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Property Rights on Unused Assets and Investment Incentives: Evidence from Brazil

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Abstract

It is usually stated that property rights security on assets positively affects investment incentives since it guarantees the ability to get the future benefits from investment. Yet, the empirical evidence on this relationship is ambiguous. From a theoretical point of view, this is not surprising since property rights security on asset may even entail a negative effect on investment incentives as long as property right are endogenous to investment (Besley, 1995) or investors are characterized by time-inconsistent preferences (Vertova, 2020). Instead, from a theoretical point of view, a clear-cut negative relationship exists between property rigths security on unused assets (the expected ability to invest on a unsued asset) and investment incentives. In this paper I test this theoretical prediction using a difference-in-difference matching method on Brazilian municipal data. I find that land occupations by Landless Workers'Movement (as a proxy for property rights insecurity on unused assets) positively affect the degree of land use (as a proxy for investment) In Brazilian municipalities.

Keywords: Difference-in-difference, Land Investment, Landless Workers'Movement, Property Ritghs

JEL Category: D23, Q15, 013

1. Introduction

The effects of property rights on investment incentives and economic performance is a crucial issue to be studied both theoretically ann empirically. Private property rights, defined as the expected ability of an economic agent to use an asset (Barzel, 1997; Lueck and Miceli, 2005), represent the main feature that distinguishes a capitalist economy from a pre-capitalist one, where the right to invest on a certain asset is collectively shared. From Alchian and Demsetz (1973) on, there is a large consensus among economists about the investment-enhancing effects of private property rights. The basic idea is that private property rights, reducing the risk of expropriation, increases the expected value of an investment and hence the incentives to invest faced by the owner. As a consequence, the role of the State in codifying property rigths on productive assets is generally considered as crucial to promote investment and growth, even if it may incur public costs.

Yet, empirical literature provide mixed evidence about the relationship between asset security and investment incentives. Several empirical works about property rights security and investment incentives have primarly focused of the impact of titling (i.e. the provisionof the formal title of private property) on investment. The results are ambiguous: while some works evidence a significatly positive effect of titling on the propensity to invest (e.g. Alston et al, 1996; Feder et al., 1998; Banerjee et al, 2002; Field, 2005), others show that in some cases titling has a little or null impact (e.g. Besley, 1995; Migot-Adholla et al., 1991; Pickney and Kimuyu, 1994; Place and Otsuka, 2002).

The existence of mixed results about the effect of titling on investment is not surprising from a theoretical point of view. Indeed, property rights security on asset always entails positive incentives to invest on only if two necessary conditions jointly hold. First, property rights must be exogenous to investment, i.e. the degree of property rights security does not depend on the level of investment. If instead property rights were to depend positively on investment, the opposite would be possible: weaker property rights may entail a higher level of investment (Besley, 1995). An example is when undertaking more investment on asset increases the probability to obtain the title on the asset istelf. Second, investors must be characterized by time-consistent preferences. If instead some investors were time-inconsistent, asset security may exacerbate their propensity to delay of even procrastinate profitable invetsment (Vertova, 2020). This means that a negative relationship between property rights security on asset and investment incentives may emerge.

There are good reasons to believe that these twp necessary conditions, i. e. the exogeneity of property righst security and owners'time consistency, do not hold in many contexts. For example, Besley (1995) interprets his mixed results about tenure security and investment in Ghana with the explanation that farmers can affect land rights through their investment behaviour. Moreover the tendency to procrastinate a profitable investment due to a preference for immediate gratification has been reckoned as a usual feature of investors'everyday life, as already described by Adam Smith (1776) and Irving Fisher (1930).

While the effect of asset security on investment incentives is theoretically ambiguous, a clear-cut comparative statics prediction exists about the relationship between property rights security on unused asset, i.e. the expected ability to invest on a unused asset, and investment incentives. I define an asset as "unused" when no investment is made on this asset. Consider a landowner who does not use a certain fraction of her land. Two reasons may explain this behaviour: either investing on this part of land is not profitable given the owner's time preferences or it is profitable but the owner is procrastinating the investment. Consider now a situation where property rights security on unused land is lowered in such a way the probability to lose the control of the unused part of the asset is increased with respect to the initial conditions. This new situation necessarily leads to stronger (or at least non weaker) incentives to invest for three motives. First, as proved by Vertova (2020), higher insecurity on unused asset may push time-inconsistent investors to undertake an investment that otherwise they would have delayed ot even procrastinated. Second, as suggested by Besley (1995), the level of investment on this part of asset may increase since, as long as the probability to keep the control of asset when unsued is lower than the probability to keep the control of the asset when used, property rights are endogenous to investment. FInally, a complementary factor that may push owners to undertake higher investment on unsued asset is related to a possible preference for the control of the asser itself regardless its profitability and use (for example when land ownership is a positional good).

In this paper I test empirically the theoretical prediction that property rights insecurity on unsed assets has a positive effect on investment using municipal data on land use in Brazil and micro-data on the political activity of the Landless Workers'Movement (MST). This Braziian social movement, founded in 1988, has the explicit aim to redistribute unused land to landless peasants. The main strategy adopted by MST to pursue this objective consists in occupying unproductive properties. Hence its activity has caused a reduction in the degree of property rights security on unused land (and only on unused land). Since the political activity of MST varies across Brazilian municipalities, I can analyze the impacty of MST activity on land use thorugh a methodology borrowed from the programme evaluation literature, i.e. the difference-in-difference (DID) method. In particular, under the hypothesis that the geographical proximity of MST occupations make more salient for landowners the insecurity of property rights on their unused asset, I test whether or not the change in land use between 1985 and 1995 is significantlyh different for the sub-sample of municipalities where MST undertook some occupations between 1988 and 1995 with respect to other municipalities. In order this quasi-experimental contest to be reliable, the sampling must be random. HOwever, MST allocations acrosso municipalities may be non random: hence a problem of selection bias exists. By taking the double difference (DID), I can eliminate any time-invariant selection bias. Moreover, I adopt a propensity score matching model in order to eliminate any time-variant selection bias on observable variables. The results show that land occupations by MST (as a proxy for property rights insecurity on unsued asset) positively affect the degree of land use for agricultural purposes (as a proxy for investment) in Brazilian municipalities.

The rest of the paper is organized as follows. In section 2 I describe the socio-economic background of Brazil and the role of MST in the context of land reform. In section 3 I describe the dataset and the econometric strategy adopted. In section 4 I present the empirical results. FInally, in section 5, I draw some concluding remarks.

2. Property rights on unused asset and land use in Brazil

The Brazilian case is a very suitable context to analyze the relationship between property rights on unused asset and investment incentives. Brazil is one of the countries with the most concentrated land ownership structure in the world. In 1985 the Gini coefficient was equal to 0,85, the 9th highest in the world, with the largest 1% of the farms'owners holding 45% of the agricultural land (Alston et al, 2005). Furthemore, there are many unproductive properties, in particular among *latifundia,* while the number ot landless peasants is estimated in more than 3 millions. Inherited from the colonial period, this highly concentrated land ownership structure has been considered a crucial problem by many Brazilian Governments, but until now alla land reforms have obtained modest results.

An important social and political actor in the context of land reform is represented by Landless Workers'Movement (MST). FOunded in 1985, this a a movement of landless peasants whose aim is to promote land redistribution. The re-democratization process of the mid 1980s, culminated with the approval of the new Brazilian Constitution in 1988, favored the development of this movement, which spread all over the country. In particular, MST has profited of the dictate of article 184 of the Constitution, which mandates the Government to expropriate and redistribute unproductive properties. Since 1988, Landless Workers' Movement has begun to use the strategy to invade unproductive propertie sand to transform these occupations in expropriations by the *National Institute for Colonization and Agrarian Reform* (INCRA), a public agency with the authority to expropriate and redistribute unused land. In the 1990s MST has grown rapidly, gaining a large consensus in the Brazilian society, and it is now considered one of the most successful grassroots movements in the world.

The beginning of MST occupations in mid 1980s represents a good proxy for change in property rights (in)security on unsed asset. Indeed the strategy followed by MST activists is to invade and reclaim only unused land, without touching those lands that are productively used. After having invaded a field, MST typically asks INCRA to INtervene in order to expropriate and redistribute it among landless peasants. In many cases this strategy is successful. This means that MST occupations have succeded in creating a wedge between property rigths security on respectively used and unused land. Theoretically, as discusses before, this should imply an increase in the degree of land use by the owners. In order to test this prediction, I adopt an empirical strategy based on the progran evaluation literature. I assume that the beginning of MST occupations has represented a political structural break that has lowered property rights security on unproductives properties. My ancillary assumption is that this political shock is more salient for owners operating in proximity of the places where MST occupations are made. Given this hypothesis, I test whether or not change in land use across the first cycle of MST occupations is significantly different for those municipalities where some occupations were undertaken (*treated group*) with respect to other municipalities (*untreated group*). In particular my hypothesis is that treated municipalities should have known a higher increase (or lower decrease) in the degree of land use than non treated ones.

Notice that Brazilian Constitution does not only favors expropriations of unproductive land, but also gives a preferential privilege to squatters with respect to title holders. In particular, in case squatters develop unused land (up to 50 hectares) for five consecutive years without any opposition from the owner, they can obtain title through adverse possession. If instead the land owner protests, squatters cannot maintain the possession of the land but have the right to obtain by the landownera compensation for any improvement they have made. This means that, essentially, The Constitution authorizes the invasions of private unused land. However, this constitutional rule conflicts with the Brazilian civil law that suppports the sanctity of title held by landowners without recognizing any right of squatters. This inconsistency in legislation is cause of violent conflicts between landowners and squatters (Alston et al., 2000). A better understanding of the economic benefits and costs of the two different legislative approaches requires to analyze the relationghip between property rights insecurity on unproductive assets and investment incentives.

3. Data and Empirical Strategy

3.1 Data

The data used in this paper come from three sources. Municipal data for 1985 and 1995 on several features of agricultural activity, population, GDP and geographical area come from IPEA, the official Brazilian Government research institute. Data on MST occupations from 1985 to 1995 come from *Commissao Pastoral da Terra* (CPT). A Romanic Catholic Institution founded in 1975 to address the problem of unjust land distribution and violence in the countrysied in Brazil. From 1988 CPT collects data on all landless workers'occupations in Brazil. In particular, the municipality where each occupation was made is recorded. Finally, I use data on land expropriations by INCRA from 1979 to 1985, that come from a data collection made by INCRA itself.

In order to match these datasets, some problems arise. In particular, the number and the borders of Brazilian municipalities changed radically with the administrative reform in 1991. Since my aim is to compare the degree of land use between 1985 and 1995, I necessarily need to make some adjustments in the raw data in order to have time-invariant geograhical units called AMC-70, corresponding to the municipal units in 1970and kept constant as if no administrative reform was made in 1991[1]. However data on MST occupations from 1988 to 1995 refer to municipalities and I cannot match them with AMC-Data level: indeed for those occupations made after 1991 in new or reformed municipalities I cannot know the AMC unit they refer to. The only way to cope with this problem consists in using municipal level data, but making an appropriate restriction of the dataset. In particular, I keep all and only those municipalities existing in 1970 that were not subject to any change of borders in the 1991 administrative reform, while I drop all the other municipalities. In this way, among the 3951 municipalities in 1970, I select the 2893 time-invariant municipalities. After these adjustments in the raw data, I can work on a panel dataset with two years (1985 and 1995) and 2893 time-invariant municipalities. Data description is reported in the Appendix.

3.2 Empirical Strategy

In this analysis, using municipal level panel data, I adopt a difference-in-difference matching model to assess the impact of MST occupations (as a proxy for property rights insecurity on unused asset) on the degree of land use. The basic idea is to compare the change in the degree of land use between 1985 and 1995 respectively for those municipalities that during this period met somme MST occupations (treatment group) and those that did not (comparison group). The method I propose, combining the difference-in-difference method with the propensity score matching analysis, can substantially reduce the bias due to non-experimental evaluations (Heckman et al., 1997, 1998). Indeed the difference-in-difference allows to correct those differences between treatment and control groups that are due to time invariant chiaracteristics. Moreover, the propensity score matching method allows for selecting a comparison group that minimizes the possible bias induce by non random allocations by landless workers depending on some observable characteristics correlated with the change in outcome.

Let me formalize this method within my specific setting. Define as Y_{it}^{1} the degree of land use for municipality i in year t (where $t \in \{1985, 1995\}$) if the municipality has been exposed to some land occupationsbetween 1988 and 1995 (i.e. if it has been "treated"). Instead, define as Y_{it}^{0} the degree of land use for the same municipality if not exposed to any land occupation between 1988 and 1995 ("non treated"). The impact of MST occupations on the degree of land use is: $Y_{i,1995}^{1} - Y_{i,1995}^{0}$. Consider the dummy variable MST_i that takes value 1 if some land occupations were made by MST in municipality i between 1988 and 1995 and 0 otherwise. The average impact of MST occupations on land use can be expressed as: $E(Y_{i,1995}^{1} - Y_{i,1995}^{0})/(MST = 1)$. A missing data problemi s faced. Indeed, I do not know what the degree of land use in 1995 would have been in treated municipalities had they not been treated, i.e. it is not possible estimate $E(Y_{i,1995}^{0})/(MST = 1)$. Therefore causal inference must rely on the choice of the appropriate comparison group to estimate the counterfactual mean.

Suppose that the following assumption holds:

$$E(Y_{it}^{0}/MST = 1, t = 1995) \text{-} E(Y_{it}^{0}/MST = 1, t = 1985) = \qquad (1)$$

$$E(Y_{it}^{0}/MST = 0, t = 1995) \text{-} E\left(Y_{it}^{0}/MST = 0, t = 1985\right)$$

This assumption states that the average change in land use in treated municipalities would have been the same as in the non treated municipalities in the absence of MST occupations. In this case the cou

[1] Andrade et al. (2004) and De Vreyer and Spielvogel (2005) work with AMC-data level.

$E(Y_{it}^{0}/MST = 1, t = 1995)$- $E(Y_{it}^{0}/MST = 1, t = 1985)$ +k,

where $k = E(Y_{it}^{0}/MST = 0, t = 1995)$- $E\left(Y_{it}^{0}/MST = 0, t = 1985\right)$

Hence, given the above assumption, I can simply test the effcet of MST occupations on land use with a difference-in-difference estimator:

$$\widehat{\propto}_{DID}= \left(\bar{Y}_{1995}^{T} - \bar{Y}_{1985}^{T}\right) - \left(\bar{Y}_{1995}^{N} - \bar{Y}_{1985}^{N}\right),$$

whee $\bar{T}^{T}$ and $\bar{T}^{N}$ are the mean outcome respectively of treated and non treated municipalities in our sample.

However assumption (1) does not necessarily hod because the allocation of MST occupations across Brazilian municipalities may be non random. Whether or not a certain municipèality gest a MST occupation may depend on some time-variant municipal characteristics that are correlated with the change in land use between 1985 and 1995. Notice that, instead, selection based on timje invariant characteristics doe not create any bias because the estimator in difference-in-difference.

In this case, a simple comparison of the outcome bewteen municipalities with occupations and municipalities without occupations would imply a biased difference-in-difference estimator.

If the selection of a municipality where to undertake a land occupation is based on observable characteristics, a matching methoid can be used to correct this selection bias. Given the set of observable variables in 1985, X, the following assumption must hold:

$E(Y_{it}^{0}/X$, MST=1, t=1995)- $E(Y_{it}^{0}/X$, MST=1, t=1985)=

$= E(Y_{it}^{0}/X$, MST=1, t=1995)- $E(Y_{it}^{0}/X$, MST=0, t=1985) (2)

Analogously to assumtion (1), assumption (2) states that the average change in land use in the treated municipalities would have been the same as in non treated municipalities in the absence of MST occupations. However, differently from assumption (1), this must hold conditionally on the set of observable variable X. This means that the counterfactual of each treated municipality is represented by a non treated municipality (or a set of non treated municipalities) with the same X-realizations. Moreover. Matching assumed that $0 < Prob(MST = 1/X) < 1$: this further assumtion guarantees that any municipality can be potentially selected by MST to make an occupation. Actually, if selection occurs, only on observables, the matching method allows to build an experimental dataset (where the treatment can be considered as random) starting from a non experimental one (where the treatment is non random).

When several observable variables are involved, it is convenient to use a propensity score matching method. Let $P(X_i) = Prob(MST = 1/X_i)$ denote the propensity score. The propensity score measures the probability that a certain municipality is selected by MST (between 1985 and 1995) to undertake an occupation ad a function of the osbervable charecteristics of this municipality in 1985. Rosenbaum and Rubin (1983) prove that if no selection bias remains when controlling for X, then no bias remains when controllin for P(X). Propensity score matching method uses P(X) to select the comparison group for each of the treated units. In our setting, municipalities with occupations (treatment group) are matched with municipalities without occupations (the control group) on the basis of their propensity score. Difference-in-difference is then applied to test for the impact of MST occupations on land use.

3.3 Implementation of the strategy

In this paper, I first run difference-in-difference on the overall sample of municipalities (*simple difference-in difference)*. This method allows to remove any possible bias due to differences in time-invariant unobservable characteristics between treated and non treated municipalities. Then, in order to cope with futher possible selection bias on observables, I adopt a *difference-in-difference matching method*: I first match treated and non treated municipalities on the basis of their propensity score and then I apply the difference-in-differenc method on the restricted sample. The difference-in-difference estimators test the impact of MST occupations on the change of land use in Brazilian municipalities between 1985 and 1995.

In the difference-in-difference estimation, I run the following simple regression:

$$y_{mt} = \gamma_t + \beta(MST_m * \gamma_t) + \varepsilon_{mt} \quad (3)$$

The dependent variable y_{mt} is the fraction of the total area turned into agricultural activity with respect to the geographical area in municipality m and year t; γ_t is a time fixed effect that equals 1 if t=1995 and 0 if t=1985; $(MST_m * \gamma_t)$ is an interaction term given by the product of two dummies: the time dummy γ_t and the dummy MST_m that takes the value 1 if at least one occupation by MST happened between 1988 and 1985 and 0 otherwise; ε_{mt} is the error term. The time dummy absorbs common/aggregate schocks for all municipalities, whereas $\hat{\beta}$ captures difference-in-difference effect.

As a first step, I run regression (3) on the overall sample of treatment and control observations (*simple difference-in-difference*). Notice that, running this regression, I am implicitly assuming that MST occupations are randomly assigned to the municipalities. Given this assumption and the availability of a large sample, the evolution of covariates is either independent of treatment status, in which case it does not influence the difference-in-difference effect, or it depends on treatment status, in which case bias the difference-in-difference estimate capturing part of the effect.

As a second step, I run regression (3) on a subset of the overall sample, composed of all treated observations and some matched control observations (*difference-in-difference matching*). In this case, a matching method is implimented in order to select an appropriate control group which minimizes the possible bias due to non random assignments of MST occupations to the municipalities. The matching is performed on the basis of a propensity score measure, estimated for each municipality running the following logit regression:

$$MST_m = \sum_{j=1}^{N} \partial_j X_{jm} + u_m \quad (4)$$

The dependent variable of regression (4) is a dummy variable equal to 1 if the municipaliy has experienced some MST occupations during the period 1988-1995 and 0 otherwise. The set of explanatory variables X_j includes N municipal variables calculated in year 1985. The choice of the covariates to be included in this regressioni is not straighforward. Heckman et al. (1997) show that omitting important variabkles can substantially increase bias in resulting estimates. In order to verify condition (2), I should include all and only those variables that influence simultaneously the selection by MST and the outcome variable. Moreover, notice that the variables included among the covariates should be uneffected by MST, hence they should be either fixed over time or measured before the cycle of MST occupations. In my setting, I should include all and only those variables, calculated in 1985, that could affect both the decision by MST to undertake or not some land occupation in a certain municipality and the evolution of land use between 1985 and 1995. I have included the following municipal level variables: per capita gross product in 1985; average value of agricoltural production in 1985; average profit per hectare in agricultural activity in 1985; average investment per hectare in agricultural activity; average number of bovines per hectare in 1985; fraction of irrigated land on the total used land in 1985; average number of tractors per hectare in 1985; average number of employed per hectare of land in 1985; average number of establishments per hectare of land in 1985; fraction of used land in 1985: Finally, I ave included a dummy variable that takes the value 1 if at least one expropriation by INCRA happened in that municipality between 1978 and 1985 and 0 otherwise. The rationale for including this last explanatory variable is that landless workers may be influenced by the past INCRA activity: indeed previous INCRA expropriations may be and index for the probability to become owners of previously occupied land and hence ot may be a strong incentive for MST to select a certain area to make an occupation.

Once the propensity score of each municipality is estimated, I use the nearest neighbour matching (or one-to-one matching) to generate the control group: for each treated municipality I select for the comparison group one non-treated municipality corresponding to the closest in terms of propensity score. In next section I report the results corresponding to the nearest neighbour matching with no replacement: a certain non-treated municipality can be used only once to match treated municipalities[2]. I also run alternative one-to-one matching methods. In particular, I run a nearest neighbour matching with replacement (where a non treated municipality can be used more than once). Moreover, since the nearest neighbour matching faces the risk of bad matches if the closest neighbour is far away, I impose some alternative maximum propensity score distances (calipers) equal respectively to 0,05, 0,01 and 0,005. Finally, I impose the common support condition, i.e. I drop all observations whose propensity score is smaller than the minimum and larger than the maximum in the opposite group. I run different matching methods combining in all possible ways all these options. Since the results obtained using any of these methods are almost identical to the nearest neighbout matching with no replacement, in the next section I report only the results corresponding to this baseline case.

Both simple difference-in-difference regression and difference-in-difference matching regression are run using three alternative dependent variables. Firt, I use the dependent variable y_1 which represents the fraction of land put in productive use as a proportion of the total geographical area of the municipality. Notice that y_1 includes also the productively used assets occupied by squatters. Therefore, using y_1 as outcome, the possibly significant difference-in-difference effect of MST occupations on the degree of lans use may be due to the fact that part or all the land recently occupied by MST is put in productive use by landless workers. Since I am interested in testing whether or not MST occupations have an effect on the degree of land use of investors through the effect they can produce on their expectations about future returns of land investment, I use alternative outcome variablkes where occupied land are netted out. Therefore I construct two alternative dependent variables. Firts, I generate the outcome variable y_2 by subtracting from the overall productive land the overall agricultural land under an occupation regime and then making the ratio with respect to the entire productive land. Second, I create the outcome variable y_3 subtracting from the overall productive land only a certain fraction of occupied land, corresponding to the fraction of agricultural land put in productive use on the total agricultural land (then, also in this case, I compute the ratio with respetc to the overall geographical area). In other terms, I construct y_3 by assuming that the fraction of occupied land put in productive use is equal to the fraction of the overall productively used land.

4. Empirical Results

Table 1 and 2 report descriptive statistics (means and standard deviations) respectively for municipal data from IPEA in 1985 and 1995 and for data on MST occupations (during the period 1988-1995) and INCRA expropriations (period 1978-1985). A description of how these variables are constructed is presented in the Appendix. From Table 1 one can notice that the degree of land use in 1985, as measured by variables y_1, y_2 and y_3 is on average higher in 1985 than in 1995.

[2] Notice that, using nearest neighbour matching without replacement, the estimates depend on the order in which observations are matched. Hence I need to order randomly the observations before running matching.

Table 1. Descriptive statistics – Municipal Panel Data

Variables	Observations	Mean in 1985	Std.Dev. in 1985	Mean in 1995	Std.Dev. in 1995
y1	2893	0.750	0.305	0.656	0.262
y2	2893	0.720	0.302	0.634	0.261
y3	2893	0.723	0.301	0.636	0.260
Population density	2893	1.041	5.543	1.097	5.977
Per capita GDP	2893	4.328	11.809	3.098	3.286
Average value of agricultural activity	2893	0.743	1.531	0.462	1.477
Number of establishments per he	2893	0.027	0.035	0.021	0.027
Investment in agriculture per he	2893	0.147	0.285	0.055	0.082
Profit in agriculture per he	2893	0.339	1.026	0.161	0.765
Fraction of irrigated land	2893	0.010	0.029	0.019	0.050
Number of employed per he	2893	0.148	0.236	0.139	0.323
Number of tractors per he	2893	0.005	0.161	0.006	0.012
Number of bovines per he	2893	0.466	0.057	0.058	1.372

Y1: Fraction of land (on total geographical area) put in productive use for agricultural activity.
Y2: Fraction of land (on total geographical area) put in productive ise for agricultural activity, net of overall occupied land.
Y3: Fraction of land (on total geographical area) put in productive use for agricultural activity, net of productively used occupied land.

Table 2. Descriptive statistics – MST occupations and INCRA expropriations

Municipalities	MST occupations (1985-1995)	INCRA expropriations (1978-1985)
Number of non-treated municipalities	2793	2865
Number of treated municipalities	144	37

In Table 3 I report the results of logit regression (4). Only few coefficients in the table are significant. This should not be considered as a sign of problem: indeed, since the aim of estimating (4) is to calculate the propensity score and not to model a correct underlying selection mechanism, the empirical specification can include manu correlated variables. Two covariates are significant in predicting the allocation of MST occupations among municipalities. In particular, MST occupations between 1985 and 1995 tend to be associated to municipalities where the degree of land use in 1985 is higher and where INCRA has made at least one land expropriation. This latter result should not surprise since the past activity by INCRA may be interpreted by squatters as a signal for the probability to obtain the formal title on occupied land. The former resulti s instead less expected since it is sensible that landless workers prefer to occupy land in municipalities where the degree of land us eis lower. Since it is plausible that both the intial level of land use and past INCRA expropriations affect the evolution of the degree of land use, there is scope for matching to correct for a possibly relevant selection bias.

Table 3. Determinants of MST occupations (logit estimation)

Explanatory variables	**Determinants of MST occupations**
y1	0,683*** (2.23)
Past INCRA expropriations	1.863***(4.69)
Population Density	0.019 (1.34)
Per capita GDP	-0.019 (-0.86)
Average value of agricultural activity	0.215 (1.01)
Number of establishments per he	-2.838 (-0.87)
Investment in agriculture per he	-0.250 (-0.41)
Profit in agriculture per he of use	-0.251 (-0.97)
Fraction of irrigated land	2.250 (0.62)
Number of employed in agriculture per he	0.286 (0.35)
Number of tractors per he	-29.43 (-1.46)
Number of bovines per he	-0.415 (-1.32)
Pseudo R2	0.025
Observations	2891

NOTES: z-statistica are in parentheses. Significance levels are denoted by ***=1%, **=5%, *=10%.
The dependent variables takes value 1 if at least one MST occupation was made in the municipality between 1985 and 1995 and 0 otherwise.

Table 4 reports the simple difference-in-difference results, obtained from the estimation of regression (3) on the overall sample of observations. The time dummy can capture much variation in the degree of land use betewwn 1985 and 1995. Indeed, as expected, the sign of the coefficient of the time-dummy variable is negative in all the three cases (respectively with dependent variable y_1, y_2 and y_3): this means that during the period 1985-1995 alla muncipalities were subject to a common negative shock on the degree of land use due to factors operating at an aggregate level. This difference-in-difference effect is instead positive and significant respectivelt at 5% for y_1 and 10% for y_2 and y_3. This means that in those municipalities where some (at least one) occupations were made, the reduction in the degree of land use between 1985 and 1995 was significantly lower. This means that MST occupations have positively affected the incentives to put land in productive use. The lower significance levels in difference-in-difference effects for outcome variables y_2 and y_3, as compared with y_1, suggests that part of the positive effect of MST occupations on asset use may be due to a directly productive activity of squatters on the occupied and previously unused land.

While the difference-in-differece method absorbs the possible selection bias due to time invariant factor, the results presented in Table 4 may be bised by time variant factors affecting simultaneously the allocation of MST among municipalities and the change in outcome. In order to minimize this bias as much as possible, I run a difference-in-difference matching estimation. An appropriate control group for treated municipalities is selected on the basis of the propensity score previously estimated using the nearest-neighbour method with no replacement. The difference-in-difference estimation (3) is run on the corresponding matched sample. The results of this estimation are shown in Table 5. One can notice that the difference-in-difference effect still remains positive in all the three cases. Moreover, their significance levels are remarkablt improved: in all the three cases the difference-in-difference effect is positive with significance at the 1% level. This suggests that simple difference-in-difference regression underestimates the impact of MST occupations on change in land use between 1985 and 1995 because of a selection bias. In particular, I suspect that this is due to the fact that landless workers tend to select the municipalities with higher initial degree of land use, which is negatively correleted with the evolution of land use over time. I also check for how these results may change when some variations on the matching method are introduced (common support, replacement, with caliper). Since the results are almost identical, they are not reported.

Table 4. Simple Difference-in-Difference Regression

Effects	**y1**	**y2**	**y3**
Difference-in-difference Effect	0.048** (1.96)	0.045*(1.85)	0.045*(1.87)
Year fixed effect	-0.096*** (-12.46)	-0.088 (-11.67)	-0.089***(-11.84)
Constant	0.750 (141.78)	0.720***(137.11)	0.723***(138.25)
Observations	5751	5751	5751
R2	0.027	0.023	0.024
F stat	79.95 (0.000)	68.07 (0.000)	70.09 (0.000)

NOTES: t-statistics are in parentheses. Significance levels are denoted by ***=1%; **=5%; *=1%.

Table 5. Difference-in-Difference Matching Regression

Effects	**y1**	**y2**	**y3**
Difference-in-difference Effect	0.080*** (2.68))	0.074***(2.47))	0.075***(2.50)
Year fixed effect	-0.135***(-5.26)	-0.127 (-4.89)	-0.128***(-4.97)
Constant	0.757*** (51.05)	0.729***(48.86)	0.733***(49.41)
Observations	576	576	576
R2	0.047	0.040	0.042
F stat	13.93 (0.000)	12.02(0.000)	12.42 (0.000)

NOTES: t-statistics are in parentheses. Significance levels are denoted by ***=1%; **=5%; *=1%.
The method used to match observations is the Nearest Neighbour Propensity Score Matching without replacement.

5. Concluding remarks

In this paper I test the theoretical prediction that property rights security on unused asset (i.e. the expected ability to control an unused asset) negatively affects investment incentives. In particular, I use data on land use in Brazilian municipalities to test whether or not the first cycle of landless workers'occupations (1988-1995) as a proxy for property rights insecurity on unsued land, positively affected the evolution of the degree of land use between 1985 and 1995. The beginning of MST occupations can be considered as a political shock on property rights on unproductive properties whose effect may be heterogenous across municipalities. My hypothesis is that the geographical proximity of MST occupations make more salient for landowners the insecurity of property rigths on their unused asset. Hence I treat this problema s a typical programme evaluation one, comparing the change in land use between 1985 and 1995 respectively in those municipalities that met at least one MST occupation between 1988 and 1995 and in those municipalities that did not (difference-in-difference). Since MST allocations across municipalities may be correlated with some observable or unobservable municipal-level factors affecting changes in outcome, a problem of selection bias exists. The difference-in-difference methos allows to drop out any selection bias on time-invariant factors. Moreover. I use a propensity score matching method in order to minimize any time-variant selection bias on observable variables.

The results of this empirical analysis show that the first cycle of MST land occupations positively affected the degree of land use for agricultural purposes in Brazilian municipalities. These findings corroborate the theoretical prediction that property rights insecurity on unsued assets is invesment-enhancing because it promotes investment in previously unused assets.

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Appendix – Data Description

MST occupations (MST_m): dummy variable which takes value 1 if at least one occupation by Landless Workers' Movement was made in municipality *m* between 1988 and 1995 and 0 otherwise. The database of MST occupations is called *Dataluta MST* and is privately provided by *Commissao Pastoral da Terra* (CPT).

Past INCRA expropriations: a dummy variables which takes value 1 if at least one expropriation by INCRA was made in a certain municipality between 1988 and 1995 and 0 otherwise. The database of INCRA expropriations is publicy provided by INCRA (http://www.incra.gov.br/_htm/serveinf/_htm/areas2.asp).

IPEA data (at municipal level). IPEA data are publicy provided by the Instituto de Pesquisa Economica Aplicada (IPEA) at the web page http://ipeadata.gov.br/ipeaweb.dll/ipeadata?336407953. In particular, the data used in this paper were constructed as follows:

Population density (1985 and 1995): the total population resident in a certain municipality in 1985 (1995) is obtained by linearly interpolating the total population resident in this municipality in 1980 and 1991 (1991 and 2000). Population density is obtained as a ratio between total population and total geographical area (in hectares). Source: Instituto Brasileiro de Geografia e Estatistica (IBGE).

Per capita GDP (1985 and 1995): ratio between total GDP at municipal level in constant 2000 U.S. dollars (in 1985 and 1995) and total population in the corresponding municipality (as constructed before). Source: IBGE.

Average value of agricultural activity (1985 and 1995): ratio between the nominal value of agricultural production (excluded rural industry) in constant 2000 U.S. dollars and the total municipal area assigned to agricultural activiy (in hectares). Source: IBGE.

Number of establishments per hectare (1985 and 1995): ratio between the total number of establishments for agricultural activity and total municipal area assigned to agricultural activity. Source: IBGE.

Investment in agriculture per hectare (1985 and 1995): ratio between total investment realized in the municipality for agricultural activity in constant 2000 U.S. dollars and total geographical area. Source: IBGE.

Profits in agriculture per hectare (1985 and 1995): ratio between total profits in constant 2000 U.S. dollars realized in agricultural activity and total geographical area. Total profits are obtained as difference betewwn total revenue and total expenditure for agricultural activity (both in constant 2000 U.S. dollars). Source: IBGE.

Fraction of irrigated land (1985 and 1995): ratio between the extent of irrigated land (in hectares) and total municipal area assigned to agricultural activity (in hectares). Source: IBGE.

Number of employed per hectare (1985 and 1995): ratio between the total number of people employed in agricultural activity and the total municipal area assigned to agricultural activity (in hectares). Source: IBGE.

Number of tractors per hectare (1985 and 1995): ratio between the total number of tractors employed in agricultural activity and total municipal area assigned to agricultural activity (in hectares). Source: IBGE.

Number of bovines per hectare (1985 and 1995): ratio between total number of bovines employed in agricultural activity and total municipal area assigned to agricultural activity (in hectares). Source: IBGE.

Dependent variable y1 (1985 and 1995): ratio between the total area used productively for agricultural activity (in hectares) and total municipal area assigned to agricultural activity (in hectares). The total area used productively for agricultural activity is obtained as a difference between total municipal area assigned to agricultural activity and the sum of non used productive land and non improvable land (both in hectares). Source: IBGE.

Dependent variable y2 (1985 and 1995): ratio between the total area used productively for agricultural activity net of occupied land (in hectares) and the total municipal area assigned to agricultural activity (in hectare). Total area used productively for agricultural activity net of occupied land is obtained as a difference between total municipal area assigned to agricultural activity and the sum of non used productive land, non improvable land and occupied land. Source: IBGE.

Dependent variable y3 (1985 and 1995): ratio between the total area used productively for agricultural activity net of an estimate of productively used land , and the total municipal area assigned to agricultural activity (in hectares). The estimate of productively used occupied land is made by assuming that the fraction of occupied land put in productive use corresponds to y1. Source: IBGE.