AGRICULTURE AND GOVERNMENTS IN AN INTERDEPENDENT WORLD

PROCEEDINGS
OF THE
TWENTIETH
INTERNATIONAL CONFERENCE
OF AGRICULTURAL ECONOMISTS

Held at Buenos Aires, Argentina
24–31 August 1988

Edited by
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Washington DC, USA

INTERNATIONAL ASSOCIATION OF
AGRICULTURAL ECONOMISTS
QUEEN ELIZABETH HOUSE
UNIVERSITY OF OXFORD

1989

Dartmouth

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*The Behaviour of Land Prices and Land Rents in Brazil****

INTRODUCTION

During the 1970s economists in Brazil became interested in the behaviour of the prices of land and land rents. Even though the availability of data since 1966 was a pre-condition for these studies, it is clear that the analyses were motivated largely by the type of agricultural policy adopted in Brazil in this period – almost entirely concentrated on rural credit at concessionary rates of interest.

In this paper we perform a quantitative study of the determinants of land prices and rents based on a simple model. In order to accomplish that, the next section presents a summary of the evidence on land prices (and other relevant variables) and the main issues of the current debate. A simple theoretical scheme for the determination of land prices and land rents in the presence of imperfections in the credit market is then developed for the case of Brazil and in the next section the estimating procedures and results are discussed. Some concluding remarks close the paper.

EVIDENCE AND CONTROVERSIAL ISSUES

Land prices and rural credit policy

Table 1 presents the evolution of land prices and land rents in the Centre-South of Brazil (States of Minas Gerais, Rio de Janeiro, São Paulo, Paraná, Santa Catarina, Rio Grande do Sul, Goiás, Maro Grosso do Sul and Mato Grosso), as well as data on other selected agricultural and macroeconomic variables of interest. One striking fact shown is the substantial growth of land prices in the years 1972–5 – they rose twice as fast as land rents. There was another exceptional price rise in 1986 followed by a fall of at least equal size in 1987 (not shown here).

This table also provides information on general macroeconomic conditions (growth of GNP per caput, inflation, and the degree of official indexation, that is

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***We would like to thank Sérgio da Cruz Waddington for his efficient assistance with the research.

TABLE 1 *Land prices, land rents and some agricultural and macroeconomic indicators – Brazil*

Year	Real land prices (Cz$/ha)	Real rents (Cz$/ha)	Land rents/ land prices (%)	Credit Subsidy/ Value of Ag. Production	Per Caput GNP Growth	Agric. income/total income%		Deflated Agricult. prices	Rate of Inflation	Deflated monetary correction
						current prices	1980 prices			
1966	3092	269	8.7	6.0	3.6	14.1	16.8	92	38.8	0.9
1967	2842	288	10.1	3.7	1.3	13.7	17.5	86	24.3	–1.4
1968	2693	313	11.6	3.5	6.7	11.7	16.5	84	25.4	–0.2
1969	2408	284	11.8	2.1	6.4	11.4	15.5	91	20.3	–1.2
1970	2413	300	12.4	1.9	7.2	11.5	14.4	100	19.3	0.0
1971	2799	369	13.2	1.9	8.6	12.1	14.3	102	19.5	1.9
1972	3374	439	13.0	0.7	9.3	12.1	13.3	111	15.7	–0.5
1973	5259	596	11.3	0.0	11.2	12.5	11.6	137	15.5	–1.5
1974	8742	664	7.6	9.0	6.4	12.1	10.0	146	34.5	–1.6
1975	9640	711	7.4	9.3	2.7	11.2	11.0	146	29.4	–3.4
1976	9369	633	6.8	19.0	7.1	12.1	10.2	181	46.3	–5.8
1977	9362	588	6.3	11.3	2.1	13.6	11.0	201	38.8	–6.5
1978	8804	557	6.3	13.5	2.3	10.7	10.2	172	40.8	–2.6
1979	8567	527	6.2	30.3	4.6	10.2	9.9	169	77.2	–15.8
1980	9286	570	6.1	31.0	6.5	10.0	10.0	159	110.2	–28.0
1981	9848	578	5.9	19.5	–5.7	9.0	11.0	127	95.2	0.9
1982	8906	534	5.9	25.7	–1.5	7.7	10.7	113	99.7	0.2
1983	7104	502	7.1	13.9	–4.9	9.8	11.1	124	211.0	–16.6
1984	7972	581	7.3	1.8	3.1	10.2	10.9	128	223.8	0.0
1985	9742	607	6.2	1.0	5.6	9.8	10.9	128	235.1	–2.2
1986	19084	887	4.6	n.a.	n.a.	n.a.	n.a.	157	65.0	–19.5

Sources: FGV, Central Bank and IBGE.

monetary correction), as well as on variables of interest for the analysis of agriculture. For example, it shows that agricultural prices rose during the seventies and fell in the 1980s.

The decline in the land rent/land price ratio, which was observed with a simultaneous increase in the volume of credit to agriculture and decrease in the rate of interest charged on agriculture credit (always negative during the period), was in large part responsible for the hypothesis that the rural credit subsidy was capitalized in the price of land, leaving at the same time unaffected land rents (Castro, 1978 and Sayad, 1977). The argument goes as follows: first it is assumed that the policy affects neither the product nor the factor markets, so that the rural credit borrower retains all the income transfer implicit in the subsidy. In practice, all the credit is allocated ('diverted') to nonagricultural uses (more specifically, to the financial market) either legally (through substitution of equity by credit funds) or illegally. Second, it is also assumed that access to the rural credit market is possible only if the agent is a (rural) landowner. On these assumptions, it follows that land prices rise while marginal returns to productive use of land (as of any other factor of production) do not change. In a less strict version, it is admitted that part of the borrowed funds is applied in agriculture and another part is transferred to the financial sector, in which case the effectiveness of the policy could, in principle, be measured by the net increase in financial resources devoted to agricultural activities. Finally, to complete the argument, it is believed that land rents do not increase because renters of land do not have access to credit.

A somewhat different approach to this question of the effectiveness of the subsidized rural credit policy points out that the supply of credit at negative real interest rates and with special conditions for repayment mitigates the financial consequences of adverse fluctuations of agricultural income, that is, it reduces downside risks (Rezende, 1985). Accordingly, the policy reduces the probability of loss of land by individual farmers due to liquidity problems; land as an asset becomes then less risky and its price rises. This provides a third reason why land prices are positively affected by subsidized credit (the other two are capitalization of subsidy earned in the financial market and possibly higher marginal returns to productive use of land).

As to land rents, it is clear that their behaviour depends upon the particular structure of the land renting market. For instance, if land for rent is supplied predominantly by credit-using farmers, and if marginal returns to land used by these farmers rise as a result of the credit policy, then the equilibrium level of rents should also rise, even if renters do not have access to credit.

Given the lack of sufficient *a priori* information on the actual structure of the land renting market, the alternative left to us was to infer such a structure from the econometric tests performed. Thus we propose, in this paper, a model in which the direct link between land rents, on the other hand, and land rentals earned by credit-using farmers, on the other, is ruled out, thanks to the assumption that land for renting is supplied by landholders incapable of earning these potential land rentals. On this assumption, and also on the more conventional hypothesis that renters do not have access to subsidized credit, it is then shown that credit policy may indeed affect differently land rentals – and consequently also land prices – and land rents, as envisaged by the previous literature on the subject.

Inflation and financial markets

Land prices are the present value of the flow of returns associated to that asset. This flow has to be discounted by taking into account the opportunity cost of capital for the landowner, which can be taken, as an approximation, to be the prevailing real interest rate in the financial market. If there was no credit subsidy, one would argue that the higher the interest rate, the lower the price of land because in equilibrium more resources would be diverted away to the financial market. Nonetheless, in an economy distorted by a credit subsidy this relationship may not hold. A higher market rate of interest – given that on rural credit – is equivalent to an increase in the subsidy which in turn shifts to the right the demand for land.

In the presence of inflation the links between the land market and the financial market may be even more complicated. Suppose that there is an asset which is perfectly indexed, so that its real return is known with certainty. Investors willing to hedge against inflation will prefer to hold that asset instead of others, including land. The extent of this preference is certainly positively correlated with the level of inflation since the higher the inflation the higher the variance of relative prices and of inflation itself. Thus, in the presence of such an asset, one would observe a negative association of land price with inflation. In the absence of this asset, however, and if land is believed to be a good hedge against inflation by wealth holders, then one would observe a positive association of land price with inflation.

It is interesting to note that the rise in the price of land observed in 1986 is frequently attributed to the elimination of the monetary correction during the stabilization of the economy (the Cruzado Plan). This, accordingly, led investors to reduce the share of financial assets in their portfolio in order to buy land and other assets whose prices were not controlled (shares, real estate, cattle, and so on). This process took place in the opposite direction in 1987 when monetary correction was reintroduced in the economy.

We believe that the above explanation is essentially correct. However, one has to realize that the agricultural sector experienced a boom in the crop year 1986/1987. If may be argued that this was influenced by the extremely low values of the real interest rate charged on rural credit.

LAND MARKETS AND IMPERFECT CREDIT MARKETS: A SIMPLIFIED THEORETICAL SCHEME

Three groups of agents are considered in the analysis of land markets to be presented in this section. Land-holders are divided into two groups: 'agricultural producers' and 'nonagricultural investors'. These two groups are similar in that they have enough capital to bid in the land market. However, while agricultural producers are endowed with information on agricultural technology and markets and are capable of earning potential returns to land by using it directly rather than renting it out, nonagricultural investors are not.

On the demand side of the land renting market one finds a third group of agents with information on agricultural technology and markets, but with no

capital to bid in the land market. These are small landless farmers who do not have direct access to the rural credit system; for this reason, their current expenses are financed at the market rate of interest. Alternatively, they may borrow from the landowners from which they rent the land, in which case a differentiation could be introduced within the group of nonagricultural investors between 'landlords' and 'equity investors' proper. Landlords keep closer ties with and derive a significant share of their income from agriculture, have to spend time and resources in monitoring their tenants and sharecroppers, and are clearly eligible to borrow from the rural credit system. Equity investors (as Castro, called them), on the other hand, are much less involved with agriculture and hold land mainly to appropriate the credit subsidy, expected capital gains from land price appreciation and also fiscal incentives. However, since there are agents willing to rent-in land, these equity investors might as well realize that extra income (Sayad, 1982). It is natural then to assume that all land acquired is offered in the land renting market.

Each agent will solve an allocation problem that will generate individual demands for land-holding, for land renting and supplies of land for renting. Denoting the market rate of interest by i, the rate of interest on rural credit by s, the price of land by v, the rent by r, the ratio between the price of the agricultural good and the price of agricultural inputs by p, the land yield by y, the amount of subsidized credit by w, the quantity of land acquired by agricultural producers by A_p, the quantity of land acquired by nonagricultural investors (which will be also the quantity supplied in the land renting market) by A_e and the quantity of land demanded for renting by A_r, we can specify the demand and supply functions.

For nonagricultural investors, and ignoring expected gains from land price appreciation and from using land as a tax shelter, it is postulated that:

$$A_e = A_e (r, i, s, v, w) \tag{1}$$

The partial derivative with respect to r is positive, because the higher the rent the higher is the incentive to buy that asset. The partial derivative with respect to w is also positive because for $s < i$, as assumed, the higher w, the higher the subsidy. The partial derivatives with respect to s and v are negative since they are 'costs' for this agent. The sign of the partial derivative with respect to i is not determined since an increase in i has two effects: it raises the opportunity cost of capital invested but, given s (smaller than i), it raises the subsidy on rural credit.

For agricultural producers we postulate that the quantity of land to be acquired is given by:

$$A_p = A_p (p, w, i, s, v, y) \tag{2}$$

The partial derivative with respect to p is positive; the partial derivatives with respect to s and v are negative, with respect to y and w are positive and with respect to i is not determined, because this variable affects the producer both as a cost and as a return.

Finally, the demand for rented land is as follows:

$$A_r = A_r (p, r, i, y) \tag{3}$$

The partial derivatives with respect to r and i are negative and the partial derivatives with respect to p and y are positive.

Given these behavioural assumptions, we may now state the equilibrium conditions of the model. Letting T be the (given) supply of land we have:

$$A_e + A_p = T \tag{4}$$

and

$$A_e = A_r \tag{5}$$

Solve the model for the five endogenous variables (A_e, A_p, A_r, r, v) as functions of the exogenous variables (p, w, i, s, y). The equilibrium values of r and v (as well as of A_e, A_p and A_r) can then be written as:

$$r = r\,(p, y, w, s, i) \tag{6}$$
$$v = v\,(p, y, w, s, i) \tag{7}$$

The comparative statics of the model indicates that these reduced form equations have definite signs – positive – only for p and y. Consider an increase in w or a decrease in s: the direct negative impact on r (following the shift to the right in the supply of land for renting) may be compensated for by an indirect, positive impact on r through higher land prices (v). As for i, the reason for the indeterminacy of its sign in (6) and (7) lies in the same indeterminacy of its sign in (1) and (2).

Following the previous discussion, two other exogenous variables were included in the estimation of (6) and (7): i) the rate of inflation x, with positive sign if land is used as a hedge; and ii) the GNP gap h, with expected positive sign in both equations (Brandão, 1986).

ESTIMATING PROCEDURES AND RESULTS

We limited ourselves to the estimation of equations (6) and (7). The dependent variables r and v were calculated, for each state, as weighted averages of rents and land prices for pasture and crop lands; the weights being the proportions of total area used for cattle grazing and for growing crops. Averages of these rs and vs were then calculated for the Centre-South, the weights being, now, the share of each state in the total amount of pasture and crop lands, evaluated at 1975 average prices for Brazil. The variable p was obtained, for each state (and for the Centre-South through weighted averages), as a ratio between indices of producer prices and of inflation (IGP-DI), all published by FGV. A general price deflator was preferred to available indices of agricultural input prices because the latter have a limited coverage and produced inconsistent results. The variable y was calculated by first deflating the total value of crop production (for each state and the Centre-South aggregate) by the corresponding indices of producer prices (for crops); these crop production values, at constant prices, were then divided by the

corresponding total cropped areas. A variable called deflated value of production per hectare was also calculated by simply dividing the current value of crop production by the inflation index; the livestock sector was not included in these variables because annual data on pasture area are not available. The variable w was measured by the real amount of credit for crops (deflator: IGP-DI) divided by cropped area. The real rate of interest on rural credit was calculated from average nominal rates on agricultural loans (obtained from Central Bank INPES estimates) and the rate of inflation (IGP-DI). The total amount of subsidy per hectare, calculated by the expression (-s) x (w), was also used in some regressions. The GNP gap (h), taken from Pereira (1986), who kindly updated his results to meet our needs, is defined as the log of the ratio actual GNP/potential GNP. The inflation rate x is the December to December variation of IGP-DI; and, for i, we used as proxy the 'deflated monetary correction', that is, the real variation of OTN (an indexed government bond). Finally, the real variation of the Rio de Janeiro stock market index was also included in the econometric tests.

The above variables were defined both for each state and for the entire Centre-South region. Regressions were runs for the Centre-South aggregate and for all states taken together that is, by pooling cross-section and time-series data. We will refer to the regressions using Centre-South averages as the 'Centre-South regressions', reserving the expression 'pooling regressions' for those including the entire sample formed by the nine states located in the Centre-South, each with 20 observations (1966 to 1985).

Table 2 presents some selected results. With respect to land rents, the following observations can be made. According to models 3 and 4, real prices received by farmers (p) and land yield (y) have non-significant coefficients; but note that the value of agricultural production per hectare, that represents the product of these two variables, has a positive coefficient in models 1 and 2. The amount of credit w and the real interest rate on rural credit s are significantly positive (models 3 and 4), while the value of the credit subsidy (defined as (-s) x (w)) shows a non-significant coefficient in models 1 and 2. Although the results on real prices and land yield are somewhat unexpected, the ones on s, w, and (-s) x (w) are consistent with the type of structure previously hypothesized for the land renting market.

Table 2 also shows that land rents are positively correlated to the business cycle, since the variable h (the GNP gap) showed up significantly positive in all experiment; as for the other variables (inflation rate, real monetary correction and stock market index), their effects on land rents (models 1–4) are very similar to those on land prices.

With respect to land prices (models 5 to 8), real agricultural prices (p) and land yield (y) are significant and have positive signs (in the Centre-South regressions – nos. 5 and 6 – we utilized, instead of these two variables, the value of agricultural production because of the small number of observations; this was done also for land rents, in regressions 1 and 2). The real value of credit subsidy is significant and positively related to land prices in the Centre-South regressions; similarly, in the pooling regressions (nos. 7 and 8), credit per hectare (w) and the real interest on agricultural credit (s) are significant and have the expected signs. The coefficient for the GNP gap is always positive and significant, a fact consistent with theoretical expectations. The inflation rate had a positive coefficient; its

TABLE 2 *Regression results: land prices and land rents*

Regression Number	Dependent Variable	Constant	Independent variables: Real Agricultural prices (p)	Land Yield (y)	Value of Ag. Production per hectare (p.y)	Credit per hectare (w)	Real Interest Rate on Agricultural Credit (s)	Real Value of Credit Subsidy (–sw)	Inflation Rate (x)	Deflated Monetary Correction (i)	Deflated Variation in Stock Market Index	GNP Gap (h)	Trend	R^2	DW
1	Land rent,	–2.45			0.80			–0.005	0.002	0.0099	–0.00016	2.1		0.93	1.80
	CS	(–1.42)			(2.75)			(0.24)	(1.38)	(2.43)	(–0.76)	(2.5)			
2	Land rent,	–2.25			0.79			–0.008	0.0012	0.0093	–0.0002	1.98	0.004	0.93	1.73
	CS	(1.17)			(2.58)			–0.35)	(0.82)	(2.00)	(–0.77)	(2.09)	(0.33)		
3	Land rent,	1.68	0.366	0.073		0.21	0.006		0.003	0.01	–0.0003	3.00		.91	–
	pooling	(6.85)	(0.37)	(1.25)		(5.37)	(3.76)		(9.65)	(4.75)	(–2.58)	(8.55)			
4	Land rent,	2.01	0.06	0.081		0.18	0.006		0.0003	0.009	–0.0003	2.71	0.0096	0.91	–
	pooling	(5.53)	(0.60)	(1.39)		(3.90)	(3.94)		(3.63)	(3.49)	(–2.75)	(6.42)	1.22		
3	Land price	–3.67			1.13			0.15	0.003	0.018	–0.005	2.19		0.98	2.62
	CS	(–2.1)			(3.82)			(7.00)	(2.80)	(4.3)	(–2.4)	(2.61)			
6	Land price,	–3.81			1.14			0.15	0.0034	0.02	–0.005	2.27	–0.003	0.98	2.73
	CS	(–1.96)			(3.67)			(6.17)	(2.20)	(3.88)	(–2.22)	(2.37)	(–0.21)		
7	Landprice	0.92	0.68	0.23		0.17	0.011		0.005	0.024	–0.0003	3.09		0.93	–
	pooling	(2.7)	(5.1)	(2.86)		(3.3)	(–5.4)		(10.6)	(8.17)	(–1.67)	(6.43)			
8	Land price,	1.4	0.70	0.24		0.13	–0.011		0.004	0.020	–0.0003	2.70	0.01	0.93–	
	pooling	(2.7)	(5.2)	(3.0)		(2.2)	(–5.07)		(4.1)	(6.5)	(0–1.8)	(4.70)	(1.20)		

Notes:
[a]Values in parenthesis are t-statistics.
[b]All regressions are in logs. except the variables: real interest on agricultural credit, GNP gap, trend, inflation rate, deflated monetary correction and deflated variation in stock market index.
[c]All regressions have been estimated with annual data from 1966 to 1985 (20 observations for regressions with Centre-South averages as dependent variables, and 180 (20 years, 9 states) for regressions pooling cross-section and time-series data.
[d]$\bar{R}^2$ is the value of R^2 adjusted for degrees of freedom.
[e]Dummy variables specific to each state, included in the pooling regressions, are not included in this table for reasons of space.

significance declines, however, as a trend variable is introduced (compare models 7 and 8). This indicates that land is still used us a hedge against inflation, despite the widespread indexation of the Brazilian economy. The positive coefficient for the market rate of interest implies that diversion of credit funds occurs and leads to higher land prices. Finally, one notices that the stock market index is negatively correlated to land prices, although significance levels are low.

CONCLUDING COMMENTS

A basic issue that has been raised in the literature on land prices and land rents in Brazil is the role played by the subsidized rural credit policy. While there is agreement that concessionary interest rates raise land prices, the effect of the policy on land rents has been the subject of controversy. Some argue that it should be none, due to the lack of access to credit by renters; others point out that it is necessary to know the structure of the land renting market before any conclusion can be reached on the behaviour of rents.

In this paper, a particular model of the land renting market was proposed in which only non-farming land-holders, that is, 'landlords' and 'equity investors', supply land for renting, as a kind of by-product of their portfolio demand for land. Subsidized credit is available directly to these landholders but not to renters. This structure generates analytical implications that are, to some extent, supported by the econometric tests reported in the paper. Limitations of the data and the exploratory character of the econometric analysis recommend, however, that these results should be reviewed with caution. Our factual knowledge of the structure of land renting market is insufficient; for instance, it is known that medium and large farmers also rent-in land in Brazil, but it is not known to what extent, nor their degree of access to the rural credit system. On the other hand, the renting-out of land by 'agricultural producers' has been explicitly ruled out by the assumption that returns to productive services of land self-used by these farmers are higher than cash rents (due to their privileged access to credit); but this aspect should be the object of further research, especially in view of the drastic reduction in credit availability and subsidy rate that have occurred in the 1980s.

It is of great concern in Brazil that the holding of rural land by non-farming investors, for portfolio reasons or for seeking credit subsidies or fiscal incentives, has raised the barrier to landownership by small landless farmers (through pushing up land prices) and increased land idleness. While Sayad (1982) has already questioned the latter conclusion, in this paper landholding by non-farmers is seen as playing a positive role in agriculture, to the extent that farmers – small or big – may use land without having to buy it. However preliminary, the empirical results are consistent with this perspective.

Given the limitations of the study, some issues could not be dealt with. In the first place, it is clear that the amount of land demanded for renting by smaller farmers is not independent of general labour market conditions. For instance, if wages rise, the amount of land rented-in by these farmers will fall. Preliminary attempts to deal with this issue here (including rural wages in the regressions) did not produce satisfactory results and for this reason were not included in our discussion. In the second place, the total availability of land, a variable of crucial

importance included in equation (4), was considered not only an exogenous variable but also a constant, even though the trend may capture some of its affects. Land availability has sharply increased in Brazil in the last two decades, thanks both to infrastructural growth and to agronomic innovations that turned profitable to agricultural use huge areas in Central Brazil (the *cerrado*). This expansion of the land base has to be taken into account in any historical study of land prices; but the complexities of the matter precluded its consideration in a short paper like the present one. For instance, it is possible that this expansion has been only partially exogenous, that is, that some form of supply response has to be modelled. Future research should deal with these as well as other issues in this truly unknown, but extremely relevant (for economic as well as for social-political reasons) territory of land markets in Brazil.

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DISCUSSION OPENING – FERNANDO HOMEM DE MELO

As the title indicates, Brandão and Rezende's paper is a contribution to the analysis of land prices and land rents in Brazil, using a partial equilibrium model and emphasizing the determining role of the subsidized rural credit policy which Brazil utilized, particularly during the 1970s, which the authors consider to be the most important component of the country's agricultural policy. Negative interest rates for rural credit predominated mainly during the 1970s. Nowadays rural credit in Brazil operates with positive interest rates, in spite of the high inflation rates (24 per cent in July, 1988).

I will make two types of comment: first, on points in the paper itself and, second, I will try to raise some points related to policy implications for further discussion. In the second section it seems to me that the link between the land market and the financial market under conditions of high and/or increasing inflation rates deserved more emphasis. In that respect what can be said about the behaviour of agricultural prices relative to the 'monetary correction' (average inflation), and consequently about the amount of the interest rate subsidy? Is it possible that a larger risk resulting from agricultural operations under high inflation rates would offset the subsidy effect?

Regarding the section 'Estimating Procedures and Results' I would ask for

some additional comments on the use of an index of general prices (IGP-DI) as the denominator of producer's price and input prices, rather than input prices themselves. Additionally, it seems to me that more should have been written on the 'somewhat unexpected' results coming from the variables real prices received by farmers (p) and land yield (y). Also, the 1970s was a decade of intense generation and adoption of technological innovation in Brazil's agriculture. Still with respect to variable y – land yield, why did not the authors use a traditional yield index to measure those changes? The results for (s) – the rate of interest on rural credit, (w) – the amount of subsidized credit, as well as (–s) (w) are, as the authors point out 'consistent with the type of structure previously hypothesized for the land renting market'. That is, they positively affect land rents and land prices. That brings me to the second type of comment, to the policy implications of the paper.

Although the authors are quite clear about the limitations of their study, I would like to ask them to comment on a few general questions: Is there a role to be performed by a policy of subsidized credit in agriculture? What about the case of small producers *vis-à-vis* the larger ones in such a policy? Finally, given a situation of high and/or increasing inflation rates, what would be the appropriate way of dealing with the question of interest rates in rural credit?