Land Tenure Insecurity and Economic Growth in Brazil

Claudio Araujo
Catherine Araujo Bonjean
Jean-Louis Combes
Pascale Combes Motel

CERDI, CNRS, University of Auvergne

We examine the consequences of land tenure insecurity on economic growth in Brazil. We use an overlapping generations model with two sectors: an agricultural sector and a manufacturing sector. Land is specific to the agricultural sector and capital goods are specific to the manufacturing sector. Moreover land is a fixed production factor. Saving takes the form of either land or capital goods purchases, and saving composition depends on transaction costs generated by land tenure insecurity. It is shown that land tenure insecurity implies a decrease in land prices and a reallocation of savings in favour of capital goods. Two econometric restrictions can be tested on a panel of the Brazilian federation states: land tenure insecurity has a negative impact on land prices and a positive one on economic growth. Land tenure insecurity is proxied by the number of squatters. These two restrictions are not rejected.

JEL Classification: O41, Q15, O54

Key words: Land tenure insecurity, Squatters, Overlapping generations model, Land prices, Economic growth, Brazil.

Correspondence: C. Araujo or J-L. Combes, CERDI, 65 Bd François Mitterrand, 63000 Clermont Ferrand, France. Email: C.Araujo@u-clermont1.fr and J-L.Combes@u-clermont1.fr ; Tel: +33 4 73 17 74 20 or +33 4 73 17 75 13. The authors wish to thank the participants of the scientific conference of the AUPELF-UREF Network for Economic Analysis and Development in March 2004 and the participants of the AFSE Annual Congress in September 2004, as well as two anonymous referees.
INTRODUCTION

In this article, we look at the impact of land tenure insecurity on the economic growth of Brazil. In this country, land concentration and legal insecurity which weighs on property rights are a source of violent conflicts for the access to land between land owners and squatters (Alston, Libecap and Mueller, 1999). The history of Brazil is marked by important settlement movements of agricultural establishments by landless farmers, and the generally abortive attempts of land redistribution. Yet paradoxically, where land reform remains today an essential objective of the authorities, the literature points to a negative link between the development of the land market and growth.

Generally speaking, agricultural reforms are aimed at creating more efficient land allocation among the potential different users and are justified by efficiency and equity goals (e.g. de Janvry et alii, 2001; Deininger, 1999, 2003). Thus, land redistribution in favour of small farmers excluded from the credit market is allowing a relaxation of liquidity constraints linked to the acquisition of an indivisible asset. The redistribution of land also fosters an increase in farm productivity, where there exists an inverse relationship between the farm size and productivity (Binswanger, Deininger and Feder, 1995; Junqueira Assunção and Ghatak, 2003; Junqueira Assunção, 2003).

Moreover, securing property rights is generally considered to be favourable to investments and therefore, to agricultural growth, although this point is controversial (e.g. Brasselle, Gaspart and Platteau, 2002; Banerjee and Ghatak, 2004). These microeconomic arguments are reinforced by the macroeconomic analyses, which show evidence of a positive link between the reduction of inequalities in the distribution of assets and economic growth (Birdsall and Londono, 1997; Deininger and Squire, 1998; Persson and Tabellini, 1992). In addition, the redistribution of land assets and the securing of property rights are often considered to be a way of combating rural poverty and favouring growth.

However, certain recent studies moderate these positive arguments. In a model where land is a fixed factor of production and an asset entering into the portfolio of agents at the same time, an increase in land prices brings about a lower capital investment and a weaker level of revenue (Eaton, 1987). This means that land purchases are to the detriment of the accumulative assets, a source of growth. In this analytical context, the absence of a land market due to an extreme land concentration, favours capital investment and, therefore, growth (Drazen and Eckstein, 1988). Nevertheless, if one supposes that land holdings provide a source of benefit for the households by the services that it can provide (prestige, property services...) the eviction effect on the capital
brings about a reduction in revenues (Deaton and Laroque, 2001). So, according to these analyses, agricultural reform in the form of distribution of land titles that can be exchanged in a market, has a negative impact on growth.

The theoretical model exposed in the first part is built on an arbitrage condition between the land asset and the capital used in the manufacturing sector. The characteristic of our approach is to take into account the specific transaction costs of the land asset resulting from the poor definition of property rights. We view transaction costs here as the sum of costs which result from the contractual relationship in the land market, and that can prevent the acquisition of property rights. The transaction costs increase, in this article, from an excessive charge in the protection of the land property rights which dissuades potential land buyers. We show therefore, that an evict effect exists when land tenure insecurity is modified. This results in two restrictions – a negative effect of land tenure insecurity on the price of land and a positive effect on economic growth. These two restrictions are tested in the second part with the help of an econometric panel analysis on the 27 states of the Brazilian Federation. Notably, we make the hypothesis that the number of squatters is a proxy of land tenure insecurity. The implications of the model for land policies are presented in the conclusion.

1 THE THEORETICAL MODEL

We start with an overlapping generations model, inspired by Eaton (1987) and Drazen and Eckstein (1988), consisting of two sectors and three production factors. Land is a production factor specific to the agricultural sector, but also a savings support alternative to capital, as are, for example, titles of public debt (Diamond, 1965), money (Samuelson, 1958) or housing (Deaton and Laroque, 2001).

The population made up of L, household owners of production factors and therefore of firms, is supposed to be constant. Households and firms consume and produce during two periods (t and t+1). At period t, a household provides a work unit in the manufacturing or agricultural sector. He derives an income that is either consumed or saved. Savings are invested in manufacturing or agricultural sectors. The household wealth helps to finance the consumption for the period t+1. This is to say that households do not dispose of any initial wealth and leave no bequests to future generations.
1.1 Production

The economy is made up of a manufacturing sector and an agricultural sector. The first produces an amount \( M \). The second jointly produces an amount \( A \), and a land security service. The two goods \( M \) and \( A \) are perfect substitutes in household consumption and act as capital: their prices are equal and fixed at 1. The markets are supposed to be competitive.

The manufacturing sector uses capital \( (K) \) and labour \( (L^m) \). The agricultural sector uses land \( (T) \) and labour \( (L^a) \). Labour is perfectly mobile between the sectors and the households do not support any cost linked to sectorial reallocations of labour. The land supply is considered to be fixed at each period. The production technologies where the returns to scale are constant are described by the following production functions:

\[
M_t = M(K_t, L^m_t) \quad (1)
\]

\[
A_t = A(T_t, L^a_t) \quad (2)
\]

These are assumed to be continuous and at least twice differentiable. The marginal productivities are positive and decreasing. They verify the Inada’s conditions. Furthermore, the impact of labour on the marginal capital productivity of land is not negative. The goods produced by the manufacturing sector are either consumed or invested and, as a result, the capital price is also equivalent to the numeraire. The depreciation rate of the capital is negligible.

Land is not a cumulative factor in the same way as capital goods. Its marginal productivity therefore depends only on the level of labour used in the agricultural sector.

Let \( w_t \) be the current wage rate on date \( t \), \( r_t \) the effective interest rate, \( p_t \) the price of land and \( C_t = C(p_t, T_t; \alpha_t) \) a transaction cost linked to the acquisition of land. This results in legal insecurity and of the difficulty, in Brazil, of respecting the land property rights. For an agricultural firm, the risk of expropriation or of the illegal occupation of land by squatters generates a protection cost of its property rights or cost of exclusion. The transaction cost increases in relation to the value of the transactions \( p_t, T_t \), and the land tenure insecurity noted by \( \alpha_t \). When property rights are perfectly respected, the transaction cost is nil, \( C(p_t, T_t; 0) = 0 \). The marginal cost \( \partial C/\partial T \) belongs to the interval \([0,1]\) and increases with \( \alpha_t \).

The representative firm of the manufacturing sector maximises \( V^m \), the anticipated inter-temporal profit is defined in the following manner:

\[
V^m = -(K_{t+1} - K_t) + \frac{1}{1 + E_{t+1}^{r_{t+1}}} E_t \left( M(K_{t+1}, L^m_{t+1}) - w_{t+1} L^m_{t+1} + K_{t+1} \right) \quad (3)
\]
$E_t$ is the mathematical expectation operator conditional on the information available in $t$. The initial capital $K_t$ belonging to the ‘old households’ is given, and the final capital $K_{t+2}$ is nil, as the firm which belongs to the ‘old households’ for the period $t+1$ sells the whole of its productive capital at the end of the period $t+1$. In other words, in period $t$, the firms of the manufacturing sector choose the level of their investment. In period $t+1$, they produce then sell their entire assets. The control variables are therefore, $L_{m,t+1}$ and $K_{t+1}$.

The representative firm of the agricultural sector maximises $V^a$, the expected inter-temporal profit which takes into account the capital gains:

$$V^a = \left( p_t T + C \left( p_t T; \alpha \right) \right) + \frac{1}{1 + E_{t+1}^T} \left( A(T, L^a_{t+1}) - w_{t+1} L^a_{t+1} + p_{t+1} T \right)$$  \hspace{1cm} (4)

At period $t$, the agricultural firm buys the land which will become productive in $t+1$. Moreover, it supports the land transaction cost. In $t+1$, it produces then sells the land to the ‘old households’. The control variables are $L_{a,t+1}$ and $T$.

The maximisation of the expected inter-temporal profits leads to the following first order necessary conditions:  \hspace{1cm} 1, 2

$$E_t \frac{\partial M_{t+1}}{\partial K_{t+1}} = E_t r_{t+1} ; K_{t+1} - K_t > 0$$  \hspace{1cm} (5)

$$E_t \frac{\partial M_{t+1}}{\partial L_{m,t+1}} = E_t w_{t+1} ; L_{m,t+1} > 0$$  \hspace{1cm} (6)

$$E_t \frac{p_{t+1} - p_t}{p_t} + \frac{1}{p_t} E_t \frac{\partial A_{t+1}}{\partial T} = E_t r_{t+1} + \frac{\partial C}{\partial T} ; p_T > 0$$  \hspace{1cm} (7)

$$E_t \frac{\partial A_{t+1}}{\partial L_{r,t+1}} = E_t w_{t+1} ; L_{r,t+1} > 0$$  \hspace{1cm} (8)

The equation (5) signifies that capital is paid according to its marginal productivity, under the hypothesis of perfect competition.

A capital increase in the manufacturing sector increases the marginal productivity of labour and therefore the wage rate in the whole economy. The

\hspace{1cm} 1 The Inada’s conditions eliminate corner solutions. Furthermore, the sufficient second order conditions are respected.

\hspace{1cm} 2 In the hypothesis of perfect expectations, the mathematical expectation operator can be omitted.
labour market equilibrium is restored by a flow in the households from the agricultural sector towards the manufacturing sector [equations (6) and (8)]. Capital accumulation leads to a workforce transfer towards the manufacturing sector.

Equation (7) is an arbitrage condition between land and capital. The right-hand side term represents the opportunity cost of land holding. It is made up of the anticipated increase in the effective interest rate from the marginal cost on the land transactions. The left-hand side represents the anticipated marginal gain brought about by the holding of an additional unit of land. It is the sum of the expected variation in the land price and of its anticipated marginal productivity.

In the absence of a speculative bubble on the land price, the expected land price variation is nil. The equation (7) becomes an equation of the equilibrium price $p^*_{t}$ of land:

$$p^*_{t} = \frac{E_r \frac{\partial A_{t+1}}{\partial T}}{E_r t_{t+1} + \frac{\partial C_t}{\partial T}}$$

(7a)

From the latter equation, a proposition can be derived:

**Proposition 1**: An increase in the land tenure insecurity has a negative impact on the land price.

Indeed, an increase in land tenure insecurity $\alpha_t$, increases the marginal transaction cost $\frac{\partial C_t}{\partial T}$ and increases the opportunity cost of land ownership. According to equation (7a), this results in a decrease in the land price. An increase in the interest rate leads to a decrease in the land price by increasing the opportunity cost of land ownership. Finally, a rise in the marginal productivity of land leads to an increase in the land price.

1.2 Consumption

Let $x_{1,t}$ and $x_{2,t+1}$ represent respectively the consumption of a ‘young household’ and of an ‘older household’. This is composed of both manufactured and agricultural assets. The land security service is consumed once by a household during period $t$. Let us assume that, during its youthful period, the household provides inelastically one unit of labour. That is to say that there is no consumption leisure choice. The household maximises its inter-temporal utility:

$$U \equiv U(x_{1,t}, x_{2,t+1})$$

(9)
The utility function is additively separable through time. Future utility flows are discounted at a constant rate. Marginal utilities are positive and non-increasing. The household has the following instantaneous budget constraints:

\[
\begin{align*}
    x_{1_t} &= w_t - s_t, \\
    x_{2, t+1} &= (1 + E_{r, t+1}) r_t
\end{align*}
\]

There are no initial and final assets. The first order necessary conditions allow establishing the following saving function: 3

\[
s_t = s(w_t, E_{r, t+1})
\]

The marginal propensity to save labour incomes belongs to the \([0;1]\) interval. An increase in labour income leads to a smaller increase of permanent income and, therefore, an increase in savings. This result is the consequence of the absence of labour income during the second period. The anticipated interest rate positively affects savings if the substitution effect is greater than the income effect. Under the hypothesis of an instantaneous logarithmic utility (inter-temporal elasticity of substitution is one), the substitution effect is the same as the income effect. The saving function (11) depends therefore, only on the current wage rate.

### 1.3 The Economic Dynamics

The capital stock in \(t+1\) increased by the land value, is equal to the savings of the young households: 4

\[
K_{t+1} + p_t T = s(w_t) L
\]

According to equations (6) and (8), \(w_t\) depends on the capital stock for the same period. We can therefore establish, in the general case, the capital dynamics:

\[
K_{t+1} + p_t T = D(K_t) L, \quad D' > 0 \text{ and } D'' < 0
\]

3 As for most overlapping generation models, the inter-temporal household budgetary constraint establishes that the household wealth is equal to the current wage rate. The second order sufficient conditions are respected.

4 This equality between a stock and a flow is an usual result in this type of model. Cf. the appendix for its establishment.
\[ D(K_t) \] allows us to establish a recurrence relation that links current capital to future capital.\(^5\) Its properties result from those of the savings function and from the production technology in the manufacturing sector. Under usual hypotheses on the functional forms (for example, using Cobb-Douglas production technology), the function \( D(K_t) \) is increasing and concave. This results in a convergence towards the steady-state.\(^6\) A second testable econometric proposition follows the economic dynamic.

**Proposition 2:** An increase in land tenure insecurity has a positive effect on economic growth.

Indeed, a decrease in land tenure insecurity \( \alpha_t \) leads to a reduction in the marginal cost of land transactions, a rise in the land price and a decrease in the capital stock in the manufacturing sector. This results in an eviction effect, slowing down accumulation, increasing the interest rate of the steady-state and, therefore, penalising economic growth. More generally, the arbitrage condition implies that all exogenous shocks which lead to an increase in the expected profitability of agricultural activities are detrimental to productive capital accumulation and economic growth. Thus, agricultural reform leads to a reduction in land tenure insecurity and/or to the growth of the marginal land productivity, for example, by the reduction of the average size of the firms, and will have a positive impact on the profitability of the agricultural sector and a negative impact on growth.

Drazen and Eckstein (1988) establish a similar result by considering the case where the land market is missing and land is held by a limited number of large owners who pass it on from generation to generation. Thus, these authors show that an increase in the number of land owners could have the effect of reducing the capital stock of the economy in the steady state. In other words, missing land markets lead to a larger accumulation of capital. This result can be assimilated to a special case of our model for a very large \( \alpha_t \), which prevents land transactions.

## 2 ECONOMETRIC ANALYSIS

The theoretical model comprises two restrictions corresponding to propositions 1 and 2. The econometric model uses an auxiliary hypothesis relative to the measure of land tenure insecurity.

---

\(^5\) This is true for the equality of the marginal labour productivities in the two sectors.

\(^6\) Eaton (1987) established the sufficient conditions in which a normal state exists, with a strictly positive capital stock. This avoids a corner solution where the integrality of saving is dedicated to land purchases.
2.1 Auxiliary hypothesis: approximation of land tenure insecurity by the number of squatters

In Brazil, land tenure insecurity is strongly linked to the high level of land concentration and to the struggle for access to land by rural workers. Indeed, Brazil has inherited from its colonial past a very unequal land structure and remains with a Gini coefficient of 0.850 in 2000 as one of the countries in the world where land is the most unequally distributed.\(^7\)

The historical model of land occupation is that of the latifundia controlled by a rural oligarchy close to the political power. In the second half of the 19th century, the introduction of land ownership titles allowed the fazendeiros (large owners) to spread their power, so much so that the small farmers who did not have the means to buy land, became illegal occupants. Land legislation thus generated the appearance of landlesses, the posseiros, who worked land which they did not own. This also reinforced the phenomenon of the illegal land settlements (grilagem de terras) by which the fazendeiros-grileiros created vast land plots cultivated by posseiros, by monopolising them with the falsification of documents, corruption and crime. The expropriation movements multiplied at the beginning of the 20th century with, notably, the arrival of multinational companies and the creation of rail and road infrastructures.

In the middle of the 20th century, organised forms of resistance appeared against expropriation and the struggle for access to land, under the aegis of the Catholic church\(^8\) and the communist party. Farmers’ leagues and rural workers’ syndicates organised land occupations, first in the south of the country then in all the states. The military coup d’État in 1964 provisionally put an end to the farmers’ movements and in spite of the promulgation of the ‘Land Statute’ which constituted the first project of agricultural reform; land redistribution actions were minimal up until 1984. They mainly consisted of the installation of families into the framework of colonisation projects of the Amazon (Table 1). Paradoxically, the opening of pioneering fronts and the development of industrial zones in the Northern states provoked the massive arrival of immigrants which increased the number of posseiros. The military period is also a phase of the modernisation of agriculture which essentially favoured the larger land ownerships, and reinforced the process of land concentration by the absorption of the smaller farmers by the medium and large farmers\(^9\).

---

7 Source: INCRA, Cadastro de Imoveis Rurais

8 In 1975, the Catholic Church created the Pastoral Land Commission (CPT) which assured the articulation of the different movements of the countrymen.

9 The Gini index of the distribution of land for the whole of Brazil went from 0.731 in 1960 to 0.858 in 1970 and 0.867 in 1975 (IBGE).
parallel, the assassination of rural workers in the course of land conflicts increased greatly (Table 1).

Resistance against expropriation and the struggle for access to land intensified from 1984 with the creation of the movement of rural workers without land (MST) and the increase in the number of land occupation in the Southern states, in the state of São Paulo and of Mato Grosso do Sul. However, it is only since 1995, with the change of government, that these actions have allowed an acceleration of the process of agricultural reform, a significant increase in the number of settlements (assentamentos) and a reduction in rural criminality (Table 1).

<table>
<thead>
<tr>
<th>Table 1: Land Tenure Redistribution and Criminality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Settled Families</td>
</tr>
<tr>
<td>Hectares Distributed</td>
</tr>
<tr>
<td>Number of Assassinations of Rural Workers Per Year</td>
</tr>
</tbody>
</table>

Source: CPT and MST

Since 1950, the successive agricultural censuses which count the squatters (ocupantes) provide a picture of the evolution of the phenomenon of land settlements. The ocupantes can be found in all the states of the federation. They illegally farm the land belonging to private owners, religious institutions or to the State (Figure 1). They are particularly numerous in the poorer states of the North and Northeast where they occupy nearly 20% of the farms compared to 4 to 7% in the South and Southeast. The central western states are in an intermediary situation in terms of revenue and of how they access the land. After a sharp increase between 1970 and 1975, which corresponded to the expansion of the agricultural frontier, the role of the squatters decreased. This went from about 25% in 1975 to 12% in 1996.

In the econometric estimations, we are using the number of squatters, expressed as a percentage of the total number of farms, to proxy the land tenure insecurity in the different Brazilian states. As the history of Brazil shows, their presence is at the same time a cause and a consequence of land tenure insecurity. On the one hand, the invasion of land by squatters brings about a risk of expropriation for the owner. On the other hand, the property rights insecurity leads to the illegal appropriation of land (grilagem) (Araujo and Araujo Bonjean, 1999).
2.2 Sample and method of estimation

The model is estimated on a panel data sample: six periods (1970, 1975, 1980, 1985, 1990, 1995) and 27 states of the Brazilian Federation. The estimation method is the Two-Stage Least Squares. Instrumental variables are justified in three ways. Firstly, it allows us to neutralise the simultaneous bias between Squatters and land rent variables. Then, it protects against the attenuation bias inferred from the measurement errors in the explanatory variables. Finally, it guarantees against the consequences of omission of the pertinent variables correlated with the explanatory variables.

The Student statistics and the p-values are corrected from heteroscedasticity by White’s method (1980). The equations are submitted to different specification tests. The statistic of Nakamura and Nakamura (1981) tests the exogeneity of the explanatory variables. The suridentification test of Sargan (1988) evaluates the quality of the instruments and more particularly, their residual orthogonal character. In proposition test 1, the auxiliary equation adjusted $R^2$ is also reported, in which the Squatters variable is explained by instrumental variables. This statistic assures us that the instruments are not weak (Araújo, Brun and Combes, 2004). The RESET test of Ramsey (1969) tests the accuracy of the functional form $^{10}$.

---

$^{10}$ The test variables are the explanatory variables introducing predictions squared, cubed and to the power of 4.
2.3 Econometric test of proposition 1: land tenure insecurity and land price

According to equation (7a) an increase in the number of squatters, a variable that approximates land tenure insecurity, leads to a reduction in the equilibrium land price. This restriction can be tested by estimating two specifications of an explanatory equation of the land price which differs according to the control variables 11.

Table 2: Proposition 1 Test

<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>Equation 1</th>
<th>Equation 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient (p-value)</td>
<td>Coefficient (p-value)</td>
</tr>
<tr>
<td>Rent</td>
<td>1.066 (0.001)</td>
<td></td>
</tr>
<tr>
<td>Squatters</td>
<td>-1.042 (0.000)</td>
<td>-0.905 (0.000)</td>
</tr>
<tr>
<td>Price of rice</td>
<td>0.914 (0.002)</td>
<td></td>
</tr>
<tr>
<td>Price of manioc</td>
<td>0.372 (0.024)</td>
<td></td>
</tr>
<tr>
<td>Price of maize</td>
<td>-0.202 (0.217)</td>
<td></td>
</tr>
<tr>
<td>Price of tobacco</td>
<td>0.093 (0.372)</td>
<td></td>
</tr>
<tr>
<td>Price of electricity</td>
<td>-0.226 (0.338)</td>
<td></td>
</tr>
<tr>
<td>Price of kerosene</td>
<td>-0.259 (0.408)</td>
<td></td>
</tr>
<tr>
<td>Rainfall</td>
<td>0.004 (0.321)</td>
<td></td>
</tr>
<tr>
<td>(Rainfall)²</td>
<td>-0.000 (0.202)</td>
<td></td>
</tr>
<tr>
<td>Surface</td>
<td>-0.326 (0.052)</td>
<td></td>
</tr>
<tr>
<td>Control of individual heterogeneity</td>
<td>Regional dummy variables</td>
<td>Regional dummy variables</td>
</tr>
<tr>
<td>Control of temporal heterogeneity</td>
<td>Trend</td>
<td>Trend</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.640</td>
<td>0.749</td>
</tr>
<tr>
<td>Number of observations</td>
<td>72</td>
<td>87</td>
</tr>
<tr>
<td>Endogenous variables</td>
<td>Rent, squatters</td>
<td>Squatters</td>
</tr>
</tbody>
</table>

**Tests**

<table>
<thead>
<tr>
<th></th>
<th>Equation 1</th>
<th>Equation 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auxiliary equation adjusted $R^2$</td>
<td>0.793</td>
<td>0.844</td>
</tr>
<tr>
<td>Nakamura &amp; Nakamura (p-value)</td>
<td>$F = 2.96 (0.059)^a$</td>
<td>$t = 1.33 (0.19)^b$</td>
</tr>
<tr>
<td>Sargan (p-value)</td>
<td>$\chi^2 = 12.17 (0.204)$</td>
<td>$\chi^2 = 0.065 (0.798)$</td>
</tr>
<tr>
<td>Reset (p-value)</td>
<td>$F = 0.93 (0.43)$</td>
<td>$F = 1.263 (0.294)$</td>
</tr>
<tr>
<td>Jarque-Bera (p-value)</td>
<td>$\chi^2 = 1.17 (0.56)$</td>
<td>$\chi^2 = 1.48 (0.477)$</td>
</tr>
</tbody>
</table>

The variables are expressed in logarithms.
List of instruments:
Equation 1: price of rice, cotton, maize, tobacco, electricity, kerosene, pesticides, rainfall, delayed Squatters variable, Gini coefficient of the distribution of land, average area of ventures.
Equation 2: delayed Squatters variable, Gini coefficient of the distribution of land.

11 The numerous works of the agricultural economy have been found to estimate the relation between the price of land and its productivity (e.g. Falk and Lee, 1998). Within this framework, we can also quote, in the case of the states of Pará and of Paraná, the work of Alston, Libecap and Schneider (1996) who show the effect of ownership rights on the value of land.
In the first specification (equation 1, Table 2), the marginal productivity of the land is approached by the constant, rental by hectare in local currency, of which the expected sign is positive (e.g. Roche and McQuinn, 2001; Lence and Miller, 1999; Engsted, 1988). In the second specification (equation 2, table 2) the variables, assumed to be exogenous and determining the farm profit (output prices, input prices, rainfall, farm land area) are introduced into the equation of the price of land. Indeed, they are narrowly correlated with the marginal productivity of the land (e.g. Roche and McQuinn, 2001). We expect a positive sign of the output prices and a negative sign of input prices and of the farm land area. In effect, it is generally considered that the smaller farms are more efficient than the larger ones (Junqueira Assunçao, 2003). The test of Nakamura and Nakamura (Table 2) does not invalidate the hypothesis of non exogeneity of the variables Rent and Squatters 12.

The equations successfully are not rejected by econometric tests (Table 2) 13. In particular, the test of Sargan allows us to reject the hypothesis according to which the Gini coefficient of the distribution of land could directly influence the price of land, as it correlates with the structure of the land market 14. Whatever specification is retained, the Squatters variable has the expected negative sign.

2.4 Econometric test of proposition 2:
land tenure insecurity and economic growth

The recurrence equation (13) summarizes the dynamic of the economy. This allows us to predict the conditional convergence of this towards its steady state. It is tested under the hypothesis of the \( \beta \) conditional convergence – which links the growth rate of the product per capita to the initial GDP per capita and to the variables determining the steady state (e.g. Barro and Sala-I-Martin, 1996). In particular, according to the model, land tenure insecurity measured by the number of squatters must have a positive impact on the economic growth by increasing the productive capital per capita at the steady state. The other control variables which have been retained are: life expectancy at birth at the beginning of the period, and the average number of years of study of individuals aged more than 25 years at the beginning of the period. These variables bring together the effect of human capital on growth.

---

12 In equation 2, the Nakamura-Nakamura test weakly rejects the exogenous hypothesis of the Squatters variable. Also, in order to prevent any bias in the estimation, we choose to draw upon this variable.

13 In the two specifications, the trend captures the demographic movements and the common technological changes in all the states.

14 We thank a reporter for this comment.
Table 3: Test for proposition 2

Dependent variable: growth rate of GDP per capita

<table>
<thead>
<tr>
<th>Explanatory Variables</th>
<th>Equation 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial GDP per capita</td>
<td>-0.196 (0.012)</td>
</tr>
<tr>
<td>Initial life expectancy</td>
<td>0.231 (0.055)</td>
</tr>
<tr>
<td>Initial years of study</td>
<td>0.077 (0.179)</td>
</tr>
<tr>
<td>Squatters</td>
<td>0.272 (0.076)</td>
</tr>
<tr>
<td>Control of individual heterogeneity</td>
<td>Individual fixed effects</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.289</td>
</tr>
<tr>
<td>Number of observations</td>
<td>154</td>
</tr>
<tr>
<td>Endogenous variable</td>
<td>Squatters</td>
</tr>
</tbody>
</table>

Tests

<table>
<thead>
<tr>
<th>Tests</th>
<th>Equation 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nakamura &amp; Nakamura (p-value)</td>
<td>$F = 4.483 (0.013)$</td>
</tr>
<tr>
<td>Sargan (p-value)</td>
<td>$\chi^2 = 2.167 (0.705)$</td>
</tr>
<tr>
<td>Reset (p-value)$^a$</td>
<td>$F = 0.110 (0.856)$</td>
</tr>
</tbody>
</table>

The variables of GDP and of human capital are expressed in logarithms.
List of instruments: delayed Squatter variable, Gini coefficient of the distribution of land, average area of the venture, delayed initial GDP.

$^a$: The test variables are the explanatory variables predicted and introduced as squared or cubed.

The estimation recalls the phenomenon of conditional convergence: the initial GDP per capita negatively influences economic growth such that the variables of human capital have a positive and significant impact. The Squatters variable has the expected positive impact on growth.

3 LAND POLICY IMPLICATIONS

The econometric results do not invalidate the two propositions established in this paper: land tenure insecurity reduces the price of land but favours economic growth in Brazil by reducing the demand for land. By its eviction effect affecting productive capital, an increase in land prices has therefore a negative effect on economic growth. This result joins a phenomenon observed notably in Brazil, where one notices that the distribution of land does not generally allow new farmers to develop their plots and to get out of poverty if it is not accompanied by investments.

It is clear that land tenure insecurity cannot be socially optimal when it generates negative external effects (violence, crime, conflict...). Land reform remains the source of an important social benefits. In order to not penalise growth, the reforms in Brazil must not privilege the distribution of the alienation rights (abusus) but should favour the distribution of usufruct rights.
(usus and fructus). In other words, the central objective of land reform should be securing the property rights of which we expect that it will favour the development of a rental market which is not very active at present, most notably because of land tenure insecurity. According to the last agricultural census, only 2.4% of farmed land was under rent. The broadening of the land rental market does not lead to an eviction effect of productive capital and must therefore be preferred to the measures favouring the emergence of a demand for land. In an environment where the rights of ownership are secured, fiscal instruments (overtaxing, fiscal exoneration on rentals etc.) appear to be the most appropriate tools for favouring the development of the rental market.

These results cannot obviously easily be generalised to other countries. The distribution of the abusus rights is only optimal in a context of severe social tensions which feed the land tenure insecurity. In a calm social situation, the distribution of the abusus rights could favour the reduction of social fractures and by the way favour access to credit, by reducing discrimination and encouraging productivity improvements.  

4 APPENDIX

In this economy the markets for goods and the land tenure security service clear:

\[
\left(x_{1i}^m + x_{2i}^a\right)L + \left(K_{r+1} - K_i\right) = M_i \quad \text{for the manufacturing sector}
\]

\[
\left(x_{1f}^m + x_{2f}^a\right) + \frac{\partial C_{r-1}}{\partial T} p_{r-1} T = A_i \quad \text{for the agricultural sector}
\]

\(x^m\) and \(x^a\) represent respectively the consumption of manufactured goods and agricultural goods, \(x^m + x^a = x\). The expression \(\partial C/\partial T)pT\) represents the value of the production of a joint land tenure security service in the agricultural sector, which is consumed by young people or the elderly. We can interpret the marginal cost of the transaction as the price of this service. The overall uses and resources balance is thus:

\[
\left(x_{1f} + x_{2f}\right) + K_{r+1} - K_i + \frac{\partial C_{r-1}}{\partial T} p_{r-1} T = M_i + A_i
\]

15 We thank an anonymous referee for this comment.
Assuming constant returns to scale using profit maximising conditions, equations (5), (6), (7) and (8), we get:

\[
\left( x_{1,t} + x_{2,t} \right)L + K_{t-1} - K_{t} + \frac{\partial C_{t-1}}{\partial T} p_{t-1} T = w_{t} L + r_{t} K_{t} + \left( 1 + r_{t} \right) p_{t-1} - p_{t} + \frac{\partial C_{t-1}}{\partial T} p_{t-1} T
\]

We rearrange this expression to find the consumers’ instantaneous budget constraints:

\[
K_{t+1} + p_{t} T + \frac{\partial C_{t-1}}{\partial T} p_{t-1} T = \left( w_{t} - x_{1,t} \right)L + \left( 1 + r_{t} \right) \left( K_{t} + p_{t-1} T \right) + \frac{\partial C_{t-1}}{\partial T} p_{t-1} - x_{2,t} L
\]

After simplification we get:

\[
K_{t+1} + p_{t} T = s_{t} L + \left( 1 + r_{t} \right) \left( K_{t} + p_{t-1} T \right) - x_{2,t} L
\]

If \( K_{t} + p_{t-1} T = s_{t-1} L \) then \( K_{t+1} + p_{t} T = s_{t} L \)

REFERENCES


JUNQUEIRA ASSUNÇÃO J. & M. GHATAK (2003), « Can Unobserved Heterogeneity in Farmer Ability Explain the Inverse Relationship between Farm Size and Productivity », Economic Letters, 80, 2, pp. 189-194.

JUNQUEIRA ASSUNÇÃO J. (2003), « Distribuição de terra e as políticas publicas voltadas ao meio rural brasileiro », in Brazil: Inequality and economic development in Brazil, World Bank, vol II, Washington DC.


