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Estimating the Willingness to Pay for Tenure Security in Brazilian Favelas

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Abstract: This paper examines willingness to pay for housing tenure security in favelas in six Brazilian states, Ceara, Paraiba, Pernambuco and in the north-east, Minas Gerais and Sao Paulo in the south-east, and Rio Grande do Sul in the south, using data from the national household survey (Pesquisa Nacional por Amostra de Domicilios, PNAD) for 2002. We use a quasi-experimental technique by combining the inverse probability weighting estimator proposed by Hirano and Imbens (2001) with an interval regression model to shed light on what might be seen as the effect of title ownership on housing values in Brazilian favelas once selection on observed characteristics are controlled for. We also use state fixed effects to control for idiosyncratic characteristics of states. We interpret the resulting estimate in the same vein as Friedman et al (1988) as an estimate of the willingness to pay for tenure security.

As far as we know, this is the first attempt at estimating willingness to pay for tenure security in Brazilian favelas. Our results suggest that people living in favelas are willing to pay on average an additional 18% of the value of their house for tenure security. However we find that among the poor willingness to pay for tenure security is substantially less, and for some disappears entirely. We suggest that this may be either because households in smaller and longer established favelas may have developed informal mechanisms to ensure their security or because the poor are skeptical about the real security the title represents in that environment. We argue that these estimates are useful for public policy in Brazil, where millions of households live in informal dwellings and interventions involving land regularization do not appear to account for households' willingness to pay. We also simulate the likely cost of a titling programme and the consequences for household debt burdens.

JEL classification: I30; O18; R21

Key words: urban housing; housing demand; tenure security; informal settlements; slums; poverty; welfare

Introduction

Squatting is a widespread form of housing tenure in many developing countries and has attracted much attention from policymakers due to the size and proliferation of informal settlements and concerns about the negative consequences on the welfare of both squatters and residents of neighboring formal settlements. There is much evidence that those without tenure security are more likely to be poor and there is a growing empirical literature on the welfare impacts of formalizing tenure. The *favelas* in Brazil are no exception, and the complexity of problems facing residents of *favelas* has been well documented.[1] An estimated 45 million people live in *favelas* (UN HABITAT, 2010), representing around a quarter of the urban population. The rapid growth in informal housing in Brazil is illustrated in Cavalcanti et al (2004). During the second half of the 1990s, 84% of all new housing units in Brazil were built informally.

There is growing consensus that an approach of formalizing squatter areas may be more effective than forcibly removing people and re-housing them elsewhere. Although there have been some high profile attempts at clearing squatters from land that has been illegally settled, Brazil has introduced a number of policy initiatives aimed at regularizing the occupation of squatter areas. UN-HABITAT (2010) reports that between 2000 and 2010, the living conditions of approximately 10 million Brazilians improved, with slum incidence falling from 31.5 to 26.4 per cent. This is due in part to a falling population growth rate and slowing rural-urban migration,[2] but also reflects a broader commitment to narrowing urban inequalities, including slum upgrading programmes and land tenure regularization, new social housing and urban infrastructure projects; the creation of a Ministry of Cities; and the adoption in 1988 of a constitutional amendment safeguarding citizens' rights to housing. In 2003, for example, the Brazilian government implemented a land titling program *Papel Passado* with the objective of providing land titles to 750,000 households across the country.[3]

Despite the perverse incentives it might create, this approach is seen as more cost-effective than alternatives tried in the past, such as moving people to social housing neighborhoods (see Angel 2000). The potential benefits of a land regularization program that provides land title to households in *favelas* are argued to be significant, ranging from the presence of the state and the supply of local public goods such as garbage collection, electricity, piped water etc. (Hoy and Jimenez, 2006), to greater investment in houses (with consequent health benefits), better access to credit markets and higher adult labour supply (de Soto, 2001, Field, 2005, Field and Kremer, 2003, Galiani and Shargrodsky, 2010, and Moura et al., 2011).

An important finding of Hoy and Jimenez (2006) suggests that higher tenure security raised the demand for local public goods in squatter urban areas of Indonesia. The authors use the theory of clubs, with clubs represented by neighborhoods, cities etc. to argue that land registration could

[1] For a recent profile see IBGE (2010)
[2] See Financial Times 2011
[3] See Moura (2009) for a detailed description.

increase the local supply of public goods. The authors differentiate between formal and informal housing sectors using a stylized fact that informal sector residents have less access to infrastructure provided by the state because they do not pay property tax. Therefore the under-provision of local public goods could lie in a technological constraint.[4]

It could be argued though that in squatter areas the informal rules, such as conduct code that permeate inter-personal relationships, may play a critical role in minimizing asymmetric information problems and make the cooperative behavior pays off. Although the theoretical model does not explicitly account for the issue of informal institutions, the theory of clubs accounts for the asymmetric information problem as it deals with an optimal size of the club.[5]

The most recent contribution to the literature is Field (2005), who used the difference-in-differences approach to estimate the impact of a Peruvian land title programme on home investment in slum areas. The author found a large impact on home improvements financed out of pocket. This result is important as it suggests that land titles tend to mitigate the problem of a qualitative housing deficit in squatter areas even in the absence of a well-functioning credit market.[6] Even though there is widespread consensus that formalization of squatted areas has many benefits, there are remarkably few estimates of how tenure security is valued by residents in squatter areas. Given the efforts of state authorities, not just in Brazil, to transfer legal status on squatted areas, there is a paucity of information on how much squatters value such legal status, or on how much different types of households might be willing to pay. This is surprising given that the World Bank on its own disbursed US$14.3 billion (2001 dollars) in shelter lending between 1975 and 2005 (Buckley and Kalarickal, 2005). The housing economics literature does contain estimates of willingness to pay for a range of housing characteristics, such as building type, size of house, infrastructure, distance from the city centre and key amenities (Daniere, 1994, Long et al, 2009, Yusuf and Koundouri, 2005) but tenure security is generally not included in the set of attributes. Dasgupta and Lall (2006) analyse the impacts of alternative slum upgrading instruments using data for three cities in Brazil, but do not examine land titling. One of the very few studies which does estimate willingness to pay for tenure security in slums is Friedman et al (1988). They estimate that owned squatter dwellings in Manila (where squatter dwellings are defined as those that lack tenure security) would sell for approximately 25% more if they were located in the formal sector.

This paper seeks to fill this lacuna by estimating willingness to pay for tenure security in *favelas* in Brazil. We examine how willingness to pay varies by state and by household income, and what this represents in terms of the household budget of various quantiles of the income distribution.

[4] According to the authors (2006, p. 5-6), "it may be more difficult to arrange for garbage collection in the informal sector if access to streets is relatively poor. The result is that informal sector residents will face a higher cost to LPG [local public goods] provision and so undersupply is the likely outcome".
[5] For a comprehensive discussion about the role played by informal institutions, see North (1990).
[6] Field (2005) analysis suggests that credit was not the main driver for home improvement, although the descriptive statistics point to a problem of credit rationing (excess demand for credit) after regularization.

We observe that unconditional estimates of house values do not appear to vary between titled and untitled properties in the lower half of the house value distribution, but that above the 70th percentile, titled properties have higher values. Our conditional estimates, which take into account differences between characteristics of titled and untitled dwellings and their occupants, reveal that willingness to pay for tenure security is on average around 18% of the value of dwellings, but that this varies substantially across states, possibly reflecting differences in slum characteristics, and dwindles among the poor.

Data

This paper uses the Brazilian Household Surveys (*Pesquisa Nacional por Amostra de Domicilios*, PNAD) of 2002 to estimate willingness to pay for tenure security among informal settlement dwellers. The PNAD surveys are very large, nationally representative surveys, commonly used to estimate living standards in Brazil. They have been conducted on an almost annual basis since the 1980s and the survey design and sampling methodology is broadly similar over time. They contain a wealth of information on household demographics, employment and income sources and on the type of housing that families occupy. In general, the PNAD surveys are not specifically designed to investigate housing in any depth, but the 2002 survey contains information on the estimated value of each dwelling (in interval form), whether or not a land title is held, the size of the dwelling in square meters, number of rooms and bedrooms, whether or not the household has exclusive use of a bathroom (amongst other dwelling characteristics) and whether the dwelling is located within a *favela*.[7]

This data therefore allows us to estimate the effect of holding a title on the value of dwellings, i.e., a proxy for the willingness to pay (WTP) for tenure security. We focus on owned dwellings (rather than rented) for a number of reasons. Friedman et al (1988) find in their study of slums in Manila that renters and owners are very different in terms of observable characteristics, and that renters have a lower willingness to pay for tenure security than owners. The PNAD also does not report if rented dwellings possess a land title. Given that it is not unusual to find households in *favelas* who own their house but not the land it is built on, we focus our analysis on owners.[8]

Table 1 shows that land title ownership is generally very widespread in the Brazilian *favelas*. Overall, more than seventy percent of dwellings possess a land title and in some places this reaches hundred percent. However there are a number of states where titling is less well established and

[7] The PNAD survey identifies *favelas* as a sector type (*tipo de setor*). A *favela* is classified as subnormal agglomerate (*aglomerado subnormal*) which denotes dwellings that have been constructed illegally on public or private land, that do not conform to building regulations and standards and that have limited access to basic public services. See IBGE (2010) for a fuller definition.

[8] In addition, we believe the estimate of the value of the dwelling is likely to be more accurate for those that are owned, given the respondent is the owner rather than a tenant.

so we focus our attention on these states. We apply an *ad hoc* threshold of eighty percent to identify states with a reasonable level of variation in land titling incidence.

In this paper we therefore focus our attention on households living in *favelas* in six Brazilian states, Ceará (CE), Paraíba (PB), Pernambuco (PE), in the north-east, Minas Gerais (MG) and São Paulo (SP) in the south-east, and Rio Grande do Sul (RS) in the south of Brazil.[9] These six states have been chosen because they show sufficient variation in titling ownership that allows us to identify the impact of land title on housing values. It is possible that authorities in states where the size of the slum population is smaller, or more recently established, have found it easier to roll out titling programmes. Some support for this is to be found in Friedman et al's (1988) study of slums in Manila: willingness to pay for tenure security declined with the age of the slum, with dwellings located in slums that had been established for more than thirty years showing no significant difference in value.

There are some important differences in the characteristics of slums between states in Brazil which may help us to understand differences in willingness to pay for tenure security. IBGE (2010) maps the different location and size of slum areas in several cities in Brazil, and shows that slums exhibit substantial variation in terms of their proximity to transport and service infrastructure, amenities and economic centres, contiguity with other slums, as well as in their size. São Paulo for example contains the highest number of individual separate slum areas - over two thousand according to IBGE (2010) and the majority (70%) of slum areas contain fewer than 1000 dwellings. In Recife, Pernambuco, on the other hand, where there are only around 350 slum areas, 65% of these have more than 1000 dwellings.

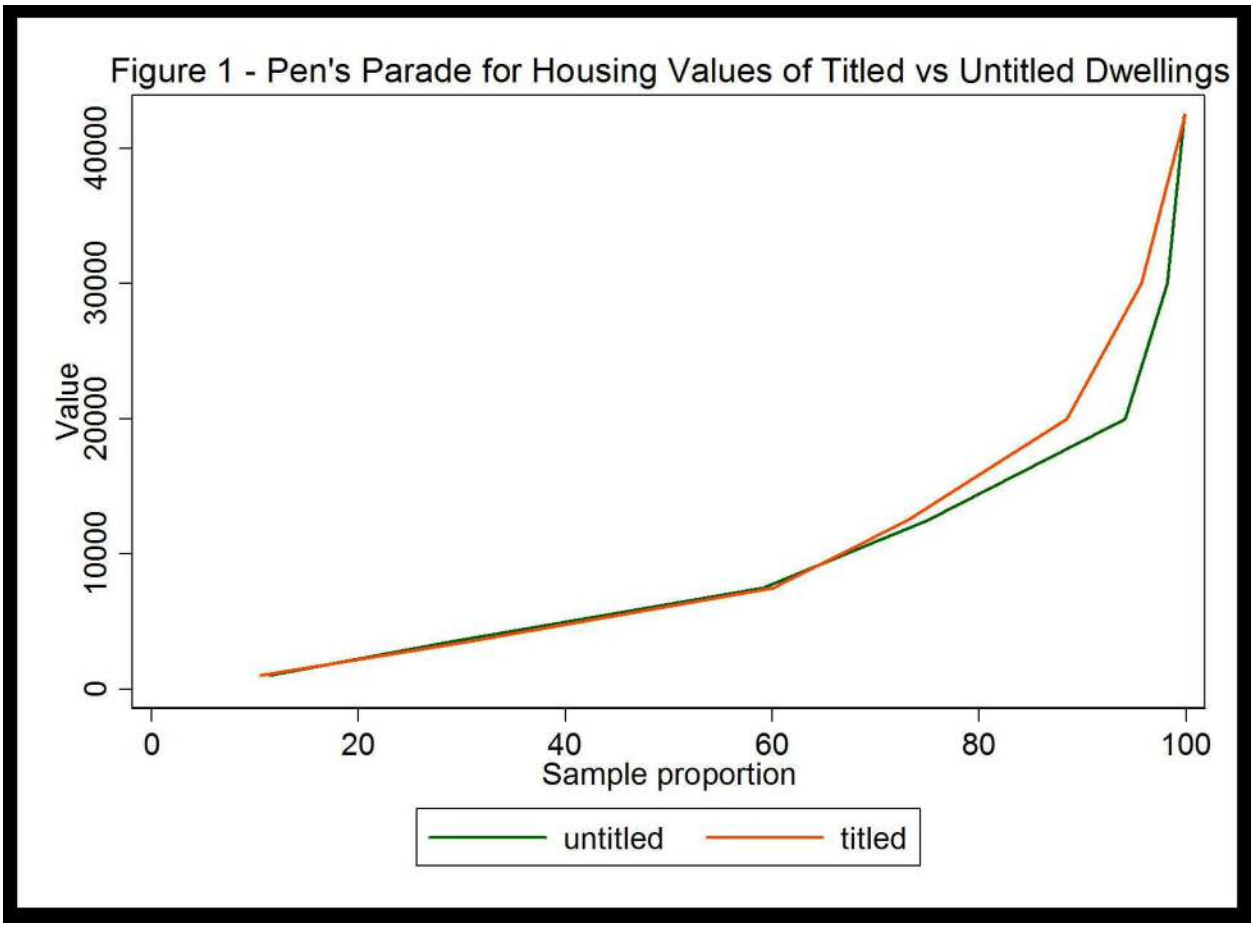
[9] We opted to drop Alagoas due to the small sample size.

Table 1: proportion of titled and untitled owned dwellings in *favelas*, 2002

UF	Untitled (%)	Titled (%)	Sample size (n)
Amazonas	1.45	98.55	344
Para	4.38	95.62	639
Maranhao	0	100	33
Piaui	0.54	99.46	184
Ceara	37.37	62.63	926
Paraiba	36.76	63.24	272
Pernambuco	44.49	55.51	245
Alagoas	55.56	44.44	27
Sergipe	9.09	90.91	99
Bahia	8.91	91.09	359
Minas Gerais	23.35	76.65	942
Espirito Santo	7.79	92.21	154
Rio de Janeiro	3.94	96.06	609
Sao Paulo	64.63	35.37	803
Parana	15.65	84.35	115
Rio Grande do Sul	65.13	34.87	671
Mato Grosso do Sul	0	100	14
Mato Grosso	0	100	46
Goias	0	100	57
Distrito Federal	0	100	31
Total	28.54	71.46	6,570

Source: IBGE, PNAD 2002

Housing value is estimated by the occupant in interval form, in *reais* of 2002: [0, 2000], (2000, 5000], (5000, 10000], (10000, 15000], (15000, 25000], (25000, 35000], (35000, 50000], (50000, 100000], [100000, $+\infty$). Using the mean value of each interval, we show the distribution of housing value by tenure security status in Figure 1.



Source: PNAD 2002.

As shown in figure 1, up to around the 70th percentile of housing value, land title ownership does not seem to explain any difference in housing value between titled and untitled properties. However, for the top 30% of the distribution, tenure security appears to make a difference. From this descriptive exercise we see a positive effect of land title but only at the top of the housing value distribution. This might mean, to the extent that housing value is correlated with household income, that only better off households might be willing to pay for tenure security.

Methodology

Some of the scarce estimates of willingness to pay for housing tenure security are provided by Jimenez (1984) and Friedman et al (1988). In essence, they regress the value of dwellings on a set of covariates including an indicator of tenure security, and interpret the coefficients of tenure security as a measure of the willingness to pay for tenure security. This is an indirect way of getting a sense of the willingness to pay as we are not estimating a housing demand model or able to use contingent valuation methods involving bidding for example (see Miller et al 2011 for a survey on estimating willingness to pay).

We follow Jimenez (1984) and Friedman et al (1988) in spirit in that we also interpret the coefficient of tenure security in a regression of the value of dwellings on a set of covariates as a proxy for the willingness to pay for tenure security. However, our framework draws from the quasi-experimental literature in identifying the causal effect of a treatment T on Y.[10] Using the standard notation of potential outcomes, our problem can be put as follows.

Let Y_{i1} be the value of a dwelling if it is titled and Y_{i0} otherwise. What we would like to observe is the value of a titled dwelling were it not titled. This is the fundamental problem of causal inference (Holland 1986). If the allocation of titles among dwellings in *favelas* was based on a random criterion, then the causal effect of the title on the value of dwellings could be computed as a simple difference of means of the values of titled and untitled dwellings. It is hard to believe though that this is the case.[11]

One way of identifying the causal impact of a variable T on the outcome of interest may be done by comparing the value of titled dwelling (treatment group) with untitled dwelling (comparison group) assuming that the government decision of titling is based on observable characteristics of the dwellings and their occupants. Based on the Brazilian experience of land registration, selection on observables does not seem to be an unrealistic assumption. Moura et al. 2011, for instance, conducted field work in 2007 and 2008 in two communities (*favelas*) in the city of Osasco, one of the largest cities in São Paulo's metropolitan region, and examined the impact of the land regularization programme *Papel Passado* on adult labour supply. Despite the fact that the intervention did not allow for self-selection as all individuals in the community which were assigned to the treatment group did in fact receive a land title, the authors found evidence of unbalancing in some observable characteristics of the treated and control groups, such as the education level of the household head, incidence of informal workers, and monthly household income per capita. This suggests that observable characteristics of the households were in fact involved in the selection process.

Our identification strategy depends on the assumption that the selection on observables is the main source of selection bias underlying the estimation of the impact of land title on housing values. Thus, the framework used in this paper to identify the effect of land title on the housing values depends on two conditions:

(1) The unconfoundedness assumption: $Y_{i1}, Y_{i0} \perp T \mid X$, and

(2) Common support condition: $0 < p(x) < 1$

[10] See Field and Kremer (2003) for a discussion of quasi-experimental and random experiments in the context of housing interventions.

[11] Yusuf and Koundouri (2005) show that, for Indonesia, valuations of willingness to pay for housing characteristics (water services in their study), are over-estimated if selection is ignored. Chay and Greenstone (2005) find that estimates of willingness to pay for air quality (using variations in house prices) are much higher when endogeneity is addressed.

The first condition means that the independence between the potential outcomes and the treatment is satisfied once we condition on a vector of covariates. This assumption is also referred to as the conditional independency assumption (CIA). The second condition just states that the probability of receiving the treatment given the vector of covariates X is strictly positive for both the treatment and comparison groups. This condition assures that the average treatment effect is estimated on units with similar probabilities of receiving the treatment.

We estimate the participation equation (the propensity score) with a logit regression model of title on the whole set of covariates that appear in table A2.[12] We add to that vector three individual controls that are likely to affect the probability of a household receiving the treatment but are unlikely to be affected by the treatment: age of the head of the household, years of schooling of the head, and gender of the head.[13]

With the predicted probability of the logit, we reweight the covariates of treatment and comparison groups using the following algorithm:

$w = T + \frac{(1-T)\hat{ps}}{1-\hat{ps}}$, where T takes value of 1 for titled dwelling and 0 otherwise, and $\hat{ps}$ is the predicted probability of a logit model (the propensity score). Notice that this weight implies multiplying the observables characteristics of titled dwellings by 1 and the untitled dwelling by *ps*/(1-*ps*). This weighting scheme is proposed in Hirano and Imbens (2001) as an alternative to the standard propensity score matching method to identify the average treatment effect on the treatment (ATT) parameter. Therefore, our estimate for the WTP can be seen as the average effect of land title on housing values among those houses that are already titled.

The second step consists in estimating an interval regression model for housing values. The housing value (the dependent variable) is defined in seven intervals, in *reais* of 2002: [0, 2000], (2000, 5000], (5000, 10000], (10000, 15000], (15000, 25000], (25000, 35000], (35000, 50000], (50000, 100000], [100000, +∞). Our model consists of an interval regression of housing value (in natural logs) on the title dummy, *favela*-state dummies (fixed effects) and a dummy for metropolitan region and is fitted via maximum likelihood.[14]

[12] Our logit model specification is similar to that of Friedman et al (1988). One could argue, for instance, that more educated heads are more likely to invest more in their houses and thus the instruction level of the head is not pre-determined as it affects housing values as well. Although this is likely true, the logit estimates show that the coefficients of these three regressors are statistically insignificant. Apart from that, our participation equation include some variables that may not be pre-determined, i.e. at the same time that they explain the selection to the treatment they might be affected by the treatment itself. Since we have just a cross-section we cannot rule out the chance that some of the covariates were already affected by the treatment. Therefore our point estimates should be seen with some cautious as they may not be estimating the average treatment effect of the title on the value of houses.

[13] Imbens and Wooldridge (2008) show that logit model does not need to be consistently estimated because its purpose is to select the common support of the conditional probability distribution.

[14] We do not include other controls because the sample is balanced in the covariates as will be shown below.

(3) $$Y_i = \alpha + \delta Title_i + \sum_{j=1}^{5} \beta_j state_j + \beta_7 MR_i + \varepsilon_i$$, in which Ceará is the base group.

The coefficient on *Title* gives us an unbiased estimate of tenure security on housing values. We also estimate the same model including dummies for income quartiles.

An extension of this approach explores the different proportions of titled households at state level. The approach is therefore the standard difference-in-differences as it makes use of variation in tenure security within and between states.

(4) $$Y_{ik} = \alpha + \delta Title_i + \gamma_k Title_{ik} * state_{ik} + \sum_{j=1}^{5} \beta_j state_{ij} + \beta_7 MR_i + \varepsilon_i$$

where γ is the value of *i-th* dwelling in the *k-th* state, $Title_i$ is a dummy variable that indicates if the *i-th* dwelling is titled, MR_i is a dummy that equals to one if *i-th* dwelling is located in the metropolitan region, and $state_{ik}$ indicates whether the *i-th* dwelling is located in the *k-th* state. Notice that we are fixing the *k-th* state suggesting that we will interact one of the five states with the treatment dummy per time. Thus, we run five separated regressions as eq. (4).

The effect of land title on housing value in, say, São Paulo (k = SP) is given by[15]:

$$E\left[Y \mid Title = 1, SP = 1\right] - E\left[Y \mid Title = 0, SP = 1\right] = \delta + \gamma_{SP}$$

Notice that this first difference corresponds to one within-state variation. Analogously, the within-state variation in the base group (Ceará, C) is given by:

$$E\left[Y \mid Title = 1, C = 1\right] - E\left[Y \mid Title = 0, C = 1\right] = \delta$$

Thus, the double difference estimator is given by the between-state variation, i.e.:

$$\left\{E\left[Y \mid Title = 1, SP = 1\right] - E\left[Y \mid Title = 0, SP = 1\right]\right\} -$$
$$\left\{E\left[Y \mid Title = 1, C = 1\right] - E\left[Y \mid Title = 0, C = 1\right]\right\} = \gamma_{SP}$$

Finally, we check whether the "willingness to pay" for tenure security varies between-states and with income level of households. For the sake of illustration, assume that we are interested in the willingness to pay of households under and above the monthly household income distribution. We estimate the following model:

$$Y_{ij} = \alpha + \delta Title_i + \sum_{j=1}^{5} \beta_j state_{ij} + \tau 1\left(hhincome \le median\right) + \gamma_k Title_i * state_{ik} +$$
$$\phi_k state_{ik} * 1\left(hhincome \le median\right) + \rho_k Title_i * state_{ik} * 1\left(hhincome \le median\right) + \beta_7 MR_i + \varepsilon_{ij}$$

[15] For the sake of simplicity the income and MR coefficients are not included in this exercise.

where $1(hhincome \leq median)$ is an indicator function that takes the value of 1 when the household income is under the median. Again, we run five separated regressions as we interact one state per time. The effect in the state of São Paulo (SP) would be given by:

$$E[Y \mid Title=1, SP=1, income_{med}=1] - E[Y \mid Title=0, SP=1, income_{med}=1] = \delta + \gamma_{SP} + \rho_{SP}$$
$$E[Y \mid Title=1, SP=1, income_{med}=0] - E[Y \mid Title=0, SP=1, income_{med}=0] = \delta$$

Subtracting these two differences we get $\rho_{SP} + \gamma_{SP}$ which gives us the impact of land title in SP among households with income under the median compared to households with income above the median. Doing the same for the base group we get

$$E[Y \mid Title=1, C=1, income_{med}=1] - E[Y \mid Title=0, C=1, income_{med}=1] = \delta + \gamma_{C}$$
$$E[Y \mid Title=1, C=1, income_{med}=0] - E[Y \mid Title=0, C=1, income_{med}=0] = \delta$$

Subtracting these two differences we get γ_C, which is the effect of land title on the value of dwellings among households from Ceará with income under the median compared to households from the same state but with income above the median.

Thus, the triple difference estimator is given by ρ. Notice that we are comparing households with similar household income level from different states. The coefficient of the interaction term ρ provides an estimate of the "willingness to pay" for tenure security of households from São Paulo with income under the median compared to households from the same income group from Ceará.

Results

Table A1 shows the distributions of covariates used in the logit model[16] before and after reweighting. Comparing with the unweighted sample it is clear that the weighting function has resulted in distributions of covariates of titled and untitled dwellings that are very similar. In fact, the Hotelling test cannot reject the null of equal means between the two weighted distributions of covariates.[17] Figure A1 illustrates the overlap (common support) condition by plotting the kernel density distributions of the propensity scores for titled and untitled dwelling after reweighting the covariates. We present our logit model estimates in Table A2 for reference. It is interesting to note that the coefficients of the household head characteristics are not statistically significant. This result provides an extra support to our identification strategy as titling ownership seems to be explained exclusively by observables characteristics of dwellings.

The figures A2 and A3 support even further this assumption. Figure A2 compares the household income distribution of titled and untitled households in our sample. Based on the Pen's Parade,

[16] We present our logit model estimates in Table A2 for reference.
[17] F(36,3397) = 0.8113.

there is no first order stochastic dominance as both distributions overlap most of the time. However, figure A3 shows that, except in the very lower end of distributions, the income distribution of untitled households dominates in second order the income distribution of titled households. This suggests that land titling programmes might prioritise households at the bottom of income distribution, an observation also verified by Moura et al (2011) in Osaco using data from a field work conducted in 2007.

Table 2 shows the results of the interval regression for the original, unweighted sample, and the weighted sample, i.e. eq 1. Although qualitatively similar, the magnitude of the point estimate of the effect of title is very different, approximately 25% lower in the weighted sample, illustrating the hazard of not accounting for the potential endogeneity between titling and housing value.

Table 2 – Estimates of the Willingness to Pay for Tenure Security in the Brazilian Favelas

	Original Sample	Weighted Sample
Title (WTP)	0.22***	0.17***
	(0.036)	(0.037)
Paraiba	0.065	0.083
	(0.068)	(0.068)
Pernambuco	0.16**	0.084
	(0.079)	(0.076)
Minas Gerais	0.29***	0.19***
	(0.048)	(0.053)
São Paulo	0.68***	0.64***
	(0.046)	(0.052)
Rio Grande do Sul	0.39***	0.25***
	(0.065)	(0.079)
Metropolitan Region	0.30***	0.41***
	(0.052)	(0.051)
Constant	8.22***	8.25***
	(0.060)	(0.061)
Sigma	-0.11***	-0.14***
	(-7.26)	(-8.55)
Observations	3411	3411

Note: ***, **, * Significant at 1%, 5% and 10% respectively. Robust standard errors in parentheses.

Looking at the second column of results, one observes that, on average, titled dwellings are valued 18.5 percent more than untitled dwellings that share very similar observables characteristics.[18] We interpret these coefficients as an indirect estimate of the willingness to pay for tenure security in *favelas*. Thus, on average, a household living in a titled dwelling would be willing to pay up to 18.5 percent more for it than if it did not have tenure security. Friedman et al (1988) interpret this

[18] The correct magnitude of the title coefficient is given by: [exp(0.17)-1].100 = 18.5%.

as a risk premium – the amount a resident, on average, is willing to pay to avoid the risk of eviction.

The following table presents estimates for an interactive model where we interact title with state and then with the income indicator function. The "state-title" interactions show that titled dwellings in *favelas* earn a premium in almost all states: in Pernambuco for example, titled dwellings are valued 73%[19] higher than untitled dwellings. However there is some variation across states: in São Paulo, the premium for titled dwellings is only 28%. These variations in willingness to pay may reflect the age and/or size of slums in each state. In São Paulo, home to some of the oldest slums in Brazil but which IBGE (2010) describes as relatively small, we observe lower willingness to pay. This may explain why São Paulo has one of the lowest proportions of titled slum dwellings. One possible underlying explanation may be due to the existence of well-established informal property rights that are easier to enforce in smaller and older slums. Pernambuco, where titling incidence is 20 percentage points higher than in São Paulo, and willingness to pay for security is almost three times that of São Paulo, has much larger slums than in São Paulo (IBGE, 2010).

Table 3 - Estimates of the Willingness to Pay for Tenure Security in the Brazilian *Favelas*

[19] 100*[exp(0.55)-1]=73.3%

Heterogeneous Effect by State Level – Weighted Sample

	Housing Values PB	Housing Values PE	Housing Values MG	Housing Values SP	Housing Values RS
Title	0.16***	0.16***	0.12***	0.065	0.19***
	(0.040)	(0.039)	(0.041)	(0.046)	(0.039)
PB*Title	0.11				
	(0.086)				
PE*Title		0.17			
		(0.14)			
MG*Title			0.18**		
			(0.093)		
SP*Title				0.29***	
				(0.079)	
RS*Title					-0.36***
					(0.14)
Paraiba	0.026	0.080	0.087	0.068	0.093
	(0.082)	(0.068)	(0.067)	(0.068)	(0.068)
Pernambuco	0.084	-0.0038	0.083	0.077	0.087
	(0.076)	(0.092)	(0.076)	(0.076)	(0.076)
Minas Gerais	0.20***	0.19***	0.078	0.20***	0.19***
	(0.053)	(0.054)	(0.088)	(0.053)	(0.054)
Sao Paulo	0.63***	0.63***	0.62***	0.52***	0.64***
	(0.052)	(0.052)	(0.052)	(0.066)	(0.052)
Rio Grande do Sul	0.25***	0.25***	0.24***	0.23***	0.39***
	(0.079)	(0.079)	(0.079)	(0.079)	(0.10)
Metropolitan Region	0.41***	0.41***	0.42***	0.40***	0.42***
	(0.051)	(0.052)	(0.051)	(0.052)	(0.051)
Constant	8.25***	8.25***	8.27***	8.32***	8.22***
	(0.062)	(0.063)	(0.062)	(0.066)	(0.062)
Ln Sigma	-0.14***	-0.14***	-0.14***	-0.14***	-0.14***
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Observations	3411	3411	3411	3411	3411

Note: ***, **, * Significant at 1%, 5% and 10% respectively. Robust standard errors in parentheses.

The coefficient of land title is positive and significant in four of the regressions, and suggests that titled dwellings in Ceará (base group) are worth from about 13 to 21 percent more than untitled ones.

The coefficients of the interaction terms are statistically significant in three of the regressions, have the same magnitude for MG and SP but are negative for RS. In MG and in SP a titled dwelling is estimated to be worth about 27% more than a titled dwelling in the base group. On the other hand, in RS a titled dwelling worth about 37% less than a titled one in CE.

The table allows us to estimate the impact of tenure security in each of the five states. We only

need to sum the coefficients of the dummy "Title" with the coefficients of interaction terms and then test the null hypothesis that the sum is different from zero. The table below shows the sum of the coefficients and the F-test for the hypothesis tests.

Table 4 – Impact of Tenure Security within States

	δ+ϒ	Exp(δ+ϒ)-1	F-test
PB	0.27	0.31	12***
PE	0.33	0.39	6.28**
MG	0.31	0.36	13.2***
SP	0.30	0.35	30***
RS	-0.17	-0.16	1.56

Note: ***, ** Statistically significant at 1% and 5% respectively.

Except in Rio Grande do Sul, land title has a positive effect on housing values. In all cases the magnitude surpasses 30%. In PE the impact approaches 40%. This result has a direct implication for public policy as it suggests that land title programmes can potentially affect the wealth distribution of the economy by reducing wealth inequality as tenure security increases the value of assets of low-income households. The positive impact goes even further if second and third order effects are taken into account, such as access to credit, improvement in health of children, increase of labour supply of adults, reduction of children's labour supply, and local supply of public goods etc.

The next table shows the results of the model with interaction terms between state and a dummy variable that takes value of 1 if the monthly household income is below the median.

Table 5 - Estimate of the Willingness to Pay for Tenure Security in the Brazilian *Favelas*
Heterogeneous Effects by State and Income Level – Weighted Sample

	Housing Value PB	Housing Value PE	Housing Value MG	Housing Value SP	Housing Value RS
Title	0.24***	0.21***	0.13**	0.0038	0.26***
	(0.052)	(0.051)	(0.059)	(0.060)	(0.052)
1(hhincome)	-0.68***	-0.67***	-0.60***	-0.99***	-0.63***
	(0.058)	(0.056)	(0.061)	(0.064)	(0.058)
Title*1(hhincome)	-0.21***	-0.15**	-0.100	0.080	-0.20***
	(0.073)	(0.070)	(0.078)	(0.077)	(0.071)
PB*Title	-0.15				
	(0.12)				
PB*Title*1(hhincome)	0.16				
	(0.11)				
PB*1(hhincome)	0.36**				
	(0.16)				
PE*Title		0.28			
		(0.24)			
PE*Title*1(hhincome)		0.059			
		(0.21)			
PE*1(hhincome)		-0.50*			
		(0.28)			
MG*Title			0.29***		
			(0.11)		
MG*Title*1(hhincome)			-0.36***		
			(0.14)		
MG*1(hhincome)			-0.029		
			(0.16)		
SP*Title				0.35***	
				(0.098)	
SP*Title*1(hhincome)				0.62***	
				(0.11)	
SP*1(hhincome)				-0.17	
				(0.16)	
RS*Title					-0.41**
					(0.17)
RS*Title*1(hhincome)					-0.44***
					(0.16)
RS*1(hhincome)					0.18
					(0.23)
PB	-0.039	0.14**	0.14**	0.16**	0.15**
	(0.098)	(0.064)	(0.063)	(0.063)	(0.064)
PE	0.099	0.056	0.10	0.13*	0.10
	(0.068)	(0.19)	(0.068)	(0.068)	(0.068)
MG	0.12***	0.12***	0.15	0.11**	0.12***
	(0.046)	(0.046)	(0.10)	(0.045)	(0.046)
SP	0.39***	0.41***	0.42***	0.018	0.42***
	(0.049)	(0.049)	(0.049)	(0.082)	(0.049)
RS	0.069	0.079	0.089	0.014	0.39***
	(0.070)	(0.070)	(0.070)	(0.066)	(0.12)

MR	0.36***	0.37***	0.38***	0.35***	0.39***
	(0.048)	(0.049)	(0.047)	(0.046)	(0.048)
Constant	8.76***	8.74***	8.72***	8.99***	8.69***
	(0.063)	(0.063)	(0.065)	(0.068)	(0.066)
Ln Sigma	-0.24***	-0.24***	-0.25***	-0.25***	-0.24***
	(0.017)	(0.017)	(0.017)	(0.016)	(0.017)
Observations	3411	3411	3411	3411	3411

Note: ***, **, * Significant at 1%, 5% and 10% respectively. Robust standard errors in parentheses.

The coefficient of land title is positive and statistically significant in four regressions. In the difference-in-differences framework, this coefficient represents the difference in level of housing values, and it suggests that titled dwellings are worth more than untitled[20]. The triple difference coefficient is statistically significant in three regressions and positive only in the state of SP. These results suggest that only households with monthly income higher than the median are willing to pay for tenure security. In those cases, households at the upper end of household monthly income distribution are willing to pay 30 percent more for tenure security in MG and 36 percent in RS. Conversely though in SP, the poorest are willing to pay about 86 percent more for tenure security than the better off. This might be because the poorest in the *favelas* of SP are more vulnerable or more averse to the risk of eviction than better off households, relative to other states. This may reflect differences in housing markets and/or responses to informal dwellings in different cities across Brazil.

It is interesting to note that the coefficient for the interaction term between title and the income indicator function is negative and statistically significant in three regressions, suggesting that the housing values of titled poor are worth less than those of the untitled poor.[21] This is consistent with the second order stochastic dominance analysis and suggests that, except for the case of SP, land regularization programmes such as the Brazilian *Papel Passado* might be a pro-poor intervention as the poor would be less able to afford the costs of registration. The estimates also show that in some cases, such as in SP, the poor might be willing to pay to reduce the risk of eviction. Therefore, in the case the state faces a budget constraint that prevents it from increasing the coverage of the

[20] One of the key assumptions in the difference-in-difference approach is that the treatment and comparison groups may differ in level but not in difference. Put differently, the two groups would evolve in parallel in the absence of the treatment.

[21] An alternative interpretation could be between titled poor with titled non-poor.

land titling programme across the *favelas*, estimates of willingness to pay for tenure security could be very helpful to guide governments to minimise the costs of the intervention and target the most needed households.

Simulating the consequences on household debt ratio of housing title loans.

In order to interpret these results in monetary terms we consider the mean value of each interval of the housing value variable and estimate the WTP of households from the four states for which we found statistically significant coefficients in table 3. The calculation is based on Table 4 and performed as following:

1. In SP, the WTP is 35 percent
2. We apply this 35% to the mean value of dwellings to get the variation in housing value caused by tenure security
3. We calculate the future value applying 0.41% of monthly interest rate considering a period of three years. We then consider a hypothetical loan where households finance tenure security acquisition in three years, and so compute 36 fixed installments.[22] We divide the value of an installment by the median household income to compute the debt ratio of financed households. This is illustrated in Table 6. We also consider how the acquisition of tenure security might be financed.

[22] The Brazilian federal government, through the public financial institution Caixa Economica Federal, put in place a housing programme called *Minha Casa Minha Vida* with the purpose of tackling the issue of quantitative housing deficit in Brazil by financing housing acquisition for low-income households. The lowest effective interest rate for housing acquisition under this programme is about 5% per year (about 0.41% per month). We use that interest rate in the simulation as the income level of households in our sample would make them eligible to it. This is the interest rate set for households with total monthly gross income between 465 and 2,325 reais. More detailed information about this programme can be accessed in the link: http://www.caixa.gov.br/habitacao/aquisicao_residencial/novo/carta_cred_fgts/index.asp.

Table 6 – Simulating How Much a Household Could be Charged for Tenure Security

	Exp(ρ+ϒ)-1	Mean Housing Values	WTP: Mean Housing Values*[Exp(.)-1]	FV of WTP: WTP*[(1.0041)^36]	Installments: FV/36	Median Household Income	Debt Ratio
PB	0.31	5918.8	1834.83	2126.01	59.06	300	19.69%
PE*	0.39	7071.43	2757.86	3195.53	88.76	485	18.30%
MG*	0.36	7660.38	2757.74	3195.39	88.76	480	18.49%
SP	0.35	12361.54	4326.54	5013.16	139.25	761.5	18.29%

Source: Own calculation based on the PNAD of 2002 and Table 4.

As we saw in Table 6, willingness to pay is higher in SP and RS. The last column of the table shows the debt ratio of households with income equals to the median of monthly household income distribution. Despite the differences in willingness to pay and the median value of household income distribution, the debt ratios are very similar and are below 20 percent of the household income. Considering that these are an approximation of the household's reservation price and that the government's marginal cost of provision of tenure security is relatively small, there is significant scope for welfare enhancing. It is worth mentioning that a debt ratio of about 20 percent is very similar to the weight of rents in the household budget.

Based on some available estimates for the impact of land title on outcomes other than housing values it is very likely that the social benefits of this sort of intervention surpass the private ones. The literature has found some spillover effects of land regularisation programmes such as higher adult labour supply (Field 2007 and Moura et al. 2011), higher access to credit (Piza and Mouro, 2011) and the provision of public good services (Jimenez et al 2006), child health (Galiani and Schargrodsky, 2004).

Conclusions

We use a quasi-experimental approach and data from the Brazilian PNAD of 2002 to estimate willingness to pay for tenure security in *favelas* in six Brazilian states. We believe these are the first estimates of willingness to pay for urban land titles in Brazil and contribute to the very small body of evidence on how much slum dwellers value tenure security. We show that the impact of land title on housing values seems to be biased upwards when selection on observed characteristics is not accounted for. Controlling for the non-random selection of title status, we estimate that titled dwellings are valued at around 18% more than untitled dwellings, and we interpret this as a willingness to pay for tenure security.

We also find however that willingness to pay varies quite substantially by state, and household income level. In states where titling is already more prevalent, willingness to pay appears to be higher. We argue that this may be because these states contain larger, more densely populated slums that may in turn be more isolated from services and amenities. It is plausible to expect that residents in these areas may be willing to pay more to obtain a land title, given that titling is usually provided as part of a bundle of slum upgrading interventions. In states where titling is less common, such as São Paulo where slums are smaller and less populated, we observe that slum residents exhibit much lower willingness to pay, and the poor in these states have a negative willingness to pay, that is they would require compensation in order to accept a land title. This may reflect the age of slums in these areas, which although they have no legal status *de jure*, they have come to acquire a *de facto* legal status. In addition, it is plausible that smaller slums might engage more successfully in collective action for informal provision of local public goods such as water and electricity, and security.

The results also suggest that WTP varies with households' income level. Households with monthly income higher than the median seem to be willing to pay for tenure security, in particular in MG and RS. In SP, on the other hand, the poorer households seem willing to pay more for tenure security than the better off. We argue that this might be because the poorest in the *favelas* of SP are more vulnerable or more averse to the risk of eviction than better off households, relative to other states. Selection on unobserved characteristics cannot be ruled out though.

Government initiatives to upgrade slums that aim to recoup at least some of the costs of upgrading need to be cogniscant of these variations in willingness to pay. A titling program in a slum that is well established and has functioning local informal institutions is unlikely to be valued very highly. Efforts to upgrade slums via titling might be better focused on larger or faster growing slums where the benefits of such a programme are likely to be greater.

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Appendix

Table A1 – Descriptive Statistics for Titled and Untitled Dwellings.

	Unweighted Sample				Weighted Sample			
	Untitled		Titled		Untitled		Titled	
Variable	Obs	Mean	Obs	Mean	Obs	Mean	Obs	Mean
Wall 1 (= 1 if cement)	1504	0.88	1930	0.93	1504	0.92	1930	0.93
Wall 2 (= 1 if processed wood)	1504	0.08	1930	0.04	1504	0.05	1930	0.04
Wall 3 (= 1 if *taipa*)	1504	0.02	1930	0.02	1504	0.02	1930	0.02
Roof 1 (= 1 if *telha*)	1504	0.78	1930	0.75	1504	0.77	1930	0.75
Roof 2 (= 1 if concrete)	1504	0.20	1930	0.24	1504	0.22	1930	0.24
# Rooms	1504	4.82	1930	5.06	1504	4.89	1930	5.06
# Bedrooms	1504	2.07	1930	2.16	1504	2.10	1930	2.16
Garage (=1 if yes)	1504	0.20	1930	0.23	1504	0.22	1930	0.23
Size 1 (up to 20 m^2)	1504	0.13	1930	0.10	1504	0.10	1930	0.10
Size 2 (21 to 50 m^2)	1504	0.20	1930	0.22	1504	0.24	1930	0.22
Size 3 (51 to 80 m^2)	1504	0.30	1930	0.31	1504	0.31	1930	0.31
Size 4 (81 to 110 m^2)	1504	0.15	1930	0.13	1504	0.13	1930	0.13
Size 5 (111 to 140 m^2)	1504	0.17	1930	0.13	1504	0.13	1930	0.13
Size 6 (141 to 200 m^2)	1504	0.04	1930	0.06	1504	0.05	1930	0.06
Size 7 (more than 400 m^2)	1504	0.01	1930	0.03	1504	0.03	1930	0.03
Water procedure 1 (= 1 if general network)	1504	0.94	1930	0.93	1504	0.94	1930	0.93
Water 2 (= 1 if well water)	1504	0.01	1930	0.01	1504	0.00	1930	0.01
Bath (= 1 if the dwelling has at least one)	1504	0.94	1930	0.95	1504	0.95	1930	0.95
Exclusive bath (=1 if the bath is exclusive for the dwelling)	1504	0.91	1930	0.93	1504	0.93	1930	0.93
Sewage 1 (= 1 if the dwelling has a network collector)	1504	0.43	1930	0.52	1504	0.52	1930	0.52
Sewage 2 (= 1 if the dwelling has septic tank)	1504	0.14	1930	0.11	1504	0.10	1930	0.11
Sewage 3 (= 1 if it goes straight to the river or ocean)	1504	0.13	1930	0.11	1504	0.10	1930	0.11
Garbage 1 (= 1 if directly collected)	1504	0.75	1930	0.74	1504	0.76	1930	0.74
Garbage 2 (= 1 if indirectly collected)	1504	0.21	1930	0.19	1504	0.18	1930	0.19
Electricity (= 1 if yes)	1504	1.00	1930	1.00	1504	1.00	1930	1.00
Stove (= 1 it has at least two burners)	1504	0.99	1930	0.98	1504	0.98	1930	0.98
Filter (= 1 if there is a filter in the dwelling)	1504	0.41	1930	0.55	1504	0.57	1930	0.55
Radio (= 1 if there is a radio in the dwelling)	1504	0.90	1930	0.91	1504	0.90	1930	0.91
TV (=1 if there is a color TV in the dwelling)	1504	0.90	1930	0.89	1504	0.88	1930	0.89
Refrigerator (= 1 if there is refrigerator)	1504	0.87	1930	0.87	1504	0.85	1930	0.87
Freezer (=1 if there is freezer)	1504	0.07	1930	0.07	1504	0.08	1930	0.07
Wash machine (=1 if there is wash machine)	1504	0.28	1930	0.18	1504	0.18	1930	0.18
MR (=1 metropolitan region)	1504	0.81	1930	0.79	1504	0.79	1930	0.79

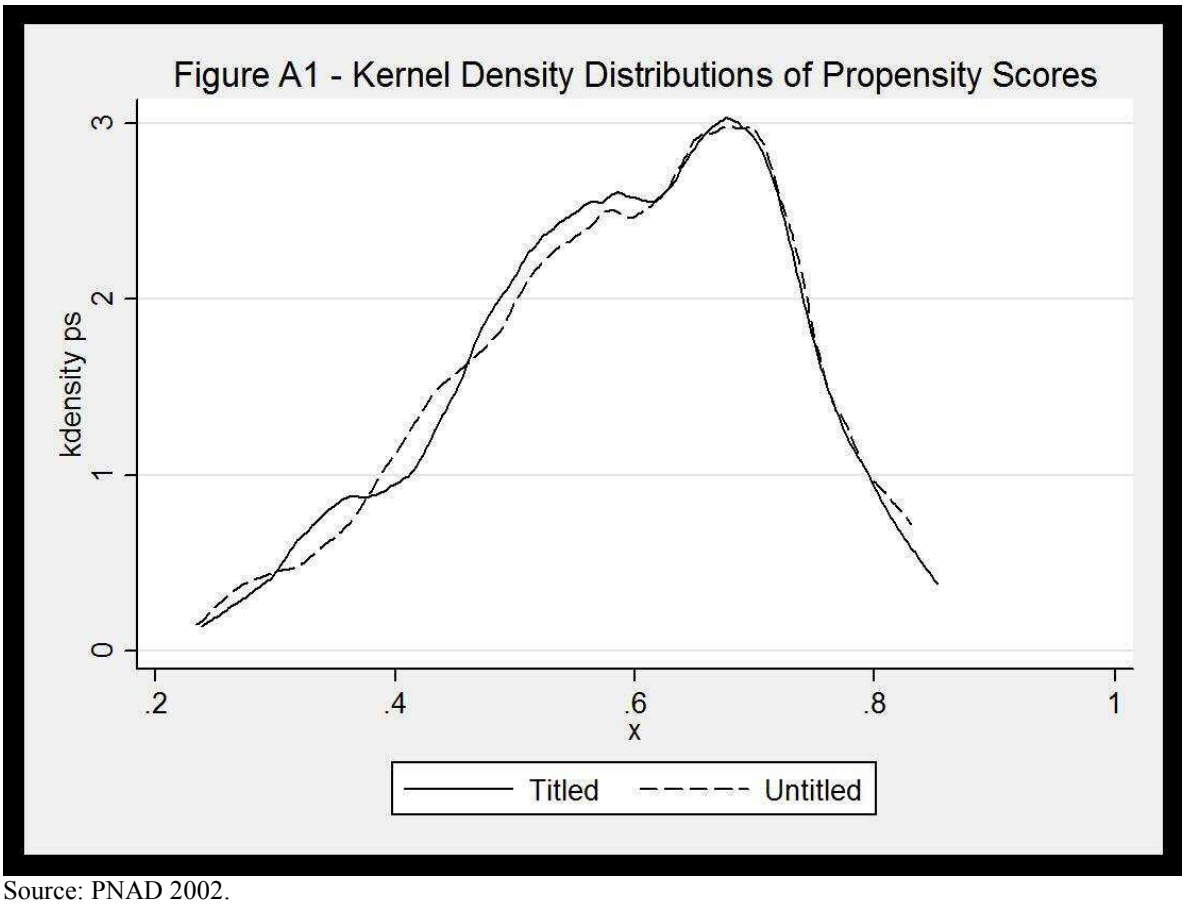
Source: PNAD 2002.

Table A2: Logit estimates for possession of a land title

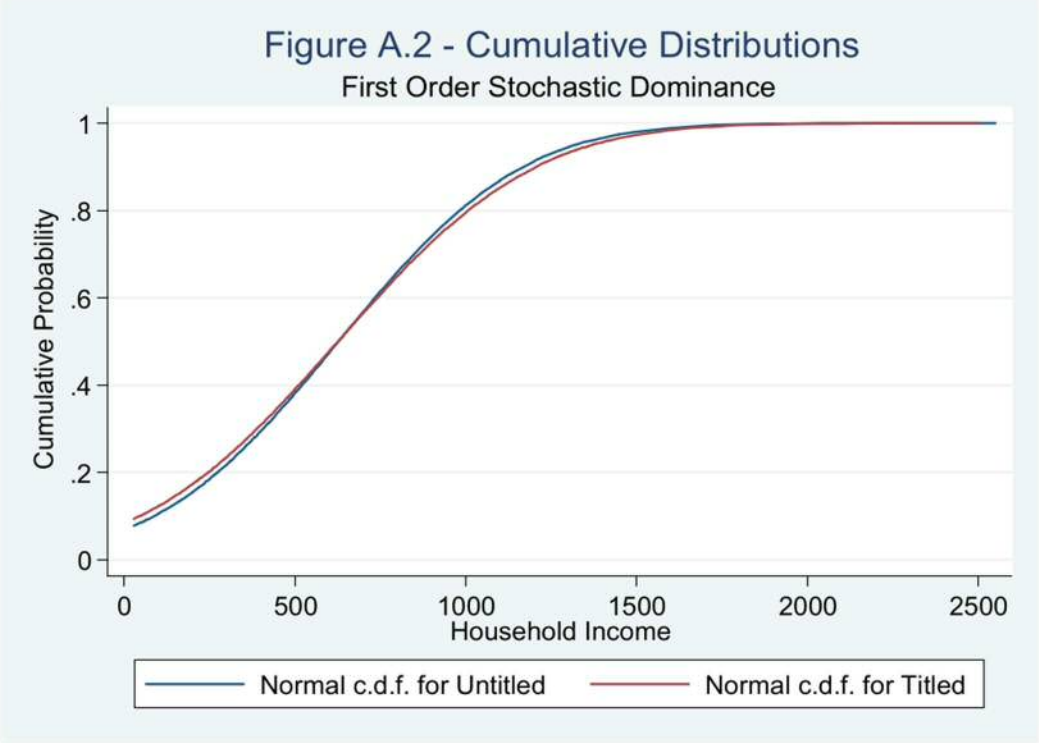
Wall 1 (= 1 if cement)	1.38***
	(0.34)
Wall 2 (= 1 if processed wood)	1.09**
	(0.36)
Wall 3 (= 1 if *taipa*)	1.01*
	(0.45)
Roof 1 (= 1 if telha)	0.29
	(0.36)
Roof 2 (= 1 if concrete)	0.44
	(0.37)
# Rooms	0.013
	(0.031)
# Bedrooms	0.073
	(0.058)
Garage (=1 if yes)	0.46***
	(0.11)
Size 1 (up to 20 m^2)	-1.69**
	(0.62)
Size 2 (21 to 50 m^2)	-1.49*
	(0.61)
Size 3 (51 to 80 m^2)	-1.61**
	(0.60)
Size 4 (81 to 110 m^2)	-1.93**
	(0.60)
Size 5 (111 to 140 m^2)	-2.07***
	(0.59)
Size 6 (141 to 200 m^2)	-1.39*
	(0.61)
Size 7 (more than 400 m^2)	-0.77
	(0.63)
Water procedure 1 (= 1 if general network)	-0.27
	(0.17)
Water 2 (= 1 if well water)	-0.45
	(0.49)
Bath (= 1 if the dwelling has at least one)	0.10
	(0.30)
Exclusive bath (=1 if the bath is exclusive for the dwelling)	0.28
	(0.23)
Sewage 1 (= 1 if the dwelling has a network collector)	0.37***
	(0.10)
Sewage 2 (= 1 if the dwelling has septic tank)	0.18
	(0.14)
Sewage 3 (= 1 if it goes straight to the river or ocean)	-0.16
	(0.13)
Garbage 1 (= 1 if directly collected)	-0.79***
	(0.19)
Garbage 2 (= 1 if indirectly collected)	-0.77***
	(0.20)
Electricity (= 1 if yes)	0.80
	(0.78)
Stove (= 1 it has at least two burns)	-1.43***
	(0.40)
Filter (= 1 if there is a filter in the dwelling)	0.46***

	(0.077)
Radio (= 1 if there is a radio in the dwelling)	0.097
	(0.13)
TV (=1 if there is a color TV in the dwelling)	-0.12
	(0.13)
Refrigerator (= 1 if there is refrigerator)	0.078
	(0.13)
Freezer (=1 if there is freezer)	0.24
	(0.15)
Wash machine (=1 if there is wash machine)	-0.87***
	(0.10)
MR (=1 metropolitan region)	-0.23*
	(0.100)
Male head	0.056
	(0.079)
Years of schooling of the head	-0.00089
	(0.0093)
Age of the head	0.0014
	(0.0028)
Constant	1.04
	(1.13)
N	3434

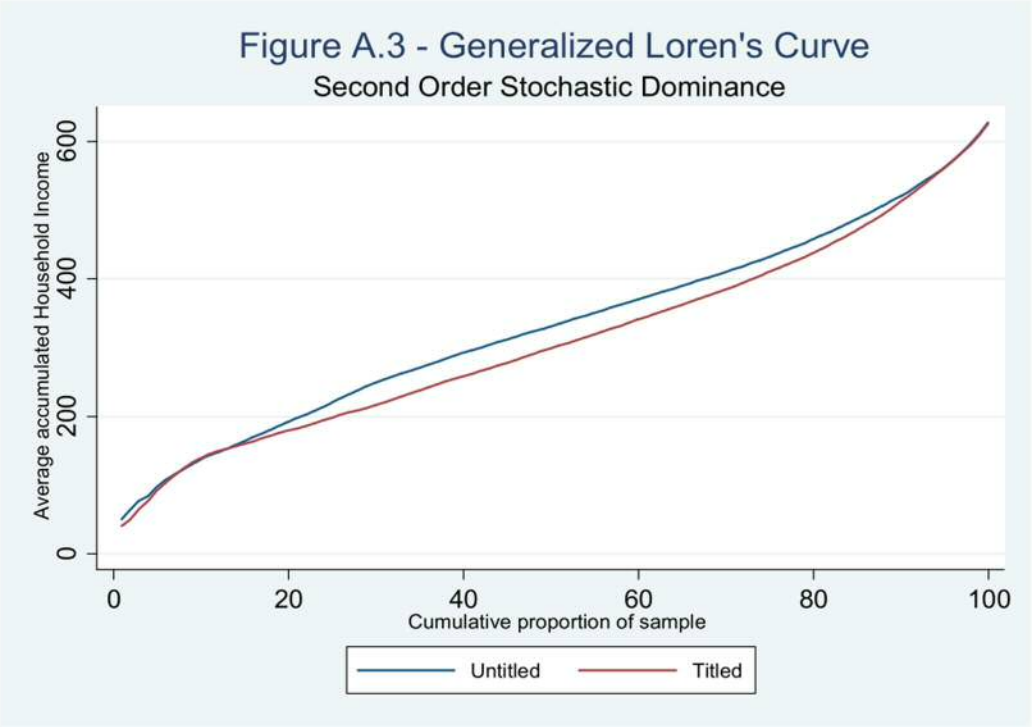
Source: PNAD 2002.



Source: PNAD 2002.



Source: PNAD 2002.



Source: PNAD 2002.