Investment effects of land titling and registration: evidence from Nicaragua

Juan R. de Laiglesia*
London School of Economics

October 2003

Abstract

This paper analyzes the importance of legal property documents in providing tenure security, enhancing agricultural investment incentives and easing access to credit. While theory predicts that better property rights on land can increase investment through increased security, enhanced trade opportunities and increased collateral value of land, the presence and size of these effects depend crucially on whether those rights are properly enforced. In Nicaragua, a troubled history of land expropriation and invasion has undermined the credibility of the property regime. The effects of a land titling and regularization program are studied to identify the effects of legal documents. In line with legal dispositions, registration is found to increase the probability of carrying out land attached investments by 5%.

1 Introduction

Institutions and their evolution play a key role in shaping the environment in which economic agents evolve, and because property relations are the backbone of the economic structure of society (Bardhan 1989), the codification and enforcement of property rights is considered as an important precondition for economic growth and development. In agrarian societies land is not only an essential factor of production and thereby the main means for households to generate a livelihood, it is often also the main means of wealth accumulation and transfer. As such, it determines not only a household's ability to produce, but also their social and economic status and even their collective identity (Deininger & Feder 1998).

Moreover, at the aggregate level, the distribution of property rights in land and its evolution is closely linked to the evolution of power relations, technological change and population pressure (Binswanger, Deininger & Feder 1995).

Secure property rights to land are regarded as crucial because they have a profound effect on incentives and on the working of markets for land and

*I would like to thank Tim Besley for his support and guidance, Klaus Deininger and the World Bank for providing the data, Robin Burgess, Julia Shvets and seminar participants at STICERD for useful comments and suggestions on an earlier verision of this paper. All errors are my own.

capital (Feder & Feeny 1991). They provide agents with the incentives to use land efficiently and to invest in its conservation and improvement, increasing the sustainability and the productivity of land as a resource. If the property system is such that it documents these rights and allows transactions, they also decrease the costs of transacting land in the market by decreasing informational asymmetries, thus helping to allocate the resource more efficiently; and, by allowing lenders to foreclose, it allows the use of land as collateral and increases credit supply.

There is little discrepancy on the theoretical underpinnings of these mechanisms. However, they rely on strong assumptions about the property rights system: it should be able to define, document, record and enforce property rights and changes in property rights in a way that is transparent and accessible. Moreover, the latter two mechanisms assume that land, credit and other factor markets function well. Because these assumptions are unlikely to be satisfied in developing countries where public property systems are imperfect and mistrusted, informational asymmetries and transactions costs are likely to make markets function less than efficiently and credit markets are underdeveloped, there has been much debate on the relative benefits and costs of reform aiming to enhance land tenure security by providing legal guarantees of property, as well as the distributional effects of such policies.

The aim of this paper is to assess the value of legal documents certifying ownership of land in Nicaragua. A history of land reforms, with different motives and legal underpinnings has created a complex structure of land rights, both in its legal foundations and on the field. The corresponding episodes of land expropriation by the state and the use of land grabs as a means of access to land by various segments of the population have severely increased tenure insecurity and have also severely undermined the strength and credibility of the property rights system itself, especially land administration institutions[1]. In this context, Nicaragua undertook a large titling program to regularize the situation of beneficiaries of the successive waves of land reform.

We must stress at this point the distinction between property rights and property *documents*, which are the focus of this paper. Formal property documents are proof that the property rights of an individual are backed by the powers of the state, at least in theory. There is not necessarily a one-to-one correspondence between formal property documents and tenure security. While conditional on enforcement by the police and the judicial system, property documents should grant secure property rights, they are by no means a necessary condition. On the one hand, the law will recognise and protect some forms of tenure - such as long standing possession - even if they are not backed by a formal document[2]. On the other hand, tenure security may be achieved via informal channels of enforcement.

The remainder of this paper is organized as follows: section (2) presents in more detail the property regime in Nicaragua and presents the data used, section (3) presents the theoretical underpinnings of the "investment effect" of legal ownership, section (4) presents basic results, while section (5) deals with econometric issues arising from the main results, including endogeneity; section

[1] Land administration institutions comprise the Public registries and the Cadastre, but property rights institutions also include those institutions granting property rights (the executive) and protecting them (police, judiciary).

[2] Nicaragua, Civil Code Art. 1732 to 1740.

(6) summarises and concludes.

2 Background and data

2.1 Background: the land property regime in Nicaragua

The stability of the land property regime in Nicaragua has suffered greatly due to the historical circumstances in which it was developed. The purpose of this section is to illustrate, based on historical developments, the current status of property rights in the country, with special emphasis on land property.

Nicaragua has known, since the early 1970s, three waves of land reform, significantly altering the property landscape.

The land reform under the Somoza regime; although on paper a land reform, the main drive of land policy under the regime of Anastasio Somoza was the extension of the agricultural frontier achieved by giving out frontier land to agricultural labourers.

Land reform under the Sandinista regime (1979 - 1990): after the overthrow of Somoza in 1979 the government distributed large tracts of land to former agricultural workers, organizing many of them into collectivist cooperatives or state farms[3]. Later on, the land reform started granting land to individuals or in cooperative regimes that permitted wider individual rights[4]. In 1988, 48% of the country's arable land was held under the various (individual, collective and state) forms of land reform ownership according to Wheelock (1990).

Following the change in government after the 1990 elections, two major events took place. On the basis of peace accords, the government continued redistributing land to ex-combatants (both ex-*contras* and members of the downsized Sandinista army and security forces), largely under cooperative arrangements[5]. Secondly, the change of government opened the door to a flood of claims for restitution of land which had been expropriated during the Sandinista regime. This led to an enormous volume of litigation, much of which was not yet resolved at the end of the 1990s and is one of the main causes of Nicaragua's galloping internal debt.

The lack of proper legal documentation of land transfers and the existence of allocations of plots to which the State had no legal right have severely undermined the credibility and integrity of the property rights regime. This is illustrated by two facts: the total surface area claimed for restitution after the 1990s government change being larger than the total land area of Nicaragua and the emergence of self-proclaimed ex-combatant bands (*desmobilizados*) which carried out land invasions both in land redistributed during the Sandinista land reform and of privately held land.

Although a description of all the possible legal documents that can be used to prove ownership and their legal support is beyond the scope of this paper,

[3] The production of commodities benefiting from larger returns to scale in production, such as sugarcane, coffee and meat, was organized in large state conglomerates.

[4] An example of this were the *cooperativas de surco muerto* (dead furrow cooperatives) where the land was farmed individually but no fences could be put up to signal the separation, in principle to allow for the use of machinery; the unused furrows used to mark those limits gave the name to the cooperatives.

[5] An infamous example in Rio Blanco, where a cooperative was handed out to members of both groups, resulted in a series of violent, even armed conflicts, for the control of land (Merlet & Pommier 2000).

we can classify them as follows; no title: a relatively large number of plots in Nicaragua are believed to have no written property title either formal or informal (14% of the plots in our sample received no document at all at the time of purchase); informal documents: usually in the form of a transfer deed that is not public (*Carta de compra-venta*) or a possessory note (*Constancia de posesión*); transitory documents: administrative documents given out as part of the land reform process (*Constancia de asignación* or *Título provisional*); supplementary titles: a special type of title issued from positive prescription that grants property rights only so far as they are unopposed; agrarian reform titles: both during the Sandinista land reform and throughout most of the 1990s land regularization programme, these titles, which are administrative rather than judicial documents, were given out - they carry a series of restrictions, most noticeably limitations on validity if dated from the transition period (February-April 1990); public deed: a well-defined full property title documenting a land transaction.

The most relevant legal point is the importance of title registration under Nicaraguan law: only a title which is registered can be used to prove property when faced with a claim by a third party as only registration ensures that conflicts with previous land owners have been settled or that a transfer has been properly carried out.

The type of document held is the main institutional restriction on registration. Informal and transitory titles cannot be registered, except in special cases in which possessory rights can be registered[6]. The last three types of title can be registered as long as the chain of title is preserved[7]. Agrarian reform titles are subject to a number of restrictions of validity and transactability, following the laws enacted during the second half of the 1990s[8] to protect property rights and to counteract abuses committed, especially during the transition period.

Throughout the 1990s the government of Nicaragua, backed by a number of donors[9], put emphasis on land rights regularization, especially in areas affected by the successive waves of land reform. The scale of the programme is remarkable: between 1992 and 2002, the government of Nicaragua issued close to 40,000 titles all over the country.

The titling program acts administratively and grants an Agrarian reform title (registered or unregistered) rather than a public deed (which would be a notaries' document certifying a transfer[10]). An important part of the evaluation of the validity of the legal edifice and the effects of the titling intervention therefore lies on the perceived differences between the two main types of full ownership

[6] Possessory rights can be registered via the use of a Supplementary Title. In the departments of Jinotega and Matagalpa, Public Registries also contain specific books to register possessory rights, which are used to prove ownership on *improvements* on land and can be used to prove length of possession.

[7] During the transition period between the February 1990 elections and the change of hands of power in April 1990, legislation was enacted that forced inscription even when the chain of title was not respected. The result of this was to lower the security granted by registration of Agrarian reform titles altogether as many were registered without preserving the chain of title and such registrations can, in principle, be challenged by previous owners or the State.

[8] Laws 209 and 278 require the revision of a substantial number of property titles and create mechanisms for automatic devolution to the state of properties failing the revision process.

[9] Under the umbrella program PNCTR (*Programa Nacional de Catastro, Titulación y Registro* - National programme of cadastre, titling and registration) the government has carried out titling and land administration modernization initiatives.

[10] And therefore would entail *buying* land from the State.

documents. While initially, reform beneficiaries received documentation short of a registered full title, the official guidelines were changed to effectively hand out only titles that had been properly registered[11,12]. Due to the declarative nature of the Nicaraguan property registry, this point is important in providing exogenous variation in registration status; if one could expect well-established farmers to have taken action to register titles, the grant of already registered titles will serve to identify the effect of titling coupled with registration.

2.2 Data sources

The main data source is the *Estudio de las Dinámicas de la Economía Rural* (Study of Rural Economy Dynamics), a survey conducted by the World Bank, the University of Wisconsin and FIDEG, a local NGO between February and April 2000. This survey contains information on household characteristics as well as information on income sources (both agricultural and non-agricultural), a detailed log of land holdings and transactions and information on investments in land. The survey also has detailed information on credit activity, including not only credit used but also denied requests and a subjective assessment of creditworthiness.

The sample for this survey was constructed using a 1996 nationally area-representative survey of 1360 farmers carried out by the Agriculture ministry (MAGFOR). This sample was then complemented by three other categories: (i) 461 households drawn randomly from the list of beneficiaries of the governmental titling programme, (ii) 372 rural households with little or no land, (iii) 282 of the households of the original sample were no longer cultivating the plot they were cultivating in 1996 and were replaced by the households who were farming the land at the time of the survey.

The presence of these categories ensures that the sample provides a complete picture of the Nicaraguan agricultural landscape, and is representative at the level of the main agro-climatic regions: the fertile Pacific strip, the hilly Northern region and the Centre of the country.[13] The data covers 3665 plots distributed over 126 municipalities within 17 departments which can be grouped into 9 larger regions.

However, the subsamples do not share the same structure below the macro-regional level, with categories (i) and (ii) being stratified further at the departmental level.

A study of household and plot level summary statistics for the sample and each of the sub-samples shows that the sub-samples are markedly different not only in terms of landholdings but also in the form of land ownership as well as land use: while most land held by titling program beneficiaries is used for seasonal crops, well established farmers and land buyers devote a large proportion of land to pastures. On average, well-established farmers and land buyers are richer than the other two groups and titling program beneficiaries are richer than the land poor. However the wealth of the first two groups is held in notably dif-

[11] Agrarian reform titles, if they are full legal proof of ownership, are short of full titles in that they carry a five year moratorium on sales.

[12] Implementation of these guidelines seems however to have been hampered by shortages in staffing and funds.

[13] The Atlantic regions are not represented due to the difficulty of access and low population density.

ferent ways. While established farmers hold higher value machinery and cattle, land buyers hold more land and are more heavily indebted. Several explanations could account for this: many purchases may have been made for extensive cattle farming, which requires less agricultural machinery but substantial fixed investment. Another possibility is that the lack of depth of the land mortgage market even for relatively well-off households pushes them to finance the land purchases at least in part by selling or not buying mobile capital assets[14] as in the mechanism proposed by (Carter & Olinto 2000).

3 Investment effects of land property documentation: theoretical background

Land titling has the effect of formalizing ownership, and as thus, has several effects:

Insofar as it enhances land tenure security, it provides incentives for investment in land attached capital, as the full return from this is reaped by the owner.

It increases the transactability of land - this is not dissociated from the above but is not exactly the same. The formalization of property rights makes them more transactable conditional on their security.

Both of the above mean that there is potentially a credit supply effect, as titled land is valuable collateral.

If the credit effect is not present, then the investment effect may still exist: as the expected return from land increases, the household will reallocate resources from other assets (e.g. cattle but also other capital goods) towards land as well as land-attached assets, such as improvements on land (irrigation, fences, etc.) as described by (Carter & Olinto 2000).

Having a title to land is essential for land to be used as collateral. Titled land is the single most used form of collateral in the 2000 sample, 35% of credit transactions are secured by land, 20% by harvest and 12% by cattle. The percentages are 60%, 7% and 12% in the formal supervised sector. On the other hand, very few credit transactions are secured with untitled land (2% of transactions in the sample).

Land titling is usually viewed as increasing security of tenure for land owners[15]. However land titling actually constitutes in essence a formalization of land property rights. In fact, whether security increases depends crucially on whether the formalized rights have an informal correspondence; in other words, if there exist informal mechanisms that protect property rights or if there is no threat on property rights, then we would not expect titling to increase tenure security.

On the other hand, whether security is increased or not, formalization of property rights will have the effect of reducing informational asymmetries on the ownership status of the plot of land. This means that the trade opportunities are likely to increase, as trade with individuals who are not members of the

[14] Finally, measurement error in the machinery value variable cannot be ruled out. The absence of detailed price data means that machinery quality and depreciation are not accounted for. This could entail a significant overvaluation of longer-serving machinery.

[15] We do not consider the effect land titling can have on security of tenure for households renting land.

same community is made less costly. It also means that, because asymmetries are reduced between borrowers and lenders, the collateral value of land will increase, thereby increasing the amount of credit available.

Given the two effects above, one would also expect the formalization of property to increase the market price of land, as it now incorporates a premium due to the increase in the credit ration that is associated to it, as well as a premium due to the enhanced liquidity of the plot in case of trade. This increase of value may reinforce the credit effect if it exists.

Finally, the standardisation in property rights that accompanies their formalisation means that property rights as supported by legal documents may be different from those rights that communities may have granted to the landholders. This is of particular interest in the case of transitions from communal to individual ownership or in the formalisation of individual ownership supported by community arrangements. This type of transition has been widely studied in the case of several African countries (Bruce & Migot-Adholla 1993) but customary land tenure regimes are understudied in Latin America[16].

4 Basic results

We begin by analysing the direct effect of property documents on investment. We consider the following general specification:

$$I_{p,h,t} - I_{p,h,t-1} = \alpha + \beta \mathbf{X}_{p,h,t} + \gamma \mathbf{Z}_{p,h} + \delta \mathbf{H}_{h,t} + \varepsilon_{p,h,t} \quad (1)$$

Where I represents investments present in plot p owned by household h at time t, the $\mathbf{X}$'s are plot level variables representing tenure status at time t, the $\mathbf{Z}$'s are other plot characteristics, and the $\mathbf{H}$'s are household level variables.

The investments considered are large land-attached investments such as sheds, silos, stables, wells and processing facilities (in particular coffee processing facilities). Because these are immobile long-term investments, security of tenure, insofar as it determines the horizon of the producer, is a key determinant of their expected return. The dependent variable is a dummy variable which takes value 1 if any of these investments has taken place between 1996 and 1999 on the given plot[17].

The dependent variables of interest are dummy variables for each of the types of document in the sample: the first three (*constancia de asignación / posesión, carta de compra/venta, provisional title*) are not sufficient to prove ownership rights (but can be used to prove possession, while the remaining documents (public deed - *escritura pública*, agrarian reform titles and supplementary titles) are full property documents and can be registered. The omitted category is

[16] The pattern of land distribution and population management during the colonial period and the dominance of *haciendas* that followed in Nicaragua, as in most of Latin America (see (Binswanger et al. 1995) for a detailed account of the emergence of property rights) seriously weakened customary forms of land ownership. However this is not to say that local networks are weak. They remain "an indispensable day-to-day reference for economic and social interaction in the local territory" (Bastiaensen 1997) and often hold the key to "access to government and outside markets". Therefore, even if social networks do not shape property rights, they may still shape the way these rights are enforced.

[17] We also have data on installations present in 1990 but we choose 1996 as the starting point because 77% of property documents were emitted before 1996, while only 46% were emitted before 1990.

"no document". A dummy variable representing the registration status is also added. In all cases legal status data is contemporaneous (i.e. 2000) data.

We use a linear specification for ease of interpretation of the coefficients, in particular in subsequent estimation where household fixed effects are used[18].

Table [1] presents results of linear regressions of this specification stripped down to the bare essentials, including only property document data. Column (1) presents the basic specification while columns (2) and (3) add respectively regional and municipal fixed effects. Errors are heteroskedasicity robust and clustered at the municipal level for all but column (1).

Only the coefficient on registration status is significant at the 5% level in all specifications, and the order of magnitude of the coefficient is robust to the inclusion of municipal fixed effects (which to a certain extent will capture major differences in land use and land quality).

Column (4) replaces the registration dummy with interactions of registration with each of the documents that can be registered[19]. Only the coefficients on registered public deeds and registered agrarian reform titles are significant among these, they are not significantly different from each other (the P-value of a Wald test of equality is 0.61), and they have the same magnitude as the registration variable. Therefore we conclude that legal status does matter for investment but only insofar as the titles are registered and that the specific type of title is not a major determinant of investment.

Insofar as legal documents have an effect through either the provision of tenure security or the availability of formal credit, the fact that only registration matters is in accord with the law, which states that only registered titles offer full protection against a claim over land ownership and that mortgages on land need to be registered.

Table [2] presents results of the full specification. Due to the finding that the type of document is not statistically significant once registration is controlled for, the type of document dummies are omitted. Further plot level controls include a dummy variable indicating whether the mode of acquisition of the plot was purchase, the time since acquisition (in years), inherent plot characteristics (area, area squared, distance from home, total investment in 1990 and a set of dummy variables for different types of topography) and a set of dummy variables for land use categories. Household controls include dummy variables for the subsample the household belongs to[20], the age of the head of household and its square, an indicator variable for female-headed households, the education of the household head, the number of males and females over 12 and the presence of at least one literate individual in the household. Household wealth is controlled by the inclusion of the value of agricultural machinery, the value of non-agricultural capital, the value of cattle, the ownership of a TV, of a radio and of other property and a dummy indicating whether the dwelling has an unpaved floor. Finally, infrastructure is controlled for by variables indicating the time to reach the nearest road and the nearest market[21].

[18] A probit regression would be problematic in the inclusion of the fixed effects. Logit regressions throw very similar results for the basic specifications.

[19] Some registries do accept to include possessory documents in the registry in a separate book, the corresponding interaction terms are not significantly different from zero at conventional confidence levels if included.

[20] Terms interacting the subsample dummy with registration status were also entered but found to be insignificantly different from zero and are omitted in the specification presented.

[21] Unfortunately, these are only available at the household level and correspond to the main

Column (1) presents results with only plot-level controls, while column (2) presents results with both plot level and household controls. Finally, column (3) excludes the categorical dummies for land use, as they are potentially jointly determined with tenure security, and thereby may pose endogeneity concerns. Excluding these variables does not change the results in any way.

The addition of controls does not significantly alter the estimate of the coefficient of interest, which remains significantly different from zero at the 1% level and between 4% and 5% in magnitude. Most coefficients on the control variables have the expected signs: investment is more likely in larger plots and in those dedicated to perennial crops and is less likely in fallow land and forest land; at the household level, land buyers[22], households with at least one literate member and cattle-rich households are more likely to invest, while households whose dwelling is further away from a road are less likely to invest.

Other coefficients have less straightforward interpretations. Time since acquisition is included to account for the fact that investment may already have been carried out if land is held for a long time, which would imply a negative coefficient on this variable and to allow for informal property rights enforcement mechanisms to which longer possession may ease access, which would lead to a positive coefficient. The fact that the coefficient is no longer significant once the subsample dummies are included suggests, however, that the observed effect is merely that of recent acquirers of land being more likely to invest.

Finally, of the variables relating to household wealth, it is noteworthy that only the value of cattle is a significant determinant of investment[23]. Cattle is in fact used as a store of value given the lack of security in land ownership and the lack of penetration of the formal financial sector. It is somehow surprising that other mobile assets, in particular agricultural machinery, do not enter the relationship significantly. Although on average land is by far the most valuable asset held by households in the sample, one would expect mobile capital to serve as an imperfect substitute form of collateral when land cannot be used as such or further guarantee is needed. However large foreclosure costs can impede the use of assets other than land as collateral altogether.

5 Econometric concerns

This section deals with econometric issues that may limit the validity of the estimates presented in section 4. We will first present the main issues and then evidence supporting our claims.

5.1 Omitted variables and unobserved characteristics

5.1.1 Measurement of the dependent variable

The coefficient on value of cattle in the results presented above suggests that we may not be measuring the right set of investments. The inclusion of a given

dwelling, rather than at the plot level.

[22] "Land buyers" are those households that enter the sample by being in a previously sampled plot. This does not therefore include all land buyers in the sample.

[23] Land value is excluded because it is very likely to be strongly influenced by registration, as registered land is more "marketable". If included, it is not statistically significant and the main results are not altered.

type of investment depends on its availability in the survey questionnaire, and therefore it may be incorrectly measured. This is a concern if the error in measurement is correlated with one - or several - of the regressors but in a more general note, if what is leading the results is investment by cattle farmers, then it is greatly important for the interpretation of the results.

For this reason, the regressions in table [3] disaggregate cattle specific improvements (cattle sheds, forrage silos, etc) from others and run separate regressions for both.

Columns (1) and (2) present results on non-cattle specific investments; columns (3) and (4) present results on cattle specific improvements. The main result is not affected either in magnitude or in significance. The coefficients on the recent buyers dummy are noteworthy and signal that recent acquirers of land are more likely to carry out cattle-related improvements while they are not so for others. The value of cattle is omitted in column (4) due to potential endogeneity. The slight change in results does suggest that value of cattle is correlated to registration and - not surprisingly - improvements. This may be the result of insufficiently precise wealth controls, but may also signal the fact that land would be used as guarantee for credit used to purchase cattle.

5.1.2 Unobserved household heterogeneity

Even if, to some extent, tenure status can be thought of as exogenous to the investment decision, unobservable household level variables that are not included in the estimation of (1) - such as legal sophistication or better measures of wealth - may be correlated both with registration status and the decision to invest. Failure to include them will make the estimates inconsistent. For this reason we run the same specification with the inclusion of household fixed effects. The estimation equation is therefore:

$$I_{p,h,t} - I_{p,h,t-1} = \beta \mathbf{X}_{p,h,t} + \gamma \mathbf{Z}_{p,h} + \alpha_h + \varepsilon_{p,h,t} \tag{2}$$

The inclusion of household fixed effects means that the estimation relies exclusively on within-household variation. For this reason, only households with more than one plot of land are included[24]. It should be noted that this has the effect of reducing variation in the data because less plots are considered and only within-household variation is taken into account; moreover, the equation is now estimated for households owning more than one plot only, which may systematically differ from households with only one plot.

If a household owns several plots, the presence of household fixed effects dilutes the credit effect mentioned above. In effect, if the credit effect is the force driving an increase in investment, then own plot characteristics will also matter insofar as they enhance the household creditworthiness. However, at a given point in time, this is fixed at the household level and therefore captured by the fixed effects. If the increase in investment can be attributed to household-level effects, such as an increase in available resources (funds and/or time) which are then invested equally among plots, we would not expect to find an effect in this specification. Finding an effect in this specification does not, however

[24] The inclusion of all households would, of course, not alter parameter estimates. It would, however, alter the variance estimates, given that these allow for clustering at the municipality level.

preclude the existence of such an effect, it would only indicate how the extra working funds are allocated.

Results are reported in table [4] along with the full specification (1) ran over the same households, for comparison purposes (column (1)). The estimate of the coefficient of interest is not altered but the statistical significance of the coefficient is reduced. We can no longer reject the hypothesis that the coefficient is zero at the 10% level (the t-statistic is 1.62). Exclusion of the potentially endogenous use of land categories (none of which is significantly different from zero) slightly alters the result, increasing the coefficient on the registration dummy; we can then reject that the coefficient is zero at the 10% level[25].

Overall, results from this specification are somewhat supportive of the basic results but not entirely convincing. The inclusion of household fixed effects captures much of the variation in the dependent variable as showed by the R^2 of the fixed effects regressions ($R^2 = 0.47$), suggesting that household effects not present in the original model are important in the investment decision. At the same time, the lack of significance of the included regressors points to the fact that important determinants of investment at the plot level (in particular a measure of the quality of land) are not included, which casts some doubts on the validity of the estimates.

5.2 Endogeneity

Given that we are not dealing with a natural experiment, endogeneity is a major concern. The results presented in table [2] are robust to the exclusion of a number of variables that could potentially be endogenous to the investment decision, such as the value of the cattle herd or the choice of use of land. We therefore turn to concerns over the endogeneity of the registration status.

Endogeneity of land property rights is a matter that was largely ignored in the literature dealing with investment effects of tenure security until the work of Besley (1995). The main argument is that past investments may enhance land tenure security; if land holders own the improvements they make on land, they may claim to own the land by virtue of this. This argument relates to the essence of property rights themselves, by relying on the idea that individuals create property rights by "mixing" their labour with a given object. Moreover, such rights are legally recognised in many countries at least to some extent, including Nicaragua.

This distinction does not however make the above argument invalid. In effect, adverse possession can be used as the basis for prescription of the owner's property rights and therefore as a means of access to property rights which are formally recognised (a mechanism known as "positive prescription" in Nicaraguan law). In turn, visible investments in land could be used to prove possession itself and therefore be used as a basis to obtain formal property rights. There are two distinct reasons why this mechanism, in our opinion, is not a major concern. Firstly, despite widespread speculation in Nicaraguan media of the

[25] Use of land dummies could be expected, however, to control for quality of land, which we have no other suitable means of controlling for. Since we would expect higher quality to be positively correlated to registration and to increase the probability of investment, this may result in an upward bias in the coefficient of interest.

massive use (and misuse) of positive prescription, the type of title which sanctions it is hardly present in our dataset[26]. Secondly, the time frame involved in the judicial mechanism (10 years continued possession) is considerably larger than the one we examine (investment within 3 years of the survey). Because of these two facts, we are relatively safe from such reverse causation concerns.

Unfortunately, this does not mean that we are free from endogeneity concerns altogether. Beneficiaries of the governmental titling programme may have received titles that were registered or unregistered, with registration depending on a number of factors which are largely exogenous to the household's investment decision, such as the presence of an unsettled claim from a previous owner or administrative competence. However, the nature of the registry is declarative, which means that, in general, registration is a decision of the household. This means that households that received a title that could be registered but was not, may have decided to register it later and even that an individual may obtain a title so as to register his property rights.

The first of these concerns can be addressed if we believe that the type of title is exogenous to the investment decision. Since only certain types of title can be registered, the type of document held is an important predictor of the registration decision. Since as suggested by the basic results presented above, what brings about investment is not so much the title itself but whether this title is registered, document types are natural instruments for registration status in the investment equation.

The relevant estimator for comparison with the results presented above is the within instrumental variables estimator (W2SLS). However, this will only control for local effects which are fixed and additive in nature. In order to make correct inference in the presence of potential correlation between errors at the local level, we present the results with standard errors corrected for clustering at the municipal level. The orthogonality conditions on the instruments are tested using the J statistic of Hansen (1982)[27].

5.2.1 Determinants of registration

As a first attempt to model the decision to register a title, we run regressions of registration status on a number of plot and household characteristics, including type of title, as well as geographic dummies. This corresponds to the "first stage" regression of the instrumental variables estimator if it is viewed as a two-stage least squares estimator[28].

For comparison purposes, we also present results from a regression omitting document type but including dummies for the mode of access: the categories are heritage (omitted), purchase, squatting, donation, agrarian reform. Results are presented in Table [5].

Regarding mode of acquisition, registration is more likely if the plot was bought, inherited or acquired through land reform and less likely if it was ac-

[26] Land held with a *título supletorio* (supplementary title) represents less than 1% of the plots in the sample.

[27] The J statistic is numerically identical to the Sargan statistic under conditional homoskedasticity but the latter is not valid for an IV regression if this assumption is violated, see (Christopher F. Baum & Stillman 2003).

[28] In the presence of heteroskedasticity the 2SLS estimator is less efficient (asymptotically) than its GMM counterpart, which takes into account the structure of the variance-covariance matrix in estimation, rather than just in the calculation of standard errors.

quired through donation or squatted[29]. Overall mode of access is not a very good predictor of registration. One reason for this is that what matters is the level of formalisation. For example a sale can be carried out privately or publicly and this will lead to different transfer deeds which impact the possibility of registration.

Results regarding title type are as expected: registration is more likely with a public deed than with any other type of title, including an agrarian reform title (the difference is quantitatively important and significant at better than the 1% level), then with agrarian reform titles (either provisional of definitive) and finally with other types of title[30]. On the whole, agrarian reform beneficiaries are less likely to register their rights, which is also underlined by the fact that having bought the land increases the chance of registration even when document type is controlled for, meaning that buyers of "reformed" land are more likely to register it than the beneficiaries themselves.

Surprisingly, apart from area, factors that influence the value of the land and that we could therefore expect to increase demand for registration, do not increase registration status[31]. A more educated head of household and a greater degree of literacy increase the chance of registration, which is a relatively heavy bureaucratic process, and so does being far from a market. This is taken as evidence that the opportunity cost of carrying out the procedure is relevant.

Finally, with the exception of the existence of another property, wealth variables are not strong determinants of registration status. The inclusion of terms interacting household assets with the various types of titles does not give any further insight either. An optimistic interpretation of this finding would be that wealth constraints are not binding in registering titles once the cost of acquiring the title is taken into account. However this may also be a consequence of either the imperfect measurement of wealth, as most measures are self-reported, or of the fact that, since the cost of registration is for a large part fixed, wealth constraints only bite for lower incomes, making the actual relationship nonlinear, which would result in an underestimation of the importance of wealth.

From the perspective of the instrumental variable estimation of the investment equation, document types are important predictors of registration, and, subject to their conforming to the orthogonality decisions, appear to be good instrument candidates.

5.2.2 Instrumental variables estimates

Table [6] reports instrumental variables estimates of the investment equation. All estimates in this table are of the mean-differenced model (with means taken at the municipal level) and are therefore within estimators.

Column (1) reports the OLS results, while column (2) reports two-stage least squares results, column (3) reports 2SLS results with robust variance-covariance and column (4) reports the asymptotically efficient GMM estimator.

[29] The "other" category includes especially non legalized donations and cooperatives. Donations are the legal figure of choice for dismembering cooperatives as they do not require a transaction.

[30] The negative coefficient on the "other" category is noteworthy as this includes in particular indigenous community titles.

[31] The inclusion of land use dummies shows that land used for perennial cultures is more likely to be registered. However these variables are very likely to be endogenous and are omitted.

The instruments are found to be orthogonal to estimation errors as we can never reject in a test of overidentifying restrictions even when taking into account potential error correlations within municipalities. Overall results are not greatly affected by instrumenting, in fact a Durbin-Wu-Hausman test between the estimates in columns (1) and (2) cannot reject exogeneity of the registration variable, or in other words, that the OLS specification is correct, and therefore, more efficient. The effect of registration is therefore estimated to be of the order of 5%.

There remains one caveat about the estimates presented that cannot be easily lifted with the results presented. We have relied for instrumentation on the variation in registration status that is related to differences in documentation within municipalities. In order to ensure that this variation is not correlated with household unobservables it would be necessary to have a proper control group in order to estimate the effect of the titling programme itself.

6 Conclusions

The evidence presented from a programme of land titling in Nicaragua suggests that land titling significantly increased land-attached investments. The absence of evidence of enhanced access to formal credit, in turn, leads us to conclude that the intervention had the effect of increasing security and that this was the main channel through which it provided benefits. The ability to observe households with multiple plots allows us to examine this channel in depth without fear of contamination by the presence of unobserved household characteristics.

We can conclude that the legal status of ownership matters for economic outcomes. In particular, beyond the perceived security granted by titles themselves, registration was found to have significant effects on land-attached investments. This is remarkable because it corresponds to differences in legal protection of property rights in a society that questions openly its judicial system and where the legal edifice that underpins property rights over land is complex and often exhibits contradictory propositions or is left to widely differing interpretations, and where we would not expect producers to have a high level of legal sophistication.

Preliminary results show no clear indicative evidence of a credit supply link. This is not surprising given the macroeconomic conditions in Nicaragua during the period of study, in particular the application of a structural adjustment program with the consequence of severe credit tightening and the disappearance of several major banks, including the public development bank.

Concerns remain about the possibility that other variables may affect both registration and investment, and more work is needed, rooted on the mechanisms of the titling process, to obtain a satisfactory answer to fears that endogeneity may be partially driving the results; instrumental variable estimates suggest that this is not a major problem, but they rely on variation between types of title, and therefore are not ideal to estimate the effect of the titling programme, itself mostly concerned with providing agrarian reform titles.

Moreover, we have not addressed a major measurement issue that stems from the following consideration. It is possible that impacts of such programmes be differentiated across categories of households. In their study of a titling program in Paraguay, Carter & Olinto (2000) found that there was a credit

supply channel through which benefits accrued to titling program beneficiaries but that this effect was differentiated and was of significant importance only for large farms. Although there is little evidence that such a mechanism in credit markets could be at work here, other forms of household heterogeneity could imply such a differential effect. The evidence presented suggests that local, informal property rights enforcement mechanisms are at play at a par with formal, legal ones. This has been studied at the level of property regimes by Platteau (2000), but at the individual level, it cannot be taken for granted that access to these enforcement mechanisms (both formal and informal) is homogeneous between households. We found no evidence that wealth was a major factor in determining this access, but other factors, such as political connections or social capital may play an important role in shaping property rights and therefore the distribution of the benefits of such a programme. This is, in principle, subject for further study, however it should also be considered a caveat in the interpretation of the results above if such factors could drive the registration decisions.

References

Bardhan, P. (1989), Alternative aproaches to the theory of institutions in economic development, *in* P. Bardhan, ed., 'The Economic Theory of Agrarian Institutions', Clarendon Press, chapter 1, pp. 3 – 17.

Bastiaensen, J. (1997), Non-conventional rural finance and the crisis of economic institutions in Nicaragua, *in* J. P. de Groot & R. Ruben, eds, 'Sustainable Agriculture in Central America', Macmillan press ltd, chapter 12, pp. 191–209.

Besley, T. (1995), 'Property Rights and Investment Incentives: Theory and Evidence from Ghana', *Journal of Political Economy* **103**(5).

Binswanger, H. P., Deininger, K. & Feder, G. (1995), Power, Distortions, Revolt and Reform in Agricultural Land Relations, *in* J. Behrman & T. Srinivasan, eds, 'Handbook of Development Economics', Vol. Volume III, Elsevier Science B.V.

Brasselle, A.-S., Gaspart, F. & Platteau, J.-P. (2002), 'Land Tenure Security and Intvestment Incentives: Puzzling Evidence from Burkina Faso', *Journal of Development Economics* **67**, 373–418.

Bruce, J. W. & Migot-Adholla, S. E., eds (1993), *Searching for Land Tenure Security in Africa*, The World Bank.

Carter, M. R. & Olinto, P. (2000), 'Getting Institutions "Right" for Whom: Credit Constraints and the impact of Property Rights on the Quantity and Composition of Investment', (Staff Paper No. 433).

Carter, M. R., Wiebe, K. D. & Blarel, B. (1994), Tenure Security for Whom? Differential Effects of Land Policy in Kenya, *in* J. W. Bruce & S. E. Migot-Adholla, eds, 'Searching for Land Tenure Security in Africa', the World Bank, pp. 141–168.

Christopher F. Baum, M. E. S. & Stillman, S. (2003), Instrumental variables and GMM: Estimation and testing.

de Janvry, A., Gordillo, G., Platteau, J.-P. & Sadoulet, E. (2001), *Access to Land, Rural Poverty and Public Action*, Oxford University Press.

Deininger, K. & Chamorro, J. S. (2002), 'Investment and Income Effects of Land Regularization. The case of Nicaragua', *Policy Research Working Paper* (2752).

Deininger, K. & Feder, G. (1998), 'Land Institutions and Land Markets', *Policy Research Working Paper* (2014).

Feder, G. & Feeny, D. (1991), 'Land Tenure and Property Rights: Theory and Implications for Development Policy', *The World Bank Economic Review* **5**(1).

Feder, G., Onchan, T., Chalamwong, Y. & Hongladarom, C. (1988), *Land Policies and Farm Productivity in Thailand*, The World Bank, The Johns Hopkins University Press, Baltimore and London.

Foltz, J., Larson, B. A. & Lopez, R. (2000), Land Tenure, Investment, and Agricultural Production in Nicaragua.

Hansen, L. (1982), 'Large sample properties of generalized method of moments estimators', *Econometrica* **50**(3), 1029–1054.

Jonakin, J. (1996), 'The Impact of Structural Adjustment and Property Rights Conflicts on Nicaraguan Agrarian Reform Beneficiaries', *World Development* **24**(7), 1179–1191.

Kochar, A. (1997), 'An Empirical Investigation of Rationing Constraints in Rural Credit Markets in India', *Journal of Development Economics* **53**, 339–371.

Merlet, M. & Pommier, D. (2000), 'Estudios sobre la tenencia de la tierra', IRAM (Institut de Recherches et d'Applications de Méthodes de Développement). Managua, Nicaragua.

Platteau, J.-P. (2000), 'Allocating and Enforcing Property Rights in Land: Informal versus Formal Mechanisms in Subsaharian Africa', *Nordic Journal of Political Economy* **26**(1), 55–81.

Stanfield, J. D. (1995), 'Insecurity of Land Tenure in Nicaragua', *Land Tenure Centre Research Paper* (120).

Wheelock, J. (1990), *La Reforma Agraria Sandinista: 10 Años de Revolución En el Campo*, Ed. Vanguardia. Managua.

Table 1

	(1) Fixed investment 96-99 (dummy)	(2) Fixed investment 96-99 (dummy)	(3) Fixed investment 96-99 (dummy)	(4) Fixed investment 96-99 (dummy)
Possession document	-0.018	-0.029	-0.008	0.005
	[0.31]	[0.48]	[0.13]	[0.09]
Private transfer deed	0.043	0.030	0.027	0.027
	[0.90]	[0.90]	[0.67]	[0.66]
Provisional title	-0.045	-0.067	-0.023	-0.003
	[0.51]	[1.97]+	[0.71]	[0.09]
Public deed	0.026	0.018	0.030	0.018
	[0.58]	[0.42]	[0.69]	[0.37]
Agrarian reform title	-0.033	-0.027	-0.007	-0.008
	[0.75]	[0.63]	[0.15]	[0.17]
Communal title	-0.028	-0.016	-0.008	-0.086
	[0.30]	[0.19]	[0.09]	[1.52]
Supplementary title	0.034	0.031	0.085	0.096
	[0.37]	[0.32]	[0.83]	[0.82]
Other	-0.085	-0.078	-0.119	-0.119
	[1.01]	[1.92]+	[2.41]*	[2.41]*
Registered	0.034	0.032	0.043	
	[2.36]*	[2.49]*	[3.54]**	
Registered Public deed				0.055
				[2.45]*
Registered Agrarian reform title				0.041
				[2.50]*
Constant	0.085	0.038	0.069	0.072
	[2.02]*	[1.00]	[1.76]+	[1.82]+
Fixed effects	no	region	municipal	municipal
Observations	3210	3210	3210	3210
R-squared	0.01	0.03	0.08	0.08

Absolute value of t statistics in brackets

+ significant at 10%; * significant at 5%; ** significant at 1%
All regressions except (1) with standard errors clustered at municipal level (2) includes region fixed effects (3) and (4)

Table 2

	(1) Fixed investment 96-99 (dummy)	(2) Fixed investment 96-99 (dummy)	(3) Fixed investment 96-99 (dummy)
Registered	0.042	0.045	0.049
	[3.94]**	[3.92]**	[4.28]**
Bought	0.011	0.005	0.004
	[0.91]	[0.36]	[0.30]
Time	-0.002	-0.001	-0.001
	[2.13]*	[1.03]	[0.80]
Area	0.000	0.000	0.000
	[2.39]*	[2.26]*	[2.30]*
Square or area	-0.000	-0.000	-0.000
	[1.26]	[1.28]	[1.33]
Distance	0.000	-0.000	-0.000
	[0.02]	[0.05]	[0.22]
Investment in 1990	-0.001	-0.001	-0.001
	[1.40]	[1.09]	[0.87]
Ondulated	0.028	0.029	0.029
	[1.56]	[1.71]+	[1.59]
Hilly	0.004	0.009	0.007
	[0.22]	[0.50]	[0.37]
Steep	0.015	0.019	0.014
	[0.61]	[0.75]	[0.56]
Other topography	-0.028	-0.025	-0.021
	[0.34]	[0.31]	[0.27]
Perennial	0.051	0.049	
	[2.20]*	[2.11]*	
Pastures	0.027	0.009	
	[2.03]*	[0.66]	
Forest	-0.070	-0.072	
	[3.71]**	[4.12]**	
Fallow	-0.066	-0.071	
	[3.49]**	[3.24]**	
House plot	0.024	0.027	
	[0.82]	[0.92]	
Fruit	-0.028	-0.007	
	[1.17]	[0.28]	
Other	0.085	0.073	
	[3.62]**	[2.91]**	
FIDEG		-0.026	-0.024
		[0.62]	[0.56]
Titling		0.029	0.028
		[1.48]	[1.32]
Land Buyers		0.059	0.058
		[1.67]+	[1.78]+
Agricultural machinery 1990 (in '000000 of C$)		-0.001	-0.002
		[0.41]	[0.61]
Non-agricultural capital (in '000000 of C$)		0.095	0.184
		[0.30]	[0.61]
Value of cattle (in '000000 of C$)		0.354	0.395
		[3.34]**	[3.69]**
Time to road		-0.000	-0.000
		[1.95]+	[2.24]*
Time to market		0.000	0.000
		[1.33]	[1.19]
Constant	0.060	0.108	0.108
	[3.32]**	[1.44]	[1.43]
Observations	3200	3174	3174
R-squared	0.10	0.11	0.10

Robust t statistics in brackets
+ significant at 10%; * significant at 5%; ** significant at 1%
All regressions with standard errors clustered at municipal level
Note: OLS regressions. All regressions with municipal fixed effects, controls for age of head, age of head squared, female head, education of head, males over 12, females over 12, literacy (at least one literate in household), TV ownership, radio ownership, other property, dwelling with earth floor

Table 3

	(1)	(2)	(3)	(4)
	Non cattle-specific investment dummy	Non cattle-specific investment dummy	Cattle specific investment dummy	Cattle specific investment dummy
Registered	0.017	0.021	0.027	0.029
	[1.86]+	[2.30]*	[2.77]**	[2.94]**
Bought	0.009	0.008	-0.008	-0.004
	[0.99]	[0.89]	[0.78]	[0.34]
Time	0.000	0.000	-0.001	-0.001
	[0.74]	[1.01]	[1.97]*	[1.72]+
Area	0.000	0.000	0.000	0.000
	[2.62]**	[2.50]*	[1.26]	[1.64]
Square or area	-0.000	-0.000	0.000	-0.000
	[2.54]*	[2.49]*	[0.03]	[0.38]
Distance	0.000	0.000	0.000	-0.000
	[0.59]	[0.48]	[0.05]	[0.06]
Investment in 1990	-0.001	-0.000	-0.001	-0.001
	[0.70]	[0.39]	[1.10]	[0.98]
Ondulated	0.027	0.028	0.009	0.010
	[2.26]*	[2.04]*	[0.58]	[0.66]
Hilly	0.004	0.003	0.007	0.008
	[0.34]	[0.21]	[0.43]	[0.51]
Steep	0.001	-0.002	0.012	0.010
	[0.09]	[0.13]	[0.50]	[0.45]
Other topography	0.032	0.035	-0.086	-0.083
	[0.48]	[0.57]	[2.09]*	[1.99]*
Perennial	0.058		-0.002	
	[2.74]**		[0.12]	
Pastures	-0.002		0.010	
	[0.16]		[0.87]	
Forest	-0.029		-0.053	
	[1.61]		[3.47]**	
Fallow	-0.025		-0.054	
	[1.87]+		[3.86]**	
House plot	0.022		0.015	
	[1.54]		[0.62]	
Fruit	-0.019		-0.009	
	[0.92]		[0.45]	
Other	0.052		0.036	
	[3.05]**		[1.67]+	
FIDEG	-0.039	-0.035	0.019	0.007
	[1.89]+	[1.74]+	[0.50]	[0.20]
Titling	0.012	0.011	0.032	0.019
	[0.80]	[0.69]	[2.12]*	[1.33]
Land Buyers	0.026	0.025	0.054	0.051
	[1.82]+	[1.79]+	[3.03]**	[2.81]**
Agricultural machinery 1990 (in '000000 of C$)	-0.000	-0.000	0.001	0.002
	[0.00]	[0.11]	[0.53]	[0.77]
Non-agricultural capital (in '000000 of C$)	-0.345	-0.284	0.372	0.407
	[1.67]+	[1.37]	[1.08]	[1.16]
Value of cattle (in '000000 of C$)	0.146	0.154	0.329	
	[2.15]*	[2.32]*	[3.63]**	
Time to road	-0.000	-0.000	-0.000	-0.000
	[0.61]	[0.78]	[2.02]*	[2.08]*
Time to market	-0.000	-0.000	0.000	0.000
	[0.13]	[0.21]	[2.11]*	[1.88]+
Constant	0.065	0.067	0.103	0.113
	[1.23]	[1.24]	[1.29]	[1.40]
Observations	3174	3174	3174	3174
R-squared	0.10	0.09	0.11	0.10

Robust t statistics in brackets
+ significant at 10%; * significant at 5%; ** significant at 1%

Note: OLS regressions. All regressions with municipal fixed effects and errors robust to intra-municipal error correlation, controls for age of head, age of head squared, female head, education of head, males over 12, females over 12, literacy (at least one literate in household), TV ownership, radio ownership, other property, dwelling with earth floo

Table 4

	(1)	(2)	(3)	(4)
	Fixed investment 96-99 (dummy)	Fixed investment 96-99 (dummy)	Fixed investment 96-99 (dummy)	Fixed investment 96-99 (dummy)
Registered	0.040	0.050	0.050	0.060
	[3.06]**	[1.94]+	[1.61]	[1.83]+
Bought	-0.008	-0.010	-0.012	-0.010
	[0.47]	[0.50]	[0.37]	[0.32]
Time	0.000	0.002	0.002	0.002
	[0.17]	[1.51]	[1.03]	[1.08]
Area	0.000	0.001	0.001	0.001
	[1.55]	[2.43]*	[1.76]+	[1.69]+
Square or area	-0.000	-0.000	-0.000	-0.000
	[0.52]	[1.80]+	[1.53]	[1.45]
Distance	0.000	-0.000	-0.000	-0.000
	[0.89]	[0.10]	[0.11]	[0.17]
Investment in 1990	-0.000	0.003	0.003	0.003
	[0.19]	[0.69]	[0.46]	[0.54]
Ondulated	0.007	-0.006	-0.006	-0.021
	[0.45]	[0.23]	[0.18]	[0.59]
Hilly	0.012	-0.019	-0.019	-0.026
	[0.57]	[0.62]	[0.53]	[0.69]
Steep	0.056	0.053	0.053	0.048
	[1.44]	[0.92]	[0.71]	[0.68]
Other topography	0.087	0.320	0.320	0.318
	[0.70]	[1.46]	[1.05]	[1.07]
Perennial	0.058	0.058	0.058	
	[2.04]*	[1.46]	[1.19]	
Pastures	-0.004	0.006	0.006	
	[0.21]	[0.27]	[0.22]	
Forest	-0.043	-0.037	-0.037	
	[1.99]*	[1.05]	[1.17]	
Fallow	-0.059	-0.032	-0.032	
	[3.69]**	[1.03]	[1.10]	
House plot	0.046	0.061	0.061	
	[1.05]	[1.46]	[1.16]	
Fruit	0.023	-0.246	-0.246	
	[0.62]	[0.76]	[0.88]	
Other	0.040	-0.027	-0.027	
	[0.98]	[0.48]	[0.48]	
FIDEG	-0.096			
	[2.06]*			
Titling	0.030			
	[1.09]			
Land Buyers	0.048			
	[2.02]*			
Agricultural machinery 1990 (in '000000 of C$)	-0.004			
	[1.50]			
non-agricultural capital (in '000000 of C$)	-0.078			
	[0.21]			
Value of cattle (in '000000 of C$)	0.245			
	[1.71]+			
Time to road	-0.000			
	[1.86]+			
Time to market	0.000			
	[1.46]			
Constant	0.048	0.026	0.026	0.031
	[0.47]	[0.79]	[0.59]	[0.71]
Observations	1894	1894	1894	1906
R-squared	0.16	0.47	0.47	0.46

Robust t statistics in brackets

+ significant at 10%; * significant at 5%; ** significant at 1%

Note: OLS regressions. (1) with municipal fixed effects and errors robust to intra-municipal error correlation, controls for age of head, age of head squared, female head, education of head, males over 12, females over 12, literacy (at least one literate in household), TV ownership, radio ownership, other property, dwelling with earth floor. (2) to (4) with household fixed effects. (3) and (4) with cluster effects-robust standard errors

Table 5

	(1)	(2)
Mode of access	Registered	Registered
Bought	0.013	
	(0.49)	
Squatted	-0.476	
	(4.77)**	
Donated	-0.239	
	(3.27)**	
Agrarian reform	-0.026	
	(0.56)	
Other	-0.240	
	(1.65)+	
Type of document		
Possession document		0.200
		(3.15)**
Private transfer deed		-0.086
		(1.36)
Provisional title		0.405
		(2.58)**
Public deed		0.671
		(13.56)**
Agrarian reform title		0.476
		(8.52)**
Communal title		0.238
		(1.71)+
Supplementary title		0.153
		(0.99)
Other		-0.145
		(2.25)*
Bought		0.061
		(2.17)*
Time	0.005	0.005
	(5.03)**	(5.28)**
Area	0.001	0.000
	(3.17)**	(1.80)+
Square or area	-0.000	-0.000
	(3.06)**	(2.10)*
Distance	-0.000	-0.000
	(0.57)	(0.00)
Investment in 1990	-0.002	-0.002
	(0.40)	(0.39)
Education of head	0.018	0.013
	(2.68)**	(2.15)*
Literacy	0.075	0.079
	(1.79)+	(1.96)+
Agricultural machinery 1990 (in '000000 of C$)	0.477	0.356
	(0.53)	(0.15)
non-agricultural capital (in '000000 of C$)	0.642	0.464
	(1.86)+	(1.43)
Value of cattle (in '000000 of C$)	-0.027	-0.078
	(0.16)	(0.47)
Other property (dummy)	0.074	0.068
	(2.27)*	(2.27)*
Time to road	-0.000	0.000
	(0.26)	(0.31)
Time to market	-0.000	-0.000
	(1.86)+	(2.16)*
Constant	0.449	-0.131
	(4.95)**	(1.36)
Observations	3175	3173
R-squared	0.26	0.42

Robust t statistics in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%

Note: OLS regressions. Both with municipal fixed effects and standard errors robust to clustering at the municipal level. Other controls include topographical dummies, age of head, female head dummy, subsample fixed effects, number of adults in the household, tv ownership, radio ownership, earth floor in dwelling

Table 6

	(1)	(2)	(3)	(4)
	Mean-differenced OLS	Mean differenced 2SLS	2SLS, robust VarCov	GMM
Registered	0.049	0.064	0.064	0.045
	(4.28)**	(2.26)*	(2.34)*	(1.81)+
Bought	0.004	0.003	0.003	0.006
	(0.30)	(0.22)	(0.20)	(0.52)
Time	-0.001	-0.001	-0.001	-0.001
	(0.80)	(1.16)	(0.92)	(0.89)
Area	0.000	0.000	0.000	0.000
	(2.30)*	(3.41)**	(2.26)*	(2.19)*
Square or area	-0.000	-0.000	-0.000	-0.000
	(1.33)	(1.28)	(1.25)	(1.11)
Distance	-0.000	-0.000	-0.000	0.000
	(0.22)	(0.20)	(0.24)	(0.94)
Investment in 1990	-0.001	-0.001	-0.001	-0.002
	(0.87)	(0.54)	(0.92)	(1.61)
Ondulated	0.029	0.028	0.028	0.027
	(1.59)	(1.84)+	(1.63)	(1.60)
Hilly	0.007	0.005	0.005	0.013
	(0.37)	(0.34)	(0.31)	(0.80)
Steep	0.014	0.015	0.015	0.029
	(0.56)	(0.57)	(0.62)	(1.24)
Other topography	-0.021	-0.020	-0.020	-0.023
	(0.27)	(0.24)	(0.27)	(0.30)
FIDEG	-0.024	-0.055	-0.055	-0.042
	(0.56)	(1.74)+	(1.66)+	(1.31)
Titling	0.028	0.027	0.027	0.025
	(1.32)	(1.32)	(1.30)	(1.31)
Land Buyers	0.058	0.059	0.059	0.050
	(2.95)**	(3.22)**	(2.96)**	(2.70)**
Agricultural machinery 1990 (in '000000 of C$)	-0.002	-0.002	-0.002	-0.001
	(0.61)	(0.27)	(0.58)	(0.16)
Non-agricultural capital (in '000000 of C$)	0.184	0.057	0.057	0.059
	(0.61)	(0.93)	(5.79)**	(6.46)**
Value of cattle (in '000000 of C$)	0.395	0.400	0.400	0.481
	(3.69)**	(3.97)**	(3.82)**	(5.39)**
Time to road	-0.000	-0.000	-0.000	-0.000
	(2.24)*	(2.28)*	(2.31)*	(3.43)**
Time to market	0.000	0.000	0.000	0.000
	(1.19)	(1.41)	(1.26)	(2.17)*
Constant	0.010	0.007	0.007	0.008
	(3.30)**	(1.29)	(3.81)**	(4.18)**
Observations	3174	3173	3173	3173
R-squared	0.04			
Overid test statistic		Sargan: 5.535	Hansen J=6.639	Hansen J=6.639
P-value		0.477	0.356	0.356

Robust t statistics in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%

Note: all regressions include controls for age of head, female head, education of head, tv and radio ownership and ownership of another plot.