Property Rights Improvement and Credit Reallocation: Theory and Evidence from Urban India

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Abstract

This paper studies the effect of land deregulation on credit access by Indian firms. I model the deregulation of holdings and transfers of land in the late-1990's India as a change in the transaction costs of land collateral in a contracting model of loans subject to moral hazard. The model predicts that the deregulation allows for an expansion of land collateralization and a larger leverage of land collateral; and that the net effects on firm borrowings are heterogeneous in firm size and landholdings. I test these predictions empirically using a large panel dataset of Indian firms. I find that the land deregulation led to greater land transactions overall; and that the deregulation reallocated credit from the landless, landed-small, and large firms, to the landed-medium firms.

JEL Classification Codes : D23, O12, O16, R33, R52
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1 Introduction

Credit constraints faced by people in less developed economies are one of the crucial impediments to economic development, by hampering a process of capital and wealth accumulation both at micro and macro levels [Aghion and Bolton (1997), Banerjee and Newman (1993), Galor and Zeira (1993)]. Evidence indicates that firms and small enterprises in less developed economies are severely credit-constrained, even if their marginal rate of return to capital is high [Banerjee and Duflo (2008), de Mel, McKenzie and Woodruff (2008)]. Although asymmetric information in credit markets is the fundamental source of the credit constraints, insecure property rights worsens the credit constraints as they limit the borrowers' ability to pledge against default with collateral, as emphasized by De Soto (2000).[1] Interplay between asymmetric information in the credit markets and insecure property rights particularly harm the poor households and firms in these economies who need collateral to access external financing. Programs of property-rights titling and property reforms are, therefore, expected to improve credit access by raising the ability to collateralize assets, paving a way toward a sustainable economic development.

In this paper, I study the impacts on borrowers' credit access of the property-rights improvement, made possible by an Indian land deregulation, with an emphasis on the distributional consequences. First, I develop a model of loan contract with moral hazard and costly land transactions. To guide my distributional argument that follows, I take into account heterogeneous effects on credit demand by borrowers, and the potential general-equilibrium effects arising from an increased aggregate demand for credit. Second, I empirically test the theoretical predictions by using a quasi-experimental repeal of the urban land ceilings and regulation (henceforth, simply "land regulation"), which was implemented in more than 60 of the largest Indian cities/urban agglomerations in 1999, and a panel dataset of Indian firms. In particular, I assess whether the property-rights improvement results in an average increase in credit access, or in a reallocation of credit across borrowers.

For more than 20 years in the late 20th century, Indian firms and households in major large cities have experienced an artificial restriction of property rights of land and buildings. Until it was repealed in 1999, the Urban Land (Ceiling and Regulation) Act, enacted by the parliament of India in 1976, provided ceiling limits in holdings of vacant land, prohibited transfers of land and buildings, and restricted building construction in 64 of the largest urban agglomerations, limiting the owners' exclusive rights to use and transfer the real estate assets. In practice, the limited rights of use and transfers of land effectively restricted land transactions. Hence, the deregulation made it possible for land to be transferred (to creditors or purchasers), thus

[1] Malfunctioning financial institutions are other sources of credit constraints, as they restrict one's ability to utilize a full capacity to relax the constraint. Judicial reforms in India to more efficiently process the disputes over debt recovery and collateral seizure are studied by von Lilienfeld-Toal, Mookherjee and Visaria (forthcoming), Vig (2011) and Visaria (2009).

allowing for a greater use of land as collateral for loans. In 1999, the Repeal Act gave rights to repeal the regulation to state governments of India, providing a variation in status and timing of the land deregulation across states and years. By 2003, all the union territories (including Delhi) and the states of Gujarat, Haryana, Karnataka, Madhya Pradesh, Orissa, Punjub, Rajasthan, and Uttar Pradesh, have repealed the regulation, while the states of Andhra Pradesh, Assam, Bihar, Maharashtra, and West Bengal, kept it effective until 2008. I use this variation as a source of exogenous change in property rights to estimate the deregulation impacts in a difference-in-differences identification strategy.

Property-rights improvement changes the incentives of the treated people, as widely discussed in the literature.[2] I argue in this paper that in the case of credit access, property-rights improvement induces more land collateralizations and more frequent land transactions, and that the credit impacts are largely driven by these behavioral responses. First, I theoretically argue how the borrowers' strategies of land collateralization, with or without the regulation, creates heterogeneous treatment effects of the property-rights improvement. My model incorporates a borrower's choice of the degree of asset collateralizations as part of the repayment schedule. Comparative statics show how the collateralization strategy of the borrower changes as the land rights improve. I show that under land regulation, a borrower will rationally choose not to provide land collateral when the investment size exceeds a certain level, and, that as a result, medium-sized firms do not collateralize land under land regulation, resulting in a severe credit-rationing for these firms. Repeal of the land regulation induces these medium-sized firms to utilize a full capacity of land collateral, allowing them to experience a substantial increase in their ability to pledge against default. I call this expansion of the land collateralization the "*extensive* margin of the deregulation effect". Second, I empirically assess how property-rights improvement results in an increase in land liquidity, measured by the transaction likelihood, and show that the liquidity mechanism plays a key role in connecting the improved land rights with the ultimate effects on borrowings. As a result of improved land liquidity, the property rights improvement raises the leverage of land collateral, allowing for a uniform increase in credit access of firms with land collateral. I call this improvement in the leverage of land collateral "the *intensive* margin of the deregulation effect".

The degree to which a firm is affected by a property-rights improvement is governed by a mixture of the extensive, as well as intensive, margins of the effect, which are, in turn, determined by their landholdings and the size of the collateralizable assets, and the potential general-equilibrium effects. First, by focusing on the partial-equilibrium impacts where the return to be offered to lenders is given, the model predicts that there are three kinds of firms

[2]Existing literature consistently finds that more secure property rights cause higher income per-capita [Acemoglu, Johnson and Robinson (2001)], induce more investment [Besley (1995), Goldstein and Udry (2008), Galiani and Schargrodsky (2010), Hornbeck (2010), Johnson, McMillan and Woodruff (2002)], and reallocate resources to more productive use [Field (2007), Wang (2011), Wang (forthcoming)]. See Besley and Ghatak (2010) for the extensive review of the literature.

with qualitatively heterogeneous treatment effects, based on the decomposition of the treatment effect into the extensive and intensive margins: (1) medium-sized firms that experience both the extensive and intensive margins of the effects, (2) landed-small firms that experience only the intensive margin of the effects, and (3) landless firms that are not affected at all, which are essentially the same as large firms that can attain the first-best contract even under land regulation.

In addition to the partial-equilibrium impacts, negative general-equilibrium effects may arise to the extent that the increased aggregate demand for credit improves the lenders' opportunity cost of credit. Our model allows for an increase in the lenders' outside option in response to the increased credit demand in order to show that net effects can be negative for landless, landed-small, and/or large firms, since the direct effects for them are so small that the general-equilibrium effects are likely to dominate the direct effects. The model also predicts that the large general-equilibrium effects can kill the average increase in credit demand, leaving the net effect to be a reallocation of credit among borrowers.

I use a panel dataset of urban Indian firms from the Prowess database from the Center for Monitoring of Indian Economy (CMIE), to fully control for the time-invariant firm fixed effects and to allow for a heterogeneity across firms in the initial size and the landholdings. Over the sample period 1991 through 2007, the treatment group is made up of states that repealed the land regulation after 1999 until 2003, while the control group includes states that kept it active for the entire sample period. I first compare observations of firms in the treatment states before and after the land deregulation, and then compare them with observations of firms in the control states before and after the land deregulation. In estimating heterogeneous effects, I additionally compare firms within the treatment states in terms of firm size and the landholdings.

Empirical analysis shows that the land deregulation makes it more likely that the firms in the treatment states participate in both sides of the land market. Nonetheless, I find statistically significant estimates only from a subsample of the mega cities where the ceiling limit was tightest at $500m^2$, but not from the other subsamples of smaller cities with relatively slack ceiling limits. I interpret this result as evidence of the distorted asset markets only in the tightly regulated areas where the regulation was a binding constraint for a large number of firms. Nonetheless, the impacts of the land deregulation are huge since in the dataset, more than half the firms are located in the mega cities, and a much larger fraction of capital is concentrated in the mega cities.

Despite the evidence of the improved land liquidity, the estimated average effects on secured borrowings are small in magnitude and not statistically significant for both full and subsamples, similar to the findings of Field and Torero (2006). On the other hand, I find significant heterogeneous treatment effects for different categories of firms in the mega cities, and the estimated effects are consistent with the predictions of the model. The estimated heterogeneous effects on secured borrowings indicate evidence of the inverted-U shaped treatment effects, by which the medium-sized landed firms benefit the most, while the landless, landed-small, and large firms all reduce their borrowing. The estimated heterogeneous effects thus suggest that the deregulation reallocates credit among borrowers, instead of raising the average credit access. Heterogeneous effects are quite robust to an inclusion of various kinds of state-trends. Additional results of comparison of pre-trends in treatment and control firms indicate that the observed effects are not driven by the differential pre-trends. Finally, I find no average, as well as heterogeneous, effects on credit access in places where land liquidity did not improve, consistent with the argument of the role of land liquidity in connecting property rights and credit access.

This paper contributes to a recent literature of estimating the effect of improving property rights on credit access. A body of reaserch finds little evidence of an increase in the average credit access when land rights improve.[3] This paper, instead, provides evidence of credit reallocation among borrowers, by going one step further to consider heterogeneous treatment effects and the general-equilibrium effects.

This paper is not the first to consider the distributional consequences of a particular source of financial development. Besley, Burchardi and Ghatak (forthcoming) consider the distributional effect of the property rights improvement in a theoretical setting, stressing the role of the competition among lenders.[4] von Lilienfeld-Toal, Mookherjee and Visaria (forthcoming) investigate the distributional effect of institutionally improving creditor rights to recover their credit, stressing the lenders' outside option, the point I take up in this paper.[5] This paper thus joins these papers, by addressing that the land deregulation may not result in financial development in average terms, while it reallocates credit among borrowers.

The following sections are organized as follows. Section 2 introduces the model and analyzes how the repeal of the land ceilings and regulation affects a loan contract. It also derives empirically relevant equations from the comparative statics of the deregulation. Section 3 discusses the regulation and deregulation of urban land of India in the last 40 years. Section 4 explains the dataset I use in the empirical analysis, and my identification strategy. Section 5 discusses the effect on the secured borrowings and shows the results. Section 6 discusses the

[3]Field and Torero (2006) find that the Peruvian program of land titling did not increase the access to credit from private banks, while it increased the access to credit from the public banks. Galiani and Schargrodsky (2010) find that the Argentinian program of land titling during the 1980s and 1990s resulted in a only modest increase in mortgage loans, but not in the other forms of loans. Wang (forthcoming) finds that the Chinese housing reform allowed households to finance their entrepreneural activities by capitalizing on the value of the housing properties that they had rented from the state but purchased at subsidized prices.

[4]They suggest that the effects are non-linear and heterogeneous by borrowers' wealth, consistent with my results. They also suggest that without a sufficient degree of lender competition, all the benefits of the improved property rights accrue to the lenders, instead of to the borrowers, which is again consistent with my results.

[5]They find, similar to my results, that the credit is progressively reallocated from the small firms to the large firms. Together with von Lilienfeld-Toal and Mookherjee (2010), they stress the importance of the general-equilibrium effect of a policy. The point of their argument is that an institutional change aiming at expanding the set of contracts that debtors can access could change the relative position of creditors in a contract.

effect on the land liquidity and shows the results. Section 7 concludes.

2 Theoretical Analysis of Land Deregulation

I consider a model of loan contract with moral hazard, by borrowing a model in von Lilienfeld-Toal, Mookherjee and Visaria (forthcoming), and allow for a distortion in the real estate market. Firms maximize profits by investing in a project that potentially generate positive returns, but do not necessarily hold enough wealth to self-finance the investment. Thus, the firms need to turn to outside investors to finance the investment. Credit market imperfection, however, does not allow all the firms to obtain enough external funds, unless they guarantee loans by collateral of physical assets that can also be used in production, in order to raise their pledgeability. I assume that the asset collateral is composed of real estate (that is, land and building, but henceforth I call it"land") and/or plant and machinery (henceforth, simply"machines"). My aim in this theory section is to see what happens in the credit market when the government-imposed regulation in the land market is repealed. To do so, I first consider the case where there is no land regulation. Next, I examine the case where there is land regulation, and hence liquidity of land is so low that the collateral value of land is low, which then hampers the pledgeability of firms that put up land collateral.

2.1 Model Setup

Timing of events is as follows. First, the loan contract, which specifies the loan size x and repayment schedule, is agreed upon by a risk-neutral firm and a risk-neutral lender. The firm then uses the funds raised from the outside lender in production. After the production has taken place, there occurs either one of two states of nature. The project financed by the outside investor succeeds with probability p and returns $q(x)$, and in the other state, the project fails with probability $1-p$ and returns nothing. This uncertainty is purely idiosyncratic in that any behavior by the firm cannot change its likelihood.[6] For the tractability of the model, I assume that the $q(\cdot)$ function is twice-differentiable, and satisfies the following properties: $q'(0)=\infty$ and $q'(\infty)>0$, implying that regardless of the marginal cost of investment, it is optimal to invest in a positive value. After profits are made in each state, firms have two options, either making a repayment or reneging the contract. When the loan contract is honored, repayment R_i is made in each state, $i=s$ or f. When a firm chooses to renege the loan contract, they will enjoy returns from investment, $q(x)$, while they lose the reputational value of d, which is the

[6]Therefore, I abstract from the *ex-ante* moral hazard. Uncertainty in the model is interpreted as an ideosyncratic shock to the Hicks-neutral technology parameter. Thus, the uncertainty for one firm is not correlated with that for another firm. Each contract is agreed upon separately by the bundle of a firm and a lender. In other words, there is no macroeconomic component in this uncertainty that is shared by all firms in the economy, in which case the outside investors need to insure against the systemic risk where all the firms are hit by a negative shock. We abstract from this kind of situation.

short-hand of the future profit stream they can get, had they not reneged the contract. Since the outcome of the project is assumed to be publicly observable and verifiable by a third party, the case in which the firm does not repay can be brought to the court by which all productive assets are potentially ordered to be legally seized.[7] I allow for repayment to take a form of either cash payment or collateral provision, or both. Since I assume, for simplicity, that firms do not hold cash to begin with, cash repayment comes only from returns from investment, which occurs only in the success state.[8]

Although firms have incentives to acquire assets to increase the capital stock to expand the productive capacity and obtain larger profits, they may not be able to do so when there is a possibility that firms divert to the private benefit, a portion of returns from investment without making a repayment prescribed in the contract. Therefore, the optimal contract agreed upon by the lender must induce firms not to divert the return, and to honor the contract by making the repayment. Such incentive-compatibility constraints are taken into account for each state in the contract. In the success state, the firm's profits, net of repayment obligation, must be larger than, or equal to, the diverted profits, net of loss in assets legally seized by the court as well as the reputational costs.[9]

$$q(x) - R_s \geq q(x) - (M + L) - d, \tag{IC_s}$$

where R_s is the repayment in the case of the project's success, M and L are machines and land, respectively, and their sum is the value of the firm's total productive assets, and d is the repuational costs of the firms when they renege on the contract. In the failure state, on the other hand, the incentive compatibility constraint is such that the firm's loss caused by the repayment must be less than the loss in assets seized in the court and in reputation.

$$-R_f \geq -(M + L) - d, \tag{IC_f}$$

[7]We implicitly assume that the legal enforcement is so strong that bringing the disputed case into the court will work effectively as the punishment device. It is also known that the legal process in debt recovery takes quite a long time in the courts (See for example, Visaria (2009) and von Lilienfeld-Toal, Mookherjee and Visaria (forthcoming)). We could also interpret this case as the restriction of the reneging firm to use the assets productively. To the extent that the long duration of the court process keeps the firms from fully exploiting the productive capacity, disputing in the court could work as the punishment device.

[8]It is easy to incorporate cash holding in the model, but it does not generate meaningful implications of the model. More importantly, I theoretically abstract from the risk management of firms. In a dynamic setup of the decision making of a firm's credit access and investment, the foreclosure of productive assets in the failure state would make it hard for it to operate in the following periods. Taking this fact into account, the firm would keep a portion of cash holdings or profit retention in case of the project's failure. This sort of risk management is decided in conjunction with a potential reduction in the investment size x. Justification for the fact that I do not examine the risk management comes from my another assumption that the borrower firms are risk neutral.

[9]In this model, I assume that when they renege the contract, the firm can divert the entire profits from the project while the entire assets are stripped by the court.

where R_f is the repayment by the firm in the case of the project's failure. Note that in this state, the project does not generate profits so the repayment comes only from collateral.

Finally, the optimal contract must provide the outside investor at least as much as he can get outside the particular contract.[10] Reward to the investor is the expected repayment from the firm, and the outside opportunity is the principal as well as the interest of the loan, x.

$$\overline{R} \equiv pR_s + (1-p)R_f \geq (1+\pi)x, \tag{IR}$$

where $\overline{R}$ is the expected repayment from the borrower firm, and π is the lenders' opportunity cost of credit (or, the interest rate).

2.2 First- and Second-Best Contract without Land Regulation

Let us suppose there is no urban land regulation, so that the asset markets are perfect. The first-best contract without the land regulation will be that the firm maximizes the output by choosing the investment scale x at a constant cost of credit of $1+\pi$, that is, it maximizes

$$pq(x) - (1+\pi)x, \tag{1}$$

giving us the first-order condition for all firms, $pq'(x^{FB}) = 1+\pi$ at the optimal level of investment $x = x^{FB}(\pi)$. Note that an increase in the outside interest rate for the investor, π, decreases the first-best level of investment.

When a firm does not attain the first-best contract due to the moral hazard, the firm has to secure the loans by asset collaterals. The optimal contract for the firm maximizes the profits

$$pq(x) - \big[pR_s + (1-p)R_f\big], \tag{2}$$

with the loan size x, the incentive constraints in (IC_s) and (IC_f) and the participation constraint in (IR). It turns out that in an economy without land regulation, maximum repayment is achieved in each state when all the collateralizable assets, $M+L$, are pledged, whereas the reputation of the borrower raises the borrower's pledgeability only in the success state simply because her limited liquidity does not allow her to repay more than the asset value, $M+L$, in the failure state. Combined with (IR), all the constraints are jointly expressed, but with the restriction that each costraint needs be satisfied, as

$$(M+L) + pd \geq \overline{R} \equiv pR_s + (1-p)R_f \geq (1+\pi)x, \tag{3}$$

[10] I implicitly assume here that the matching of a borrower and a lender in the credit market is in favor of lenders: that is, borrowers compete for lenders. More general implications of the general-equilibrium effects of a particular contract for competition for matching is studied by von Lilienfeld-Toal and Mookherjee (2010).

and the loan demand by a firm with assets (M, L) becomes

$$x(W;\pi) = \frac{pd}{1+\pi} + \frac{W}{1+\pi}, \tag{4}$$

where W ($\equiv M + L$) is the collateralizable assets. It implies that the loan demand is increasing in the size of firm's collateralizable assets, and decreasing in the lender's outside interest rate π. Note that in the case without land regulation, the way a firm makes a repayment to the lender does not matter. That is, to the extent that land is as liquid as machines, the composition of asset collateral does not affect the size of obtainable loans. This does not hold when there is transaction costs of land.

2.3 Transaction Costs in Land Market and Potential Distortion

Now I introduce into the model the land regulation that generates the transaction cost in the land market. Firms incur the transaction cost when they either sell or buy land in the market. Liquidation of land will return only t (< 1) fraction of the internal value for the firm. Acquisition of land will cost $1/t$ (> 1) fraction of the internal value. $1 - t$ fraction of the land value will be lost during the transaction. Now that there are transaction costs in the land market, it becomes crucial for the firm to consider the way it makes a repayment. Since the lender requires the firm to cover the potential transaction costs, there will be a gap between the loss in value that the firm has to give up when they repay by liquidating land, and the actual repayment received by the lender. Loss in the firm's value due to repayment in the success and failure states then become $R_s^F = r_s^m\,(q(x) + M) + r_s^l L/t$, and $R_f^F = r_f^m M + r_f^l L/t$, respectively. $r_i^m \in [0,1]$ and $r_i^l \in [0,t]$ are the fractions of values of liquid assets and illiquid land to be promised to the lender as collateral in state i, respectively. Notice that the upper bound of r_i^l is t, since the rest of the value is lost during the process of the transaction. Note also that since I assume that machines are fully liquid, machines are treated here as if they are cash. On the other hand, the investor receives $R_s \equiv r_s^m\,(q(x) + M) + r_s^l L$, and $R_f \equiv r_f^m M + r_f^l L$ in each state. The difference between R_i^F and R_i is the value to be lost during the transactions of land, and to be covered by the borrower.[11] Because borrowers are covering the transaction costs, the repayment coming from asset values does not depend on how it is financed. That is, the asset liquidation is equivalent to the asset collateralization.

Now that the collateral composition has a first-order significance to the loan size and repayment incentives, the contract also specifies the firm's collateralization strategy, $(r_s^m, r_s^l, r_f^m, r_f^l)$, besides the triple of size and repayment schedule (x, R_s, R_f).

Incentive constraints are modified so that the land transaction costs are reflected. Given

[11] Here again, superiority of lenders in the bargaining position plays a role in making the borrower cover the costs.

the expression for the repayment in success and failure states, R_s^F, R_f^F, it becomes

$$M + L + d \geq r_s^m \left(q(x) + M\right) + \frac{r_s^l}{t} L, , \tag{IC_s^T}$$

and

$$M + L + d \geq r_f^m M + \frac{r_f^l}{t} L. \tag{IC_f^T}$$

Lender's individual rationality constraint, (IR), is modified to incorporate the firm's collateralization strategy, but the lender expects to be repaid the value, net of the land transaction cost.

$$p\left[r_s^m \left(q(x) + M\right) + r_s^l L\right] + (1-p)\left[r_f^m M + r_f^l L\right] \geq (1+\pi)x. \tag{IR^T}$$

Optimal loan contract under the land regulation maximizes the borrower's profits

$$p\left(1 - r_s^m\right) q(x) - \left(\left\{p r_s^m + (1-p) r_f^m\right\} M + \frac{p r_s^l + (1-p) r_f^l}{t} L\right) + M + L + d, \tag{5}$$

subject to the constraints (IC_s^T), (IC_f^T), and (IR^T).

2.4 First- and Second-Best Contract under Land Regulation

The first-best contracts in a credit market with costly land transactions are same as the first-best contracts in markets without transaction costs. As in the previous subsection, we have $pq'(x^{FB}) = 1 + \pi$ as the first-order condition for the first-best contract, from the optimization of (1).

By contrast, the optimal contracts under the land regulation are different from the optimal contracts without the land regulation. Presence of land transaction costs distorts the collateral provision of borrowers, which substantially reduces the borrowers' ability to pledge against default. In the following, I discuss how borrowers rationally opt out to effectively use land as collateral.[12] In particular, land is not seized in certain circumstances under the optimal contracts.

Under the optimal contracts, land is not seized in the event of project's success. The return from the project are mainly used to repay the debt and interest, since it is profitable for every firms to repay first with liquid assets (cash and machines collateral) , and secondly with illiquid assets (land). Since land seizure occurs only after all the return from the project is already pledged for repayment, the contracts that requires land seizure do not increase firm's profits. It rather reduces the profits due to the transaction costs. This situation can be avoided by not agreeing upon the contract that requires land to be seized in the project's success. No land is, therefore, seized as collateral in equilibrium.

[12] All the details are fully discussed in proof of Proposition 1 in the Appendix.

The IC constraints are binding in the success state under the optimal contracts, hence the asset collateral and reputation effectively boosts up the borrowers' pledgeability in this state. Intuition behind this result is the fact that for firms that cannot attain the first-best loan contract, the marginal return from investment is strictly higher than the marginal cost of capital, as long as liquid assets are used for repayment. In this state, firms repay up to the point where the repayment equals the collateral value of machines and land, plus reputation. Although land is not seized on the equilibrium path, land works effectively as collateral. On the other hand, the IC constraints do not bind in the failure state. Due to the limited liquidity on hand in this state, no firms can exploit the full capacity of collateral plus reputation. Firms repay up to the point where marginal cost of liquidating assets is equal to, or at least as low as, the marginal return from the investment. Marginal cost of asset liquidation varies across firms, depending on the liquidity of assets that the firms use as collateral at margin. Unlike the success state, there will be some firms that use illiquid assets as collateral for repayment in this state, which generates heterogeneous strategies of asset collateralization.

Up to this point, there is no heterogeneity across borrowers in terms of their pledgeability beyond the collateralization capacity determined by the total asset size. Once the asset seizure in the failure state is taken into account, there appear heterogeneous collateralization strategies of borrowers in the failure state. First, for firms with a relatively small scale of project, land is seized in the failure state because the marginal return from an additional investments exceeds the marginal cost of land liquidation. Hence, these firms are willing to collateralize land in the failure state. Land collateralization occurs only when the project scale is small enough to expect high marginal returns from project, which can offset the deadweight loss due to the land liquidation in the failure state. These firms exploit full capacity of asset collateral to boost up the pledgeability in both states of nature. Second, for firms investing in a relatively large scale of project, land is not seized in the failure state because the marginal returns from an additional investment is smaller than the marginal cost of land liquidation. Hence, these firms do not pledge land as collateral in the failure state. By so doing, they avoid incurring the transaction costs arising from liquidating land in the market. For this type of firms, land collateral plays a role in boosting up the pledgeability only in the success state. This partial collateralization of land substantially reduces their ability to pledge in accessing external funds, resulting in a severe credit-rationing.

What differentiates the size of project and loans are the size of total collateralizable assets and the land share of those assets. Large firms, defined as firms that have large collateralizable assets, can borrow a lot by pledging a lot of assets as collateral, while small firms borrow less since they have little to pledge as collateral. There is a threshold level of loans and project, above which land is not collateralized, while below which land is collateralized. If the land share of assets is large, even large firms end up with the threshold level of investment since they do not collateralize land. On the other hand, if the land share of assets is large, small firms can reach the threshold level of investment by collateralizing their land. As a result, there is a pool of loan contracts, in which the loan size and the state-contingent repayments are same but the rate of land collateralization varies across borrowers, depending on their total collateralizable assets and the land share of those assets. The next proposition summarizes the loan demand as a function of the firm size and the land share in total assets, given the market prevailing interest rates and the degree of land transaction costs.

Proposition 1 (Loan contract under the regulation)**.** *Under the optimal contract, the loan demand is a non-convex function of the land share in collateralizable assets, ω, the total collateralizable assets, W and the lender's interest rate π. More specifically,*

$$x = \begin{cases} x^{FB}, & \text{if} \quad W \in \left[W^{FB}(\omega;\pi), \infty\right), \\ \frac{pd}{1+\pi} + \frac{1-(1-p)\omega}{1+\pi} W, & \text{if} \quad W \in \left[\inf W^{+}(\omega;\pi,t), W^{FB}(\omega;\pi)\right), \\ \overline{x}(t,\pi), & \text{if} \quad W \in \left[\sup W^{-}(\omega;\pi,t), \inf W^{+}(\omega;\pi,t)\right), \\ \frac{pd}{1+\pi} + \frac{1-(1-p)(1-t)\omega}{1+\pi} W, & \text{if} \quad W \in \left[0, \sup W^{-}(\omega;\pi,t)\right). \end{cases} \tag{6}$$

Solid black line with two kinks in Figure 2 illustrates the loan demand as a function of the total collateralizable assets, given the land share in assets. A pooling of contracts are illustrated as the flat line, over which the rate of land collateralization decreases as the firm size (size of total collateralizable assets), W, increases. Smaller firms than those that can reach the threshold level of investment at $\overline{x}(t,\pi)$ use all the land as collateral, while larger firms do not use land as collateral. Thus, the demand curve is steeper for a lower scale of investment than for a higher scale. An increase in the collateralizable assets for a given land share results in a sharper rise in the loan demand for a low-scale investment than for a high-scale investment. This contrast is entirely driven by the fact that land is fully collateralized for the low-scale investment, while it only partially plays a role of collateral for the high-scale investment. Solid red line with only one kink in Figure 2 illustrates the loan demand for firms that have no land. Small firms are credit-rationed because they have little to pledge against default. Overall, the shape of Figure 2 illustrates how landed medium-sized firms experience a severe credit-rationing due to the fact that land does not effectively work as collateral in the failure state. From now, I call firms that obtain a smaller loan than the threshold level the small firms, firms that can obtain loans greater than the threshold but smaller than the first-best level the medium-sized firms, and firms that can attain the first-best loan contracts the large firms.

2.5 Comparative Statics of Repealing the Land Regulation

Now that the optimal contract is specified, I examine the comparative statics of repealing the land regulation. First I consider the case where the land regulation is repealed so that the land transaction costs are removed, but the impact appears only locally without generating an indirect effect through an increase in the market-prevailing interest rates. More precisely, I examine what the optimal contract would look like when the liquidation cost is repealed, namely as $t \to 1$, without any effect on the interest rate π. Lastly, I examine the case where the general-equilibrium effect is at play through the change in the price of credit, π.

When the land regulation and the transaction cost are repealed, it increases the firm's demand for credit through two distinct channels: extensive and intensive margins. The extensive margin of the deregulation increases the collateralization rate of land for the firms that only partially use land collateral under the regulation. Only the firms with relatively small scale of investment fully utilize land collateral even under the land regulation and will not enjoy the extensive margin of the deregulation. For the firms with an investment scale greater than or equal to the threshold level, the post-deregulation collateralization rate of land increases as the transaction cost decreases (as t increases). When it is completely repealed, these firms start to put up land in full as collateral in the failure state. The intensive Margin of the deregulation equally affects all firms that have land, by increasing the collateral value of a unit of land. Although the collateral of a unit of land with an internal value of 1 to a borrower firm only has a value of t to the outside lender under the regulation, the external value of the collateral improves as the transaction cost decreases (as t increases). The next proposition summarizes these effects.

Proposition 2 (Extensive and Intensive Margins of Deregulation)**.** *When the land regulation is repealed, and hence the land transaction costs are removed ($t \to 1$), all landed firms gain from the intensive margin, while only landed medium-sized firms gain from the extensive margin as well. More precisely,*

1. *(Extensive Margin) The threshold level of investment, below which firms fully collateralize land, increases for a given level of π: $\partial \overline{x}(t, \pi)/\partial t > 0$. Moreover, it reaches the first-best level of loans when the transaction costs are fully removed ($\lim_{t \to 1} \overline{x}(t, \pi) = x^{FB}$).*
2. *(Intensive Margin) The collateral value of a unit of land improves.*

There are three groups of firms in the economy, based on the heterogeneous direct treatment effect of the land deregulation. The first group, which I call the landed medium-sized firms, gains the most from the land deregulation, both from intensive as well as extensive margins. The second group, which are landed-small firms, gains from the intensive margin. Firms that have land but are too small in size to gain the extensive margin, will fall into this category. The last group, which are landless firms or firms that can attain the first-best contracts under the land regulation, gains nothing. Firms in this group are not directly affected by land deregulation.

Now, given this proposition, however, an increase in the aggregate demand for credit could raise the interest rates of the lenders. As intensively discussed in von Lilienfeld-Toal, Mookherjee and Visaria (forthcoming), the elasticity of the credit supply will play a key role in determining the equilibrium level of outstanding debt and the interest rates. To the extent that the supply is elastic with respect to the interest rates, an increase in the aggregate demand results in an increase in the equilibrium outstanding debt. If the supply is inelastic, the increased demand is suppressed by the increased interest rates to meet the supply. Since any general-equilibrium effect of this sort affects all the firms equally negatively, there will be firms that are indeed worse off as a result of land deregulation. Those that do not gain from the direct effect can be worse off.

Proposition 3 (Comparative statics of repealing the regulation with the general-equilibrium effect)**.** *Given the extensive and intensive margins of the land deregulation, an increase in the interest rates caused by the inelastic supply of credit ($\pi \to \pi'$) will make some firms worse off. That is,*

1. *for landless firms that borrow against machine collateral and reputation, there is no direct effect and the net effect will be negative;*
2. *for large firms that can attain the first-best contracts under the land regulation, there is no direct effect and the net effect will be negative; and*
3. *for landed-small firms, the direct effect comes from the intensive margin, but the net effect can be negative, depending on the degree of the general-equilibrium effect.*

Notice that the general-equilibrium effect in this proposition will not create heterogeneity in the treatment effects. It is generated by the direct effect through the extensive margin of the deregulation, as discussed above. The general-equilibrium effect makes the net effect negative for some firms, implying that there will be a reallocation of credit among firms in a particular direction. Proposition 3 suggests that the specified types of firms were protected in terms of credit access by the land regulation, although they are not necessarily the most productive users of credit in the economy. Credit allocation under the regulation, therefore, can be viewed as inefficient as compared to credit allocation without the regulation.

Depending on the presence and degree of the general-equilibrium effects of the land deregulation, therefore, there will be a distinct theoretical prediction for credit access of the affected firms: a credit growth or a credit reallocation. First, credit access should increase, on average, if the credit supply is elastic with respect to interest rates. There is no negative general-equilibrium effects that contract credit demand. The degree of the treatment effects is heterogeneous across borrowers: landed-medium firms should gain the most. Second, if the credit supply is not elastic enough, credit access does not increase on average, and it is reallocated among borrowers. The direction of a reallocation is from landless, landed-small and/or large firms to landed-medium firms. Which of the two outcomes will appear depends on the elasticity of credit supply that was not affected by the land deregulation in itself. Next proposition summarizes the theoretical predictions of the deregulation effect on borrowings, net of potential general-equilibrium effects.

Proposition 4. *Depending on the elasticity of credit supply, either of the following will occur.*

1. *if credit supply is elastic with respect to interest rates, there will be a credit growth on average; largest gains accrue to landed-medium firms; landed-small firms will gain a little, whereas landless and large firms will not be affected, or*

2. *if credit supply is not elastic enough, there will be a credit reallocation among borrowers; landed-medium firms increase borrowings, while landless, landed-small, and large firms reduce borrowings.*

In the following empirical sections, I empirically investigate which of a credit reallocation or a credit growth appears as a result of the land deregulation in urban India. Moreover, I also investigate and directly test the potential heterogeneity in treatment effects. Before doing so, the next section introduces the institutional background of land (de)regulation in India.

3 Urban Land Regulation and Deregulation in India

In this section, I discuss unique experiences of urban India in the last 35 years. The central government and the parliament of India set the regulation of land and buildings in 1976 by the Urban Land (Ceiling and Regulation) Act. Although it was aimed to provide equal opportunities for all urban individuals, firms and any other sort of organizations, or for the poor in particular, it was widely recognized in the 1990's that the Act did not work the way in which it was designed. In 1999, the Act was repealed by India's Parliament.

3.1 The Urban Land (Ceiling and Regulation) Act, 1976

The Urban Land (Ceiling and Regulation) Act, known as the ULCRA, was enacted by India's Parliament on Feburary 17, 1976. The ULCRA had been at work in 64 urban agglomerations, each of which consisted of the central city and its surrounding suburban areas.[13] It had three distinct dimensions of regulation: landholdings, real estate market transactions, and building construction. It not only set the ceiling limits on both ownership and possession of land,[14] but

[13] The ULCRA made clear that the law does not apply to any governmental bodies including the government companies, as well as any banks defined in Banking Regulation Act of 1949.

[14] Land on which buildings were constructed before the implementation of the ULCRA were not subject to the ceilings. The fact that possession of land of the size greater than the ceiling limits is restricted means that the leased land is also subject to the regulation.

it also prohibited transfers of land and buildings among individuals and firms, and restricted the construction of buildings in the urban agglomerations. In the following subsections, I argue how each dimension of the regulation had created the transaction costs in the land market and the investment in buildings.

64 urban agglomerations from all across India, having at least 2 hundred thousand people, were chosen to be given the ceiling limits in landholdings, which were calculated based on the population size in the 1971 Census. Those urban agglomerations were decomposed into four groups based on their population size in the year 1971, among which the three largest urban agglomerations (Delhi, Mumbai, Kolkata, henceforth called "A-cities") had the severest ceiling limit at $500m^2$ per person.[15] The next 5 largest cities (Hyderabad, Ahmadabad, Bangalore, Kanpur, and Pune, henceforth called "B-cities") had the second severest ceiling limit at $1000m^2$ per person. Depending on the population size in the 1971 Census, all the other urban agglomerations were classified to the groups with the ceiling limits of either $1500m^2$ or $2000m^2$ (henceforth, "C-cities" or "D-cities", respectively). Table 3 illustrates the classification of the 61 urban agglomerations to four categories based on the population size in the 1971 Census, as well as on the status of the ULCRA at the end of the sample period, which is the year 2007. No household or firm was allowed to own and possess land of a greater size than the ceiling limits. Excess land beyond the ceilings was in many cases, acquired by the state governments in return for a small amount of compensation, which could not exceed 2 thousand Indian Rupees, a value equivalent to 47 US Dollars.[16][17]

The Act also prohibited transfers of land and buildings, irrespective of whether a person holds land in excess of the ceiling limit. For any form of transfer of land and buildings, land traders must submit a notification of the trade to the state governments, and obtain an approval for the transactions. However, if the transfer of land and/or buildings was processed by way of sale, rather than mortgage, gift, or lease, and if the state government decided not to approve the transaction, then the state government was authorized to acquire the urban properties for a payment calculated from the standards set in the Land Acquisition Act, 1894, which was usually quite small. This part of the Act effectively made potential land sellers unwilling to participate in the land transaction for fear of their land being expropriated without any

[15]The state of Tamil Nadu did not adopt the ULCRA, but enacted similar law called the Tamil Nadu Urban Land (Ceiling and Regulation) Act, 1978. It was effective until it was repealed in June 16, 1999. For this Act, the ceiling for industrial undertakings in the biggest cities was $2000m^2$, the next biggset cities for $3000m^2$ and the smallest cities for $4000m^2$. For other legal persons, the biggest cities have a limit of $500m^2$, the next biggest cities have$1500m^2$ and the smallest citeis have $2000m^2$. Thus, the ceiling system was different from the ULCRA. We, therefore, exclude the state of Tamil Nadu from the empirical analysis as including it might confound the treatment effect of repealing the ULCRA. Tamil Nadu has three cities designated in the ULCRA: Chennai as a A-city, and Madurai and Coimbatore as B-cities.

[16]One Indian Rupee was equivalent to 0.0235 U.S. Dollars on March 31st in 1999. Exchange rate has not changed since then up until 2011.

[17]In many other cases, disputes over the ownership of excess vacant land were brought to the special court, called the Urban Land Tribunals.

reasonable basis. Since it is, in general, necessary for both productive and unproductive firms to adjust their land holdings, either by selling or buying, in the process of business expansion, this Act did harm to firms in need of the asset adjustment and/or capital investment. Even if the expansion was not necessary, land consolidation may have been required to be more efficient in production. Prohibition of transfer of land and buildings restricted all these kinds of opportunities that the firms may have wanted to exploit.

This Act also regulated the construction of buildings. First, the ceiling limits were introduced for the areas of buildings if the buildings included a dwelling unit. Unlike the landholdings, the ceiling limits in the areas of buildings construction were given to two broadly defined groups of 64 urban agglomerations. One for the union of the A- and the B-cities was $300m^2$ and the other for the union of the C- and D-cities was $500m^2$. It is worth noting that the ceiling limits were applicable only to construction of buildings with dwelling units. Secondly, no matter whether a building had a dwelling unit, the building constructed after the implementation of the ULCRA could be ordered to be either partially or entirely demolished by the state government for the sake of the public. Although much depended on the arbitrary nature of decisions made by the state governments, this part of the regulation made the land-holders unwilling to invest much in the building construction. It could have, in turn, hindered the demand for land, as acquiring new land did not allow the firm to expand the business too much. Thus, it is implied that firms that were land-constrained were also constrained in terms of the building investment.

Although ownership and possession of land as well as transfers of land and buildings were prohibited in general, the state governments allowed certain exceptions to be granted. Nonetheless, the criteria for grant exemptions were not so clearly nor sufficiently given in the Act that a huge degree of discretion was given to the state governments, and hence the granting decisions were quite arbitrarily made. This arbitrary nature of the exemption provision created severe confusion and hesitation in firms' (and households') decision to participate in the land market transactions.

3.2 Institutional Background and Repeal of the ULCRA

The motivation behind the implementation of the ULCRA was the idea that it would be good to achieve a more equal land distribution in urban areas of India. The first paragraph of the Act briefly but concisely summarizes the aim of the Act:

> An Act [...] provide[s] for the imposition of a ceiling on vacant land [...], for the acquisition of such land in excess of the ceiling limit, to regulate the construction of buildings on such land [...], with a view to preventing the concentration of urban land in the hands of a few persons and speculation and profiteering therein and with a view to bringing about an equitable distribution of land in urban agglomerations

to subserve the common good.[18]

The States of Andhra Pradesh, Haryana, Gujarat, Himachal Pradesh, Karnataka, Maharashtra, Orissa, Punjab, Tripura, Uttar Pradesh and West Bengal and all the union territories initially adopted the Act. Subsequently in the same year, it was adopted by six more states, namely Assam, Bihar, Madhya Pradesh, Manipur, Meghalaya and Rajasthan. As a result, the ULCRA came into force in 17 states and three union territories until it was repealed by the federal government in 1999.

Although the ULCRA was aimed at preventing concentration of urban land in hands of a few households and firms and to ensure an equitable distribution of urban land, hurdles to achieve the desired outcomes were soon realized, and the land acquisition for the public use through the ULCRA could not be achieved on account of numerous litigations.

The Government finally decided to repeal the Act, and the Urban Land (Ceiling and Regulation) Repeal Act became effective on January 11th of 1999 when the ordinance of this Act was notified, after the state governments of Haryana and Punjab passed a resolution for repeal of the Act. Initially the Repeal Act was applicable in Haryana, Punjab and all the union territories. Subsequently, the Repeal Act was adopted by the state governments of Uttar Pradesh, Gujarat, Karnataka, Madhya Pradesh, Rajasthan and Orissa over the period from 2000 through 2003. It was only in the fiscal year 2007-2008 that, among the other non-repealing states, Andhra Pradesh and Maharashtra followed suit in the adoption of the Repeal Act.[19] The state governments of Assam, Bihar and West Bengal have not adopted the Repeal Act, 1999, as of today.

4 Data and Identification Strategy

In the empirical section of this paper, I use a panel dataset of Indian firms. Data come from the Prowess database by the Center for Monitoring of Indian Economy (CMIE), which covers large parts of all industries, mostly from the manufacturing sector, for the period 1989 through 2008. According to the CMIE, the companies covered in the database account for more than 70% of industrial output, 75% of all corporate taxes, and more than 95% of excise duties collected by India's government. The database includes all companies traded on India's major stock exchanges, and several others including the central public sector enterprises, although private sector firms account for 92% of the total number of firms in the Prowess database, and they account for about half the total sales. 27% of Prowess companies are listed on either one of the two major Indian stock exchanges.[20] Information contained in the database mainly comes

[18]Parts of the paragraph are omitted by the author.

[19]Repeal of the ULCRA became mandatory in the federal policy agenda, called the Jawaharlal Nehru National Urban Renewal Mission (JNNURM), initiated in 2005. A grant was also provided for the state governments once they repealed the ULCRA under the JNNURM.

[20]They are the Bombay Stock Exchange and the National Stock Exchange.

from the annual reports of companies (balance sheets and income & expenditure statements), in which all (registered) Indian firms are required by the Companies Act of 1956 to disclose information on financial as well as quantitative information on production, sales, consumption of raw materials, and energy use.

I use a sample of firms that are in either treatment states or control states. There are ten treatment states that repealed the land regulation, the ULCRA, in or after 1999, whereas there are five control states that had the regulation throughout the sample period over 1991-2007. The end of the sample period is chosen as the year 2007, because states of Andhra Pradesh and Maharashtra repealed the regulation in the year 2008, but my dataset does not have a sufficient number of observations in and after the year 2008. I exclude firms located outside the 61 cities targeted by the land regulation, since those firms are not affected by both the regulation and deregulation. I also exclude firms that are foreign-owned, government-owned, or in financial or real estate sectors. Foreign-owned firms are likely to have access to foreign credit markets, and a large part of their external funds may be raised outside India. Similarly, the government-owned firms may be funded by the government bodies in a way that non-government-owned firms cannot be funded. Financial firms are net suppliers of credit. Firms in the real estate sector are directly affected by the (de)regulation, so that the deregulation effect for these firms embeds an increase in credit demand arising from operational reasons, rather than from the institutional improvement *per se*. I use the year 1990 as the base year of my variables of firm characteristics as defined below. Base year 1990 is eight years before the land regulation is repealed, and discussion of repealing it merely started at the time. Therefore, the firm characteristics in the base year 1990 barely reflect expectations of the future deregulation of land in 1999. To further avoid unnecessary simultaneity, I use the sample over the period 1991-2007 in the empirical analysis, for which there are eight years both before and after the land deregulation at 1999.

In the following empirical analyses, I examine sub-samples of firms in different categories of cities. Main reasons for this decomposition come from (1) the institutional environment, and from (2) the nature of the dataset. First, as described in the previous section, the land regulation designated tighter land ceilings for larger cities. For example, the biggest four cities (Chennai, Delhi, Kolkata, Mumbai) had $500m^2$ of the ceiling limit. Therefore, it is more likely that firms in the larger cities were facing binding constraints as a result of the land regulation, creating room for heterogeneous deregulation impacts across categories of city size. Second, most of the firms in the database are located in larger cities. For example, more than half the firms are in the biggest four cities. To avoid picking up effects of firms' self-selection into larger cities as the effect of repealing the tighter regulation, I need to compare firms that clear the same criteria of self-selection into larger cities. In estimating the heterogeneous effects across firms within a category of cities with the same ceiling limit, focusing on decomposed sub-samples, allows me to control for self-selection of firms into cities with the different size and ceiling limits.

I construct variables that characterize the firms. First, *city* indicates the city (or district) where each firm locates, constructed from the information on registered office address. Unfortunately, the Prowess database does not provide detailed information on the exact locations of their landholdings.[21] I therefore, instead, assume that firms' landholdings are located in the same *city* as the registered office address. *Land and Building* is the bookvalue of land and buildings that a firm owns to use in production, net of accumulated depreciation. *Collateralizable Assets* is the bookvalue, net of accumulated depreciation, of tangible assets of a firm, which include *Land and Building*, Plant and Machineries. I also call it the firm-size in the following discussion. *Share of Land and Building* is the ratio of *Land and Building* to *Collateralizable Assets*, which by definition takes on a value between zero and one. Our main outcome variable, *Secured Borrowing*, is the net borrowing backed by collateral. *Repeal* is an indicator variable that takes on a value of one if the land regulation is not effective in the state a firm locates, and zero otherwise.

Inability to precisely locate firms' landholdings potentially generates measurement errors in *Land and Building*. Although the data limitation on the locations of firms' landholdings force us to assume that they hold land in the same city as the registered office, firms may hold plots of land in other areas. More important, they may hold land both in the regulated and the non-regulated areas. To the extent that this is the case, treating the whole landholding of a firm in a same manner generates a measurement error. Since large firms are more likely to have large landholdings, the measurement error, if ever, should be large for large firms. Despite this potential attenuation bias, I show in the following empirical section of estimating the effect on borrowings, that the magnitude of the estimates are quite large and statistically significant.

My identification strategy comes from the difference-in-differences estimation, in which variations in the deregulation status across states and years are exploited. This strategy is valid as far as the variations across states and years are driven by factors that are not correlated with my outcome variables that are the land trades and the secured borrowings. In other words, the decision by and timing of the state governments' adopting the federal repeal of the ULCRA needs to be reasonably exogenous to the outcome variables.

[21] Although the Prowess database provides some information, including locations of land and buildings, at the plant level, I do not use that information for the following reasons. First, it is only for listed firms, which comprise 27% of the total number of firms in the Prowess database, that provide plant-level data. Second, the segmentation of the business is left to the discretion of firms, still leaving ambiguous what part of land and buildings are located in the regulation areas.

5 Credit Market Impacts of Repealing the ULCRA

In this section, I estimate the effects of the land deregulation on borrowings of Indian firms in two distinct but related specifications. The first specification examines the heterogeneous effects in terms of two dimensions of firm characteristics: landholdings and collateralizable assets. The second specification examines, in addition, non-linear effects in collateralizable assets. Choice of specifications depends on the assumption I make in the size distribution of Indian firms. In particular, non-linear effects may not appear if firms are distributed in a low range of size, whereas such effects will appear if there are large firms that can attain the first-best contract. I explore both of these two assumptions in two different specifications below.

5.1 Empirical Strategy to Estimate the Deregulation Impacts on Credit Access

The theoretical analysis in the previous section indicates that the treatment effects of repealing the land regulation are heterogeneous in terms of two of the firm characteristics. First, heterogeneity in the collateralization strategy of firms results in a variation in the treatment effect: given the land share in assets, medium-sized firms, that do not use land as collateral under the ULCRA regime, will begin to rely on the land collateral for credit, and hence raise the external funds more, while small firms enjoy only an improvement of land liquidity and large firms will not gain from the land deregulation. Second, different land shares in assets result in heterogeneous treatment effects: given the size of a firm, firms with a larger share of land in assets, will increase pledgeability by more, since firms with the same size ought to have the same level of pledgeability, had there not been the ULCRA, regardless of the composition of collateral assets. However, heterogeneous treatment effects with respect to the land share in assets appear only in the low range of firm size for a given land share. Relatively large firms, but not large enough to reach the first-best contract, will not gain further from larger landholdings. Threshold level in firm size, above which there is no heterogeneous effect in the land share in assets and below which the treatment effect increases with the land share, increases as the land share increases.

Under the assumption that firms are distributed in a relatively lower range of the asset-size taking given the land share in assets, our empirical specification is then formulated as follows: loan market outcomes for firm i in state s in year t is

$$\begin{aligned}\ln x_{ist} = \beta^1 \text{Repeal}_{st} + \beta^2 \big(\text{Repeal}_{st} \times \ln W_i\big) \\ + \beta^3 \big(\text{Repeal}_{st} \times \omega_i\big) + \beta^4 \big(\text{Repeal}_{st} \times \ln W_i \times \omega_i\big) + c_i + \mathbf{\Lambda}_t + \epsilon_{ist}. \qquad (7)\end{aligned}$$

Full specification of regressions include various kinds of covariates. In all specifications, we add year fixed effects. Year dummy controls for the macroeconomic shocks that affect both treatment and control groups in the same way in a given year. As another aggregate-level fixed effects, we add the interaction of year dummy with the initial level of the collateralizable collateralizable assets. This additional control picks up the time-varying effect of the initial asset size at the macroeconomic level.[22] Similarly, I also add the interaction of year dummies with the initial land share in assets, which picks up the macroeconomic shock that is heterogeneous in land share.[23]

Another set of controls are state-specific trends, which control for the differences in trends of credit growth across states. Including this additional control also serves as a robustness check of our identification strategy. If the statistical significance on the coefficients of interest is lost by including the state-specific trends, it means that the adoption of repealing the ULCRA is largely statistically associated with the state trends in credit. We also take into account the state-specific trends by total asset size and land share. For example, small firms as of 1994 in Delhi, one of our treatment states, may be in a faster-growing trend than small firms in Maharashtra that belong to the control group. Therefore, including the state-specific trends trims out all the trend differences in credit across the narrowly defined cells: first by state, then by the state-asset size cell and/or by the state-land size cell.

If firms are distributed more widely in terms of the size, the precise specification should include the size squared to fully take into account the non-linear inverted-U shaped treatment effects. As an alternative specification of a more general form, and also as a sort of the robustness check, I run the regression of the following specification:

$$\begin{aligned}\ln x_{ist} = {} & \beta^1 \text{Repeal}_{st} + \beta^2\big(\text{Repeal}_{st} \times \ln W_i\big) + \beta^3\big(\text{Repeal}_{st} \times \omega_i\big) \\ & + \beta^4\big(\text{Repeal}_{st} \times \ln W_i \times \omega_i\big) + \beta^5\big(\text{Repeal}_{st} \times \ln W_i^2\big) + c_i + \mathbf{\Lambda}_t + \epsilon_{ist} \qquad (8)\end{aligned}$$

I add the same controls for this specification, as for the baseline specification. As implied from the theoretical analysis, and in particular from Figure 3, the net effect of the deregulation will be heterogeneously shaped as an inverted-U. A fifth term is included to account for the inverted-U shaped treatment effects, given the land share in assets. To the extent that the treatment effects are indeed the inverted-U shape in terms of firm size, after controlling for land share in assets, I expect to obtain a negative estimate for β^5 and a positive estimate for β^6. I expect a positive estimate of β^6 because the peak of the inverted-U shaped treatment effects should appear in the medium range of firm size. Prediction of the sign of β^4 is difficult

[22] For example, during the sample period of our study, only a part of all cohorts of firms are targeted for a special credit provision [Banerjee and Duflo (2008)]. By allowing this control to be time-varying, it picks up the effect of the targeted credit provision at the nation level.

[23] For example, Securitization and Reconstruction of Financial Assets and Enforcement of Security Interests Act of 2002, known as the SARFAESI Act, improved the secured creditor rights by allowing them to seize the collateral assets as soon as the borrower decides to go bankrupt, which may or may not improve the loan contracting of a given firm [Vig (2011)].

to obtain, as it reflects the direction of a change in the peak of the inverted-U treatment effects as the land share in assets ω increases. As ω increases, only both tails of the distribution over size, experience an increase in the treatment effect.

5.2 Results on Secured Borrowings

Table 4 shows the difference-in-differences estimates of the land deregulation on the secured borrowings for the full sample of Indian firms. The dependent variable is a log of the outstanding secured borrowings. The estimate in column (1) indicates that the average impact is small in magnitude and not statistically significant. Columns (2), (3), and (4) show results for heterogeneous effects in terms of firm characteristics. In all specifications, the estimates on *Repeal* are consistently positive and statistically insignificant, implying that the theoretical prediction of the negative general-equilibrium effects are unlikely working. In column (2), the estimate of the effect of the interaction between *Repeal* and the firm size is negative, a sign in the opposite direction as predicted by theory, but statistically insignificant. I find a statistically and economically significant estimate of the coefficient on *Repeal* interacted with the land share in assets, in the direction predicted by theory. The estimate implies that a one percentage point increase in the land share, all else being constant, is associated with a 0.4 percentage points increase in the treatment effect of the land deregulation. The estimate on the triple interaction among *Repeal*, the firm size, and the land share is positive but not statistically significant. Specifications in columns (3) and (4) check whether the treatment effects are inverted-U shaped in terms of firm size, after controlling for the land share. Although the signs of the estimates of the interaction terms are the same as the theory predicts, most of the estimates are statistically insignificant. Positively significant effect of the interaction between *Repeal* and the land share lost its magnitude and statistical significance in both specifications.

Next, I use four different subsamples of firms that experienced different intensities of the land regulation. This decomposition is motivated by the fact that a large part of firms in our dataset are located in biggest cities with tightest ceiling limit in landholdings at $500m^2$. Table 5 shows the results for the subsample of Indian firms in A-cities and the smaller others. The left panel of Table 5 shows the estimates from the subsample of A-cities, and the right panel from the subsample of the other smaller cities. In both subsamples, the average effects in columns (1) and (5) are small in magnitude, ranging from 3.6 to 4.8 percentage points, but not statistically significant.

Once I take into account the heterogeneity across firms, however, I obtain statistically significant estimates from A-cities, which are exactly consistent with the theoretical predictions for all the specifications in columns (2), (3), and (4). The negative estimates on *Repeal* from the subsample of A-cities imply that there are general-equilibrium effects of the increased lenders' opportunity costs of credit, possibly through an increase in interest rates. The magnitude of the negative effects on the smallest group of firms ranges from 42 to 57 percentage points, which is a substantial reduction in secured borrowings. According to the estimates in column (2), the firms with a little less than the average size and the average land share in assets break even in terms of the treatment effect, the point at which the positive treatment effects of the land deregulation are offset by the negative general-equilibrium effect. Compared to the break-even firms, firms that are larger in size are affected positively, while firms that are smaller are negatively affected. For firms with the average level of initial land share in assets at 0.28, the break-even firms are as large as 17.51 Rs.Crore as of 1990, which is about 44 percentile of the size distribution of firms.[24] Similarly, firms that have a higher land share in assets are positively affected in comparison to the break-even firms, while firms that have a lower land share in assets are negatively affected. For firms of the average size at 97.35 Rs.Crore, the break-even firms have at least as large as 10.8 percents of the assets in the form of land and building.[25]

Columns (3) and (4) indicate that the treatment effects are indeed in the inverted-U shape, and the peak of the inverted-U shaped treatment effects are somewhere in the medium in size. I add as an additional regressor the interaction term of *Repeal* with the firm-size squared. To the extent that the effects are nonlinearly inverted-U shaped, we should have a negative estimate of a coefficient on this variable, and a positive estimate on the interaction between *Repeal* and the firm size. The estimated coefficients are economically and statistically significant, and the signs of the estimates are in the predicted directions. Inclusion of the triple interaction among *Repeal*, the firm size, and the land share does not significantly change the magnitude of the estimates on the interactions of $Repeal_{st}$ with the firm size and the size squared. Therefore, as predicted by the theory, firms in the upper-tail of the size distribution are relatively more weakly affected by the land deregulation than those in the medium range of the distribution, who gain the most.

The fact that the negative general-equilibrium effect is so huge at 42 to 57 percentage points implies that the lenders' supply of credit is quite inelastic with respect to interest rates, so an increase in the aggregate demand for credit is suppressed enough to meet the supply without changing the total outstanding debt. Combining the results regarding both average and heterogeneous effects in the left panel of Table 5, credit is considered to be reallocated from landless, landed-small and/or large firms to landed-medium firms.

In the right panel of Table 5, most of the estimates of heterogeneous effects are not statistically significant in columns (6), (7), and (8). The estimates on *Repeal* are all positively insignificant, which implies that there is unlikely general-equilibrium effects. The estimates of the deregulation effects for large firms are negatively insignificant, implying that there is no

[24] 17.06 Rs.Crore is equivalent to $3.89 million, based on the exchange rate at Rs. 45 per U.S. dollar. One Rupees Crore is equivalent to ten million rupees.

[25] This is about 19 percentile of the distribution in land share in assets.

heterogeneous effects of the land deregulation in terms of firm size. However, I observe statistically significant effects of having a higher land share in assets in columns (6) and (8), but not in (7). The estimates imply that only relatively small firms gain from the land deregulation through their landholdings, consistent with the theoretical prediction. Although inconclusive from the statistical point of view, there are unlikely heterogeneous effects in terms of firm size and general-equilibrium effects in the smaller cities.

Table 6 shows results of the robustness check, by examining the inclusion of state trends, for the subsample of A-cities. Adding state trends turns the insignificant average impact in column (1) into a negatively significant estimate in column (2). This implies the possibility that the repealing state, Delhi, had a steeper upward trend in secured borrowings, and that the land deregulation was driven, at least partly, by the pre-1999 trend. However, Delhi, one of union territories, did not decide to adopt the repeal of the land regulation on its own, and the repeal at the national level was driven by decisions of other states. Thus, it is unlikely that the Delhi's repeal of the land regulation was driven by the pre-trend of secured borrowings of firms in Delhi. To further investigate the validity of my identifying assumption, I examine statistical association between state pre-trend in borrowings and the states' adoption of the land deregulation in the next subsection.

Columns (3) through (11) in Table 6 show the results of heterogeneous treatment effects of the land deregulation when various state trends are included as additional regressors. I control for two sorts of state trends: average state trend, and asset-specific state trends. Adding the asset-specific state trends controls for any differences in trends in the borrowings for firms with the same asset holdings across states. Although it imposes strong restrictions, I find that the estimates are both qualitatively and quantitatively robust to the inclusion of the state trends.

5.3 State Pre-Trend and Adoption of the Repeal of the ULCRA

In this subsection, I discuss the validity of my empirical strategy. To identify the credit market effect of the land deregulation, potential outcomes in the credit markets have to be independent of the land deregulation in 1999. However, it may be the case that the state governments' decision on repealing the ULCRA was triggered by state pre-trends in firms' borrowings. To address this issue formally, I regress the pre-deregulation trend in secured borrowings (1990-1998) onto the state deregulation.

$$\Delta \ln x_{is}^{90-98} = \beta Repeal_s + \gamma Repeal_s \cdot Lag_s + e_{is} \tag{9}$$

The falsification test of the statistical association between the state pre-trends in outcome variables and the deregulation status requires me to find insignificant estimates on β when the *Repeal* variable is the sole main regressor. To the extent that the adoption of repealing the ULCRA by state governments is induced by the pre-treatment low percentage and level changes in credit access, β in the above specification ought to be negative and statistically significant. $\Delta \ln x_{is}^{90-98}$ captures the percentage changes in the secured borrowings of firm i in state s over the period. Since the *Repeal* variable has its variation only across states, β captures its average correlation with the credit size of firms within each state. I also run this regression for the different time spans as 1992-1998, 1994-1998, and 1996-1998 to see how the pre-trends in long- and short-urn are associated with the land deregulation.

Similarly, the variation in timing of the adoption of the federal-level decision on repealing the ULCRA by the state governments may be caused by the relative performances of firms' credit access across states prior to the federal deregulation. By defining Lag_s as a variable that captures the lag in years of adopting the repealing of the ULCRA from the federal deregulation in January 1999, I regress the pre-deregulation growth of credit market outcomes of firms on the interaction of $Repeal_s$ with Lag_s variable too. If the early adoption of the federal decision by a state government is chosen because of the bad credit market outcomes of firms within the state, the estimate is found to be statistically significant. That is, a lower growth rate of credit market outcomes is associated with a smaller lag of the adoption by the state government, resulting in a positive estimate of β.

Table 7 shows the results of the falsification test. Panel A shows the estimates of regressing the pre-treatment credit growth of firms over the period 1990-1998 on the deregulation decisions made by the state governments. The sample for this panel consists of firms in both treatment and control states that appear in Table 2, which include three union territories (Chandigarh, Delhi and Pondicherry) where the treatment status is subject to the decision by the states of Haryana and Punjub. To account for the potential serial correlation within each state, standard errors are clustered at the state level. The estimates suggest that pre-trends in secured borrowings over a various time span are, on average, uncorrelated with the later adoption of the Repeal Act by the state governments. However, I do observe, in column (2), a statistical association with the deregulation variable of the long-term pre-trend of secured borrowings when the lag in years of the adoption is added as another regressor; however, such effects disappear long before the federal deregulation arrives in 1999. This indicates that early repealer states had different trends in early 1990s from the late repealer states, but that the difference disappeared in the late 1990s, before the Repeal Act arrived in 1999. I conclude from this table that both the treatment status as well as the timing of deregulation by states are plausibly exogenous to the credit market outcomes of firms. This result suggests that adding the state trend as an additional control can remove a portion of the positive treatment effects to the extent that the trend in the treatment states picks up after the land deregulation.

6 Liquidity Impacts of Repealing the ULCRA

In this section, I estimate the deregulation impact on firms' transaction likelihood of land. I argue that to the extent that the land regulation restricted land transactions, the land deregulation allows for greater land transactions.

The mechanism through which the land deregulation affects the credit market outcomes is that an improvement in land liquidity results in an increase in the collateral value of land. The empirical strategy of this part of the study is motivated by Shleifer and Vishny (1992)'s argument that the number and the economic conditions of potential buyers of an asset raises the liquidation value of the asset. Land liquidity improves when repealing the land regulation pushes potential land traders into land markets, by removing the constraints that make these potential land traders unwilling to participate in the market. I argued in the previous section that the ULCRA set three distinct constraints: the ceiling limits in the landholdings, the prohibition of transfers of land, and the regulation of building construction. Ceiling limits directly restrict firms from owning or possessing as large a size of land as they wish, had there been no limits, which decreases the demand for land. Prohibition of transfers effectively makes potential land sellers unwilling to participate in the land market for fear of their land being expropriated, which decreases the supply of land. Regulation of building construction makes the land holders unwilling to invest in the building construction, and therefore, makes the potential land buyers further unwilling to invest in land and building construction, leading to a further deterioration of the land demand. Repeal of all these sources of distortions would induce potential land traders, both demanders and suppliers, to engage in land transactions, making it easier and less costly for them (including banks) to match with another trader from the other side of the land market. State governments also released land that were acquired under the ULCRA regime, after it was repealed. Thus, there will be an influx of land traders, to the extent that the land regulation was binding. An improvement of the land liquidity is largely driven by these land traders.

Although the price impact of the land deregulation is ambiguous from the view of the Walrasian market because both the demand for, and the supply of, land presumably increase at the time of the land deregulation, prices of a plot of land can increase once the reduction in search cost and the resulting increase in land liquidity is taken into account. Literature of search and bargaining models based on Diamond (1982) consistently finds that the asset prices for more liquid assets become higher than those for less liquid assets, reflecting a liquidity premium that the investors are willing to pay for the short search times. Once the search friction is taken into account, the improved land liquidity will increase the unit price of land, resulting in higher collateral value of land. Although I cannot analyze the effects on land prices of the land deregulation since I do not observe land prices over the sample period of this study, the collateral value of land should reflect the liquidity premium, an increased liquidity, measured by the transaction likelihood of land.

6.1 Empirical Strategy to Estimate the Deregulation Impact on Land Liquidity

To empirically estimate the deregulation impacts on land liquidity, I first construct three measures of land liquidity (z_{ijst}) from the original data. The three measures are (1) a dummy indicating whether a firm is a net buyer of land, (2) a dummy indicating whether a firm is a net seller of land, and (3) a dummy indicating whether a firm participates in the land market as a net buyer or a net seller in a given year. Since the gross value of land holdings is the sum of historical expenditures, $G_{ijst} \equiv \sum_{\tau=0}^{t} p_{s\tau} \cdot \Delta g_{ijs\tau} = p_{st} \cdot \Delta g_{ijst} + G_{ijst-1}$, where G_{ijst} is the gross value of land and Δg_{ijst} is the amount of land added in a year t. By taking the first-differences between years, we get

$$\Delta G_{ijst} \equiv G_{ijst} - G_{ijst-1} = p_{st} \cdot \Delta g_{ijst}. \tag{10}$$

Although what we are ultimately interested to know is the impact on Δg_{ijst}, I cannot separate it from p_{st} without the information of land prices. Since I do not have that information, I rely on dummies based on ΔG_{ijst}, which fully indicate the direction of the net land transaction. In other words, we have $\Delta G_{ijst} \lesseqgtr 0 \iff \Delta g_{ijst} \lesseqgtr 0$, given the assumption that $p_{st} \neq 0$. It is worth noting that in order to precisely capture the impact on the land liquidity, I use the gross value of land, rather than the value of land plus buildings, in constructing our measures of the land liquidity.[26] Values of buildings potentially include values newly invested in buildings, which do not necessarily reflect the market liquidity of land. It is interpreted more as capital investment in line with investment in plant and machineries. Therefore, in this subsection, I use the gross value of land to extract information regarding land transactions.

My empirical strategy is based on the difference-in-differences estimation of a linear probability model. The three measures of land liquidity are regressed on the deregulation variable and control variables:

$$z_{ijst} = \beta Repeal_{st} + c_i + \mathbf{\Lambda}_t + \epsilon_{ijst}. \tag{11}$$

To take into account the possibility that firms in different industries may have systematically different demand for land, time-varying industry fixed effects, $\mathbf{\Phi}_{tj}$, are added instead of year fixed effects, $\mathbf{\Lambda}_t$, in some specifications. Year dummy controls for macroeconomic shocks as well as the confounding factors arising from national-level policies. Since the regression is based on the linear probability model, the interpretation of the estimates are straightforward:

[26] The ”land” part of capital consists of land and buildings, while ”machines” are composed of plant and machineries. Therefore, the notion of capital composition reflects the idea that assets of different generality (or specificity) are combined in production. Land and buildings are general in terms of its productive ability, while plant and machineries are more industry-specific.

β captures an increase in probability of a firm being either a net buyer or seller, or participating in the land market.

I investigate the average impact of land deregulation on land liquidity from the sample of all firms that exist in a given year, which includes entry and exit of firms during the sample period. My specification only has $Repeal_{st}$ as a main regressor, but no interaction terms with firm-characteristics, because we need to know the market-wide liquidity, rather than the liquidity for a particular subset of firms.

6.2 Results on Land Liquidity

Table 8 shows the estimates of the deregulation effects on the average land liquidity. The measure of land liquidity is an indicator of whether a firm participates in either or both side(s) of the land market as a seller or a buyer. Columns (1) and (2) use the full sample, while the other columns use the subsamples decomposed by city size in order to see the heterogeneous impacts of the different regulation intensities. For each subsamples, columns of even numbers include the time-varying industry fixed effects to control for the differential trend in demand for land by different industries. Panel I shows the estimates of the regression of land transactions as the outcome variable, which is an indicator of whether a firm is either a net buyer or seller of land in a given year. Although the results from the full sample show economically and statistically insignificant effects on land liquidity, results from decomposed subsamples show significant increases in transaction probabilities. I find an increase in land transactions at 1-percent level of significance in A-cities, whereas increases in smaller cities are less significant at 10-percent. Panel II shows the results of the buying probability, where the dependent variable is an indicator of whether a firm is a net buyer of land in a given year. I find a statistically significant effect on the land-buying probability for firms in A-cities, where the regulation was most stringent in terms of the ceiling limits of land holding. Inclusion of time-varying industry fixed effects in column (4) does not change the magnitude of the estimate and the standard error, suggesting that an increase in the buying probability is not driven by a surge in the need for land for some industries during the sample period. I also find statistically significant estimates from firms in smaller cities, but the significance is at 10-percent. Panel III shows the similar results for the land-selling probability, where the dependent variable is an indicator of whether a firm is a net seller of land in a given year. I again find significantly positive effects only for firms in A-cities. The probability of buying and selling both increased by about 1 percentage point in A-cities. In smaller cities, however, the estimates are not statistically significant.

Overall, the transaction likelihood of land increased in both sides of land markets in A-cities, whereas its increase in smaller cities were limited, particularly in the supply side of the markets. From the analyses of this section, I conclude that the land liquidity improved in

A-cities, but not in the other cities. Although we find some evidence of the improved land liquidity in B-cities, it also suggests that the effect is too weak to appear as a statistically significant net effect. Findings from the previous section that the significant heterogeneous effects on borrowings are found only in A-cities are driven in part by the observed increase in land liquidity, because as the theoretical model predicts, the behavioral responses to the land deregulation are considered to be caused by an improvement of land liquidity.

7 Conclusion

This paper has investigated the qualitative as well as quantitative effects of repealing the land ceilings and regulations that had restricted the land transactions in urban area of India for at least a quarter of century. The key contribution of the paper is to provide both theoretical and empirical models that explain the fact that the landless, and landed-small and large firms all reduced their borrowing backed by collateral, while the landed medium-sized firms increased their secured borrowings after land deregulation.

A theoretical mechanism explaining this result relies on firm heterogeneity: the extensive margin of the deregulation induces firms that opted out of the land collateral under the regulation to rely on land collateral, while the intensive margin of the effects raises the collateral value of a unit of land. General equilibrium effects appear if the supply of credit is elastic with respect to interest rates, so that deregulation directly increases the aggregate demand for credit. Net effect of the deregulation may make landless, landed-small and large firms worse off, while conferring significant benefits on landed medium-sized firms. Empirical results are consistent with this model, suggesting that the general-equilibrium effects seem to work and that credit is reallocated among firms. Nonetheless, these effects are only observed in the mega cities where the ceiling limits of landholdings were tightest under the land regulation. Regression estimates on land transactions suggest that the deregulation improved land liquidity in the mega cities, but not in the other cities.

There are a few limitations of this paper. First, the dataset did not allow me to precisely locate each firms' landholdings, creating measurement error in the landholdings and the attenuation bias in the estimates. However, the estimates are robustly significant, and are large in magnitude, suggesting that the true effects may be much larger had there not been measurement error. Second, due to data limitations, I could not examine the impact of borrower's interest rates. Although the Prowess Database contains the total interest payments of firms, it did not allow me to analyze how interest rates of secured loans changed after the land deregulation. As a result, the degree of the general-equilibrium effect could not be directly examined.

Finally, whether the resulting credit allocation improved efficiency at the aggregate level is left unanswered. We theoretically find that the firms that benefited the most from the land deregulation are particularly credit-constrained due to the inability of land collateralization. However, it does not necessarily mean that they are the most productive users of credit. To fully address the issue of efficiency in credit allocation, we need to connect credit market outcomes with productivity, which requires a more detailed analysis of production. Since land regulation directly influences the asset management and capital accumulation of firms, firm production is, in itself, directly affected by the land deregulation. These lines of research are being examined in my ongoing work.

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Appendix A : Proofs

Proof of Proposition 1. Proof of Proposition 1 requires five lemmas.

For a low level of the firm's assets, the first-best scale of investment is not attainable. Although putting up asset collaterals allows firms to boost up the pledgeability, they are still credit-rationed have they not held enough amount of assets. Such a second-best loan contract specifies the loan size as well as the repayment schedule for each state of nature. Second-best contract requires the borrower firm to repay in cash, either from the firm's retention or from the liquidation of assets (collateral). While cash repayment from the retention does not involve additional costs, the repayment from asset liquidation makes the borrower to incur the transaction costs in selling assets in the markets. Land transaction, in our context, involves a substantial transaction costs (or liquidation costs hereafter) that bears the deadweight loss to the economy as a whole. The lenders that have no incentives to take this loss will offer a contract to the borrower who is willing to take responsibility of the deadweight loss. Our formulation of the model specifies the fractions of assets (either machines, or land and building) used for repayment by liquidation. Our first result indicate that the less liquid assets (land) are not liquidated by any firm when the project is successful.

Lemma 1. *Under the optimal contract, liquid assets are first collateralized, and illiquid land is collateralized only after the liquid assets are used up for repayment. Furthermore, land is not indeed liquidated to repay when the project is successful; that is,* $r_s^l = 0$.

Proof of Lemma 1. We show this claim in steps: (1) $(r_s^m, r_s^l) \subset \Theta \equiv \{(m,l)|m = 1, l \in [0,1]\} \cup \{(m,l)|l = 0, m \in [0,1]\}$, (2) $r_s^l = 0$ if $r_s^m = 1$ under the optimal contract.

(1) Suppose otherwise that $(r_s^m, r_s^l) \subset \Xi \equiv \{(m,l)|m \in [0,1], l \in [0,1]\} \setminus \Theta$, where $\Theta \equiv \{(m,l)|m = 1, l \in [0,1]\} \cup \{(m,l)|l = 0, m \in [0,1]\}$. Now consider, for a given x, to raise r_s^m by $d\epsilon$ and to decrease r_s^l by $\{M + q(x)\}d\epsilon/L$ so that the left-hand side of (IR) is kept constant. There must be a small value of $d\epsilon$ (> 0) that allows this manipulation at any point in Ξ. This is feasible in (IC_s) as the right-hand side changes by

$$\{M + q(x)\}d\epsilon - \frac{\{M + q(x)\}d\epsilon}{t} = \frac{t-1}{t}\{M + q(x)\}d\epsilon, \tag{12}$$

which is strictly negative for t being less than one. Similarly, the change in profits is

$$-p\{M + q(x)\}d\epsilon + \frac{p\{M + q(x)\}d\epsilon}{t} = \frac{1-t}{t}p\{M + q(x)\}d\epsilon, \tag{13}$$

which is strictly positive for a given x. Thus, it contradicts to the fact that the contract is optimal. The process continues either until r_s^m hits the upper bound that is one, or until r_s^l hits the lower bound that is zero.

(2) Without loss of generality, it suffices, from the previous claim, to show that $r_s^l = 0$ if $r_s^m = 1$. Now let's suppose otherwise that $r_s^l > 0$ (and $r_s^m = 1$). Consider to lower r_s^l by $d\epsilon$, which is feasible in (IR) and (IC_s). It is feasible in (IR) because when $r_s^m = 1$, the (IR) condition is slack at any $x < x^{FB}$ since $pq(x) > (1 + \pi)x$ (Otherwise, no firm will start a project.). The decrease in r_s^l will raise profits by $tLd\epsilon/t$, which is strictly positive. Thus, decreasing r_s^l is feasibly profitable, contradicting to the fact that the contract is optimal. ■

It indicates that when the project is successful, liquid assets and cash are first used for repayment, while illiquid land is liquidated only when all the liquid assets are used up for the repayment. This liquidation strategy of borrower firms is quite intuitive since the land liquidation involves the deadweight loss that is paid by the borrower firm but can not be recovered. Firm's liquidation starategy reflects their incentives to avoid the dead weight loss due to the land liquidation. This lemma further states that the land liquidation will never occur in the case of the project's success. Since all the reward from the project is already pledged for repayment when illiquid land is collateralized, it is not only that an increase in the project scale caused by an incremental land liquidation will not increase the firm's profits, but an additional land liquidation indeed causes a loss in profits due to the deadweight loss. Therefore, land liquidation will not occur in the event of the project's success under the optimal loan contract.

Next lemma shows that under the optimal contract, higher repayment rate (r_s^m) and/or higher scale of investment (x) are chosen so that the incentive compatibility constraint (IC_s) binds. Raising the repayment rate is profitable since even though it directly reduces the firm's profits, it increases the investment scale that would bring about higher enough profits to compensate the loss in profits. This result is obtained from the fact that over the entire range of the second-best scales of investment, returns from investment are strictly higher than the cost of capital, that is $eq'(x) > 1+\pi$ for all $x < x^{FB}$. Therefore, as long as investment scale is increased enough, decreasing the repayment, which accompanies a reduction in the investment scale, is profitable. As a result, the incentive compatibility constraint (IC_s) is binding under the optimal contract.

Lemma 2. *Under the optimal contract, the incentive compatibility constraint in the success state, (IC_s), is binding.*

Proof of Lemma 2. When the (IC_s) condition is not binding, it implies that there is room for the investment scale x to increase profitably. We consider to raise x in the following two cases: (1) when the repayment rate r_s^m is large relative to the investment scale x ($pr_s^m q'(x) < 1+\pi$), (2) when the repayment rate r_s^m is small relative to the investment scale x ($pr_s^m q'(x) < 1+\pi$).

(1) ($pr_s^m q'(x) > 1+\pi$) Incrementally raising an investment scale does not affect the participation constraint in (IR^T), while it raises profits and makes (IC_s^T) binding. Since this sort of profitable operation is feasible, the slack (IC_s^T) contradicts to the fact that the contract is optimal.

(2) ($pr_s^m q'(x) < 1+\pi$) Suppose that (IC_s^T) is not binding. Consider to raise r_s^m by $d\mu$, and also raise x. (IR) requires that an increase in x should be less than a certain level,

$$dx \le \frac{p\{M+q(x)\}d\mu}{(1+\pi) - pr_s^m q'(x)}, \tag{14}$$

which is positive. There must be $d\mu$ close to zero so that increases in both $d\mu$ and dx is feasible in (IC_s). Change in profits is

$$\begin{aligned} \Delta\text{Profits} &= -e\{A+q(x)\}d\mu + e(1-r_s^m)q'(x)dx \\ &\ge e\{A+q(x)\}d\mu\left[\frac{eq'(x) - er_s^m q'(x)}{(1+\pi) - er_s^m q'(x)} - 1\right], \end{aligned}$$

which is strictly positive, regardless of the value and sign of $er_s^m q'(x)$, since $eq'(x) > 1+\pi$ for all $x < x^{FB}$. Therefore, raising x and r_s^m is feasibly profitable. Contradiction. ∎

Now with this lemma, the loan contract problem becomes much simplier expressed. By substituting the binding (IC_s) constraint for the term $r_s^m\{M+q(x)\}$, the optimal contract maximizes the borrower's profits

$$pq(x) + (1-p)(M+L+d) - (1-p)\left\{r_f^m M + \frac{r_f^l}{t}L\right\} \tag{15}$$

by choosing x, r_f^m, and r_f^l, subject to (IC_f^T) and

$$p(M+L+d) + (1-p)\left\{r_f^m M + r_f^l L\right\} \ge (1+\pi)x. \tag{IR^*}$$

Combined with the binding (IC_s) constraint, (IR) constraint becomes (IR^*) in which the investment scale is now only a function of repayment rates in the failure state. Objective function becomes simpler in that the repayment in the event of the project's success does not involve the investment scale explicitly. Therefore, an increase in the investment scale leads to an increase in profits, while the investment scale is limited by the repayment ability (hence pledgeability) of the borrower, which is then dependent upon the firm's strategies of land collateralization (r_f^m, r_f^l). Next proposition summarizes the liquidation strategies based on the investment scale.

Lemma 3. *There is a unique investment level $\overline{x}(t,\pi)$ $(< x^{FB})$ such that $tpq'(\overline{x}(t,\pi)) = 1+\pi$, and that*

1. *for all $x < \overline{x}(t,\pi)$, $(r_f^m, r_f^l) = (1,t)$, and*
2. *for all $x > \overline{x}(t,\pi)$, $(r_f^m, r_f^l) = (1,0)$.*

Proof of Lemma 3. Proof proceeds in steps: (1) $(r_f^m, r_f^l) \subset \Theta \equiv \{(m,l)|m=1, l\in[0,1]\} \cup \{(m,l)|l=0, m\in[0,1]\}$, (2) $r_f^m = 1$ under the optimal contract, and (3) $r_f^l = t$ for $x < \overline{x}$ and $r_f^l = 0$ for $x > \overline{x}$ under the optimal contract.

(1) Suppose otherwise that under the optimal contract, $(r_f^m, r_f^l) \subset \Xi \equiv \{(m,l)|m \in [0,1], l \in [0,1]\} \setminus \Theta$, where $\Theta \equiv \{(m,l)|m = 1, l \in [0,1]\} \cup \{(m,l)|l = 0, m \in [0,1]\}$, and consider to raise r_f^m by $d\epsilon$ and to decrease r_f^l by $Md\epsilon/L$ so that the left-hand side of (IR^*) is kept constant. There must exist a small $d\epsilon$ close to zero that allows this operation at any points in Ξ. This operation is feasible in (IC_f^T) since the change in the right-hand side is

$$Md\epsilon - \frac{Md\epsilon}{t} = \frac{t-1}{t}Md\epsilon, \tag{16}$$

which is strictly negative as $t < 1$. Change in profits is

$$\frac{1-t}{t}(1-p)Md\epsilon, \tag{17}$$

which is strictly positive. Thus, raising r_f^m while decreasing r_f^l is profitable, contradicting the fact that the contract is optimal.

(2) Suppose otherwise that $r_f^m < 1$ under the optimal contract. From the previous claim, it implies that $r_f^l = 0$. Therefore, the (IC_f^T) constraint is not binding. Consider to raise r_f^m by $d\epsilon$, which is feasible in (IC_s^T). From (IR^*), the change in x should satisfy $(1-p)Md\epsilon \geq (1+\pi)dx$, which implies

$$dx \leq \frac{(1-p)M}{(1+\pi)}d\epsilon. \tag{18}$$

From (15), the change in profits is therefore

$$\begin{aligned} \Delta\text{Profits} &= pq'(x)dx - (1-p)Md\epsilon \\ &\leq \left(\frac{pq'(x)}{1+\pi} - 1\right)(1-p)Md\epsilon, \end{aligned}$$

which is strictly positive since $pq'(x) > 1+\pi$ for all $x < x^{FB}$. Therefore, increasing r_f^m and x up to the point where (18) is satisfied is feasible and profitable, contradicting the fact that the contract is optimal.

(3) We prove the last part separately, namely (a) $r_f^l = t$ for $x < \overline{x}(t,\pi)$, and (b) $r_f^l = 0$ for $x > \overline{x}(t,\pi)$.

(a) Suppose otherwise that $r_f^l < t$ (and $r_f^m = 1$), and consider to raise r_f^l by $d\epsilon$. Since (IC_f^T) is non-binding, it is feasible in (IC_f^T). Change in x must satisfy $(1-p)Ld\epsilon \geq (1+\pi)dx$ so that (IR^*) holds. Therefore, the change in x is

$$dx \leq \frac{(1-p)L}{1+\pi}d\epsilon, \tag{19}$$

which is strictly positive. Now the change in profits is, from (15),

$$\begin{aligned} \Delta\text{Profits} &= pq'(x)dx - (1-p)\frac{L}{t}d\epsilon \\ &\leq (\frac{pq'(x)}{1+\pi} - \frac{1}{t})(1-p)Ld\epsilon, \end{aligned}$$

which is positive when $tpq'(x) > 1+\pi$, that is, when $x < \overline{x}(t,\pi)$ where $tpq'(\overline{x}) = 1+\pi$. Therefore, for the range of $x < \overline{x}(t,\pi)$, increasing r_f^l is feasible and profitable. Contradiction.

(b) Suppose otherwise that $r_f^l > 0$ (and $r_f^m = 1$), and consider to decrease r_f^l by $d\epsilon$. This is feasible in (IC_f^T). Change in x must satisfy $-(1-e)Gd\epsilon \geq (1+\pi)dx$ so that (IR^*) holds. Therefore, the change in x is

$$dx \leq -\frac{(1-p)L}{1+\pi}d\epsilon, \tag{20}$$

which is strictly negative. Now the change in profits is, from (15),

$$\begin{aligned}\Delta\text{Profits} &= pq'(x)dx + (1-p)\frac{L}{t}d\epsilon \\ &\leq (\frac{1}{t} - \frac{pq'(x)}{1+\pi})(1-p)Ld\epsilon,\end{aligned}$$

which is positive when $1+\pi > tpq'(x)$, that is, when $x > \overline{x}(t,\pi)$ where $tpq'(\overline{x}) = 1+\pi$. Therefore, for the range of $x > \overline{x}(t,\pi)$, increasing r^l_f is feasible and profitable. Contradiction. ■

Implication of this claim is first that firms investing in a relatively large scale of the project do not collateralize land to repay in any state. Therefore, they don't incur the transaction costs arising from the land collateral. These firms don't collateralize land in the failure state because it is costly to provide land collateral, relative to the gains from investment. Combined with Lemma 1, these firms never rely on the land collateral in either state. It substantially reduces the pledgeability that the firms can exploit to access to external finance. Secondly, firms with a relatively small scale of the investment are willing to collateralize land in the state of the project's failure. Land collateralization occurs only when the project scale is small enough to expect high marginal returns from the project in the success state, which can offset the deadweight loss due to the land liquidation in the failure state. Land collateral plays only partially a role of boosting up the pledgeability because even these firms do not collateralize land in the success state.

Above proposition identified the unique repayment schedule under the optimal contract for any level of the investment except for the threshold level $\overline{x}$, for which there are a pool of contracts with different rates of land collateralization. Larger firms will have lower rates of land collateralization. We show below that the optimal contract is, however, unique for each level of the total assets. We also show that there is a unique level of the collateralizable assets that allows firms to attain the first best investment scale for each land share in the assets. We define W ($\equiv M+L$) as the total collateralizable assets. We also denote ω as the land share of the firm, which is defined as $\omega = M/W$.

Lemma 4. *For a given level of π and the land share ω, there exists a unique level of the total collateralizable assets $W^{FB}(\omega;\pi) = (1+\pi)x^{FB}/\{1-(1-p)\omega\}$ such that*

1. *for all $W \geq W^{FB}(\omega;\pi)$, FB level of investment is attainable ($x = x^{FB}$),*
2. *for all $W < W^{FB}(\omega;\pi)$, (IR) (and hence (IR^*)) binds.*

Proof of Lemma 4. First part of the proof is straightforward from the previous result. For all $x > \overline{x}(t;\pi)$, the collateralization rates are $(r^m_f, r^l_f) = (1,0)$ from Proposition 1. So, (IR^*) implies that $(1-(1-p)\omega)W \geq x(1+\pi)$. x^{FB} ($> \overline{x}(t;\pi)$) satisfies this inequality so long as W is greater than $W^{FB}(\omega;\pi) \equiv x^{FB}(1+\pi)/(1-(1-p)\omega)$.

For the second part, suppose not (i.e. (IR^*) is non-binding under the optimal contract). Then increasing x by a small $d\epsilon$ is feasible in (IR^*), and it increases the profits by $eq'(x)d\epsilon$ without affecting expected repayment. It contradicts the fact that the contract is optimal. ■

Since (IR) constraint binds for the firms that cannot attain the first-best, their investment scale is determined by this binding (IR) constraint once the collateralization rates in the failure state is identified. Since we know the collateralization rates for almost all range of investment scale from Proposition 3, the next proposition completes the identification of the optimal contract, showing the optimal collateralization rates for the threshold level of investment.

Lemma 5. *For a given set of the land share ω, the market interest rate π and the liquidation cost t, there is a non-empty set of the optimal contracts in which the investment level is $\overline{x}(t,\pi)$ and the land collateralization is $r^l_f = g^*(W,\omega;t,\pi)$, for $g^* \in (0,1)$. Moreover, the level of land collateralization g^* is unique for all levels of the collateralizable assets W in the set.*

Proof of Lemma 5. We first show that (1) there exists a non-empty set of W in which the optimal investment size is $\overline{x}(t,\pi)$. Next, I show that (2) within this set, the optimal land liquidation (r^l_f) is a decreasing function of the total assets W, and that the function is unique for all W in this set.

(1) Let's first define the sets of W that can achieve the high-scale as well as low-scale investment. Define $W^-(\omega;\pi,t) = \{w \in \Re_+ | \forall x \le \overline{x}(t,\pi), [1-(1-p)(1-t)\omega]w = x(1+\pi)\}$, and $W^+(\omega;\pi,t) = \{w \in \Re_+ | \forall x \ge \overline{x}(t,\pi), [1-(1-p)\omega] = x(1+\pi)\}$. $W^-(\omega;\pi,t)$ is the set of W that allows the firm to attain only the low-scale investment defined as $x < \overline{x}(t,\pi)$. Similarly, $W^+(\omega;\pi,t)$ is the set of W that allows the firm to attain the high-scale investment defined as $x > \overline{x}(t,\pi)$.

Now I will find the upper-bound of $W^-(\omega;\pi,t)$ and the lower-bound of $W^+(\omega;\pi,t)$. For all $W \le \sup W^-(\omega;\pi,t)$, $W \in W^-(\omega;\pi,t)$. And for all $W \ge \inf W^+(\omega;\pi,t)$, $W \in W^+(\omega;\pi,t)$. From the definition of two sets,

$$\sup W^-(\omega;\pi,t) = \frac{\overline{x}(t,\pi)(1+\pi)}{1-(1-p)(1-t)\omega} \tag{21}$$

$$\inf W^+(\omega;\pi,t) = \frac{\overline{x}(t,\pi)(1+\pi)}{1-(1-p)\omega}. \tag{22}$$

Both $\sup W^-(\omega;\pi,t)$ and $\inf W^+(\omega;\pi,t)$ are increasing in ω. Since I have $\sup W^-(\omega;\pi,t) < \inf W^+(\omega;\pi,t)$ as long as $t < 1$, the overlap of the two sets over $\Re_+$ is non-empty for all ω but $\omega = 0$.

(2) Since (IC_s) is binding and $r_f^m = 1$, the firm's expected payment for $W \in (\sup W^-, \inf W^+)$ is $p(M+L) + (1-p)(M+gL)$, where $g \in (0,t)$ is the fraction of land to be liquidated to repay in the failure state. g is bounded above by L (< 1) by construction. By rearranging the expression with the land share $\omega \equiv L/(M+L)$, (IR^*) becomes

$$\{1-(1-p)(1-g)\omega\}W = x(1+\pi). \tag{23}$$

Note that (IR^*) binds for all $x < x^{FB}$. Given the investment size x, the level of the land liquidation g is unique for the total assets of a firm W. We argue that for $W \in (\sup W^-, \inf W^+)$, the optimal investment size is fixed at $x = \overline{x}(t,\pi)$ and the optimal land liquidation is $g = g^*(W,\omega;t,\pi)$ that solves the above equation for $x = \overline{x}(t,\pi)$. g^* is decreasing in W because from the implicit function theorem applied to the equation (23), $dg^*/dW = \{(1-p)(1-g)\omega - 1\}/(1-p)\omega W < 0$ for all $W \in (\sup W^-, \inf W^+)$.

Since g and W are one-to-one taking x as given, it suffices to show that the optimal level of g is $g^*(W,\omega;t,\pi)$ for each $W \in (\sup W^-, \inf W^+)$. We prove this claim by the following two steps: (a) $g \ge g^*(W,\omega;t,\pi)$ under the optimal contract, (b) $g \le g^*(W,\omega;t,\pi)$ under the optimal contract.

(a) Suppose otherwise for a contradiction that $g < g^*$ (hence $x < \overline{x}(t,\pi)$) under the optimal contract. Consider to raise g by $d\epsilon$. Since $g^* < t$, this is feasible in (IC_f^T). Binding (IR^*) requires x to increase by $(1-p)Ld\epsilon/(1+\pi)$. Then, the resulting change in profits is, from (15),

$$\begin{aligned} \Delta\text{Profits} &= pq'(x)dx - \frac{(1-p)L}{t}d\epsilon \\ &= \frac{(1-p)Ld\epsilon}{t(1+\pi)}\left[tpq'(x) - (1+\pi)\right] \\ &> 0. \end{aligned}$$

Last inequality comes from the inequality, $tpq'(x) > (1+\pi)$ for all $x < \overline{x}(t,\pi)$. Thus, raising g is feasible and profitable, contradiction the fact that the contract is optimal.

(b) Suppose similarly for a contradiction that $g > g^*$ (hence $x > \overline{x}(t,\pi)$) under the optimal contract. Consider now to decrease g by $d\epsilon$. This is obviously feasible in (IC_f^T). Binding (IR^*) requires x to decrease by $(1-p)Ld\epsilon/(1+\pi)$. Then, the resulting change in profits is

$$\begin{aligned} \Delta\text{Profits} &= \frac{(1-p)L}{t}d\epsilon - pq'(x)dx \\ &= \frac{(1-p)Ld\epsilon}{t(1+\pi)}\left[(1+\pi) - tpq'(x)\right] \\ &> 0. \end{aligned}$$

Last inequality comes from the inequality, $tpq'(x) < (1+\pi)$ for all $x > \overline{x}(t,\pi)$. Thus, decreasing g is feasible and profitable, contradiction the fact that the contract is optimal. ■

Among the firms obtaining the threshold investment scale, the firms with the smallest collateralizable assets will collateralize all the land they own. By so doing, they can attain the highest investment scale that provides the largest profits net of repayment and the liquidation costs. As the collateralizable asset size W increases for a given share of land ω, the optimal rate of land collateralization decreases so that the total repayment value is unchanged. This is because as the firm size becomes larger, they substitute machines for land as collateral. However, keeping relying on land collateral to access to a larger loan is not profitable. Firms with highest collateralizable assets that obtain the threshold scale $\overline{x}$ will not liquidate land as they own large enough value of machines. ■

Proposition 2 (Extensive and Intensive Margins of Deregulation). *When the land regulation is repealed, and hence the land transaction costs are removed ($t \to 1$), all landed firms gain from the intensive margin, while only relatively large landed firms gain from the extensive margin. More precisely,*

1. *(Extensive Margin) Threshold level of the investment below which firms fully collateralize land increases: $\partial\overline{x}(t,\pi)/\partial t > 0$. Moreover, it reaches the first-best level of loan when the transaction costs are fully removed ($\lim_{t\to 1}\overline{x}(t,\pi) = x^{FB}$).*
2. *(Intensive Margin) Collateral value of a unit of land improves.*

Proof of Proposition 2. First part of this Proposition is easily obtained from the definition of $\overline{x}(t;\pi)$. Since it is defined to satisfy $tpq'(x) = 1+\pi$, by applying the Implicit Function Thoerem to this equation, I get

$$\frac{d\overline{x}(t;\pi)}{dt} = -\frac{q'(\overline{x})}{tq''(\overline{x})} > 0, \tag{24}$$

since $q''(x) < 0$ for all x. Furthermore, since we know that in the first best contract, $pq'(x^{FB}) = 1+\pi$ is satisfied, we have $tq'(\overline{x}) = pq'(x^{FB})$, implying that

$$(t-1)q'(\overline{x}) = q'(x^{FB}) - q'(\overline{x}) < 0. \tag{25}$$

The left hand side of the equality converges to zero as t approaches 1, since $q'(\overline{x})$ converges to a some positive number. This completes the proof.

Second point of the proposition can be directly shown by looking at the effect on the small scale investment. Pledgeability of a firm with a low scale investment can be expressed $\tilde{W}(t;\omega,W) \equiv \{1-(1-p)(1-t)\omega\}\,W$, and the marginal effect of the deregulation on the pledgeability of the relatively small firms is

$$\frac{\partial\tilde{W}(t;\omega,W)}{\partial t} = (1-p)\omega W > 0, \tag{26}$$

which allows the firm with the collateralizable assets, W, and the land share, ω, to access a larger loan. ■

Appendix B : Data

Our main explanatory variable *Repeal* is constructed as follows. First, I assume that the firm's production is mainly taken place where the firm's headquarter is located. The Prowess has information on the address of the firm's headquarter, from which I assign the *city* to each firm. I also assume that the firms in the dataset never relocated over the sampling period 1990-2007, so long as their headquarters are located in the same city. Secondly, *city* are classified to two groups, either urban or rural, among which the urban cities fall into one of the categories A, B, C or D, shown in the table 3. The other group of *City* is the rural cities in which firms were never affected by the ULCRA. Lastly, *Repeal* is given one if *City* is in the urban cities of the states that repealed the ULCRA in a given year, and zero otherwise.

Since I use the Prowess of only the period 1990-2007, there are five non-repealing states of the ULCRA, namely Andhra Pradesh, Maharashtra, Assam, Bihar, and West Bengal, although the first two repealed it in 2008. These states are the control group in the empirical analyses that follow. States of Haryana, Himachal Pradesh, Manipur, Meghlaya, Tripura had repealed the ULCRA at some points, but there were no urban agglomeration that falls in the categories from A through D for which the Act was in effect at the time of repeal. Thus, no firm in these states was affected by the ULCRA in any way. States that never regulated land transactions will be used as another control group. Classification of states into the treatment and control groups is shown in Table 2 with a variation in timing of the land deregulation.

Our main outcome variable is the net value of outstanding borrowings secured by collaterals. I use the variables of assets: *Collateralizable Assets* is the sum of the net values of real estate assets, plant and machineries. I calculate from this variable the land share in assets, ω, as a ratio of the net value of real estate assets to the net value of the collateralizable assets. I do not use just land, but the sum of land and building as the variable concerning land in the empirical analysis that follows.

I use the base-year values of *Land Share*, *Land and Building* and *Collateralizable Assets* in 1990 as the initial levels. Later I examine the heterogeneous impacts of the land deregulation based on these initial values. This is to avoid the endogeneity of these variables, caused by the reverse causality from the credit size to these firm characteristics. Plus, the base year 1990 is 9 years before the repeal of the ULCRA is taken place, so I assume that the levels of these variables in 1990 are not affected by the expectation of the future repeal of the ULCRA.

Figure 1: **Timing of Events**

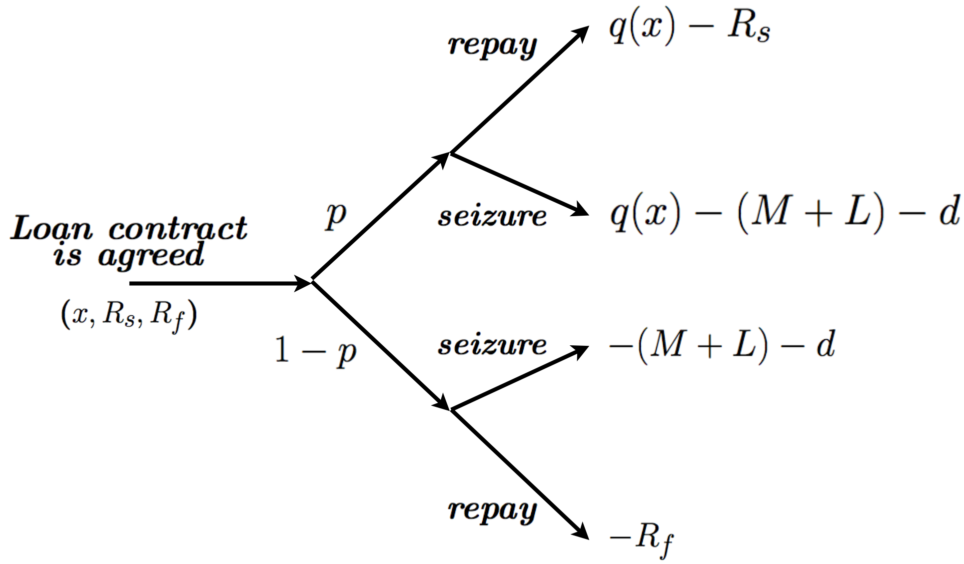

Figure 2: **Credit Demand and Partial Equilibrium Effect**

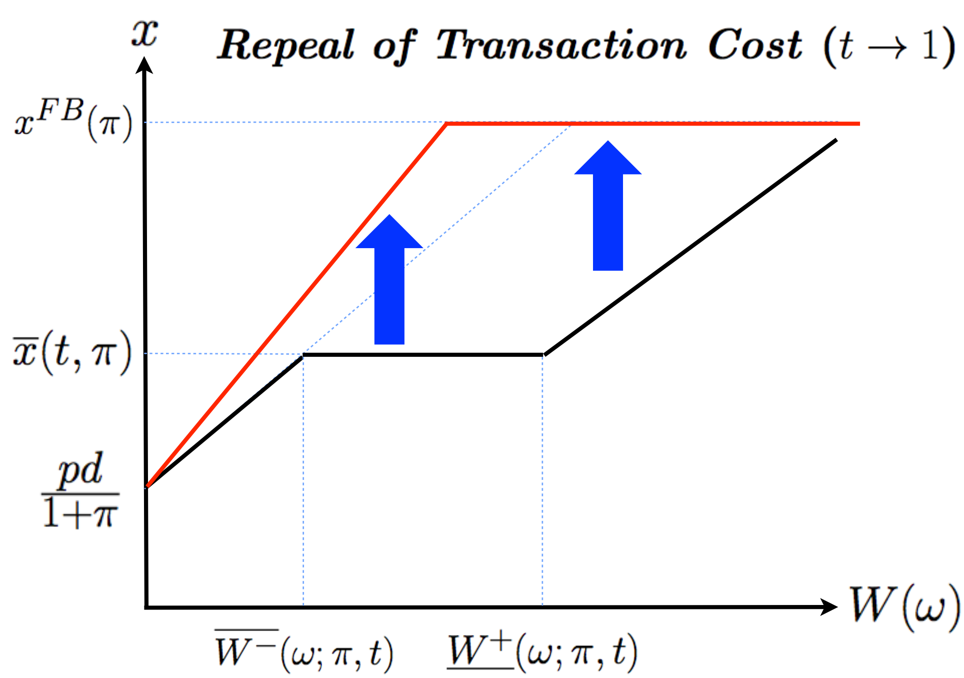

Figure 3: **General Equilibrium Effect and Net Effect**

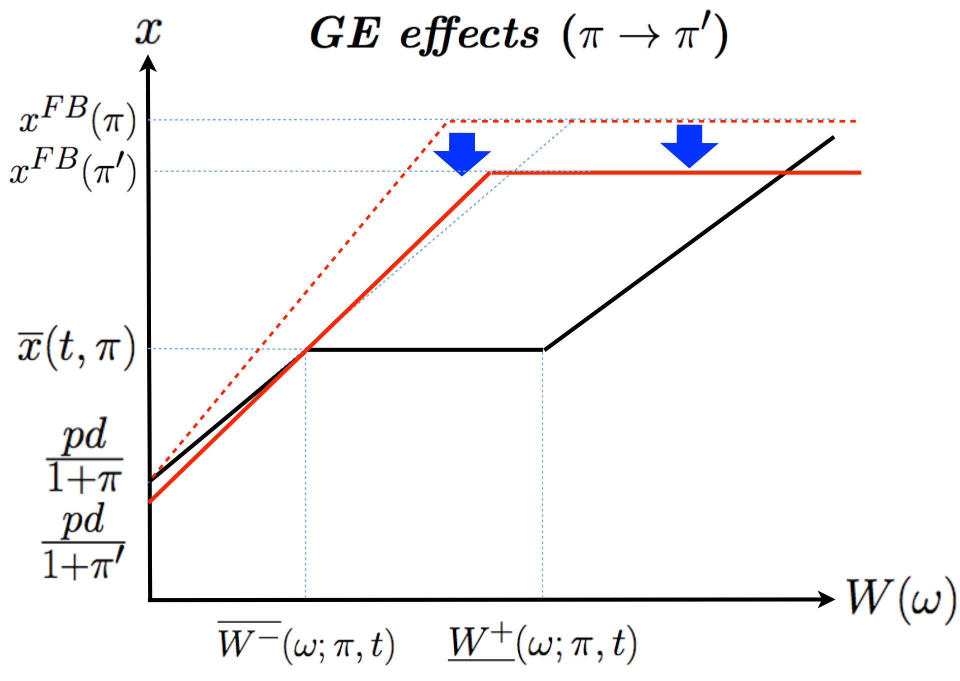

Table 1: **Descriptive Statistics**

	Mean	S.D.	Min	25th percentile	50th percentile	75th percentile	Max
Full Sample							
Collateralizable Assets	147.1	919.3	0	6.441	22.21	70.35	48,351
Land and Building	28.50	108.3	0	1.708	5.387	18.32	4,918
Share of Land and Building	0.330	0.247	0	0.149	0.260	0.452	1
ln(Collateralizable Assets)	3.199	1.715	0	2.007	3.145	4.268	10.79
ln(Land and Building)	1.003	0.910	0	0.400	0.749	1.310	6.866
Collateralizable Assets in 1990	90.63	258.1	0	7.383	22.17	61.85	3,080
Land and Building in 1990	15.72	37.53	0	1.458	4.239	12.47	449.2
Share of Land and Building in 1990	0.256	0.202	0	0.122	0.200	0.327	1
ln(Collateralizable Assets in 1990)	3.183	1.560	0	2.126	3.143	4.141	8.033
ln(Land and Building in 1990)	0.742	0.629	0	0.367	0.592	0.920	4.662
Secured Borrowing	102.7	408.5	0	5.040	18.27	61.39	14,562
ln(Secured Borrowing)	2.985	1.747	0	1.798	2.959	4.133	9.586
Repeal	0.125	0.331	0	0	0	0	1
N	13,044						
#. Firms	1,011						
Sub-Sample of A-cities							
Collateralizable Assets	166.4	1,113	0	5.155	19.38	69.59	48,351
Land and Building	33.96	130.0	0	1.446	5.447	20.41	4,918
Share of Land and Building	0.361	0.263	0	0.162	0.293	0.509	1
ln(Collateralizable Assets)	3.114	1.810	0	1.817	3.015	4.257	10.79
ln(Land and Building)	1.084	0.984	0	0.404	0.815	1.446	6.839
Collateralizable Assets in 1990	97.35	277.5	0	5.948	20.74	62.33	3,080
Land and Building in 1990	18.38	43.30	0	1.327	4.375	13.40	449.2
Share of Land and Building in 1990	0.280	0.215	0	0.131	0.227	0.367	1
ln(Collateralizable Assets in 1990)	3.121	1.646	0	1.938	3.079	4.148	8.033
ln(Land and Building in 1990)	0.811	0.710	0	0.372	0.621	1.028	4.662
Secured Borrowing	108.6	467.8	0	3.950	15.31	55.93	14,562
ln(Secured Borrowing)	2.872	1.804	0	1.599	2.792	4.042	9.586
Repeal	0.0681	0.252	0	0	0	0	1
N	8,194						
#. Firms	629						

Note: *Land* is the gross book value. *Building* is the book value of building for production, net of accumulated depreciation. *Collateralizable Assets* consist of *Land and Building* and *Machineries* that are the book value of plant and machineries, net of accumulated depreciation. *Share of Land and Building* is the ratio of *Land and Building* to *Collateralizable Assets*. Variables in log are calculated by taking logarithm of original values after adding one, in order to keep observations with a value less than one. All the financial variables are deflated by the Wholesale Price Index at March 2003, and reported in unit of 10 million Indian Rupees (equivalent to 1 Crore Rs.).

Table 2: **Timing of the Repal of the ULCRA by the State Governments**

YEAR OF REPEAL	STATE
1999	Chandigarh, Delhi, Pondicherry, Punjub
2000	Gujarat, Karnataka, Uttar Pradesh
2001	Madhya Pradesh
2002	Rajasthan
2003	Orissa
2008	Andhra Pradesh, Maharashtra
Not yet repealed	Assam, Bihar, West Bengal

Note: The ULCRA was repealed during the fiscal year that ends at the end of March of specified years. States of Haryana, Himachal Pradesh, Manipur, Meghlaya, Tripura had repealed the ULCRA at some points, but there were no urban agglomeration that falls in the categories A through D for which the land ceiling was in effect at the time of repeal. Among the earliest repealer states, Chandiharh, Delhi, and Pondicherry are the Union Territories and are directly governed by the federal government.

Table 3: **Ceiling Limits and Status of ULCRA**

Land Ceilings	ULCRA Repealed	Not Repealed Yet
A $500m^2$	Delhi	Kolkata, Mumbai
B $1000m^2$	Ahmedabad, Bangalore, Kanpur	Hyderabad, Pune
C $1500m^2$	Agra, Allahadad, Amritsar, Bareilly, Bhopal, Gwalior, Hubli-Dharwar, Indore, Jabalpur, Jaipur, Jodhpur, Lucknow, Ludhiana, Meerut, Mysore, Rajkot, Surat, Vadodara, Varanasi	Dhanbad, Jamshedpur, Nagpur, Patna, Sholapur, Ulhasnagar, Visakhapatnam, Vijayawada
D $2000m^2$	Aligarh, Ajmer, Belgaum, Bhavanagar, Bikaner, Chandigarh, Cuttack, Dehradun, Durg-Bhilainagar, Jamnagar, Gorakhpur, Jullundur, Kota, Mangalore, Moradabad, Nagpur, Pondicherry, Raipur, Saharanpur, Ujjain	Asansol, Durgapur, Guntur, Guwahati, Kolhapur, Nasik, Ranchi, Sangli, Thane, Warangal

Note: This table classifies into 8 distinct categories of treatment status the cities where the ULCRA had been effective until the federal repeal in 1999. Ceiling limits are based on the population size of the cities in 1970 census. Status of the ULCRA is as of the end of the sample of our empirical analysis, that is 2004.

Table 4: **Impacts of Repealing the ULCRA on Secured Borrowings for Full Sample**

	(1)	(2)	(3)	(4)
Repeal	0.021	0.102	0.131	0.060
	(0.066)	(0.241)	(0.400)	(0.389)
Repeal $\times \ln W$		-0.026	0.125	0.222
		(0.065)	(0.923)	(1.060)
Repeal $\times\ \omega$		0.425***	0.175	0.391*
		(0.155)	(0.217)	(0.233)
Repeal $\times \ln W \times \omega$		-0.099		-0.088
		(0.062)		(0.095)
Repeal $\times \ln W^2$			-0.084	-0.121
			(0.419)	(0.492)
Observations	13,044	13,044	13,044	13,044
R^2	0.025	0.038	0.036	0.038
Number of Firm	1,011	1,011	1,011	1,011
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Note: This table shows the difference-in-differences estimates of the deregulation effect on secured borrowings. All specifications include the firm fixed effects and the year fixed effects. All the relevant interactions to estimate coefficients on the main regressors of the interactions are included. $\ln W$ is the log of the 1990 level of collateralizable assets (Land, Building & Machineries), ω is the 1990 level of the observed land share. All the monetary value is in unit of 10 million Indian Rupees (or 1 Crore Rs.), and deflated at the March 2003 Wholesale Price Index. Standard errors are clustered at the state-level. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: **Impacts of Repealing the ULCRA on Secured Borrowings for Firms in A-cities & Others**

	A-cities				B,C,D-cities			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Repeal	0.048	-0.419***	-0.483***	-0.569***	0.036	0.080	0.260	0.230
	(0.051)	(0.010)	(0.024)	(0.008)	(0.095)	(0.178)	(0.391)	(0.401)
Repeal × $\ln W$		0.133***	0.901***	0.966***		-0.033	-0.653	-0.902
		(0.015)	(0.005)	(0.039)		(0.110)	(1.320)	(1.546)
Repeal × ω		0.590**	0.217**	0.532***		0.979***	0.639	1.116***
		(0.071)	(0.096)	(0.074)		(0.209)	(0.794)	(0.301)
Repeal × $\ln W$ × ω		-0.147***		-0.122***		-0.175		-0.223
		(0.010)		(0.009)		(0.394)		(0.411)
Repeal × $\ln W^2$			-0.386***	-0.404***			0.283	0.421
			(0.012)	(0.025)			(0.625)	(0.740)
Observations	8,194	8,194	8,194	8,194	4,850	4,850	4,850	4,850
R^2	0.824	0.827	0.826	0.827	0.784	0.792	0.791	0.792
Number of Firm	629	629	629	629	382	382	382	382
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: This table shows the difference-in-differences estimates of the deregulation effect on secured borrowings. All specifications include the firm fixed effects and the year fixed effects. All the relevant interactions to estimate coefficients on the main regressors of the interactions are included. $\ln W$ is the log of the 1990 level of total collateralizable assets (Land, Building & Machineries), ω is the 1990 level of the observed land share. All the monetary value is in unit of 10 million Indian Rupees (or 1 Crore Rs.), and deflated at the March 2003 Wholesale Price Index. Standard errors are clustered at the state-level. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: **Robustness Check : Difference-in-Differences Estimates with State-Trend for Firms in A-Cities**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Repeal	0.048	-0.098***	-0.419***	-0.596***	-0.410***	-0.483***	-0.662***	-0.457***	-0.569***	-0.743***	-0.549***
	(0.051)	(0.008)	(0.010)	(0.038)	(0.021)	(0.024)	(0.055)	(0.032)	(0.008)	(0.029)	(0.028)
Repeal × $\ln W$			0.133***	0.137***	0.024**	0.901***	0.887***	0.758***	0.966***	0.958***	0.813***
			(0.015)	(0.007)	(0.011)	(0.005)	(0.019)	(0.011)	(0.039)	(0.051)	(0.043)
Repeal × ω			0.590***	0.610***	1.249***	0.217**	0.253***	0.836***	0.532***	0.553***	1.186***
			(0.071)	(0.030)	(0.179)	(0.096)	(0.060)	(0.107)	(0.074)	(0.032)	(0.176)
Repeal × $\ln W$ × ω			-0.147***	-0.140***	-0.136***				-0.122***	-0.115***	-0.111***
			(0.010)	(0.014)	(0.009)				(0.009)	(0.012)	(0.008)
Repeal × $\ln W^2$						-0.386***	-0.377***	-0.369***	-0.404***	-0.398***	-0.383***
						(0.012)	(0.015)	(0.013)	(0.025)	(0.027)	(0.024)
Observations	8,194	8,194	8,194	8,194	8,194	8,194	8,194	8,194	8,194	8,194	8,194
R^2	0.824	0.825	0.827	0.827	0.827	0.826	0.827	0.827	0.827	0.827	0.827
Number of Firm	629	629	629	629	629	629	629	629	629	629	629
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Trend	No	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
State Trend × $\ln W$	No	No	No	No	Yes	No	No	Yes	No	No	Yes
State Trend × ω	No	No	No	No	Yes	No	No	Yes	No	No	Yes

Note: This table shows the difference-in-difference-in-differences estimates of the deregulation effect on secured borrowings. Columns (1), (3), (6), and (9) are reproduction of the previous Table 5. All other columns include state-trends. Columns (5), (8), and (11) further include the state-trend interacted with the initial firm assets to control for the differential trends across states based on initial asset values. All specifications include the firm fixed effects and the year fixed effects. All the relevant interactions to estimate coefficients on the main regressors of the interactions are included. $\ln W$ is the log of the 1990 level of collateralizable assets (Land, Building & Machineries), ω is the 1990 level of the observed land share. All the monetary value is in unit of 10 million Indian Rupees (or 1 Crore Rs.), and deflated at the March 2003 Wholesale Price Index. Standard errors are clustered at the state-level. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: **Falsification Test of Statistical Association between Pre-Trends and Deregulation**

Dependent Var.	Secured Borrowing		Land Transaction	
	(1)	(2)	(3)	(4)
Panel A : *Growth Rates between 1990 and 1998*				
Repeal	0.083	-0.400**	-0.056	-0.104
	(0.120)	(0.178)	(0.039)	(0.078)
Lag in Yrs		0.262***		0.026
		(0.081)		(0.031)
Observations	738	738	589	589
R^2	0.001	0.010	0.005	0.006
Panel B : *Growth Rates between 1992 and 1998*				
Repeal	0.088	-0.170	-0.041	-0.032
	(0.087)	(0.140)	(0.033)	(0.036)
Lag in Yrs		0.141**		-0.005
		(0.059)		(0.016)
Observations	1,115	1,115	915	915
R^2	0.001	0.004	0.002	0.002
Panel C : *Growth Rates between 1994 and 1998*				
Repeal	0.085	-0.024	-0.042**	-0.023
	(0.070)	(0.114)	(0.016)	(0.040)
Lag in Yrs		0.060		-0.010
		(0.050)		(0.026)
Observations	1,904	1,904	1,384	1,384
R^2	0.001	0.002	0.002	0.002
Panel D : *Growth Rates between 1996 and 1998*				
Repeal	0.016	-0.018	-0.024	-0.055**
	(0.021)	(0.042)	(0.014)	(0.022)
Lag in Yrs		0.019		0.017
		(0.023)		(0.015)
Observations	2,605	2,605	2,360	2,360
R^2	0.000	0.000	0.001	0.001

Note: This table falsifies the statistical association between the pre-treatment growth rates of secured borrowings and land and the adoption and timing of the land deregulation. This table shows the estimates of regressing the pre-treatment growth of firms' credit and land on the deregulation decisions made by the state governments. Panel A through D use the different spans of the sample periods. Panel A uses the Growth rates between 1990 and 1998, the year before the federal repeal of the land regulation. Panel B, C and D use the growth rates between 1992 and 1998, between 1994 and 1998, and between 1996 and 1998. *Repeal* takes on a value of one if the state a firm belongs to is a deregulation state, and zero otherwise. $LaginYrs$ is the lag in years of the state adoption of the land deregulation since the federal decision. Sample consists of firms in both treatment and control states, which include three Union Territories (Chadingarh, Delhi and Pondicherry) where the treatment status is subject to the decision by the state of Haryana and Punjub. Dependent variables are the differences in log of secured borrowings, and an indicator whether a firm is a net land trader (either buyer or seller). Standard errors are clustered at the state-level. *** p<0.01, ** p<0.05, * p<0.1.

Table 8: **Average-Liquidirty Impacts of Repealing the ULCRA**

Sample	(1) Full	(2) Full	(3) A-cities	(4) A-cities	(5) B-cities	(6) B-cities	(7) C-cities	(8) C-cities	(9) D-cities	(10) D-cities
Panel I : Land Transaction (Buying or Selling)										
Repeal	-0.001	0.000	0.021***	0.022***	0.042*	0.038*	0.014	0.013	0.044*	0.041
	(0.019)	(0.019)	(0.007)	(0.008)	(0.022)	(0.020)	(0.017)	(0.017)	(0.024)	(0.027)
R^2	0.047	0.053	0.042	0.049	0.052	0.069	0.065	0.095	0.075	0.099
Panel II : Buying Probability										
Repeal	-0.001	0.001	0.009***	0.011***	0.039*	0.032*	0.023	0.025	0.049*	0.046
	(0.012)	(0.012)	(0.002)	(0.004)	(0.019)	(0.019)	(0.017)	(0.020)	(0.028)	(0.030)
R^2	0.058	0.065	0.050	0.058	0.059	0.078	0.091	0.125	0.087	0.111
Panel III : Selling Probability										
Repeal	-0.000	-0.001	0.012***	0.011***	0.003	0.006	-0.009	-0.012	-0.005	-0.005
	(0.009)	(0.008)	(0.005)	(0.004)	(0.008)	(0.008)	(0.011)	(0.011)	(0.013)	(0.014)
R^2	0.017	0.020	0.018	0.022	0.021	0.034	0.014	0.038	0.015	0.034
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Industry FE × Year FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Observations	61,942	61,373	36,988	36,723	13,331	13,100	6,374	6,339	5,249	5,211
Number of Firm	10,025	9,911	6,192	6,147	2,099	2,045	972	965	762	754

Note: This table shows the estimates of the difference-in-differences estimation with three distinct outcome variables: Dependent variable is an indicator of whether a firm participates in either side of the land market (i.e. either buyer or seller) in Panel I, an indicator of whether a firm is a net buyer of land in Panel II, and an indicator of whether a firm is a net seller of land in Panel III. Robust standard errors are clustered at the state-level. Column (1) and (2) includes firms in A, B, C and D cities in both treatment and control states. Column (3) and (4) uses only firms in A cities (mega cities), and so on. Columns of even numbers include the time-varying industry fixed effects as the other regressors. Industries are classified at the 1-digit level NIC classification. *** p<0.01, ** p<0.05, * p<0.1.