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Non-Agricultural Land Use and Land Reform: theory and evidence from Brazil *

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Abstract

This paper examines the effect of nonagricultural land use on agrarian organization and land reform, providing a simple model to determine its policy implications and some evidence on its importance. It is argued that, if land-rental market is imperfect, there is a role for redistributive land policies and the following implications hold: (i) land reform is more probable to enhance efficiency in a low-wage economy; (ii) such policies should aim small farmers instead of landless people, obtaining land from large landholders. Empirical evidence suggests this is a relevant issue in Brazil, specially during periods of high macroeconomic instability.

JEL Classification: O13, Q15, Q24

Key words: land reform; land use; agricultural development

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Introduction

Land reform is a pervasive and controversial issue in Latin America. Economists and policy makers usually associate the highly unequal pattern of land ownership to many aspects of economic development such as poverty, inequality, efficiency, political power, racial conflicts and environmental strain. However, after many years of trials, access to land remains an unsolved problem in most of these countries.

Despite of some differences in implementation, land reform programs in Latin America have a common feature of being embedded in an economic environment where market imperfections and policy distortions tend to set a wedge between the price of land and the capitalized value of the income stream generated from agriculture. Land is used not only as an agricultural input but also as a source of other benefits - "as a hedge against inflation, as an asset that can be liquidated to smooth consumption in the face of risk, as collateral for access to loans, as a tax shelter, or as a means of laundering illicit funds" [De Janvry, Key and Sadoulet (1997)]. Specially in countries characterized by high macroeconomic instability (as in Latin America), people demand land as a mechanism of protection against aggregate uncertainty.

This paper focus on the non-agricultural motive of landholding, providing a theoretical model to address its policy implications and some evidence on its relevance. The analytical framework is based on a model of occupational choice under financial constraints which emphasizes a specific mechanism for the non-agricultural land use; namely, it focuses on the land as a safe device for saving. Although this is the central mechanism of the model, which was conveniently chosen because of the empirical test, qualitative results seem to hold in a more general context.

The mechanics of the model is quite simple. It is considered an agrarian economy where peasants are heterogeneous in terms of initial wealth and farming skills (they are equally productive as labourers). Even unskilled peasants, who cannot manage agricultural production, might demand land as a safe device to transfer wealth among periods of life. [1] If the land-rental market does not work properly, those idle farmers keep their land unimproved, implying in a decrease of the aggregate agricultural production and an inefficient resource allocation. This situation gives support to land reform programs and imposes some conditions on the design of such policy. On the other hand, in an economy with perfect land-rental market, unskilled farmers, who demand land simply as a

[1] The structure of occupational choice, heterogeneity and credit constraint is adapted from Assunção and Ghatak (2003). The difference here due to the fact that land provides nonagricultural payoffs and, therefore, unskilled peasants demand land even when they cannot undertake agricultural production.

store of value, can lease out their land to be cultivated by skilled peasants, increasing the overall agricultural output and establishing an efficient resource allocation. In other words, the land-rental market can establish an efficient resource allocation, even where people demand land for non-agricultural purposes. Since land-rental markets in Latin America are relatively thin,[2] this result suggest an interesting possibility for public policy that have not been pursued.

The model yields two interesting predictions regarding the design of land reform programs. First, those policies are more likely to enhance efficiency in low-wage economies because equilibrium responses of prices, wages and occupational choices might offset initial efficiency gains of land redistribution. This countervailing general equilibrium effect does not occur in a low wage prereform equilibrium. If land reform decreases the wage rate, there is a reduction in the opportunity cost of becoming a farmer. As a result, new idle farms would arise, outweighing the final effect. As suggested by Moene (1992), in a different context, this result imply that land reform is better in land scarce economies. Second, land reform should aim small farmers instead of landless peasants in order to improve efficiency. As long as occupational choice is endogenous, agricultural workers may decide to stay in their previous job, selling the land provided by the program for consumption. Another reason why small farmers should be the target of such policies comes from a simple self-selection argument based on the fact that the farm size contains information about farmer's ability and land use.

The literature on land reform and agrarian organization is vast and cover experiences from all over the world.[3] Although some authors have constructed models that exhibit features oft-observed in Latin America to analyze agrarian organization and land reform, such Conning (2001) and Conning and Robinson (2001), most of the literature consider general aspects or case studies from Asia.[4] A systematic analysis of the impact of the nonagricultural land use on agrarian organization and land reform, which constitutes the objective of this paper, however, was not pursued by the existing literature, notwithstanding the recognition by many scholars of its importance.

[2] According to the World Census of Agriculture, less than 5% of the agricultural land is rented in Latin America. In Europe, it represents almost 25% of the total area. In fact, aggregated indicators show that Latin American countries combine a highly skewed distribution of land with the predominance of owner or ownerlike form of land tenure, and agricultural land is mostly represented by meadows and pastures, remaining under-exploited.

[3] For comprehensive surveys see Binswanger and Deininger (1997), Carter and Zegarra (2000) and Deininger and Feder (2000).

[4] See Grossman (1994) and Horowitz (1993) for political economy aspects of land reform or the studies of land reform in India by Besley and Burgess (2000) and Banerjee, Gertler and Ghatak (2002).

The model also defines an empirical strategy for testing the existence of a non-agricultural component of land demand through the comparison between land prices and land-rental rates. In an economy with land-rental market, the theoretical analysis shows that land prices can be expressed as a sum of two terms - the land-rental rate and a term related to the non-agricultural land use. Three approaches to test the existence of this additional component are used in the paper. The first one is based on the fact that exogenous macroeconomic shocks are expected to affect land prices and rental rates differently according to the model. In the second approach, cointegration tests between time series of land prices and land-rental rates are used to test the existence of a (non-stationary) non-agricultural component of land demand. Finally, the third one is based on the literature of testing the present value model of asset price, following Campbell and Shiler (1987).

The empirical test is performed using data from Brazil, which is an interesing case study for the purpose of this paper. Brazil has one of the most skewed land distribution in the world. The Brazilian economy, in the period covered by the data, is characterized by high inflation rates and many episodes of high instability, and land reform has been on the policy agenda for a long time. In one of the tests, the launching of a sequence of drastic measures to contain the inflationary process during the 1980s and 1990s is explored as a source of exogenous variation to the comparison between the responses of detrended land prices and land-rental rates. Despite there is some careful empirical studies regarding the effects of land reform, little attention has been giving to land use. The fact that the data used come from one country with a long history of macroeconomic instability and the relatively long time period allows some progress on this direction.

The results do not reject the hypothesis that land ownership provides non-agricultural payoffs in Brazil. The announcement of the economic plans has determined a current increase of 33% in land prices of cropland and an increase of 41% in the subsequent period, both statistically significant. The effect on land-rental rates, on the other hand, was insignificant in statistical terms, which according to the model suggest that land is being used as a safe asset during risky periods. Shocks seem to affect the demand for land ownership but not the demand for land leasing. For meadows and pastures, the response from the rental rates is also significant but much less important than the that of land prices.

The cointegration analysis suggests the existence of this non-agricultural land demand especially for meadows and pastures. For cropland, one cannot reject that both series present a common trend. The exceptions are the Central-West region (where the result is the opposite) and the North region (where the test does not apply because both series are stationary).

More evidence in this direction is given by the results from the Campbell and Shiller's methodology. The formal tests of the restrictions imposed by the present value model of land price determination failed to support these constraints and, therefore, the model itself for both pastures and cropland in all regions. This result is in conformity with the empirical literature on the determination of farmland prices. [5] Land prices are determined not only by the present value of expected future cash flows from agriculture but also by other factors.

The remainder of the paper is organized as follows. The next section presents the theoretical arguments about how the non-agricultural purpose of landholding is likely to affect efficiency in economies with and without land-rental market. Section 2 discusses the implications of the model for the design of redistributive land reform programs. The empirical analysis is presented in Section 3. Section 4 concludes.

1 Basic model

Consider an economy with an infinite number of periods and overlapping generations of two-period-lived peasants. In each period, a large population with mass normalized to 1 is born, with a time invariant and absolutely continuous wealth distribution $G(a)$. All individuals are sorted and named according to their initial wealth - the peasant labeled 0 is the poorest and the peasant labeled 1 the richest. Peasants devote their first period of life to production and the second one to consumption.

The key feature of our model is that land provides non-agricultural payoffs to its owners. As pointed out by Berry and Cline (1979), "in countries with poorly developed capital markets, especially those with chronic inflation, landowners may find it attractive to hold land for speculative gain - or merely to accomplish the store of value objective". The model focuses on this issue assuming that there is a monetary loss in the savings between the young and old ages that occurs with probability $\pi \in [0, 1]$ prevented only by the holding of land titles. The parameter π can be interpreted in different ways - it can represent the probability of stealing, the probability of a financial crisis, or simply the inflation rate.

Individuals have an endowment of 1 unit of labor which is supplied ineslastically, either in their own farm or working for someone else as an agricultural laborer. Although the population is completely homogeneous with respect to the ability to work, there is heterogeneity in farming skills. Only skilled peas-

[5] See, for example, Falk (1991), Clark *et al.* (1993) and Goodwin *et al.* (2003).

ants are able to undertake agricultural production, constituting *active farms*. Unskilled farmers cannot produce, spending all their time endowment to assure property rights of *idle farms*.[6] The distribution of skills is assumed to be independent of the distribution of wealth. At each level of wealth, a fraction α of individuals is skilled and the remaining fraction of $1-\alpha$ is unskilled.

The agricultural good, taken as numeráire, is produced by skilled farmers and consumed by everybody. Skilled farmers can produce q units of output per hectare using a fixed-coefficients production function which requires one worker for every unit of land. The production takes one period to be done and the inputs, land and labor, can be hired in competitive markets at prices p and w, respectively. Whether a peasant is skilled or unskilled has no effect on his productivity as a worker and so the wage rate is uniform and, to simplify, it is paid in the next period.

The dynamics of the economy is as follows. Each generation produces or works when young and consumes when old. In a period t, young farmers spend their wealth buying land from the old-aged farmers of previous generations and contracting young workers to be paid in the second period. In the second period, peasants receive their incomes (wages or agricultural profits), sell their land to youths of the next generation and spend their final wealth in consumption.

Initially, it is assumed there is no land-rental market[7] - section 1.3 examine the consequences of openning a land-rental market for this economy. Unskilled farmers cannot use their titles to prevent monetary loss and also lease-out their land to skilled peasants for agricultural production. The only option for them is to retain a portion of their wealth in the form of idle land.

Finally, in order to keep the analysis of occupational choices interesting, agents cannot borrow to finance their land purchases. Hence, the access to land is constrained by the initial wealth as in the literature of occupational choices with financial constraints (e.g. Banerjee and Newman, 1993; Galor and Zeira, 1993). Denoting the farm size by T, the lack of a credit market implies that $pT \leq a$, for a peasant with initial wealth a.

Given the structure described above, the consumption of an agent born in

[6] This is an assumption that simplifies the presentation of our main results, and it is reasonable for countries where the property right system is underdeveloped. (Alston, Libecap and Mueller, 2002; De Soto, 2000)

[7] Many arguments have been used to determine imperfections in land rental markets: risk sharing [Cheung (1969)], hidden actions and moral hazard [Stiglitz (1974); Ghatak and Pandey (2000); Eswaran and Kotwal (1985)], screening [Hallagan (1978) and Allen (1982)] and limited liability constraints [Shetty (1988); Laffont and Matoussi (1995)].

period t, is:

$$c_{t+1}=\begin{cases}(1-\pi)\,a_t+w_t, & \text{if worker,}\\ (1-\pi)\,(a_t-p_tT_t)+p_{t+1}T_t, & \text{if idle farmer,}\\ (1-\pi)\,(a_t-p_tT_t)+(q-w_t+p_{t+1})\,T_t, & \text{if active farmer;}\end{cases}\tag{1}$$

where a_t is the initial wealth, p_t is the price of land and T_t is the farm size. Notice that a proportion $1-\pi$ of wealth that is not used for land purchasing is lost. Young farmers buy land at price p_t selling it in the next period at price p_{t+1}. In summary, landholding provides three kinds of potential benefits: agricultural profits, protection against the monetary loss, and price appreciation. Since G time-invariant, the rest of the paper will neglect the last one.

1.1 Occupational choices

The analysis of the occupational choices involves a comparison between consumption profiles, given the land price and the wage rate. First, note that the dynamics of the model is very simple, comprised of a simple sequence of static decisions. Since the wealth distribution is time-invariant, only stationary equilibria are considered. Thereafter, it is assumed that $p_{t+1}=p_t=p$ and all time indices are dropped. [8]

Both idle and active farmers choose their farm size taking p as given. The absence of a credit market means that the land demand belongs to the interval $\left[0,\frac{a}{p}\right]$. Since the final consumption is a linear function of T in (1), they decide either $T=0$ (becoming workers) or the maximum size affordable - $T=\frac{a}{p}$. Equivalently, the labor demand for active farmers is equal to $\frac{a}{p}$ because the agricultural technology requires one worker for each hectare of land. Substituting the labor and land demands in (1), the final consumption becomes

$$c=\begin{cases}(1-\pi)\,a+w, & \text{if worker,}\\ a, & \text{if idle farmer,}\\ \left(\dfrac{q-w}{p}+1\right)a, & \text{if active farmer.}\end{cases}\tag{2}$$

The occupational choice follows from the comparison of consumption possibilities in (2). Skilled peasants choose among all the three possible occupations,

[8] The use of a dynamic model due simply to the necessity of building a meaningful land market where the transactions occur between young peasants (buyers) and old-aged peasants (sellers).

becoming active farmers if, and only if,

$$q \geq w \text{ and } a \geq \frac{wp}{q - w + \pi p} \equiv a_1. \tag{3}$$

If $q \geq w$, active farms are more profitable than idle farms, and every skilled farmer undertakes the agricultural production. On the other hand, unskilled peasants are limited in choice; they must become a worker or an idle farmer. They establish themselves as idle farmers if, and only if,

$$a \geq \frac{w}{\pi} \equiv a_2. \tag{4}$$

It is easy to see that $a_1 < a_2$ if, and only if, $q > w$. The occupational choices can be completely described by the initial wealth if $q \geq w$ as depicted in figure 1.

[Insert Figure 1]

Lemma 1.1 (Assunção and Ghatak, 2003) *For every pair (w, p) such that $w \leq q$, idle farms are (weakly) larger than active farms on average.*

Lemma 1.1 is a consequence of heterogeneity in farming skills coupled with credit market imperfections. This result is especially interesting in the context presented here because it implies that the farm size contains information regarding land use. Figure 1 shows that all farmers with plots with size $T \in \left[\frac{a_1}{p}, \frac{a_2}{p}\right]$ demand land only for agricultural production. A fraction $1 - \alpha$ of large landowners, with $T > \frac{a_2}{p}$, retain their holdings in the form of idle farms, without agricultural production. Section 2 will examine the implications of this result for the design of redistributive policies.

1.2 Equilibrium

An equilibrium in the land market should equalize the aggregate demand for land to the fixed supply of land $\bar{T}$. Conditions (3) and (4) determine that skilled peasants with wealth greater than a_1 and unskilled peasants with wealth greater than a_2 demand $\frac{a}{p}$ hectares of land each one. Therefore, the equilibrium condition in the land market can be arranged as

$$\alpha \int_{a_1}^{\infty} adG(a) + (1 - \alpha) \int_{a_2}^{\infty} adG(a) = p\bar{T}. \tag{5}$$

Equation (5) determines the total expenditure in land purchase is equal to the value of the land endowment.

There is a subsistence activity which requires one unit of labor to generate a payoff of $\underline{w}$ without land. This is available to any individual. It is assumed that the agricultural technology strictly dominates the subsistence activity, that is,

$$q > \underline{w}. \tag{6}$$

In order to simplify the notation, individuals in the subsistence sector will be referred simply as workers with $w = \underline{w}$. As a result, the equilibrium wage rate belongs to the interval $[\underline{w}, q]$. If $w > q$, the labor demand is zero because nobody aspires to become active farmer, resulting in a decrease in w until $w \leq q$. However, if $w < \underline{w}$, the labor supply is zero, since the subsistence activity provides a better alternative.

In the labor market, the equilibrium condition is given by

$$\alpha \frac{1}{p} \int_{a_1}^{\infty} a dG(a) \leq \alpha G(a_1) + (1 - \alpha) G(a_2), \tag{7}$$

with the strict inequality holding only if $w = \underline{w}$. The left-hand side of (7) is the demand for labor while the right-hand side is the labor supply. Based on the possible wages, it is useful to distinguish three possible cases: $w = \underline{w}$, $\underline{w} < w < q$ and $w = q$.

Case $w = \underline{w}$: in equilibrium, an excess of supply in the labor market implies that a positive portion of individuals engaging in the subsistence activity exists, and the equilibrium wage rate is $w = \underline{w}$. The total number of peasants in the subsistence activity is given by

$$\alpha G(a_1) + (1 - \alpha) G(a_2) - \alpha \frac{1}{p} \int_{a_1}^{\infty} a dG(a).$$

Case $\underline{w} < w < q$: in this case, nobody undertakes the subsistence activity and (7) holds with equality.

Case $w = q$: nobody undertakes the subsistence activity and skilled individuals are indifferent towards becoming active or idle farmers, resulting in $a_1 = a_2$. It is a limiting case in which the fraction of land cultivated as active farms is determined by the labor supply, and conditions (5) and (7) determine that $G(q/\pi) = \alpha \bar{T}$, which is compatible only with a particular configuration of the parameters of the model.[9] A fraction α of the land is occupied by active farmers employing all non-farmers workers.

These cases are determined by the endowments of the economy and the wealth distribution. For example, given G, if the land endowment $\bar{T}$ is sufficiently low, only the equilibrium with $w = \underline{w}$ can prevail. On the other hand, if $\bar{T} > \frac{1}{\alpha}$, the

[9] If $\bar{T} > \frac{G(q/\pi)}{\alpha}$ active farms and idle farms are equally profitable, and the fraction of active farms is smaller than α determined by the labor supply (which is equal to $G(q/\pi)$).

equilibrium wage rate is $w = q$. Therefore, this observation leads to a natural interpretation of each possible equilibrium according to the abundance of land.

In order to evaluate the role of public policies, a notion of agricultural efficiency based on the aggregate agricultural production is used. An allocation is said to be *efficient* if the associate aggregate agricultural production, Q, is equal to the maximum possible value $q\bar{T}$.

In the model, agricultural production is undertaken only by skilled peasants with wealth greater than a_1. Thus, the aggregate agricultural production is

$$Q = q \cdot \left[\frac{\alpha}{p} \int_{a_1}^{\infty} a dG(a) \right].$$

Using (5), Q can also be expressed in terms of a_2, in equilibrium, i.e.,

$$Q = q \cdot \left[\bar{T} - \frac{1-\alpha}{p} \int_{a_2}^{\infty} a dG(a) \right] < q\bar{T}, \tag{8}$$

where $q\bar{T}$ is the maximum aggregate agricultural production feasible.

In the case of $w = q$, equation (7) implies that $\frac{\alpha}{p} \int_{a_1}^{\infty} a dG(a) = G(a_1)$, resulting in the minimum possible value for the aggregate agricultural production $Q = \alpha q \bar{T}$. Since $a_1 \leq a_2$, it is easy to show from Figure 1 that the minimal proportion of cropped land is α.

The equilibrium allocation is efficient only if there are no idle farmers, which happens only if $\pi = 0$. The next proposition summarizes the agricultural efficiency of agricultural production in the model discussed above.

Summary 1 *In the absence of a land-rental market, the equilibrium is not efficient. Agricultural efficiency is attained, for any G, only if $\pi = 0$.*

The existence of a non-agriculture use of land, expressed by $\pi > 0$, determines a reduction in the agricultural production, since part of the land endowment is retained as idle farms. Unskilled peasants demand land only to prevent monetary losses. Since there is no land-rental market, those farms are kept unimproved. On the other hand, if $\pi = 0$, all the land is used for agricultural purposes and the maximum feasible production is achieved.

1.3 Openning a land-rental market

The land-rental markets might not work because of financial constraints or threats against property rights. In such situations there is a role for policy interventions. In the case of financial constraints, for example, measures as credit for land-rental can be used to overcome the problems related to *ex ante* limited liability constraints [Laffont and Matoussi (1995)]. And when the problem is related to the threats of squatting by the tenant, measures to improve tenure secure can used as an important instrument of land policy [Macours, De Janvry and Sadoulet (2001)]. Despite many implementation issues that are not taken into account, the following analysis suggests that improvements in land-rental market should constitute a target to public policies. It is shown that a land-rental market could establish an efficient allocation of resources even in the presence of non-agricultural purpose of landholding. Another result from the openning of a land-rental market is the determination of an empirical strategy for testing the existence of non-agricultural landholding.

In the perfect land-rental market case, decisions about farm size T and cultivated area A are disentangled. During youth, individuals decide land purchases and land leases. Peasants whose cultivated area exceeds farm size have to pay a rent to cover the difference $A - T$. On the other hand, young peasants with idle land receive rents for the unused portion.

Let s denote the rental rate. Then, the consumption during the old-age in the case of perfect land-rental market becomes

$$c = \begin{cases} (1-\pi)\, a + w, & \text{if worker,} \\ (1-\pi)\left[a - pT - s\,(A-T)\right] + pT, & \text{if idle farmer,} \\ (1-\pi)\left[a - pT - s\,(A-T)\right] + pT + (q-w)\, A, & \text{if active farmer.} \end{cases}$$

In each occupation, consumption is linear both in A and in T, which arises the occurence of corner solutions. Analogously to the previous case, the absence of a credit market implies that $pT + s\,(A - T) \leq a$.

The following analysis considers only equilibria in which

$$q - w - (1-\pi)\, s > \pi p + (1-\pi)\, s. \tag{9}$$

Otherwise, active farmers do not cultivate any area, a situation with no economic interest. Under (9), active farmers choose $T = 0$ and $A = \frac{a}{s}$. Idle farmers, on the other hand, choose $A = 0$ and $T = \frac{a}{p-s}$. The analysis of the no land-rental market case still applies and the new thresholds (levels of wealth associated with the indiference among the occupations) are given by $a_1'' = \frac{ws}{q-w-(1-\pi)s}$ and $a_2'' = \frac{w(p-s)}{\pi p+(1-\pi)s}$. Notice that condition (9) implies in $a_2'' > a_1''$.

The aggregate demand for land property is $(1-\alpha)\int_{a_2''}^{\infty} \frac{a}{p-s} dG(a)$ while the aggregate demand for cultivated area is $\alpha \int_{a_1''}^{\infty} \frac{a}{s} dG(a)$. The equilibrium conditions in the land sales and rental markets are given by, respectively,

$$(1-\alpha)\int_{a_2''}^{\infty} adG(a) = (p-s)\bar{T} \tag{10}$$

and

$$\alpha\int_{a_1''}^{\infty} adG(a) = s\bar{T}. \tag{11}$$

The aggregate agricultural production is, therefore, $Q = q\frac{\alpha}{s}\int_{a_1''}^{\infty} adG(a) = q\bar{T}$. These findings can be summarized as follows.

Summary 2 *In all equilibria with agricultural production (in which (9) holds), a perfect land-rental market drives the economy towards an agricultural efficient equilibrium, even if* $\pi > 0$.

The existence of a perfect land-rental market makes the land property irrelevant for agricultural production, since there is no investiment [10] in the model and peasants have complete access to land in a competitive rental market. All available land is used for agricultural production, resulting in efficiency. As a consequence of the linearity of the model, unskilled peasants own all available land, which is rented out to and cultivated by skilled farmers.

Finally, the new equilibrium conditions can be arranged to generate an interesting empirical strategy for testing the existence of a non-agricultural reason in the land demand. Equations (10) and (11) imply that:

$$p = \frac{1}{\bar{T}}\left[\alpha\int_{a_1''}^{\infty} adG(a) + (1-\alpha)\int_{a_2''}^{\infty} adG(a)\right] \tag{12}$$

and

$$s = \frac{\alpha}{\bar{T}}\int_{a_1''}^{\infty} adG(a). \tag{13}$$

Eq. (12) shows that the land price p is the sum of two parts - a component due to the demand of land for agricultural production and another component related to a non-agricultural land use. The rental rate s, on the other hand, is defined only by the first one. Eqs. (12) and (13) determine that

$$p = s + x, \tag{14}$$

where x represents the value of the non-agricultural land use. Therefore, an exogenous change in π affects p and s differently, allowing the identification of the x component. This is the baseline of the empirical strategy of section 3.

Summary 3 *In equilibrium, the price of land (for sale) can be written as* $p = s+x$, *where* s *is the rental rate and* x *is an additional component reflecting*

[10] For a recent analysis of the effect of land tenure on investments, see Banerjee and Ghatak (2003).

the non-agricultural land use. The effects of an exogenous change in π over p and s are different, i.e., $\frac{\partial p}{\partial \pi} \neq \frac{\partial s}{\partial \pi}$.

2 Implications for land reform

Redistributive land policies have been adopted in many developing countries in order to promote agricultural development. [11] This section examines the implications of our model for the design of such policies. Different policy targets are evaluated considering the agricultural efficiency criteria of last section.

Initially, notice that figure 1 defines three different classes of peasants:

- **Agricultural workers / landless peasants**: poor skilled peasants with wealth below a_1 and unskilled peasants with wealth below a_2. Individuals within this class do not have enough wealth to acquire an adequately profitable farm, preferring to employ themselves as workers.
- **Small farmers**: individuals operating plots with size $T \in \left[\frac{a_1}{p}, \frac{a_2}{p}\right]$. All landowners within this group are skilled peasants.
- **Large landholders**: farmers with plot size $T > \frac{a_2}{p}$. A fraction α of those farmers is skilled and the remaing fraction $1-\alpha$ of those farms are operated by unskilled peasants.

Redistributive land policies in many countries has consisted of important land tranfers from large landholders to landless people. Our model suggest that, even if the ability of each potential beneficiary is perfectly observed such redistribution may not lead to efficiency improvements. The long-run sustainability of the new land distribution depends on what happens with the post-reform wages.

Let us consider first the case where the social planner can distinguish between active and idle farms. Any transfer from idle farms to skilled farmers improves the aggregate agricultural production. Once the agricultural technology faces constant returns to scale the choice of the beneficiaries is driven solely by the initial wealth - all skilled farmers with $a \geq a_1$ are potential beneficiaries and the farm size does not play any particular role.

All peasants with wealth strictly below a_1 and unskilled peasants with wealth strictly below a_2 are choosing to become workers. As a result, marginal increases of a for those peasants do not affect their occupational choice. Therefore, if the beneficiaries are landless they will sell the received plots for consumption.

[11] See Deininger and Feder (2000) for a survey.

After the reform, the response from the new equilibrium wage rate may offset the initial effects of the redistribution. A decrease in the post-reform wage rate implies in a decrease in a_1 and a_2. In other words, the opportunity cost of buying a farm decreases rising the demand for land. The reduction in a_2 represents a higher demand of land for the store of value objective, offsetting the initial effect of the land reform program. The price of land, on the other hand, does not have any adverse effect on efficiency, since the occupational choice of unskilled peasants is independent of this variable.

Therefore, an ideal land reform should keep the initial wage rates unchanged or even increase them. In the context of the model, it can be attained if the land used in the program come from large idle farms. In this case, after reform there is an increase in the labor demand much more significant than the increase in the labor supply, which raises the chance of a higher wage rate. Obviously, in the case of a low wage rate equilibrium $w = \underline{w}$ a redistributive policy from unskilled farmers to skilled farmers has an unambiguous effect on the agricultural production.

Consider now a situation in which the ability of each farmer is not observed. As a consequence, policy instruments are restricted to be conditioned only on the farm size, and transfers from unskilled peasants to skilled farmers are not allowed. In this context, there are two selection problems on the implementation of redistributive policies: the choice of the beneficiaries and the land to be confiscated or bought.

Our model has a partial solution for this problem, indicating that small farmes should be the beneficiaries. Although the type of farmers is not directly observed, it can be identified by the farm size. The previous sections has showed that all farms with small plots, varying from $\frac{a_1}{p}$ to $\frac{a_2}{p}$, are cropped. In order to prevent a higher wage rate after reform, the previous observation about the size of the farms to be confiscated/bought still holds. But now this procedure will get unimproved land only with probability $1 - \alpha$.

The previous analysis is summarized in the following proposition.

Summary 4 *A redistributive land reform have the following properties:*

- *equilibrium responses to transfers targeting landless peasants might offset the initial efficiency gains;*
- *the effects of the reform are sustainable if the pre-reform wage rate is $w = \underline{w}$;*
- *if the pre-reform wage rate is $w > \underline{w}$ and the type of peasants is observed, transfers from large unskilled landholders to skilled farmers are more likely to enhance efficiency;*
- *if the type of peasants is unknown, transfers should aim small farmers to increase the agricultural production.*

3 Empirical evidence

This section explores the contents of equation (14) in order to evaluate the existence of a non-agricultural purpose for landholding in Brazil. It is assumed the following stochastic processes for p_t and s_t:

$$p_t = s_t + x_t, \tag{15}$$

and

$$s_t = h_t + u_t,$$

where h_t is a (possibly non-stationary) random process describing the evolution of the agricultural market, x_t is the term related to the nonagricultural motive of landholding and u_t is a white noise.

The empirical strategy is threefold. First, it is used the fact that π affects p through s and x. According to the previous model, exogenous shocks in π determine different responses in p and s. The first set of empirical results check the existence of a component x through exogenous variations in π. The second set of results examine the existence of a component x through a cointegration test, based on the Stock and Watson (1988) representation of common trends. If x_t is nonstationary and not cointegrated with h_t, it is possible to identify it in a cointegration test. Finally, the strategy developed by Campbell and Shiller (1987) to study stock market price movements is applied to formally test the validity of the constant discount rate version of the present value model of farmland prices.

3.1 Data description

The data used here consists of semestrial observations of land prices for sale and rental covering the period from 1966 to 2000. It is collected by the Getúlio Vargas Foundation, which gathers information from more than 3600 local agencies scattered in many districts in Brazil. Observations refer to actual transactions, collected within the districts at the end of each semester. There is data on prices of meadows and cropland for the five Brazilian regions - North, Northeast, Central-West, Southeast and South. [12]

[Insert Table 1]

Table 1 shows a summary of descriptive statistics for the prices of the whole country. A simple comparison between the basic statistics of land prices for

[12] All prices were deflated to 2000 level, using the IGP-DI (General Price Index calculated by the Getúlio Vargas Foundation).

sales and rentals reveals important differences. The prices of land for sale are more volatile, more asymmetric and they have heavier tails for both meadows and cropland. The coefficient of variation of the sale's price is 2-times (3-times) bigger for the case of meadows (cropland). The skewness reflects the fact that sharp increases in prices are much more frequent than decreases, as shown in figures 2 and 3. As long as the recent Brazilian macroeconomic history has experienced more variability than the Brazilian agriculture sector, those results constitute a first indication of the non-agricultural land use in Brazil.

[Insert Figure 2]

[Insert Figure 3]

3.2 Macroeconomic instabilities and land price

The first empirical test is based on a sequence of policies adopted to contain the inflationary process during the 1980s and 1990s. Those "heterodox" policies have resulted in unexpected (and exogenous, from the point of view of agricultural producers) increases in the uncertainty of the economy, led by notions concerning inertial inflation. The launching of the economic plans aimed specifically at containing inflationary inertia through a set of measures including the de-indexation of the economy, temporary price freezes, and a freeze on financial assets to reduce the economy's liquidity and generate resources for the budget. The uncertainty introduced into the economy by those drastic measures generated a large shift in the demand for safe assets, including land.

The nonagricultural component of land demand is identified by comparing the effects of the launching of such policies on the land prices for sales and rental. Two dummy variables were built - one indicating the launching of a new economic plan in the current semester and another one related to the institution of an economic plan in the previous semester. The following plans are considered: Cruzado (february, 1986), Bresser (june, 1987), Summer Plan (january, 1989), Collor (april, 1990) and Real (june, 1994).

Regressions for the whole Brazilian sample were estimated and reported in Table 2. The dependent variables were detrended by using the Hodrick-Prescott filter and centered around the original mean. Therefore, the intercept of each regression can be interpreted as the averaged land price in the absence of new economic plans at the current and previous semester. The coefficients of the dummy variables represent the average changes in prices at the lauching of the economic plans and in the subsequent semester.

[Insert Table 2]

Table 2 shows that the economic plans promoted significant increases in land prices for sales of both meadows and cropland in the current and next semester, accounting for more than 15% of the total variability of these variables from 1966 to 2000. The effects over rental rates are much smaller and statistically insignificant for cropland. This suggest that the response of land prices for sale to an exogenous increase on the macroeconomic instability is larger compared with rental rates, which is consistent with the existence of a nonagricultural purpose of landholding according to the theoretical model.

For meadows, the economic plans have determined an increase of almost 40% in land prices of sales in the current semester and up to 50% in the next one. The rental rates have experienced a much lower increase, around 20%. For cropland, table 2 shows significant increments only for land prices, both in the current and subsequent semesters.The difference between meadows and cropland might be a result of the demand for livestock as another source of hedge.

3.3 A cointegration test

The second approach presented to identify nonagricultural land use follows from a cointegration test. Based on the Stock and Watson (1988) representation for a cointegrated system, if p_t and s_t are cointegrated they can be described as a stationary and specific component plus a nonstationary common trend. Therefore, if p_t and s_t are not cointegrated, both variables are determined by different nonstationary process. In this case, equation (15) implies not only that x is nonzero but it is nonstationary. If both p_t and s_t are stationary or cointegrated, it is not possible to assert anything about land use since the possibility of x_t being nonzero but stationary cannot be ruled out.

[Insert Table 3]

Table 3 presents the results of cointegration tests for meadows and cropland for each Brazilian region and for the whole country. All tests were carried out using Jonhansen's approach, assuming two lags for the VAR in levels. Considering the whole country, the results suggest the existence of a nonagricultural component of land demand for meadows. Land prices for sale and rental rates are cointegrated for Brazilian cropland. One possible explanation for this fact is that cattle farms are easier to manage than crop farms. Therefore, individuals demanding land for nonagricultural purposes choose to buy meadows because they offer an easier way to obtain additional agricultural payoffs.

The results of table 3 also indicate an interesting difference between the Central-West region and the rest of the country.[13] Regions Northeast, Southeast and South present the same pattern of the country as a whole. On the other hand, it seems that the nonagricultural motive of landholding for the Central-West region regards cropland. This region is characterized by the existence of large tracts of land used for the production of agricultural commodities for exportation, cultivated by capital intensive methods. The opportunity cost of keeping idle those plots compensates the agency costs related to the labor force.

3.4 The present value approach

This section uses the methodology of Campbell and Shiller (1987) to test whether land prices are defined by expected present value of future agricultural rents. In order to present this methodology, consider the conventional present value formula of land price determination[14]:

$$p_t = \sum_{i=0}^{\infty} \delta^{i+1} E_t s_{t+i}, \tag{16}$$

where s_t is the land rental rate, $\delta \in [0, 1]$ is a (constant) discount factor, and E_t denotes mathematical expectation, conditional on the full public information set I_t.

The strategy applied here consists in a battery of tests to evaluate the validity of (16). The analysis consider a new variable $S_t \equiv p_t - \frac{\delta}{1-\delta} s_t$, refered as the *spread* and defined as the difference between the land price and a multiple of the rental rate. Note that if $E_t s_{t+i} = s_t$ for all $i > 0$ then $S_t = 0$. Equation (16) determines the following expressions for S_t:

$$S_t = \frac{1}{1-\delta} \sum_{i=0}^{\infty} \delta^i E_t \Delta s_{t+i} \tag{17}$$

and

$$S_t = \frac{\delta}{1-\delta} E_t \Delta p_{t+i}. \tag{18}$$

Equations (17) and (18) say that the spread S_t is a weighted average of future changes in the rental rate s_t or it is linear in the optimal forecast of the change in the land value p_t.

[13] Results for the North region are not analyzed because both series are stationary. Thus, our test does not apply.

[14] A general formulation also includes a constant term, which was omitted for to simplify notation (see Campbell and Shiller, 1987).

The first step in the Campbell and Shiller (1987) methodology is the estimation of δ. One possibility is to estimate δ from the regression of p_t on a constant plus s_t. If $E_t s_{t+i} = s_t$, equation (16) implies that the coefficient on s_t is $\delta / (1 - \delta)$.

[Insert Table 4]

The test 1 presented in table 4 is based on equation (18). The present value model determines that, if one regress Δp_t on S_{t-1} and other variables, the coefficient on S_{t-1} should be $(1 - \delta) / \delta$, and the coefficients on the other variables should be zero. The other variables considered were the dummies related to the launching of stabilization plans in the current and previous period. table 4 reports two versions of tests - one with the joint test and another considering only the test on the coefficient of S_{t-1}. Both types reject the validity of (18) for meadows and cropland in each Brazilian region and for the country as a whole.

The test 2 in table 4 consists in a set of unit root tests. If Δs_t is stationary, it follows from (17) that S_t is stationary; (18) then implies that Δp_t is stationary. Except for the cases of meadows in Northeast and South, all results depicted in table 4 do not reject these implications. Thus, S_t and Δs_t (or the pair S_t and Δp_t) can be used as stationary variables that summarize the bivariate history of s_t and p_t.

Consider the following VAR representation for S_t and Δs_t:

$$\begin{bmatrix} \Delta s_t \\ S_t \end{bmatrix} = \begin{bmatrix} a(L) & b(L) \\ c(L) & d(L) \end{bmatrix} \begin{bmatrix} \Delta y_{t-1} \\ S_{t-1} \end{bmatrix} + \begin{bmatrix} u_{1t} \\ u_{2t} \end{bmatrix},$$

where $a(L)$, $b(L)$, $c(L)$ and $d(L)$ are polynomial in the lag operator, all of order p. The number of lags p for each system was chosen by the Akaike information criterion (AIC), and they are presented in the first column of table 5. table 5 also shows two different implications of the present value relation for the VAR system.

[Insert Table 5]

A weak implication of (17) is that S_t must linearly Granger-cause Δs_t. As shown by test 3 in table 5, this condition is rejected in the regions North and Northeast, as long as for cropland in Southeast and meadows in South. There is strong evidence that spreads Granger-cause land rental rates for Brazilian meadows, Central West, Southeastern meadows and Southern cropland.

The conditions analyzed above are derived as necessary conditions for the expected value theory represented by (16). The full set of restrictions, however, is more demanding. Campbell and Shiller (1987) show that the constraints imposed on individual coefficients of the VAR system are:

$$c_i = -\frac{\delta}{1-\delta}a_i, \; i = 1, ..., p;$$

$$d_1 = \frac{1}{\delta} - \frac{\delta}{1-\delta}b_1,$$

$$d_i = -\frac{\delta}{1-\delta}b_i, \; i = 2, ..., p.$$

The formal tests of the theory are presented in table 5 as test 4. The null hypotheses are rejected very strongly by Wald tests, indicating that the present value formula does not hold for the samples. All p-values are much lower than 0.001. In fact, figure 4 shows that the actual spread does not seem to move closely to the theoretical spread. As shown by Falk (1991), both series are negatively correlated,[15] i.e., land prices tend to be unusually high (with respect to the present value theory) when the present values of expected future changes in rents are unusually low.

[Insert Figure 4]

4 Conclusion

Latin American countries have a long history of land reforms and some authors have recognized that land is those countries is not only an agricultural input but also a source of other benefits. This paper has analyzed the implications of nonagricultural land use to agrarian development, providing some predictions regarding the role and the design of land reform programs. It was argued that unskilled farmers, who cannot undertake agricultural production, might be obligated to keep their land unimproved if the land-rental market does not work perfectly. Poor skilled farmers, on the other hand, cannot buy those lands because the land price is above the expected present value of the agricultural profits. Therefore, imperfections in the land-rental market coupled with nonagricultural motives for landholding produce an inefficient allocation of resources.

The policy implications for the design of land reform programs in Latin America, besides the importance of enhancing the land-rental market, rely on two main issues. The first one comes from countervailing general equilibrium responses from prices (land price and wage rate) and occupational choices. An

[15] The correlation among actual and theoretical spreads is -0.44 for cropland and -0.78 for meadows and pastures.

increase in the wage rates after reform might offset initial gains from the reform if the beneficiaries decide to become laborers. This is less likely to occur in a low-wage economy, as shown by the model. The second issue is related to the information on farmer's ability contained in the observation of the farm size. The model suggests that those unskilled peasants who cannot manage agricultural production decide to buy farms only above a certain critical size, because their earnings are solely nonagricultural. Skilled farmers, on the other hand, are willing to become landowners of smaller farms, because they can get both agricultural and nonagricultural payoffs from land. This simple self-selection argument means that small farmers are predominantly skilled when compared with landless peasants or large landholders, which helps to solve the important question of targeting in the implementation of land reform programs. Therefore, the model suggest that such programs should aim at small farmers instead of landless people in order to enhance efficiency.

The model have also defined an empirical strategy to test its main hypothesis. Evidence based on land prices and land-rental rates from Brazil does not reject the existence of this nonagricultural component of land demand. The launching of economic plans during the 1980s and 1990s increased the uncertainty of the economy and raised land prices in more than 30%. This first result was interpreted as an evidence of the existence of the nonagricultural component of land demand, since the effect on land-rental rates were less important. Cointegration analysis of land prices and rental rates reveals that this phenomenon, except for the Central West region, occurs mostly for meadows and pastures - land prices and rental rates of cropland present a common trend. The formal tests of the present value model have strongly rejected that null hypothesis that land prices can be written as the discounted value of future agricultural rents. Therefore, the policy implications of the theoretical model seem to hold in the Brazilian case - an interesting and significant case study for land reform.

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Figure 1– Occupational Choices

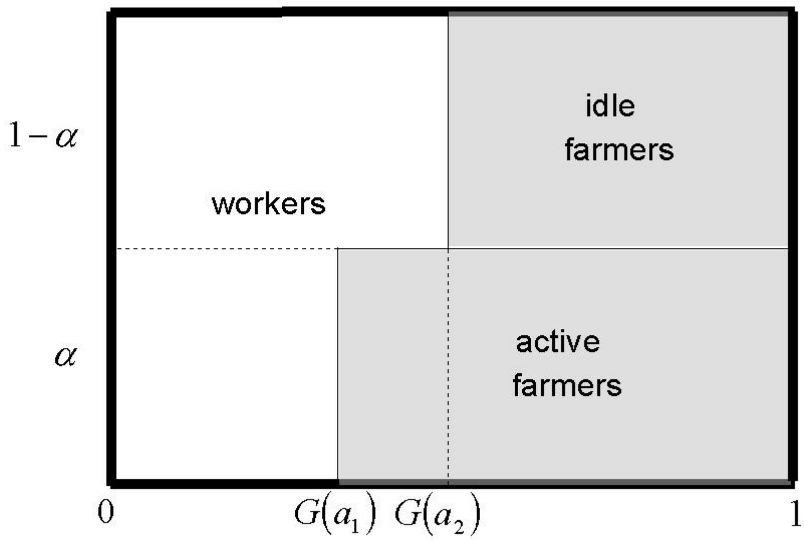
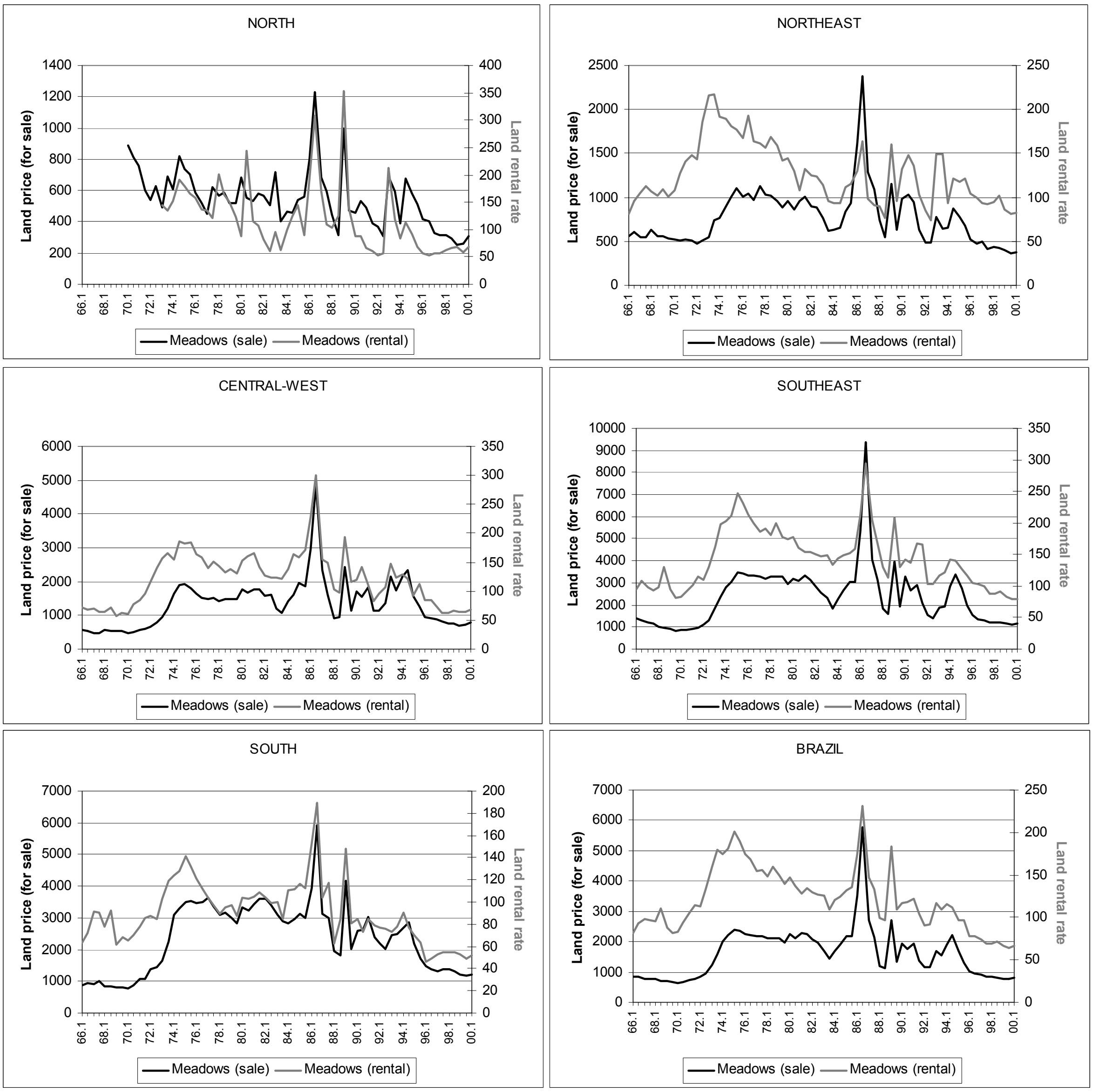
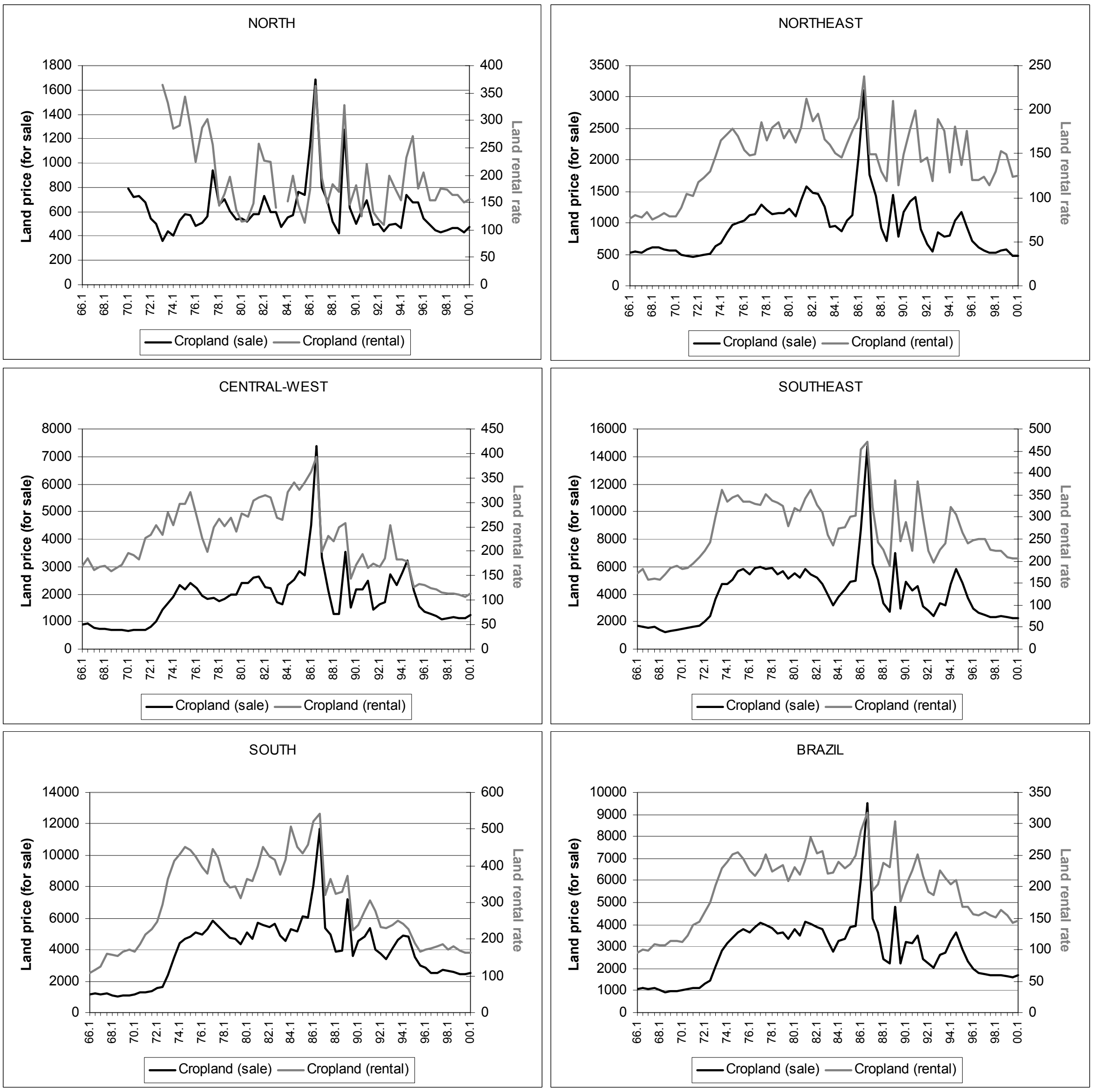


Figure 2 – Land Prices for Sale and Rental – Meadows, 1966-2000



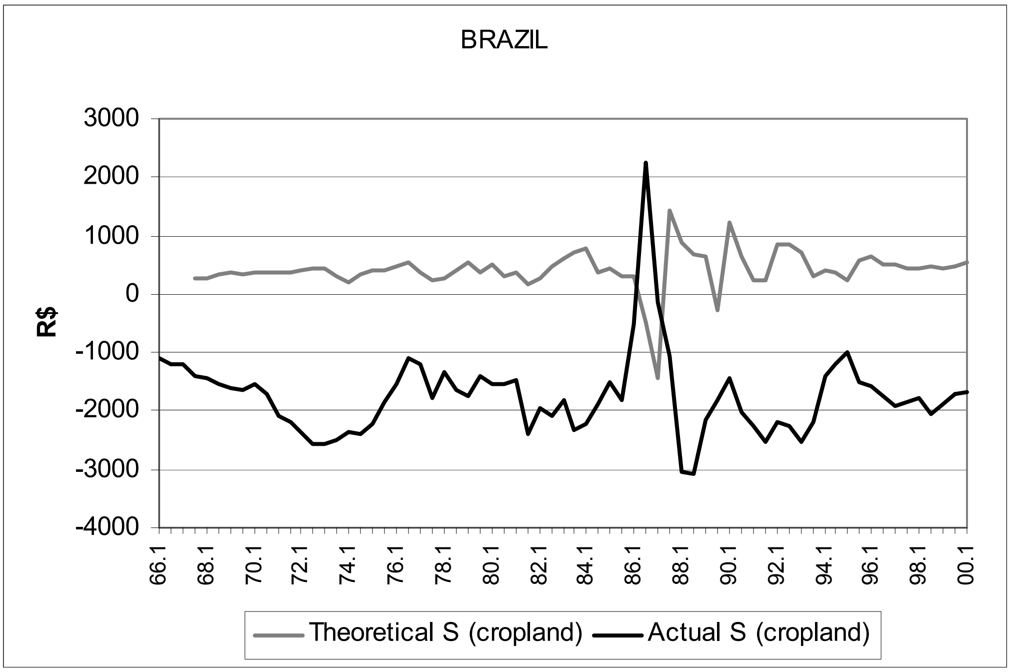
Fonte: CEA/IBRE/FGV

Figure 3 – Land Prices for Sale and Rental – Cropland, 1966-2000



Fonte: CEA/IBRE/FGV

Figure 4 – Theoretical vs actual spreads, 1966-2000



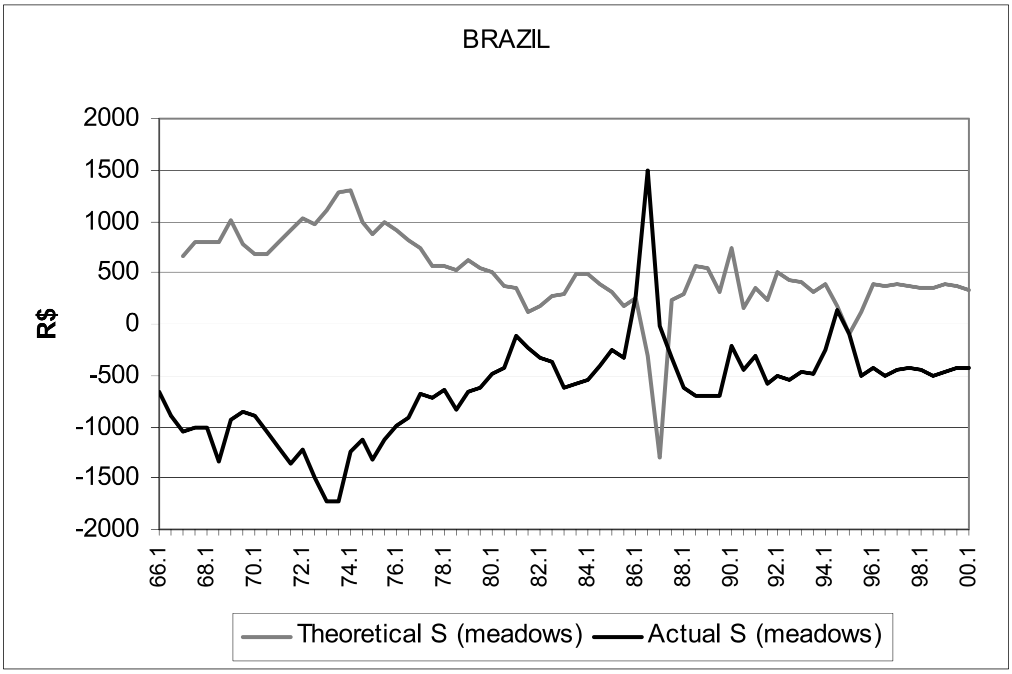


Table 1– Summary statistics for detrended land prices – Brazil – 1966-2000

Statistics	Meadows		Cropland	
	rental	sale	rental	sale
Number of observations	69	69	69	69
Mean	121.32	1616.10	197.40	2786.73
Median	117.61	1580.95	193.50	2723.70
Maximum	212.09	4952.82	270.46	8045.96
Minimum	84.69	574.53	144.39	1267.43
Standard deviation	18.97	538.65	22.50	844.11
Coefficient of variation	0.16	0.33	0.11	0.30
Skewness	1.85	3.39	0.77	3.51
Kurtosis	9.82	22.88	4.75	23.39

Source: Getúlio Vargas Foudation – IBRE
Note: all series were detrended and centered on the original mean. Since the original time series were nonstationary, we use the Hodrick-Prescott filter to detrend them in order to compute meaningful statistics.

Table 2 – Effects of Economic Plans on Land Prices

Estimates	Meadows		Cropland	
	Sale	Rental	Sale	Rental
(A) Constant	1520.1 (0.0000)	118.2 (0.0000)	2643.8 (0.0000)	196.4 (0.0000)
(B) *Dummy variable*: new economic plan in t	591.1 (0.0120)	24.0 (0.0046)	877.8 (0.0183)	11.1 (0.2983)
(B) / (A)	38.9%	20.3%	33.2%	5.7%
(C) *Dummy variable*: new economic plan in $t-1$	733.1 (0.0021)	19.2 (0.0219)	1095.1 (0.0036)	2.95 (0.7877)
(C) / (A)	48.2%	16.2%	41.4%	1.5%
R^2	0.17	0.14	0.15	0.02

Note: all series were detrended and centered on the original mean. Since the original time series were nonstationary, we use the Hodrick-Prescott filter to detrend them in order to compute meaningful statistics. All *p-values* are in parentheses.

Table 3 – Cointegration Tests

Regions	Land Type	Likelihood ratio test		# cointegration relations
		h = 0	h = 1	
Brazil	**Cropland**	19.55	3.46	1**
	Meadows	13.37	1.71	0
North	**Cropland**	20.15	8.90	Both stationary
	Meadows	21.52	6.93	Both stationary
Northeast	**Cropland**	17.84	6.64	1**
	Meadows	12.61	3.44	0
Central-West	**Cropland**	15.12	1.09	0
	Meadows	15.51	2.60	1**
Southeast	**Cropland**	31.85	8.96	Sales stationary
	Meadows	14.89	3.06	0
South	**Cropland**	19.84	4.59	1**
	Meadows	15.10	4.84	0
Critical Values	**1% (*)**	20.04	6.65	
	5% (**)	15.41	3.76	

Note: tests were carried out using Johansen's approach assuming 2 lags for the VAR in levels.

Table 4 – Tests of the Present Value Formula I

	Test 1(a): $\Delta p_t = \alpha S_{t-1} + \beta x_t + \varepsilon_t$		**Test 2**(b): Unit Root Tests Δs_t stationary $\Rightarrow$ $S_t, \Delta p_t$ stationary		
	$H_0 : \alpha = \frac{1-\delta}{\delta}, \beta = 0$	$H_0 : \alpha = \frac{1-\delta}{\delta}$	Δs_t	S_t	Δp_t
Brazil					
Meadows	0.0001	0.0067	-10.07***	-3.65**	-9.61***
Cropland	0.0000	0.0000	-10.83***	-4.13***	-10.05***
North					
Meadows	0.0000	0.0000	-9.80***	-5.75***	-11.39***
Cropland	0.0000	0.0000	-9.76***	-3.93**	-10.14***
Northeast					
Meadows	0.0000	0.0000	-10.64***	-2.78	-9.04***
Cropland	0.0002	0.0045	-13.54***	-3.32*	-8.24***
Central-West					
Meadows	0.0000	0.0002	-10.04***	-4.46***	-9.48***
Cropland	0.0000	0.0000	-10.56***	-4.60***	-9.30***
Southeast					
Meadows	0.0001	0.0053	-9.04***	-4.68***	-9.58***
Cropland	0.0000	0.0000	-10.03***	-9.13***	-15.28***
South					
Meadows	0.0068	0.0974	-11.26***	-2.46	-11.17***
Cropland	0.0005	0.0000	-8.99***	-6.73***	-10.26***

Note: (a) Columns report the *p*-values of Wald tests considering chi-square distribution. (b) Test statistics for variable X_t are based on the *t*-statistics on α in the regression $\Delta X_t = \mu + \beta t + \alpha X_{t-1}$. The *t*-statistic is corrected for serial correlation in the equation residual following the Phillips-Perron procedure. Significance levels are: (*) 10%, -3.17; (**) 5%, -3.48; (***) 1%, -4.10.

Table 5 – Tests of the Present Value Formula II

	Lags[c]	Test 3: S_t Granger-cause Δs_t		Test 4[d]: Full set of restrictions Wald	
		$H_0 : S_t \Rightarrow \Delta s_t$	$H_0 : \Delta s_t \Rightarrow S_t$	χ^2 statistic	p-value
Brazil					
Meadows	1	0.02177**	0.61975	50.6	0.00000***
Cropland	2	0.00233***	0.09705*	69.7	0.00000***
North					
Meadows	1	0.87022	0.88335	80.9	0.00000***
Cropland	5	0.27411	0.61781	393.2	0.00000***
Northeast					
Meadows	2	0.09571*	0.01086**	73.8	0.00000***
Cropland	2	0.02195**	0.03378**	43.9	0.00000***
Central-West					
Meadows	1	0.00448***	0.28831	72.4	0.00000***
Cropland	1	0.00000***	0.15050	48.7	0.00000***
Southeast					
Meadows	6	0.03816**	0.23201	73.0	0.00000***
Cropland	1	0.75401	0.93071	89.2	0.00000***
South					
Meadows	6	0.01936**	0.04448**	153.7	0.00000***
Cropland	2	0.00000***	0.92000	31.8	0.00000***

Note: (c) The number of lags is chosen by the Akaike information criterion (AIC).

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