Priests, Conflicts and Property Rights: The Impacts on Tenancy and Land Use in Brazil

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Lee J. Alston
Institute of Behavioral Science and Economics, *University of Colorado*
National Bureau of Economic Research

Bernardo Mueller
CERME - UNB
Department of Economics
University of Brasília

Abstract

Historically, and today, tenancy has been a mechanism for career advancement in agriculture by laborers, yet in Brazil and throughout Latin America, tenancy rates are low compared to the U.S. and the OECD countries. We test for the importance of insecure property rights in Brazil on the reluctance of landowners to rent because of a fear of expropriation arising from land reform. We found that land conflicts reduce the likelihood of tenancy and sharecropping and affects land use decisions with impacts on agricultural efficiency. We instrument land conflict with the presence of Catholic priests.

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Abstract

Historically and today tenancy has been a mechanism for career advancement in agriculture by laborers, yet in Brazil and throughout Latin America, tenancy rates are low compared to the U.S. and the OECD countries. We test for the importance of insecure property rights in Brazil on the reluctance of landowners to rent and to invest because of a fear of expropriation arising from land reform. We instrument land conflicts with the distribution of Catholic priests from a period before the Church became directly involved in land-related issues. We find that land conflicts reduce the likelihood of tenancy and affect land use decisions with negative impacts on agricultural efficiency. The extant literature on the impact of secure property rights on investment and land use shows either greater or lesser investment, our findings are more nuanced: we find lower investment in highest and lowest productivity land uses. We also show that insecure property rights led to a net increase in farm size contributing to the already highly concentrated nature of land holding in Brazil.

1. Introduction

Compared to the rest of the world, farmers in Brazil rely relatively little on tenant contracts.[1] In agriculture, career mobility is associated with moving up the agricultural ladder from working for wages to renting to owning [Alston and Ferrie 2005]. Alone, this fact may not present a puzzle but coupled with the large number of landless peasants and large amounts of unused land the question is: why don't landowners with unused or under-utilized land negotiate land rental contracts with the landless.[2] In Brazil this avenue for advancement has been hurt by a reluctance of owners to rent in areas experiencing land conflict. The lack of rentals is an important issue because Brazil is geographically a large country, roughly the size of the continental U.S. and has an expanding agricultural frontier, some of which is cutting into the Amazon. If the lack of land rentals is pervasive across Brazil and also signals inefficiency in production, the total magnitude is likely to be large when summed across the country. Some scholars have attributed the lack of rentals to a fear by landlords that renters will become *de facto*

[1] The use of land rentals is relatively low across all of Latin America. de Janvry, Macours and Sadoulet (2002) present tables showing the importance of land rentals across the world and for certain countries in Latin America. For the world, tenancy stood at 23% in 2000 (Federico, 2006). In Brazil, for 1996 tenancy was 2.5% (of total hectares) and 11% (of the number of farms) (IBGE, 2007).

[2] The MST (Landless Peasant Movement) estimates that there are 4 million landless peasants in Brazil. However, this estimate includes all who are 'demanding land' and is broader than those with actual aptitude for agriculture and the intention to stay on the land.

owners because of existing legislation making it extremely costly to evict tenants, if they are in default with their rental payments [Buanin et al. (2008); Conning and Robinson (2007); de Janvry, Macours and Sadoulet (2002); de Janvry and Sadoulet (1989); Deininger (2003) and Macours (2002).] A similar fear of rentals may arise from land reform projects [de Janvry, Macours and Sadoulet (2002), Rezende (2006)]. For example, in Brazil, land should be put to productive use or it may be subject to compensated expropriation [Alston, Libecap and Mueller (1999)]. Renting land could be deemed unproductive use by land reform agencies and as a result owners would be fearful of renting [Buanin et al. (2008), Brandão et al. (2001); Deininger and Chamorro (2003); Jamarillo (2001); World Bank (1994: 199-200)]. An additional explanation for the lack of rentals rests on the labor and capital intensity of different crops. Some land may not be worth the opportunity cost of capital, and the return to applying labor via a rental contract may be close to zero. As such landowners may opt to leave land vacant as a potential store of value or in some cases collateral for credit to be used elsewhere. Alternatively, if farmers are fearful that land may be invaded and expropriated if left idle, they might opt to rent to demonstrate use and possession, particularly if the landlord has reason to trust the renter. To the extent that land conflict and land reform policies affect land rentals and encourage expansion of the agricultural frontier into the Amazon, deforestation will result. By estimating the impact of land conflict on land rentals and land use we can better judge the deficiencies in current land reform policies and this can be a guide for better policies in the future. Better land reform policies can be trebly important: 1) Lives can be saved and poor people's lot improved if tenancy is a step on the agricultural ladder; 2) land reform policies can improve the productivity of agriculture in Brazil; and 3) land reform policies can slow the rate of deforestation in the Amazon, which holds the largest stock of tropical forests in the world. We test for the impact of land conflict on land rentals and land use by using *municipio* (county) level data from the Brazilian censuses along with data on land conflicts from the Pastoral Land Commission (CPT).

2. Theoretical Hypotheses about Tenancy

2.1. Literature Review

The theoretical literature on tenancy is voluminous. We assume that the standard explanations for the efficiency of sharecropping and tenancy – share and fixed-rent - are now public knowledge. By standard explanations we mean risk and transaction costs.[3] In short,

[3] By transaction costs we mean the information, monitoring and enforcement costs associated with contracting. They include issues of moral hazard and adverse selection. We also follow in the footsteps of the agricultural economists

depending on the endowments of landlords and workers as well as their preferences towards risk, there exist conditions such that the optimal operator status can be either, owner-operator (with only household or with hired wage workers); sharecropper; share tenant; or fixed-rent tenant.[4]

In the U.S. in the 19th and early 20th centuries there was a life-cycle to contract choice which agricultural economists referred to as the agricultural ladder. The 'ladder' referred to the movement with age from the statuses of wage worker to tenant to owner [Alston and Ferrie (2005); Alston and Kauffman (1997) and (1998)]. Climbing the rungs on the ladder meant acquiring human and physical capital as well as improving socio-economic status. Most transaction cost explanations for contract choice rest on the costs of information, negotiation, supervision and enforcement. The plethora of explanations based on transaction costs (or market failures) arose because many economists initially took to heart the Marshallian inefficiency argument and then had difficulty explaining why various forms of tenancy and sharecropping have been so ubiquitous over time and space (Marshall, 1890). Now economists are turning the issue on its head: why are there some regions of the world that rely too little on tenancy and sharecropping, given the existence of transaction costs? Consistent figures are difficult to find but both North America and Europe stand out in the high percentage of land and farm establishments rented. For example, de Janvry, Macours and Sadoulet (2002; pp. 24-25) present data showing that farmers in the U.S. leased 45% of agricultural land in 1988 and in Europe the figures for 1995 range from a low of 12% for Ireland to above 60% for Belgium, France and Germany. The figure for the U.S. in 2007 was 38.5% (US Census of Agricuture 2007, Vol. 1 Table 58). Figure 1 shows the evolution of tenancy in Brazil from 1920 to 1995. The total number of farm establishments that were rented fell by nearly half from 1970 (20%) to 1995 (11%), while the corresponding area fell from a high of 10% in 1940 to a low of 2.5% in 1995.

[Figure 1 here]

Recent explanations for the lack of rentals in developing countries rest on the insecurity of property rights. Insecure property rights may reduce the prevalence of rentals because of difficulties in conflict resolution. If it is difficult to evict tenants who do not meet the rental terms, landlords may respond by using wage labor or by only renting to those they trust such as relatives

analyzing tenancy in the early part of the 20th century. For a review of the some of the earlier work of agricultural economists see Alston and Higgs (1982).

[4] De Janvry, Macours and Sadoulet (2002) provide a very helpful table of the 'contextual conditions' under which each land tenure status is observed.

and friends.[5] In some countries tenants receive the right to purchase the land that they rent and not surprisingly landlords may be reluctant to rent.[6] Some governments prohibit land rentals on land redistributed through land reform projects, either *de facto* (because there are frequently delays in assigning formal titles) or *de jure* because of a fear of absentee beneficiaries.[7]

De Janvry and Sadoulet (1989) examine the impact of land reform in Latin America by integrating the choice of agricultural organization with the political economy of reform to analyze what they call 'the lost game of Latin American land reform.' The equilibrium they see prevailing in most of Latin America is one where the threat of reform in the 1960s induced large and medium sized farms to modernize and increase their productivity so as to preempt any form of expropriation, which in turn increased their economic and political power thus hindering any future attempts at reform even though reform could potentially lead to large net social gains. Their approach is a good description of the history of tenancy in Brazil where legislation put into place in the early 1960s was explicitly hostile to tenancy and sharecropping, inducing landowners to expel masses of tenants from their lands in the following decades.

Conning and Robinson (2007) and Besley et al. (2011) analyze the impact of property rights on tenancy in India through models and empirical tests that are closely related to the objective of this paper. In both cases insecurity of property rights arises from reforms pushed by the government to protect tenants and/or landless peasants. These reforms make renting out less attractive to landowners thus leading to less use of tenancy contracts. We will describe their approaches below and in the next subsection present a simplified framework for thinking about the impact of property rights on contract choice and land use that we use to test the Brazilian data.

Conning and Robinson (2007) analyze the effect of property rights insecurity on agricultural organization by linking a model of contract choice to a political economy model of potential property rights reform. In the contract choice model the key feature is the existence of an essential non-traded factor (skill) that is required for production in addition to land and labor. Because this factor cannot be traded, the efficient organization of agriculture requires farm sizes that are proportional to the distribution of this factor, with land being leased from those who do not have enough of the essential factor to those with an excess relative to their own holding of

[5] Macours (2002) found that in the Dominican Republic landlords were more likely to rent to those in their same social network.

[6] This was the case in the Pampas in Argentina under Peron (Gallo, 2003); and in the Dominican Republic following legislation passed in 1972 (de Janvrey, Macours and Sadoulet, 2002).

[7] Brazil is probably not atypical in the long delays associated with assigning formal titles. In Mexico, until recently, the government forbade the renting of *ejidos*.

land. This second-best situation will hold if property rights are secure. But if landowners have reasons to fear that future events might bring a change in the security of property rights, such as a land-to-the-tiller reform, then the agents might optimally chose to forgo the potential gains of entering into tenancy contracts so as to avoid the losses that will be borne if the threat does materialize. The approach includes two factors increasing the transaction costs of renting land: a non-traded factor and insecure property rights; with both reform and the extent of tenancy being endogenously determined. The most important testable hypothesis that emerges from the model is that anything that increases the threat to property rights will lower the incidence of land rentals. We test this hypothesis with county level data for Brazil in Section 4.

Besley et al. (2011) utilize a natural experiment to test the impact of insecure property rights. Besley et al. take advantage of a reorganization of state boundaries in India in 1956 that left districts with very similar social and economic characteristics but subject to different types of tenancy and land reforms. Their model focuses on the reaction of landowners to the constraints and uncertainty that arise from different land reforms. They find that reform led to a reduction in tenancy as many landlords opted to sell their land. This resulted in a reduction of land inequality as land was transferred to poorer individuals including many previous tenants. This redistribution did not benefit all social groups, however, for members of the middle castes were more likely to have the means to purchase land than the lower castes who were typically laborers or sharecroppers rather than tenants. The reforms thus led to an increase in landlessness among the lower castes. The decrease in sharecropping was accompanied by an increase in the agricultural wage as landlords that no longer relied on tenants or sharecroppers increased their demand for workers but this was not sufficient to compensate the welfare loss of the poorer sub-group.

2.2. Conceptual Framework

In this subsection we describe the mechanisms through which property rights affect the decision of landowners and peasants to enter into tenancy contracts. We focus on a landowner's decision of contract choice (who will use the land) and land use (what will be planted). Because our data for Brazil is at the *municipio* (county) level, it is important to understand a mechanism operating at the *municipio* level. In any given *municipio* there are *N* landowners, each with different personal characteristics (e.g., wealth, age, education, experience and acquaintances), and different land characteristics (e.g., location, fertility, access, topography, water and type of title). Because of these varied characteristics, there are different dispositions by each landowner to rent

out all or some of their land. The landowner makes his decision by comparing the expected net present value of holding the land under tenancy, Π^T, versus the net present value of the best alternative use, Π^A, which could be using the land herself, leaving the land idle, or selling it.[8] When $\Pi^T > \Pi^A$ the landowner would opt to rent the land and when $\Pi^T < \Pi^A$ the best alternative use would be chosen, with the landowner indifferent in case of equal expected net present values.

In any given *municipio* there is a distribution of landowners according to the difference between the NPVs from using the land under tenancy compared to the next best alternative use. This distribution ranges from landowners on the left for whom tenancy is less attractive than the alternative use to those on the right for whom the expected returns from renting the land are higher than the expected returns from using or selling the land. There is therefore a cutoff point in the distribution where $\Pi^T = \Pi^A$. Given the historical lack of tenancy in Brazil and Latin American one would expect much of the mass of the distribution in these countries to be to the left of the cutoff.

The issue that we analyze in this paper is: what happens to the distribution of landowners if property rights in the *municipio* become less secure? That is, what is the impact of weaker property rights on the extent of tenancy in a given *municipio*? For those landowners in either of the tails of the distribution small changes in property right security will not impact their decisions. Tenancy is either very attractive or excessively risky (unprofitable) for them and their decision would not be affected. But for those closer to the cutoff point the change in property right security might lead to a different decision. In which direction does the deterioration of property rights move the distribution? The answer to this question depends on what happens to both Π^T and Π^A. Because both of these net present values will likely fall when property rights become less secure, the direction and magnitude of the shift of the distribution relative to the cutoff point depends on the change in landowners' expectations of profits in response to the change in property rights. If the security of property rights reduces the expected NPV from tenancy more than it does the expected NPV from the best alternative use, then the distribution

[8] The actual decision would be between all the possible combinations of land contracts overtime, such as waiting x amount of time before renting the land, then renting it for at least the legislated minimum amount of time, then taking the land back for y amount of time before renting it again or not. To simplify we consider only the choice between renting now forever, and not renting at all. The basic point about the impact of property rights can be made without loss of generality in this simplified context.

moves to the left and the extent of tenancy in the *municipio* decreases. If Π^A decreases more than Π^T then the distribution moves to the right and tenancy becomes more prevalent.

What are the channels through which a decrease in the security of property rights affects Π^T and Π^A? There can be both direct and indirect effects. The direct effect on tenancy is the case when the landowner perceives a greater risk of having her land invaded or expropriated if she rents it out. This would be the case of a land-to-the-tiller type of land reform (see Conning and Robinson, 2005) or as explicitly stated in the 1964 Brazilian Land Statute (Article 20): "The expropriations by the Public Power will be directed towards: … V – areas that present high incidence of renters, sharecroppers or squatters." The direct effect on the alternative use would be to force the landowner to make the land more productive than optimal (which might be to leave it idle) so as to preempt an invasion. This is the reaction found by several studies on property rights such as Besley (1995), Carter and Olinto (2003), Place and Otsuka (2003) among others.

But even when the landowner does not perceive a very high probability of having her land directly impacted, there can be important indirect effects from weaker property rights that reduce her expected return from the land. In the case of tenancy the landowner might perceive an increased risk that the person to whom she rents will not abide by the contract, e.g., by not paying the rent in full, in a timely manner or defaulting completely. In addition a landowner may worry that the tenant does not care for the land by making the needed investments. According to Almeida (2002), who interviewed a sample of landowners that were or had been engaged in renting out land in Brazil, these are major concerns when deciding whether to enter in tenancy contracts. Less secure property rights in a *municipio* alter the landowners' perception of the risk of having the contract violated by the rentee and affect the probability of redress through the courts or government. In Brazil where the legislation, policy and public opinion clearly side with the weaker part in agrarian relations (Alston, Libecap and Mueller, 2010), the result of higher insecurity in the *municipio* would be to reduce the expected NPV of a tenancy contract. Finally, the indirect impact of more insecure property rights on a landowner who opts not to rent is to reduce the value of his land, which affects access to credit and opportunities to sell the land.

The question is: whether the direct and indirect impacts of property rights insecurity will be larger on Π^T or on Π^A (or will have no effect on either)? This is essentially an empirical issue, though our prior from the qualitative accounts is that the decrease in Brazil in the property rights of landowners will reduce tenancy. There is evidence in both directions in the literature for

several different countries around the world (see Besley, 1995; Conning and Robinson 2007; Besley et al. 2011; Pande and Udry 2006; Place and Otsuka 2002; Carter and Olinto, 2003; Deininger and Ali 2008; Ghatak and Roy 2007; Biswanger, Deininger and Feder 1995; among others). There is also evidence that each of these channels is at play in shaping the incentives of Brazilian landowners (see Alston, Libecap and Mueller 1999, 2000; Hidalgo et al. 2010; Rezende 2006; Vertova 2006; Moura and Bueno 2009). Insecure property rights make landowners reluctant to rent out the land, but if they are unwilling to use their land, which was often the case in Brazil in the period we study, renting out may offer protection against invasion and expropriation. The empirical test in this paper determines whether renting increases or decreases in the face greater insecurity of property rights in Brazil. If we find that *municipios* that experienced more conflicts, our measure of property rights insecurity, have a greater extent of tenancy, then the net effect of conflicts will have been to move the distribution to the right and we can conclude that tenancy is less sensitive to weaker property right than use of the land by the landowner. Alternatively if we find (and expect) that conflicts reduce tenancy we can conclude that the negative effect of weak property rights on tenancy outweighs its positive incentives for landowners to put idle land to use through renting or selling.

The impact of property rights on land use decisions can be analyzed in a manner similar to the contract choice decision described above. Our data classifies all land in a *municipio* as natural forest, planted forest, permanent crops, temporary crops, natural pasture, planted pasture, fallow, usable but unused and unusable. A land owner or operator compares the net present value of putting the land under all possible combinations of these land uses and chooses the combination that gives the highest expected return. Here too, the varied characteristics of the operators and of their land leads to a (multi-dimensional) distribution of land use choices with different farms being put to different combination of uses. As in the case of contract choice, changes in the security of property rights will affect land use decisions. There are basically two concerns that arise from insecure property rights. The first is that some uses of the land, such as leaving it idle or in natural pasture, are considered by land reform legislation, as unproductive uses that do not contribute towards the constitutionally mandated 'social function of the land,' so the farm will be formally subject to expropriation and informally vulnerable to invasion by organized groups of landless peasants. We expect that a deterioration in property rights will lead to reduction in idle land and natural pasture. The second concern of landowners is that insecure property rights increase the risk of investing. Even though productive farms are typically not invaded or

expropriated, insecure property right in the form of conflicts and violence in the *municipio* can disrupt labor, land, credit and input/output markets as well as adversely affect transportation, local politics and government services, reducing the expected returns to investments.[9] By estimating the impact of conflicts on each type of land use, we will be able to determine the circumstances under which property rights induce or dissuade investment. Because each type of land use is differently susceptible to each of the two impacts of weak property rights – greater risk of expropriation of idle or unproductive land, and an ambiguous impact on investment to increase productivity - the test allows us to determine which effect prevails in Brazil.

3. Data and Empirical Strategies

3.1 – Introduction

We utilize data that includes all *municipios* (counties) in Brazil and contains variables that measure both the agro-climatic/geographic determinants of contract choice, as well as the political economy determinants. We estimate a system where the dependent variable of each equation is the percent of total farm area that is held under each of the four categories included in the Brazilian Agricultural Census: fixed rent, sharecropper, owner and squatted/occupant (no formal title).[10] In order to measure the extent to which contract choice is determined by the natural and physical endowment of each county, we use as independent variables the percent of total farm land that is placed under cotton, rice, coffee, cane, beans, manioc, corn and soybeans. Each crop has its own physical attributes and agro-climatic requirements which determine where they can be grown and the best farm size, given relative prices. At the same time each crop's attributes along with attributes of the landowner imply that a given type of contract would be best for dealing with the problems inherent in its production. Coffee, for example, is a perennial crop, by nature labor intensive, has few economies of scale and consequently tends to be produced more productively by smaller owner-run farms than by fixed rent contracts.[11] Other variables that control for the impact of endowments, capturing elements of geography, transport costs and

[9] A productive farm might be invaded if its title is suspected not to be legitimate.
[10] In the Brazilian Agricultural Census fixed rent are those properties that belong to a third party but are worked by a producer who pays a previously set fixed quantity in cash or its equivalent in products. Sharecroppers work properties that belong to a third party in exchange of a previously set proportion of the production. Occupants are those on land that belongs to some third party (may be public land) with no payment in exchange, which might be the case of squatting or of consensual cession of the use of the land. Owned land belongs to the producer on the land.
[11] Potentially long term leases could deal with the perennial nature of coffee but perennial leases may be more problematic with respect to the legislation's emphasis on beneficial use, issues that we discuss shortly.

climate, are the distance to state capital, transport costs to São Paulo, existence of train stations, latitude and longitude.[12]

The major objective of the empirical test is to ascertain whether the choice of agricultural organization in terms of contract choice is essentially determined by endowments, that is agro-climatic and geographic factors, or whether political economy factors also have an effect; distorting the choice of contract in terms of efficiency, given the crop mix in the county. To this end we use data collected by the Pastoral Land Commission of the Catholic Church (CPT) to measure the extent of land-related violence in each county from 1985 to 1995. In those places that experienced violence and conflict, land owners and claimants expect a greater probability of intervention from the government, generally in the form of expropriation and redistribution of land to landless peasants through the creation of settlement projects (Alston, Libecap and Mueller, 1999a, 1999b, 2000, 2008). The struggle for land in Brazil since the mid 1980s has essentially revolved around the strategy by organized groups of landless peasants, such as the Landless Peasants Movement (MST), of selectively invading properties that are legally vulnerable to expropriation (regions with high tenancy, low productivity, weak title and/or large holdings) so as to attract the government and force it to expropriate in their favor. The impact of conflicts affects not only the decision of whether to plant or not, but also whether to engage in tenancy contracts. One of the main reasons for this is that the Land Statute of 1964, which still underpins all of the land related legislation. The Land Statute of 1964 imposes very rigid limits for tenancy contracts and explicitly states that farms in rental arrangements may be preferable candidates for redistribution.[13] The origins of this bias in the legislation may be a reaction to the historically very unequal distribution of wealth and power in the Brazilian countryside. Nevertheless, as noted in World Bank (1994: 199):

> … the perverse effect is to reduce access to exactly those people the regulations were designed to protect. In addition, the Land Statute contains other provisions that relate the incidence of renting and sharecropping to the possibility of expropriation of farms, that is, the law provides that "expropriation... will be applied to: ... areas with high incidence of renters, sharecroppers and squatters." The threat of expropriation may have been much more effective in constraining the rental market and sharecropping arrangements than the provisions that regulate such arrangements. This seemed to be particularly true when claims for land reform were increasing.

[12] Other factors such as soil type, temperatures, rain, and sunshine are partially captured by state dummies.
[13] For a very good discussion of the hostility towards tenancy arrangements in Brazilian legislation see Rezende (2006, section 8). See also Romeiro and Reydon (1994).

Another strong legal impediment to tenancy in Brazil is the 1963 Rural Worker Statute that extended the set of legal labor benefits already held by urban workers to those in agriculture (Rezende and Kreter, 2007; The Economist, 2011: 43).[14] The Statute set regional minimum wages, established the 13th salary, holidays, payment for overtime, 48-hour workweek and limited the employers' acceptable justifications for firing. It is argued by several authors that even though this regulation was not well enforced, it was far from innocuous and the imposition of these encumbrances led landowners to dispense hordes of rural workers, both tenants and wage workers and to switch towards using temporary workers [Saint, 1980; Ribeiro and Stolf, 1975; Nichols, 1971, IPARDES 1978; Carvalho, 1991].

Given this nature of land and labor policy in Brazil and in accordance with our conceptual framework, the expectation is that the variable that measures conflict will be negatively related to both the percentage of area in fixed rent and sharecropping and positively related to the area in owner-farmed properties, even after controlling for endowments. Although labor legislation and those parts of the land legislation that directly refer to tenancy impose impediments to this type of contracting, land reform legislation may provide incentives in the other direction. As noted above, land reform today in Brazil starts with invasion of unproductive properties by organized landless peasant groups with the government providing land reactively. In this scenario it may make sense for a landowner who wants to hold land but not yet put it to use, to lease the land as a means to make it productive and thus immune to expropriation.[15] Our results will allow us to test which effect of conflicts dominates in Brazil, or if they cancel each other out. If we find a positive and statistically significant impact of land conflict on fixed rent and sharecropping, then we can conclude that land reform provides incentives for landowners to enter into more rental arrangements than they would in the absence of conflicts, and the low levels of tenancy in Brazil would be even lower without conflicts. This result would be in line with that found in Ghana by Besley (1995), in Uganda by Place and Otsuka (2002), in Paraguay by Carter and Olinto (2003), in Africa by Pinckney and Kimuyu (1994) and for Brazil by Vertova (2006). If, however, we find the coefficient of conflicts in the fixed rent and sharecropping equations to be negative, this will

[14] To the present day Brazil possesses very progressive labor laws conceding a wide set of benefits and privileges to rural and urban workers. Labor justice in Brazil almost always decides in favor of the employee, which at least reduces uncertainty. However these benefits make for more rigid labor markets and may increase unemployment.

[15] During much of the 1970s and 1980s the lack of a more highly developed financial system meant that land ownership was a widely used instrument to hedge against inflation. This resulted in large areas of unproductive latifunidia despite the possibility for the owners to gain twice by renting the land out to productive use while still fulfilling its financial objective. Rezende (2006) argues that the lack of rentals results from the hostility of the agrarian legislation towards tenancy arrangements.

be strong evidence of a perverse effect of land legislation on the choice of agricultural contract leading to inefficiencies of the type predicted in the models by Conning and Robinson (2007), Besley et al. (2011) and de Janvry and Sadoulet (1989).[16] It is also possible that different impacts prevail in different regions, for different types of producers and in different periods of time. We test for these possible variations where the data allow.

In addition to testing the effect of property rights on tenancy, we also estimate its impact on land use, that is, the decision whether and what to plant. We use the same independent variables from the tenancy equations (endowments plus conflicts) in a system of eight land use equations where the dependent variables are the percent of land in the *municipio* in: natural forest, planted forest, permanent crops, temporary crops, natural pasture, planted pasture, fallow, and usable but unused land.[17] The impact of conflict in each of these equations will provide additional evidence of whether insecure property rights increase or decrease productive activity. Before turning to the results, it is necessary to address the problem of endogeneity of conflicts.

3.2 – Instruments for the First-stage Estimation of Conflict

Our major objective is to determine the relative impacts of conflicts and endowments on contract choice and land use. However, there is a potential endogeniety of conflicts that would render OLS estimates inconsistent, given that land invasions and other forms of violence may be more probable in areas where there is a greater incidence of tenancy arrangements and farms without formal title. Similarly, certain types of land uses, such as forests or unused land, are characterized as unproductive and may attract invasion and expropriation. We confirm this endogeneity by a Hausman-Wu test which we present in the results section (Tables 4 and 5). Therefore we need to find appropriate instruments for conflict in order to estimate a first-stage equation that will allow us to control for the potential simultaneity. These instruments must be correlated with conflicts but should have no direct link to contract choice or land use. The dependent variable of the second-stage regressions is contract choice and land use in 1996.

[16] Pande and Udry (2006) provide a very detailed review of the literature on the effect of property rights on economic outcomes in agriculture in developing countries. In Table 5 they summarize numerous studies for many different countries. The results in the literature vary considerably leading the authors to conclude that "… land titling and registration typically increase agricultural productivity and farm investment. However, the extent of increase depends upon the details of the titling program and the pre-existing land tenure system."

[17] The census ascribes all the land in a *municipio* to a mix of these eight land uses plus another category 'useless land'. The sum of the area in these nine categories adds up to 100% of the farm land in that *municipio*. We suspect that the 'useless land' category is calculated by residual because when all nine variables are used in the system it results in covariance matrix of errors that is singular. We take the amount of 'useless' land as given and not a choice, and thus leave this variable out of the system. The average value of this variable is 4.7% of total area.

Because we want to determine the impact of conflict on contract choice and land use, the conflict data aggregates all land-related conflicts in each county from 1985 to 1995.[18]

An appropriate instrument should be a variable that has a strong relationship with rural conflicts. A natural place to look is at groups and organizations that helped landless peasants to organize and fight for their rights. There has long been a struggle for land in Brazil leading to violence and conflicts. But, with the exception of a few isolated historical cases, it was only in the early 1980s that there came about a systematic increase in the number of organized groups of landless peasants throughout the entire country. As is often the case with grassroots movements, the widespread emergence of organized landless peasants groups in the 1980s in Brazil was not a spontaneous phenomenon, but rather the result of other social groups that sought to catalyze social change by organizing and prompting peasants into action. The main motivation for these groups was the extremely poor living conditions and high levels of exploitation of the rural poor in Brazil, which are essential features of the country's historical legacy. A measure of the presence of such catalyzing groups across *municipios* would thus be a strong candidate for an instrumental variable for conflicts, though we would still have to certify that the presence of these groups was in no way affected by the existence of tenancy arrangements or specific of land uses.

Three potential catalyzing groups are rural unions, opposition political parties and the Catholic Church. Due to lack of data on rural unions and probable violation of the exclusion restriction for opposition parties we focus on the Church. During the 1970s the Catholic Church in Brazil was undergoing a process of change in its political stance, and its relation to the military regime and ruling elites. In this period it became the "most progressive Church in Latin America" (Bruneau, 1985: 271) and explicitly announced a 'preferential option for the poor'. By the early 1980s the Church was explicitly engaged in organizing groups of landless peasants throughout the country to demand their rights (Mainwaring and Wilde, 1989). As noted by Houtzager (2001):

> The church was an ideal institutional host. It is a transnational institution with firm roots in rural communities. It is able, on the one hand, to garner critical resources, information, and political support from national and international sources and, on the other, it is a local actor represented by the Bishop, the parish priest and local pastoral agents. Progressive clergy and lay activists in Brazil were able to mobilize rural social groups (primarily small farmer and peasant groups) and local resources through the church's impressive associational web, its own elaborate organizational structure, and a popular religious identity. The church's myriad pastoral programs, the CPT and other church entities, linked community leaders and activists to each other and to the national movements of the left emerging in the transition. … Religion conferred a degree of legitimacy and provided

[18] Conflict data is only available for years since 1985.

> protection from repression by local elite groups and the national state. This depth of the church's involvement in organizing rural social groups and its direct, self-conscious, sponsorship of these groups' involvement in a national movement, distinguishes the church as institutional host from the church as a simple ally. Houtzager (2001: 23-24)

This key role of the Church in organizing rural communities is highlighted by one of the founders and still currently the main leader of the Landless Peasant Movement (MST) João Pedro Stédile in Menezes Neto (2007):

> The CPT (Pastoral Land Commission) was the practical application of the Theology of Liberation, which was an important contribution to the landless peasants' struggle from the ideological point of view. The priests, pastoral agents and pastors discussed with the peasants the need for them to organize themselves. The Church stopped doing messianic work and saying to the peasant: 'Wait and you will go to heaven.' Now they started saying 'You have to get organized and fight to solve your problems here on earth'.

Adriance (1991, 1994, 1995), Hewitt (1990) and Krischke (1991), Mainwaring (1986), Maybury-Lewis,(1994) recognize the critical role of the Catholic Church in enabling the rural organizations that changed the nature of the struggle for land in the 1980s. Therefore a variable that measures the strength of the church's presence in a given *municipio* during this period should correlate with the existence of conflicts over land. We do have data on the number of priests per *municipio* for several years starting in 1966, so this variable may be used as an instrument for conflict if it also passes the exclusion restriction (investigated below).

In order for priests to be appropriate instruments for conflict in our contract choice and land use regressions it is necessary that priests are distributed across *municipios* in a manner unrelated to land contracts and land use. It may seem natural that if the Church cared about landlessness they would tend to focus their presence in those areas where there was a greater incidence of landownership concentration, sharecropping, inequality and other potentially explosive agrarian issues. In order to investigate the determinants of the location of priests we analyzed the historical timing of the Catholic Church's involvement in agrarian issues in order to pick a period before it had expressed concerns or taken actions to systematically assist the landless and rural poor. Fortunately, there is a distinctly recognizable and well documented trajectory of the Church's ideological and practical shifts over the past decades which we can exploit to assure that our measure of priest allocation is not linked to the way land was being used. During the 1970s in most of Latin America, and most prominently in Brazil, the Catholic Church gradually abandoned its traditional position as an ally of the prevailing regimes and ruling elites to take an

explicit stand in favor of the poor and dispossessed. The first manifestation of this change was the meeting of the Latin American episcopate in Medellin, Columbia, in 1968. The meeting produced a document, which instead of being based on religious dogma and doctrine was inspired by Dependency Theory and Liberation Theology, with clear anti-capitalist rhetoric professing the need for the Church to play a central role in combating poverty and inequality (Brito, 2010). During the 1970s this point of view sparked much controversy and disagreement within the Church as conservative forces resisted these new ideas. The culminating point of this power struggle was in a subsequent meeting of the Latin American episcopate in Puebla, Mexico, in 1979 after which the episcopate issued a new document. Even though the conservative forces counted with the presence of the newly elected Pope John Paul II, who attended the meeting, the outcome was a clearly progressive document in which the Church officially established the famous 'preferential option for the poor.'

In Brazil the Church had supported the military coup of 1964 but as the regime became increasingly repressive it shifted to a clearly opposing position by the mid-1970s (Skidmore, 2003: 247). In 1975, the Brazilian Catholic Church created the Pastoral Land Commission (CPT), demonstrating a growing concern for agrarian issues, though at that point it focused only on Amazonian states. But most importantly, in 1980 a General Assembly of the Brazilian Bishops released an official document called "The Church and Problems of the Land" in which it emphatically affirmed its intention to play a direct role in improving the lot of the rural population. After a long diagnosis directly blaming the capitalist system for the exploitation of rural workers and landless peasants, the document proposes to take the following (among other) lines of action as guiding principles of its pastoral commitments:

> 2nd – We commit to denounce openly inequitable and violent situations that are committed in our dioceses and parishes and **to combat** the causes of those injustices and violence …
>
> 3rd – We reaffirm our support for the initiative of workers' organizations **placing our power and means at the disposal of their cause** … Our pastoral action, careful not to substitute the initiatives of the people, will **stimulate the conscious and critical participation of workers in unions, associations, commissions and other forms of cooperation, so that they can be truly autonomous and free, defending their interests and coordinating the demands of their members and of their entire class**. (CNBB, 1980: paragraphs 97 and 98. Our emphasis in bold.)

This document in 1980 can be interpreted as marking the point at which the Church in Brazil started to actively and directly engage with agrarian issues. There may

have been individual and isolated instances in the 1960s and increasingly in the 1970s where priests and other lay church members got involved in such issues. But this document marks the turning point where this involvement became an explicit policy of the Church as whole. It is noteworthy that the bishops' document was approved by an overwhelming majority of 174 votes against 4 (Martins, 1980: 39). The following years from 1980 to 1985 would be the heyday of the Church's involvement in land-related issues. It is during this period that the Landless Peasants Movement (MST) was incubated, having been officially founded in 1984. Our conflict data begins in 1985 partly because it was at this point that land invasions started to become a sufficiently widespread and systematic phenomenon to merit record keeping.

Yet, after the first half of the 1980s, the Church's direct association with land-related issues started to wane. In part this happened as a result of their own success in jump starting grassroots organizations such as the MST, unions and cooperatives that eventually became autonomous and self-organized. Also, with re-democratization in 1985 several other mediating groups that had been suppressed during military period (re)emerged and actively competed with the Church for the role as the main institutional link for the new peasant groups, foremost among these political parties, NGOs and unions. Other determinants of the decline of the Church's direct involvement in agrarian issues include the direct pressure from the Vatican under Pope John Paul II (who was strongly anti-Marxist) and staunch competition from evangelical movements (Adriance, 1992; Serbin, 2000). Hewitt (1990) noted that:

> In more recent years the Church has become increasingly confused with respect to support for societal transformation. Not only has the upper hierarchy become more fractious, a tendency toward conservatism has also become apparent. The Church as an institution has returned to previous modes of political influence and appears to be **abandoning its support for grassroots movements in favor of direct pressure on political policy makers**. (pg. 148)

From the description above one can visualize a graph of the evolution of the Church's **direct** involvement in agrarian issues over time that starts at low levels in the 1960s, gradually increases until the mid-1970s when it bends upward, spiking in the early 1980s only to drift back down systematically to moderately low levels by the 1990s. This timing is central for our identification strategy. The dependent variables in our analysis (land contracts and land use) are from 1996. The key explanatory variable (conflicts as a proxy for property rights) is from the period of 1985-1996. By using priest data from 1966

as an instrument for conflicts, that is, before the Church demonstrated the inclination and propensity to get directly involved in land-related issues, this variable can be viewed as randomized for the purpose of estimating conflicts. The allocation of priests in the early 1980s may have been affected by the Church's decision to directly interfere with rural issues at that time. But the allocation of priests in 1966 was not contaminated by this change that would only take place some 15 years later. Menezes (2009: 1) notes that those isolated cases prior to the early 1960s where religion took part in the struggle against rural strife "… took place out of institutionalized churches, especially the Catholic Church." For our purposes the allocation of priests by 1966 can thus be assumed to have been determined by a series of historical and tradition-related factors with roots prior to that time, with agrarian issues not featured prominently among them. This 'randomized' allocation persisted until the early 1980s due to institutional inertia, that is, the Church simply did not change its distribution of priests significantly over time.[19] The correlation of the number priests per 1000 rural population in 1966 and 1985 is a high 0.81. This suggests that even when the Church did make the decision to get directly involved in land-related issues it probably did so not so much by changing the number of priests in different locations as by encouraging those priests that were already there to be more proactive on agrarian issues.

The withdrawal of the Church from direct hands-on support for peasant movements by the mid-1990s is also important for our identification strategy. If landholders in 1996 had their decision to enter into tenancy arrangements affected by the greater or lesser presence of priests in the region, our identification strategy could be compromised. However, as we have argued, by that time the Church no longer played a direct part in the struggle for land. Instead other groups representing landless peasants, most notably the MST replaced the previous role of the Catholic Church. Thus the marker that landowners would use to gauge the risk involved in entering into tenancy contracts or in planting different crops, would not be how many priests there are in the region but

[19] During this period there was actually a drop in the number of priests as fewer candidates were willing to undertake this career and lifestyle. This trend only changed in the late 1970s as a rising supply of candidates from lower classes and rural backgrounds appeared to substitute for the dwindling number of middle class candidates that had traditionally filled the ranks of the priesthood (Antoniazzi, 2003: 6). This fact may also be a cause and consequence of the Church's involvement in agrarian issues at that point in time.

rather the presence of mobilized groups of landless peasants with their characteristic red flags flying and waiting for the right moment to launch another invasion.

A final concern regarding priests as an instrument is that the data on rural conflict is collected by the Pastoral Land Commission (PLC), which is part of the Church, so that the correlation we find between priests and conflicts could potentially be due to a bias in the way the PLC collects data on conflicts. The concern is that the data may under-represent conflicts in areas where there are fewer priests because the PLC has a weaker presence in such places. In this case any impact of priests on conflict in our estimation would not be solely through the channel of priests organizing grassroots movements, but also partly due to the data-collection process. Note, however, that even if the data is skewed in this way it does not violate the exclusion restriction for priests to be a suitable instrument. It would mean that our estimate of the impact of priests on violence would be overstated, and that in the second stage our measure of property right insecurity would not be as encompassing, but nevertheless the estimation would be consistent. We note that the Pastoral Land Commission conflict data seems to be complete and is used not only by the Church as the definitive measure of rural unrest, but also by the government, the landless movements, the press and academics.[20] Whereas there is great controversy regarding the numbers of families that the government claims to have settled in its land reform program, we have found no critiques of the CPT data of land conflicts.

In order to better capture the catalyzing effect of priests over rural organization we interact the priest variable with another variable that measures the 'frontierness' of the *municipio*. The idea is that frontier areas are more contentious, with less well-defined property rights than areas that are already well established (Garcia-Jimeno and Robinson, 2009). Similarly, in these areas the priests suffer less monitoring from hierarchical superiors that tend to be less progressive and thus have greater liberty to pursue more radical interventions. This strategy allows us to identify how the effect of priests on conflicts varies with the socio-political nature of the county in question. We will assess the robustness of our results without the interaction of frontierness in Section 4.4.

In order to measure the 'frontierness' of a given county we take advantage of the fact that over time the number of *municipios* in Brazil has greatly increased through the subdivision of

[20] Hidalgo et al. (2010) use Pastoral Land Commission data from 1988 to 2004 and claim that their results are robust to different samples and measures that are used to assess if there is any coverage or reporting bias in the data.

counties into two or more autonomous entities. This movement has lead to an increase from 643 *municipios* in 1872 to 5,507 in 2000. The evolution of the number of *municipios* suggests that the creation of new *municipios* accompanies the expansion of the economic, demographic and agricultural frontiers (Reis, Pimentel and Alvarenga, 2009). As the frontier expands there is a natural tendency for political-administrative decentralization by creating new counties out of localities within the original *municipio*. Our index of 'frontierness' uses this correlation to create a measure of the *municipios* that have undergone a greater process of frontier expansion. The subdivisions that take place over time have made comparisons of county-level data over time very difficult. Fortunately, the Census has recently created minimum comparable areas (MCA) that aggregate the data in such a way that makes comparison possible (IBGE, 1984; Reis, Pimentel and Alvarenga, 2009). In our empirical tests we use the MCAs for 1970-2000 which aggregate the 5,507 counties in year 2000 into 3659 comparable areas. We create our index of 'frontierness' by counting the number of *municipios* in 2000 that are in each of these MCAs. The great majority of MCAs (2894 out of 3659) did not undergo any modification from 1970 to 2000, indicating a consolidated frontier process. The remaining 765 MACs underwent varying number of subdivisions, with the distribution varying from 482 MCAs that subdivided twice to one that subdivided 52 times. We use our 'frontier' variable in the conflict equation both to access its own impact on conflict as well as interact it with our data on priests. An alternative to try to capture the same effect is the distance from the state capital, which we also use, however the frontier index is superior as the furthest places are not always where the frontier has expanded the most.

3.3. Data

Our estimation procedure involves a first-stage regression to obtain the predicted level of conflicts per hectare in each county, and then a second stage where contract choice or land use is the dependent variable. This involves four general groups of variables which we describe briefly here, leaving the details to Appendix 1. Our observations are at the level of minimum comparable areas for the period 1970-2000, which comprises a total of 3,659 observations. Some of the variables were available for downloading from IPEADATA (www.ipeadata.gov.br) in the MCA format, but other variables, such as the conflict and priest data, and even some of the agricultural census variables had to be aggregated to fit the MCA format.[21]

[21] We thank Mario Miranda and Adam Canton for research assistance preparing the data.

The first group of variables is from the Agricultural Census (IBGE). This includes the contract choice variables (% of total farm land), crop mix (% of total farm land), land use variables (for example, natural forest, planted forest, permanent crops, temporary crops, and pasture, all in % of total farm land), average size of farms (hectares), and tractors per hectare. We use agricultural data for both 1995 and 1985, sometimes to calculate growth rates.

We use conflict data from the Pastoral Land Commission (CPT) of the Catholic Church. The CPT released data on conflicts in yearly reports since 1985. The data cover threats, murders, murder attempts and land invasions (occupations), by *municipio*. We used this data to create a simple additive index. In this index we gave a weight of ten to occupations because these are central to land conflicts and involve large numbers of people. A non-weighted index yielded essentially the same results.[22] In creating the index the total number of violence-related incidents is divided by the number of farms in the *muncipio*.

Our third set of variables measures the presence of the Catholic Church in each county. We use data from Catholic Hierarchy (http://www.catholic-hierarchy.org/) which provides not only the number of Catholics and of priests per diocese but even the names of all the bishops. In order to make the diocese level data compatible with the county and MCA data we used the Catholic Census of Brazil compiled by CERIS (1997). The data on priests is available for several different years starting in the early 20th century. We choose to use data for 1966 because this is prior to the Church's active engagement with landless peasants and it is also the earliest year for which the data cover all *municipios* given our use of minimum comparison areas. We divide the number of priests by rural population to account for the different diocese sizes.

Our final group of variables captures assorted effects. There are variables that control for geographic and climatic variations such as distance of the county to the state capital, transportation cost to São Paulo, number of train stations and latitude and longitude coordinates. Other variables control for economic and political effects such as county GDP. We present descriptive statistics in Table 1.

[Table 1 here]

[22] The index is merely additive instead of being created by principal components because most observations had no conflicts, and these methods do not work well when the series have many zeros.

3.4. A Preliminary Test of the Instrument

To determine if priests pass the exclusion restriction we investigate whether the past incidence of tenancy affected the way the Church subsequently allocated priests. In Table 2 we investigate the determinants of the allocation of priests by regressing priests against five sets variables: i) their own lagged values; ii) the incidence of tenancy (sharecropping and fixed rent) in the past; iii) economic and social variables (population growth, GDP growth, schooling and income); iv) geographic variables (distance to state capital, frontier index, latitude and longitude); and v) state dummies. The purpose is to see if the allocation of priests in 1985 (the height of the Church`s involvement in agrarian issues) was affected by the existence of tenancy in the previous decade. If we find this link, then the instrument would not satisfy the exclusion restriction.

[Table 2 here]

In Column I, we regressed the number of priests (per 1000 rural population) in 1985 against the number of priests in 1966. The estimated coefficient is close to 1 and statistically significant at 1%, which indicates a strong inertia in the distribution of priests. The value for the R-squared (0.64) shows that the past allocation in 1966 explains most of the variation of the distribution of priests in 1985, suggesting little change over time. In Column 2 the tenancy, economic, social and geographic variables are added, as well as state dummies. The past value of the distribution of priests dominates all other variables with the same near-unitary coefficient of Column I, confirming the highly inertial character of the allocation of priests. Distance to the state capital is the only other variable that is significant, reflecting that there are fewer priests further from the central regions. Given that the adjusted R-squared is the same in both specifications indicates that for this period, looking solely at past allocations of priests is sufficient to understand current allocations with very little information being gained from other variables. The fact that the distribution of priests in 1985 was not affected by the existence of tenancy in the previous fifteen years suggests that the Church did not use a strategy of placing more priests where there were more tenants and squatters. The finding that the allocation of priests does not vary much over time suggests that the strategy in the late 1970s and early 1980s was to increase the level of effort of all priests towards agrarian issues, given their current allocation, i.e., working through the intensive rather than the extensive margin. Furthermore,

because we use priests in 1966 as an instrument, which is 30 years earlier than the contract choice and land use dependent variables in our main regressions, we have a strong case that the allocation of priests was randomized for the purpose of our main regressions determining contract choices and land use.

4. Estimation and Results

4.1 – First-stage: Determinants of Rural Conflict

In Table 3 we present the results of the first-stage regression where we estimate the determinants of rural conflict per 1000 farms using priests as an instrument. We used a Tobit procedure because there are 2,974 observations censored at zero, that is, without any conflicts from 1985 to 1995. Priests are interacted with the frontier index, so the estimated impact of priests on rural conflict has to be interpreted taking into account the coefficients of all three variables, priests, frontier and the interaction term. This impact is more easily perceived in Figure 2 in which we plot the estimated coefficient of priests for every value of the frontier index in our sample (1 to 52).[23] The interpretation is that for *municipios* where the frontier index equals 1, that is, those that have been consolidated since 1970, the estimated coefficient for priests is negative but not significant. For *municipios* with a frontier index greater than or equal to 2 the impact of priests on conflict is positive, significant and growing as the index increases. An additional priest per 1000 rural population in a county with a frontier index of 10 leads to 0.31 additional conflicts per 1000 farms. At a frontier index of 20 this value jumps to 0.71 conflicts. The results indicate that priests serve as catalysts for land related conflict by organizing social movements. The interaction qualifies this perception by showing that it is stronger in areas that are currently undergoing a more intense frontier process. Besides these impacts through priests, the frontier index also has a positive and significant direct effect on conflicts, with a unit increase in the index leading to an additional 0.03 conflicts per 1000 farms. A McDonald and Moffit (1980) decomposition of the marginal effects of the independent variables on the number of conflicts shows that 19% of these effects work through *muncipios* that already have conflicts (above the limit) and 81% through those that do not. Importantly for policy, this implies that policies that seek to reduce the determinants of rural conflicts should not focus exclusively in areas that have

[23] The coefficient of the interaction term in Table 3 is the value that holds when the frontier index is zero, a value which makes no sense as the index starts at 1. Similarly the reported standard deviation for the estimate of this coefficient ignores some covariance terms which should be taken into account. The correct interpretation of the interaction term taking these issues into account is given in the graph of Figure 3.

already experienced violence, as the potential for conflict is often latent even in areas that have been apparently peaceful in the past.

[Table 3 here]

[Figure 2 here]

Apart from the frontier variable none of the other geographic variables are statistically significant, though the effect of temperature and other climatic factors are also partially captured by the state dummies. Some variables that control for the level of agricultural activity in the county are found to be negative and statistically significant. These variables are the number of tractors per hectare and the proportion of rural to urban population. These results indicate that conflicts are less likely, *ceteris paribus*, where there is more rural economic activity. On the other hand greater population growth from 1985 to 1995 – which includes migration – has a positive and significant effect on conflicts as does population density. Similarly those *municipios* that experienced greater rates of GDP growth from 1985 to 1995 registered more violence.[24] The data are very clear in showing that conflicts are more likely in regions where there are rents to be captured, a notion which is in line with several models of the evolution of property rights, such as Demsetz (1967) and Alston, Harris and Mueller (2009).[25]

Finally there are the crop mix variables, all in % of total area for 1995. The results show that coffee and beans are less likely, *ceteris paribus*, to lead to conflict. Soybeans and sugarcane on the other hand are found to be positively associated with conflict. In addition state dummies are statistically significant for several states, indicating that there are many idiosyncratic factors not captured in our other variables.

4.2 – Second Stage: Determinants of Contract Choice

The objective of this second-stage regression is to test for the determinants of contract choice. The dependent variables are the percent of total farm land that is cultivated under fixed rent, sharecropping, by the owner, or cultivated without formal title. We estimate a system of four

[24] We used GDP growth rather than levels to reduce the possibility of endogeneity of GDP. Removing GDP from the equation has practically no effect on the other results.

[25] Hidalgo et al. (2010) reach the opposite conclusion when estimating the impact of negative shocks to income on the number of land invasions, instrumented by the amount of rainfall, especially in *municipios* with higher income concentration. They find that agricultural income and land invasions are negatively correlated. The two studies are different in that their central interest is the impact of income on conflict and we are estimating conflict in a first-stage regression where income is used merely as a control. We used agricultural GDP growth (1985-1996) rather than levels so as to attenuate the possibility of endogeneity of income. When income is excluded all other results are practically unchanged.

equations through seemingly unrelated regression. The advantage of this method is that we can restrict the coefficients of every variable in the four equations to add up to zero. This is desirable because the dependent variables are measured in percent of total farm land so that if a change in an independent variable causes one of the dependent variables to rise, this must be compensated with a decline in one or more of the other three dependent variables. Furthermore, because the conflict variable that enters each equation is endogenously estimated in the first stage, the method will actually be three-stage least squares, which besides applying instrumental variable estimation to each equation also controls for 'contemporaneous' correlation in the errors. A Hausman-Wu test in each of the four equations (see last line in table 3) shows that instrumental variables are necessary. The exogeneity of conflicts is strongly rejected (1%) for the sharecropping, fixed rent and owner cultivated equations, and at 5% for squatted/occupied land. We present the non-instrumented and thus not consistent results in Table A1 in Appendix 2.

The purpose of the estimation is to ascertain the relative impacts of endowments and political/institutional factors on the form of agrarian organization. The endowments of a given county are captured by the crop mix that is found to prevail in 1995, the idea being that given relative prices, the choice of crops is overwhelmingly determined by agro-climatic and geographic factors, e.g., you can't grow coffee too far south because of frost. We also use latitude and longitude coordinates as well as variables that measure distance to the state capital, transportation costs, the growth from 1985 to 1995 of the *municipio's* GDP, tractors, cattle, population growth, urbanization and population density as additional endowment controls to the crop mix variables.

We use the conflict variable that we estimated in the previous section to capture the political/institutional determinants of contract choice. The conflict variable includes any incidence of land related violence that was registered from 1985 to 1995 by the Pastoral Land Commission. The assumption is that the existence of such events in a *municipio* reflects a perception by economic agents of property rights insecurity that, given the biases in Brazilian land legislation and enforcement discussed in section 2, may affect their choice of contract. Our interest is to determine both the direction and magnitude of conflict on contract choice. The conceptual framework in Section 2 demonstrated that property rights insecurity can impact the use of tenancy either negatively and positively, depending on how net present values of

alternative land uses are affected in any given case. We present our estimation results in Table 4.[26]

[Table 4 here]

The results show that the crop mix in a given county affects the form of agrarian organization. Most of the estimated coefficients for the eight crops are statistically significant in each of the four equations. Both fixed rent and sharecropping contracts are more probable where operators plant cotton, soybeans, rice and sugar cane; fixed rent is less probable where operators plant coffee and corn; and the planting of beans and manioc having no statistically significant effect. These results are compatible with generally held perceptions of the nature of these crops. For example Almeida and Buainain (2001: 4-5) state that in Brazil fixed rent contracts are particularly intense in rice growing areas. The magnitudes of the impacts of the crop variable will be discussed below in comparison to the impact of conflicts. First we interpret the impact of the other variables. Latitude and/or longitude are statistically significant in all of the four equations except sharecropping, thereby increasing the confidence that we are controlling for geographic and climatic factors so that any effect captured by the conflict variable will be *ceteris paribus*. We found that counties that are more distant from the state capital used more sharecropping and were squatted less. Transport costs to São Paulo increased the area in squatting and reduced the owned area. The presence of train stations increased the area in fixed rent contracts and reduced owned area.

The positive effect of GDP growth from 1985 to 1995 on squatted areas and the negative effect on owner-run areas is an indication that less-developed areas tended to grow more during this period. An increase in the number of tractors per hectare had the effect of causing *municipios* to be more sharecropper and squatter intensive to the detriment of owner-operated area. Increases in cattle reduced squatted and increased owned area, while population density increased fixed rent and reduced owned areas. The greater the proportion of rural to urban population increased the land operated by squatters and reduced fixed rent.

Conflicts per farm is the main variable of interest. The results show that increases in conflicts lead to lower use of fixed rent and sharecropping, with a corresponding increase in owner run and squatted farms. All coefficients are statistically significant. This result provides strong evidence that property rights insecurity is detrimental to the adoption of tenancy

[26] Table 4 shows the results using data on priests for 1966. Using data on priests from 1970, 1980, 1985 or 1995 gives the same basic results, which once again shows that the distribution of priests has not changed dramatically across *municipios* over time. Results provided by the authors by request.

arrangements and may have important efficiency effects as recognized by the large literature on the economics of agricultural organization. The evidence in our test corroborates for Brazil the hypotheses in Conning and Robinson (2007), Besley et al (2011) and de Janvry and Sadoulet (1989) concerning the perverse effects of politics and conflict.

Not only are the impacts of conflicts and of the endowment variables significant, but they are also quite large. If all variables are set to their mean values and conflicts at zero, the predicted proportion of agricultural land in fixed rent and in sharecropping would be 7.3% and 3.2%. If the number of conflicts is increased to 4.4, which is the average number of conflicts per 1000 farms in those *municipios* that had any conflicts, then those proportions drop to 3.8% and 0.4%. That may not look like much of a drop, but if applied to total area in farms in the country, the reduction in area in fixed rent would be greater than the area of North Korea (117,000 sq. km.) and the reduction in sharecropping area would be greater than Portugal (93,000 sq. km).

Of the crop variables the ones that had the greatest impact were cane, soybeans and rice. A one-standard deviation increase in the area dedicated to cane would increase, *ceteris paribus*, the proportion of area in fixed rent from 6.9% to 9.9% and in sharecropping from 3.2% to 4.2%. This is equivalent to the area of South Korea (99,000 sq. km) and Azerbaijan (32,000 sq. km), respectively. The impact of soybeans on fixed rent area would be an increase of 2.2%, which also implies an increase the size of a small country if extended to the entire agricultural area of Brazil. Although the estimated coefficients in Table 4 are small, the impacts when extended to the entire country are very consequential.

Ideally we would like to take into account in the estimation procedure the fact that spatial autocorrelation may be present, as several of the variables in a given *municipio* may be affected by the levels of the same variable in neighboring *municipios*. Our framework contained several indirect effects where landowners had their decisions affected by what happens to other farms. Presumably conflicts in neighboring *municipios* could also affect their profit expectations. In the absence of an econometric procedure that allows us to control for spatial autocorrelation in the context of Three Stage Least Square estimation with a first stage Tobit, in Appendix 3 we provide a sensitivity analysis using alternative estimating procedures and show that spatial autocorrelation, though present, does not affect the results significantly.

4.3 – Second Stage: Determinants of Land Use

In Table 5 we present the results from the eight equation system of land use determinants. Similarly to the contract choice system the purpose here is to estimate the impact of insecure

property rights on the choice of what to plant, controlling for natural endowments and other factors. Different types of land uses have different implications for how vulnerable a farm is to invasion and expropriation for land reform purposes. Land that is not being used productively is by constitutional mandate liable to be expropriated by the government. With re-democratization in 1985 land reform was a major policy issue, so the possibility of losing the land due to lack of productivity during the period under analysis was a major concern. The government associates each of the eight land uses in our data with a different level of perceived productivity. Unused (but usable) land is clearly the least productive activity. Fallow land, though not used at that moment in time, may be considered an investment, though it might nevertheless be targeted by landless peasants. Though pasture may be highly productive, it is often a default option for leaving the land unused in Brazil. Our data distinguishes between natural and planted pasture, where the latter can be assumed to carry a greater level of security of property rights. Forest is also disaggregated into natural and planted, though planted forests are only 2.2% of total farm area. Forest is typically considered an unproductive use of the land and may be vulnerable to expropriation, though there is environmental legislation that requires farmers to hold parts of their properties in its original vegetation.[27] Finally permanent and temporary crops involve higher levels of investments which imply that the land is fulfilling its social function and can therefore not be expropriated. The average coverage of each land use are (though there is significant local variation): natural forest 15%, planted forest 2%, permanent crops 5%, temporary crops 16%, natural pasture 25%, planted pasture 23%, fallow 3%, unused 5% and useless land 5%.

The purpose of this test is to determine whether insecure property rights in a region induce farmers to adopt more productive activities as predicted by Besley (1995), Place and Otsuka (2002), Olinto (2003), Pinckney and Kimuyu (1994) Vertova (2006) and others, or whether the reaction is to withhold investment as predicted by Alston, Libecap and Mueller (199a, 1999b, 2000), Conning and Robinson (2007) and others. The advantage of using a system of eight land use equations with interlinked coefficients through zero-sum constraints is that we can get a more detailed picture of the response to insecure property rights. Rather than examining a land use activity individually, we can get a picture of how the decisions of all the farmers in a given *municipio* calibrate among different land uses that have different vulnerabilities when faced with tenure insecurity.

[27] The mandated % of land to be held in forest is routinely violated and sanctions are weak. In short, the environmental legislation is not a binding constraint.

[Table 5 here]

The results in Table 5 show a pattern of land use that supports some elements of both of the hypotheses above. Even after controlling for the impact of crop type and geographic endowments, conflict has a statistically significant impact on all types of land use except fallow. The impact of conflict is to reduce the area of both the more productive land use (temporary crops) and the least productive land uses (unused land and natural pasture), with a corresponding increase in the intermediate types of land use (permanent crops, forests and planted pasture). Table 6 shows the magnitudes of the impact of conflicts on land use. The first line shows the predicted percent of each land use category when conflicts are set to zero and all other variables are set at their means using the estimated coefficients from Table 5. The second line shows how these proportions change when conflicts are increased to 4.4, which is the average number of conflicts per 1000 farms in those *municipios* that had a positive number of conflicts. The third line shows the percentage change due to conflicts, and the fourth line calculates what would be corresponding change in area under each land use category if we treated the whole country's agricultural area as a single *municipio*. For the sake of comparison the final line lists countries whose areas are approximately equal to the changes that would take place if conflicts go from 0 to 4.4. This shows that although the percentages affected are small, the total impact in terms of land area and people involved is large.

The biggest impact would be a drop in the percentage of natural pasture from 19.7% of the total farm area in the *municipio* to only 2.8%. For the country as a whole this is equivalent to an area the size of Greece. In Brazil natural pasture is often an unproductive use of the land, often not stocked with cattle or already in a degraded state. As such it would not be fulfilling its social function and could be invaded by landless peasants for expropriation through land reform. The same is true of unused but usable land, which would drop from 4.6% to 0.9% of the total farm area due to the presence of conflicts. The results for both of these types of land use support the hypothesis that insecure property rights raise the level of investments as unproductive land would be put to a higher valued use. However, the area in temporary crops would also drop due to conflicts in the *municipio*, from 18.4% to 15.3% of total farm area. In this case weaker property rights lead to a reduction in investment. Even though the decrease in the area of the unproductive uses is larger than that of the highly productive use, the monetary impact is probably higher for the decrease in temporary crops. Because we are dealing with percentages the decrease in temporary crops, natural pasture and unused land have to be compensated by increases in other

uses. The main compensating change happens with planted pasture which increases from 25.6% of total farm area to 36.9%, an area equivalent to Honduras if one considers the impact for the entire country. This suggests that one of the main impacts of conflict might be to lead natural pasture to be transformed into planted pasture, which is less immune to invasion and land reform. Additionally, the results indicate more conflict leads to higher levels of natural and planted forest, and also permanent crops. The impact for the country as a whole is equivalent to the area of a small country for each of these land uses (see Table 6). For the case of planted forest and permanent crops, the result suggests that planting trees is considered a productive use of the land for the purposes of land reform, making this land less prone to expropriation. For the case of natural forest the most probable interpretation is that land holders refrain from clearing the land in the presence of insecure property rights, as removing the forest cover is a highly costly investment that makes the land more susceptible to invasion.

The upshot from the system of equations in Table 5 is that property rights are highly consequential for land use choices. However, the impact is not unidirectional as is often supposed in the debate in the property rights literature. Instead there is a readjustment in the face of property rights insecurity that discourages both the more highly productive land uses, where the land holder has more to lose, and the unproductive land uses, which are subject to invasion and expropriation, with a corresponding increase in land uses that do not require high levels of investment but enough to be deemed productive for the purposes of land reform.

[Table 6 here]

4.4 – Testing the appropriateness of the instruments

In Section 3.2 we provided the historical and political rationale for why priests can be considered randomized for the purposed of estimating land use and contracts. In this section we provide a statistical analysis of the instrument's appropriateness. For the results in Table 4 and 5 to be valid the priest variable must have certain properties. The first is that it should have a clear effect on conflict. The second is that there must be no direct link between contract choice/land use and priests, except through the channel of conflicts. One way to test for the first property, that is, whether the instruments are weak, is through an F-statistic on the joint significance of the instruments in the first-stage regression (Stock, Wright and Yogo, 2002). If the F-statistic is greater than a given threshold value then the instruments can be considered as not being weak. The threshold value at 5% for the case of 5 instruments is 9.20 (Stock, Wright and Yogo, 2002: Table 1 pg. 522). Table 7 Panel A shows the results for the contract choice equations and Panel B

the results for the land use system. In each panel we compare the results shown above in Tables 4 and 5 with an alternative specification where the interaction term of priests and frontier is dropped. In both specifications the null hypotheses of weak instruments is clearly rejected.

In order to test the second property of the instrument, that is, the exclusion restriction, a Sargan–Hansen statistic to test for over identifying restrictions would be recommended. However this is not possible in our case because the second stage is estimated using the fitted value from the first stage as a single instrument rather than plugging in the separate fitted values. This procedure is necessary because the first stage is nonlinear (Wooldridge, 2002: 542; Angrist and Pischke, 2009: 191). Applying 2SLS reasoning directly with a non-linear first-stage is not guaranteed to produce first-stage residuals that are uncorrelated with fitted values and covariates. In any case we show in Table 7 that our main results are robust to a different specification of the instruments. In both panels the results concerning the impact of property rights on contract choice and on land use still hold if priests are used as an instrument without the frontier interaction. There is some slight non-systematic variation in the magnitude of the coefficients but the signs and statistical significance remains unchanged.[28]

[Table 7 here]

5 – Which Tenancy Contracts are Forgone Due to Property Rights Insecurity?

With census data aggregated at the *municipio* level we cannot directly examine which types of contracts are most affected by the property rights insecurity in the form of land conflicts. Figure 3, constructed using that data, shows the distribution of fixed rent and sharecropped farms both in terms of area and number of properties. These distributions show that sharecropping tends to take place on smaller farms, but this does not provide any information on the channels through which conflicts affect contract choice. We can, however, get at this issue indirectly by using our data to test the determinants of average farm size. This can be done by using the results from the contract choice regression (Table 4) to calculate how a change in conflicts affects average farm size through its effect on contract choice. In order to do this we assume that all the variables in the contract choice regression, as well as the instruments in the conflict regression, affect average farm size indirectly through the choice of contract type. In Table 8 average farm size is regressed on the contract variables and add state dummies to capture other fixed local effects. Because the

[28] The results are also robust to using data on priests from other years after 1966.

four contract type variables add up to zero we cannot have them all simultaneously in the regression and must leave one out. The excluded variable is the one against which the estimated coefficients for the other three variables will be interpreted. Each estimated coefficient measures the amount by which average farm size changes given a change in that coefficient keeping the other two fixed. If we exclude the variable '% owned', for example, the estimated coefficient for '% fixed rent' gives us a measure of how an increase in the % area under fixed rent and the corresponding decrease in % area of owned properties, keeping 'sharecrop' and 'squatted/occupied' fixed affects average farm size. In Table 8 we show four estimations each excluding one of the four contract variables. We will focus only on the first Column that excludes owned properties because our main interest is to understand how violence affects the choice between renting and owner-operated.

[Figure 3 here]

[Table 8 here]

The results show that a decrease in the area under fixed rent leads to a decrease in average area, and that a decrease in sharecropped area leads to an increase in average area, both statistically significant at 1%. This implies that when conflicts reduce both types of contracts, as we showed above, the impact on average farm size is different through fixed rent and sharecropping. Because a drop in fixed rent reduces average farm size, it must be that the fixed rent contracts that are being forgone on the margin involve farms larger than the average size. Thus an increase in conflicts that reduces fixed rent contracts is on average impeding farm owners with larger properties (compared to the average in the *municipio*) from contracting for a fixed rent. With sharecropping the effect is the opposite. When violence decreases sharecropping, the average farm size increases, which implies that the sharecropping must occur predominantly on properties below the *municipio* average. The coefficient for squatted is not statistically different from zero so no changes to average farm size take place when squatted area changes. These results show that the losses in efficiency due to insecure property rights that we identified involve mostly the forgoing of fixed-rent contracts on larger size farms and the forgoing of sharecropping contracts on smaller size farms.

In order to measure the magnitude of these effects we use the contract choice equations in Table 4 to estimate how much a change in violence from zero to the average level of violence in those *muncipios* that had any violence (that is, 4.4 conflicts/1000 farms) affects average farm size through its impact on fixed rent and sharecropped farms. The effect of this change in conflicts on

average farm size through its impact on fixed rent is a decrease from 169 to 148 hectares, that is, a drop of 12%. The effect through sharecropping is an increase in average farm size from 169 to 213 hectares, a 26% increase. These are not trivial changes. They imply that when property rights are insecure due to conflicts in the *municipio* the pattern of land holding is greatly affected. Both the increase in average size that results from the decrease of sharecropping as well as the decrease that results from lower fixed rent are inefficient as they preclude gains to trade that would be realized were it not for the insecurity of property rights caused by conflict. Furthermore, the 46 hectare increase due to less sharecropping is greater than the 21 hectare fall due to less fixed rent, so that in net average farm size increases, which many view as undesirable in a country with such high land ownership concentration as Brazil.

Our paper has shown that insecure property rights have lead to inefficiencies in tenancy markets and land use in Brazil. But given that policy reform typically leads to many general equilibrium responses one may wonder whether other intended or unintended consequences may have mitigated those inefficiencies. Besley et al. (2011) found that although tenancy reforms reduced the incidence of tenancy in India, it also reduced land inequality and raised the agricultural wage, improving the welfare of some intermediate caste families, though most lower caste families were harmed. In the Brazilian case, we do not find any silver ling. In this section we produced evidence showing that property rights insecurity has increased inequality in Brazil. This result is corroborated by the fact that the Gini coefficient for landownership for the country as a whole has actually increased in the past decades, from 0.836 in 1960 to 0.854 in 2006.[29] Although nearly 10% of the country's area has been redistributed through land reform since 1964, this has had very little impact on the organization of agriculture as settlement projects often re-concentrate through sales, remain unproductive and dependent on transfers or are abandoned.[30] In Brazil land reforms are compensated takings which limit the amount of land that can be redistributed from landowners to the landless. Moreover, our results indicate that some farmers alter land use to reduce the probability of being subject to expropriation. The alteration of land use dissipates some of the rents from agriculture.

[29] This is significantly higher than most other countries: US – 0.776 (2002), Argentina – 0.777 (2002), France – 0.552 (1998), Canada – 0.640 (1991).

[30] Only 5% of the 8.310 land reform settlement projects have reached the final stage where they become emancipated from the state. A survey sampling 1000 families in these finalized projects found that 47.7% of the families do not produce enough for their own consumption and only 27.7% have any surplus to sell in markets (IBOPE, 2009).

6 – Concluding Remarks

In Brazil, land reform policy, by affecting the security of property rights via increasing land conflicts, has had a perverse impact on land rentals resulting in an inefficiency or inability to realize the gains from agricultural contracting. In a large commodity based country like Brazil the losses are undoubtedly high. Even if there are other reasons not related to land conflict for why some farmers may want to hold large and unproductive properties, such as to hedge against inflation (very relevant for the time period of our data) or for political power, it would still be advantageous to the prospective tenant and sharecroppers, as well as to society, for the landowner to rent the land and profit twice (Rezende, 2006; Sayad, 1982). Similarly we show that conflicts reduce both the investment in productive temporary crops and the incidence of idle land, skewing land use towards low level productivity uses, mainly pasture.

The very low levels of tenancy and productive land use in Brazil and much of Latin America are thus a puzzle. The difficulty of solving this paradox lays not so much in being able to point to causes of this behavior. In this paper we have provided very robust evidence that insecure property rights are an important deterrent to tenancy arrangements and more productive land use. The greater puzzle, as noted by Conning and Robinson (2007: 421) is why economic agents are not able to contract around these inefficiencies.

The extent of the losses from forgoing rental contracts in Brazil has in the recent past led to several attempts at getting around the impediments of tenancy by creating special regional programs where all the necessary conditions would be provided by policymakers and other organizations for rental transactions to take place. Buainain et al. (2008) survey some of these attempts and conclude that "however well considered the initiatives are, they have not achieved their goals … county administrations do not manage to use either the incentives or the coercive instruments required to induce landowners and landless farmers to negotiate under equal conditions leading to mutually profitable contracts." It is the understanding of this greater inability to credibly commit to not expropriating rented farms and thereby the inability to realize the gains from contracting that is the real puzzle to be explained. Put another way: given that both landowners and tenants would benefit from more secure property rights, what are the impediments to a more sensible land reform policy? We conjecture that the answer rests on the politics of land reform, a debate that entails the entire electorate and not simply the parties to the contract. Given Brazil has the highest land inequality in Latin America, with a highly urbanized and enfranchised citizenry, voters favor a land reform policy based on redistribution which has

the unintended consequence of increasing land conflicts and reducing the career mobility prospects of many landless rural peasants.

References

Adriance, Madeleine C. 1991. "Agents of Change: The Roles of Priests, Sisters, and Lay Workers in the Grassroots Catholic Church in Brazil," *Journal for the Scientific Study of Religion*, 30(3): 292-305.

Adriance, Madeleine C. 1992. "The Paradox of Institutionalization: The Roman Catholic Church in Chile and Brazil," *Sociological Analysis*, Vol. 53, Special Presidential Issue on Conversion, Charisma and Institutionalization: S51-S62.

Adriance, Madeleine C. 1994. "Base Communities and Rural Mobilization in Northern Brazil," *Sociology of Religion*, 55:2, 163-178.

Adriance, Madeleine C. 1995. "The Brazilian Catholic Church and the Struggle for Land in the Amazon," *Journal for the Scientific Study of Religion*. 34(3): 377-382.

Allen, Douglas and Dean Lueck. 1992. "Contract choice in modern agriculture: cash rent versus cropshare." *Journal of Law and Economics*, 35 (2), 397-426.

Almeida, Patricia. 2002. *Arrendamento e Acesso à Terra no Brasil*. Master Dissertation at the University of Campinas, UNICAMP.

Almeida, Patricia J. and Antonio M. Buainain. 2001. "Arrendamento de Terras: uma Contribuição ao Neoinstitucionalismo Econômico," In: III International Conference on AgriChain/Networks Economics and Managemente, 2001, Ribeirão Preto/SP – USP, - 24 a 26 de outubro de 2001, p. 10-30.

Alston, Lee J., Samar K. Datta and Jeffrey B. Nugent. 1984. "Tenancy Choice in a Competitive Framework with Transactions Costs," *Journal of Political Economy*, 92 (December): 1121-1133.

Alston, Lee J. and Joseph P. Ferrie. 1999. *Paternalism and the American Welfare State: Economics, Politics, and Institutions in the U.S. South, 1865-1965*. New York: Cambridge University Press 1999).

Alston, Lee J. and Joseph P. Ferrie. 2005. *Time on the Ladder: Career Mobility in Agriculture,* 1890-1938. *The Journal of Economic History*, Cambridge University Press, Vol. 65(04): 1058-1081, December.

Alston Lee J. and Robert Higgs. 1982. "Contractual Mix in Southern Agriculture since the Civil War: Facts, Hypotheses and Tests," *Journal of Economic History*, XLII (June): 327-353.

Alston, Lee J. and Kyle Kauffman. 1998. "Up, Down and Off the Agricultural Ladder: New Evidence and Implications of Agricultural Mobility for Blacks in the Postbellum South," *Agricultural History* 72,: 263-279.

Alston, Lee J. and Kyle Kauffman. 1997. "Agricultural Chutes and Ladders: New Estimates of Sharecroppers and Welfare Implication for the Southern Agricultural Labor Market, 1900-1960," *Journal of Economic History* (June): 464-475.

Alston, Lee J., Edwyna Harris and Bernardo Mueller. 2009. "*De Facto* and *De Jure* Property Rights: Land Settlement and Land Conflict on the Australian, Brazilian and U.S. Frontiers" NBER Working Paper No. 15264, September.

Alston, Lee J., Gary D. Libecap, and Bernardo Mueller. 1999a, "A Model of Rural Conflict: Violence and Land Reform Policy in Brazil." *Environment and Development Economics*, Cambridge:UK, 4:135-160.

Alston, Lee J., Gary D. Libecap, and Bernardo Mueller. 1999b. *Titles, Conflict and Land Use: the Development of Property Rights and Land Reform on the Brazilian Amazon Frontier*, Ann Arbor, The University of Michigan Press.

Alston, Lee J., Gary D. Libecap, and Bernardo Mueller. 2000, "Property Rights to Land and Land Reform: Legal Inconsistencies and the Sources of Violent Conflict in the Brazilian Amazon." *Journal of Environmental Economics and Management*, 39:162-188.

Alston, Lee J., Gary D. Libecap, and Bernardo Mueller. 2010. "Interest Groups, Information Manipulation in the Media, and Public Policy: The Case of the Landless Peasants Movement in Brazil" NBER Working Paper No. 15865.

Angrist, Josua D. and Jorn-Steffen Pischke. 2009. *Mostly Harmless Econometrics: An Empiricist's Companion*. Princeton University Press.

Antoniazzi, Alberto. 2003. "A História da OSIB e os Desafios da Formação." 13ª Assembléia da OSIB – Organização dos Seminários e Institutos do Brasil, Belo Horizonte.

Bailey, Martin J. 1992. "Approximate Optimality of Aboriginal Property Rights," Journal of Law and Economics, XXXV(1), 183-198.

Bardhan, Pranab and Dilip Mookherjee. 2008. "Determinants of Redistributive Politics: an Empirical Analysis of Land Reform in West Bengal." Working Paper, Department of Economics, University of California, Berkeley, September.

Besley, Timothy. 1995. "Property Rights and Investment Incentives: Theory and Evidence from Ghana." *Journal of Political Economy*, 103 (5): 903-937.

Besley, Timothy, Jessica Leight, Rohini Pande and Vijayendra Rao. 2011. "The Regulation of Markets: Evidence from Tenancy Reform in India," London School of Economics, Economic Organization and Public Policy Series Discussion Paper EOPP/2011/31.

Binswanger, Hans P., Klaus Deininger and G Feder. 1995. "Power, Distortions, Revolt and Reform in Agricultural Land Relations." In *Handbook of Development Economics, Volume III*, ed. Jere Behrman and T.N. Srinivasan, Amsterdam: Elsevier Science: 2659-2772.

Brandão, Antônio S., Guilherme S. Bastos Filho, Alexandre P. Brandão. 2001. "Land Markets and Rural Poverty Alleviation," Chapter 4 in World Bank, *Rural Poverty Alleviation in Brazil: Towards an Integrated Strategy- Vol. 1: Policy Summary*, World Bank, Report No. 21790-BR

Brito, Lucelmo L. 2010. "Medellín e Puebla: epicentros do confronto entre progressistas e conservadores na América Latina," *Revista Espaço Acadêmico*, Nº 111, Agosto: 81-89.

Bruneau, Thomas. 1985. "Church and Politics in Brazil: the Genesis of Change," *Journal of Latin American Studies*, n. 17: 271-293.

Buainain, Antônio M., Patrícia J. Almeida, Fernando de Lima and José Maria de Silveira. 2008. "Land Rental Markets and Land Access in Brazil," *Basis Brief: Assets and Market Access*, CRSP, July, http://www.basis.wisc.edu.

Carvalho, Marcia S. 1991. "A Pequena Produção de Café no Paraná," PhD diss. University of São Paulo, Dept. of Geography.

Carter Michael R. and Pedro Olinto. 2003. "Getting Institutions 'Right' for Whom? Credit Constraints and the Impact of Property Rights on the Quantity and Composition of Investment," *American Journal of Agricultural Economics*, Vol. 85, pp. 173-186, 2003

CERIS – Centro de Estudos Religiosos e Investigações Sociais. 1997. *Anuário Católico do Brasil*, Rio de Janeiro, Vol. 10: 1-973.

Cheung, Steven N.S. 1969. *The Theory of Share Tenancy*. University of Chicago Press, Chicago.

CNBB – Confederação Nacional dos Bispos Brasilieros. 1980. *Igreja e Problemas da Terra*. São Paulo. Ed. Paulinas.

Conley, Timothy G. 1999. "GMM Estimation with Cross Sectional Dependence," *Journal of Econometrics*, 92: 1-45.

Conning, Jonathan H. and James A. Robinson. 2007. Property Rights and the Political Organization of Agriculture. *Journal of Development Economics* 82: 416-447.

de Janvry, Alain and Elisabeth Sadoulet. 1989. "A Study in Resistance to Institutional Change: The Lost Game of Latin American Land Reform," *World Development*, Vol. 17, No. 9: 1397-1407.

de Janvry, Alain, Karen Macours, and Elisabeth Sadoulet. 2002. "Access to Land in the Rural Development Agenda," Sustainable Development Department, Inter-American Development Bank, Washington D.C.

Deininger, Klaus and José S. Chamorro. 2004. "Investment and Income Effects of Land Regularization: The Case of Nicaragua." Agricultural Economics 30 (2): 101-16.

Deininger, Klaus and Gershon Feder. 2000. Land Institutions and Land Markets. In *Handbook of Agricultural Economics,* ed. Jere Behrman and T.N. Srinivasan, Amsterdam: Elsevier Science: 2659-2772.

Deininger, Klaus and Ali, Daniel Ayalew. 2008. "Do Overlapping Land Rights Reduce Agricultural Investment? Evidence from Uganda," *American Journal of Agricultural Economics*, Vol. 90, Issue 4, pp. 869-882, http://ssrn.com/abstract=1263062 .

Demsetz, Harold. 1967. "Towards a Theory of Property Rights", *The American Economic Review*. Volume 57, Issue 2 May, 1967, 347-359.

The Economist. 2011. "Employer, Beware," March 12th – 18th 2011, pg. 43.

Federico, Giovanni. 2006. "The 'Real' Puzzle of Sharecropping: Why is it Disappearing?" *Continuity and Change*, 21(2): 261-285.

Gallo, Andres. 2003. "Rural Rent Legislation in Argentina: Congress and Renters, 1912-1943," Working Paper.

Garcia-Jimeno, Camilo and Robinson, James A. 2009. "The Myth of the Frontier," NBER Working Paper Series, March, Vol. w14774, pp. -, 2009. Available at SSRN: http://ssrn.com/abstract=1352954 .

Ghatak, Maitreesh and Roy, Sanchari. 2007. "Land Reform and Agricultural Productivity in India: A Review of the Evidence" *Oxford Review of Economic Policy*, Vol. 23, No. 2, pp. 251-269. Available at SSRN: http://ssrn.com/abstract=1151129 .

Hayami, Yujiro and Keijiro Otsuka. 1993. *The Economics of Contract Choice: an Agrarian Perspective*. Oxford: Oxford University Press.

Hewitt, Warren E. 1990. "Religion and Consolidation of Democracy in Brazil: The Role of the Comunidades Eclesiais de Base (CEBs)," *Sociological Analysis*, 50:2, 139-152.

Hidalgo, F. Daniel, Suresh Naidu, Simeon Nichter, and Neal Richardson. 2010. *The Review of Economics and Statistics,* August 2010, 92(3): 505–523.

Houtzager, Peter P. 2001. "Collective Action and Political Authority: Rural Workers, Church, and State in Brazil," Theory and Society, Vol. 30, No. 1, Feb: 1-45.

IBGE. 1984. *Áreas Mínimas de Comparação a Nível Municipal : 1980-1970-1960*. Rio de Janeiro, IBGE.

IBGE. 2007. *Séries Estatísticas & Séries Históricas*, Rio de Janeiro, IBGE, Censo Agropecuário 1920 to 1995/96: http://www.ibge.gov.br/series_estatisticas/subtema.php?idsubtema=100 .

IPARDES. 1978. *O Trabalhador Volante no Estado do Paraná*, Vol I, Curitiba.

Krischke, Paulo, J. 1991. "Church Base Communities and Democratic Change in Brazilian Society," Comparative Political Studies, Vol. 24, No. 2: 186-210.

Macours, Karen, Alain de Janvry, and Elisabeth Sadoulet. 2007. "Insecurity of Property Rights and Matching in the Tenancy Market", submitted to The Economic Journal, revised October 2007.

Mainwaring, Scott. 1986. *The Catholic Church and Politics in Brazil, 1916-1985*, Stanford: Stanford University Press.

Mainwaring, Scott and Alexander Wilde. 1989. *The Progressive Church in Latin America*. Notre Dame: University of Notre Dame, Press/Kellogg Institute.

Mançano, Bernardo F. and João P. Stédile. 1999. *Brava Gente: A Trajetória do MST e a Luta pela Terra no Brasil*, São Paulo, Editora Fundação Perseu Abramo.

Marshall, Alfred. 1890. Principles of Economics. Edited by C.W. Guillebaud, Macmillan Company London (1961).

Martins, José S. 1980. "O Documento da Terra Prometida," *Reforma Agrária: Boletim da Associação Brasileira de Reforma Agrária*, Unicamp, Ano X, Mar./Abr. N^{o} 2: 39-43.

Maybury-Lewis, Biorn. 1994. *The Politics of the Possible: The Brazilian Rural Worker´s Trade Union Movement, 1964-1985*, Philadelphia, Temple University Press.

McDonald, John F. and Robert A. Moffit. 1980. "The Uses of Tobit Analysis," *The Review of Economics and Statistics*, Vol. 62, No. 2, May: 318-321.

Menezes Neto, Antonio J. 2007. "A Igreja Católica e os Movimentos Sociais do Campo: a Teologia da Libertação e o Movimento dos Trabalhadores Sem Terra," *Cadernos do CRH* (UFBA), v. 20, p. 331-342.

Menezes Neto, Antonio J. 2009. "A Igreja Católica e a Luta pela Terra no Brasil," IV Simpósio Internacional de Geografia Agrária, Niteroi: SINGA: 1-16.

Moura, Maurício J.S.B. and Rodrigo, L.S. Bueno. 2009. "How Land Title Affects Income," ANPEC - Brazilian Association of Graduate Programs in Economics, Proceedings of the 37th Brazilian Economics Meeting, No. 203.

Murrell, Peter. 1983. "The Economics of Sharing: a Transactional Cost Analysis of Contractual Choice in Farming," *The Bell Journal of Economics*, 14 (1), 283-293.

Nichols, William H. 1971. "A Fronteira Agrícola na História Recente do Brasil: O Estado do Paraná, 1920-65," *Revista Paranaense de Desenvolvimento*. Curitiba, set-out., 26:19-53.

OECD. 2005. "OECD Review of Agricultural Policies – Brazil," OECD, Trade and Agricultural Directorate, ISBN 9264012540, http://www.oecd.org/document/62/0,3746,en_2649_33797_35555454_1_1_1_1,00.html

Ondetti, Gabriel A. 2008. *Land, Protest and Politics: the Landless Movement and the Struggle for Agrarian Reform in Brazil*, Pennsylvania State University Press.

Pande, Rohini and Christopher Udry. 2006. "Institutions and Development: A View from Below," with Chris Udry in Proceedings of the 9th World Congress of the Econometric Society, eds. R.Blundell, W.Newey and T.Persson, Cambridge University Press.

Pinckney, Thomas C. and Peter K. Kimuyu. 1994. "Land Tenure Reform in East Africa: Good, Bad or Unimportant?" *Journal of African Economies*, Vol. 3, No. 1: 1-28.

Place, Frank and Keijiro Otsuka. 2002. "Land Tenure Systems and Their Impacts on Agricultural Investmetns and Productivity in Uganda," *Journal of Development Studies*, 38 (6):105-124.

Reis, Eustáquio, Márcia Pimentel and Ana I. Alvarenga. 2009. "Áreas mínimas comparáveis para os períodos intercensitários de 1872 a 2000," Rio de Janeiro, IPEA-DIMAC.

Rezende, Gervasio C. 2006. "Políticas Trabalhista, Fundiária e de Crédito Agrícola no Brasil: Uma Avaliação Crítica," *Revista de Economia e Sociologia Rural*, Vol. 44, No. 1: 47-78.

Rezende, Gervasio C., Ana C. Kreter. 2007. "Agricultural Labor Legislation and Poverty in Brazil: A Transaction Costs Approach" *Revista de Economia Agrícola*, v. 54: 121-137.

Romeiro, Ademar and Bastiaan P. Reydon (coords.) 1994. *O Mercado de Terras*. Brasília: IPEA, 1994, Estudos de Política Agrícola (Documentos de Trabalho, 13).

Ribeiro, M.C.M and M.I. Stolf. 1975. "A Moradia do Trabalhador na Fazenda de Café Paulista," in E. Carone (ed.) *O Café: Anais do II Congresso de História de São Paulo*. São Paulo: 135-156.

Saint, William S. 1980. "Mão-de-Obra Volante na Agricultura Brasileira: Uma Revisão da Bibliografia," *Pesquisa e Planejamento Econômico*, IPEA, Vol. 10, Agosto, No. 2:503-526.

Sayad, João. 1982. "Especulação com Terras Rurais: Efeitos sobre a Produção Agrícola e o Novo ITR," *Pesquisa e Planejamento Econômico*, v. 12, n. 1, p. 87-108, abr.

Serbin, Kenneth P. 2000. "The Catholic Church, Religious Pluralism, and Democracy in Brazil," in (editors) P.R. Kingstone and T.J. Powers *Democratic Brazil: Actors, Institutions, and Processes*, University of Pittsburg Press.

Skidmore, Thomas. 2003. *Uma História do Brasil*, São Paulo, Paz e Terra, 4th edition.

Stiglitz, Joseph E. 1974. "Incentives and Risk Sharing in Sharecropping," *Review of Economic Studies*, 41 (2), 219-255.

Stock, James H., Jonathan H. Wright and Motohiro Yogo. 2002. "A Survey of Weak Instruments and Weak Identification in Generalized Method of Moments," *Journal of Business & Economic Statistics*, October, Vol. 20. No. 4: 518-529.

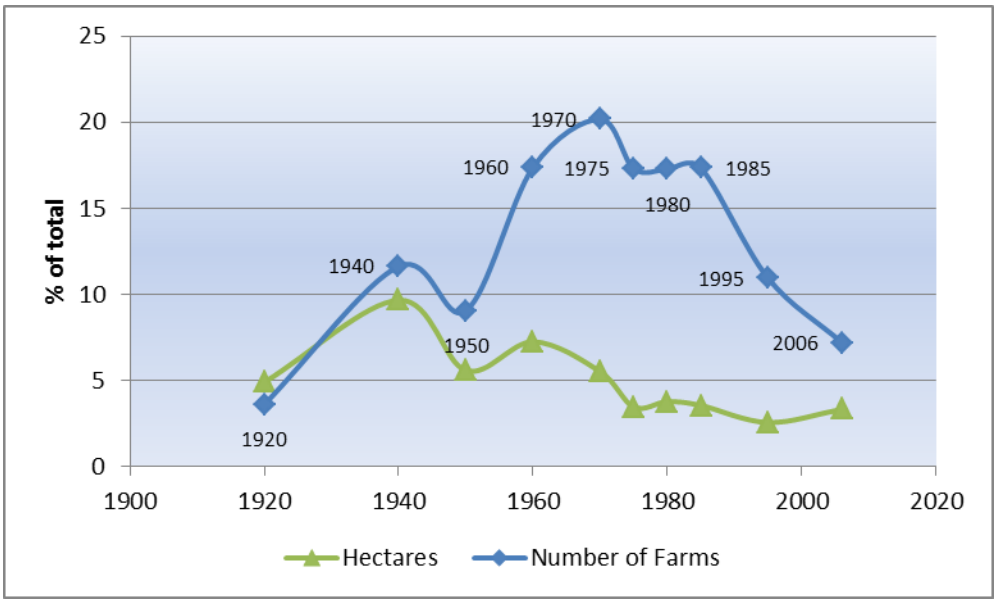
Valdés, Alberto and Johan A. Mistiaen. 2001. *Rural Poverty Alleviation in Brazil: An Integrated Strategy, Vol. 1: Policy Summary*, Washington, World Bank.

Vertova, Pietro. 2006. "Property Rights on Unused Asset and Investment Incentives: Evidence from Brazil," Tilburg University, Center for Economic Research, Discussion Paper 48.

Wooldridge, Jeffrey M. 2002. *Econometric Analysis of Cross Section and Panel Data*, MIT **Press.**

World Bank. 1994. "Brazil: The Management of Agriculture, Rural Development and Natural Resources, Vol. 2 Background Papers" Natural Resource Management and Rural Poverty Division, Country Department, Latin America and the Caribbean Region, July 31.

Figure 1 – Evolution of Tenancy over time in Brazil



Source: IBGE (2007). Data for 2006 from the 2006 Agricultural Census and may not be perfectly comparable.

Figure 2 – Interaction of Priests and Frontier: Effect of Priests on Conflicts.

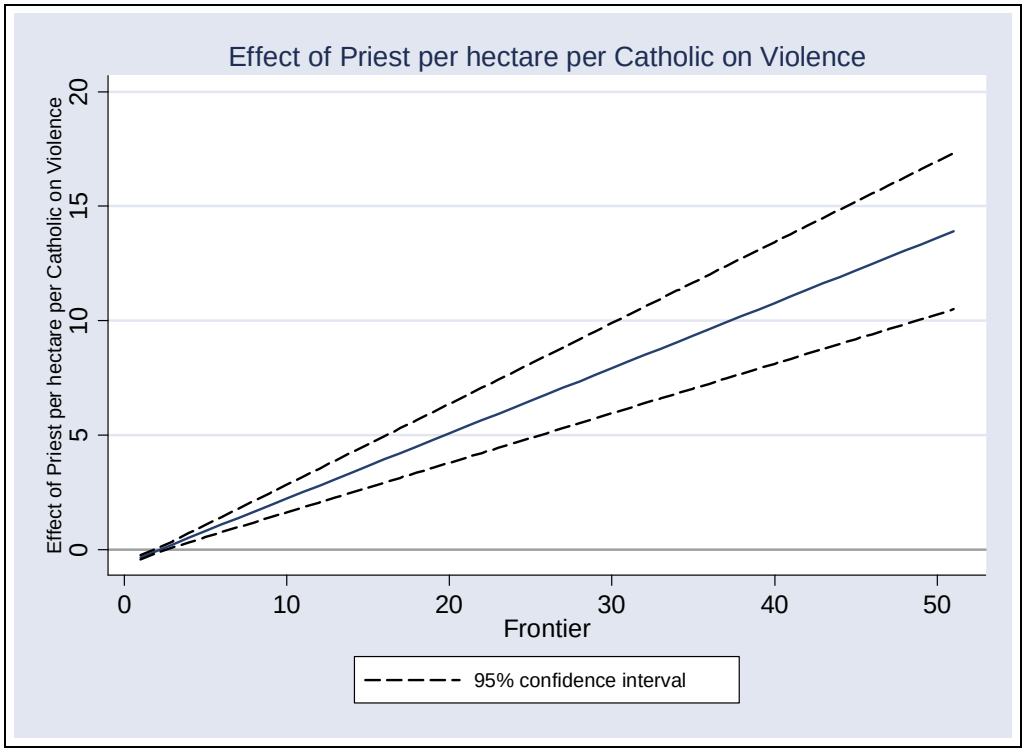


Table 1 – Descriptive Statistics

Variable	N	Mean	Stand. Dev.	Min	Max
Conflicts per 1000 farms	3659	0.7877	5.918	0	283.582
Priests per rural population 1966	3647	15.670	66.913	0.052	3562.50
Priests per rural population 1985	3631	16.658	42.231	0.073	831.683
Frontier	3659	1.505	2.262	1	53
Political opposition 1982 (%seats – MDB)	3659	0.340	0.243	0	1
Political opposition 1996 (% seats – PT)	3659	0.025	0.057	0	0.615
Population density 1995	3640	240.62	13,572.77	0.0087	818,792.3
GDP growth 1985-1995 (log)	3643	-0.165	0.677	-4.806	4.062
Tractors per hectare1995	3640	0.004	0.007	0	0.130
Average size of farms (hec.) 1995	3640	93.720	174.619	0.104	4296.837
Cattle per hectare1995	3640	0.556	1.227	0	63.462
Latitude	3659	-16.491	7.644	-33.519	3.843
Longitude	3659	44.881	5.833	32.411	72.67
Rural/Urban Population (1995)	3621	1.071	1.631	0.0004	63.661
Population growth 1985-1995	3659	0.121	0.666	-0.960	38.349
Natural Forest (% total farm area) 1995	3640	0.154	0.136	0	0.900
Planted Forest (% total farm area) 1995	3640	0.022	0.054	0	0.799
Temporary crops (% total farm area) 1995	3640	0.163	0.174	0	0.993
Planted pasture (% total farm area) 1995	3640	0.231	0.217	0	0.901
Natural Pasture (% total farm area) 1995	3640	0.250	0.184	0	0.911
Permanent crops (% total farm area) 1995	3640	0.053	0.093	0	1
Usable but not used (% total farm area) 1995	3640	0.048	0.069	0	0.601
Fallow area (% total farm area) 1995	3640	0.031	0.039	0	0.313
% of land in Fixed Rent contracts, 1995	3640	0.049	0.073	0	0.781
% of land in Sharecropping contracts, 1995	3640	0.021	0.041	0	0.714
% of land farmed by owner, 1995	3640	0.892	0.104	0	1.00
% of land squatted/occupied, 1995	3640	0.038	0.063	0	1.00
Cotton, % 1995	3640	0.003	0.012	0	0.315
Rice, % 1995	3640	0.008	0.026	0	0.709
Coffee, % 1995	3640	0.012	0.038	0	0.429
Cane, % 1995	3640	0.039	0.142	0	1.00
Beans, % 1995	3640	0.024	0.047	0	0.715
Manioc, % 1995	3640	0.009	0.027	0	0.580
Corn, % 1995	3640	0.048	0.067	0	0.851
Soybeans, % 1995	3640	0.021	0.136	0	0.901
Distance to state capital (km)	3659	240.467	158.039	0	1365.742
Transport cost to São Paulo (index)	3658	1475.81	1114.83	0	10,511.92
Train stations	3659	0.485	1.696	0	63

Table 2 – Determinants of Priest Allocation

Dep. Variable: Priest per 1000 rural pop in 1985	**I**	**II**
Priest / 1000 rural pop 1966	1.09***	1.09***
	(11.96)	(11.48)
Fixed rent % (1970)		3.109
		(0.40)
Sharecrop % (1970)		-10.553
		(-1.15)
Squatted/Occupied % (1970)		-2.178
		(-0.78)
Population growth 1970-80		-0.012
		(-0.01)
GDP growth 1970-80		0.063
		(0.42)
Income (1970)		-0.00001
		(-1.41)
Schooling (1970)		1.453
		(1.53)
Distance to state capital		-0.008**
		(-2.41)
Frontier		0.088
		(0.90)
Latitude		0.009
		(0.03)
Longitude		0.327
		(1.55)
Constant	0.805	-23.517*
	(0.75)	(-1.88)
Number of observations	Total: 3631	Total: 3631
State dummies (27 states)	No	Yes
R^2 adjusted	0.64	0.64
F(k, n-k)	142.94	74.79
Prob>F	0.0000	0.0000

OLS regression. t-stats in parentheses. Robust standard errors. Statistical significance 1% ***. 5% **, 10% *.

Table 3 – Determinants of Rural Conflict – First Stage Equation

Dep. Var.: **Violence 1985-1996**	
Priests per rural population	-0.629***
	(-10.47)
Frontier	0.233***
	(5.01)
Interaction: Priest x Frontier	0.287***
	(8.21)
Agricultural GDP growth	2.683***
1985-1995.	(4.68)
Distance to state capital	0.004
	(1.39)
Transport cost to São Paulo	0.001
	(1.26)
Number of train stations	0.150
	(0.80)
Latitude	0.195
	(0.84)
Longitude	-0.359
	(-1.35)
Cattle per hectare1995	-0.656
	(-0.67)
Tractors per hectare1995	-1240.63***
	(-8.57)
Rural/Urban Population	-1.650***
(1995)	(-4.28)
Population growth 1985-1995	1.236***
	(2.65)
Population density 1995	0.010***
	(4.68)
Cotton, % of total farm area	-25.481
	(-0.62)
Rice, % of total farm area	-19.454
	(-0.95)
Coffee, % of total farm area	-46.258***
	(-2.65)
Cane, % of total farm area	9.899***
	(3.71)
Beans, % of total farm area	-52.060***
	(-3.79)
Manioc, % of total farm area	-24.394
	(-1.45)
Corn, % of total farm area	6.119
	(0.72)
Soy Beans, % total farm area	23.556***
	(4.08)
Constant	19.994
	(1.10)
Number of observations	Total: 3616
	Censored at 0: 2967
	Uncensored: 648
State Dummies (27 states)	Yes
Pseudo R^2	0.14
$\chi^2(55)$	1131.91
Prob>χ^2	0.0000

Tobit Estimation. t-stats in parentheses. Statistical significance: 1% ***. 5% **, 10% *. Weighted by the number of county subdivision from 1970-2000.

Table 4 – Determinants of Contract Choice

	Fixed Rent (%)	Sharecropper (%)	Owner (%)	Squatted/Occupant (%)
Conflict per 1000 farms	-0.008***	-0.006***	0.010***	0.004**
	(-3.60)	(-4.21)	(3.39)	(2.50)
Cotton, % of total farm area	0.428***	0.181***	-0.689***	0.080
	(4.21)	(2.61)	(-4.99)	(1.05)
Rice, % of total farm area	0.275***	0.227***	-0.512***	0.011
	(5.97)	(7.19)	(-8.18)	(0.30)
Coffee, % of total farm area	-0.146***	0.042*	0.124***	-0.021
	(-4.14)	(1.73)	(2.60)	(-0.78)
Cane, % of total farm area	0.187***	0.068***	-0.225***	-0.030***
	(17.77)	(9.47)	(-15.73)	(-3.83)
Beans, % of total farm area	-0.050	0.089***	-0.167***	0.129***
	(-1.40)	(3.61)	(-3.42)	(4.76)
Manioc, % of total farm area	0.062	0.097***	-0.695***	0.536***
	(1.21)	(2.78)	(-9.98)	(13.94)
Corn, % of total farm area	-0.042*	0.021	0.019	0.002
	(-1.70)	(1.23)	(0.57)	(0.11)
Soy Beans, % total farm area	0.218***	0.032***	-0.219***	-0.032**
	(13.21)	(2.82)	(-9.73)	(-2.55)
Frontier	-0.0004**	0.00003	0.0009***	-0.0005***
	(-2.28)	(0.21)	(4.05)	(-4.05)
GDP growth 1985-1995	0.006**	0.004**	-0.013***	0.003**
	(2.47)	(2.40)	(-3.87)	(1.52)
Latitude	-0.004***	-0.0001	0.005***	-0.001**
	(-4.60)	(-0.15)	(4.64)	(-2.15)
Longitude	-0.001	-0.0007	-0.003**	0.005***
	(-0.93)	(-1.01)	(-2.01)	(5.79)
Distance to state capital	-0.000002	0.00002***	0.00001	-0.00003***
	(-0.19)	(2.66)	(0.58)	(3.23)
Transport cost to São Paulo	0.000003	-0.0000002	-0.00001**	0.00001***
	(0.73)	(-0.10)	(-2.52)	(3.68)
Number of train stations	0.002***	-0.0001	-0.003***	0.0003
	(3.57)	(-0.21)	(-2.85)	(0.60)
Population density 1995	0.00002**	0.000001	-0.00002**	-0.000003
	(2.06)	(1.47)	(-1.96)	(-0.52)
Rural/Urban Population 1995	-0.002**	-0.0008	-0.00005	0.003***
	(-2.32)	(-1.56)	(-0.05)	(4.59)
Population growth 1985-1996	0.003	0.002	-0.002	-0.003
	(1.12)	(1.36)	(-0.62)	(-1.61)
Tractor per hectare growth 1985-1995	-0.243	0.512***	-0.775**	0.507***
	(-1.06)	(3.26)	(-2.48)	(2.94)
Cattle per hectare1995	-0.002	0.0002	0.007**	-0.005***
	(-0.65)	(0.11)	(2.06)	(-2.96)
Constant	0.077	0.075	1.100***	-0.248***
	(1.09)	(1.54)	(11.42)	(-4.68)
Number of observations	Total: 3616	Total: 3616	Total: 3616	Total: 3616
State dummies (27 states)	Yes	Yes	Yes	Yes
Pseudo R^2	0.17	0.05	0.18	0.22
$\chi^2(44)$	1757.51	720.98	1754.12	1649.15
Prob>χ^2	0.0000	0.0000	0.0000	0.0000
Hausman-Wu Test	$X^2(1)=25.06$	$X^2(1)=30.66$	$X^2(1)=21.18$	$X^2(1)=5.39$
H_0: Conflicts are exogenous.	p-value= 0.0000	p-value=0.0000	p-value=0.0000	p-value=0.0202

Estimated by 3-Stage Least Squares using predicted conflict as the single excluded instrument (Wooldridge, 2002: 542). t-stats in parentheses. Statistical signif.: 1% ***. 5% **, 10% *. The coefficients for all four equations are constrained to add up to 0 for every variable.

Table 5 – Determinants of Land Use

	Natural Forest %	Planted Forest %	Perm. Crops %	Temp. Crops %	Nat. Pasture %	Plant. Pasture %	Fallow %	Unused %
Conflict per 1000 farms	0.006**	0.006***	0.017***	-0.007***	-0.038***	0.063***	0.00003	-0.008***
	(3.17)	(6.21)	(8.97)	(-5.00)	(-9.60)	(8.20)	(0.06)	(-7.70)
Cotton, % of total farm area	-0.731***	-0.098	-0.097	0.815***	-0.511	0.736***	-0.015	-0.099
	(-4.65)	(-1.19)	(-0.60)	(6.59)	(-1.45)	(2.67)	(-0.35)	(-1.03)
Rice, % of total farm area	-0.356***	-0.063*	-0.111	0.531***	-0.071	-0.099	0.155***	0.013
	(-4.99)	(-1.70)	(-1.51)	(9.48)	(-0.45)	(-0.79)	(7.75)	(0.31)
Coffee, % of total farm area	-0.223***	-0.116***	1.056***	-0.213***	-0.135	-0.319***	-0.018	-0.032
	(-4.10)	(-4.08)	(18.79)	(-4.97)	(-1.11)	(-3.34)	(-1.16)	(-0.96)
Cane, % of total farm area	-0.157***	-0.053***	-0.034**	0.647***	-0.162***	-0.244***	0.017***	-0.014
	(-9.95)	(-6.36)	(-2.12)	(52.18)	(-4.59)	(-8.81)	(3.81)	(-1.45)
Beans, % of total farm area	-0.097*	0.047*	-0.077	0.623***	-0.123	-0.264***	0.021	-0.129***
	(-1.83)	(1.68)	(-1.41)	(14.96)	(-1.04)	(-2.84)	(1.39)	(-4.00)
Manioc, % of total farm area	-0.862***	-0.029	0.428***	0.908***	-0.573***	0.050	0.024	0.055
	(-10.78)	(-0.70)	(5.23)	(14.47)	(-3.22)	(0.36)	(1.06)	(1.16)
Corn, % of total farm area	-0.195***	-0.052***	0.023	0.499***	-0.299***	-0.096	0.088***	0.031
	(-5.07)	(-2.61)	(0.60)	(16.53)	(-3.48)	(-1.42)	(8.19)	(1.32)
Soy Beans, % total farm area	-0.075***	-0.039***	-0.092***	0.782***	-0.081	-0.404***	-0.059***	-0.031**
	(-2.92)	(-2.89)	(-3.47)	(38.69)	(-1.41)	(-8.96)	(-8.17)	(-2.02)
Frontier	0.002***	-0.0002	-0.0001	0.0004	-0.002***	0.0005	-0.0001	-0.0001
	(5.77)	(-1.37)	(-0.32)	(1.57)	(-3.13)	(1.03)	(-0.96)	(-0.79)
GDP growth 1985-1995	0.007**	-0.0003	-0.029***	0.002	0.036***	-0.024***	0.001	0.008***
	(2.04)	(-0.18)	(-8.68)	(0.83)	(4.89)	(-4.27)	(1.44)	(4.11)
Latitude	0.004***	-0.0008	0.004**	-0.0003	-0.029***	0.018***	0.002***	0.003***
	(2.62)	(-1.05)	(2.49)	(-0.29)	(-9.40)	(7.50)	(4.34)	(4.01)
Longitude	0.003**	-0.001*	0.003	0.002*	-0.031***	0.026***	0.0006	-0.002**
	(2.12)	(-1.72)	(1.61)	(1.79)	(-9.21)	(9.85)	(1.41)	(-2.21)
Distance to state capital	0.000001	-0.00005***	-0.0001***	-0.000001	0.0001**	0.00004*	-0.000004	0.00003***
	(0.05)	(-5.72)	(-5.80)	(-0.04)	(2.33)	(1.03)	(-0.78)	(2.61)
Transport cost to São Paulo	-0.000002	0.0000002	-0.000002	0.000006	0.00007***	-0.0001***	-0.000002	0.00000006
	(-0.41)	(0.08)	(-0.37)	(1.55)	(6.75)	(-9.24)	(-1.20)	(0.11)
Number of train stations	-0.004***	0.001**	-0.002**	-0.002*	0.008***	-0.003	0.0008**	0.0007
	(-3.93)	(2.09)	(-2.07)	(-1.86)	(3.47)	(-1.53)	(2.52)	(1.08)
Population density 1995	0.00002**	-0.00002***	0.00003**	0.00002**	0.00002	-0.0001***	0.0000001	0.00001**
	(2.17)	(-2.99)	(2.34)	(2.38)	(0.66)	(-4.32)	(0.02)	(2.00)
Rural/Urban Population 1995	0.003**	0.0001	0.002	0.0006	-0.005**	-0.0008	0.0007**	0.0004
	(2.28)	(0.23)	(1.40)	(0.67)	(-2.05)	(-0.41)	(2.09)	(0.61)
Population growth 1985-1995	0.007**	-0.0004	-0.004	0.005**	0.006	-0.016***	-0.00008	0.003
	(2.10)	(-0.25)	(-1.25)	(2.11)	(0.83)	(-2.95)	(-0.09)	(1.64)
Tractor per hectare growth 1985-1995	-0.407	-0.107	2.747***	3.661***	-4.465***	-2.472*	-0.013	0.051
	(-1.14)	(-0.57)	(7.52)	(13.16)	(-5.62)	(-3.92)	(-0.13)	(0.23)
Cattle per hectare1995	-0.038***	-0.012***	-0.016***	-0.006**	0.021	0.058***	-0.004***	-0.004*
	(-10.65)	(-6.38)	(-4.31)	(-2.13)	(2.71)	(9.27)	(-3.71)	(-1.90)
Constant	0.532***	1.096*	-0.140	-0.155*	1.681***	-1.273***	0.00004	0.215***
	(5.02)	(1.74)	(-1.29)	(1.87)	(7.11)	(-6.88)	(0.00)	(3.39)
Number of observations	Total: 3616	Total: 3616	Total: 3616	Total: 3616	Total: 3616	Total: 3616	Total: 3616	Total: 3616
State dummies (27 states)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.37	0.07	0.11	0.74	0.12	0.29	0.38	0.23
$\chi^2(44)$	4904.52	829.24	993.45	14975.28	1225.01	2787.73	2421.12	2340.63
Prob>χ^2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Estimated by Three Stage Least Squares. t-stats in parentheses. Statistical signif.: 1% ***. 5% **, 10% *. The coefficients for all eight equations are constrained to add up to 0 for every variable. A Hausman-Wu endogeneity test rejects exogeneity of conflicts in all of the equations at 1% (except Natural Forest at 5%) except Fallow.

Table 6 – Impact of Conflict on Land Use

% of Total Farm Area	Natural Forest (%)	Planted Forest (%)	Perm. Crops (%)	Temp. Crops (%)	Natural Pasture (%)	Planted Pasture (%)	Fallow (%)	Unused Land (%)
Conflict = 0	11.5%	4.3%	8.9%	18.4%	19.7%	25.6%	2.22%	4.6%
Conflict = 4.4	14.0%	6.8%	16.2%	15.3%	2.8%	36.9%	2.23%	0.9%
Change in land use (%)	2.5%	2.5%	7.3%	-3.1%	-16.9%	11.3%	0.01%	-3.7%
Total area in Brazil (km^2)	888,823	53,960	75,412	342,489	780,171	996,332	83,025	163,441
Change due to conflict (km^2)	22,242	1,383	5,500	-10,603	-132,038	112,945	11	-6,027
Comparison	Israel	Hong Kong	Brunei	Lebanon	Greece	Honduras	-	Palestinian Territories

Notes: Calculated using the coefficients from Table 4 setting all variables at their mean levels and the estimated state dummy for São Paulo. 1 sq. km. = 100 hectares. Change due to conflict calculated by multiplying total agricultural land area in Brazil by predicted % in each category, with conflict = 0 and conflict = 4.4, and subtracting.

Table 7 – Analysis of Instruments

Panel A	F-test first stage	Sharecrop (impact of conflict)	Fixed-Rent (impact of conflict)	Squatted/ Occupied (impact of conflict)	Owned (impact of conflict)
Priests 1966 w/ interaction	F(3, 3568) = 53.95	-0.006***	-0.008***	0.004**	0.010***
		(-4.21)	(-3.60)	(2.50)	(3.39)
Priests 1966, no interaction	F(1,3569) = 55.28	-0.008***	-0.004**	0.008***	0.004
		(-4.48)	(-2.15)	(3.80)	(1.56)

Panel B	F-test first stage	Nat. Forest	Plant. Forest	Perm. Crops	Temp. Crops	Nat. Pasture	Plant Pasture	Fallow	Unused
Priests 1966 w/ interaction	F(3, 3568) = 53.95	0.006**	0.006***	0.017***	-0.007***	-0.038***	0.063***	0.00003	-0.008***
		(3.17)	(6.21)	(8.97)	(-5.00)	(-9.60)	(8.20)	(0.06)	(-7.70)
Priests 1966 no interaction	F(1,3569) = 55.28	0.003*	0.003***	0.018***	-0.003**	-0.044***	0.032***	-0.0001	-0.009***
		(1.64)	(3.37)	(9.12)	(-2.21)	(-9.76)	(8.84)	(-0.26)	(-7.88)

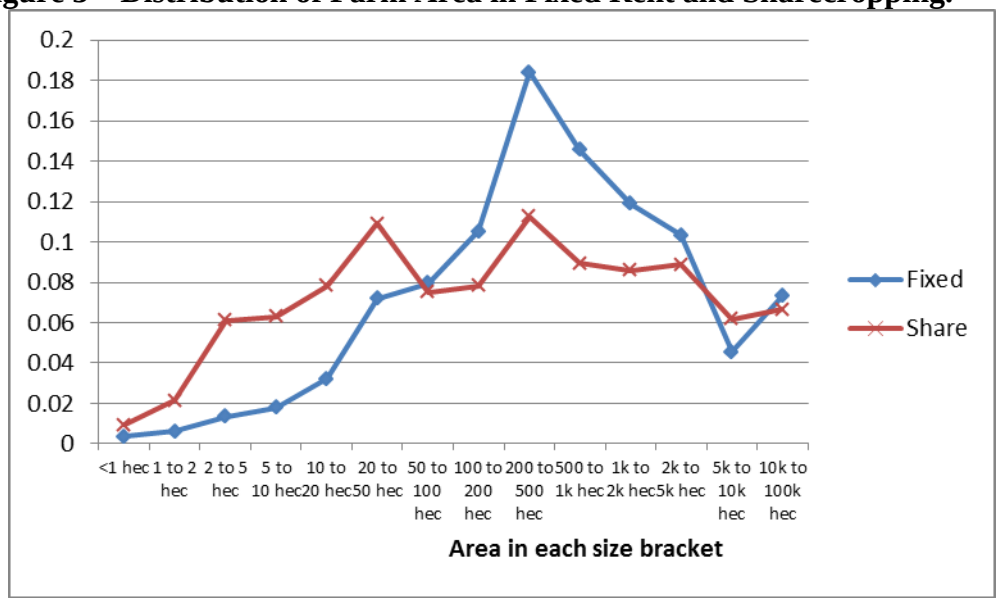
The first Column in each panel shows an F-test on the instruments in the first stage conflict estimation. The remaining Columns show the estimated coefficient and t-stat for the instrumented conflict variable on the second stage regressions. The remaining results are omitted in the interest of space. * = 10%, ** = 5% and *** = 1% statistical significance.

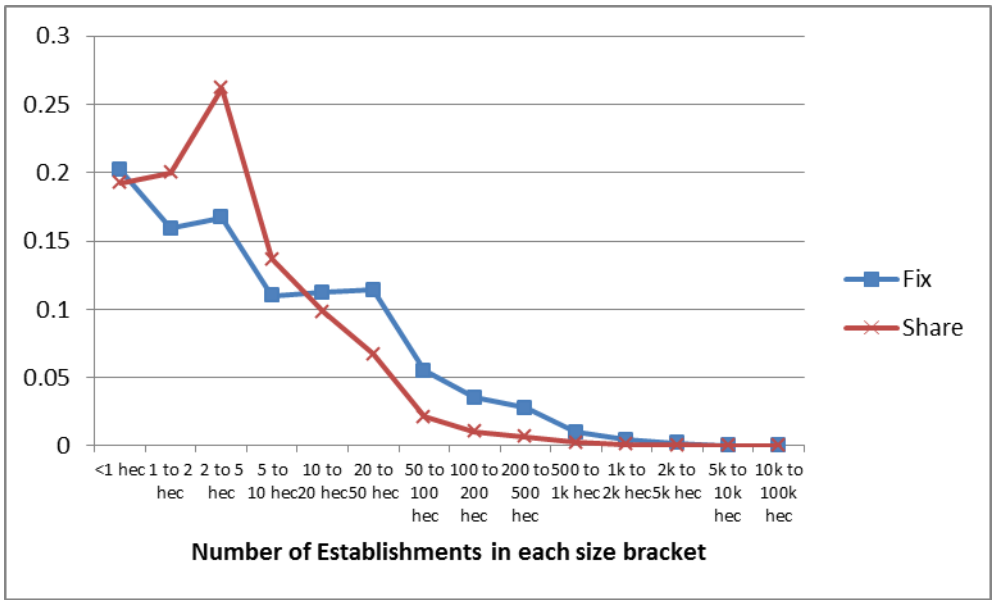
Table 8 – Impact of Contract Choice on Average Farm Size

Dep. Variable: Avg. farm size (hectares)	**Excluded category: Owner**	**Excluded category: Fixed Rent**	**Excluded category: Sharecropping**	**Excluded category: Squatted/Occupant**
Sharecrop (% of total farmland)	-1604.23***	-2193.30***		-1461.7***
	(-6.34)	(-6.64)		(-4.41)
Fixed Rent (% of total farmland)	596.05***		2165.2***	765.5***
	(5.40)		(6.22)	(5.42)
Squatted/Occupant (% of total farmland)	-182.0	-782.59***	1392.2***	
	(-1.30)	(-5.57)	(4.01)	
Owner (% of total farmland)		-593.5***	1564.1***	160.8
		(-5.50)	(6.01)	(1.17)
Constant	181.7***	776.61***	-1384.7***	16.6
	(3.89)	(7.20)	(-5.02)	(0.14)
Number of observations	Total: 3616	Total: 3616	Total: 3616	Total: 3616
State dummies (27 states)	Yes	Yes	Yes	Yes
R^2	0.393	0.397	0.385	0.390
R^2 - adjusted	0.388	0.392	0.380	0.385
F(29,3526)	99.42	100.09	98.04	98.84
Prob>F	0.0000	0.0000	0.0000	0.0000

Instrumental Variables Estimator. Instruments are all the right-hand side variables in Table 4. t-stats in parentheses. Statistical significance: 1% ***. 5% **, 10% *.

Figure 3 – Distribution of Farm Area in Fixed Rent and Sharecropping.





Appendix 1 – Data

Total number of observations = 3659. This the AMC7097 grouping created by IPEA/IBGE which makes data comparable from 1970 to 2000 by adding, or in some cases averaging, the data of *municipios* that sub-divided from 1970 to 1997. There are 27 states. The data for most of the variables are available for two set of years, 1985 and 1995/96. Agricultural data and Priest data can be added for 1980 and 1975, but Conflict data only goes back to 1985. Not all variables are used in the estimation but we list all variables available.

Agricultural data (source = IBGE Agricultural Census)

1) Area in farms (1985 and 1996), hectares.
2) Number of establishments (1985 and 1996).
3) Total municipio area (fixed)
4) Farm area in natural forest (1985 and 1996), hectares.
5) Farm area in planted forest (1985 and 1996), hectares.
6) Farm area in permanent crops (1985 and 1996), hectares.
7) Farm area in temporary crops (1985 and 1996), hectares.
8) Farm area in natural pasture (1985 and 1996), hectares.
9) Farm area in planted pasture (1985 and 1996), hectares.
10) Farm area left fallow (1985 and 1996), hectares.
11) Farm area productive but not used (1985 and 1996), hectares.
12) Farm area unsuitable for productive use (1985 and 1996), hectares.
13) Total area in farms run by owner (1985 and 1996), hectares.
14) Total number of owner run farms (1985 and 1996).
15) Total area in rented farms (1985 and 1996), hectares.
16) Total number of rented farms (1985 and 1996).
17) Total area in sharecropped farms (1985 and 1996), hectares.
18) Total number of sharecropped farms (1985 and 1996).
19) Total area in squatted farms (1985 and 1996), hectares.
20) Total number of squatted farms (1985 and 1996).
21) Number of heads of cattle (1985 and 1996).
22) Number of tractors (1985 and 1996).
23) Investments realized in the year R$ (thou) of 2000(mil) (Deflated) (1985 and 1996).
24) Revenues received in the year R$ (thou) of 2000(mil) (Deflated) (1985 and 1996).
25) Expenditures in the year R$ (thou) of 2000(mil) (Deflated) (1985 and 1996).
26) Area irrigated (1985 and 1996) hectares.
27) Total number of tractors in the municipio (1985 and 1996).
28) People working in farms (1985 and 1996).
29) Area in cotton (1985 and 1996) hectares.
30) Area in rice (1985 and 1996) hectares.
31) Area in coffee (1985 and 1996) hectares.
32) Area in sugar cane (1985 and 1996) hectares.
33) Area in beans (1985 and 1996) hectares.
34) Area in manioc (1985 and 1996) hectares.
35) Area in corn (1985 and 1996) hectares.
36) Area in soy beans (1985 and 1996) hectares.

Conflict data

37) Number of murders, yearly data (1985 to 1995). (Pastoral Land Commission)
38) Number of threats of murder, yearly data (1985 to 1995). (Pastoral Land Commission)
39) Number of murder attempts, yearly data (1985 to 1995). (Pastoral Land Commission)
40) Number of occupations/invasions, yearly data (1988 to 1995). (Pastoral Land Commission)
41) Area expropriated for land reform, yearly data (1979 to 1996). (INCRA/Ipeadata)
42) Capacity for settling families in settlement projects, yearly data (1979 to 1996), unit=families. (INCRA/Ipeadata)
43) Number of expropriations, yearly data (1979 to 1996). (Pastoral Land Commission) (INCRA/Ipeadata)

Priest data (source Catholic Hierarchy – The hierarchy of the Catholic Church http://www.catholic-hierarchy.org/)

44) Number of Catholics, data for 1966, 1975, 1985, 1995 (proximate years in some cases).
45) Total population (data from Catholic Hierarchy, not IBGE), for 1966, 1975, 1985, 1995 (proximate years in some cases).
46) Number of priests in Diocese, data for 1966, 1975, 1985, 1995 (proximate years in some cases).
47) Number of Catholics per priest, for 1966, 1975, 1985, 1995 (proximate years in some cases).

Other data

48) Area of entire municipio, square kilometers (oddly this varies from 1985 to 1996) (IBGE/Ipeadata).
49) Distance from the municipio head to the federal capital, kilometers, fixed for 1985 and 1996.
50) Distance to the state capital kilometers, fixed for 1985 and 1996.
51) Transport cost to São Paulo (index) – Nucleo de Estudos e Modelos Espaciais Sistêmicos, http://www.nemesis.org.br/ .
52) Number of train stations in the município - Nucleo de Estudos e Modelos Espaciais Sistêmicos, http://www.nemesis.org.br/ .
53) Latitute, degrees, fixed for 1985 and 1996.
54) Longitude, degrees, fixed for 1985 and 1996.
55) Total population, 1980 and 1996. (IBGE/Ipeadata)
56) Total rural population, 1980 and 1996. (IBGE/Ipeadata)
57) Total urban population, 1980 and 1996. (IBGE/Ipeadata)
58) Economically active population 1985 and 1996. (IBGE/Ipeadata)
59) Economically active rural population 1985 and 1996. (IBGE/Ipeadata)
60) Economically active urban population 1985 and 1996. (IBGE/Ipeadata)
61) County GDP in R$ of 2000 (thou) (deflated), 1985 and 1996. (IBGE/Ipeadata)
62) County agricultural GDP in R$ of 2000 (thou) (deflated), 1985 and 1996. (IBGE/Ipeadata)

63) Appendix 2

Table A1 - Non-Instrumented Results

	Fixed Rent (%)	Sharecropper (%)	Owner (%)	Squatted/Occupant (%)
Conflict per 1000 farms	0.0002	-0.00004	-0.0001	-0.0001
	(1.41)	(-0.42)	(-0.31)	(-0.81)
Cotton, % of total farm area	0.463***	0.208***	-0.734***	0.062
	(5.93)	(4.33)	(-6.59)	(0.91)
Rice, % of total farm area	0.308***	0.252***	-0.553***	-0.007
	(8.72)	(11.53)	(-10.96)	(-0.23)
Coffee, % of total farm area	-0.127***	0.056***	0.101***	-0.030
	(-4.70)	(3.35)	(2.63)	(-1.29)
Cane, % of total farm area	0.175***	0.059***	-0.210***	-0.024***
	(22.63)	(12.33)	(-19.03)	(-3.56)
Beans, % of total farm area	0.0008	0.128***	-0.231***	0.102***
	(0.03)	(8.09)	(-6.31)	(4.56)
Manioc, % of total farm area	0.047	0.086***	-0.676***	0.543***
	(1.20)	(3.52)	(-12.02)	(15.80)
Corn, % of total farm area	-0.027	0.032***	-0.001	-0.006
	(-1.45)	(2.74)	(-0.04)	(-0.34)
Soy Beans, % total farm area	0.213***	0.028***	-0.212***	-0.029**
	(16.66)	(3.53)	(-11.63)	(-2.58)
Frontier	-0.0004***	0.0001	0.0009***	-0.0006***
	(-2.67)	(0.62)	(4.78)	(-4.71)
GDP growth 1985-1995	0.0002	-0.0005	-0.006***	0.006***
	(0.15)	(-0.58)	(2.75)	(4.75)
Latitude	-0.003***	0.0009**	0.004***	-0.002***
	(-4.10)	(2.23)	(4.18)	(-3.72)
Longitude	0.001	0.0008*	-0.005***	0.004***
	(1.43)	(1.89)	(-5.57)	(6.13)
Distance to state capital	-0.00003***	0.00001	0.00004***	-0.00002***
	(-3.21)	(1.18)	(3.53)	(-2.93)
Transport cost to São Paulo	-0.000001	-0.000003**	-0.00001*	0.00001***
	(-0.54)	(-1,99)	(1.90)	(5.14)
Number of train stations	0.002***	-0.0004	-0.002***	0.0006
	(3.69)	(-1.49)	(2.72)	(1.27)
Population density 1995	0.00001	-0.0000003	-0.00001	0.000002
	(0.99)	(-0.10)	(-0.96)	(0.49)
Rural/Urban Population 1995	-0.0008	-0.0001	-0.001	0.002***
	(-1.45)	(-0.22)	(-1.57)	(4.39)
Population growth 1985-1995	-0.001	-0.0007	0.003	-0.009
	(-0.99)	(-0.69)	(1.15)	(-0.64)
Tractor per hectare growth 1985-1995	-0.081	0.636***	-0.976***	0.421***
	(-0.46)	(5.88)	(3.90)	(2.75)
Cattle per hectare1995	-0.004**	-0.002	0.009***	-0.004***
	(-2.13)	(-1.43)	(3.75)	(-2.68)
Constant	-0.054	-0.028	1.26***	-0.181***
	(-1.21)	(-1.01)	(19.86)	(-4.66)
Number of observations	Total: 3616	Total: 3616	Total: 3616	Total: 3616
State dummies (27 states)	Yes	Yes	Yes	Yes
R^2	0.44	0.28	0.42	0.42
$\chi^2(44)$	2835.14	1404.88	2033.70	2587.83
Prob>χ^2	0.0000	0.0000	0.0000	0.0000

Estimated Seemingly Unrelated Regresion. t-stats in parentheses. Statistical signif.: 1% ***. 5% **, 10% *. The coefficients for all four equations are constrained to add up to 0 for every variable.

Appendix 3 – Sensitivity Analysis for Spatial Autocorrelation

Ideally we would like to take into account the effect of spatial autocorrelation in our regressions in Table 4. Although we are able to run estimation procedures controlling for spatial autocorrelation using latitude and longitude to indicate each *municipio's* location, we have not found any program or routine that can do so in the context of three-stage least squares estimation with all coefficients of the same variable constrained to add up to zero across equations and when the first stage is a Tobit. Therefore, for the purpose of sensitivity analysis we did three separate estimation procedures which can be compared to ascertain the relative impact on results of spatial autocorrelation versus the 3SLS. The first step is to use GMM estimation with the estimated level of conflict from the first-stage Tobit directly in each separate second-stage contract-choice equation. This procedure was then repeated including an additional procedure (Conely, 1999) which takes into account also the possibility of spatial autocorrelation of errors, that is, the impact of neighboring *municipios'* variables on a given *município´s* dependent variable. The estimates from the two GMM procedures can be compared to see how much spatial autocorrelation affects the results. The second step is a comparison of the 3SLS results in Table 4 and the non-spatial GMM estimation in order to ascertain how much of the former results are due to taking into account contemporaneous correlation and to constraining the coefficients to add up to zero. The relative impacts of spatial autocorrelation and of the 3SLS can then be compared. The estimated coefficient of conflict in the contract choice equations is shown in Table A2.[31]

Table A2 – Sensitivity Analysis for Estimation Procedure

	Coefficient of Estimated Conflict (from 1st stage) in Contract Equations	**Fixed Rent (%)**	**Sharecrop (%)**	**Owner (%)**	**Squatted/Occupant (%)**
1	Three Stage Least Squares, Instrumental variables, no spatial correction (Table 3)	-0.008*** (-3.60)	-0.006*** (-4.21)	0.010*** (3.39)	0.004** (2.50)
2	GMM Instrumental variables, separate equations, no spatial correction	-0.020* (-1.82)	-0.010** (-2.38)	0.033*** (2.68)	-0.004* (-1.65)
3	GMM instrumental variable, spatial autocorrelation (Conley, 1999)	-0.020 (-1.63)	-0.011* (-1.92)	0.033** (2.16)	-0.004 (-1.46)
	Number of observations	3616	3616	3616	3616

Lines 2 and 3 estimated using IPEAGeo 1.0.0. t-stat in parentheses. Statistical significance: 1% ***, 5% **, 10% *. Spatial GMM based on Conley (1999) using latitude and longitude as x and y coordinates with proportional distance set at 10% of maximum distance. Same controls used as in Table 4 except state dummies.

[31] The results for the other variables are omitted in the interest of space.

Line 1 in Table A2 shows the estimated coefficient for conflict using 3SLS, replicated from Table 4. Line 2 shows the GMM estimates with no consideration of spatial autocorrelation. Finally line 3 shows the GMM estimates including the correction for autocorrelation. Comparison of lines 2 and 3 show the impact of spatial autocorrelation on the standard errors. By construction the estimated coefficients are the same. Comparison of line 1 and 2, none of which consider spatial autocorrelation, show the impact of estimating the equations in a system by 3SLS with constrained coefficients rather than estimating separate equations through GMM, though the same instruments are used in both procedures.

The comparisons show that including the impact of spatial autocorrelation has very little impact on the t-stats, which become slightly smaller but do not change the result of the tested hypotheses. In both cases conflicts are found to reduce fixed rent and sharecropping, though no effect is found on squatted/occupied land. On the other hand, the impact of using 3SLS is large. The estimated coefficients vary and the t-stats become larger, adding substantial statistical significance to the result that the tenancy contracts are inhibited by conflict. The 3SLS results are preferable to the GMM results because they are more efficient econometrically. This is so for two reasons. The first is that the simultaneous estimation of the equations including the 'contemporaneous' correlation of errors makes the estimates more efficient. The second is due to the additional information that is added by the constraints that force all coefficients of each variable to add up to zero across equations. The upshot is that we can have confidence in the results presented in Table 4, with perhaps a small but inconsequent underestimation of the standard errors. The same conclusion extends to the estimates of the land use variables in Table 5.