incentivise firms from investing in capital, thereby leading to a shrinkage in the size of the industrial sector.[11] This holds whenever the transactions costs are sufficiently large to begin with, which is realistic given that land markets in LDCs are rife with imperfections (see Section 3). The theoretical framework generates two key hypotheses regarding the effect of ceiling size on capital, and firm profits for our sample states: *Hypothesis 1* - total capital increases with ceiling size; and *Hypothesis 2* - industrial output increases with ceiling size. In other words, restrictions on land ceiling size following the imposition of land ceiling legislations are likely to limit both capital investment and industrialisation.

The rest of the paper focuses on testing the empirical validity of these hypotheses using historical state-level data from India, the key explanatory variable being land ceiling size. We shall examine the effect of a change in ceiling size on two the selected outcome variables, total capital, as well as indices of industrialisation, namely, share of manufacturing and registered number of factories. Given that ceiling size was laid down by various state legislations in the 1960s and 1970s (under central guidelines), being a function of the area under cash crops in the pre-1971 years, and of soil fertility in the post-1971 years (see Section 3), we construct two sets of ceiling sizes for each state, one between 1960-71, and another from 1972-1985.[12] The temporal variation in land ceiling sizes across the sample states provides us with a useful exogenous variation to exploit. This exogeneity arises because of a number of reasons. First, soil quality is given exogenously for individual plots and to some extent by the fact that historical state boundaries for the sample states that did

al., 1995. As argued by Alston et al. (2012), the absence of *de jure* property rights – as was the case in frontier regions of several countries, including Australia, Brazil and the U.S. – led to problems in land acquisition.

[9] In Brazil, there were conflicts between landowners and squatters over property rights (Alston et al., 2000).

[10] There is evidence of inter-state variation in land records, land tittling and land registration fee all of which add to transaction costs of land acquisition (Mishra and Suhag, 2017).

[11] See, for example, Ghatak et al. (2013), who argue that in the the automobile sector there was actually a reduction in the amount of capital invested post these legislations.

[12] We also consider a variant where we extend the sample from 1960 to 2015 so that the two ceilings for each state span 1960-1971, and 1972-2015.

not change over 1960-85. Second, the decision about what kind of crops to grow, i.e. whether food, or cash crop, is largely up to the individual land-users and not determined by the state. Third, and more importantly, the timings of the introduction of ceiling legislations were determined by the central Ministry of Agriculture and were thus random for the individual states. Given that the central government issued nationally applicable guidelines pertaining to ceiling sizes since 1972 (Venkatsubramanian, 2013),[13] the ability of the states to manipulate ceiling size is likely to be limited. Finally all our regressions control for a number of state-level time-varying observed characteristics plus state and year dummies account for state- and year-level unobserved trends. Taken together, we take ceiling size to be largely exogenous to the indices of capital investment used as the key outcomes in our analysis.

All Indian states experienced changes in mandated ceiling size after 1971, with 14 out of the 16 sample states experiencing a drop after 1971, whereas the remaining two states, namely Madhya Pradesh and Rajasthan, had experienced increases. We, therefore, start by exploring the ceiling effects in a comparative perspective: (a) effect of post 1971 ceiling size relative to pre-1971 level; we find that the post-1971 ceiling legislations had adversely impacted both investment in total capital and total number of registered factories relative to pre-1971 ones. (b) In order to further explain the results in (a), we next consider the effects of a decline in ceiling size relative to an increase within a difference-in-difference framework. Our analysis shows that states experiencing a fall in ceiling size after 1971 (relative to those experiencing an increase) had significantly lower total capital and also lower registered factories than those that did not, lending support to Hypotheses 1 and 2.

Second, we pool our state-level data to assess the aggregate ceiling effects as well within a pooled OLS framework: in particular, we regress various outcomes on ceiling size (average or that on ceiling on most fertile land) among other controls. *Ceteris paribus*, states with lower ceiling size tends to have lower total capital invested, as well as lower number of registered firms, which is consistent with our central hypothesis 1. We also document that states with smaller ceiling sizes tend to have smaller share of manufacturing output, thereby indicating a link between legislated ceiling size and deindustrialisation in our baseline sample 1960-85 (a period when much of the ceiling legislations were introduced). Further, we show that the baseline results hold, albeit somewhat weakly, even when we use an extended state-level panel data for the period 1960-2015.

We perform several additional exercises to test for the robustness of the results. Among possible sources of confounding, we first examine the likelihood that states may differ in their zeal in implementing land legislations, thus generating policy uncertainty for investors. To this end we include an additional control variable - the cumulative total number of land legislations by a state in a given year. Second, capital investment could be affected by other state level policies, e.g. those pertaining to labour unrest, as well as state politics. As a proxy for a state's ability in controlling labour unrest, we include man days lost in a year as an additional variable. Finally, to control for state-level politics, we include the vote percentage of the Indian National Congress (the dominant political party during the relevant period) as an additional variable. Of course, some time-varying unobservables, e.g., pro-business attitudes or role of green revolution, may still be present and we try to eliminate the possibility that these time-varying unobservables may influence our results. In a bid to examine any effect of pro-business attitude of some states, we re-estimate the model after dropping the two key pro-business states, Gujarat and Maharashtra. To test for any possible confounding arising from the Green Revolution, we examine the implications after dropping Punjab, and Haryana, the two key states that benefitted from this agricultural revolution. The central

[13] National guidelines issued in 1972 specified that the land ceiling limit would be: (i) 10 acres for the best land, (ii) 18-27 acres for the second class of land; and (iii) 27-54 acres for the rest, with a slightly higher limit in the hill and desert areas.

result that states with smaller ceiling size had lower capital investment remains robust to all these additional considerations.

While land reforms of course had many positive consequences, results from this study offer some policy implications to lower the transaction costs of land acquisition. The first one relates to property rights reform- initiating registration and digitisation of all land records- to ease transferability of land thereby lowering the non-strategic transaction costs of land acquisition. Second, given the variations in soil quality, farm size and alternative non-farm opportunities across the Indian states, there is a need for a local rather than a 'national' consent clause for land acquisition as in the recent Land Bill 2015 to lower the strategic transaction costs. Finally, these land acquisition policies can be complemented by accompanying policies like reform of labour laws (Besley and Burgess 2004), development of road and transport infrastructure (Asher and Novosad, 2020), as well as ensuring access to credit (Banerjee and Duflo, 2010) to boost capital investment.

2 Literature Review and Contributions

To the best of our knowledge, this is the first paper to argue, using both theory and empirics, that the imposition of ceiling size restrictions in India had an unexpected detrimental impact on capital investment, and also on the pace of industrialisation. Our results contribute to various strands of the existing literature. There is now a growing literature on how various public policy interventions may affect investment, productivity and earnings in developing countries. One central theme is that well defined property rights lower transaction costs, improve resource allocation, and boost investment (Ding and Lichtenberg, 2011; Galliani and Schargrodsky, 2011). Along this line, Besley and Burgess (2000) showed that Indian states with *more* land reform legislations experienced greater poverty reduction. Our paper complements this literature: we study a scenario where not only are property rights ill-defined, but land markets are imperfect too, thus generating significant transaction costs for land acquisition. Land ceiling legislations can thus exacerbate such transactions costs, with possible implications for capital investment and industrialisation. Further, our focus is on legislated land ceiling size, rather than the number of land legislations per state as in Besley and Burgess (2000).

Second, there is an emerging literature on land acquisition for industrial/infrastructural use. In particular, Banerjee et al. (2007) and Sarkar (2007) make the case that the use-value of land may be higher than its sale-price, while Ghatak and Banerjee (2009) suggest that such discrepancy can arise because of incomplete markets. Ghatak and Mookherjee (2014) further argue that the farmers displaced by acquisition of agricultural land ought to be over-compensated. Finally, Roy Chowdhury (2012) considered the role of the holdout problem (that typically arises when one buyer faces multiple sellers) in a setting where the landowners' find it difficult to manage large sums of money. Our paper adds to this literature by providing a connection between land ceiling legislations and transaction costs of land acquisition on the one hand, and between such transactions costs and the extent of capital investment and industrialization on the other.

Third, the industrial location literature identifies the importance of wage, access to road, electricity, power, market, corporate taxes, labour and bankruptcy regulations (Besley and Burgess 2004; Lall and Chakravorty, 2005; Deichmann et al. 2008; Tarantino 2013) for industrialisation. There is also some literature (Lucas, 2000; Ngai, 2004) that attributes the persistence of poverty in some countries to their delay in initiating the process of industrialisaiton. Gollin et al. (2002) examine why industrialisation may start at different dates in different countries, and why it can be slow; their analysis, in particular, highlight the role of agricultural productivity in economic development. Henderson and Turner (2020) highlight the slow process of urbanisation in south Asia even when urban income and wages are significantly higher. Our paper complements this literature by finding yet another link between agriculture and industry - one that runs from ceiling legislations to inadequate transfer of land from agriculture to industry (even when agricultural productivity is lower than that in industry), thus impeding the process of industrialisation and urbanisation too.

Fourth, our paper connects to the broader literature on the effect of ceiling legislations on farm size and agricultural productivity. Adamopoulos and Restuccia (2017; 2019; 2020) demonstrate that the widespread use of ceiling legislations in many countries has generally led to fall in farm size around the world. In fact, Adamapoulos and Restuccia (2014) argue that farm size is an important factor in unravelling the low productivity problem in agriculture in poor countries. Our analysis another implication of reduced farm size, and its effect on industrial productivity.

Finally, our findings contribute to the emerging literature on premature deindustrialisation, see e.g. Rodrik (2015) and Amirapu and Subramanian (2015). In particular, our analysis links the ceiling legislations to the hypothesis of premature deindustrialisation documenting that restricted ceiling size that may increase the costs of land acquisition for industries may cause total capital and manufacturing output share to fall.

3 Land ceiling, land fragmentation and land acquisition for industries in India

In this section we discuss various aspects of the Indian land ceiling legislations, as well as the Indian experience with land acquisition.

Ceiling legislations and land fragmentation: Starting in the early 1950s the Indian government induced various state governments[14] to pass a slew of legislations with a view to abolish landlordism, distribute land through imposition of ceilings, protect tenants and consolidate landholdings. Among these, our analysis focuses on land ceiling legislations. These legislations attempt to create surplus land by taking possession of land in excess of the ceiling, with the objective of redistributing such land among landless labourers, which would give rise to land fragmentation and multiple small landholders. While such ceiling legislations were passed in all states by 1961-62, there was a lot of heterogeneity in implementation.[15] In the interest of uniformity, a new policy was introduced in 1971 (Venkatasubramanian, 2013). In this legislation, all land was divided into three categories: (i) dry land; (ii) single-cropped; and (iii) multi-cropped, with a lower ceiling-height being applied to relatively more fertile land. Further, it fixed ceiling-height based on landholding per household, rather than per individual members of a household, and also attempted to fix loopholes in earlier legislations by (a) allowing for fewer exemptions from ceilings, (b) making retrospective "benami" transactions illegal, and (c) mandating that one could not move the courts on ground of infringement of fundamental rights.

The ceiling regulations however were not implemented very efficiently in all Indian states.[16] In fact, only 0.91 million hectares of surplus land was distributed till 1980-81 (Bandopadhyay, 1986). Further, till the beginning of the Seventh Five Year Plan, while the area declared surplus was 72

[14] Land is under the state list of the Indian constitution.

[15] The height of the ceiling varied from state to state, and was different for food and cash crops. The unit of application also differed across states: in some states ceiling restrictions were imposed on the 'land holder', whereas in others such restrictions were imposed on the 'family'.

[16] The sixth 5 year plan of India (1980-85) stated, "Often, the necessary determination has been lacking to effectively undertake action, particularly in the matter of implementation of ceiling laws,$\cdots$." (quoted in Bandopadhyay, 1986).

lakh acres, the area actually distributed was only 44 lakh acres (Venkatasubramanian, 2013).[17] We would argue however that despite this inefficiency in implementation, ceiling legislations had led to a significant amount of land fragmentation.

Such fragmentation can be attributed to the pre-emptive transfer of land by landowners who were apprehensive of losing their land following such legislations, such transfers being wide spread and often mala fide. In an illuminating report, the Directorate of Land Records and Surveys, West Bengal (1968) document the ways such Benami transfers – either to relatives, or even non-relatives – were arranged.[18] While many states tried to prevent such transfers, e.g. by banning transfers after a certain cutoff date (at least among relatives), such restrictions were not too effective because of various reasons. First, much of the mischief had already been done by the time these restrictions were put into place.[19] Second, such malfeasance was not only hard to catch, but also difficult to prove in courts given the use of various shady practices, e.g. unregistered sale of land, joint pattas, and complex chain of transfers.[20] Such transfers were of course easier if the land ceilings were imposed on individuals rather than families, and it did not help that many states were actually doing precisely that prior to the 1971 legislations.[21]

By their very nature, official estimates of mala fide transfers are hard to get. Nonetheless an indirect estimate of their magnitude can be found in Bandopadhyay (1986). Based on the agricultural census, he reports that the operational agricultural area had decreased by 12.93 million hectares between 1970-71 (when the new ceiling laws were introduced) and 1980-81. Bandopadhyay (1986) attributes this decrease to "conscious and wilful dispersion of land, obviously with a view to avoiding the ceiling laws," arguing that this decrease cannot be attributed to devolution given that the number of operational holdings has gone down by 0.62 million over the same period, rather than going up (Table 2, Bandopadhyay, 1986).[22]

Taken together, we argue that an immediate effect of land ceiling legislations was land fragmentation, irrespective of whether these legislations were implemented efficiently or not. To that end, Figure 2 (panels (a) and (b)) demonstrates that there is a positive relationship between ceiling size (average, or that on most fertile land) and the average size of cultivable landholding per household (available from the agricultural census data) in our sample. Further Table 1A compares average cultivable land holding size in low ceiling states before and after 1971.[23] Thus we find that average

[17] Of this, 16 lakh acres were reserved for specific public purposes. The process involved in the distribution of surplus land was complicated and time consuming thanks to the intervention of the courts. Many land owners surrendered only inferior and uncultivable land. The allottees, in many cases, could not make proper use of the land as they did not have the money to improve the soil.

[18] Quoted in Ghosh and Nagaraj (1978).

[19] To quote Haque and Sirohi (1986), "Between verbal discussion, introduction of ceiling legislation and final passing of the bill in the form of an Act, there was such a time-gap that people could always conveniently make nami or benami transfer of all land above the expected ceiling."

[20] One could use 'amalnamas' (unregistered sale of land) so as to establish that land transfers were made prior to any critical cut-off date. Further, such transfers could involve complex transfers - X transfers land to Y (a third person) who re-conveys the same to X's son-in-law, etc. In states like Assam where joint pattas were allowed, landowners would get land registered in joint pattas including people who have acreage below the ceiling limit.

[21] Not all fragmentation was because of mala fide transfers of course and could also arise, for example, in case zamindari families governed by the Mitakshara school of inheritance distributed their land among all living members of their family. There are other ways of avoiding ceiling laws that need not lead to increased fragmentation, e.g. deliberate suppression of the amount of land held, the recording of agricultural land as fisheries, or orchards, etc.

[22] See Section 6.2 for more discussion.

[23] Since we do not have comparable information for pre-1960 years, we cannot do the same before/after comparison for the 1960s legislations.

cultivable landholding, both per household and per person, were significantly lower after the 1971 legislation (further discussion in Section 7.5). Further, according to the 1971 legislation ceiling size varies inversely with soil fertility. Thus states with more fertile land tend to have smaller average cultivable landholding because of greater land fragmentation there. As argued earlier in the Introduction, such land fragmentation would be to increase transaction costs of land acquisition.

Large transaction costs of land acquisition: We next argue that transactions costs in the land market were significant to begin with. In the absence of any direct estimate of transaction costs, we start by observing that the land market in India is not very active (Chakrabarty 2013), a fact that is consistent with transactions cost of land acquisition being large. The thinness of Indian land markets can be traced to various institutional infirmities. For one, not only is registration of property not mandatory, costs of doing so are high, and include a registration fee, along with stamp duty, both of which are on the higher side (Mishra and Suhag 2017). Stamp duty rates vary between 4% and 10% across Indian states, whereas in other countries these rates typically range between 1%-4%. Further, registration fee is an additional 0.5% to 2%, on average. Since these rates are calculated on the cost of the property, these could end up being fairly big amounts in cases of high property values. Consequently, property transfers are often not registered, with such opacity adding to the transaction costs of land acquisition. This is especially problematic since in India land ownership is presumptive in nature, being established through various documents, in particular registered sale deeds (see further discussion in subsection 7.5).

Land acquisition: Till 2013, land acquisition in India was governed by the Land Acquisition Act of 1894, which was later amended in 2013. There was a further amendment in 2015 (proposed by the ruling BJP government): the proposed amendments removed requirements for approval from farmers to proceed with land acquisition under five broad categories of projects. This has faced tough resistance from key opposition parties, who have called the proposed amendments "anti farmer" and "anti poor".[24] While the bill was passed in Lok Sabha, it stalled in the Rajya Sabha. Despite promises to sort out land acquisition problems, nothing has been been done after 2015.

In India land acquisition has proven to be quite unpopular; in fact, public protests about such acquisitions are common and further add to the costs as these protests also tend to delay production, recall the Nano agitations discussed earlier. Such protests against land acquisition have been taking place all over India - in Nandigram, West Bengal against building a chemical hub (Banerjee et al., 2007), in Orissa against the building of a steel plant by Posco (Chandra, 2008), against the Jharkhand government for building a steel plant and also a power project in Khuntia district (Basu, 2008), against the Himachal Pradesh government for building an international airport along with air cargo hub at Gagret in Una district (Panwar, 2008), etc.

An important reason behind such protests is that the amount paid as compensation is quite low relative to the current indices of prices prevailing in the economy. Such low compensation can be traced to several factors, the greater bargaining power of large industrialists vis-á-vis small and marginal land owners, an unsympathetic bureaucracy,[25] the practice of land prices being based on the value recorded in the sale deeds etc.[26] Forcible dispossession with little compensation, reneging

[24]For Industrial corridors, Public Private Partnership projects, Rural Infrastructure, Affordable housing and defense projects, the amendment waives the consent clause of farmers, which requires "approval of the 70% of the land owners for PPP projects and 80% for the private entities." Further the bill recommended that in the event of a family selling its land, one member of the family would be offered a job in the concerned project. families would be much higher in states with greater soil fertility because these states faced lower ceiling size, which in turn meant that they had lower average size of cultivable land.

[25]In fact, relative to the bureaucracy, the judiciary has awarded higher compensations on the average (Singh 2013).

[26]As far as compensation for land acquisition is concerned, the government only compensates actual landowners,

on promises of resettlement, and even defrauding by middlemen and contractors are common.[27]

The consequences of land acquisition in India are therefore manifold. On the one hand, it may, and often does, lead to landlessness, joblessness, and marginalisation of landowners with resultant effects on food insecurity, morbidity and mortality. This raises serious concerns about the extent to which land acquisition can provide long-term benefits to local populations and contribute to sustainable development, as well as poverty reduction (e.g., Deininger et al. 2011). On the other hand, failed or stalled attempts at land acquisition delays projects significantly, thus slowing down the pace of industrialization, and failing to generate employment opportunities.

4 Framework

Consider an economy populated by a representative consumer, and competitive profit-maximizing firms that produce either of two consumption goods, agricultural (A), or industrial (I). The profits from these firms, if any, goes to the consumer. There are two factors of production, land (h), and capital (k).[28] Including land in the production function is part of our key insight that in many less developed countries, including India, land acts as a bottle-neck in the production process. In order to formalise this idea we shall assume that land and capital are gross complements, i.e. the elasticity of substitution between land and capital is not "too large". The aggregate supply of land is constant and given by H.

Production. While industry uses both factors of production, combining them using a CES technology, agriculture only uses land. This formulation captures the fact that industry is more capital intensive vis-á-vis agriculture in a fashion that is expositionally convenient. Letting h_i denote the amount of land used in sector i, $i = \{A, I\}$, and k denote capital input into industry, the production functions of the industrial and the consumption goods are given by:

$$I(k, h_I) = [k^\rho + h_I^\rho]^{\frac{1}{\rho}}, \quad (1)$$

$$A(h_A) = Y h_A, \quad (2)$$

where Y (> 0) is total factor productivity in agriculture and $\rho < 0$. Given that $\rho < 0$, the elasticity of (factor) substitution in industry σ ($= \frac{1}{1-\rho}$) satisfies $0 < \sigma < 1$. The fact that capital and land are gross complements (i.e. $\sigma < 1$) captures the fact that land essentially acts as a constraint on the size of a plant that a firm can build, so that the elasticity of substitution between them is small. Recall that a Cobb-Douglas production function has $\sigma = 1$, whereas $\sigma = 0$ for a Leontief production function. Thus we focus on technologies having elasticity of substitution between capital and land that lie in between these two cases.

We shall use the notations $I_k = \frac{\partial I}{\partial k}$, $I_h = \frac{\partial I}{\partial h_I}$, $I_{kk} = \frac{\partial^2 I}{\partial k^2}$, $I_{hh} = \frac{\partial^2 I}{\partial h_I^2}$ and $I_{kh} = \frac{\partial^2 I}{\partial k \partial h_I}$. For later reference, we note that $I_k = \left(\frac{I}{k}\right)^{\frac{1}{\sigma}}$, $I_h = \left(\frac{I}{h_I}\right)^{\frac{1}{\sigma}}$, $I_{kk} = \frac{1}{\sigma}\left(\frac{I}{k}\right)^{\frac{1}{\sigma}}\left[\frac{1}{I}\left(\frac{I}{k}\right)^{\frac{1}{\sigma}} - \frac{1}{k}\right]$, $I_{hh} = \frac{1}{\sigma}\left(\frac{I}{h_I}\right)^{\frac{1}{\sigma}}\left[\frac{1}{I}\left(\frac{I}{h_I}\right)^{\frac{1}{\sigma}} - \frac{1}{h_I}\right]$, $I_{kh} = \frac{1}{\sigma I}\left(\frac{I}{k}\right)^{\frac{1}{\sigma}}\left(\frac{I}{h_I}\right)^{\frac{1}{\sigma}}$.

and does not consider those who do not own land, but are still adversely affected by land acquisition, e.g. landless labourers, fishermen, and artisans. Thus the poorest of the poor, in particular tribals, bear a disproportionately large fraction of the costs of displacement, with roughly one in ten Indian tribal being a displaced person.

[27] In China the matter has been made worse by the fact that farmers do not have land ownership rights (only user rights), and they are much more at the mercy of the arbitrary decisions of local government officials in collusion with commercial developers.

[28] In Appendix 1 we introduce labour as well, finding that the results in this section remain qualitatively robust.

Firms are price takers in both factor, as well as product markets. Let p be the price of the industrial good, with the price of the agricultural good being normalized to 1. We assume that the land market is imperfect,[29] in that acquiring land for industrial use involves a per unit price that is τ times its price in the agricultural sector, where $\tau > 1$. As discussed earlier, the imposition of land ceiling laws would increase fragmentation, thereby increasing the per unit transactions costs τ. Thus, in our comparative statics exercises, we shall let an increase in τ capture the effects of land ceiling laws. Moreover, industry imports capital from the rest of the world[30] at a price of r. Letting s_A (respectively s_I) denote the price for agricultural land (respectively industrial land), we therefore have that:

$$s_I = \tau s_A. \tag{3}$$

Thus the profit function in industry is given by

$$\pi_I(k, h_I) = p[k_I^\rho + h_I^\rho]^{\frac{1}{\rho}} - s_I h_I - rk, \tag{4}$$

while that in agriculture is

$$\pi_A(h_A) = Yh_A - s_A h_A. \tag{5}$$

Profit maximization ensures that factor prices equal their respective marginal revenue products:

$$r = pI_k = p\left(\frac{I}{k}\right)^{\frac{1}{\sigma}}, \tag{6}$$

$$s_I = pI_h = p\left(\frac{I}{h_I}\right)^{\frac{1}{\sigma}}, \tag{7}$$

$$s_A = Y. \tag{8}$$

Using (3), (7) and (8), we have that

$$\tau Y = pI_h. \tag{9}$$

Consumption. The utility function of the representative consumer is

$$U = \phi \, log \, c_A + (1 - \phi) \, log \, c_I, \tag{10}$$

where c_A (respectively c_I) denotes consumption of the agricultural (respectively industrial) good, and $0 < \phi < 1$. Her income comprises of profits (which, given competitive firms, is zero) and income from sale of land $s_I h_I + s_A h_A$, so that her budget constraint is given by:

$$c_A + pc_I = s_I h_I + s_A h_A. \tag{11}$$

[29] That the land market in LDCs are typically thin has been remarked upon by Morris and Pandey (2009), and Sarkar (2007), among others. This thinness can be traced among other reasons to poor land records, and a slow moving legal-justice system.

[30] This captures the reality that less developed countries import a significant fraction of their capital requirements. In India, for example, capital and intermediate goods constituted 29.93% and 35.44% of total import respectively in 1960-61. The corresponding figures were 35.44% and 36.14% in 1965-66, 23.76% and 52.84% in 1970-71, and 15.09% and 63.58% in 1974-75 (Pitre, 1981, Table 6). Even as late as 2015, capital goods constituted 0.6% of GDP (Agarwal and Sengupta, 2017).

Her consumption levels are therefore:

$$c_A = \phi[s_I h_I + s_A h_A], \tag{12}$$

$$c_I = (1-\phi)\frac{s_I h_I + s_A h_A}{p}. \tag{13}$$

Market clearing conditions. The factor market for land, as well as the two goods markets must clear. Factor market clearing entails:

$$H = h_A + h_I. \tag{14}$$

Turning to the goods market, the market clearing condition in agriculture is

$$A = c_A, \tag{15}$$

while that in industry is

$$I = c_I. \tag{16}$$

Equilibrium. An allocation (k, h_I, h_A, c_A, c_I) and a price vector (p, s_I, s_A) constitutes an equilibrium if (a) (k, h_I) maximizes industry profits, and h_A maximizes agricultural profits, so that (6), (7) and (8) hold, (b) (c_A, c_I) maximizes consumer utility, so that (12) and (13) are satisfied, (c) the factor and goods markets clear, i.e. (14), (15) and (16) hold, and (d) the transaction cost condition (3) is satisfied.

5 The Equilibrium Analysis with Comparative Statics

In this section we begin by characterising the equilibrium and then examine how a change in transaction costs τ affects the variables of interest, i.e. capital, land use, and the capital output ratio in industry, i.e. k, h_I, and $\frac{k}{I(k,h_I)}$.

We can simplify (3), (6), (7), (8), (12), (13), and (14) to obtain (6) and (9). Further from Walras's law, it is sufficient to consider market clearing in agriculture (15), which, given (2) and (12), simplifies to

$$Y(H - h_I) = \phi[s_I h_I + s_A h_A]. \tag{17}$$

Thus the equilibrium is characterized by the system of three equations (6), (9) and (17) in the three endogenous variables k, h_I and p.[31]

We then turn to comparative statics. Totally differentiating equations (6), (9) and (17) with respect to p, k, h_I and τ, we have that

$$pI_{kk}dk + pI_{kh}dh_I \quad +\left(\tfrac{I}{k}\right)^{\frac{1}{\sigma}}dp \quad = 0, \tag{18}$$

$$pI_{kh}dk + pI_{hh}dh_I \quad +\left(\tfrac{I}{h_I}\right)^{\frac{1}{\sigma}}dp \quad = Y d\tau, \tag{19}$$

$$Z' dh_I \quad = \phi Y h_I d\tau, \tag{20}$$

[31] Given that production technologies and utility functions are well behaved, standard arguments show that an equilibrium exists, see e.g. Mas-colell et al., 1995, Section 17.C.

where $Z' = -Y[1 - \phi + \phi\tau] < 0$. We next introduce some notations that simplify the exposition:

$$D \equiv \begin{vmatrix} pI_{kk} & pI_{kh} & (\frac{I}{k})^{\frac{1}{\sigma}} \\ pI_{kh} & pI_{hh} & (\frac{I}{h_I})^{\frac{1}{\sigma}} \\ 0 & Z' & 0 \end{vmatrix}, \quad D^{h\tau} \equiv \begin{vmatrix} pI_{kk} & 0 & (\frac{I}{k})^{\frac{1}{\sigma}} \\ pI_{kh} & Y & (\frac{I}{h_I})^{\frac{1}{\sigma}} \\ 0 & \phi h_I Y & 0 \end{vmatrix}, \text{ and } D^{k\tau} \equiv \begin{vmatrix} 0 & pI_{kh} & (\frac{I}{k})^{\frac{1}{\sigma}} \\ Y & pI_{hh} & (\frac{I}{h_I})^{\frac{1}{\sigma}} \\ \phi h_I Y & Z' & 0 \end{vmatrix}.$$

Using (9), straightforward calculations show that

$$D = \frac{Z'p}{\sigma k}(\frac{I}{k})^{\frac{1}{\sigma}}(\frac{I}{h_I})^{\frac{1}{\sigma}} = \frac{Z'\tau Y}{\sigma k}(\frac{I}{k})^{\frac{1}{\sigma}} < 0, \tag{21}$$

$$D^{h\tau} = \frac{p\phi h_I Y}{\sigma k}(\frac{I}{k})^{\frac{1}{\sigma}}(\frac{I}{h_I})^{\frac{1}{\sigma}} = \frac{\tau\phi h_I Y^2}{\sigma k}(\frac{I}{k})^{\frac{1}{\sigma}} > 0, \tag{22}$$

$$\text{and, } D^{k\tau} = -(\frac{I}{k})^{\frac{1}{\sigma}} Y^2[1 - \phi + \phi\tau(1 - \frac{1}{\sigma})]. \tag{23}$$

We next turn to comparative statics on τ. To begin with,

$$\frac{dh_I}{d\tau} = \frac{D^{h\tau}}{D} = \frac{\phi h_I Y}{Z'} < 0, \tag{24}$$

since $Z' < 0$. Thus, as is intuitive, an increase in τ makes land acquisition by industry costlier, thereby reducing land use in industry.

We next examine the effect of a change in τ on k:

$$\frac{dk}{d\tau} = \frac{D^{k\tau}}{D} = -\frac{Y\sigma k}{Z'\tau}[1 - \phi + \phi\tau(1 - \frac{1}{\sigma})]. \tag{25}$$

Thus whenever transactions cost τ is sufficiently large to begin with, i.e. $\tau > \bar{\tau} \equiv \frac{1-\phi}{\phi}\frac{\sigma}{1-\sigma}$, an increase in τ reduces investment in industry. Assuming that τ is not too small, may not be unrealistic in the context of developing countries. This is for several reasons. First, with land markets in LDCs being imperfect, land acquisition is difficult and τ is likely to be large. Second, $\bar{\tau}$ is increasing in σ. Thus this condition is more likely to be satisfied if the elasticity of substitution σ is small, which is likely to hold given that land acts as a constraint on industry.

Note that for $\tau > \bar{\tau}$, both k and h_I declines with an increase in τ. Thus total industrial output declines as well.

Proposition 1. *An increase in transactions cost τ:*

(a) reduces capital use k whenever τ is not too small to begin with, i.e. $\tau > \bar{\tau} = \frac{1-\phi}{\phi}\frac{\sigma}{1-\sigma}$;

(b) reduces land use in industry h_I; further, it reduces industrial output $I(k, h_I)$ whenever $\tau > \bar{\tau}$.

We next examine the effect of a change in Y, i.e. total factor productivity in agriculture on capital and industrial output. While a change in τ remains our focus, these results help us sharpen the predictions that we take to data. Totally differentiating equations (6), (9) and (17) with respect to p, k, h_I and Y, we have that

$$\begin{aligned} pI_{kk}dk + pI_{kh}dh_I \quad &+\big(\tfrac{I}{k}\big)^{\frac{1}{\sigma}}dp &&= 0, && (26)\\ pI_{kh}dk + pI_{hh}dh_I \quad &+\big(\tfrac{I}{h_I}\big)^{\frac{1}{\sigma}}dp &&= \tau dY, && (27)\\ Zdh_I \quad & &&= 0. && (28) \end{aligned}$$

Define $X \equiv [h_I(1+\phi\tau) - H]$, where we note that X is negative from (17). As before we define:

$$D^{hY} \equiv \begin{vmatrix} pI_{kk} & 0 & \big(\frac{I}{k}\big)^{\frac{1}{\sigma}} \\ pI_{kh} & \tau & \big(\frac{I}{h_I}\big)^{\frac{1}{\sigma}} \\ 0 & 0 & 0 \end{vmatrix} = 0, \text{ and, } D^{kY} \equiv \begin{vmatrix} 0 & pI_{kh} & \big(\frac{I}{k}\big)^{\frac{1}{\sigma}} \\ \tau & pI_{hh} & \big(\frac{I}{h_I}\big)^{\frac{1}{\sigma}} \\ 0 & Z & 0 \end{vmatrix} = \tau Z\big(\frac{I}{k}\big)^{\frac{1}{\sigma}} < 0,$$

since Z is negative. We therefore have that $\frac{dk}{dA} > 0$ and $\frac{dh_I}{dA} = 0$, i.e. an increase in agricultural productivity has no effect on industrial land use, and increases the amount of capital use.

Proposition 2. *An increase in agricultural total factor productivity Y:*

(a) increases capital use k, but has no effect on land use h_I;

(b) increases industrial output.

Remark 1. *In Appendix 1, we extend the analysis to allow for labour, in addition to capital and land. Further, we allow for a feature of the labour market that is of importance to many countries, namely minimal wage regulations. In India, such regulations can be traced back to the Minimum Wages Act 1948. This was followed by the Payment of Bonus Act, 1965, the Equal Remuneration Act, 1976, and the Code on Wages, 2019. Minimal wage regulations however have a long history even outside of India, with some form of living/minimum wages being legislated as far back as 1894 in New Zealand (the Industrial Conciliation and Arbitration Act), 1907 in Australia (the Harvester decision) and 1917 in Mexico (Article 123, VI of the Federal Constitution). We find that the comparative statics results, i.e. Propositions 1 and 2, are robust to this extension.*

Remark 2. *In Appendix 2, we illustrate how, in the presence of the* holdout problem, *the price paid by the monopoly firm is higher under land fragmentation. In order to focus on the issue of bargaining, in this exercise we abstract from general equilibrium aspects of the problem and consider a simple monopoly firm that uses land and labour in a generalized Leontief technology. We find that the ceiling laws, working via land fragmentation, can increase land price, thereby reducing firm profits, and also the amount invested in both land and capital.*

5.1 Testable hypotheses

We next discuss some testable implications of Propositions 1 and 2, relating them to the land ceiling legislations in India in particular. As we discuss earlier in sections 1 and 3, the impact of these legislations is to increase fragmentation of land, either directly, or indirectly, because of the transfers induced by such legislation. This makes the acquisition of land by firms more difficult, thereby increasing the transactions cost of purchasing land, i.e. τ. Let us compare two hypothetical regions, say A and B, where suppose A is more fertile relative to B, so that after imposition of land fertility based ceiling legislation, region A ends up being relatively more fragmented. What are the empirical implications of land ceiling legislations in these two regions?

- First consider capital investment. Proposition 1(a) shows that, after controlling for soil fertility, the amount of capital invested in region A would be lower. Whereas Proposition 2(a) suggests that, after controlling for τ, the amount of capital is likely to be higher in region A since Y would be larger. Taken together, we have that while an increase in τ reduces capital investment if soil fertility is controlled for (H1), the effect however is ambiguous if one does not control for soil fertility (H1(a)).
- Next Proposition 1(b) suggests that such land ceiling legislation can slow down the pace of industrialization, and may even lead to exit, which is our second testable hypothesis H2.

Summarizing the preceding discussion we have the following testable hypotheses:

H1: After controlling for soil fertility, imposition of land ceiling legislations lowers investment in industry.

H2: After controlling for soil fertility, imposition of land ceiling legislations slows down firm entry and lead to exit of firms, thus lowering the number of firms.

We now take to the data to test the empirical validity of these hypotheses in our sample.

6 Data and Empirical Model

6.1 Data

From our earlier discussion recall that most of the major Indian states had passed at least two ceiling legislations, one during 1960-1971, and another after 1971. We thus have two sets of observations on ceiling size for each state: one for the period 1960-71, and another for 1972 onwards.[32] This leads to differences in ceiling sizes not only across states, but also over time for a given state (see Appendix 3 and Figure 1). It is also evident from Figure 1 that 14 out of 16 sample states had experienced a drop in ceiling size after 1971 (more on this later). Accordingly, we consider the average ceiling size for the full sample period (either 1960-1985 or 1960-2015, see discussion later); as an alternative we also redo the analysis using ceiling size on most fertile land for the post-1971 years (see further discussion below).

We collate ceiling size variables from various sources including Chaudhuri (1960), Besley and Burgess (2000), and Government of India (2014). Appendix 3 provides further information on ceiling size data (see note on ceiling size). We have compiled other state-level data from a variety of official sources including Ozler et al. (1996), and Besley and Burgess (2000). The primary data is collected for 16 major Indian states[33] for a period of 26 years starting from 1960 to 1985 during which much of the land ceiling legislations were introduced, yielding a sample of about 416 state-year observations. We also extend the baseline 1960-85 data to 2015 to consider the long-term impact of legislated land ceiling size on capital investment and pace of industrialisation. This is done by using various official data sources including Central Statistical Office, Annual Survey of Industries, Office of the Registrar General and Census Commissioner and the Reserve Bank of India Handbook on State Statistics. In Appendix 4, Table A4.1 summarises the variable definitions and

[32] Section 3 has a more detailed discussion of these legislations.

[33] The States Reorganisation Act, 1956 reorganised the states based on linguistic lines resulting in the creation of a number of new states. The sample states included in our study include 16 major states formed by 1960, which naturally excludes the north-eastern and other states formed afterwards. Haryana split from the Punjab in 1965 and, after this date, we include Haryana as a separate observation.

data sources in our sample for the 1960-85 sample, and Table A4.2 does the same for the extended 1960-2015 sample.[34] We focus on sixteen major Indian states.

Using the Orbis database available from Bureau van Djik, we also consider the firm-level data for the period 1996-2012. We start by plotting the location of the head quarters of the listed firms across the Indian states in 2012. Consider Figure A3.1 in Appendix 3. The green dots show the locational distribution of the head-offices of the listed firms. Evidently, there is a high concentration of firms head-quartered in the western states of Gujarat, Maharashtra, and also in and around Delhi/Haryana/Punjab. In contrast there is a dearth of manufacturing firms along the Gangetic plain. Although firm location can be influenced by many factors (e.g., see Deichman et al. 2008), a higher concentration of listed Indian firms in the western and north-western states (where land is arid or semi-arid relative to that in the Gangetic plains) is noteworthy. This motivates us to examine the impact of legislated land ceiling size on capital investment in the Indian states. In the rest of the paper, we empirically assess the impact of land ceiling size on the observed capital investment indices (total capital, as well as capital output ratios), registered number of factories and share of manufacturing output in the Indian states, after accounting for other observed factors and some unobserved fixed effects too that may influence these outcome variables.

6.2 Empirical Strategy

In this sub-section we describe the key regression variables and also explain our empirical strategy.

For testing hypothesis H1, the outcome variable of interest is the total capital in state s in year t. We use the natural logarithm of total capital, abbreviated as Ln(Totalcapital), so as to allow for any possible non-linearity. The source of the state-level data on fixed capital, working capital, as well as total value added, is the Annual Survey of Industries (ASI). Using a panel data framework, we can therefore trace the change in these measures of capital across states and over time.

For hypothesis H2, the outcome variables of interest are firm entry/exit in state s in year t. In the absence of information on firm entry/exit at the state-level, we proxy it by the number of factories registered under the Payment of Wages Act 1936 (Factory), also available from the ASI data-base. We use the natural logarithm of total number of registered factories (abbreviated as Ln(factory)) to allow for any possible non-linearity. As an alternative outcome variable we also consider the share of manufacturing (both registered and unregistered) output in net state domestic product (shmfg in short).[35]

Key explanatory variables: Our key explanatory variable is land ceiling size – the maximum area (in hectares, ha for short) of land that a household/individual can hold in a state over time – as laid down by various land ceiling legislations. Recall that in the 1960s, ceiling size was based on share of cash crops, so that we do not have information on ceiling sizes for land categorized on the basis of fertility - arid, single-cropped, and multi-cropped. Accordingly, we construct two ceiling size variables: (i) $AverageCeilings_{st}$: It is the simple mean of ceiling sizes on all land – most fertile, less fertile and dry/infertile land – in state s in year t after 1971. (ii) As a robustness exercise we also use an alternative ceiling size variable $MostFertileCeilings_{st}$ (available only from 1971) that indicates the ceiling size on most fertile land. We collate the data on ceiling size from various sources including Chaudhuri (1960), Besley and Burgess (2000), and Government of India (see Appendix 3). Mean ceiling size on most fertile land is 15 ha (hectare) and the median ceiling

[34] Although Bihar, MP and UP were respectively split into Bihar and Jharkhand, MP and Chhatisgarh and UP and Uttarakhand in 2001, we continue to treat them as Bihar, MP and UP as before.

[35] Information on net state domestic product and also net state domestic product from manufacturing is available from India's national accounts for various years.

size is 13 ha (1972-85); average ceiling size on any land is 17 ha, while the median ceiling size is 16 ha (1960-85). Unsurprisingly, the ceiling size on most fertile land is smaller relative to the average ceiling size. We find that there is sufficient time-series and cross-section variations in ceiling size (see Appendix 3 Figure A3.1 for a sample of states). Since we have only 16 states in our sample that limits the degree of variation in ceiling size, we also consider the corresponding farm-level data with more cross-section units, ensuring more variations in the chosen outcome variables.

Effects of ceiling legislations on ceiling size: We next demonstrate that the various ceiling legislations did affect ceiling size, thus validating our use of ceiling size as an explanatory variable. To that end Figure 2 plots ceiling size against the variables used in various ceiling laws, in particular share of land used for cash crops (between 1960-71), and soil fertility (between 1972-85). (i) The top panel plots the fitted line between ceiling size (both average and that on ceiling on most fertile land) and cultivable land across the sample states over 1960-1985, finding that both ceiling size variables increase monotonically with an increase in average cultivable land per household. (ii) The middle panel shows the relationship between ceiling size and share of land used for cash crops in the pre-1972 years. Evidently, both measures of ceiling size decline with an increasing share of land used for cash crops in the 1960s. (iii) The final panel shows the relationship between ceiling size and soil fertility in the post-1971 years. In this case too the fitted relationships between these two ceiling size variables turn out to be negative, indicating that ceiling size fell with increasing soil fertility.

Exogeneity of ceiling variables: We then expand on our earlier discussion (in the Introduction) to argue that the outcomes of interest are unlikely to affect ceiling size. First, the legislated ceiling size was related to nature of the crop produced until 1971, and soil fertility from 1972 onwards (under the guidance of the central government) as documented earlier. Second, the timings of the legislations imposed by the Centre are likely to be random for the states and are unlikely to be influenced by the future industrialisation policies of successive state governments. However, since there could still be important omitted factors, we therefore control for observed state characteristics (X_{st}), as well as state (S_s) and year (θ_t) fixed effects (see below). Finally, we also test for the presence of pre-trends, if any, in our outcomes (a la Borusyak and Jaravel, 2017) before 1972, treating it as an event (see Appendix 5 for the construction of F-statistic).[36] (a) All the F-statistics (see Table 3) reject the null hypothesis that there are pre-trends in the outcomes of interest before the event date 1972. (b) We also use the same F-test for testing pre-trends in both soil fertility and population density (panel g) before 1972. The F-statistics are respectively 10.70 and 29.61 for soil fertility and population density, thereby rejecting the null hypothesis that there are pre-trends in the data before 1972.

6.3 Relative effects of ceiling size

A comparison of ceiling sizes in the 1960s and 1970s shows that all states experienced changes in mandated ceiling size after 1971, with 14 out of the 16 sample states experiencing a drop after 1971, whereas the remaining two states, namely, Madhya Pradesh and Rajasthan had experienced increases (See Figure 1). These changes induce us to explore the nature of the ceiling effects within a comparative perspective: (a) effect of post 1971 ceiling size relative to pre-1971 level; (b) effect of a decline in ceiling size relative to the rest.

(a) We start by assessing the effect of post-1971 ceiling size (relative to its earlier level) on selected outcomes of interest in various states as per our hypotheses. In doing so, we run the

[36] We could not do the same for the 1960 legislations since we do not have the data prior to 1960.

following regression on selected outcomes Y_{st} as follows:

$$Y_{st} = \alpha_0 + \alpha_1 Ceilingsize_{st} + \alpha_2 Post1971_t + \alpha_3 Ceilingsize_{st} \times Post1971_t + \alpha_4 X1_{st} + S_s + v_{st}, \quad (29)$$

where $Ceilingsize_{st}$, X_{st}, θ_t and S_s carry the same interpretations as in (31), and $Post1971_t = 1$ for $t \geq 1972$ and 0 otherwise. Note that $X1_{st}$ includes all other control variables including soil fertility as in (31). Note that the year dummies will now be subsumed in the Post1971 dummy. The coefficient of interest is α_3 associated with the interaction term between Ceilingsize and Post1971. The estimated coefficient captures the effect of post-1971 ceiling size (relative to its pre-1972 level) on the set of outcomes. As such the estimated interaction coefficient accounts for the relative ceiling size effect on selected outcomes in our sample.

Control Variables: We also include X_{st} , a set of control variables, lagged by one period so as to minimise the potential omitted variable bias, if any, of the estimates:

- *Log (state output):* This variable is the natural log of Net State Domestic Product available from the World Bank. This allows us to control for the heterogeneity in economic prosperity across the sample states over time.

- *Population density:* Population density is the ratio of total state-level population to geographic size of the state in each year using Population Census data (Census of India, Registrar General and Census Commissioner, Government of India). Inclusion of this variable allows us to account for time-varying population pressure on land arising from in/out migration, as well as refugee inflow in certain states (e.g., Punjab in the west and Bengal in the east) in the post independence years, that may influence land price premium and therefore capital investment. It would also address any potential concern that states where landholdings were trending downwards because of population pressure may set lower land ceilings.

- *Percentage share of SC/ST Population:* Scheduled castes (SC) and scheduled tribes (ST) tend to be over-represented among the Indian poor. Traditionally they are less educated as well. Hence states with higher SC/ST population shares could be major beneficiaries of the land redistribution programme, while their predominance in a state may also indicate lower human capital status of the state which may discourage corporate investment.

- *Percentage share of Urban to Rural population:* In general more urbanised states are more industrialised and more developed, with better human and physical infrastructure including access to road, river, ports. These states may therefore be better placed for attracting capital.

- *Literacy rate ($\frac{Total\ number\ of\ literates}{total\ population} * 100$):* State-level literacy rate reflects the human capital of the state which is a major determinant of capital investment and productivity.

- *Net sown area share:* Given that there is little or no systematic data on soil fertility, we use the ratio of net sown area to total land area in a state as a proxy. We find that the correlation between this variable and ceiling size, especially after the 1971 ceiling legislations is only 0.01 in our samples (statistically significant at 1% level), for both 1960-85 and 1960-2015 samples. The variance inflation factor is therefore close to 1, which is much less than the bench mark value 4 over which multicollinearity poses estimation problems. Including this variable therefore does not pose any such issue in our sample. The reason for this low correlation may lie in the fact that while ceiling size is based on soil quality since 1971, the share of net sown area in a state not only depends on soil fertility, but also on access to other factors of production including irrigation, credit, labour, seeds, fertilisers, etc., with both

HYV seeds, and fertilisers becoming increasingly common from around mid-60s, especially in certain states adopting green revolution in the mid-60s or so.

- *Dummy variables:* Equation (31) also includes two dummies, namely year-level (θ_t) and state (S_s) level dummies to account respectively for the unobserved aggregate time-varying and state-level time-invariant factors that may also influence the outcomes of interest. As such we focus on within state variation in outcomes, thus eliminating the concern for inter-state migration, for example. While year-level dummies θ_t account for the aggregate unobserved year-specific trends (e.g., policy changes at the centre) common to all the states, (S_s) would account for the state-level unobserved time-invariant factors affecting a state's history (e.g., presence of a successful business community), geography (access to port, difficult terrain, arid weather or success of land consolidation programmes), culture, institutions, all of which may also influence the outcomes of interest.

In addition to the baseline controls X, we re-estimate the model including several additional controls in a bid to rule out competing explanations:

- *Policy uncertainty:* This is proxied by the cumulative total number of land laws legislated in a state s in year t. This variable accounts for the states' proactiveness in land legislations which may increase policy uncertainty in securing land in the state s in year t and therefore may lower capital investment.

- *Labour militancy:* We proxy this by the man days lost in a state in a year due to strikes and other union activities (note that this information is only available for the period 1960-85). The variable accounts for the political unrest in the state s in year t. Inclusion of this control allows us to exclude the possibility that the observed ceiling effect on capital investment indices is net of the labour militancy in the state.

- *Political support for social democracy:* This is proxied by the percentage of votes won by the Indian National Congress (INC) in a state s in year t. Congress is one of the national political parties in India whose social democratic platform is generally considered in the centre to centre-left of Indian politics. Inclusion of the variable would account for the role of social democracy on land acquisition and therefore on capital investment in our analysis.

  (b) Given that ceiling size fell in 14 out of 16 sample states, we further assess the impact of fall in ceiling size (relative to its increase) in the post 1972 years in our sample. To this end, we estimate the following equation to assess its effects on Y_{st} as follows:

$$Y_{st} = \gamma_0 + \gamma_1 Ceiling\_fall_{st} + \gamma_2 Post1971_t + \gamma_3 Ceiling\_fall_{st} \times Post1971_t + \gamma_4 X_{st} + S_s + w_{st}, \quad (30)$$

  where $Ceiling\_fall_{st}$ is a binary variable taking a value 1 if the s-th state experienced a drop in ceiling size in year t and 0 otherwise. Among other factors, we include $Ceiling\_fall_{st}$, $Post1971_t$ and their interactions in each column. We include the same set of X variables (including soil fertility) as in (29). Year dummies are therefore absorbed in the post-1971 dummy. As before, we are particularly interested in γ_3, controlling for all other factors. In contrast to equation (29), (30) accounts for the relative effect of a drop in ceiling size (vis-a-vis a rise) on the selected outcome variables Y_{st} in our sample. These estimates are analysed in the next section.

6.4 Aggregate effects of ceiling size

Finally, we consider the aggregate effects of ceiling size on selected outcomes of interest over the whole sample period with state and year fixed effects.

The regression for determining any outcome variable Y_{st} in the s-th state in the t-th year, now takes the following form:

$$Y_{st} = \beta_0 + \beta_1 Ceilingsize_{st} + \beta_2 SoilFertility_{st} + \beta_3 X_{st} + S_s + \theta_t + u_{st}, \tag{31}$$

where X_{st} is a set of control variables, and S_s and θ_t are respectively state and year dummies. The variables $Ceilingsize_{st}$ and $SoilFertility_{st}$ are of course self-explanatory.

The coefficient of interest for us is the estimated coefficient of the ceiling size variable that accounts for the marginal effect of ceiling size on the selected outcomes pertaining to capital investments in our sample, ceteris paribus.

Inclusion of these additional controls allows us to eliminate the possibilities that the observed ceiling effects on capital investment indices are not due to policy uncertainty, labour militancy, political support for social democracy.

- *Green revolution:* We also eliminate the possibility that the observed ceiling effects could be due to green revolution that started in the mid-60s that enhanced soil fertility of land; one possibility is that successful green revolution is likely to raise the return from agriculture, thus inducing farmers away from industry. Since green revolution had primarily affected two of the Indian states, namely, Punjab and Haryana, we re-estimate our equations after dropping Punjab and Haryana.

- *Pro-business policies:* We attempt to eliminate the possibility that the observed ceiling effects are an artefact of the pro-business policies followed by some states. Since Gujarat and Maharashtra are the two states perceived to be most pro-business in the pre-1990s years, we re-estimate the baseline regression after dropping Gujarat and Maharashtra.

7 Empirical Findings

In this section, we test the empirical validity of our hypotheses H1 and H2. We expect that higher (lower) ceiling size would increase (decrease) total capital (H1), as well as the number of registered factories and the share of manufacturing output (H2). We start with the sample for 1960-85 during which most ceiling laws were legislated and then extend the sample to 1960-2015 to explore if the baseline effects also hold over the longer run. As before, we consider both the relative and aggregate ceiling effects on the outcomes of interest as per our hypotheses.

7.1 Baseline estimates: 1960-85

Recall that hypothesis H1 predicts that total capital is lower in states with lower ceiling size. For the states in the top 10-th and bottom 10-th percentile in the distribution of average ceiling size (states with large and small ceilings respectively), we compare the means (average) of total capital, total factories and also share of manufacturing sdp in total sdp before and after the introduction of the 1972 ceiling legislations (Table 1). While, we find no significant mean difference for any capital investment measures between states with large and small ceilings sizes before 1972, the mean difference in total capital is positive and also becomes statistically significant after 1971. In other words, after 1971, mean ln(total capital) is significantly larger in the states with larger ceiling size, indicating a positive relationship between average ceiling size and total capital in the post-1971 years.[37] Although the effect is similar for ln(total factories), the difference between low and high ceiling states remain statistically insignificant in this case.

***********Insert Table 1 here **************

Given that these are only simple comparisons of outcomes between low/high ceiling states, we next move on to multiple regression framework to examine if these mean comparisons hold after controlling for other factors that may also influence the outcomes of interest.

7.2 Relative Effects of ceiling size

As indicated in Figure 1, after 1971 legally mandated ceiling size changed in all sample states, allowing us to exploit a difference-in-difference framework. Accordingly, we consider two cases of relative effects of ceiling size: (a) effects of ceiling size after 1971 relative to that in earlier years in a state, and (b) effects of a fall in ceiling size (relative to a rise) after 1971 as 14 out of 16 sample states experienced a drop in ceiling size. All control variables are lagged by one period to minimise potential simultaneity bias, if any and all standard errors are clustered at the state level.

Table 2 summarises the effects of the post-1971 changes in ceiling size on selected outcome variables, namely, the natural logarithm of total capital (column 1), as well as two indices of industrialisation (share of manufacturing output in column 2, and natural logarithm of registered factories in column 3) using equation (29).

****Insert Table 2 here ****

Of particular interest to us is the coefficient of the interaction term $Ceilingsize_{st} \times \text{Post1971}_t$. Panel a shows the estimates using ceiling size on most fertile land. Ceteris paribus, the estimated coefficients of the interaction term are positive and statistically significant for ln(total capital) in column (1) and ln(registered factories) in column (3) though it is only statistically significant for ln(total capital); the estimated interaction coefficients remained statistically insignificant for share of manufacturing (column 2) and ln(total registered factories) in column (3).

Panel b shows the corresponding effects using the average ceiling size variable. In this case the estimated interaction term is positive and statistically significant for ln(total capital) and also for ln(total registered factories), but remained statistically insignificant for share of manufacturing in column 2.

****Insert Table 3 here ****

Table 3 further tests the robustness of these results by including additional controls, namely, natural logarithm of man days lost due to strikes, voter turnout, Congress vote percentage, cumulative number of land reform legislations in a state in a year; the latter reflects the proactiveness of the state in land reform legislaitons and may enhance the policy uncertainty for an investor; total number of land legislations vary between 0 to 11 across the sample states over the years. Other things remaining unchanged, we obtain very similar estimates of the interaction coefficients: states with higher ceiling size in the post-1971 years (relative to earlier years) had significantly higher total capital and also total number of registered factories; these effects are more pronounced when using average ceiling size in our sample.

****Insert Table 4 here ****

[37]Note, however, that we are unable to do similar comparisons for years before/after 1960/61 as we do not have observations prior to 1960.

Table 4 then uses the extended sample 1960-2015 to test further robustness tests of these estimates. Columns (1)-(3) show the estimates using ceiling size on most fertile land while columns (4)-(6) show the corresponding estimates using average ceiling size. Note that the estimated coefficients of the interaction terms are all positive in columns (1)-(6), but these estimated coefficients are only statistically significant when using average ceiling size.

Taken together, these estimates confirm the validity of H1 and H2 in that states with lower ceiling size on land – on the average, as well as the most fertile – after 1971 (relative to pre-1972 years) tend to have lower total capital and lower total registered factories. Results are somewhat weaker for the extended sample though we still find support for H1 and H2 using average ceiling size variable. Evidently, these results reflect the fact that there has been a drop in ceiling size in 14 out of 16 samples states after 1971, which is further assessed below using Equation (30).

d

Next, we compare the selected outcome variables in states that experienced a fall in ceiling size after 1971 (relative to those that did not) using Equation (30). Table 5 shows the effects of a fall in ceiling size after 1971 (irrespective of whether we use average ceiling size or ceiling size on most fertile land) on selected outcome variables, namely, ln(total capital), share of manufacturing and ln(total registered factories) in state s in year t respectively in columns (1)-(3). Panel a shows the estimates using ceiling size on most fertile land while panel b shows those using average ceiling size.

****Insert Table 5 here ****

As before, the coefficient of interest is the one associated with the interaction term $Ceiling\_fall_{st} \times Post1971_t$. The estimated coefficient of the interaction term is negative in all columns (1)-(3), but is statistically significant only in the determination of ln(total capital) irrespective of the choice of ceiling size variable. In other words, these estimates highlight the presence of a second order effect of a drop in ceiling size (relative to an increase) on total capital, thus further strengthening the results shown in Table 2 and Table 3.

7.3 Aggregate effects of ceiling size

Finally, we consider the estimates of equation (31) to determine the aggregate effects of ceiling size on selected outcome variables in our sample. As before, all control variables are lagged by one period to minimise any potential simultaneity bias of our estimates and all standard errors are clustered at the state level.

Estimates using average ceiling size. We first report on the estimates using the average ceiling size variable for the period 1960-85, controlling for various observable economic variables, as well as state and year dummies to account for the unobserved state and year fixed effects. Table 6 shows the effects of average ceiling size on selected outcome variables, namely, natural logarithm of total capital (columns 1-2) and indices of industrialisation (share of manufacturing output in columns 3 and 4 and also natural logarithm of registered factories in columns 5 and 6 respectively). Columns 1, 3, 5 show the estimates using linear average ceiling size variable while columns 2, 4, 6 show those using linear spline of average ceiling size variable, namely, if ceiling size is greater than its first quartile value in the sample. Panel a shows the baseline estimates while panel b shows the estimates with additional controls (see discussion below).

***********Insert Table 6 here **************

Estimates using linear average ceiling size variable suggest that the coefficient estimates of average ceiling size variable is positive and statistically significant only for share of manufacturing. The latter indicates that smaller (greater) ceiling size would significantly lower (increase) share of manufacturing, thus highlighting the adverse effects of limited ceiling size on manufacturing output and lending support to H2. However, the same does not hold when we replace the average ceiling size variable by its spline in column (4) of the table. The effects of average ceiling size on ln(total capital) and ln(total factories) turn out to be negative but statistically insignificant here. We, however, get strong positive effects of average ceiling size on ln(total capital) and ln(total factories) in columns (2) and (6) respectively, only when we replace the linear average ceiling size variable by its spline: average ceiling size being greater than its first quartile value Q1.

As expected, the estimated coefficients of both variables are positive and statistically significant at 1% or lower value. Thus, states with larger than the Q1 value of average ceiling size will have significantly larger total capital (supporting H1) and also more registered factories (supporting H2) in our sample, but only when we use the linear spline of the average ceiling size variable. Taken together, the relationships between average ceiling size and the outcomes could be linear or non-linear depending on the outcomes of interest.

Panel b augments Panel a results by augmenting the baseline regression with a number of control variables. First, we include CLR, which is the cumulative sum of total number of land legislations made in a state s in year t. CLR accounts for the states' proactiveness in land legislations which may increase uncertainty in securing land and therefore may lower capital investment.The estimated coefficient of lagged CLR is negative for total capital, thus supporting our conjecture that proactive states in this respect tend to suffer from lack of capital investment. Second, we include the votes won by the socially democratic Indian National Congress (INC) party. Ceteris paribus, Congress vote percentage remains statistically insignificant for any outcome variables in any specification. Further we include the ln(number of man days lost) to account for strike actions in the state, which may discourage capital investment; the estimated coefficient however remains statistically insignificant in all specifications. More importantly, inclusion of these additional control factors does not alter our key result pertaining to the effect of ceiling size on selected outcomes. Using the linear average ceiling size variable: states with smaller ceiling size tend to have significantly lower total capital (column 2) and also lower share of manufacturing (column 3); while the relationship between average ceiling size and share of manufacturing is linear, the corresponding coefficient is positive and statistically significant for ln(total capital) only when we replace the linear average ceiling size variable by it spline, namely, average ceiling size being greater than its first quartile value Q1. The estimated coefficient is positive for ln(factory), but remains weakly significant in this case. Taken together, the augmented equation still lend support to hypotheses H1 and H2 in our sample.

Estimates using ceiling size on most fertile land. Table 7 shows the effects of ceiling size on most fertile land on selected outcome variables, namely, natural logarithm of total capital (columns 1-2) and indices of industrialisation (share of manufacturing output in columns 3 and 4 and also natural logarithm of registered number of factories in columns 5 and 6 respectively). Ceiling size on most fertile land is the key explanatory variable here: columns 1, 3, 5 show the estimates using linear ceiling size variable on most fertile land while columns 2, 4, 6 show those using linear spline of the same ceiling size variable, namely, if ceiling size on most fertile land is greater than its median value. All regressions include control for a number of factors that may also influence the outcome variables as per (29): net state domestic product, population density, share of population of scheduled castes and tribes, share of urban population, literacy rate, land Gini, soil fertility as well as the state and year dummies. Panel b shows the estimates with additional controls CLR, total mandays lost and also total Congress vote percentage.

***********Insert Table 7 here **************

Using the linear ceiling size on most fertile land as the key explanatory variable, its estimated coefficient is positive for ln(total capital), share of manufacturing and ln(total registered factories), though it is statistically significant only for share of manufacturing; the latter indicates that states with smaller ceiling size tend to have significantly smaller share of manufacturing, controlling for all other factors.

If, however, we consider the linear spline of ceiling size on most fertile land, the estimated coefficients are positive for all selected outcome variables as before, but statistically significant only for ln(total registered factories). Taken together, these estimates lend support to both hypotheses H1 and H2, after controlling for soil fertility among others.

Panel b then shows the estimates of the augmented model with additional controls for the cumulative sum of all land laws legislated (CLR) in a state s in year t, man days lost as well as Congress vote percentage. Our central results pertaining to the effects of ceiling size are confirmed after including the additional controls. While the linear ceiling size variable is positive and statistically significant for the share of manufacturing output, ceiling size on most fertile land being greater than its median value Q2 is statistically significant in determining ln(total capital) as well as ln(total registered factories). Again, these results confirm the robustness of our ceiling size estimates to the inclusion of additional controls, while lending support to our key hypotheses H1 and H2.

Taken together, there is evidence from our sample that lower ceiling size on most fertile land tends to significantly constrain investment in total capital, total number of registered factories as well as share of manufacturing output. These results are, therefore, broadly in line with the results using average ceiling size variable (Table 6) and support our key hypotheses H1 and H2, after controlling for soil fertility among others.

7.4 Eliminating competing explanations

In this sub-section we argue that our results are not confounded by other competing factors that may influence the outcomes of interest.

Policy uncertainty: As discussed earlier, proactivity on part of states in implementing land legislations may create policy uncertainty in acquiring land for industries and could therefore affect capital investment. To eliminate the possibility that our ceiling effects are not biased by this factor, we control for the number of land legislations issued by a state s in year t (abbreviated by CLR_{st}). As panels b of Tables 6 and 7 demonstrate, our central results continue to hold even after controlling for CLR_{st}, respectively using average ceiling size and ceiling size on most fertile land.

Pro-labour policies: It is also possible that capital investment in the sample states are influenced by pro- or anti-labour policies pursued by them. While we cannot quantify such labour policies, we do observe the number of man days lost due to worker strikes for each state in a year. Such loss of man days indicates the presence of strong labour unions and could be a proxy for pro-labour policies followed by the states. We therefore include the log of man days lost because of worker strike as an additional control to eliminate the possibility that the observed ceiling effects reflect this. The results, summarised in panel b of Tables 6 and 7, continue to lend support to our key hypotheses H1 and H2, suggesting that our results are not an artefact of the presence of states persuing pro-labour policies.

Pro-business policies: Table A4.3 in Appendix 4 presents the estimates of selected outcomes in our sample after dropping Gujarat and Maharashtra (using average ceiling size variable). These states are traditionally known to be pro-business and it is possible that they were introducing policies to boost capital investment concomitantly with ceiling legislations, which in turn could bias the ceiling effects of capital estimates.[38] Evidently, these new estimates are compatible with

[38]In Gujarat, industrialisation was boosted by the establishment of an Indian Institute of Management in 1961,

our baseline results in Tables 6 and 7, suggesting that these results cannot be attributed to the presence of pro-business states.

Effects of green revolution: Finally, Table A4.4 in Appendix 4 shows the estimates after dropping Punjab and Haryana, two states that largely benefitted from the introduction of the Indian green revolution that started around the mid-60s. This is of interest because the green revolution was accompanied by increasing irrigation, use of high-yielding variety seeds, chemical fertiliser, all of which may boost soil fertility and therefore may confound the baseline estimates pertaining to capital investment for industries. Table A4.5 however confirms that our central results still go through thus lending support to hypotheses H1 and H2; these results also reject the possibility that these results are an artefact of the presence of Punjab and Haryana in the sample.

Evidence from extended sample 1960-2015: Our analysis of aggregate effects of ceiling size was so far based on sample data from 1960-85. We next extend the analysis to the period 1960-2015, with a view to assessing the long-run effects of ceiling size on indices of capital investment, if any.

***********Insert Table 8 here **************

Panel a shows the estimates using average ceiling size and Panel b shows those using ceiling size on most fertile land. Columns (1)-(3) summarise the estimates of the three outcome variables, namely, natural logarithm of total capital (column 1), share of manufacturing output (column 2) and natural logarithm of registered factories (column 3), central to the hypotheses of interest.

Evidently, capital investment measures are significantly lower when linear average ceiling size is lower in the extended sample too (see panel a). The corresponding effects using ceiling size on most fertile land tend to be weaker. In this case, the linear ceiling size effect is positive for all three capital investment indices, but turns out to be statistically significant only for ln(total factories). For share of manufacturing, however, we identify some non-linear ceiling size (on most fertile land) effect. In other words, the ceiling size effect on ln(total capital) is somewhat weaker in the extended sample relative to that for the 1960-85 period; however, it continues to be highly significant for both share of manufacturing as well as ln(total registered factories) irrespective of the choice of the ceiling size variable. These extended sample results lend support to H2 that states with smaller ceiling size lend to have lower level of industrialisation as reflected in lower total number of registered factories as well as lower share of manufacturing.

7.5 Empirical validity of the transaction cost hypothesis

Section 7.1 argues that states with low ceiling size not only have significantly lower investment in capital, but also less factories and lower share of manufacturing output, results that are consistent with our predictions in H1 and H2. As per our theoretical model, we attribute these results to the higher transaction costs of acquiring land in states with lower ceiling size because of greater land fragmentation after introduction of ceiling legislations (see Section 3 and Appendix 2). In this section, we shall now assess the relevance of the land fragmentation and transaction costs hypothesis in the light of available information.

Non-strategic costs of acquisition: Earlier in the Introduction we discussed both the non-strategic and the strategic costs of acquiring land for industries. Non-strategic costs include legal costs of writing a contract, including stamp duties, as well as registration fees.[39] By international standards,

GIDC in 1962, Dairy Development Board in 1965, etc. Similarly, in the 1960s and the 1970s Maharashtra gained from its transport infrastructure, concentration of commercial bank branches, as well as a stable power situation. Some of these relative advantages were of course whittled away in the 1980s as other states started doing better.

[39]A stamp duty is a tax on the value of instruments used in various business transactions. There are two sub-classifications: judicial stamp duties and nonjudicial stamp duties. Judicial stamp duties are fees collected from

Indian stamp duties, in particular non-judicial stamp duties, are very high, often in excess of 10%, thus imposing a high cost of compliance. Further, the process for the payment of stamp duties (and the registration of the sale deed) is exceptionally complex and time-consuming. Consequently, stamp duties have been subject to a good deal of evasion and fraud, with under declaration of land being very common. While there are small variations in stamp duties across the states (imposed centrally), the stamp duties remained largely invariant during 1960-85 (Alm et al. 2004) - most changes in stamp duties came in the 1990s. Because of high non-strategic costs of acquiring land, e.g. high stamp duty, registration fees, etc. property transfers are often not registered, with such opacity adding to the transaction costs of land acquisition (see Mishra and Suhag, 2017). These costs get multiplied if a buyer has to acquire multiple plots of land; the latter in turn may cause delays and legal conflicts in land acquisition pushing up transactions costs further.

Strategic costs of acquisition: As discussed in the Introduction, conflicts in the process of land acquisition for industries are common in many economies, though systematic long-term data is hard to come by. A report by RRI and TISS[40] analyzes 289 ongoing land conflicts—around 25-40 percent of active and substantive land conflicts in India. It found that these conflicts have impacted 3.2 million people and posed a risk to over Rs. 12 trillion (US$179 billion) worth of investments.[41] Singh (2013) also documents conflicts over land acquisition recorded in the High Courts of Punjab and Haryana. Most of these disputes pertain to the amount of compensation, in particular those granted by government officer. Besides, some disputes related to compensation for the other properties such as the superstructures, trees, wells, etc. Also, there were a few cases of dispute over ownership of the land acquired, condonation in filing the application, grant of compensation on account of severance, apportionment of compensation and disagreement on the land type.

Given the lack of systematic and direct data in this respect, we now seek to provide some indirect evidence for the transactions cost hypothesis. In particular, we argue that there is a negative relation between legislated ceiling size and average landholding in a state. In other words, states with smaller ceiling size had more land fragmentation and hence smaller landholding size, which, we argue, increases the transactions costs of land acquisition.

***********Insert Table 9 here **************

First, consider states which are not too fertile, i.e not in the top 10% in the distribution of ceiling size on most fertile land. Using the information available from successive agricultural censuses between 1961-91 in India, Table 9 compares the average cultivable land holding per household, as well as per person, before and after 1972 for these states. We have already shown that ceiling size dropped in fourteen out of sixteen sample states after 1971 (see Figure 1). It is evident from Table 9 that the mean cultivable land holding per household, as well as that per person, was significantly lower in the states with very small ceiling size after 1971 (relative to earlier years) in our sample.

Second, this trend is also evident from Figure 3 that shows the relationship between ceiling size (average, as well as that on most fertile land) and average cultivable land per household. The relationship is distinctly upward sloping, indicating that the size of land holding per household is

litigants in courts, and are best viewed as court fees. For most states, judicial stamp duties are relatively small in magnitude. Non-judicial stamp duties are typically a one-time charge on the transfer of immovable property; because the charge is a one-time payment whose tax base is the value of the transaction, it can appropriately be seen as a tax on the transaction.

[40]"Land Conflicts in India: An Interim Analysis" by RRI and TISS.

[41]Three-quarters of these land-related conflicts involved common lands. More than 40 percent of all land-related conflicts analyzed involved forest lands, the majority of which occurred in regions where the state has failed to recognize the customary rights of tribal communities.

smaller in states with lower ceiling size. The positive relationship between ceiling size and average landholding holds irrespective of the choice of the ceiling size variable (average, or on most fertile land).

***********Insert Table 10 here **************

Finally, Table 10 shows the parametric estimates of ceiling size on land holding size in our sample states, both cultivable and total land holding. Columns (1)-(2) show the estimates for cultivable landholding per household, while columns (3)-(4) show the estimates for total landholding per household over 1960-85. We find that for each case, average landholding is increasing in ceiling size, irrespective of the choice of the ceiling variable – average ceiling size or ceiling size on most fertile land.

Evidently these findings are compatible with those made by Bandyopadhyay (1986): (i) between 1970-71 to 1980-81, there has been an increase in small (those who own 1-2 ha land) and marginal farmers (those who own less than 1 ha), though the extent varies across the states. (ii) Between 1970-71 to 1980-81, there has been a drop in the size of operational holding of large farmers in most Indian states, even if marginally.

Taken together, the available evidence lends support to our conjecture of land fragmentation, which in turn increases transactions costs.

8 Conclusion

Transferring land from (relatively low productivity) agriculture to industry has proved to be difficult in many developing and emerging economies. We went further to show that land ceiling legislations in India too had reduced farm size, which in turn enhanced transaction costs of land acquisition for factories. We argue that this can be one contributory factor to the premature deindustrialisation seen in many such economies (as documented by Rodrik (2016) in general, and by Amirapu and Subramanian (2015) in the Indian context). Ours is the first paper to document the role of legislated ceiling size in explaining these trends.

Departing from the existing literature, the present paper argues that land ceiling legislations, an important component of land reforms in many countries including India, can lead to greater fragmentation, thereby making land acquisition more costly, and hence reducing capital investment, as well as the pace of industrialization. Moreover, note that such ceiling legislations have been adopted not just in India, but in many populous emerging countries: Bangladesh in 1984, Ethiopia in 1975, South Korea in 1950, Pakistan in 1972 and 1977, Sri Lanka in 1972, and Philippines in 1988 in Asia; many poor southern American countries too adopted ceiling legislations at various points in time.[42]

The paper therefore speaks to both the deindustrialisation, and the transfer puzzle in general, and not just in the Indian context, but beyond the Indian border. In so doing, it brings together two issues that are critical to the development of such economies - land acquisition and land reform.

We exploit the variation in land ceiling size legislations across states and over time to argue that, irrespective of whether ceiling legislations were implemented effectively or not, these were important exogenous drivers of capital investment and pace of industrialisation. In particular, we examine how these legislations affected total capital investment and pace of industrialisation within a state. First of all the timings of these legislations are taken to be random. Also, we control for

[42]Further, there was a substantial decrease in average farm size and labour productivity in all these countries within a decade or two of these reforms (Adamopoulos and Restuccia (2014); Adamopoulos and Restuccia (2019)). The latter links to the issue identified in this paper, namely deindustrialisation triggered by well-meaning land ceiling legislations.

various time-varying state characteristics, and state and year fixed effects, as well as rule out the possibility of pre-trends in the outcome variables prior to the 1971 legislations. Results identifying both relative and aggregate effects of ceiling size on selected capital investment measures suggest that states with more fertile land (and therefore with lower legislated ceiling size, especially after 1971) tend to have lower investment in total corporate capital. Such states also have a lower number of registered factories, and hence a lower pace of industrialisation as well, thus supporting both hypotheses H1 and H2.

These results, coupled with the fact that states with smaller ceiling size had faced greater land fragmentation (as reflected in lower average landholding size per household and per individual), suggest that the channel via which ceiling legislations affected capital investment and industrialisation does indeed involve land fragmentation. Finally our results offer at least two sets of policies: first, registration and digitisation of all land records to lower the non-strategic transaction costs of land acquisition. Second, we advocate for a 'local' rather than a 'national' consent clause for land acquisition to lower the strategic transaction costs. Of course, these policies need to be accompanied by complementary policies, e.g., reform of labour laws, development of transport and infrastructure as well as ensuring easy access to credit, to boost capital investment.

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Tables

Table 1. Mean comparisons of the capital investment before and after 1971 ceiling law, 1960-85

The table below compares indices of mean capital investment in low (bottom 10th percentile) and high (top 10th percentile ceiling states before and after 1971 ceiling laws. In addition to ln(total capital), we consider ln(total number of registered factories) and share of manufacturing output in state net domestic product as the relevant capital investment indices. Significance level: *** p<0.01, ** p<0.05, * p<0.1

Before 1972	Large ceilings (top 10th percentile)	Small ceilings (bottom 10th percentile)	Mean difference-T-statistics
Ln(Total capital)	7.35	7.44	-0.3348
Ln(Total factory)	6.35	7.16	- 1.7633
Share of mfg.	0.09	0.13	-1.9506
After 1971			
Ln(Total capital)	7.89	7.48	2.8759***
Ln(Total factory)	7.80	7.11	1.5668
Share of mfg.	0.10	0.13	1.5148

Table 2. Difference-in-difference pre-post 1971 effects of ceiling size on selected outcomes, 1960-85

The table shows the effect of 1971 changes in ceiling size (relative to that prior to 1971) on selected outcome variables, namely, natural logarithm of total capital (column 1) and indices of industrialisation (share of manufacturing output in column 2 and also natural logarithm of registered factories in column 3). Panel A shows the estimates using ceiling size on most fertile land while Panel B show the corresponding estimates using average ceiling size variable. Post1971 is a binary variable taking a value 1 if years>=1972 and 0 otherwise. We also include an interaction of ceiling size with Post1971 in both Panel a and Panel b. All regressions include other controls: net state domestic product, population density, share of population of scheduled castes and tribes, share of urban population, literacy rate, land Gini, soil fertility, natural logarithm of man days lost due to strikes. All control variables are lagged by one year to minimise any potential simultaneity bias. All regressions also include state dummies; year dummies are absorbed in Post1971 dummy. Standard errors are clustered at the state level. Significance level: *** p<0.01; ** p<0.05; * p<0.1.

Panel a	(1)	(2)	(3)
VARIABLES	Ln(totalcapital)	Sh. Mfg output	Ln(factory)
MostfertileCeilings	0.1693	0.0604***	-0.4090**
	(0.208)	(0.011)	(0.158)
post1971	-1.8434**	0.0186	-0.4929
	(0.714)	(0.019)	(0.422)
MostfertileXPost1971	0.1130**	-0.0007	0.0273
	(0.045)	(0.001)	(0.028)
Constant	2.1617	-0.9574***	11.2524***
	(3.387)	(0.174)	(2.443)
Observations	344	336	318
R-squared	0.354	0.922	0.956
Panel b	Ln(totalcapital)	Sh. Mfg output	Ln(factory)
Average ceiling	-0.0081	-0.0001	-0.0033*
	(0.006)	(0.000)	(0.002)
Post1971	-1.2696***	0.0087	-0.6843***
	(0.396)	(0.008)	(0.196)
AveragenCeilingxPost1971	0.0785***	-0.0002	0.0422***
	(0.025)	(0.001)	(0.012)
Constant	4.7068	-0.1052	6.3542***
	(3.466)	(0.076)	(1.505)
Observations	344	336	318
R-squared	0.384	0.922	0.963
Other controls	Yes	Yes	Yes
State dummies	Yes	Yes	Yes

Table 3. Difference-in-difference pre-post 1971 effects of ceiling size on selected outcomes, 1960-85 - with additional controls

The table shows the effect of 1971 changes in ceiling size (relative to that prior to 1971) on selected outcome variables, namely, natural logarithm of total capital (column 1) and indices of industrialisation (share of manufacturing output in column 2 and also natural logarithm of registered factories in column 3). Panel a shows the estimates using ceiling size on most fertile land while Panel b show the corresponding estimates using average ceiling size variable. Post1971 is a binary variable taking a value 1 if years>=1972 and 0 otherwise. We also include an interaction of ceiling size with Post1971 in both Panel a and Panel b. All regressions include controls: net state domestic product, population density, share of population of scheduled castes and tribes, share of urban population, literacy rate, land Gini, soil fertility, natural logarithm of man days lost due to strikes, voter turnout, Congress vote %, cumulative number of land reform legislations in a state in a year. All control variables are lagged by one year to minimise any potential simultaneity bias. All regressions also include state dummies; year dummies are absorbed in Post1971 dummy. Standard errors are clustered at the state level. Significance level: *** p<0.01; ** p<0.05; * p<0.1.

	(1)	(2)	(3)
VARIABLES	Ln(totalcapital)	Sh. Mfg	Ln(factory)
Panel a			
Most fertile ceilings	0.1862	0.0640***	-0.3941**
	(0.188)	(0.011)	(0.170)
Post 1971	-1.8505**	0.0132	-0.5000
	(0.666)	(0.016)	(0.455)
MostfertilexPost1971	0.1168**	-0.0004	0.0280
	(0.041)	(0.001)	(0.029)
Constant	-0.1651	-0.982***	11.3347***
	(3.721)	(0.152)	(2.888)
Observations	335	327	312
R-squared	0.360	0.923	0.953
Panel b	Ln(totalcapital)	Sh. Mfg	Ln(factory)
Average ceilings	-0.0095	-0.0001	-0.0032*
	(0.005)	(0.000)	(0.002)
Post 1971	-1.2671***	0.0078	-0.6728***
	(0.403)	(0.008)	(0.186)
AveragexPost1971	0.0822***	-0.0001	0.0417***
	(0.022)	(0.001)	(0.011)
Constant	2.0651	-0.0853	6.7312***
	(4.239)	(0.080)	(1.578)
Observations	335	327	312
R-squared	0.396	0.923	0.960

Table 4. Difference-in-difference estimates of pre-post 1971 effects of ceiling size on selected outcomes in extended sample 1960-2015

The table shows the effect of 1971 changes in ceiling size (relative to that prior to 1971) on selected outcome variables, namely, natural logarithm of total capital (column 1) and indices of industrialisation (share of manufacturing output in column 2 and also natural logarithm of registered factories in column 3) using 1960-15 data. Columns (1)-(3) show the estimates using ceiling size on most fertile land while columns (4)-(6) show the corresponding estimates using average ceiling size variable. Post1971 is a binary variable taking a value 1 if years>=1972 and 0 otherwise. We also include an interaction of ceiling size with Post1971 in both Panel a and Panel b. All regressions include controls: net state domestic product, population density, share of population of scheduled castes and tribes, share of urban population, literacy rate, soil fertility, cumulative number of land reform legislations in a state in a year. All control variables are lagged by one year to minimise any potential simultaneity bias. All regressions also include state dummies; year dummies are absorbed in Post1971 dummy. Standard errors are clustered at the state level. Significance level: *** p<0.01; ** p<0.05; * p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Ln(totalcapital)	Share of mfg	Ln(factory)	Ln(totalcapital)	Share of mfg	Ln(factory)
Most fertile ceilings	0.6700***	-0.016***	0.4835***			
	(0.186)	(0.004)	(0.064)			
Post1971	2.2011	-0.0067	0.1601	0.7457	-0.0133	-0.2907
	(1.505)	(0.036)	(0.490)	(0.757)	(0.015)	(0.247)
Most fertilexPost1971	0.0349	0.001	0.004			
	(0.108)	(0.002)	(0.031)			
Average ceiling				-0.0217	-0.0006*	-0.009***
				(0.014)	(0.000)	(0.003)
AveragexPost1971				0.0622*	0.0012	0.0347**
				(0.044)	(0.001)	(0.015)
Constant	-8.4890**	0.3114***	1.5054	1.8513**	0.1031***	8.5746***
	(3.165)	(0.078)	(1.140)	(0.766)	(0.027)	(0.235)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
State dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	594	829	635	594	829	635
R-squared	0.914	0.791	0.945	0.916	0.795	0.947

Table 5. Difference-in-difference estimates of relative fall in ceiling size after 1971 on selected outcome variables

This table shows the estimates of a fall in ceiling size after 1971 on selected outcome variables in our sample, within a difference-in-difference framework. Ceiling_fall is a binary variable taking a value 1 for the states that experienced a fall in ceiling size. Post1971 is a binary variable taking a value 1 if years>=1972 and 0 otherwise. All regressions in panel a also control for lagged values of a number of control factors: net state domestic product, population density, share of population of scheduled castes and tribes, share of urban population, literacy rate, soil fertility. Panel b estimates include additional controls: natural logarithm of man days lost due to strikes, voter turnout, Congress vote %, cumulative number of land reform legislations in a state in a year. All control variables are lagged by one year to minimise the potential simultaneity bias. All regressions also include state dummies; year dummies are subsumed in Post1971. Standard errors are clustered at the state level. Significance: *** p<0.01; ** p<0.05; * p<0.1.

Panel a	(1)	(2)	(3)
VARIABLES	Ln(totalcapital)	Share of mfg	Ln(factory)
Ceiling fall	0.4657	-0.0811***	0.4755
	(0.951)	(0.017)	(0.435)
post1971	0.3946	-0.0170	1.8592
	(1.342)	(0.031)	(1.082)
Ceiling fall*post1971	-0.8392***	-0.0042	-0.2858
	(0.228)	(0.009)	(0.278)
Constant	2.0515	-0.0770	6.6188**
	(4.173)	(0.110)	(2.870)
Other controls	Yes	Yes	Yes
State dummies	Yes	Yes	Yes
Observations	344	336	318
R-squared	0.489	0.935	0.970
Panel b	Ln(totalcapital)	Share of mfg	Ln(factory)
Ceiling fall	0.3819	-0.0554**	0.7676
	(1.063)	(0.019)	(0.543)
post1971	0.7376	0.0059	2.0819*
	(1.133)	(0.031)	(1.110)
Ceiling fallxPost1971	-0.8446***	-0.0059	-0.2862
	(0.252)	(0.010)	(0.259)
Constant	-0.9845	-0.0368	6.8718**
	(4.490)	(0.108)	(2.840)
Other controls	Yes	Yes	Yes
State dummies	Yes	Yes	Yes
Observations	335	327	312
R-squared	0.517	0.936	0.969

Table 6. Aggregate effects of average ceiling size on selected outcome variables, 1960-85 - Pooled OLS estimates

The table shows the effect of average ceiling size on selected outcome variables, namely, natural logarithm of total capital (columns 1-2) and indices of industrialisation (share of manufacturing output in columns 3 and 4 and also natural logarithm of registered number of factories in columns 5 and 6 respectively). Average ceiling size on most fertile land is the key explanatory variable here: columns 1, 3, 5 show the estimates using linear average ceiling size variable while columns 2, 4, 6 show those using linear spline of average ceiling size variable, namely, if ceiling size is greater than its first quartile value. All regressions shown in top panel a include control for a number of factors that may also influence the outcome variables: net state domestic product, population density, share of population of scheduled castes and tribes, share of urban population, literacy rate, land Gini and soil fertility. Regressions shown in the bottom panel b include additional controls, namely, total number of land laws legislated in a state s in year t as measured by the variable CLR, total mandays lost and also total Congress vote percentage. All control variables are lagged by one year to minimise any potential simultaneity bias. All regressions also include state and year dummies. Standard errors are clustered at the state level. Significance level: *** p<0.01; ** p<0.05; * p<0.1.

Panel a	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Ln(totcapital)	Ln(totcapital)	Sh of mfg	Sh of mfg	Ln(factory)	Ln(factory)
Average ceiling size	-0.0131		0.0031***		-0.0172	
	(0.015)		(0.001)		(0.020)	
Average ceilings>Q1		1.3470***		-0.0357		2.5659***
		(0.514)		(0.024)		(0.827)
Constant	3.8735	1.5959	-0.2516*	-0.1182	7.4843*	4.4607
	(2.527)	(2.207)	(0.119)	(0.118)	(3.642)	(2.845)
State & Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	344	344	336	336	318	318
R-squared	0.434	0.434	0.934	0.934	0.968	0.968
Panel b	With additional controls					
Average ceilings	-0.0154		0.0030***		-0.0289	
	(0.015)		(0.001)		(0.023)	
Average ceilings>Q1		1.6578**		-0.0559		0.8028*
		(0.737)		(0.050)		(0.492)
Constant	7.157***	6.7452***	-0.2080*	-0.1284	12.1967**	11.4251**
	(2.529)	(2.312)	(0.100)	(0.104)	(5.467)	(4.914)
State & Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	335	335	327	327	312	312
R-squared	0.571	0.571	0.933	0.933	0.968	0.968

Table 7. Aggregate effects of ceiling size on most fertile land on selected outcome variables, 1960-85 - Pooled OLS estimates

The table shows the effect of ceiling size on most fertile land on selected outcome variables, namely, natural logarithm of total capital (columns 1-2) and indices of industrialisation (share of manufacturing output in columns 3 and 4 and also natural logarithm of registered factories in columns 5 and 6 respectively). Ceiling size on most fertile land is the key explanatory variable here: columns 1, 3, 5 show the estimates using linear ceiling size on most fertile land while columns 2, 4, 6 show those using linear spline of the same ceiling size variable, namely, if ceiling size is greater than its median value. All regressions in Panel a include control for a number of factors that may also influence the outcome variables: net state domestic product, population density, share of population of scheduled castes and tribes, share of urban population, literacy rate, land Gini, soil fertility. All control variables are lagged by one year to minimise any potential simultaneity bias. Regressions shown in the bottom panel b include additional controls, namely, total number of land laws legislated in a state s in year t as measured by the variable CLR, total mandays lost and also total Congress vote percentage. All regressions also include state and year dummies. Standard errors are clustered at the state level. T-statistics are shown in the parentheses; significance level: *** p<0.01; ** p<0.05; * p<0.1.

Panel a	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Ln(totalcapital)	Ln(totalcapital)	Sh of mfg	Sh of mfg	Ln(factory)	Ln(factory)
MostfertileCeilings	0.4305		0.0609***		0.1179	
	(0.619)		(0.010)		(0.376)	
MostfertileCeilng>Q2		1.3470*		0.0459		2.5659***
		(1.771)		(0.047)		(0.827)
Constant	-2.5026	2.1769	-1.0062***	-0.1998**	5.3758	4.4607
	(6.575)	(7.842)	(0.198)	(0.076)	(3.348)	(2.845)
State & Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	344	344	336	336	318	318
R-squared	0.434	0.434	0.934	0.934	0.968	0.968
Panel b	With additional controls					
MostFertileCeilings	-1.0721*		0.0603***		-0.2878	
	(0.529)		(0.011)		(0.532)	
Mostfertile ceiling>Q2		2.4493**		0.0559		3.0643***
		(0.950)		(0.050)		(0.833)
Constant	21.7548*	4.2959	-0.973***	-0.18**	15.454	8.361*
	(11.450)	(4.993)	(0.195)	(0.071)	(12.208)	(4.403)
State & year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	335	335	327	327	312	312
R-squared	0.571	0.571	0.933	0.933	0.968	0.968

Table 8. Aggregate long-term impact of ceiling size on selected outcomes, 1960-2015- Pooled OLS

The table shows the long-run effects of ceiling size on indices of capital investment in our sample over 1960-2015. Panel A shows the estimates using average ceiling size and Panel B shows those using ceiling size on most fertile land. Columns (1)-(3) summarise the estimates of the three outcome variables, namely, natural logarithm of total capital (column 1), share of manufacturing output (column 2) and natural logarithm of registered factories (column 3). Q1, Q2, Q3 respectively refer to the first, second and third quartiles of the distribution of land ceiling size (average or that on most fertile land) in our sample. All regressions also control for net state domestic product, population density, share of population of scheduled castes and tribes, share of urban population, literacy rate, soil fertility. All control variables are lagged by one year to minimise the potential simultaneity bias. All regressions also include state and year dummies. Standard errors are clustered at the state level. Significance level: *** p<0.01; ** p<0.05; * p<0.1.

VARIABLES	(1) Ln(totalcapital)	(2) Ln(factory)	(3) Sh. Of mfg
Panel A			
Average ceilings>Q1	0.6652*	0.3896**	0.0399***
	(0.350)	(0.152)	(0.012)
Constant	3.3515***	8.1559***	0.0465*
	(0.223)	(0.325)	(0.024)
Other controls	Yes	Yes	Yes
State &year dummies	Yes	Yes	Yes
Observations	596	637	830
R-squared	0.979	0.966	0.850
Panel B			
Most fertile ceiling	0.0976	0.3950***	
	(0.064)	(0.077)	
Most fertile Q1			0.0525***
			(0.016)
Most fertile Q2			0.0273
			(0.022)
Most fertile Q3			0.0700**
			(0.025)
Constant	3.3515***	8.1559***	0.0465*
	(0.223)	(0.325)	(0.024)
Other controls	Yes	Yes	Yes
State &year dummies	Yes	Yes	Yes
Observations	596	637	830
R-squared	0.979	0.966	0.850

Table 9. Mean comparisons of average cultivable landholding in low ceiling states before and after 1971 ceiling law for those below 90th percentile 1960-85

The table compares average cultivable land holding (per household and per person) before and after the 1971 ceiling law in low ceiling states, i.e., when the ceiling size is below the 90th percentile value (i.e., p90=0). Levels of significance: *** p<0.01; ** p<0.05; * p<0.1.

	States with small ceilings (p90=0)		t-statistics
	Before 1971 State-level data	After 1971	
Average cultivable landholding per household (ha)	0.035	0.028	2.2339**
Average cultivable landholding per person (ha)	$1.35*10^{-9}$	$8.34*10^{-10}$	5.6410***

Table 10. Effect of ceiling size on average landholding (total and cultivable), 1960-85 years

The table shows the relationship between ceiling size and land holding size, both total and cultivable land holding. Other controls are as in Table 3: net state domestic product, population density, share of population of scheduled castes and tribes, share of urban population, literacy rate, land Gini, soil fertility, natural logarithm of man days lost due to strikes. All control variables are lagged by one year to minimise the potential simultaneity bias. All regressions also include state and year dummies. Standard errors are clustered at the state level. Significance level: *** p<0.01; ** p<0.05; * p<0.1.

VARIABLES	(1) Average cultivable land	(2) Average cultivable land	(3) Average land holding	(4) Average land holding
Average ceilings	0.0014***		0.0288***	
	(0.000)		(0.006)	
Most fertile ceilings		0.0089**		-0.2751**
		(0.004)		(0.118)
Mostfertile>Q3				1.8694***
				(0.430)
Constant	0.0213	-0.0662	1.1939	5.8139**
	(0.071)	(0.053)	(1.320)	(2.537)
other controls	Yes	Yes	Yes	Yes
State dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Observations	194	194	194	194
R-squared	0.993	0.993	0.998	0.998

Figures

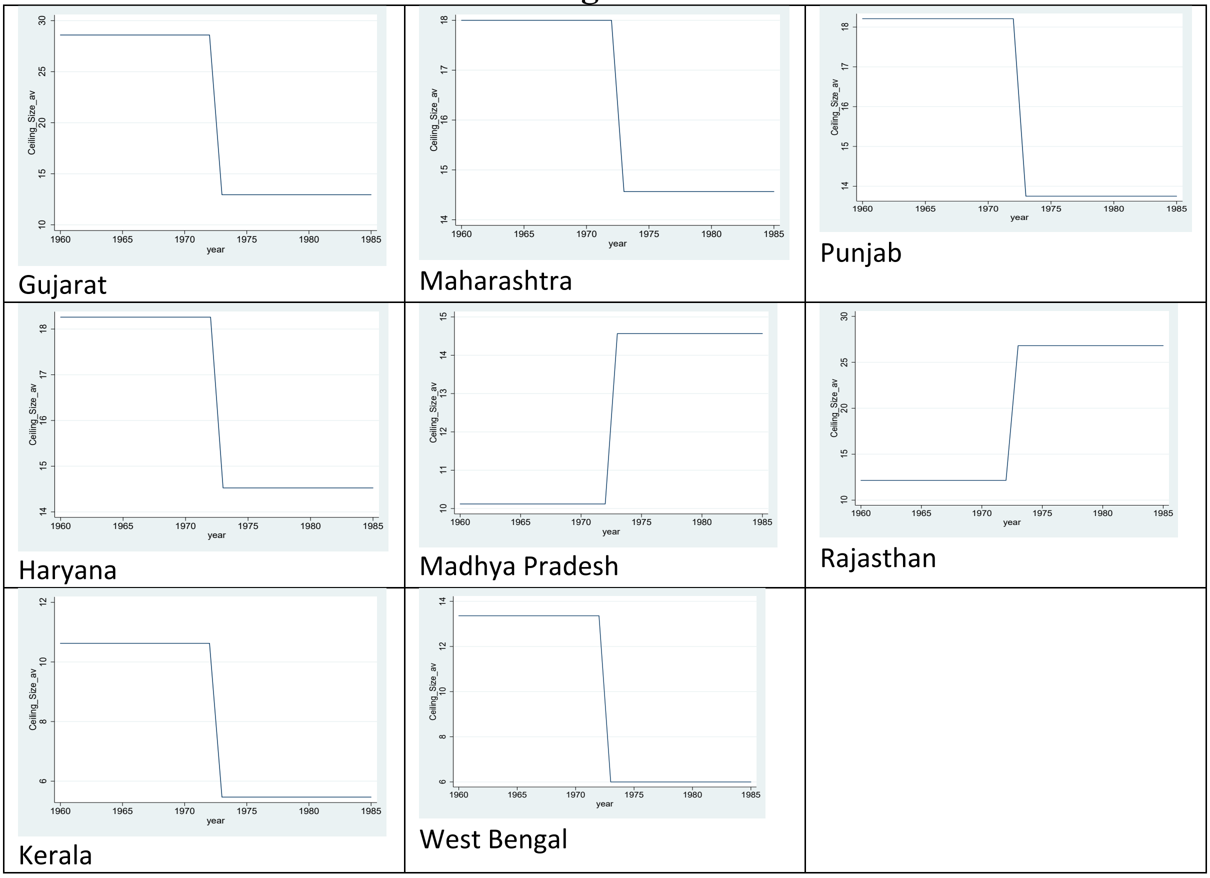


Figure 1. Inter-state variations in ceiling size in our sample over 1960-85

The figure plots the ceiling size among selected states over 1960-85. Note that fourteen out of sixteen sample states (with the exception of MP and Rajasthan) had experienced a drop in ceiling size after 1972.

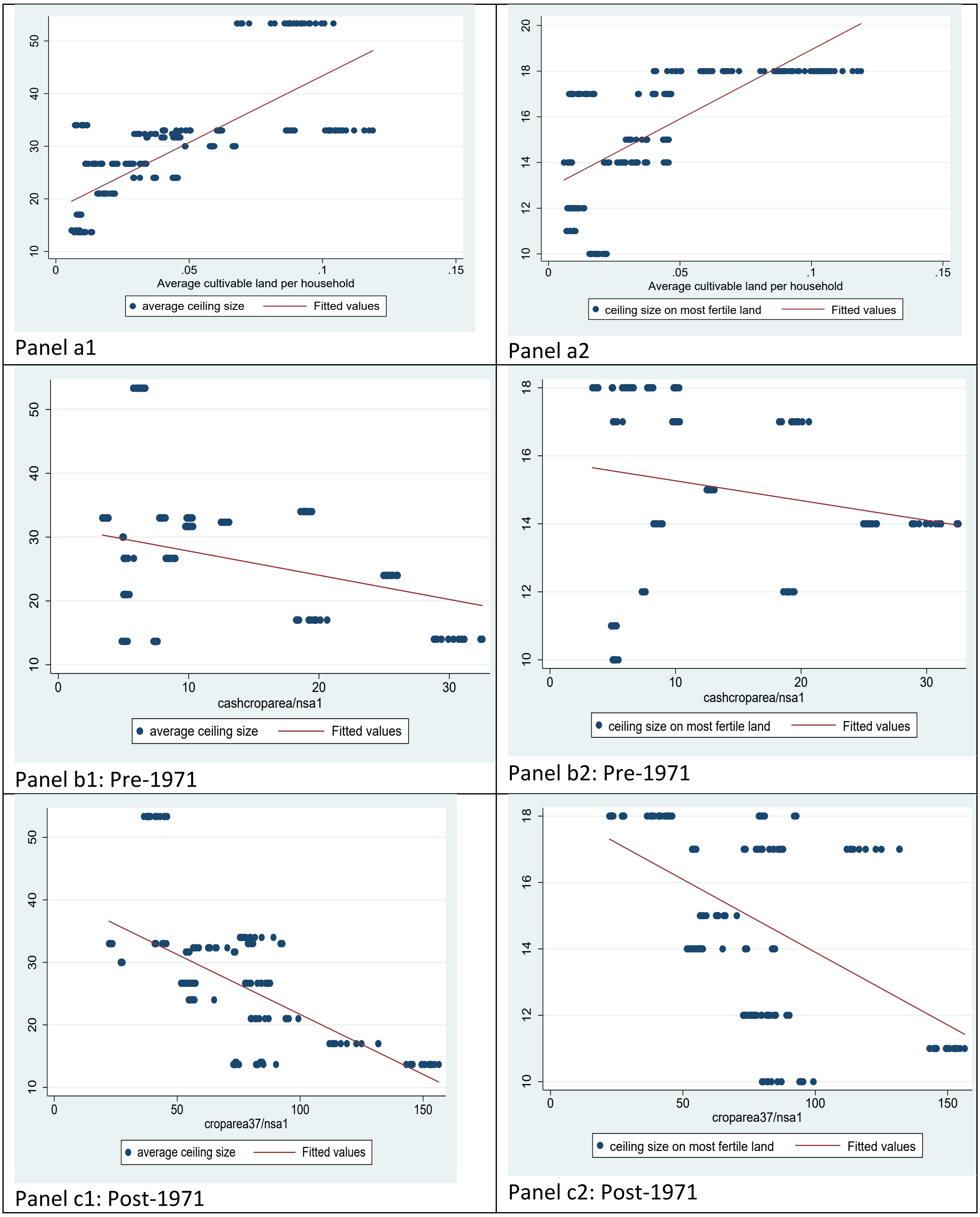
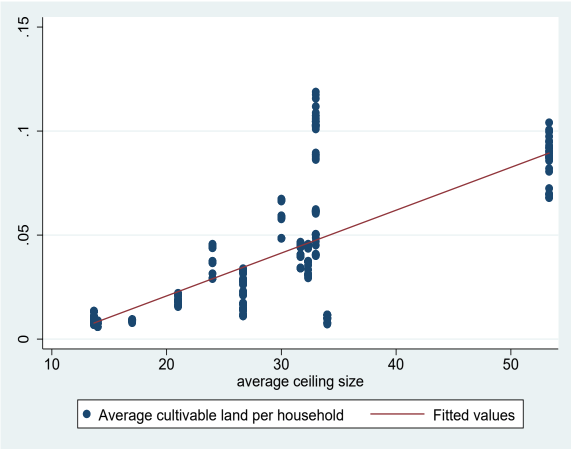
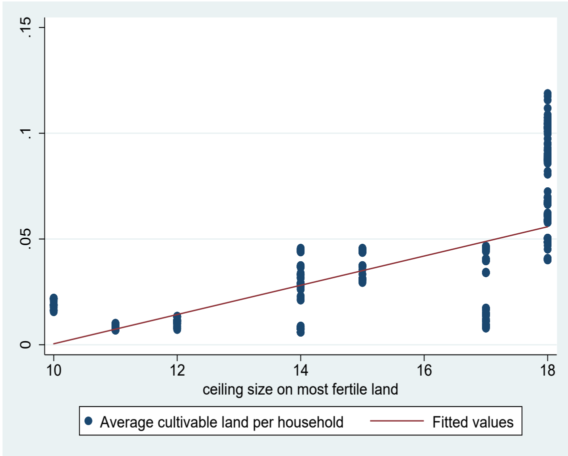


Figure 2. Empirical validity of ceiling legislations in determining ceiling size

Panels (a)-(c) show the correspondence between ceiling size (average on the left panel and that on most fertile land on the right panel on the vertical axis) on the one hand and respectively average cultivable land, share of cash crop area (in the pre-1971 years) and proxy for soil fertility (post-1971 years) on the other in our sample.



Panel a. Average cultivable land holding



Panel b. Average cultivable landholding

Figure 3. Effect of ceiling size on average landholding per household

The figure shows the effect of ceiling size, average and that on most fertile land, on average cultivable land per household (on the vertical axis).

1 Appendix 1: Production with land, labour and capital

We now introduce labour into the production process, which of course is realistic. Further, this allows us to introduce another feature that is of importance for many countries, including India, namely minimal wage restrictions. We modify the baseline model so as to allow for these aspects. Thus we consider an economy with two consumption goods, A and I, and three factors of production, labour (l), land (h), and capital (k). The representative consumer has a labour supply of $L = 1$ which she supplies inelastically to the two sectors. While industry uses all three factors of production, agriculture does not use capital, and only uses land and labour. With some abuse of notation we let $I(k, h_I, l_I)$ denote industrial, and $A(h_A, l_A)$ denote agricultural output:

$$\begin{aligned} I(k, h_I, l_I) &= [k^\rho + \min\{l_I, h_I\}^\rho]^{\frac{1}{\rho}}, &(1)\\ A(h_A, l_A) &= Y \min\{\frac{l_A}{\alpha}, \frac{h_A}{\beta}\}, &(2)\end{aligned}$$

where $\alpha, \beta > 0$ and $\rho < 0$. Note that the specific functional form adopted for $I(k, h_I, l_I)$ keeps the analysis tractable, as well as allows us to focus on capital as the critical input into industry.

As earlier, capital is rented from abroad at a gross rental rate of r, and the land market is imperfect in that $s_I = \tau s_A$. In the labour market the government fixes a minimal wage of $\bar{w}$. We assume that minimal wage restrictions are are relatively harder to enforce in agriculture which is in the non-formal sector. For tractability, we assume that $\bar{w}$ is strictly enforced in industry, but not in agriculture. At this wage, industry utilizes l_I, and the remaining labour $1 - l_I$ remains in the agricultural sector. We assume that there is surplus labour in agriculture, in that labour demand in agriculture $l_A < 1 - l_I$, driving down agricultural wages to zero. Thus the profit function of firms in the industrial sector is given by

$$\pi_I = p[k^\rho + \min\{l_I, h_I\}^\rho]^{\frac{1}{\rho}} - rk - \bar{w} l_I - s_I h_I, \tag{3}$$

while that in the agricultural sector is

$$\pi_A = Y \min\{\frac{l_A}{\alpha}, \frac{h_A}{\beta}\} - s_A h_A. \tag{4}$$

Note that efficiency entails that in industry $h_I = l_I$, while in agriculture $\frac{l_A}{\alpha} = \frac{h_A}{\beta}$. Thus the profit functions can be re-written as

$$\begin{aligned} \pi_I &= p[k^\rho + h_I^\rho]^{\frac{1}{\rho}} - rk - (\bar{w} + s_I) h_I, &(5)\\ \pi_A &= Y \frac{h_A}{\beta} - s_A h_A. &(6)\end{aligned}$$

The profit maximization exercises yield, as usual, that factor prices equal their respective marginal revenue products:

$$\begin{aligned} r &= p I_k, &(7)\\ \bar{w} + \tau s_A &= p I_h, &(8)\\ s_A &= \frac{Y}{\beta}. &(9)\end{aligned}$$

As before let (10, in the main text) denote the utility function of the representative consumer.

She now earns wages from industrial labour, as well as rental income, so that her total income is given by

$$\bar{w}l_I + s_A(H - h_I) + \tau s_A h_I.$$

Thus her consumption of agricultural good is given by $c_A = \phi[\bar{w}l_I + s_A(H - h_I) + \tau s_A h_I]$. Thus from demand supply equality in the agricultural sector, i.e. $c_A = A(h_A, l_A)$, and using the facts that $\frac{l_A}{\alpha} = \frac{h_A}{\beta}$, $l_I = h_I$ and $s_A = \frac{Y}{\beta}$, we have that

$$\phi[\bar{w}(H - h_I) + s_A(H - h_I) + \tau s_A h_I] = Y\frac{(H - h_I)}{\beta} = s_A(H - h_I). \tag{10}$$

Clearly, a solution to (7), (8) and (10) in the three variables k, h_I and p is an equilibrium of this economy. We can then totally differentiate (7), (8) and (10) with respect to k, h_I, p and τ to obtain:

$$pI_{kk}dk + pI_{kh}dh_I \quad + (\tfrac{I}{k})^{\frac{1}{\sigma}} dp \quad = 0, \tag{11}$$

$$pI_{kh}dk + pI_{hh}dh_I \quad + (\tfrac{I}{h_I})^{\frac{1}{\sigma}} dp \quad = s_A d\tau, \tag{12}$$

$$\tilde{Z}dh_I \qquad = \phi s_A h_I d\tau, \tag{13}$$

where $\tilde{Z} = -[s_A - \phi(s_A + \bar{w}) + \phi\tau s_A]$. Moreover, from (10) we have that $\tilde{Z} < 0$.

As before we define

$$\tilde{D} = \begin{vmatrix} pI_{kk} & pI_{kh} & (\frac{I}{k})^{\frac{1}{\sigma}} \\ pI_{kh} & pI_{hh} & (\frac{I}{h_I})^{\frac{1}{\sigma}} \\ 0 & \tilde{Z} & 0 \end{vmatrix}, \quad \tilde{D}^{h\tau} = \begin{vmatrix} pI_{kk} & 0 & (\frac{I}{k})^{\frac{1}{\sigma}} \\ pI_{kh} & s_A & (\frac{I}{h_I})^{\frac{1}{\sigma}} \\ 0 & \phi s_A h_I & 0 \end{vmatrix}, \text{ and } \tilde{D}^{k\tau} = \begin{vmatrix} 0 & pI_{kh} & (\frac{I}{k})^{\frac{1}{\sigma}} \\ s_A & pI_{hh} & (\frac{I}{h_I})^{\frac{1}{\sigma}} \\ \phi s_A h_I & \tilde{Z} & 0 \end{vmatrix}.$$

It is straightforward to check that

$$\tilde{D} = \frac{\tilde{Z}p}{\sigma k}(\frac{I}{k})^{\frac{1}{\sigma}}(\frac{I}{h_I})^{\frac{1}{\sigma}} < 0, \quad \tilde{D}^{h\tau} = \frac{p\phi s_A h_I}{\sigma k}(\frac{I}{k})^{\frac{1}{\sigma}}(\frac{I}{h_I})^{\frac{1}{\sigma}} > 0.$$

We therefore have that $\frac{dh_I}{d\tau} = \frac{dl_I}{d\tau} = \frac{\tilde{D}^h}{\tilde{D}} < 0$. Thus an increase in transactions cost not only reduces land use in industry, it also reduces labour movement to industry.

Moreover, note that

$$\tilde{D}^{k\tau} = s_A(\frac{I}{k})^{\frac{1}{\sigma}}[-s_A + \phi(s_A + \bar{w}) - \phi\tau s_A + \frac{\phi}{\sigma}(\bar{w} + \tau s_A)]. \tag{14}$$

Thus there exists $\tau^* \equiv \frac{\sigma}{1-\sigma}\frac{s_A - \phi(s_A+\bar{w}) - \frac{\phi\bar{w}}{\sigma}}{\phi s_A}$ such that $\tilde{D}^k > 0$, and consequently $\frac{dk}{d\tau} < 0$, iff $\tau > \tau^*$.

Proposition 1. *Consider an economy with three factors of production, land, labour and capital. An increase in transactions cost τ:*

(a) reduces capital use k, as well as aggregate industrial production whenever τ is not too small to begin with, i.e. $\tau > \tau^*$, where $\tau^* \equiv \frac{\sigma}{1-\sigma}\frac{s_A - \phi(s_A+\bar{w}) - \frac{\phi\bar{w}}{\sigma}}{\phi s_A}$; and

(b) reduces both land use h_I, as well as labour absorption l_I in industry.

We finally examine the effect of a change in Y on capital, and the capital-output ratio. Using the fact that $Y = \beta s_A$, we can equivalently consider the effect of a change in s_A. Totally differentiating (7), (8) and (10) with respect to k, h_I, p and s_A we obtain:

$$
\begin{aligned}
pI_{kk}dk + pI_{kh}dh_I \quad & + \left(\tfrac{I}{k}\right)^{\frac{1}{\sigma}} dp & = 0, \qquad (15) \\
pI_{kh}dk + pI_{hh}dh_I \quad & + \left(\tfrac{I}{h_I}\right)^{\frac{1}{\sigma}} dp & = \tau ds_A, \qquad (16) \\
\tilde{Z}dh_I & & = N ds_A, \qquad (17)
\end{aligned}
$$

where $N = \phi\tau h_I - h_A(1-\phi)$, where $N < 0$ from (10).

Define

$$
\hat{D}^{h\tau} = \begin{vmatrix} pI_{kk} & 0 & \left(\frac{I}{k}\right)^{\frac{1}{\sigma}} \\ pI_{kh} & \tau & \left(\frac{I}{h_I}\right)^{\frac{1}{\sigma}} \\ 0 & N & 0 \end{vmatrix} = 0, \text{ and } \hat{D}^{kY} = \begin{vmatrix} 0 & pI_{kh} & \left(\frac{I}{k}\right)^{\frac{1}{\sigma}} \\ \tau & pI_{hh} & \left(\frac{I}{h_I}\right)^{\frac{1}{\sigma}} \\ N & \tilde{Z} & 0 \end{vmatrix} = \left(\frac{I}{k}\right)^{\frac{1}{\sigma}} [\tau\tilde{Z} + \frac{N}{\sigma h_I}(\bar{w} + \tau s_A)] < 0,
$$

since N and $\tilde{Z}$ are both negative. Thus $\frac{dh_I}{ds_A} = \frac{dl_I}{ds_A} = 0$, i.e. a change in agricultural productivity has no effect on land use pattern, or labour absorption in industry, $\frac{dk}{ds_A} > 0$, i.e. an increase in agricultural productivity increases capital investment.

Proposition 2. *Consider an economy with three factors of production, land, labour and capital. An increase in agricultural total factor productivity Y:*

(a) increases capital use k.

Note that the comparative statics predictions on k, h_I and $I(.)$ remains unchanged even when we allow for labour in production. Consequently, the testable hypotheses in section 4.1 remain the same as well.

2 Appendix 2

In this appendix we illustrate how, in the presence of the *holdout problem*, the ceiling laws, working via land fragmentation, can reduce firm profits, and also the amount invested in both land and capital. In order to focus on the bargaining aspect, we abstract from several aspects of the problem considered in our baseline framework. In particular we adopt a *partial equilibrium framework*, as well as focus on the industrial good sector alone.

A monopoly firm produces a good q using both capital, denoted k, and land, denoted h. The production function is given by

$$q = f(\min\{k, h\}), \qquad (18)$$

where $f(x)$ is strictly increasing and concave, i.e. $f_x(x) > 0$ and $f_{xx}(x) < 0$, whenever $x > 0$, and also satisfies the Inada conditions. Note that this formulation, while less general than that in the baseline model, captures our essential thesis that the amount of land h acts as a constraint on the amount of capital k that can be gainfully employed. The inverse market demand function is given by

$$p = D(q), \qquad (19)$$

where p is the market price, and $D(q)$ is negatively sloped.

As in the baseline framework, capital can be imported at an exogenous per unit price of r. Let the opportunity cost of 1 unit of land be Y. Thus the monopoly firm solves the following problem:

$$\max_{k,h} \pi(k,h) \equiv D(f(\min\{k,h\}))f(\min\{k,h\}) - rk - zh, \tag{20}$$

where z is the per unit price of land which will be endogenously solved via a bargaining mechanism (to be described shortly). Given the nature of the production function, it is clear that the equilibrium must involve an equal amount of k and h, so that the monopoly problem simplifies to the following:

$$\max_{h} \pi(h,h) \equiv D(f(h))f(h) - (r+z)h. \tag{21}$$

As we know from the literature, the holdout problem manifests itself in one buyer many seller bargaining situations in the presence of super-additivity in the production process. In order to define the idea of super-additivity in production, we define the optimal *gross* profit of a firm that has already acquired one (resp. 1/2) unit of land, denoting it by $\pi_m(1)$ (resp. $\pi_m(1/2)$). Clearly,

$$\pi_m(1) = f(1)D(f(1)) - r, \tag{22}$$

$$\pi_m(1/2) = f(1/2)D(f(1/2)) - r/2. \tag{23}$$

Note that $\pi_m(1)$ and $\pi_m(1/2)$ does *not* include any price already paid for land. Super-additivity in the production process is now captured via the assumption that

$$\frac{\pi_m(1)}{2} > \pi_m(1/2).$$

Moreover, in order to formalise the effect of ceiling laws, in particular land fragmentation, we shall consider two scenarios. Under the first scenario, the firm faces a single seller who has exactly one unit of land. This formalises the pre-ceiling legislation scenario. Under the second scenario, because of land fragmentation following the ceiling laws, the firm faces two sellers, each having one plot of land each of size $\frac{1}{2}$.

Scenario 1 (pre-fragmentation). Let the firm bargain with a single seller who has 1 unit of land for sale. The bargaining outcome is given by a symmetric Nash bargaining solution, where the aggregate surplus in case of agreement is $\pi_m(1)$, the dis-agreement payoff of the firm is zero, and that of the landowner is Y. Clearly, post the bargaining process, the profit of the firm is

$$\frac{\pi_m(1) - Y}{2}. \tag{24}$$

Scenario 2 (post-fragmentation). Next suppose that because of land ceiling acts, the single unit of land is split into two, with two different sellers holding a plot of size $\frac{1}{2}$ each, that yields them a return of $\frac{Y}{2}$ each. Further, land is acquired via a two stage sequential bargaining process with the two sellers, using symmetric Nash bargaining in every stage:

Stage 1: The firm bargains with seller 1 for her plot of land (of size $\frac{1}{2}$), using the symmetric Nash bargaining solution. In this stage, the aggregate surplus in case of agreement is given by the firm's expected income in stage 2.

Stage 2: The firm bargains with seller 2 using a symmetric Nash bargaining solution.[1]

As is usual, we solve this game backwards.

Stage 2: Suppose the firm has already acquired seller 1's plot, and have paid her the agreed upon price. The firm is now bargaining with seller 2. The dis-agreement payoff of the firm is $\pi_m(1/2)$, and that of the seller is $Y/2$. Thus the firm's payoff at this stage is given by:

$$\frac{\pi_m(1) + \pi_m(1/2) - \frac{Y}{2}}{2}. \tag{25}$$

Whereas in case the firm had not acquired seller 1's plot in stage 1, its payoff in stage 2 is given by

$$\frac{\pi_m(1/2) - \frac{Y}{2}}{2}. \tag{26}$$

Stage 1: We now consider the bargaining process with seller 1. In case the firm manages to acquire seller 1's plot, then the game goes to stage 2. From (25), recall the firm's continuation payoff is given by $\frac{\pi_m(1)+\pi_m(1/2)-Y/2}{2}$, which therefore constitutes the gross surplus that seller 1 and the firm bargain over. The dis-agreement payoff of the firm is $\frac{\pi_m(1/2)-Y/2}{2}$ from (26), and that of the seller is $Y/2$. Thus the firm's payoff is given by

$$\frac{\frac{\pi_m(1)+\pi_m(1/2)-Y/2}{2} + \frac{\pi_m(1/2)-Y/2}{2} - Y/2}{2}. \tag{27}$$

It is clear that the firm's profit is higher in case there is no fragmentation of land, i.e.

$$\frac{\pi_m(1) - Y}{2} > \frac{\frac{\pi_m(1)+\pi_m(1/2)-Y/2}{2} + \frac{\pi_m(1/2)-s/2}{2} - s/2}{2}, \tag{28}$$

whenever $\frac{\pi_m(1)}{2} > \pi_m(1/2)$, which is true given the super-additivity of the production process. Note that, given that firm's profit is lower under fragmentation, the average per unit price paid by the firm for land is higher under fragmentation.

Finally, assume that the firm has an opportunity cost given by X, where

$$\frac{\pi_m(1) - Y}{2} > X > \frac{\frac{\pi_m(1)+\pi_m(1/2)-Y/2}{2} + \frac{\pi_m(1/2)-Y/2}{2} - Y/2}{2}. \tag{29}$$

Thus in this example, prior to ceiling legislations, the firm was operating profitably, earning a net profit of $\frac{\pi_m(1)-Y}{2} > X$, and employing a positive amount of both land and capital. Following fragmentation, the firm however shutdowns, so that there is a reduction in both the amount of land, as well as capital employed.

[1]The results do not change if, instead, in each stage there is a non-cooperative bargaining protocol, where each agent gets to be the proposer with equal probability. Following the proposal the responder just says accept or reject.

Appendix 3: Ceiling legislations

A note on ceiling legislations and ceiling sizes in India

Besley and Burgess (2002) give and account of various land reforms legislations pertaining to abolition of intermediaries, land ceiling, land consolidation passed in the 16 major states since the early 1950s. The present paper focuses on the land ceiling acts that set the size of land ceiling in the Indian states in our sample. This is couched in terms of Chaudhuri (1960), Besley and Burgess (2000) and Government of India (2014).

Land is under the state list of the Indian constitution and by 1961-62, ceiling legislations were passed in most states. The maximum ceiling size varied from state to state, and was different for food and cash crops. The unit of application also differed across states: in some states ceiling restrictions were imposed on the `land holder', whereas in others such restrictions were imposed on the `family'. In order to bring about uniformity and comparability, a new policy was introduced in 1972 based on the fertility of land. Different land ceilings were imposed on three categories of land: (i) land cultivated with two crops; (ii) land cultivated with one crop; (iii) dry land, with the ceiling being lowest for more fertile land. Here we provide a summary account of the ceiling size between 1960-85 in our sample.

The Andhra Ceilings Bill 1958 empowers the prescribed authority in each local area to determine the extent of land ordinarily sufficient to yield a prescribed income- It is, however, higher at Rs. 5,100 per annum for each class of land in each kind of soil in that area. Since 1972, the ceiling size varies from 4.05 ha to 21.85 hectares (ha) depending on the soil fertility.

The Assam Fixation of Ceiling on Land Holdings Act, 1956 (as amended) came into force with effect from 15th February, 1958 in all the Plain Districts of Assam. The level of Ceiling was 19.87 ha plus allowable areas for orchard up to 3.645 ha. Since 1972, the ceiling was fixed 6.74 ha irrespective of whether land was fertile or not.

The Bihar Ceilings Bill 1959 lays down the ceiling area of land of different classes: ceiling size: varied between 9.71- 29.14 ha during 1960-1971 and 6.07-18.21 ha since 1972.

Gujarat imposed ceiling on landholdings of 4.05-53.14 ha until 1971; the ceiling size was set at 4.05-21.85 ha since 1972.

Haryana set a ceiling of 18.26 ha until 1971; since 1972, the ceiling varied between 7.25 ha to 21.80 ha.

J&K: J&K was the first Indian state to introduce land reform legislations as early as 1948 when it abolished all feudal institutions including Jagirs and Mukkarrarree. The ceiling size was fixed at 9.21 ha per household during 1960-71, while it varied between 3.60 ha to 9.20 ha since 1972, depending on soil fertility.

Karnataka: Ceiling size on landholdings was set at 15 ha until 1971 and varied between 4.05 ha and 21.85 ha since 1972.

Kerala: Ceiling on landholdings was 6.07-15.18 ha during 1960-1972 and 4.86-6.07 ha since 1972.

MP: Imposed ceiling on landholdings was 10.12 hectares during 1960-1972; the ceiling was 7.28-21.85 ha since 1972.

Maharashtra: The Bombay Ceilings Bill 1959 focuses on income criterion and empowers the State Government to determine for each class of land in each local region, the area sufficient to yield a net income (which is equivalent to 50 per cent of gross produce) of Rs 3,600 per annum. This area, which will vary from region to region and land to land, will be the ceiling. Since 1972, the ceiling size varies between 7.28 and 21.85 ha depending on soil fertility.

Orissa: Ceiling act was initially passed in 1960 and the size was set between 8.09-32.37 ha. Since 1972, the ceiling varies between 4.05-18.21 ha.

Punjab: Land reforms act 1972: Permissible limit (ceiling) was 7 ha. Since 1972, the ceiling size varies between 7 ha and 20.50 ha.

Rajasthan: The Rajasthan Ceiling Bill 1958 puts the ceiling area for a family consisting of five or less than five members at 30 standard acres (=12.15 Ha) of land. A 'standard acre' is the area of land which, with reference to its productive capacity, situation, soil classification and other prescribed particulars, is found likely to yield 10 maunds of wheat yearly. It became 7.28 ha since 1972 for irrigated land with two crops and the maximum ceiling size was 21.85 ha for dry land.

Tamil Nadu instituted a land ceiling of 12.14-48.56 hectares during 1960-1971; it was changed to 4.86-24.28 hectares from 1972.

UP: Ceiling on landholdings varied between 16.19-32.37 hectares during 1960-1971; since 1972 it was 7.30-18.25 hectares depending on soil fertility.

West Bengal: First land reforms act was introduced in 1955, amended 1970, 1971, 1977. According to the 1955 act, in the case of tiller (the raiyats) and the under-raiyats, the government is empowered to acquire any agricultural land in excess of 33 acres (=13.36 Ha) per individual. There were a few amendments of the law to restrict transfer of land to avoid ceiling subsequently. Since 1972, the ceiling was set at 5 ha for irrigated land with one/two crops and 7 ha for dry land.

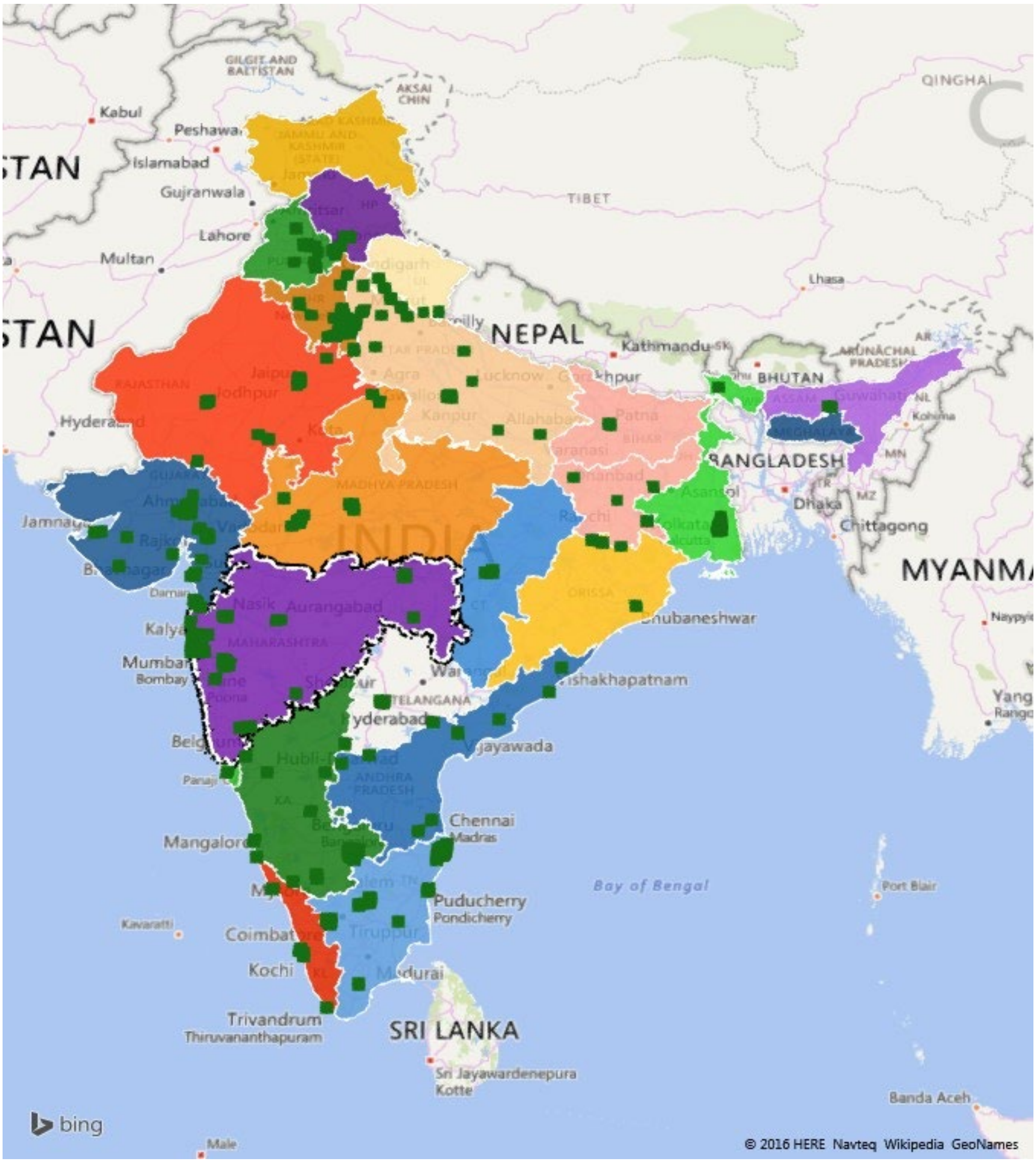
While the land reform legislations including land ceiling ones were implemented with different effectiveness across the Indian states (see Deininger and Nagarajan, 2007), our analysis makes use of the ceiling size as per land ceiling legislations.

Table A3.1: Data sources

Variables	Source: 1960-85
Dependant Variable : Fixed Capital share	Annual Survey of Industries (ASI)
Dependant Variable : Total Capital share	Annual Survey of Industries (ASI)
Dependant Variable : Ln(Total Capital)	Annual Survey of Industries (ASI)
Dependant Variable : Ln(no of factories)	Annual Survey of Industries (ASI)
Dependant Variable : share of manufacturing net (Sdp)	Annual Survey of Industries (ASI)
Key explanatory Variables	
Size Of Ceilings (in hecacres)	Chaudhuri (1960), Besley and Burgess (2000) and Government of India
Land irrigated with two crops i.e. Most fertile Land	Chaudhuri (1960), Besley and Burgess (2000) and Government of India
Average ceiling size (1960-1985)	Chaudhuri (1960), Besley and Burgess (2000) and Government of India
Average ceiling size (1973-1985)	Chaudhuri (1960), Besley and Burgess (2000) and Government of India
Controls	
Log(state Output)	World Bank
Population density	Census of India, Registrar General and Census Commissioner, Government of India
Literacy rate %	Census of India, Registrar General and Census Commissioner, Government of India
Share (SC/ST) Population	Census of India, Registrar General and Census Commissioner, Government of India
Share (Urban/Rural) Population	Census of India, Registrar General and Census Commissioner, Government of India
Log (Labour Militancy)	Census of India, Registrar General and Census Commissioner, Government of India
Soil fertility	Census of India, Registrar General and Census Commissioner, Government of India

Note: We compile the 1960-85 data from various sources including Chaudhuri (1960), Besley and Burgess (2000), Ozler et al. (1996). We used data from Central Statistical Office, Annual Survey of Industries, Office of the Registrar General and Reserve Bank of India Handbook on State Statistics to update the 1960-85 sample to 2015.

Figure A3.1. Location of sample firms across the Indian states



Appendix 4. Additional Results

Table A4.1: Summary Statistics, 1960-85

Variables	Observation	Mean	Std. Dev.
Dependant Variable : Fixed Capital share	416	1.773	0.892
Dependant Variable : Total Capital share	416	3.007	0.937
Dependant Variable : Ln(Total Capital)	416	7.511	0.534
Dependant Variable : Ln(no of factories)	377	7.6609	1.0524
Dependant Variable : share of manufacturing net sdp	402	0.1330	0.0566
Key explanatory Variables			
Size Of Ceilings (in hectares)			
Land irrigated with two crops i.e. Most fertile Land	416	15.2	2.7232
Average ceiling size (1960-1985)	416	16.90	11.561
Average ceiling size (1973-1985)	208	27.3125	9.9546
Controls			
Log(state Output)	404	12.3842	1.0398
Population density	411	558.22	343.47
Literacy rate %	372	62.16591	8.0026
Share (SC/ST) Population	411	0.2147	0.0817
Share (Urban/Rural) Population	410	0.2006	0.0733
Log (Labour Militancy)	405	12.7444	1.9909
Soil fertility	416	0.0595	0.0413

Table A4.2: Summary Statistics 1960-2015

Variables	Observation	Mean	Std. Dev.
Dependant Variable : Fixed Capital share	636	2.943	2.048
Dependant Variable : Total Capital share	636	3.867	2.253
Dependant Variable : Ln(Total Capital)			
Dependant Variable : Ln(no of factories)	658	8.444	1.038
Dependant Variable : share net sdp, manufacturing	879	0.1361	0.0575
Key explanatory Variables			
Size Of Ceilings (in hectares)			
Land irrigated with two crops i.e. Most fertile Land (1973 onwards)	896	15.2	2.7232
Average ceiling (1973 onwards)	692	25.2948	11.7774
Average ceiling size (1960-2015)	896	16.90	11.561
Controls			
Log(state Output)	892	14.068	2.031
Population density	896	631.96	1340.48
Literacy rate %	840	60.31	30.263
Share (ST/SC) pop	896	0.24	0.088
Share (Urban/Rural) Pop.	892	0.127	0.150
Soil fertility	885	0.055	0.033

Table A4.3. Capital investment estimates after dropping the pro-business states

This table shows the estimates of the selected outcome variables in all sample states except Gujarat and Maharashtra, states that follow more pro-business public policies. All regressions also control for lagged values of number of factors that may also influence the outcome variables: net state domestic product, population density, share of population of scheduled castes and tribes, share of urban population, literacy rate, soil fertility. All control variables are lagged by one year to minimise the potential simultaneity bias. All regressions also include state and year dummies. Standard errors are clustered at the state level. Significance: *** p<0.01; ** p<0.05; * p<0.1.

	(1)	(2)	(3)
VARIABLES	Ln(totalcapital)	Share of mfg	Ln(total factories)
Av ceiling>=Q1	1.2486**		
	(0.474)		
Av. Ceiling>=Q2		0.0029	0.1509
		(0.005)	(0.128)
Constant	2.2886	-0.1070	7.3698**
	(5.430)	(0.131)	(3.192)
Other controls	Yes	Yes	Yes
State & Year Fes	Yes	Yes	Yes
Observations	310	302	284
R-squared	0.506	0.897	0.964

Table A4.4. Capital estimates after dropping the green revolution states Punjab and Haryana

	(1)	(2)	(3)
VARIABLES	Ln(totalcapital)	Share of mfg	Ln(total factories)
Av ceiling>=Q1	1.2494***	-0.0080	0.1035
	(0.368)	(0.011)	(0.140)
Constant	6.0269	0.1578	7.6507**
	(5.021)	(0.138)	(3.069)
Other controls	Yes	Yes	Yes
State & Year dummies	Yes	Yes	Yes
Observations	320	315	294
R-squared	0.539	0.932	0.969

Appendix 5. Test of pre-trends

We follow Borusyak and Jaravel (2017) to test that there are no pre-trends in the outcome variables among the states in the years leading to the event date 1971 and we use an F-test to do this as follows.

Let Kit = t – Ei (E being the event date) denote the "relative time"—the number of years relative to the event date. The indicator variable for being treated can therefore be written as

$$Dit = 1\ \{t \geq Ei\} = 1\ \{Kit \geq 0\}.$$

$$Yit = \alpha_i + \beta_t + \Sigma^{\infty}{}_{k=-\infty}\ \gamma_k\ 1\{Kit = k\} + \varepsilon_{it\ \ i} \qquad (1)$$

A common way to check for pre-trends is to plot the path of $\gamma\hat{}k$ before and after treatment. Sometimes this is called the event study approach.

Here $\{\gamma_{\ k}\}$ for $k < 0$ correspond to pre-trends, and for $k \geq 0$ to dynamic effects k periods after the event E.

α_i and β_t are unit and period fixed effects, respectively, and ε_{it} is random noise. We call equation (1) the fully dynamic specification.

We perform a test for identifying the pre-trends. Start from the fully dynamic regression (1) for any outcome variable Y and drop any two terms corresponding to k1; k2 < 0. This is the minimum number of restrictions for point identification, to pin down a constant and a linear term in K_{it}. The F-test compares the residual sums of squares under the restricted and unrestricted specifications, where the former is always semi-dynamic, and the latter is fully dynamic with two restrictions. Precisely due to under-identification, the fully dynamic specification with two restrictions is effectively unrestricted and its fit is identical for any k1 and k2, so the F-statistic will be invariant to k1 and k2 even in finite samples. If the F-stat is significant, it means that we reject the null (i.e., fully dynamic specification) in favour of the restricted dynamic specification.