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

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Abstract: We examine the impact of legislated land ceiling size on capital investment and industrialisation in the Indian states. We argue that India's land ceiling legislations of 1960s and 1970s, effectively implemented or not, had increased land fragmentation and transactions costs of land acquisition for industries. We build a general equilibrium framework that captures the idea that lack of availability of land constrains industrial development, with an increase in transaction costs adding to such constraints and derive two testable hypotheses: states with smaller ceiling size are likely to have (i) lower capital investment and (ii) lower pace of industrialisation. Using state-level data from major Indian states, we find confirmation of both hypotheses, considering both relative (pre/post 1971) and aggregate effects of legislated ceiling size, ceteris paribus. We document that there is confirmation of greater land fragmentation and higher transaction costs of land acquisition in states with lower ceiling size.

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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, attributing 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) argue that between 1980-2000, the Indian economy also underwent a similar slowdown of the industrial sector. 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 led to a fragmentation of land. This 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 (see Section 2). There is a significant literature on these legislations, but scholars are divided over their efficacy. While Bardhan (1970) has argued that an unenthusiastic implementation had muted some of the benefits, especially for the poor, Besley and Burgess (2000) documented that states with large volume of legislated land reforms had experienced a significant decline in poverty. Further, Banerjee et al. (2002) concluded that tenancy reforms had improved agricultural productivity. Without denying any of these beneficial effects of land reforms, the present paper identifies an unanticipated consequence of land reforms that remains unexplored in the literature–land ceiling legislations leading to increased transaction costs of land acquisition and deindustrialisation.

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.[1] While the reasons behind such conflicts are

[1]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 (Ghatak et al. 2013),

complex, a recent survey suggests that out of 80 high-value stalled projects, more than a quarter (21 projects) are stalled due to land disputes. The consequences of these conflicts are both sizeable and visible: projects are delayed, relocated, or cancelled. As of 2009, delays in land acquisition for industrial projects were threatening investments worth USD 100 billion all over India.[2,3]

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 excess land being redistributed among the landless. However, the effectiveness of redistribution varied across states (Appu 1972; Venkatsubramanian 2013). In case implemention was efficient, these of course contributed towards land fragmentation. Even when not implemented effectively, the fear of imminent implementation had led to 'benami' transfers of land to third parties so as to prevent governmental acquisition (Appu 1972), thereby increasing fragmentation.[4] We show that states with smaller land ceiling size tend to have lower average cultivable land size (per household, as well as per individual), indicating greater land fragmentation and therefore higher transaction costs of acquiring land.[5] We elaborate on these issues further in Sections 2 and 6.5.

One likely though unintended consequence of such increased fragmentation is an increase in the per unit transaction costs of buying land. 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 acquisition costs via various channels, non-strategic, as well as strategic. The non-strategic reasons arise from 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

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opposition parties, and environmental activists, the factory was ultimately relocated.

[2]See, https://rightsandresources.org/wp-content/uploads/2016/11/Land-Disputes-and-Stalled-Investments-in-India-November-2016.pdf, a 2016 report by the Rights and Resources Initiative (RRI). 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.

[3]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).

[4]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 (see Section 2).

[5]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 (see Eastwood et al., 2010, among others).

matter how small the land involved is, the aggregate legal costs of buying any land is increasing in the number of landowners involved (see Section 6.5). This cost can be even higher in case some of the landowners were recipients of illegal benami transfers (Venkatsubramanian, 2013). Such legal-bureaucratic costs are likely to be salient in India, given its out-dated land records, improper identification of de facto, as well as de jure owners (Feder and Feeny, 1991; Ghatak and Mookherjee, 2014), mis-classification of land quality (Ghatak et al. 2013), and a slow moving and expensive legal justice system.[6,7]

Strategic reasons why fragmentation can increase transactions costs include the holdout problem that arises when one buyer bargains with multiple sellers (Roy Chowdhury, 2012; Roy Chowdhury and Sengupta, 2012). 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).[8,9] Finally, in online Appendix 1 we develop a theory of holdout that does not depend on landowners being unable 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

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

[7] 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.

[8] In Brazil, landowners and squatters had conflicts over property rights (Alston et al., 2000).

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

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.[10] The theoretical framework generates two key hypotheses: *Hypothesis 1* - total capital increases with ceiling size; and *Hypothesis 2* - industrial output increases with ceiling size.

We then focus on testing the empirical validity of these hypotheses using historical state-level data from India for 1960-85 during which much of the ceiling legislations were introduced. The key explanatory variable is land ceiling size – average ceiling, as well as ceiling size on most fertile land. We examine the effect of a change in ceiling size on selected outcome variables, total capital, as well as two indices of industrialisation, namely, share of manufacturing output and number of registered factories.[11]

The temporal variation in land ceiling sizes across the sample states provides us with a useful exogenous variation. Most importantly, the timings of the introduction of ceiling regulations were determined by the central Ministry of Agriculture and were thus considered random for any individual state. Given that the central government issued nationally applicable guidelines pertaining to ceiling sizes since 1972 (Venkatsubramanian, 2013), the ability of the states to manipulate ceiling size was also limited (see further discussion in Section 5.2).[12] We also eliminate the possibility of pre-trends in capital investment, as well as soil fertility measures before 1971 (see Section 5.2).

All Indian states experienced changes in mandated ceiling size after 1971, with 14 out of the 16 sample states experiencing a drop; the remaining two states, namely Madhya Pradesh and Rajasthan, had experienced an increase. We, therefore, start by exploring the *relative effects* of ceiling size, i.e. the effect of post-1971 ceiling size relative to pre-1971 level; we find that the post-1971 changes in ceiling had adversely impacted both investment in total capital and total number of registered factories relative to pre-1971 ones. We further consider the effects of a *decline in ceiling size relative to an increase* to identify a second order effect of ceiling size. We find that states experiencing a fall (relative to those experiencing an increase) in ceiling size after 1971 had

[10]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.

[11]We also extend the baseline sample 1960-85 to 1960-2015.

[12]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.

significantly lower total capital and also lower number of registered factories compared to those that did not.

Finally, we pool our state-level data to assess the *aggregate ceiling size effects*: in particular, we regress various capital investment outcomes on ceiling size (average and that on most fertile land) among other controls. *Ceteris paribus*, states with lower ceiling size have significantly lower total capital invested, lower number of registered firms as well as smaller share of manufacturing output in the aggregate, 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 a drop in aggregate manufacturing output share in low ceiling states arises from a drop in registered manufacturing output share pertaining to larger firms only. These results hold even when we consider the extended sample for the period 1960-2015, thus highlighting the long-term impact of ceiling size in the Indian states, both in relative and aggregate terms. Overall these results lend support to hypotheses H1 and H2.

We next document that a lower mandated ceiling size is associated with lower landholding size, which in turn means greater land fragmentation and hence higher transaction costs of land acquisition – the key mechanism for our results (see Section 6.5). Second, using land use data we show that low ceiling states had greater (lower) share of cropped (non-cropped) land, linking low ceiling size to low non-cropped land use. Moreover, larger ceiling size (in relation to cultivable landholding) had significantly boosted the number of registered factories per unit of noncropped area in a state, indicating that high ceiling states had devoted a higher proportion of non-cropped land to factories.

Finally, we perform various robustness tests. We demonstrate that our key results hold even after accounting for (a) policy uncertainty faced by investors –proxied by the cumulative total number of land legislations by a state; (b) labour unrest – proxied by the man days lost and also (c) the extent of social democracy in a state – proxied by the vote percentage of the Indian National Congress. Of course, some time-varying unobservables, e.g., pro-business attitudes or extent of green revolution, may still bias our estimates. We show that our key results hold even after dropping the two key pro-business states, Gujarat and Maharashtra, or after dropping Punjab and Haryana, two states that primarily benefitted from the green revolution. We conclude our analysis by showing that the poverty rate declined only for states with low ceiling size, possibly because, relative to high ceiling states, these are likely to be more proactive in redistributing land.

To summarise, while land reforms undoubtedly had many positive consequences (including a reduction in poverty), ours is the first paper to identify an important unintended consequence of land ceiling legislations: lower ceiling size had given rise to lower capital investment, thus highlighting a potentially important trade-off for the policy makers.

1.1 Literature Review and Contributions

Our results contribute to various strands of the existing literature. First, there is a growing literature on how public policy interventions may improve property rights. This in turn can lower transaction costs, thereby improving resource allocation, and boosting 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, attributing it to tenancy reforms and abolition of intermediaries. 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 exacerbate such transactions costs, thereby affecting capital investment and industrialisation. Further, our focus is on legislated land ceiling size, rather than the number of land legislations as in Besley and Burgess (2000). Finally, we extend Besley and Burgess (2000) to show that only the states with low land ceiling size had suffered from low capital investment, though they experienced lower poverty rate too.

Sokoloff and Engerman (2000) examine the effect of lowering land inequality on growth, arguing that Canada and United States performed better than Argentina and Brazil in the New World of 19th century because they were better able to allocate land to immigrants, thus reducing land inequality more effectively relative to Argentina and Brazil. Their argument however does not contradict our findings. First, we examine a channel that works via the effect of smaller plot size on industrial growth. This channel would have been much less important in the 19th century, when there were very few industries that required big, or even medium sized plots, so land acquisition for industry cannot have been that important. Second, and relatedly, between 1900 and 2002, US farm size had increased significantly as the number of farms declined (Dimitri et al. 2005). The opposite has happened in India: farm size has declined in successive agricultural census as number of farms, especially, smaller ones has increased (Otsuka, 2013 and Hazell, 2005), thus enhancing the salience of ceiling size in India.

Second, there is an emerging literature on the problems associated with land acquisition for industrial use. Banerjee et al. (2007) and Sarkar (2007) trace it to the fact that the use-value of land may be higher than its sale-price, while Ghatak and Banerjee (2009) and Ghatak and Mookherjee (2014) emphasise the incompleteness of markets in LDCs. Finally, Roy Chowdhury (2012) considered 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 legislated land ceiling size and transaction costs of land acquisition, and between such transactions costs and the extent of capital investment and industrialization.

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. Gollin et al. (2002) in particular, highlight the role of agricultural productivity in economic development. Our paper complements this literature by finding yet another link between agriculture and industry - from ceiling legislations to inadequate transfer of land from agriculture to industry (even when agricultural productivity is lower than that in industry), thus affecting industrialisation.

Fourth, our paper connects to the literature on the effect of ceiling legislations on farm size and agricultural productivity. Adamopoulos and Restuccia (2014; 2020) demonstrate that, the widespread use of ceiling legislations in many countries has generally led to a fall in farm size, arguing that small farm size may lower agricultural productivity in poor countries. Our analysis shows that ceiling legislations lead to smaller farm size, which in turn leads to lower capital investment and industrialisation because of higher transaction costs of land acquisition for industries.

Finally, our findings contribute to the emerging literature on premature deindustrialisation, see e.g. Rodrik (2015) and Amirapu and Subramanian (2015). Focusing on the inter-state variations, Amirapu and Subramanian (2015) show that with the exception of a very few states, share of registered manufacturing output in total output or total employment is largely flat or declining over

1980-2010 (see Figures VIIa-c). As such, 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.

2 Indian Land Ceiling Legislations

In this section we discuss the Indian land ceiling legislations and their implementation. Starting in the early 1950s the Indian government induced various state governments to pass a slew of legislations with a view to abolish landlordism, distribute land through imposition of ceilings, protect tenants and consolidate land-holdings.

Among these, our analysis focuses on land ceiling legislations. Under these legislations the government takes 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. While such ceiling legislations were passed in all states by 1961-62, there was a lot of heterogeneity in implementation.[13] In the interest of uniformity, a new policy was introduced in 1971 (Venkatasubramanian, 2013), dividing all land 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, (b) making retrospective "benami" transactions illegal, and (c) proscribing legal action based on violation of fundamental rights.

The ceiling regulations however were not implemented very efficiently in all Indian states.[14] 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 lakh acres, the area actually distributed was only 44 lakh acres (Venkatasubramanian, 2013).[15] We

[13] The height of the ceiling varied from state to state, and was different for food and cash crops. Further, ceiling restrictions were imposed on the 'landholder' in some states, and on the 'family' in others.

[14] The sixth five 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,$\cdots$."

[15] 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.

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 (Ghosh and Nagaraj, 1978). 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 (Haque and Sirohi, 1986). 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.[16] 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.

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).

Taken together, we argue that an immediate effect of land ceiling legislations is likely to be greater land fragmentation, irrespective of whether these legislations were implemented efficiently or not. We revisit this issue in Section 6.5 and provide some direct and indirect evidence.

[16] One could use 'amalnamas' (unregistered sale of land), often involving complex transfers. so as to establish that land transfers were made prior to any critical cut-off date. In states like Assam landowners would get land registered in joint pattas including people who have acreage below the ceiling limit.

3 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).[17] 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 capital input into industry, the production functions of the industrial and the consumption goods are given by:

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

$$A(h_A) = Y h_A, \tag{2}$$

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 $I_k = \left(\frac{I}{k}\right)^{\frac{1}{\sigma}}$, $I_h = \left(\frac{I}{h_I}\right)^{\frac{1}{\sigma}}$, $I_{kk} = \frac{1}{\sigma}\left(\frac{I}{k}\right)^{\frac{1}{\sigma}}\left[\frac{1}{I}\left(\frac{I}{k}\right)^{\frac{1}{\sigma}} - \frac{1}{k}\right]$, $I_{hh} =$

[17] In section 4.1 we also introduce labour, when the results remain qualitatively robust.

$\frac{1}{\sigma}\left(\frac{I}{h_I}\right)^{\frac{1}{\sigma}}\left[\frac{1}{I}\left(\frac{I}{h_I}\right)^{\frac{1}{\sigma}}-\frac{1}{h_I}\right]$, $I_{kh}=\frac{1}{\sigma I}\left(\frac{I}{k}\right)^{\frac{1}{\sigma}}\left(\frac{I}{h_I}\right)^{\frac{1}{\sigma}}$.

Note that while credit-market imperfections are salient to most less-developed countries, for tractability we model this aspect in a reduced form. One can interpret our framework as one where agriculturists suffer from credit market imperfections, making credit extremely costly. Industrialists however face these problems to a much smaller extent (because of greater collateral, and better access to the formal financial sector). Under this interpretation Y represents agricultural productivity after taking these credit market imperfections into account. Thus Y would be larger if either these institutional infirmities were less severe, or if the individuals could provide a greater amount of collateral. Moreover, Y could also be interpreted as representing not just agricultural input, but also small rural businesses.[18]

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,[19] in that acquiring land for industrial use involves a per unit price that is τ times its price in the agricultural sector, where $\tau > 1$.[20] 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 at a price of r.[21] 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

[18] In Remark 1 we discuss the implications of these broader interpretations.

[19] Morris and Pandey (2009) and Sarkar (2007) point out that the land market in LDCs are typically thin, tracing it, among other reasons, to poor land records, and a slow moving legal-justice system.

[20] That τ is greater than 1 captures the fact that many industrial projects typically require a substantial amount of land to operate. For example, in the Tata Nano project discussed earlier in the Introduction, the objective was to acquire 613 acres of land. Whereas traditional agriculture, which is the mainstay in the countries that we are interested in, does not require plot size to be significantly large. In fact, the average plot size of land in agriculture in less developed countries is quite small.

[21] In reality LDCs import a significant fraction of their capital needs. In India, capital and intermediate goods comprised 29.93% and 35.44% of total import respectively in 1960-61, 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).

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

while that in agriculture is

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

Given profit maximization, factor prices equal their respective marginal revenue products:

$$\begin{aligned} r &= pI_k = p\left(\frac{I}{k}\right)^{\frac{1}{\sigma}}, && (6) \\ s_I &= pI_h = p\left(\frac{I}{h_I}\right)^{\frac{1}{\sigma}}, && (7) \\ s_A &= Y. && (8) \end{aligned}$$

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:

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

Her consumption levels are therefore:

$$\begin{aligned} c_A &= \phi[s_I h_I + s_A h_A], && (12) \\ c_I &= (1 - \phi)\frac{s_I h_I + s_A h_A}{p}. && (13) \end{aligned}$$

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

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

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.

4 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.[22]

We then turn to comparative statics. Totally differentiating equations (6), (9) and (17) with

[22]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.

respect to p, k, h_I and τ, we have that

$$
\begin{aligned}
pI_{kk}dk + pI_{kh}dh_I \quad & +(\tfrac{I}{k})^{\frac{1}{\sigma}}dp && = 0, && (18)\\
pI_{kh}dk + pI_{hh}dh_I \quad & +(\tfrac{I}{h_I})^{\frac{1}{\sigma}}dp && = Y d\tau, && (19)\\
Z'dh_I \quad & && = \phi Y h_I d\tau, && (20)
\end{aligned}
$$

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

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

Using (9), straightforward calculations show that

$$
\begin{aligned}
D \quad &= \quad \frac{Z'p}{\sigma k}(\frac{I}{k})^{\frac{1}{\sigma}}(\frac{I}{h_I})^{\frac{1}{\sigma}} = \frac{Z'\tau Y}{\sigma k}(\frac{I}{k})^{\frac{1}{\sigma}} < 0, && (21)\\
D^{h\tau} \quad &= \quad \frac{p\phi h_I Y}{\sigma k}(\frac{I}{k})^{\frac{1}{\sigma}}(\frac{I}{h_I})^{\frac{1}{\sigma}} = \frac{\tau\phi h_I Y^2}{\sigma k}(\frac{I}{k})^{\frac{1}{\sigma}} > 0, && (22)\\
\text{and, } D^{k\tau} \quad &= \quad -(\frac{I}{k})^{\frac{1}{\sigma}}Y^2[1-\phi+\phi\tau(1-\frac{1}{\sigma})]. && (23)
\end{aligned}
$$

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. For several reasons, assuming that τ is not too small, may not be unrealistic in the context of LDCs. 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. Note that (17) can be re-written as

$$h_I = \frac{H(1-\phi)}{1-\phi+\phi\tau}. \tag{26}$$

Thus a change in Y does not affect h_I. Therefore totally differentiating equations (6) and (9) with respect to p, k and Y, we have that

$$\begin{aligned} pI_{kk}dk + \left(\frac{I}{k}\right)^{\frac{1}{\sigma}} dp &= 0, && (27)\\ pI_{kh}dk + \left(\frac{I}{h_I}\right)^{\frac{1}{\sigma}} dp &= \tau dY. && (28) \end{aligned}$$

Straightforward calculations show that

$$\begin{aligned} \frac{dk}{dY} &= -\frac{\tau p(\frac{I}{k})^{\frac{1}{\sigma}}}{p[I_{kk}(\frac{I}{h_I})^{\frac{1}{\sigma}} - I_{kh}(\frac{I}{k})^{\frac{1}{\sigma}}]} = \frac{\tau(\frac{I}{k})^{\frac{1}{\sigma}}}{\frac{p}{k\sigma}(\frac{I}{k})^{\frac{1}{\sigma}}(\frac{I}{h_I})^{\frac{1}{\sigma}}} > 0, && (29)\\ \frac{dp}{dY} &= \frac{\tau p I_{kk}}{p[I_{kk}(\frac{I}{h_I})^{\frac{1}{\sigma}} - I_{kh}(\frac{I}{k})^{\frac{1}{\sigma}}]} = -\frac{\tau I_{kk}}{\frac{1}{k\sigma}(\frac{I}{k})^{\frac{1}{\sigma}}(\frac{I}{h_I})^{\frac{1}{\sigma}}} > 0, && (30) \end{aligned}$$

since $I_{kk} < 0$. Thus an increase in agricultural productivity has no effect on industrial land use, and increases the amount of capital use, as well as p, i.e. the terms of trade between industry and agriculture.

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;

(c) increases the terms of trade between industry and agriculture.

We then discuss some robustness issues in the following remarks.

Remark 1. *We first briefly discuss other possible channels via which land reforms in general, and ceiling legislations in particular can affect industrial investment and output. As argued by Besley and Burgess (2000), two important aspects of the Indian land reform, at least as far as a reduction in poverty is concerned, are tenancy reforms and abolition of intermediaries. Arguably both can be modelled as an increase in agricultural productivity Y. Moreover, by re-distribution of land along with the conferment of formal property rights, ceiling legislations improve the ability of the individuals in the agricultural sector to provide collateral. This in turn can allow individuals to invest in agriculture, as well as set up small businesses. We can again capture all of these effects as an increase in Y. All of these should help reduce poverty, as argued by Besley and Burgess (2000). Thus land ceiling legislations appear to have two broad effects - increase the transactions costs τ, as well as agricultural productivity Y. From Propositions 1 and 2, these two however appear to have opposing effects on capital investment, and industrial output. It is of course an empirical question as to which effect, τ or Y, is likely to dominate.*

Remark 2. *In online Appendix 1, 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 investment in both land and capital.*

4.1 Labour as input

We now 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. Minimal/living wage regulations however have a long history worldwide, e.g. in New Zealand, Mexico and Australia.

We modify the baseline model so as to allow for these aspects. 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:

$$I(k, h_I, l_I) = [k^\rho + \min\{l_I, h_I\}^\rho]^{\frac{1}{\rho}}, \tag{31}$$

$$A(h_A, l_A) = Y \min\left\{\frac{l_A}{\alpha}, \frac{h_A}{\beta}\right\}, \tag{32}$$

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

$$\pi_I = p[k^\rho + \min\{l_I, h_I\}^\rho]^{\frac{1}{\rho}} - rk - \bar{w}l_I - s_I h_I, \tag{33}$$

while that in the agricultural sector is

$$\pi_A = Y \min\{\frac{l_A}{\alpha}, \frac{h_A}{\beta}\} - s_A h_A. \tag{34}$$

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

$$\begin{aligned} \pi_I &= p[k^\rho + h_I^\rho]^{\frac{1}{\rho}} - rk - (\bar{w} + s_I)h_I, && (35)\\ \pi_A &= Y\frac{h_A}{\beta} - s_A h_A. && (36) \end{aligned}$$

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

$$\begin{aligned} r &= pI_k, && (37)\\ \bar{w} + \tau s_A &= pI_h, && (38)\\ s_A &= \frac{Y}{\beta}. && (39) \end{aligned}$$

As earlier (10) denotes 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

$$\phi[\bar{w}(H - h_I) + s_A(H - h_I) + \tau s_A h_I] = Y\frac{(H - h_I)}{\beta} = s_A(H - h_I). \tag{40}$$

Clearly, a solution to (37), (38) and (40) in the three variables k, h_I and p is an equilibrium of this economy. We can mimic the earlier analysis to find out the effect of a change in transactions costs on the variables of interest.

Proposition 3. *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 then examine the effect of a change in Y on k. (The proofs of both 3 and 4 are available from the authors on request.)

Proposition 4. *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,

(b) increases price p.

Note that the comparative statics predictions on k, h_I and $I(.)$ remains unchanged even when we allow for labour in production.

4.2 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 2, the impact of these legislations is to increase fragmentation of land, either directly, or indirectly. 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 ceiling legislation can slow down 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.

5 Data and Empirical Model

5.1 Data

We collate ceiling size variables from various sources including Chaudhuri (1960), Besley and Burgess (2000), and Government of India (2014). Appendix 2 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[23] 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

[23] In Appendix 2, Table A2.1 summarises the variable definitions and data sources in our sample. The sample states included in our study include 16 major states formed by 1960 following the States Reorganisation Act, 1956. This 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.

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 3, Table A3.1 summarises the descriptive statistics for the 1960-85 sample, and Table A3.2 does the same for the extended 1960-2015 sample.[24]

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. This leads to differences in ceiling sizes not only across states, but also over time for a given state (see Figure 1 and also Appendix 2). It is evident from Figure 1 that 14 out of the 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 (see further discussion in Section 6.2).

5.2 Empirical Strategy

Using the firm-level data for the listed Indian firms from Orbis database (available from Bureau van Djik), we consider the distribution of head quarters of listed Indian firms across the country in 2012. This is shown by the green dots in Figure A2.1 in Appendix 2. Evidently, there is a high concentration of such head-quarters 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 with more fertile land. 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 with arid or semi-arid land, relative to that in the fertile Gangetic plains is noteworthy, motivating the present study. Next we explain our methodology.

Key outcome variables. 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 with the regression variables. The source of the state-level data on fixed capital, working capital, as well as total value added, is

[24] 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.

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 variable of interest is 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, we also consider the share of manufacturing (both registered and unregistered taken together) output in net state domestic product (shmfg in short).[25]

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 the 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 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 2). Mean ceiling size on most fertile land is 15 ha (hectare) and the median ceiling 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). As expected, the ceiling size on most fertile land is smaller relative to average ceiling size. We find that there is sufficient time-series and cross-section variations in ceiling size (see Figure 1 for selected sample states).

Effects of ceiling legislations on ceiling size: We next demonstrate that various ceiling legislations did affect ceiling size, thus validating our use of ceiling size as an explanatory variable (see Appendix 3 Figure A3.1). (i) The top panels a1 and a2 plot the fitted line between ceiling size (both average and that on ceiling on most fertile land) and cultivable land per household across the sample states

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

over 1960-1985, showing that there is a positive association between ceiling size variables and average cultivable land per household. (ii) The middle panels b1 and b2 show the nature of the association between ceiling size and share of land used for cash crops in the pre-1971 years, indicating a negative association between ceiling size and share of land used for cash crops. (iii) The final panels c1 and c2 show the corresponding relationships between ceiling size and soil fertility in the post-1971 years, again using both ceiling size measures. In this case too the fitted relationships confirm that ceiling size fell with increasing soil fertility. Evidently, the degree of negative association is stronger in the post-1971 years (relative to those in pre-1971 years) as the fitted lines appear steeper.

Exogeneity of ceiling variables: We then argue that the ceiling size measures are likely to be independent of the capital investment outcomes of interest. First, the legislated ceiling size was related to the nature of the crop produced until 1971, and soil fertility from 1972 onwards (under the guidance of the central government). Second, the timings of the announcement of these 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 including some rezoning policies. In particular, the Special Economic Zones (SEZs) Policy was announced in April 2000, which is much later than the key ceiling legislations that we consider in this paper. SEZs may relaxe land-use laws that reserve most rural land for agricultural production, and impose considerable bureaucratic obstacles to its conversion for industrial production (also see Blakeslee et al. 2021). However these recent SEZs are unlikely to influence the effects of ceilings that we estimate.

Since there could still be important omitted factors, we control for the observed state characteristics (X_{st}), as well as state (S_s) and year (θ_t) fixed effects (see below). Finally, we 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. This is done by constructing an F-test that 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 (see Appendix 4 for the details of the F-statistic).[26] (a) The F-statistics are 10.98 (p-value 0012), 20.40 (p-value 0.0001) and 8.48 (0.003) respectively for Ln(total capital), Ln(total number of registered factories) and share of manufacturing output of the sample states over 1960-85. All the F-statistics reject the null hypothesis that there are pre-trends

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

in the outcomes of interest before the event date 1971. (b) We also use the same F-test for testing pre-trends in both soil fertility and population density (panel g) before 1971 legislations. These F-statistics are respectively 10.70 and 29.61 for soil fertility and population density, thereby again rejecting the null hypothesis (at least at 1 percent level of significance) that there are pre-trends in these variables before 1972.

5.3 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 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; the latter tests for the second order effect of ceiling size, if any.

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

$$Y_{st} = \alpha_0 + \alpha_1 Ceilingsize_{st} + \alpha_2 Post1971_t + \alpha_3 Ceilingsize_{st} \times Post1971_t + \alpha_4 X_{st} + S_s + v_{st}, \quad (41)$$

where $Ceilingsize_{st}$ is the key ceiling size variable. Note that X_{st} includes all other control variables including soil fertility as per (41). S_s is the set of state dummies to account for the unobserved state fixed effects. $Post1971_t = 1$ for $t \geq 1972$ and 0 otherwise so 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:

(i) *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.

(ii) *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.

(iii) *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.

(iv) *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.

(v) *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.

(vi) *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.

(vii) *Dummy variables:* Equation (41) 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.

Additional controls: We also re-estimate the model including several additional controls in a bid to rule out competing explanations:

(i) *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.

(ii) *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.

(iii) *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:

$$Y_{st} = \gamma_0 + \gamma_1 Ceiling\_fall_s + \gamma_2 Post1971_t + \gamma_3 Ceiling\_fall_s \times Post1971_t + \gamma_4 X_{st} + S_s + w_{st}, \quad (42)$$

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. We not only include $Ceiling\_fall_s$ and $Post1971_t$ dummy (that takes a value 1 for year>=1972 and 0 otherwise), but also their interactions in each column. We include the same set of controls X (including soil fertility) as in (41) as well as the state dummies S_s. As before, year dummies are absorbed in the post-1971 dummy while state fixed effects drop as we consider ceiling fall rather than ceiling size. As before, we are particularly interested in γ_3, controlling for all other factors. In contrast to equation (42), (43) 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 sub-section.

5.4 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:

$$Y_{st} = \beta_0 + \beta_1 Ceilingsize_{st} + \beta_2 SoilFertility_{st} + \beta_3 X_{st} + S_s + \theta_t + u_{st}, \quad (43)$$

where X_{st} is the same set of control variables as in (41); S_s and θ_t are respectively state and year dummies. The variables $Ceilingsize_{st}$ and $SoilFertility_{st}$ are the key explanatory variables.

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. We do a number of tests to establish the robustness of our key results.

In our empirical analysis we have explored the variation in our results using both linear and non-linear ceiling size variables, showing how the results vary accordingly.

6 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. We consider both the relative and aggregate ceiling effects on the outcomes of interest in our sample.

6.1 Baseline estimates: 1960-85

We start by comparing the means (average) of total capital, total factories and also share of manufacturing output in total output between states in the top 10-th and bottom 10-th percentile in the distribution of average ceiling size (i.e., states with large and small ceilings respectively) before and after the introduction of the 1971 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 statistically significant after 1971, indicating a positive relationship between average ceiling size and total capital in the post-1971 years.[27] Although the effect is similar for ln(total factories), the difference between low and high ceiling states remains statistically insignificant in this case.

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

6.2 Relative Effects of ceiling size

As indicated in Figure 1, after 1971 legally mandated ceiling size changed in all sample states, allowing us to make pre-/post-1971 comparisons though the average values remain unchanged for both ceiling size on most fertile land (15 ha) and average ceiling size (27 ha). Accordingly, we

[27]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.

consider two cases of relative effects of ceiling size: (a) effects of ceiling size after 1971 relative to that in earlier years, 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), share of manufacturing output (column 2), and natural logarithm of registered factories (column 3) using equation (41) for the baseline sample 1960-85.

****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 is positive and statistically significant for ln(total capital) in column (1); 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, as before.

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

With additional controls: Table 3 tests the robustness of Table 2 results by including additional controls, namely, the natural logarithm of man days lost due to strikes, Congress vote percentage and 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 here: 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.

Simultaneity issue: One may argue that our results are biased because of the possible simultaneity between capital investment and net state domestic product, even if it is lagged (one of our control variables). So we proxy the lagged values of net state domestic product by the lagged values of average rainfall in a state in a year and test the robustness of our central results, arguing that rainfall in a state in a year is truly exogenous. Appendix 3 Table A3.3 shows these revised estimates of capital investment over 1960-85. Columns (1)-(3) respectively show the estimates using ceiling on most fertile land while those in columns (4)-(6) show the corresponding ones using average ceiling size. These results further confirm the robustness of our ceiling estimates.

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

Extended sample: 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. We take the latter as a confirmation of our hypotheses as the avereage ceiling is the most pertinent ceiling size variable for the extended sample.

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 and these effects are most pronounced when using average ceiling size.

Effects of fall in ceiling size: Given that there has been a drop in ceiling size in 14 out of 16 samples states after 1971, we next assess below the estimates of Equation (42), as summarised in Table 5. Panel a shows the estimates using baseline controls as in Table 2 while Panel b includes additional controls as in Table 3.

****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. 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 in Tables 2 and 3.

6.3 Aggregate effects of ceiling size

Finally, we consider the estimates of equation (43) to determine the aggregate effects of ceiling size on capital investment. 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), share of manufacturing output (columns 3-4) and natural logarithm of registered number of factories (columns 5-6) 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 (19 ha) in the sample (first quartile value of average ceiling size stays the same after 1971), accounting for some non-linearity in the relationship. This allows us to identify a threshold effect of ceiling size indicating a non-linear relationship, if any. Panel a shows the baseline estimates while panel b shows the estimates with additional controls.

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

Estimates using the linear average ceiling size variable suggest that the coefficient estimates of the average ceiling size variable is positive and statistically significant only for share of manufacturing, suggesting that smaller (greater) ceiling size would significantly lower (increase) share of manufacturing, as hypothesized. The effects of linear average ceiling size on ln(total capital) and ln(total factories) are negative but remain statistically insignificant here. We, however, obtain significant positive effects of average ceiling size on ln(total capital) and ln(total factories) in columns (2) and (6) respectively, when we replace the linear average ceiling size variable by its non-linear 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 a value of 1% or lower. 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.

Panel b augments the results in Panel a by adding new control variables to the baseline regression as shown in Table 3. These include: (a) the cumulative sum of total number of land legislations (CLR) made in a state s in year t as proxy for a state's policy uncertainty since a greater value of CLR 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 vote share of Indian National Congress (INC) party as a measure of social democracy. Ceteris paribus, Congress vote percentage remains statistically insignificant for any outcome variables in any specification. Finally, we include the ln(number of man days lost) to account for labour unrest 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 capital investment measures. 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 its non-linear spline, i.e., 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 equations broadly lend support to hypotheses H1 and H2 when considering aggregate effects in our sample, though the relationship could be linear or non-linear as documented here.

Estimates using ceiling size on most fertile land. Table 7 shows the corresponding effects of ceiling size on most fertile land on selected outcome variables over 1960-85. Columns 1, 3, 5 show the estimates using linear ceiling size variable on most fertile land while columns 2, 4, 6 show those using non-linear spline of the same ceiling size variable, namely, if ceiling size on most fertile land is greater than its median value. We do not find any threshold effect using the first quartile (13 ha) and only find a significant threshold effect for some outcome variables using the 2nd quartile or the median (16 ha). In other words, median value for most fertile ceiling size is closer to the first quartile value (19 ha) of average ceilings in our sample and these two quartile values for most fertile ceiling size do not change after 1971. Panel a regressions use the baseline specifications that control for a number of factors that may also influence the outcome variables as per (42). Panel b shows the estimates with additional controls CLR, total mandays lost and also total Congress vote percentage.

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

Evidently, estimated coefficient of the linear ceiling size on most fertile land is positive for ln(total capital), share of manufacturing and ln(total registered factories), though it is statistically significant only for share of manufacturing, controlling for all other factors. In contrast, the estimated ceiling size coefficient is positive and statistically significant for ln(total registered factories) when we use the ceiling size on most fertile land being greater than its median value.

Panel b then shows the estimates of the augmented model with additional controls for the cumulative sum of all land laws legislated (CLR), man days lost as well as Congress vote percentage. Our central results pertaining to the effects of ceiling size are again confirmed here. 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), reconfirming the validity of both H1 and H2. As in Table 6, these estimates lend support to Hypotheses 1 and 2, indicating that the underlying relationship between ceiling size and capital investment measures could be linear or non-linear.

Aggregate effects on registered manufacturing output share: Note that so far we have considered total manufacturing output share in Table 6 and Table 7. Total manufacturing output includes output from both registered and unregistered manfacturing. Registered manufacturing are those units which employs at least 10 workers, if using power and employs at least 20 workers if not using power. So registered manufacturing units are bigger, which are mote likely to require more land than unregistered units. Since our transaction cost hypothesis are more pertinent for larger registered manufacturing, we next explore if the legislated ceiling size had positively and significantly affected the registered manufacturing output share too. Appendix 3 Table A3.4 shows these estimates over 1960-85. Our key explanatory variable is ceiling on most fertile land or average ceiling size respectively in column (1) and column (2) along with other lagged controls. Ceteris paribus, the estimated coefficient of the ceiling size variable is positive and statistically significant in both columns, highlighting that states with low ceiling size had significantly lower registered manufacturing share in the aggregate. In other words, the aggregate effects on total manufacturing output share in Tables 6 and 7 have been driven by the corresponding effects on share of *registered manufacturing output*, as expected.

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 **************

Table 8 shows the estimates using average ceiling size, which is the more pertinent variable for the extended period. Columns (1)-(3) summarise the estimates of natural logarithm of total capital (column 1), share of manufacturing output (column 2) and natural logarithm of registered factories (column 3). Evidently, capital investment measures are significantly lower when linear average ceiling size is lower in the extended sample too, thus confirming the validity of our key hypotheses over the long run too.

6.4 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 among investors, thereby affecting capital investment. As panels b of Tables 6 and 7 demonstrate, our central results continue to hold even after controlling for CLR_{st}, using both average ceiling size and ceiling size on most fertile land.

Pro-labour policies: 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 that can proxy for the presence of strong labour unions and pro-labour policies followed by the state. 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.

Role of social democracy: Panels b of Tables 6 and 7 that controls for the vote share of Indian National Congress also rule out the possibility that our key results could be influenced by political economy of social democracy in the sample states.

Pro-business policies: Gujarat and Maharashtra 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.[28] Estimates of selected capital investment measures (see Table A3.5 in Appendix 3) after dropping Gujarat and Maharashtra using average ceiling size variable are similar to our baseline results in Tables 6 and 7, suggesting that our results cannot be attributed to the presence of pro-business states.

Effects of green revolution: Note that 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 A3.6 in Appendix 3 shows the estimates after dropping Punjab and Haryana, two states that largely benefitted from green revolution of the mid-60s, which confirm that our central results still go through, thus ruling out the role of green revolution in our analysis.

6.5 Empirical validity of the transaction cost hypothesis

Section 6.1 provides evidence that are consistent with our predictions in H1 and H2. We attribute these results to greater land fragmentation and therefore higher transaction costs of acquiring land for industries in states with lower ceiling size. We now document the relevance of the land fragmentation and transaction costs hypothesis in the light of available evidence.

Non-strategic costs of acquisition: From our earlier discussion, recall that the non-strategic costs of land acquisition include the legal costs of writing a contract, including stamp duties, as well as registration fees.[29] By international standards, Indian stamp duties, in particular non-judicial

[28] In Gujarat, industrialisation was boosted by the establishment of 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, and a stable power situation.

[29] A stamp duty is a tax on the value of instruments used in business transactions. There are two sub-classifications:

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), these remained largely invariant during 1960-85 (Alm et al. 2004) - most changes coming 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. Lack of digital land records in India too adds to this transaction cost of land acquistion; this is more complicated for benami transfers. The Digital India Land Records Modernisation Programme (DILRMP) was launched only in 2016 (outside our sample period) as a central sector scheme (see http://dilrmp.gov.in/). According to data available with the department of land resources, only 58,10,300 plots (out of a total of 800 million plots) in 18 states and Union territories have so far been surveyed and the Unique Land Parcel Identification Number (ULPIN)[30] assigned. At present many of the major Indian states are outside its reach and it would take a long time complete this project.

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[31] 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. Singh (2013) also documents conflicts over land acquisition recorded in the High Courts of Punjab and Haryana.[32]

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judicial and nonjudicial stamp duties. Judicial stamp duties are fees collected from litigants in courts, being relatively small in magnitude for most states. Non-judicial stamp duties are typically a one-time charge on the transfer of immovable property and can appropriately be seen as a tax on the transaction.

[30] The ULPIN is a unique, 14-digit alphanumeric ID generated for each land parcel.

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

[32] Most of these disputes pertain to the amount of compensation, in particular those granted by government officer,

Size of landholding: Given the lack of systematic and direct data to measure transaction costs of land acquisition in the sample states during the sample period, we now seek to provide some evidence using average landholding per household/individual for assessing transactions costs indirectly. In particular, we argue that there is a positive relation between legislated ceiling size and average landholding size in a state. In other words, states with smaller (larger) ceiling size had more (less) land fragmentation and hence smaller (larger) 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 1971 for the sample states with ceiling size lower than its 90 percentile value. We have already shown that ceiling size had dropped in fourteen out of sixteen sample states after 1971 (see Figure 1). It is further 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 2 (panels a and b) 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 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 that on most fertile land).

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

Finally, Table 10 shows the parametric estimates of the effect of ceiling size on land holding size in sample states, both cultivable and total land holding. Columns (1)-(2) show the estimates of *cultivable* landholding per household, while columns (3)-(4) show those of *total* landholding per household over 1960-85 respectively using alternative measures of ceiling size. For each case, average landholding is increasing significantly in average ceiling size, as well as in ceiling size on most fertile

and in some cases to compensation for the other properties, e.g. the superstructures, trees, wells, etc.

land, thus confirming that average landholding is significantly smaller (indicating greater land fragmentation) in low ceiling states.

These findings are compatible with observations 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.

Land use: Next we have collected land use data from the 1961, 1971 and 1981 Census. This gives the total cropped area in a state in the Census year, which we use to calculate the share of cropped area in total area of a state in a year. This means (1-share of cropped area) would refer to non-cropped area (i.e., share of land used for manufacturing, other non-agricultural uses as well as forests/trees/groves/barren/fallow land). We use this land use data to identify the impact of the average ceiling size on share of cropped land, which reflects the corresponding effects on share of non-cropped land. Column (1) of Table 11 shows the estimates using the linear average ceiling size variable, column (2) shows the estimates using ceiling size being greater than quartile 1 (Q1), a proxy for the low ceiling size, while column (3) shows those using the ceiling size being greater than or equal to the median value of the average ceiling size variable.

***********Insert Table 11 here **************

This exercise rules out a linear relationship as the average ceiling size variable is not statistically significant in determining the share of cropped area (see column (1)). However, we obtain a significant and positive effect of average ceiling size Q1 (first quartile that lies between 13 to 19 ha of land) on share of cropped area in column (2). There is, however, no significant effect of average ceiling size being greater than or equal to quartile two (Q2) on share of cropped area in our sample. Taken together, these estimates suggest that only states with low ceiling size (within the first quartile of average ceiling size) had experienced an increase in share of cropped area as these states (relative to those with larger than Q1 size of land ceiling) were more proactive in redistributing land to landless and marginal farmers (relative to those with larger than Q1 size of land ceiling). The latter, in turn, implies that low ceiling size has adversely affected non-cropped land that may include forests, fallow land or land used for manufacturing and other non-agricultural purposes.

Unfortunately, we are unable to finely categorise the non-cropped land into different types and hence could not trace the effects of ceiling size on these different types of land uses. Columns 4-5, however, show the estimates of registered factories per hectare of non-cropped area, which could be taken as a measure for how much of the non-cropped area is allocated to factories and hence industrialization. While column (4) use average ceiling size as the key explanatory variable, column (5) uses average ceiling size as a share of average cultivable land size per household. Note that the estimated coefficients of both are positive, but the estimated coefficient is significant in column (5) only when we use average ceiling size as a share of average cultivable land. The latter indicates that states where average ceiling size is significantly larger than the average cultivable land tend to allocate more non-cropped area for factories, thus lending support to our hypothesis.

***********Insert Table 12 here **************

Povery rate: Finally, we analyse the effect of ceiling size on a poverty index, namely, the head count ratio. This regression exercise, summarised in Table 12, confirms that only the low ceiling size states (corresponding to Q1 level in the distribution of average ceiling) that had higher share of cropped land (see Table 11) are the ones who have been successful in lowering poverty rates. The effect can only be attributed to better redistribuiton of land along with conferment of property rights in more proactive states with lower ceiling size.

Taken together, we document that states with low ceiling size had smaller landholding size and therefore greater land fragmentation and higher transactions costs of land acquistion for industries. Consequently, these low ceiling states had higher (lower) share of cropped (non-cropped land); these low ceiling states are also the only ones to experience a significant reduction in poverty rates, thus extending the key finding of Besley and Burgess (2000).

7 Conclusion

This paper speaks to the transfer puzzle, as well as the issue of premature deindustrialisation for emerging and developing economies. The transfer puzzle refers to the fact that transferring land from (relatively low productivity) agriculture to industry has proved to be difficult. Whereas premature deindustrialisation refers to the industrial slowdown witnessed in many developing economies (as documented by Rodrik, 2016, in general, and by Amirapu and Subramanian, 2015, in the Indian context).

Departing from the existing literature, ours is the first paper to document the role of legislated ceiling size in explaining these trends, arguing that these can lead to greater land fragmentation, thereby making land acquisition for industries more costly, and hence reducing capital investment, as well as the pace of industrialization. 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 exogenous variation in legislated land ceiling size 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 industrialisation. Using both relative and aggregate effects of ceiling legislations, we show that states with lower legislated ceiling size 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. Further, only lower ceiling size was associated with a drop in poverty rates, thus highlighting some benefits of low celing size as well, thereby extending Besley and Burgess (2000). These results, coupled with the fact that states with low ceiling size had faced greater land fragmentation and lower non-cropped area confirm the role of land fragmentation and transaction costs of land acquisition for industries,

Moreover, our results suggest at least two sets of policies for lowering transaction costs of land acquisition. First, registration and digitisation of all land records would help lower the non-strategic costs of land acquisition. Second, a 'local' rather than a 'national' consent clause for land acquisition would help lower the strategic costs. Of course, these need to be accompanied by complementary policies, e.g., reform of labour laws, development of infrastructure, as well as ensuring easy access to credit for boosting investment for industrialisation.

Finally, these 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.[33] Thus the present paper may

[33] Adamopoulos and Restuccia (2014) have documented that these countries experienced a substantial decrease in

have implications for countries beyond the Indian border as well.

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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 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 those 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 each ceiling size variable 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 pre-1971) on natural logarithm of total capital (column 1), share of manufacturing output (column 2) and natural logarithm of registered factories (column 3) after including 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. Panel A shows the estimates using ceiling size on most fertile land while Panel B shows those using average ceiling size. 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. Other controls are as in Table 2 and all control variables are lagged by one year. All regressions 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	Ln(factory)
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 pre-1971) on natural logarithm of total capital (column 1), share of manufacturing output (column 2) and natural logarithm of registered factories (column 3) using 1960-2015 data. Columns (1)-(3) show the estimates using ceiling size on most fertile land while columns (4)-(6) show those 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. All regressions include other controls as in Table 3, which are all lagged by one year and 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.

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)
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. Panel a regressions control for other controls as in Table 2 while Panel b include additional controls as in Table 3, which are all lagged by one year. 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 VARIABLES	(1) Ln(totalcapital)	(2) Share of mfg	(3) 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)
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)
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	
	(0.629)		(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

The table shows the long-run effects of ceiling size on indices of capital investment in our sample over 1960-2015, using average ceiling size. 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 refers to the first quartile of the distribution of average land ceiling size 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
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

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		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

Table 11. Effect of ceiling size on selected variables, 1960-85

The table shows the estimates of share of cropped land over 1960-85. Our key explanatory variable in column (1) average ceiling size for each sample state. Column (2) shows the estimate for the first quartile of the average ceiling size Q1 while column (3) shows that for average ceiling size greater than or equal to second quartile Q2 of average ceiling size. Columns 4-5 show the estimates of registered factories per hectare of non-cropped area. While column (4) use average ceiling size as the key explanatory variable, column (5) uses average ceiling size as a share of average cultivable land size per household. Other controls include lagged rainfall (as a proxy for GDP), share of SC/ST population, urban population share, literacy rate and soil fertility as before. Standard errors are clustered by state. Cluster-robust standard errors in parentheses; significance level: *** p<0.01, ** p<0.05, * p<0.1

	Share of cropped area			Factories per non-cropped area	
VARIABLES	(1)	(2)	(3)	(4)	(5)
Average ceiling size	-0.0003			0.0535	
				(0.086)	
	(0.000)				
Average ceilings Q1		0.0202***			
		(0.004)			
Average ceilings>=Q2			0.0064		
			(0.013)		
Av. ceiling size relative to average landholding per hh.					0.0068*
					(0.004)
Constant	0.0223	-0.0056	0.0081	-8.4840	-6.1702
				(6.476)	(6.641)
	(0.029)	(0.032)	(0.022)	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes
State dummies	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes
Observations	344	344	344	344	344
R-squared	0.978	0.978	0.978	0.836	0.84

Table 12. Effect of Ceiling size on poverty head count ratio

This table shows the estimates of poverty head count ratio over 1960-85. Our key explanatory variable is the first quartile (Q1) of average ceiling size indicating low ceiling size for each sample state. Columns (1)-(3) respectively show the estimates for total, rural and urban HCR. Other controls include state GDP, share of SC/ST population, urban population share, literacy rate and soil fertility. Standard errors are clustered by state. Cluster-robust standard errors in parentheses; significance level: *** p<0.01, ** p<0.05, * p<0.1.

	(1)	(2)	(3)
VARIABLES	HCR	HCR rural	HCR urban
Average ceiling Q1	-20.1159***	-18.3699**	-21.8619***
	(6.218)	(8.371)	(5.435)
Constant	103.2864**	109.5825**	96.9902**
	(38.614)	(50.912)	(33.601)
Other controls	Yes	Yes	Yes
State dummies	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Observations	344	344	344
Mean of dep. var.	49.46	53.35	45.58
R-squared	0.893	0.837	0.907

Figures

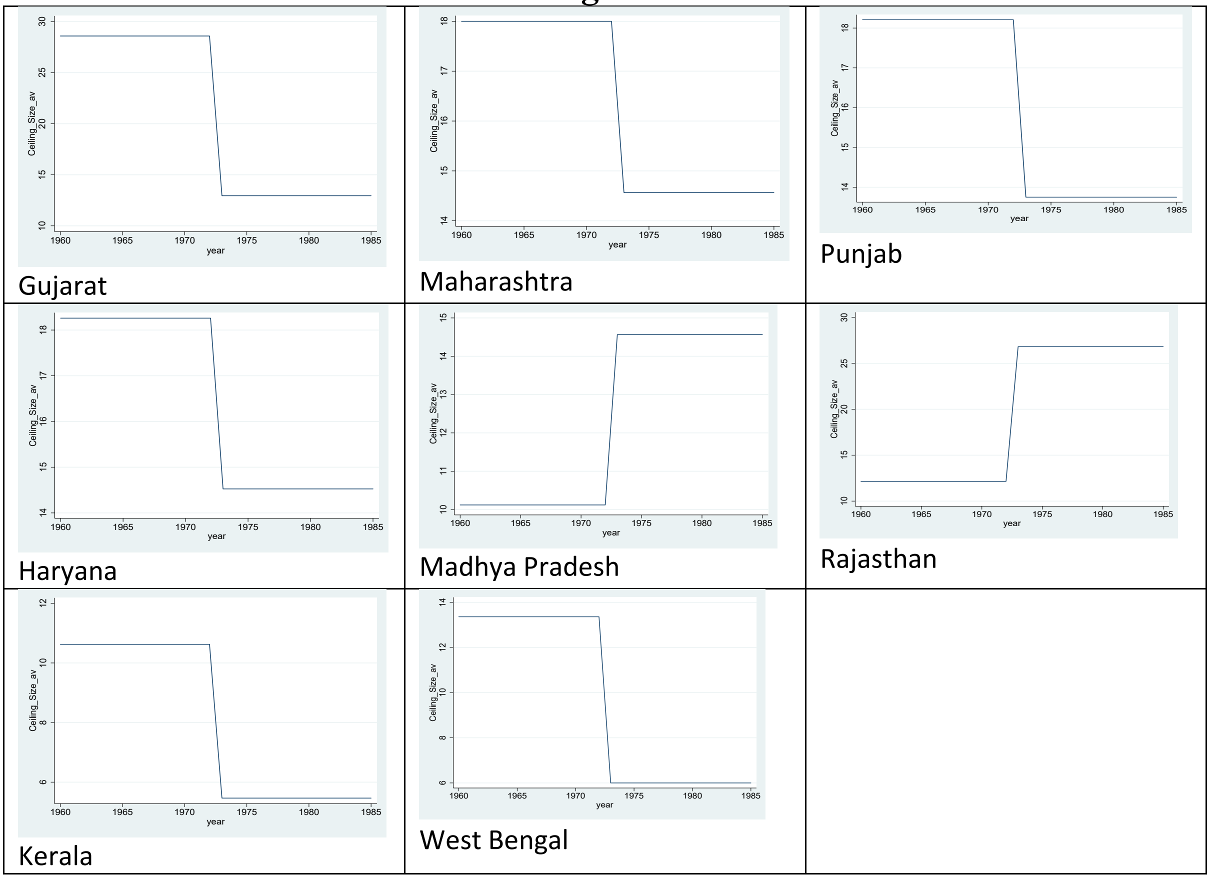


Figure 1. Inter-state variations in ceiling size in our sample over 1960-85

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.

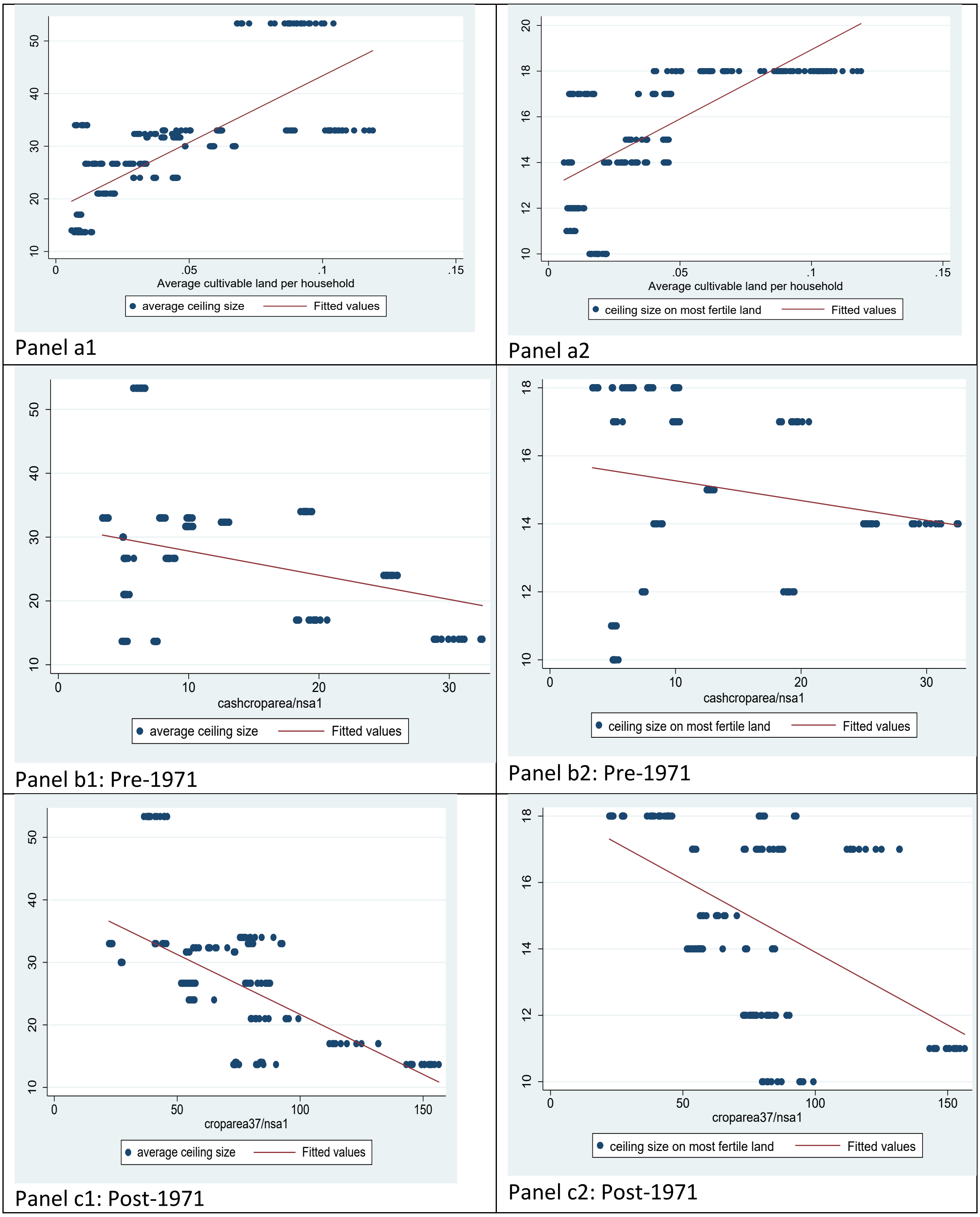
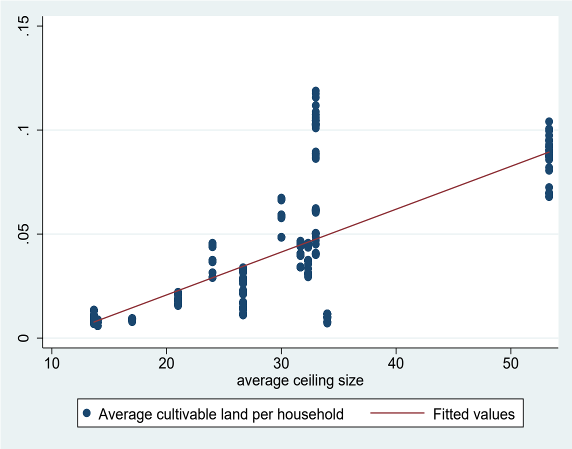
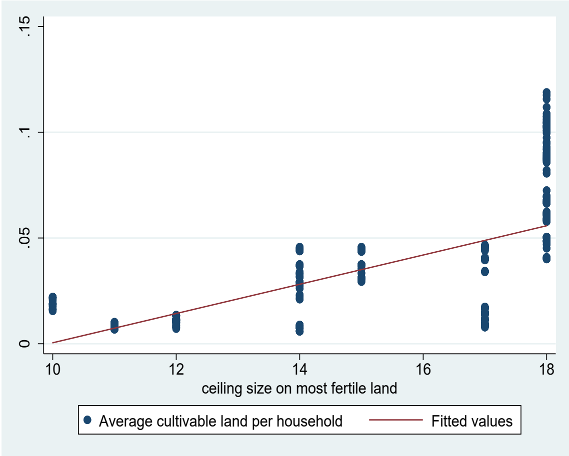


Figure 2. Empirical validity of ceiling legislations in determining ceiling size

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 Online Appendix 1: Holdout

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

$$q = f(\min\{k, h\}), \tag{1}$$

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

$$p = D(q), \tag{2}$$

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:

$$\max_{k,h} \; \pi(k, h) \equiv D(f(\min\{k, h\}))f(\min\{k, h\}) - rk - zh, \tag{3}$$

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:

$$\max_h \; \pi(h,h) \equiv D(f(h))f(h) - (r+z)h. \tag{4}$$

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,

$$\pi_m(1) = f(1)D(f(1)) - r, \tag{5}$$

$$\pi_m(1/2) = f(1/2)D(f(1/2)) - r/2. \tag{6}$$

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

$$\frac{\pi_m(1) - Y}{2}. \tag{7}$$

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:

$$\frac{\pi_m(1) + \pi_m(1/2) - \frac{Y}{2}}{2}. \tag{8}$$

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

$$\frac{\pi_m(1/2) - \frac{Y}{2}}{2}. \tag{9}$$

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 (**??**), recall the firm's

[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.

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 (**??**), and that of the seller is $Y/2$. Thus the firm's payoff is given by

$$\frac{\frac{\pi_m(1)+\pi_m(1/2)-Y/2}{2}+\frac{\pi_m(1/2)-Y/2}{2}-Y/2}{2}. \tag{10}$$

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

$$\frac{\pi_m(1)-Y}{2} > \frac{\frac{\pi_m(1)+\pi_m(1/2)-Y/2}{2}+\frac{\pi_m(1/2)-s/2}{2}-s/2}{2}, \tag{11}$$

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

$$\frac{\pi_m(1)-Y}{2} > X > \frac{\frac{\pi_m(1)+\pi_m(1/2)-Y/2}{2}+\frac{\pi_m(1/2)-Y/2}{2}-Y/2}{2}. \tag{12}$$

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.

Online Appendix 2: Background Information

A2.1. 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.

A2.2. A note on land acquisition in India

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''.[1] 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 done after 2015.

Land acquisition has proven to be quite unpopular In India; 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

[1] For Industrial corridors, Public Private Partnership projects, Rural Infrastructure, Affordable housing and defence 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. %By virtue of the 1971 land ceiling legislations, the number of affected 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.

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-a-vis small and marginal land owners, an unsympathetic bureaucracy,[2] the practice of land prices being based on the value recorded in the sale deeds etc.[3] Forcible dispossession with little compensation, reneging on promises of resettlement, and even defrauding by middlemen and contractors are common.[4]

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.

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

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

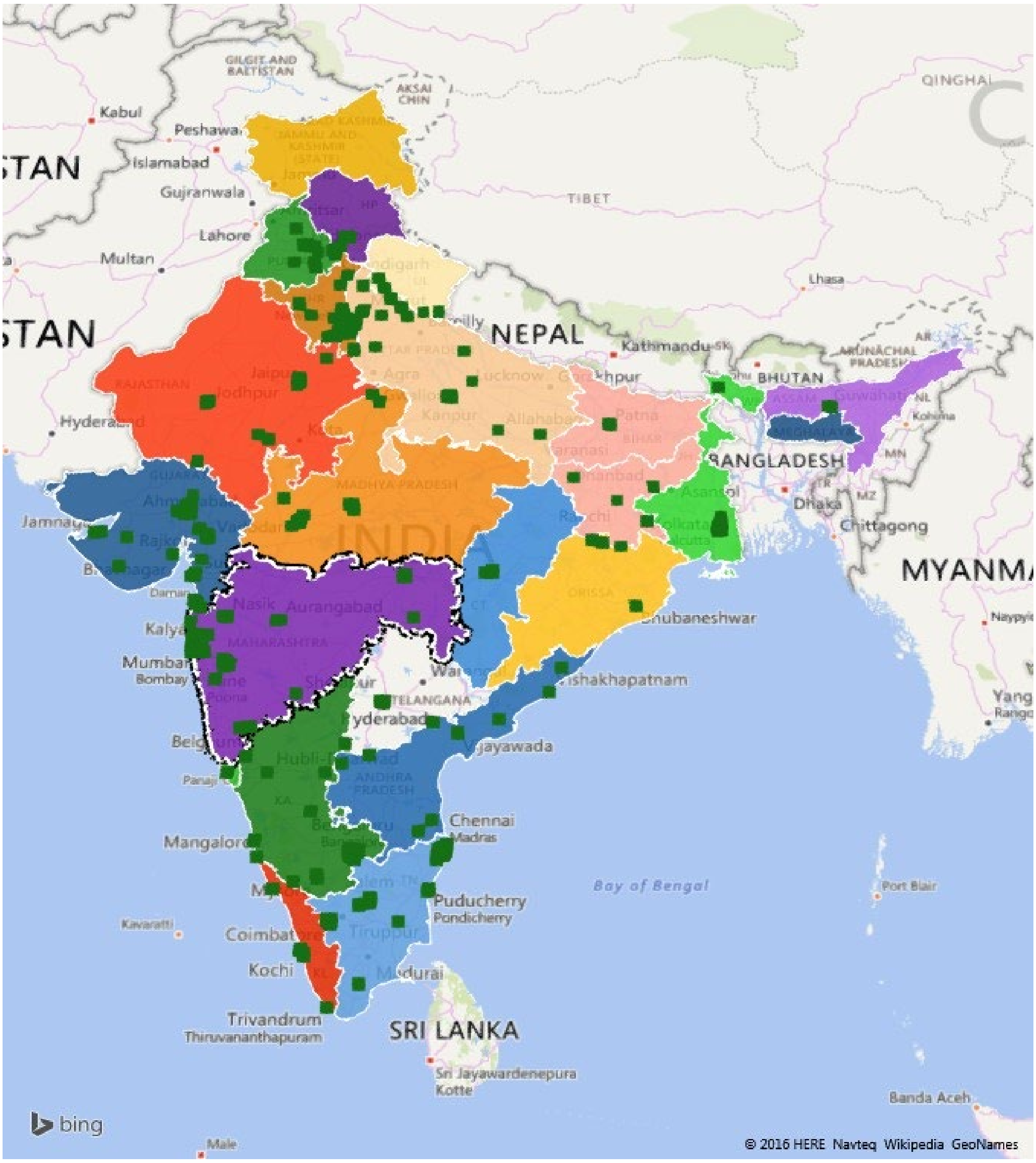
[4] In China the matter has been made worse by the fact that farmers do not have land ownership rights (only user rights), and they are much more at the mercy of the arbitrary decisions of local government officials in collusion with commercial developers.

Table A2.1: 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 A2.1. Location of sample firms across the Indian states



Online Appendix 3. Additional Results

Table A3.1: Summary Statistics, 1960-85

Variables	Observation	Mean	Std. Dev.
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
Cumulative number of land reform laws	416	2.7836	2.3554
Congress vote percentage	407	39.6211	10.8230
Soil fertility	416	0.0595	0.0413

Table A3.2: Summary Statistics 1960-2015

Variables	Observation	Mean	Std. Dev.
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 A3.3. Key capital investment estimates after replacing net state domestic product by rainfall

This table shows the relative effects of ceiling size on capital investment over 1960-85. Columns (1)-(3) respectively show the estimates using ceiling on most fertile land while those in columns (4)-(6) show the corresponding ones using average ceiling size. We test the robustness of Table 4 estimates by replacing state net GDP by the average rainfall in a state in a year. Other controls include share of SC/ST population, urban population share, population density, literacy rate and soil fertility. Standard errors are clustered by state. Cluster-robust standard errors in parentheses; significance level: *** p<0.01, ** p<0.05, * p<0.1.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	lntotalcapital	shmfg	lfactory	lntotalcapital	shmfg	lfactory
MostfertileCeilings	0.2165	-0.0169*	-0.2716**			
	(0.203)	(0.008)	(0.101)			
Post1972	-1.8412**	0.0264	-0.4673	-1.2788***	0.0098	-0.6833***
	(0.738)	(0.022)	(0.430)	(0.399)	(0.009)	(0.194)
MostfertilexPost1972	0.1129**	-0.0011	0.0260			
	(0.046)	(0.002)	(0.028)			
Average_ceilings				-0.0081	-0.0001	-0.0033*
				(0.006)	(0.000)	(0.002)
AveragexPost1972				0.0784***	-0.0001	0.0423***
				(0.025)	(0.001)	(0.012)
Rainfall	-0.0060	0.0007***	0.0077**	-0.0079	0.0005***	0.0015
	(0.006)	(0.000)	(0.003)	(0.005)	(0.000)	(0.002)
Constant	2.4207	0.1112	8.8339***	4.9547	-0.0680	6.5224***
	(3.797)	(0.127)	(1.589)	(3.332)	(0.078)	(1.271)
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	344	336	318	344	336	318
R-squared	0.354	0.920	0.956	0.382	0.919	0.963

Table A3.4. Aggregate effects of ceiling legislations on share of registered manufacturing

This table shows the estimates of share of registered manufacturing over 1960-85. Our key explanatory variable is some variant of ceiling size pertaining to ceiling on most fertile land or average ceilings as shown in columns (1)-(2) respectively. Other controls include lagged GDP, share of SC/ST population, urban population share, literacy rate, soil fertility, cumulative number of land reform legislations, Congress vote percentage, number of mandays lost due to strike action along with state and year dummies. All right hand side variables are lagged by one year. Standard errors are clustered by state. Cluster-robust standard errors are shown in parentheses; significance level: *** p<0.01, ** p<0.05, * p<0.1.

	(1)	(2)
VARIABLES	Share of registered manufacturing	
Most fertile ceilings	0.0734***	
	(0.015)	
Average ceilings		0.0021***
		(0.001)
Constant	-1.2540***	-0.2806**
	(0.249)	(0.117)
Other controls	Yes	Yes
State dummies	Yes	Yes
Year dummies	Yes	Yes
Observations	327	327
R-squared	0.953	0.953

Table A3.5. 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 A3.6. 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

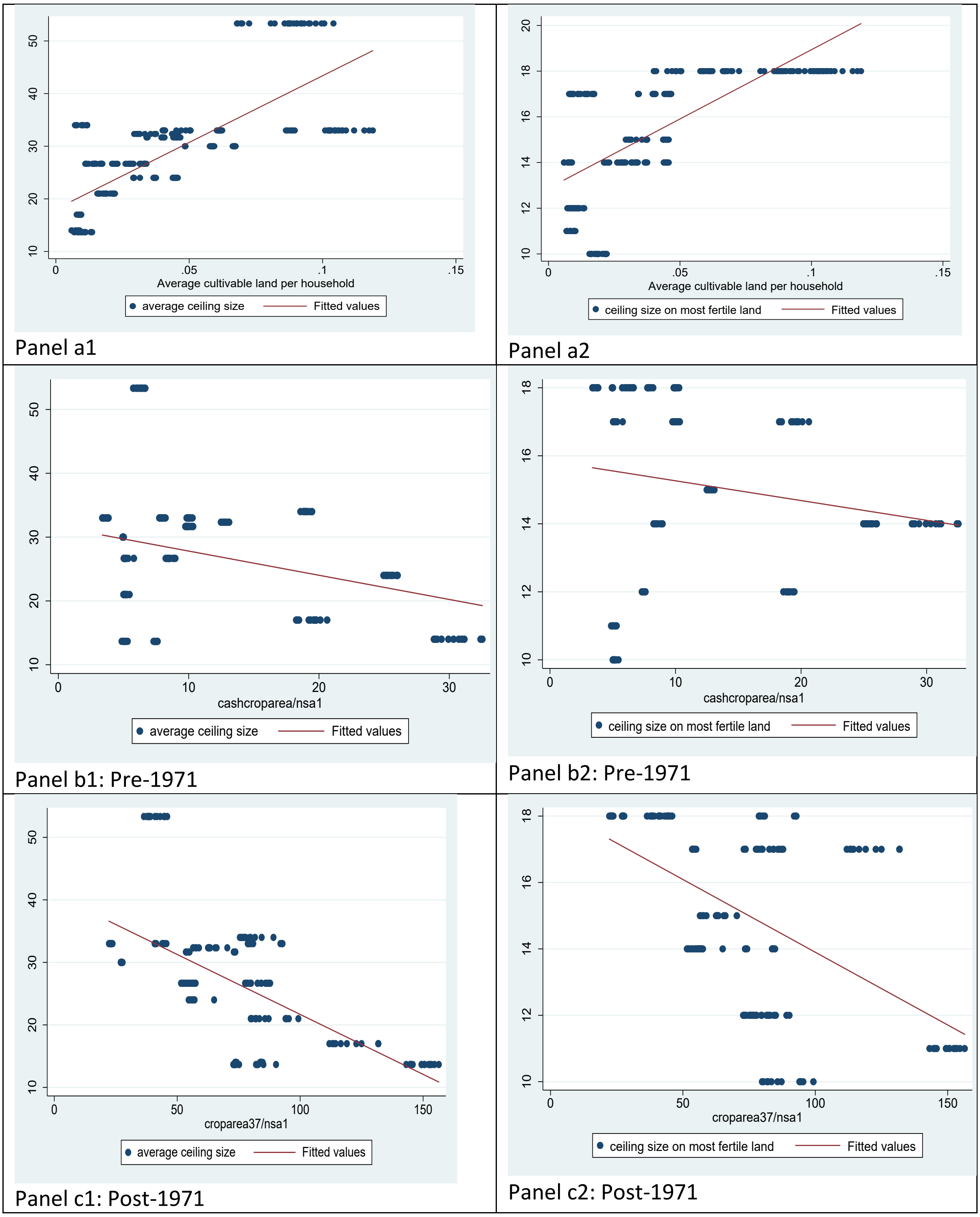


Figure A3.1. Empirical validity of ceiling legislations in determining ceiling size

Appendix Figure A4.1 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.

Online Appendix 4. 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

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

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

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.

1 Proofs of Propositions 3 and 4 for the Reviewers

Proof of Proposition 3. Clearly, a solution to (37), (38) and (40) in the three variables k, h_I and p is an equilibrium of this economy. We can then totally differentiate (37), (38) and (40) with respect to k, h_I, p and τ to obtain:

$$\begin{aligned} pI_{kk}dk + pI_{kh}dh_I \quad &+ \big(\tfrac{I}{k}\big)^{\frac{1}{\sigma}} dp \quad &= 0, \qquad (1) \\ pI_{kh}dk + pI_{hh}dh_I \quad &+ \big(\tfrac{I}{h_I}\big)^{\frac{1}{\sigma}} dp \quad &= s_A d\tau, \qquad (2) \\ \tilde{Z}dh_I \quad & \quad &= \phi s_A h_I d\tau, \qquad (3) \end{aligned}$$

where $\tilde{Z} = -[s_A - \phi(s_A + \bar{w}) + \phi\tau s_A]$. Moreover, from (40) we have that $\tilde{Z} < 0$.

As before we define

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

It is straightforward to check that

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

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

$$\tilde{D}^{k\tau} = s_A\big(\frac{I}{k}\big)^{\frac{1}{\sigma}}[-s_A + \phi(s_A + \bar{w}) - \phi\tau s_A + \frac{\phi}{\sigma}(\bar{w} + \tau s_A)]. \qquad (4)$$

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 $\tau > \tau^*$. $\square$

Proof of Proposition 4. Using the fact that $Y = \beta s_A$, we can equivalently consider the effect of a change in s_A. Totally differentiating (37), (38) and (40) with respect to k, h_I, p and s_A we obtain:

$$\begin{aligned} pI_{kk}dk + pI_{kh}dh_I \quad &+\left(\tfrac{I}{k}\right)^{\frac{1}{\sigma}}dp &&= 0, && (5)\\ pI_{kh}dk + pI_{hh}dh_I \quad &+\left(\tfrac{I}{h_I}\right)^{\frac{1}{\sigma}}dp &&= \tau ds_A, && (6)\\ \tilde{Z}dh_I \quad & &&= N ds_A, && (7)\end{aligned}$$

where $N = \phi\tau h_I - h_A(1-\phi)$, where $N < 0$ from (40).

Define

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

since N and $\tilde{Z}$ are both negative. Thus $\frac{dh_I}{ds_A} = \frac{dl_I}{ds_A} < 0$, and $\frac{dk}{ds_A} > 0$. □