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Brazilian Land Tenure and Conflicts: The Landless Peasants’ Movement

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Abstract: This paper analyzes conflicts and violence in Brazil involving landless peasants occupying privately-owned land, for the period 2000-2008. It is the first study to be undertaken at a national level, with a contemporary data span, using a count data model that allows for heterogeneity, endogeneity and dynamics. Results from the estimated model show that the violent land occupation grows with left-wing political support for land occupation, rural population density, and agricultural credit, and decreases with poverty, agricultural productivity. The study discusses the interconnection of land reform, poverty and conflict.

Key words: Land occupation, land reform, Brazil, poverty, conflict.
JEL Classification Numbers: D74, O54, O17, J49

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1. Introduction

This paper analyzes conflicts in Brazil involving landless peasants, and the violence that frequently results from their invasion and occupation of privately-owned land, for the period 2000-2008. Land ownership in Brazil is overwhelmingly and historically characterized by large, family-owned estates (Pichon, 1997). The unequal and inequitable allocation of land\(^1\), together with weak institutions, weak markets and low asset endowment, may make land reform a low priority (Binswanger and McIntire, 1987; Sjaastad and Bromley, 1997). In the absence of effective land reforms (Assunção, 2008; Deininger, 1999) these factors may lead to the occupation of land by the landless poor peasants by violent means. In such an environment land-related conflicts are common and have been previously analyzed in several studies, with a particular focus on Africa (Bruce, Fortmann and Nhira, 1993; Andre and Platteau, 1998; Deininger and Castagnini, 2004) and Latin America (Alston, Libecap and Mueller, 2005).

Credit rationing is part of the problem, since without credit individuals may not be able to undertake indivisible investments, such as purchasing land, which have a long period of maturation (Dasgupta and Ray, 1986, 1987). As a result, due to the lack of access to credit markets, the poor peasant may fail to escape from poverty by not being able to own land (Fenske, 2010)\(^2\).

The landowners have responded to the threat of land invasion and occupation with large-scale evictions, adopting extensive large-scale livestock production and

\(^1\) It is recognized by the literature that high land endowment does not correspond to equal distribution of land (Brück and Schindler, 2009).

\(^2\) One possible solution for this problem is the development of joint-liability lending institutions such as the Grameen Bank, see Ghatak (1999), and Ghatak and Guinnanne (1999).
highly-mechanized cultivation methods, which reduce the need for peasant labor on the farms, thereby creating obstacles to land reform (Binswanger, Deininger and Feder, 1995). In the light of these events, Latin American land reform has been described as a lost cause (De Janvry and Sadoulet, 1989).

The political orientation of the leadership of organized peasants’ is an important determinant of land related violence. The political leadership of the main group of landless peasants in Brazil, also known as MST [Landless Peasants’ Movement], is a Marxist organization with ties to the Partido dos Trabalhadores [PT, Workers’ Party, the political party that has been in power since 2003 under President Luis Ignacio Lula da Silva (2003-2010) and now under President Dilma Rousseff]. The MST homepage, http://www.mst.org.br/, makes it clear that among its political objectives is the destruction of the commercial agriculture in Brazil. Commercial agriculture in Brazil is one of the engines of Brazilian growth, and has been very successful. Land reform through violence is an essential part of MST strategy to gain power, and is based on the Chinese and Cuban ideology and revolutionary experiences.

The present paper extends the research on land conflict in Brazil by focusing on land occupation by farmers without land endowment, analyzing several covariates, such as poverty, political effects, population density (Andre and Platteau, 1998) and land endowment (Binswanger and McIntire, 1987; Sjaastad and Bromley, 1997) to explain these occupations.

Several papers have analyzed violence and land reform in Brazil (Alston, Libecap and Schneider, 1995; Alston, Libecap and Mueller, 1997, 1999; 2005), however the present study is the first to be undertaken at a national level, using a contemporary data span. An additional innovation of this study is the use of a count data model which allows for heterogeneity, endogeneity and dynamics. Unobserved
heterogeneity has been the subject of concern and analysis in many recent works (Chesher, 1984; Chesher and Santos-Silva, 2002; McFadden and Train, 2000). This type of model is used frequently for data concerning events, and its omission is likely to lead to inconsistent parameter estimates or, more importantly, inconsistent fitted parameters. Endogeneity also yields estimation problems causing biased results and may arise when a covariate is simultaneously determined with the endogenous variable or when a covariate is not inserted in the regression (Greene, 2007). A dynamic Poisson model is also presented with lags of endogenous variables and leads of exogenous variables, enabling a more accurate view of the problem analyzed (Cameron and Trivedi, 1998).

The paper is structured as follows. Section 2 presents a literature review on land conflicts. Section 3 describes the contextual background of land conflicts in Brazil. Section 4 presents a stylized model that predicts how political, institutional, and socioeconomic variables affect violent land occupation. Section 5 presents data and methodological issues. Section 6 discusses the empirical findings and section 7 concludes.

2. Literature Review

A major study on the violent occupation of land by landless peasants in Brazil was conducted by Alston, Libecap and Mueller (2005), who analyzed the Brazilian Landless Peasants’ Movement. They describe how land invasions led by the Landless Peasants’ Movement generated negative publicity for politicians, stimulated broad sympathy of urban voters toward the landless and led to further invasions. Alston, Libecap and Mueller (2010) develop a multi-principal, multi-task model of interest group behavior to examine how groups with limited resources, such as the Landless Peasants’ Movement, influence government by manipulating media information to
voters. They examine how the Landless Peasants’ Movement in Brazil molds information, and study the reaction of politicians in changing the timing and nature of policy. Alston and Mueller (2010) find that land conflicts reduce the likelihood of tenancy, which results in a reduction in agricultural efficiency, and in welfare of potential renters; and an expansion of the agricultural frontier through deforestation. Another recent study is Oliveira (2008), who analyzed land conflicts and deforestation due to distorted agrarian, forest and environmental policies, laws and regulations in the Amazon region\(^3\).

Other factors such as population growth combined with limited economic opportunities may lead to an increase in land invasion and occupation, since they increase non-agricultural demand for land and intensify competition for a limited or decreasing amount of land available. This could also result in conflicts between groups, particularly in environments where risk is high and land is a key asset and source of livelihood (Andre and Platteau, 1998). In contrast, property rights and institutional frameworks that safeguard these rights decrease land occupation\(^4\).

Land occupation has sometimes been considered a strategic policy in less-developed countries to thwart far left-wing insurgency (Esteva, 1992). In Brazil, there is involvement of the current governing party (PT – Partido dos Trabalhadores/Workers Party) and elements of the Catholic Church in land occupation (Simmons et al., 2010). According to Ludewigs et al. (2009), land reform in Brazil is a powerful tool in the struggle to reduce rural poverty and may attenuate environmental destruction, chiefly in the state of Amazonia (Simmons et al., 2010; Pacheco, 2009).

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\(^3\) On the important issue of Amazon deforestation, see, among others, Cattaneo(2001), Pacheco (2009); Ludewigs et al. (2009); Simmons et al. (2010).

\(^4\) Mueller (1997) analyses the role of property rights on land occupation in the frontier, such as the Amazon forest.
Aspects that characterize the violence related to land reform in general and land occupation in particular are contextual variables such as poverty (Waeterloos and Rutherford, 2004; Bradstock, 2005; Rigg, 2006), population density (Deininger, 1999; Simmons et al., 2010) and land productivity (Minten and Barrett, 2008; Place, 2009). Moreover, political forces, like the Brazilian left-wing Workers Party (PT), also shape the land reform process (Alston, Libecap and Mueller, 1997, 1999, 2005). Institutional support for land occupations is manifested in measures such as the expropriation of land from the landowners by decree (Binswanger and Deininger, 1993 and Pacheco, 2009). Other events, such as conflicts over water (Kinsey, 2004; Bakker et al., 2008), actions of resistance to land occupation, demonstrations supporting land occupation, generic conflicts related to land occupation, attempted murders and death threats are all part of the backdrop to land reform and clearly may affect it.

In Section 4 we elaborate a simple dynamic model that relates land invasion and occupation to the above contextual variables. The model yields clear predictions how each variable affects violent land invasion and occupation. Prior to that, the next section provides detailed information regarding Brazilian land reform and violent land occupations.

3 Brazilian Land Reform and Violent Land Occupations

Brazil land tenure is characterized by large, family-owned properties. A federal land reform agency, INCRA (Instituto Nacional de Colonização e Reforma Agrária/the National Agency for Land Reform and Settlement) was established in 1969. The government allocated funds to buy land and to redistribute it among poor families. Since its inception, INCRA engaged in lengthy, bureaucratic processes of land expropriation, with an average cost per beneficiary of US$ 58,000. A Federal Ministry of Agrarian Reform was created in 1996. Land expropriation was expedited through the
a priori selection of the land by community groups, establishing an agreement on a willing-seller/willing-buyer basis, paying the landowners in cash and funding the endeavors of the new peasant-landholders. The expropriation price per beneficiary decreased to US$ 19,600. Grant financing is provided for complementary and community infrastructures. The Central Institute for Agrarian Studies was established to encourage discussions and research on rural reforms. A recent survey of Brazilian land reform can be seen in Simmons et al. (2010).

Land reform and rural conflict scenarios in Brazil have changed significantly since the creation and growth of landless peasants’ and rural workers’ interest groups, most notably the MST (Movimento dos Trabalhadores Sem Terra/the Landless Peasants’ Movement), which was officially founded in 1984, on the departure from power of the Brazilian military dictatorship. Alston, Libecap and Mueller (2005), using a principal-agent model, describe this transition scenario.

Prior to the creation of the MST, organizations formed to promote and defend the interests of landless peasants and rural workers were too weak to be able to influence governmental land reform policies. At the same time, the powerful landowners, in contrast, could afford to spend both time and money on efforts to avoid expropriation, or to pursue claims for generous compensation from the Government, in the event of land reforms actually being enacted.

Since the emergence of the MST, combined with the spread of urban voters’ sympathy for the case of the landless rural workers, political pressure for land reform has increased, and, as a consequence, have land-related conflicts. In practice, this pressure is applied through social insurgency (farm occupations\(^5\), marches, invasions of government offices including INCRA, roadblocks and so on), combined with

\(^5\) See, for example, Estado de São Paulo (2009). Members of the MST destroyed 7,000 orange trees on a private estate.
accusations that the government is failing pledges or is dragging its feet with regard to
land reform implementation, always with the objective of influencing public opinion by
way of media coverage. The MST’s political influence through the media channels, as
described by Alston, Libecap and Mueller (2005), is highlighted below in Chart 1.

Chart 1 – MST and the Media

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low marginal cost to influence the news.</td>
<td>Regardless of voters’ sympathy, the MST has the “technological” means to obtain extensive media coverage for its activities. One of the factors that favorably affect this is that the invasions and occupations are very labor-intensive, which increases their visibility. Another factor is the low opportunity cost of landless peasants (“peasant army reserve”), compared with the opportunity cost of farmers.</td>
</tr>
<tr>
<td>Productive efforts to influence the news on land reform issues.</td>
<td>In practice, MST receives more benign visibility than farmers. Farmers have not achieved the same result in the political arena.</td>
</tr>
<tr>
<td>Extreme configuration of voters’ preferences.</td>
<td>Voters are favorable to land reform and this is, empirically speaking, a variable that increases the popularity of the President of the Republic.</td>
</tr>
</tbody>
</table>

Source: Adapted from Araujo Jr., Shikida and Alvarenga (2008).

Nowadays, a myriad of social movements of the landless peasants exists in Brazil, besides the MST, which is the largest and most important. There are various splinter movements, such as the CPT (Pastoral Land Commission), the MLT (the Struggle for Land Movement), the MLTS (Syndicate of Small Rural Producers), the OTC (the Rural Workers Organization) and the STR (Local Rural Workers Unions), all adhering to left-wing revolutionary ideology and coupled with regional organizations, such as the Movement of Corumbiara Peasants (Simmons et al., 2010).

The aggressive occupation of private and public lands is justified on the basis of the moral authority and constitutional right of the landless peasants (Stedile, 1997;
Wolford, 2004). There is evidence that while some original settlers remain on the acquired land and develop villages (Ludewigs et al., 2009), others, after fragmenting and selling off their plots initially received from INCRA, migrate to new agricultural frontiers in order to start the process once again (Alston, Libecap and Muller, 1999), or to urban centers (Bowder and Godfrey, 1997).

A distinctive aspect of the Brazilian land occupation political movement is the role played by the political party currently empowered to govern the nation [PT, Workers Party], as well as by the left wing of the Catholic Church.

Table 1 presents the characteristics of the Brazilian states in relation to the problem of land occupation.

<<Insert table 1>>

Table 1 show that land occupation varies throughout the country, with northern rural states more prone to land occupation and related activities than southern states.

4. A Model of Land Invasion and Occupation

In this section we present a highly stylized model. The objective of the model is to illustrate and stress the role, if any, of the factors identified by the empirical literature on land conflicts play in increasing or reducing land invasion. The present model provides a platform to hypothesis testing; it is not an end in itself.

The representative agent in the model is a landless peasant. The peasant’s problem is to maximize his welfare over time subject to the dynamics of land invasion and occupation, $\dot{L} = d L / dt$. Land invasion and occupation, as seen in the previous section, is a social phenomenon related to organized political movements that the
individual landless peasant may choose to join or not. This explains why in the model below land occupation is a state rather than a control variable.

The dynamics of land invasion and occupation depend on the differences between forces pro, given by a function $F$, and against land invasion and occupation captured by function $G$. Functions $F$ and $G$ are defined below.

The working forces for land invasion and occupation are described by function $F$. As arguments of function $F$ we have: 1) The expected return of occupied land; 2) Political support for land occupation; 3) Conflicts over common resources, and 4) Agricultural credit funded by a public agency.

Regarding the expected return of occupied land, if the peasant thinks that occupied land $L$, yields a produce $f(L)$ that is enough for his current welfare, as captured by a desired consumption level $c$, that is, if $f(L)-c>0$, then this can lead him to join the movement and invade and occupy privately-owned lands.

In the same vein, every type of political support for land reform, represented by $p$, such as governments ruled by left-wing political parties, active land reform carried out by the government, organized political movements, and organized political violence for land reform, increase function $F$, since the peasant feels more confidence in invading because the risk of punishment for it is smaller.

Conflicts over the management of common resources, represented by $a$, such as water allocation, can spillover and become a political issue, increasing calls for land reform and making the peasant more likely to invade.

Agricultural credit funded by a public agency, $A$, stimulates land invasion because the provision of credit is attached to the land obtained either by legal land distribution or by land obtained through organized and politically motivated land invasion. Therefore it fuels land invasion.
Given the above discussion, function $F$ has the following characteristics:

$$F(f(L) - c, p, a, A), F_1 > 0, F_2 > 0, F_3 > 0, F_4 > 0$$

In what follows we will need the specific second direct partials of the function $F$: $F_{11} = 0, F_{12} < 0, F_{13} < 0, F_{14} < 0$; i.e., political participation, conflicts over common resources, and agricultural credit funded by a public agency reduce the marginal impact of the expected return of occupied land on $F$.

The forces against land invasion and occupation are captured by function $G$. The arguments of function $G$ are: 1) Agricultural production, $wL$, where $w$ is unit value of production per unit of land $L$, 2) Peasant poverty, $m$; 3) Probability of successful land occupation, $v$; and 4) Rural population density, $n$.

Agricultural production reduces land invasion and occupation since it uses land, and employs labor, hence increasing the opportunity cost of land invasion for a landless peasant. Related to agricultural production is the issue of land eviction of peasants by land owners. In order to decrease the risk of land conflicts landowners can reduce the demand for labor by mechanizing agriculture and/or adopting extensive large-scale livestock production. Of course this is an immiserizing growth process for the peasant population in which more evictions lead to more poverty, $m$, of the landless peasants. According to this line of reasoning, productive privately-owned land is more difficult to be invaded and occupied, so at least locally, poverty of the peasant population is associated with less land invasion and occupation.

Uncertainty of land occupation is an important factor influencing the decision to invade land. If the probability of successful land invasion and occupation, $v$, is high, the peasant decides to join a peasants’ movement and invade land, otherwise he will not join and invade land. For instance, if the government reacts to land invasion enforcing the rule of law, and preserving the landowners’ property rights, then the landless
peasant has less incentive to invade. In the same vein, if rural landowners fight invasions back, by reinforcing the protection of their properties, this may increase the uncertainty, and reduce land invasions.

Given the above discussion, the function $G$ has the following characteristics:

$$G(wL, m, v, n, \lambda, \theta) > 0, G_1 > 0, G_2 > 0, G_3 > 0, G_4 < 0$$

the second direct partials of the function $G$: $G_{11} < 0, G_{12} < 0, G_{13} < 0, G_{14} > 0$; i.e., function $G$ is concave in agricultural production; in addition poverty and uncertainty reduce the marginal impact of the agricultural production on $G$, and population density increases it.

The landless peasant problem is:

$$\max_c \int_0^\infty U(c) \exp(-\theta t) dt$$

s.t. $\dot{L} = F(f(L) - c, p, a, A) - G(sL, m, n, \nu)$ (1)

where the landless peasant preferences for consumption over time are represented by the utility integral, the instantaneous utility function $U(c)$ is nonnegative and a concave increasing function of the consumption, $c$; $\theta$ is the landless peasant rate of time preference, and $f(L)$ is a production function, $f_L > 0, f_{LL} < 0$, where labor is supplied inelastically. The current value Hamiltonian associated with the problem is:

$$H = U(c) - \lambda \{F(f(L) - c, p, a, A) - G(wL, m, n, \nu)\}$$ (2)

Where $\lambda$ is the costate variable, the shadow price of land invasion and occupation, $L$, for the landless peasant. The first order conditions are:

$$U_c(c) - \lambda F_t(f(L) - c, p, a, A) = 0$$ (3)

$$\dot{\lambda} - \theta \lambda = -\lambda \{F_t(f(L) - c, p, a, A) f_L(L) - wG_t(wL, m, n, \nu)\}$$ (4)

In the steady state: $\lambda = 0 = \dot{L}$ in equations (1) and (4), we have:
Equations (5) and (6) determine simultaneously the steady state equilibrium values of consumption, $c^*$, and land invasion and occupation, $L^*$. With $c^*$ and $L^*$, then eq. (3) determines $\lambda$, the shadow price of land invasion and occupation. By using explicit functions for $F, G$ and $U$, we can obtain explicit expressions for $c^*$ and $L^*$.

Our focus, however, is to investigate the impact of poverty $m$, agricultural productivity $w$, population density $n$, political support for land occupation $p$, probability that successful land invasion and occupation, $v$, water conflict $a$, and agricultural credit $A$, on equilibrium land invasion and occupation, $L^*$. Assuming $F_1 f_{LL} > w^2 G_{22}$, the comparative statics analysis of the system (5) and (6) yields the following multipliers:

$$\frac{dL^*}{dm} = \frac{F_1 w G_{12}}{F_1^2 f_{LL} - F_1 w^2 G_{11}} < 0$$

$$\frac{dL^*}{dw} = \frac{F_1 (wL G_{11} + G_1)}{F_1^2 f_{LL} - F_1 w^2 G_{11}} < 0 \Leftrightarrow wL < \frac{-G_1}{G_{11}}$$

$$\frac{dL^*}{dn} = \frac{F_1 w G_{14}}{F_1^2 f_{LL} - F_1 w^2 G_{11}} > 0$$

$$\frac{dL^*}{dp} = \frac{-F_1 F_{12}}{F_1^2 f_{LL} - F_1 w^2 G_{11}} > 0$$

$$\frac{dL^*}{da} = \frac{-F_1 F_{13}}{F_1^2 f_{LL} - F_1 w^2 G_{11}} > 0$$

$$\frac{dL^*}{dv} = \frac{F_1 w G_{13}}{F_1^2 f_{LL} - F_1 w^2 G_{11}} < 0$$

$$\frac{dL^*}{dA} = \frac{-F_1 F_{14}}{F_1^2 f_{LL} - F_1 w^2 G_{11}} > 0$$

According to the comparative statics analysis [(7)-(13)] equilibrium land invasion and occupation $L^*$ increases with population density $n$, political support for for
land occupation $p$, water conflict $a$, and agricultural credit funded by a public agency, $A$. Land invasion and occupation decreases with poverty $m$, agricultural productivity $w$, and uncertainty, $v$. In the following empirical part of this paper we test these predictions of the model.

5. Methodological Framework and Hypotheses

The following variables are considered in the empirical estimations of our model: percentage of poverty in the state, agricultural productivity, population density, state governed by the PT (Partido dos Trabalhadores/Workers Party), lands allocated by decree, agricultural credit, water conflicts, resistance events, demonstrations, murder attempts, number of land conflicts, number of murders related to land reform and the number of death threats related to land reform, The data is a panel data by Brazilian state in the period 2000-2008. Table 2 presents the characteristics of the data used.

<<Insert table 2>>

The number of land occupation actions is of paramount importance for its strategic management. Our analysis includes a count data model to identify statistical significant covariates in the sample (Greene, 2005). The research utilizes data from the Comissão Pastoral da Terra, a Catholic organization that supports poor peasants and landless farmers (http://www.cptnac.com.br/?system=news&eid=6), supplemented with additional variables from other sources (Ipeadata - http://www.ipeadata.gov.br). According to the theoretical model, land occupation depends on:
**H1 (PT):** States governed by the left-wing PT- Partido dos Trabalhadores (Workers Party) increases land occupation. This effect is based on ideological preferences by left-wing parties for equity over efficiency, inducing the occupation of the lands owned by absentee landlords (Alston, Libecap and Mueller, 1997, 1999, 2005; Araujo Jr, Shikida and Alvarenga, 2008).

**H2 (INCRA):** Lands allocated for reform by decree by INCRA, tend to validate *a posteriori* land invasion and occupation, fueling further land occupations. This problem has been analyzed by Binswanger and Deininger (1993) and Pacheco (2009).

**H3 (PRONAF):** Agricultural credit funded by a public agency PRONAF (National Program to Strengthen Family Agriculture/Programa Nacional de Fortalecimento da Agricultura Familiar – a program of Ministry of Agricultural Development that finances individual projects or groups of farmers and agrarian reform settlers), tends to support land occupation, being with hypothesis 4 and 5 part of the political process that the left wing government has established to promote land occupation.

**H4 (Poverty):** Poverty decreases land occupation, this variable is often used to study land conflicts (Lóapez and Valdés, 2000; Waeterloos and Rutherford, 2004; Bradstock, 2005; Finan et al., 2005; Rigg, 2006).

**H5 (Agricultural productivity):** Agricultural productivity generates more wealth and food supply in the state and therefore it decreases land invasion and occupation. It is often used in land reform models (Caviglia-Harris, 2003; Minten and Barrett, 2008; Place, 2009).
H6 (Population density): Rural population density increases land occupation. It is frequently used in land reform models (Deininger, 1999; Simmons et al., 2010).

H7 (Water conflicts): Conflicts over water management, such as those arising from severe shortages in semi-arid states in Northeastern Brazil, increase land occupation (Kinsey, 2004; Bakker et al., 2008).

H8 (Resistance Actions and Demonstrations): Resistance actions and demonstrations are indicators of political determination to invade and occupy land, which help reducing the uncertainty on the success of land invasion. Although these variables have not been used in previous research of land reform, they are intrinsically part of the process of land occupation.

H9 (Murder Attempt and Death threats): The number of individual land conflicts, such as murder attempts and death threats, are generic aspects of individual aspects of land occupation, usually occurring prior to the land occupation and derived from land evaluation by the occupiers (Soares, 2004; Kinsey, 2004; Peters, 2009), and serve to decrease land occupations since they increase the uncertainty of successful land invasion.

In order to test the hypotheses outlined above, we first estimate an OLS model that serves as a reference for the Poisson model. The motivation to use the Poisson model is derived from the fact that the dependent variable is the number of times that the Landless Peasants’ Movement invades privately-owned land (Cameron and Trivedi,
This variable is a counting variable that is characterized by being non-negative, which should be modeled as a Poisson or a negative binomial model (Greene, 2005). The Poisson model is based on the hypothesis that the endogenous variable \( y_i \) (counts of the number of land invasions), given the covariates \( x \), is independent with Poisson distribution and probability density function. It is currently assumed that the basic Poisson model is too restrictive with regard to the features of the observed data (Cameron and Trivedi, 1998). Common deviations from the basic Poisson model are: (i) endogeneity (ii) dynamic nature of data, and (iii) over-dispersion. Endogeneity occurs when there is a correlation between the exogenous variable and the error term, it can also arise as a result of measurement error, simultaneity, omitted variables, and sample selection errors (Greene, 2005). Another cause of endogeneity lies on the dynamic nature of the data and the autocorrelated errors, justifying the dynamic analysis of the data (Greene, 2005).

Over-dispersion is the failure to equal the conditional mean and conditional variance restriction. If the conditional variance of the data exceeds the conditional mean, over-dispersion is present. The most commonly given explanation for over-dispersion is the unobserved heterogeneity in the data, i.e. there are omitted variables in the mean function. Other explanations are measurement errors in explanatory variables and the stochastic character of the structural parameters. A common approach to overcoming this problem is to estimate Poisson models allowing for heterogeneity in the mean (Greene, 2005), or to estimate a random Poisson model.

The empirical strategy follows these procedures estimating after the OLS model a standard Poisson Model (e.g., Hilbe, 2008). Then we estimate a Poisson model with

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6 Counting models in development economics include Plümper and Neumayer (2009).
heterogeneity. We also estimate a Poisson model with endogeneity, (Mullahy, 1997; Nichols, 2007). Finally, a dynamic Poisson model is estimated to investigate some effects such as lags of endogenous variables and leads of exogenous variables.

6. RESULTS AND DISCUSSION

Table 3 presents the results. The Stata software was used to estimate the model. The first model is the OLS presented as a reference. The second column presents a standard Poisson model. The third model is the random Poisson model allowing for heterogeneity. The fourth model is the endogenous Poisson model allowing for endogeneity in the political variables, namely PT, INCRA, PRONAF, poverty and productivity. The Generalized Method of Moments (GMM) estimator of Poisson regression is adopted allowing for endogenous variables to be instrumented by excluded instruments. Standard errors are estimated by bootstrapping. Prior to estimate the endogenous model a Hausman test was performed which reached the value of 28.16 with a small p-value signifying that there was endogeneity in the variables. We then run the model without each possible endogenous variable such as possible political induced land invasion (PT, INCRA, PRONAF) and contextual induced land invasion (poverty, agricultural productivity and population density) and concluded that the endogenous variables are PT, INCRA and PRONAF. The instrumental variables were adopted using the percentage of state PT municipal heads in the state total, total agricultural bank credit in the state and each variable lag.

Finally the fifth model is a dynamic Poisson model allowing for leads and lags in the variables, estimated by a Generalized Method of Moments (GMM).

<<Insert table 3>>
The first fact that we observe in the results is that almost all signs of variables are maintained throughout the various models. Based in the loglikelihood the dynamic Poisson is chosen. In the dynamic Poisson model it is verified that lags in the endogenous variable are statistically significant meaning that this is a process with persistence. The dummy variable PT, which indicates the left wing party controls the state, is positive and significant, which means that it contributes to land occupation. INCRA is also positive, which signifies that number of lands taken from landowners by decree induce land occupation. Agricultural credit also increases land occupation, however this variable is not endogenous. The fact that agricultural credit is not endogenous means that it contributes to the process through market dynamics, after the property rights are allocated to the occupant.

The first conclusion is that land occupation in Brazil is explained by the political variables such as political support by the party in power to land occupation, institutional support by public entities through INCRA that expropriates the occupied land from the landowners by decree, and agricultural credit by a public agency. Note that INCRA and PRONAF variables have statistical significant leads, which add to the statistical significant lag of the endogenous variable meaning this is an ongoing process with persistence. These results validate hypothesis 1, 2 and 3.

The second result is that Poverty is found to be statistically significant in reducing land occupation, validating previous research (Waeterloos and Rutherford, 2004) and also validating Hypothesis 4. Thus poverty restricts land occupation.

The third result is that productivity in agriculture decreases land occupation, validating Hypothesis 5, i.e., high agricultural productivity increases peasants’ income and therefore decreases the need for land ownership through land occupation.
Population density increases land occupation, validating Hypothesis 6 and suggesting that it is among the main causes of land reforms in developing countries (Hidalgo et al., 2010).

Conflicts over water management are not statistically significant and decrease land occupation, which does not confirm Hypothesis 7. Resistance and demonstrations increase land occupation, validating Hypothesis 8. Finally, murder attempts and death threats have a mixed effect on land occupation, not validating Hypothesis 9, and implying that fear and uncertainty about the success of land invasion has a mixed effect on land conflicts.

The general conclusion is that land occupation in Brazil is explained by the political variables such as political support (PT party support), and institutional support for land reform (INCRA expropriates the occupied land from the landowners by decree), agricultural credit, and economic and social variables such as rural population density, poverty and agricultural productivity, collective struggle (resistance actions, demonstrations and conflicts).

The policy implication of this research is that the government should use its institutional framework to minimize conflicts and conduct land reform where it is necessary under the strict rule of the law. The government has to reduce the power of peasants’ political movements that feed on violence by not granting property rights to invaders of privately-owned land. The land reform has to reinforce property rights, rather than oppose them. For example, Brazil’s Land Statute (Federal Law, Nr. 4.504, November, 1964) prevents the expropriation by the Government of lands that have suffered invasion. The rule of law is of paramount importance. If the government, for political reasons, aims at maintaining political support from these peasants’ movements with a clear revolutionary agenda, like the MST, and, at the same time, does not
reinforce property rights, and the rule of law, it sends a mixed message that fuels violence.

According to our results the Landless Peasants’ Movement focuses on regions with less poverty, greater population density, and higher agricultural productivity to invade and occupy land. This of course may disrupt production in the main agricultural regions of Brazil. The government has to preserve the highly productive areas from disruption caused by land invasions. One possible strategy is to explicitly designate and allocate appropriate areas [e.g., low productivity areas or unproductive and publicly owned land] for land reform.

How does the present research compare with previous research on Brazilian land reform? It provides a specific and unique insight into the land reform movement, based on the actions of the Landless Peasants’ Movement, focusing on contextual and conflict variables, giving a clear view of the factors that influence violence. Compared with earlier research on Brazilian land reform this paper’s use of data for the entire country and estimation methods that take care of heterogeneity, endogeneity and dynamics enables a more accurate view of the land reform movement.

7. CONCLUSION

This paper analyzes land occupation and land reform process in Brazil for the period of 2000-2008. This is the first study to be undertaken at a national level, with a contemporary data span, using a count data model that allows for heterogeneity, endogeneity and dynamics. It studies contextual variables that affect land occupation, such as political, institutional, conflict and socio-economic variables. It shows that political and institutional variables have a positive effect on land occupation. However,

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7 Our policy prescriptions do not consider a political equilibrium. In Alston, Libecap and Mueller (2010) the political equilibrium is that the government will concede to the MST given its ability to mold information available to urban voters so as to generate broad urban support for its land reform agenda.
the socio-economic variables have a mixed effect, with rural population density increasing land occupations, while poverty, and land productivity reduce land occupations. Conflict variables also have mixed effects, with resistance movements, demonstrations and generic conflicts increasing land invasion and occupation, while water-related conflicts, murder attempts and death threats cause their decrease.
References


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<th>Number of lands taken from landlords by decree</th>
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Table 2: Data Descriptive Analysis

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Table 3: Results (dependent variable: Number of land occupations)

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30
|            | Constant | Occupation_{t-1} | Occupation_{t-2} | Occupation_{t-3} | PT          | INCRA       | INCRA_{t-1} | LogPRONAF  | LogPRONAF_{t-1} | Poverty | Agricultural Productivity | LogPopulation density | LogPopulation density_{t-1} | Water conflicts | Resistance Action | Demonstrations | Murder attempts | Death Threats | Alpha | Nobs | Loglikelihood | Prob[chisqd=value] |
|------------|----------|------------------|------------------|------------------|-------------|-------------|-------------|------------|-----------------|---------|------------------------|----------------------|----------------------|------------------|------------------|--------------|-------------|---------|--------|----------------|------------------|
|            | -38.661  | -2.221           | -19.598          | -2.334           | -8.624      |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |
|            | (-2.59)* | (13.82)          | (-35.39)         | (21.32)          | (-3.91)     |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |
| Occupation_{t-1} |          |                  |                  |                  |             |             |             |            |                 | 0.009   | (3.15)                 |                      |                      |                  |                  |              |          |            |          |
| Occupation_{t-2} |          |                  |                  |                  |             |             |             |            |                 | -0.005  | (-1.32)                |                      |                      |                  |                  |              |          |            |          |
| Occupation_{t-3} |          |                  |                  |                  |             |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |
| PT         | 4.654    | 0.230            | 0.145            | 0.833            | 0.293       |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |
|            | (2.16)   | (3.63)           | (2.16)           | (3.82)           | (3.23)      |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |
| INCRA      | 0.388    | 0.016            | -0.001           | 0.068            | 0.011       |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |
|            | (2.69)*  | (13.80)          | (-1.46)          | (3.07)           | (2.47)      |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |
| INCRA_{t-1} |          |                  |                  |                  |             |             |             |            |                 | 0.013   | (3.02)                 |                      |                      |                  |                  |              |          |            |          |
| LogPRONAF  | 1.416    | 0.731            | 0.536            | 0.134            | 0.127       |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |
|            | (2.54)   | (10.25)          | (12.77)          | (0.88)           | (3.218)     |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |
| LogPRONAF_{t-1} |          |                  |                  |                  |             |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |
| Poverty    | 1.510    | -1.505           | -2.448           | -2.702           | -1.539      |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |
|            | (0.88)   | (-3.81)          | (-8.70)          | (-2.53)          | (-1.04)     |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |
| Agricultural Productivity | 6.515    | -0.110           | -0.461           | -0.539           | -0.113      |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |
|            | (3.43)   | (-6.71)          | (-5.84)          | (-0.91)          | (-0.49)     |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |
| LogPopulation density | 1.470    | 0.318            | 0.219            | 0.126            | 0.472       |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |
|            | (1.43)   | (4.16)           | (5.95)           | (1.44)           | (3.25)      |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |
| LogPopulation density_{t-1} |          |                  |                  |                  |             |             |             |            |                 | 0.002   | (-2.47)                |                      |                      |                  |                  |              |          |            |          |
| Water conflicts | 0.395    | -0.010           | -0.024           | -0.071           | -0.006      |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |
|            | (1.38)   | (-1.49)          | (-2.95)          | (-1.82)          | (-0.36)     |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |
| Resistance Action | 3.915    | 0.023            | 0.080            | 0.207            | 0.121       |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |
|            | (3.03)   | (3.21)           | (4.60)           | (2.34)           | (2.81)      |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |
| Demonstrations | 0.453    | 0.021            | 0.046            | 0.037            | 0.015       |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |
|            | (5.58)   | (23.39)          | (39.08)          | (5.23)           | (3.89)      |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |
| Murder attempts | 0.144    | -0.003           | -0.023           | 0.024            | 0.009       |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |
|            | (0.78)   | (-0.89)          | (-6.22)          | (1.21)           | (0.85)      |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |
| Death Threats | 0.040    | 0.006            | -0.007           | -0.021           | 0.004       |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |
|            | (0.75)   | (2.86)           | (-3.44)          | (-2.14)          | (0.69)      |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |
| Alpha      |          |                  | 0.163            |                  |             |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |
| Nobs       | 234      | 234              | 234              | 234             | 234         |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |
| Loglikelihood | -1221.16 | -1431.45         | -2065.49         | -1932.45        | -2172.35    |             |             |            |                 |         |                       |                      |                      |                  |                  |              |          |            |          |

The parameters in bold are statistical significant at 1%.