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Land Reform and Landholdings in Brazil

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Abstract

Land and wealth are closely related in rural Brazil, a country characterized by high levels of inequality in terms of income or landholdings. After presenting a historical retrospective of land concentration and land reform in Brazil, this study evaluates the impact of the land reform programme undertaken in the 1990s on land ownership and land distribution. It is shown that the programme increased landownership among poor rural families and those with less educated household heads, reducing the fraction of the other families with landholding. Also, the land reform programme increased land inequality among landowners.

Keywords: land reform, land distribution, wealth distribution

JEL classification: D31, Q15

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1 Introduction

In Brazil, wealth has been largely associated with land. From the very beginning of the colonization, only 30 years after the discovery, the Portuguese Crown divided the huge territory in 15 large tracts of land which were donated to grantees with hereditary succession. Today, Brazil has one of the most skewed land distributions in the world and, not surprisingly, it is one of the most unequal countries in terms of the income distribution. Facing the challenge of reducing inequality of land ownership and intensifying land use, the Brazilian government implemented a land reform programme in 1966, with the enactment of the Land Act. Since its creation, there are important differences in the implementation of the programme through time and space.

This study studies the structure of land ownership and land distribution in Brazil, investigating the consequences of the land reform programme implemented in the 1990s. The empirical strategy is based on the use of time and space variation of the land reform programme as a means of identifying a causal relationship of land reform on land ownership and inequality. This strategy is implemented with household-level data from the National Household Survey (PNAD), covering the period from 1992-2002 (except 1994 and 2000), and land disappropriations published by the Brazilian Institute for Land Reform (INCRA).

The main findings of the study are the following. The investigation of the effect of the land reform on landownership suggests that (i) there is no increase on the access to land of the typical Brazilian rural household; and (ii) the effect is differentiated with respect to household income and the educational level of the household head—there is an increase in land ownership of poorest households and those with the least educated heads, and a decrease for the other classes of rural households. Concentrating on the families with landholdings, the analysis of the land reform effect on the distribution of land provides evidence of an increase of the land inequality. This result is obtained both with the decomposition of the effect of land reform into household income groups and with the quantile regression analysis. Land reform seems to reduce the size of small landowners (poor households) and increase the size of those above the median (richer households).

These results contribute for a better understanding of the impact of redistributive land reform in Latin America. Although there is a vast literature addressing land reform and agrarian organization, there is little evidence about the Latin American experience (Binswanger and Deininger 1997; Carter and Zegarra 2000; and Deininger and Feder 2000). Although some authors, such as Conning (2001) and Conning and Robinson (2001), have constructed models that exhibit features often observed in Latin America to analyze agrarian organization and land reform, most of the literature considers

general aspects or case studies from Asia (Grossman 1994; Horowitz 1993; Besley and Burgess 2000; and Banerjee et al. 2002).

The study is presented in six sections. Section 1 presents the historical determinants of land concentration in Brazil. Section 2 describes the institutional background regarding the Brazilian land reform programme. Data is depicted in Section 3. Section 4 investigates the correlation between land and wealth indicators. Sections 5 and 6 evaluate the impact of the land reform on land ownership and land inequality, respectively. Then, a summary of the results and final remarks are presented in the conclusion section.

2 Historical determinants of the land distribution and land access in Brazil

2.1 Early determinants of the land concentration

The highly concentrated Brazilian land distribution is deeply rooted in the colonization process. In the 1530s, inspired by the success of land settlements in the Madeira Islands, Portugal's King João III divided Brazil into 15 territories called *capitanias hereditárias* (hereditary captaincies)—areas donated to Portuguese grantees (captains) with hereditary succession. Each captain had complete authority over his land. However, due to a series of obstacles, only a few *capitanias* have succeeded, and six of the captains never took possession of their claims (Bueno 1999).

Another wave of settlements occurred in the seventeenth century, with the increase of the global demand for sugar. In another land concentrating initiative, the crown offered large tracts of land (*sesmarias*) in order to encourage settlement and production. The holders of *sesmarias* experienced complete property rights over their holdings whenever land was kept under cultivation. It is worth noting that such a condition regarding land use remained throughout Brazil's history and was reassured in the constitution of 1988. The *sesmaria* system finished in 1822 with the Brazilian independence (Alston and Mueller 2003).

From 1822 to 1850, no land policy took place and settlers obtained land by squatting, enforcing their claims by social norms. In 1850, the landowners of the coffee plantations passed the Land Act, which set the pattern for modern landholding. The Land Act of 1850 forbade the colonial practice of obtaining land through squatting, limiting the acquisition to purchase. All existing squatters were legalized and, surprisingly, all *sesmarias* were revalidated (Alston and Mueller 2003). Concentration of land was the rule and the great majority of the people (especially after the 1888 abolition of slavery) were forced to work on large plantations and farms without any hope of acquiring a small farm of their own.

2.2 Modern determinants of land concentration

In addition to the heritage from the colonial period, the macroeconomic environment in the last 40 years has played a key role as a determinant of land distribution in Brazil. The following analysis considers landholdings as hedge against inflation and macroeconomic instabilities, both of which tend to set a wedge between the price of land and the capitalized value of the income stream generated from agriculture. Especially in periods of high macroeconomic instability, people demand land as a mechanism of protection against aggregate uncertainty. Assunção (2005) argues that this feature, coupled with imperfections in the land rental market, leads to an inefficient high concentration of landholdings. The existence of a non-agricultural component in the demand for land can be identified through the comparison between land prices and rental rates of croplands and pastures. The empirical strategy is based on the fact that while an increase on macroeconomic instability raises the land prices, the same is less likely to occur with the rental rates.

The 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 implementation of economic plans aimed specifically at containing inflationary inertia through a set of measures including the deindexation 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 non-agricultural component of land demand, as mentioned above, is identified by comparing the effects of the implementation of such policies on the land prices for sale and rental. Two dummy variables were built; one indicating the introduction 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 Plan (February 1986), Bresser Plan (June 1987), Summer Plan (January 1989), Collor Plan (April 1990) and Real Plan (June 1994).

Regressions for the whole Brazilian sample were estimated and reported in Table 1. 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 average land price in the absence of new economic plans in the current and previous semester. The coefficients of the dummy variables represent the average changes in prices at the implementation of the economic plans and in the subsequent semester. The data consist of semi-annual observations of land prices for sale and rental covering the period 1966-2000. They are collected by the Getúlio Vargas Foundation, which gathers information from more than 3,600 local agencies scattered among many

Brazilian districts. Observations refer to actual transactions, collected within the districts at the end of each semester.

Table 1: Effect of Brazilian economic plans on land prices and rental rates, 1966-2000

Estimates	Pastures		Cropland	
	sale	rental	sale	rental
(A) Constant	1520.1 (0.000)	118.2 (0.000)	2643.8 (0.000)	196.4 (0.000)
(B) <i>Dummy variable</i> : new economic plan in the current semester	591.1 (0.012)	24 (0.005)	877.8 (0.018)	11.1 (0.298)
(B) / (A) %	38.90	20.30	33.20	5.70
(C) <i>Dummy variable</i> : new economic plan in the previous semester	733.1 (0.002)	19.2 (0.022)	1095.1 (0.004)	2.85 (0.788)
(C) / (A) %	48.20	16.20	41.40	1.50
Observations	69	69	69	69
R-squared	0.17	0.14	0.15	0.02

Source: Assunção (2005).

Table 1 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 per cent of the total variability of these variables from 1966 to 2000. The effects upon rental rates are much smaller and statistically insignificant for cropland. This suggests that the response of land prices for sale to an exogenous increase in macroeconomic instability is larger compared with rental rates, which is consistent with the existence of a non-agricultural purpose of landholding. For pastures, the economic plans have determined an increase of almost 40 per cent in land prices of sales in the current semester and up to 50 per cent in the next one. The rental rates have experienced a much lower increase, around 20 per cent. For cropland, Table 1 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.

2.3 Latin American land markets

In order to put the Brazilian case in a more general perspective, this section presents some evidence on the organization of agriculture sector in Latin American countries. Land markets in Latin America present two distinguishing types of imperfections (Deininger and Feder 2000). First, land is used not only as a productive asset 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 et al. 1997). Second, land rental markets in Latin America are underdeveloped. A large body of literature has been

theoretically addressing the reasons for the imperfections in the land rental market.¹ Many reasons provide explanations for a reduction in the share of output appropriated by the tenants. Specifically, a factor that is likely to be important in most Latin American countries is the landlord's fear of loss of the land (Macours et al. 2001).

Table 2 compares several indicators of Latin America with Asia, Europe and the United States. Overall, Latin American countries combine a highly skewed distribution of land with the predominance of owner or owner-like form of land tenure, and agricultural land is mostly represented by meadows and pastures, remaining under exploited.

Table 2: International Indicators

Indicators	Latin America	Asia	Europe	United States
Number of holdings	10,281,607	143,934,358	7,625,520	1,911,859
Total area (ha.)	705,586,803	268,741,639	125,394,061	377,088,222
Average farm size	68.6	1.9	16.4	197.2
Land Gini coefficient	0.83	0.52	0.64	0.75
Agricultural land %	65.70	91.80	70.60	88.90
cropland %	20.40	99.50	65.60	52.10
meadows/pastures %	79.60	0.50	34.40	47.90
Land tenure (area)				
owner/owner-like %	85.50	88.70	61.40	33.90
rented from other %	3.60	2.80	23.30	11.60
mixed/others %	10.70	8.50	15.30	54.50
Below 10				
farms %	58.70	97.40	74.50	29.50
area %	2.50	72.60	11.40	1.20

Notes: *Latin America*—Argentina, Brazil, Colombia, Chile, Honduras, Panama, Paraguay, Peru, Puerto Rico, Uruguay, Venezuela; *Asia*—Bangladesh, Cyprus, India, Iran, Japan, Nepal, Pakistan, Philippines, Thailand, Turkey; *Europe*—Austria, Belgium, France, Italy, Luxembourg, Portugal, Spain, Switzerland, United Kingdom.

Source: FAO (1990, 2000).

This regularity can be explained by the absence of a land rental market and non-agricultural purposes for landholding (Assunção 2005). Imperfections in rental market are reflected in 85 per cent of the total area operating under owner or owner-like forms,

¹ The basic arguments are: risk-sharing (Cheung 1969); hidden actions and moral hazard (Stiglitz 1974; Ghatak and Pandey 2000; Eswaran and Kotwal 1985); screening (Hallagan 1978; Allen 1982); and limited liability constraints (Shetty 1988; Laffont and Matoussi 1995).

most of which are constituted by large landholdings. In contrast, 58.7 per cent of the farms have less than 10 hectares. In addition to the inverse relationship between farm size and productivity (Berry and Cline 1979; Feder 1985), this evidence indicates that even with low productivity, large landowners neither lease out nor sell their plots. They do not lease them out because the rental market has many imperfections. And since they obtain non-agricultural payoffs as a result of land titles, they are not willing to sell them. This conjugation makes Latin American agriculture unique, and the fact that only one-fifth of the agricultural land is not covered by pastures and meadows may be an indication of an inefficient organization of production, with significant welfare implications.

Although Asian countries, for the most part, exhibit the same tenure structure, they have a much more egalitarian distribution of land and a significantly smaller average farm size. There is no evidence of a missing rental market since it seems that there is no demand for it. The predominance of cropland indicates the high intensity of land use. The situation in European countries is similar but less evident. The rental market works, and only two-thirds of the area is operated by owner or owner-like forms. As in Latin American countries, the United States exhibits a concentrated land distribution, and the average plot size is large. However, only one-third of the area is under owner or owner-like form of tenure, and less than 30 per cent of the farms have less than 10 hectares. As a result, 52.1 per cent of agricultural land comprise crop.

3 Brazilian land reform

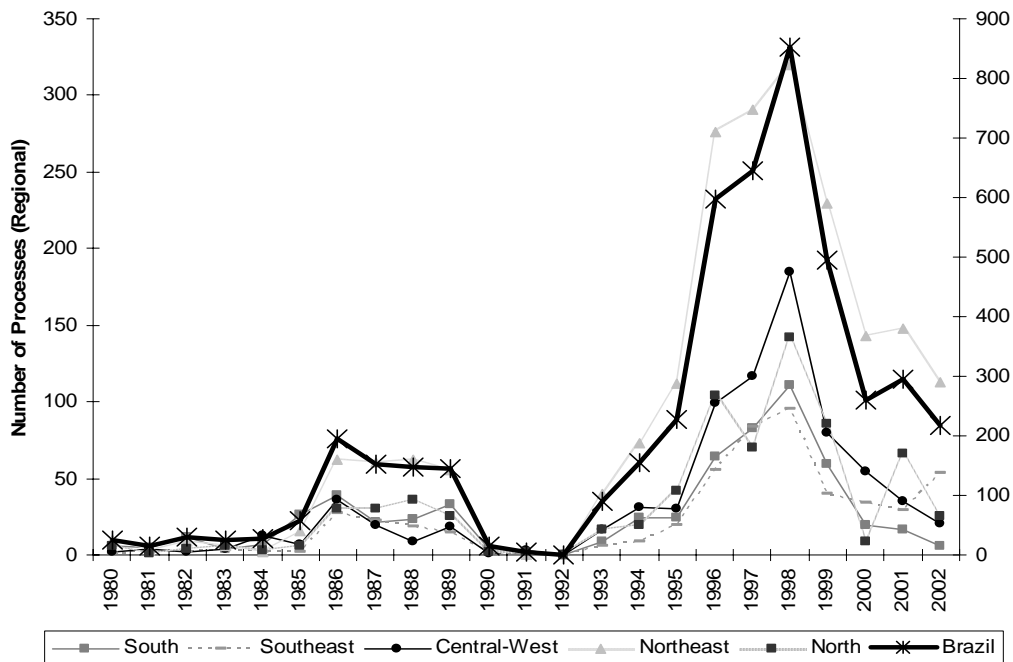
3.1 A brief history

A part of land reform history in Brazil begins with the Land Act of 1964, brought about by the military regime. The long and comprehensive text constituted detailed proposals for agrarian reform. The law created the Brazilian Institute for Agrarian Reform (IBRA) and the National Institute for Agricultural Development (INDA) in order to carry out the Act. In 1971, IBRA and INDA were merged into the National Institute for Rural Settlement and Agrarian Reform (INCRA). The Act was a means of dissuading the pressure for land redistribution of social movements, especially the 'peasant leagues' and the emerging activism of Catholic priests. The political context in Latin America in early 1960s was characterized by peasant militancies and threats of agrarian rebellions. However, instead of distributing property, the economic strategy of the military regime aimed at the modernization of the large landholders by means of subsidized rural credit. Soybean cultivation—the main target of the rural policies—generated large surpluses for export and, simultaneously, resulted in the absorption of small farmers by medium- and large-sized properties, concentrating the land distribution.

With the return of democracy in 1985, the first National Agrarian Reform Plan (1985-89) was prepared and launched, establishing the unrealistic target of settling 1.4 million

families in five years. But, as shown in Table 3, Sarney's government disappropriated less than 5 millions of hectares, slightly more than 10 percent of the initial proposal. On the other hand, Sarney's government determined the first of two significant waves of disappropriations in the recent Brazilian history, as shown in Figures 1 and 2.

Figure 1: Number of expropriations: Brazil, 1980-2002



In the following Collor government the programme came to a halt—only 15,065 hectares were disappropriated. With the impeachment of Collor and the substitution of the president, the land reform process was resumed and more than 20,000 families were settled in almost 1.5 million hectares. During his first run of office (1995-98), President Fernando Henrique Cardoso accelerated the rhythm of the settlements. As shown in Table 3, more than 7.5 millions hectares were disappropriated in the period.² Figures 1 and 2 shows that the disappropriation wave undertaken in Cardoso's administration is substantially different from the disappropriations which occurred during the Sarney government. While the disappropriated area in each year of the two governments are comparable, the number of processes established in the Cardoso's is much higher, suggesting that the settlements were more decentralized through the Brazilian territories. The period was also characterized by conflicts and land invasions, mostly associated with the Landless Workers' Movement, which is the largest social movement

² The official report indicates that the first Cardoso's government settled landless households on 12 million hectares. On the other hand, the data on disappropriation process from INCRA indicates 7.5 million hectares. The difference of 4.5 million hectares (37 per cent) may be due to settlements on public lands or even to errors in the computation of the 12 million hectares.

in Latin America with more than a 1.5 million members. In the second run of Cardoso's administration the focus of land reform changed from the disappropriation model to a new form of 'negotiated land reform' (Deininger 1998).

Figure 2: Expropriated area: Brazil, 1980-2002

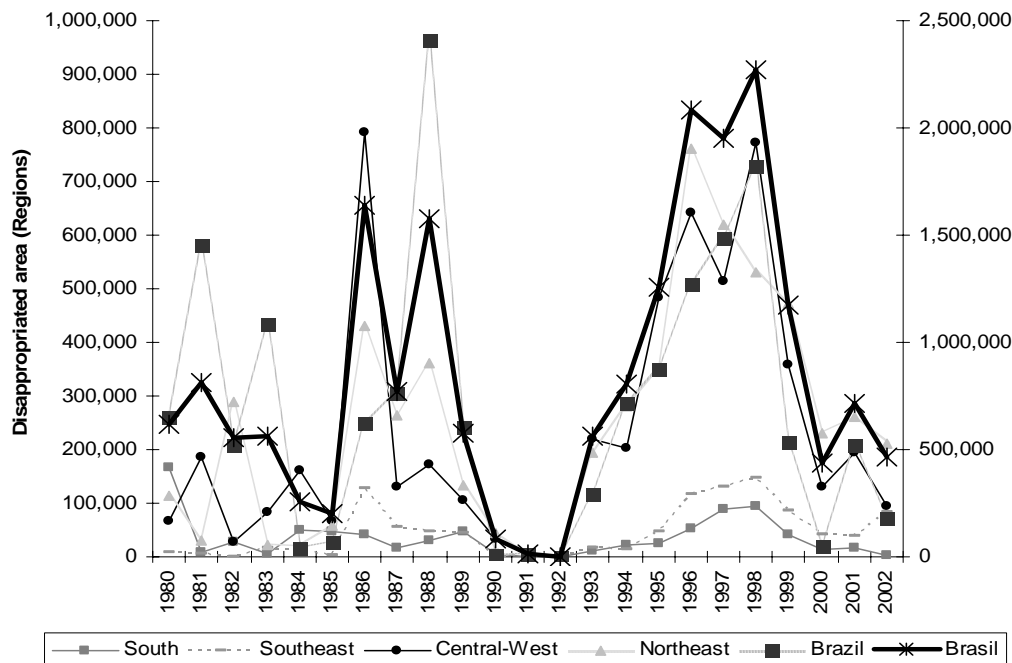


Figure 3 shows the spatial distribution of the disappropriations during the Cardoso period. The process is clearly heterogeneous, restricted to sub-regions of the country. In order to focus our analysis on the areas where the process was more concentrated, a sub-sample of selected Brazilian States is built. This study evaluates the consequences of this modern wave of land redistribution based on disappropriations, covering the period 1992-2002 and corresponding to the governments of Itamar Franco and Fernando Henrique Cardoso.

3.2 Land disappropriation: procedures and costs

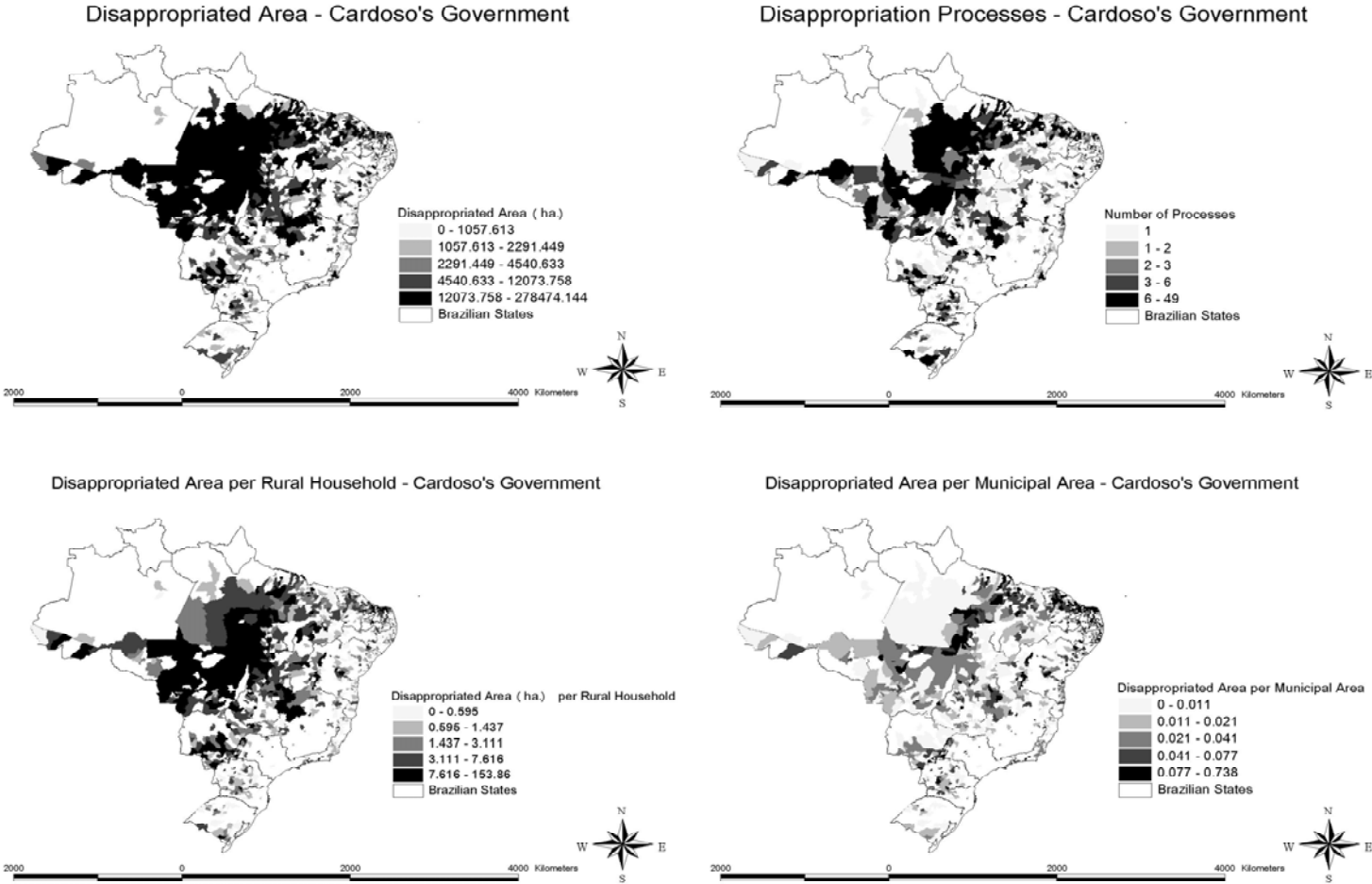
Introduced by the Land Act, the land disappropriation legislation was significantly changed by Brazil's 1988 Constitution. Since then, only unproductive land is under the risk of disappropriation for which the state needs to pay a 'fair price'. After the 1993 amendment, the 'fair price' became the 'market price'. Therefore, at the same time there is a permit of confiscation, the government needs to pay the market price which, in principle, is determined by buyers and sellers rather than anything else.

Table 3: Brazilian land reform expropriation processes from 1979 to 2003

Brazilian presidents	Brazil		North Region		Northeast Region		Central-West Region		Southeast Region		South Region	
	no. of events	total area	no. of events	total area	no. of events	total area	no. of events	total area	no. of events	total area	no. of events	total area
João Figueiredo (Mar/1979 to Mar/1985)	131	2,845,029	21	1,503,700	34	488,966	26	532,296	11	47,557	39	272,510
José Sarney (Mar/1985 to Mar/1990)	701	4,811,507	128	1,789,716	258	1,276,426	89	1,290,367	85	281,368	141	173,630
Fernando Collor de Mello (Mar/1990 to Oct/1992)	7	15,065	2	5,550	0	0	3	3,041	1	3,584	1	2,890
Itamar Franco (Oct/1992 to Jan/1995)	245	1,365,263	36	402,473	113	476,309	48	419,772	15	30,746	33	35,962
Fernando Henrique Cardoso I (Jan/1995 to Jan/1999)	2,323	7,561,048	358	2,181,950	999	2,260,640	431	2,414,377	253	442,025	282	262,056
Fernando Henrique Cardoso II (Jan/1999 to Jan/2003)	1,265	2,785,296	186	511,376	633	1,175,412	189	775,182	156	249,238	101	74,089

Source: INCRA (1999).

Figure 3: Land disappropriation in Cardoso's government



Source: National Institute for Rural Settlement and Agrarian Reform (INCRA).

This conceptual confusion in the legislation of disappropriation along with other institutional failures imposed high costs to the land reform. According to INCRA (1999), the final cost stipulated by the judicial system in the end of a disappropriation process is, on average, five times the initial evaluation. In the southeastern part of the country the averaged multiplier was 14. Reydon (2000) describes eight necessary steps of the disappropriation process. The process begins with an act signed by the Brazilian president and finish, usually, with a judicial decision. There are three issues addressed in the judicial demands: the items to be compensated, the amount of the indemnity, and the form of payment (public bonds versus cash).

4 Data

The following analysis is based on combined data from two sources. The first one, is the database on the disappropriation processes publicly available in the INCRA's website.³ The data comprises the date, farm's name, area, and municipality of each approved process of land disappropriation since 1979. The second source of information is the National Household Surveys (PNAD), collected annually⁴ since 1981 by the Brazilian Census Bureau (IBGE). Since 1992, the PNAD survey provides information on landholdings and, therefore, the period considered in the analysis is 1992 to 2002. The sample consists in all rural households available in the PNAD survey, from 1992 to 2002. The information across years refers to repeated cross-sections. It is not possible to form a panel with PNAD data.

For each household, there is information on landholdings, household head characteristics, spouse characteristics and household characteristics. Since the PNAD survey is representative at the state level, the information of each household is combined with information on land disappropriation in the corresponding state in the previous year. It is assumed, implicitly, that settlements take about one year after the disappropriation to be established. The results are robust to the use of different lags of the information about land reform. Actually, the disappropriation in the current year is very correlated with disappropriation in the previous year or two years before.

Table 4 reports all the variables considered in the analysis. We consider two main dependent variables: a binary variable indicating whether the household is landowner or not, and the logarithm of landholding area. On average, 39 per cent of all 131,775 observations in the sample hold a positive amount of land. The average farm size is 41 hectares for those with landholdings.⁵ The main independent variables in this study are those with information on land reform. There are two variables measuring land disappropriation in the state in the previous year. The first one is a dummy variable

³ www.incra.gov.br.

⁴ Except for the years of 1991, 1994 and 2000.

⁵ If we include the households with no land, the average becomes 16.6 hectares as shown in Table 4.

indicating whether or not there was any disappropriation in the state, until the previous year. More than 3/4 of the sample have at least one disappropriation process on their state. The second variable aims at capturing the intensity of the disappropriation, and it is defined as the ratio between the disappropriated area (measured in hectares) and the number of rural households of each state until the previous period. There are also three sets of control variables regarding characteristics of the household, household head and spouse. Summary statistics on all considered variables are depicted in Table 4.

Table 4: Description of the variables

Variables	Obs	Mean	Std Dev.	Min	Max
Dummy (household with landholdings=1)	131775	0.3948473	0.48882	0	1
Total area of the landholdings	131775	16.56629	149.48	0	10000
log(total area of the landholdings)	52031	11.25869	1.72691	0	18
Dummy (positive disappropriation until the previous year=1)	131775	0.7775223	0.41591	0	1
Disappropriated area per rural household in the state until the previous year	102458	0.0001445	0.00034	0	2.56E-03
Log (disappropriated area per rural household until the previous year)	102458	-9.85296	1.27841	-13.554	-5.967
Household head characteristics					
Gender	131775	0.8706887	0.33555	0	1
Age	131757	46.59258	16.0858	10	106
Years of schooling	131589	3.44639	2.95841	1	16
Dummy (employer=1)	115555	0.0461598	0.20983	0	1
Dummy (employee=1)	115555	0.4219116	0.49387	0	1
Dummy (self-employed=1)	115555	0.4730648	0.49928	0	1
Income	128465	417.0069	833.528	0.000	43032.780
Spouse characteristics					
Dummy (spouse is present =1)	131775	0.7849972	0.41083	0	1
Gender	103443	0.013727	0.16513	0	1
Age	103429	39.84355	14.4284	11	98
Years of schooling	103179	4.053121	3.06749	1	16
Income	103111	83.39452	277.456	0	22258
Number of household members	131775	4.140178	2.1597	1	24
Number of members above 60 years old	131775	0.3645987	0.65412	0	6
Number of members under 10 years old	131775	1.073899	1.29223	0	10

Household characteristics					
Per capita income	127691	174.228	348.246	0	16749
Dummy (lives on own land=1)	92928	0.8836949	0.32059	0	1
Dummy (access to piped water=1)	131274	0.472226	0.49923	0	1
Dummy (house with bathroom=1)	131271	0.6342223	0.48165	0	1
Dummy (access to electricity=1)	131267	0.6907905	0.46217	0	1
Dummy (has water filter=1)	131265	0.4307774	0.49519	0	1
Dummy (has colour TV=1)	131271	0.3636523	0.48105	0	1
Dummy (has refrigerator=1)	131255	0.4637538	0.49869	0	1

Source: IBGE, National Household Surveys (PNAD) (various).

Table 5: Distribution of household landholdings

Year	% households with landholdings	Centiles								
		1%	5%	10%	25%	50%	75%	90%	95%	99%
1992	44.2	0.3	0.6	1.0	2.0	7.3	24.2	68.0	137.9	565.0
1993	42.7	0.3	0.7	1.0	2.1	7.3	24.2	62.9	121.0	484.0
1995	42.7	0.3	0.6	0.9	2.0	6.1	24.0	62.0	121.0	615.0
1996	39.6	0.2	0.6	0.9	2.0	6.0	21.8	67.0	121.0	470.0
1997	40.4	0.3	0.6	0.9	2.0	6.1	22.0	60.5	120.0	426.6
1998	38.4	0.3	0.6	0.9	2.0	6.1	23.0	60.0	106.5	366.0
1999	39.2	0.3	0.6	1.0	2.0	6.0	20.0	58.1	111.3	423.5
2001	42.0	0.1	0.6	1.0	2.0	7.0	24.2	62.0	120.0	484.0
2002	42.2	0.2	0.6	1.0	2.0	7.0	24.2	60.0	106.5	380.0

Source: IBGE, National Household Surveys (PNAD) (various).

Table 5 presents the evolution of the percentage of households with landholdings and the land distribution of the households with positive area. There is no clear trend neither in the proportion of landowner households nor in landholding distribution. Table 6 reports the evolution of the per capita household income for the period under analysis. The only clear pattern depicted in Table 6 is that income inequality is lower when we restrict the income distribution to the households with land.

Table 6: Distribution of the per capita household income

Year	All households					Only households with landholdings				
	25%	50%	75%	90%	95%	25%	50%	75%	90%	95%
1992	40	84	172	314	457	42	87	169	278	402
1993	40	89	194	373	599	43	92	183	304	474
1995	46	93	185	348	522	54	104	186	328	491
1996	46	98	194	356	531	53	104	184	338	516
1997	45	93	185	346	544	53	104	180	341	498
1998	46	93	187	331	501	58	108	187	345	514
1999	49	98	190	339	516	57	109	188	344	514
2001	48	103	215	367	574	54	107	207	337	478
2002	50	100	200	330	480	55	103	200	320	455

Source: IBGE, National Household Surveys (PNAD) (various).

5 Wealth and land

This section assesses the relationship between land and wealth indicators in Brazil. Since there is no information on personal assets, the focus is restricted to an approximation of the household wealth. This approximation is comprised by three components. The first component is the per capita household income. Under imperfect credit markets, household's expected income is an increasing function of wealth (Banerjee and Newman 1993; Galor and Zeira 1993). Thus, information on the total household income reflects, to some extent, information on family wealth. The first column of Table 7 presents a regression of the logarithm of household landholdings on the logarithm of per capita income. The estimated coefficient suggests a very tight relationship between income and land, statistically significant at 1 per cent. In the next two columns, Table 7 shows the relationship between land and other components of household wealth. The second wealth component is consisted by durable goods: water filter, colour TV and refrigerator. And the third wealth component on which there is information in the PNAD survey is related to the value of the houses and, in particular, to the housing infrastructure. The underlying assumption of this exercise is that wealthier families lives in better equipped houses, both in terms of durable goods and in terms of infrastructure.

Table 7: The relationship between wealth indicators and landholding

Dependent variable: log (area of the household landholdings)				
	(1)	(2)	(3)	(4)
log(per capita income)	0.569*** (0.007)	0.460*** (0.008)	0.400*** (0.008)	0.317*** (0.012)
Dummy (has water filter=1)		0.293*** (0.015)	0.270*** (0.015)	0.165*** (0.015)
Dummy (has colour TV=1)		0.067*** (0.020)	0.095*** (0.019)	-0.021 (0.020)
Dummy (has refrigerator=1)		0.462*** (0.018)	0.422*** (0.022)	0.244*** (0.023)
Dummy (access to piped water=1)			0.508*** (0.021)	0.402*** (0.022)
Dummy (house with bathroom=1)			0.299*** (0.019)	0.212*** (0.020)
Dummy (access to electricity=1)			-0.620*** (0.020)	-0.570*** (0.021)
Household head characteristics	No	No	No	Yes
Spouse characteristics	No	No	No	Yes
Household characteristics	No	No	No	Yes
Constant	8.879*** (0.037)	9.070*** (0.038)	9.319*** (0.038)	7.409*** (0.217)
Year dummies	Yes	Yes	Yes	Yes
Observations	48957	48860	48859	40860
R-squared	0.13	0.16	0.19	0.26

Notes: Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Source: IBGE, National Household Surveys (PNAD) (various).

Column (2) of Table 7 reports that the presence of all durable goods are highly correlated with land. Moreover, when information on durable goods are incorporated in the regression, the coefficient of income is reduced from 0.569 to 0.460. This is evidence that income in column (1) reflects part of the household wealth which is incorporated in column (2). The same seems to occur with the introduction of the information about infrastructure in column (3). The only exception is access to electricity, which has a statistically significant and negative coefficient. The results might reflect the fact that households with larger tracts of land are located in more isolated areas. In this case, access to electricity is more related to urbanization than to wealth. Finally in column (4), all available information about the characteristics of the household, head and spouse are introduced in the regression to control for observed heterogeneity. Even after controlling for all these characteristics, land remains highly correlated to the three wealth components: per capita income, durable goods and

house's infrastructure. Thus, the following analysis about the land distribution can be also interpreted as a study of the wealth distribution in Brazil.

6 Land reform and land ownership

This section estimates the impact of land reform on the fraction of the rural households with landholdings, through household-level data. The sample comprises all surveyed rural households, whether they hold a positive amount of land or not, for the period from 1992 to 2002. Households are pooled across years, i.e., households of different periods are considered as different households. The results are estimated considering the following linear probability model⁶:

$$\Pr\{L_i > 0 \mid D_i, X_i\} = \alpha \cdot I\{D_i > 0\} + \gamma \cdot \log(D_i) \cdot I\{D_i > 0\} + \beta'X_i, \quad (1)$$

where L_i stands for the total area owned by household i , $I\{D_i > 0\}$ is a binary variable indicating whether or not there is disappropriation until the previous year in the State where household i lives, $\log(D_i) \cdot I\{D_i > 0\}$ is the logarithm of the disappropriated area per rural household in State with positive disappropriation until the previous year, and X_i is a vector of control variables including household head characteristics, spouse characteristics, household characteristics and year dummies.

Under the assumption that, given the observed characteristics, the disappropriation until the previous year is not correlated with the unobserved determinants of landholding, parameters α and γ measure the effect of land reform on the fraction of rural households with landholdings. Manipulating (1) it is possible to show that:

$$\alpha = \Pr\{L_i > 0 \mid D_i > 0, X_i\} - \Pr\{L_i > 0 \mid D_i = 0, X_i\} \quad (2)$$

and

$$\gamma = \frac{d \Pr\{L_i > 0 \mid D_i > 0, X_i\}}{d \log(D_i)} = \frac{d \Pr\{L_i > 0 \mid D_i > 0, X_i\}}{\frac{dD_i}{D_i}}. \quad (3)$$

Thus, the parameter α measures the effect of the first disappropriated hectare per rural household on the fraction of rural families with landholding, and the parameter γ represents the effect of 1 per cent change in the disappropriated area per rural household on land ownership. Results from the estimation of Equation (1) are presented in Table 8, considering nested specifications for the vector of control variables. In column (1), which control only for the year dummies, the existence land disappropriation in the previous year has an effect of 31.7 percentage points on the fraction of households with land. The effect of 1 per cent of variation in the disappropriated area per rural household

⁶ For ease of notation, it is considered $\log(0) \cdot 0 = 0$ in the interpretation of Equation (1).

Table 8: Effect of land reform on the fraction of the rural population with landholdings

Dependent variable: Dummy variable indicating whether the household own land

			Decomposition of the effect with respect to:		
	Without controls (1)	With controls (2)	income (3)	age (4)	schooling (5)
Dummy (positive disappropriation until the previous year=1)	0.317*** (0.013)	0.01 (0.014)	0.135*** (0.024)	0.089*** (0.030)	0.077*** (0.020)
Dummy (positive disappropriation) x dummy (2nd quintile)			-0.104*** (0.034)	-0.076* (0.040)	-0.043 (0.030)
Dummy (positive disappropriation) x dummy (3rd quintile)			-0.135*** (0.037)	-0.057 (0.040)	-0.141*** (0.029)
Dummy (positive disappropriation) x dummy (4th quintile)			-0.243*** (0.039)	-0.117*** (0.039)	
Dummy (positive disappropriation) x dummy (5th quintile)			-0.173*** (0.038)	-0.178*** (0.041)	
log(disappropriated area per rural household)	0.031*** (0.001)	0.002 (0.001)	0.013*** (0.002)	0.011*** (0.003)	0.007*** (0.002)
log(disappropriated area per rural household) x dummy (2nd quintile)			-0.010*** (0.003)	-0.009** (0.004)	-0.002 (0.003)
log(disappropriated area per rural household) x dummy (3rd quintile)			-0.011*** (0.004)	-0.007* (0.004)	-0.012*** (0.003)
log(disappropriated area per rural household) x dummy (4th quintile)			-0.022*** (0.004)	-0.013*** (0.004)	

log(disappropriated area per rural household) x dummy (5th quintile)			-0.014*** (0.004)	-0.020*** (0.004)	
Household head, spouse and household characteristics	No	Yes	Yes	Yes	Yes
Constant	0.407*** (0.003)	-0.063*** (0.011)	-0.055*** (0.012)	-0.041*** (0.015)	-0.083*** (0.012)
Year dummies	Yes	Yes	Yes	Yes	Yes
Observations	131775	63562	63562	63562	63562
R-squared	0.00	0.59	0.60	0.59	0.59

Notes: Terciles rather than quintiles were considered for the case of years of schooling due to the large proportion of heads with 1 year of schooling or less. Robust standard errors in parentheses. *significant at 10%; **significant at 5%; ***significant at 1%.

Source: IBGE, National Household Surveys (PNAD) (various).

increases landholding in 3.1 percentage points. However, when the full set of control variables are introduced, column (2) shows that the effect vanishes. Thus, on average, results from columns (1) and (2) of the Table 8 suggest that land reform does not increase the proportion of rural families with landholdings. On the one hand, these results might be true in the sense that Brazilian experience with land reform does not increase the access to land. On the other hand, the estimated zero effect might be the result of countervailing effects. As shown in Section 2, the Brazilian land reform programme consists on redistributive transfers from large landowners to small farmers and landless peasants. Unimproved and large tracts of land are under the risk of expropriation, while small and productive farms cannot be taken. Consequently, the process by itself has differentiated effects on the rural households.

In order to investigate possible differentiated effects, Table 8 presents estimates of Equation (1) in which the parameters α and γ are decomposed according to the household per capita income, age and years of schooling of the household head. For the cases of income and age, the sample was divided into quintiles and, for the case of schooling, it was considered terciles, due to the large number of heads with 1 year of schooling or less. The results reported in columns (3) to (5) suggest that the absence of the effect estimated in column (2) is the result of heterogeneity, related to income and education. Land reform increases the access to land of low income households and those with less educated head, considering both the occurrence of land reform (α) and its intensity (γ).

Land disappropriation increases in 13.5 percentage points the fraction of the rural families with landholding, in the first quintile of the per capita income distribution, as depicted in column (3) of Table 8. To all other groups of income, the effect is substantially lower or even negative. The effect of the intensity of the land reform, which is measured by the disappropriated area per rural household, is also positive and statistically significant to low income households. A similar pattern is presented for the educational level of the household head in column (5). Only the lowest tercile, which corresponds to the household head with 1 year of schooling or less, is affected positively by the land reform.

7 Land reform and land distribution

The previous section investigates the effect of land reform on land ownership. Here, the analysis is restricted to landowner households, aiming at estimating the effect of the land reform on the land distribution. It is not possible to assert, a priori, whether a redistributive land reform in the way were implemented in Brazil increases or reduces the average landholding size. It depends on the relationship between the holdings affected and not affected by the reform. If the farm size of the beneficiaries is smaller than the average non-affected farm, land reform tend to reduce the typical farm size. On

the other hand, if the confiscated farms are not the largest, it is possible to have an increase on the average post-reform landholdings.

The empirical analysis which follows is presented in two steps. First, it is considered the effect on the average farm size. Then, quantile regressions are used to investigate the effect of the land reform on each decile of the land distribution. The first set of results considers the following linear specification⁷ focusing on the average landholding size:

$$E(\log(L_i) | D_i, X_i) = \phi \cdot I\{D_i > 0\} + \lambda \cdot \log(D_i) \cdot I\{D_i > 0\} + \delta X_i. \quad (4)$$

Again, if the disappropriation until the previous year is not correlated with the unobserved determinants of landholding size, conditional on the observed variables X_i , the parameters ϕ and λ measure the effect of land reform on the fraction of rural households with landholdings. Simple computations with (1) show that:

$$\phi = E(\log(L_i^{D=1}) - \log(L_i^{D=0}) | X_i) \approx E\left(\frac{L_i^{D=1} - L_i^{D=0}}{L_i^{D=0}} \mid X_i\right) \quad (5)$$

and

$$\lambda = \frac{dE(\log(L_i) | D_i > 0, X_i)}{d \log(D_i)} = E\left(\frac{\frac{dL_i}{L_i}}{\frac{dD_i}{D_i}} \mid D_i > 0, X_i\right). \quad (6)$$

Thus, the parameter ϕ represents the percent change of the first disappropriated hectare per rural household on the size of the landholdings. The parameter λ is the elasticity of the size of the landholdings with respect to the disappropriated area per rural household, for those States with positive disappropriation.

Panel (i) of the Table 9 shows the estimates of Equation (4), considering different sets of control variables and decompositions. Column (1) suggests that land reform reduces the average farm size. However, controlling for all observed characteristics, the effect becomes positive. The first disappropriated hectare per household has an impact of increasing in 57.3 per cent the average farm size. It is important to keep in mind that the average of this variable in the sample, according to Table 4, is substantially smaller than 1. Similarly to the analysis of land ownership, column (3) shows that land reform has differentiated effects with respect to the household per capita income. There is a reduction on the average farm size of the 20 per cent poorest households and an increase in landholdings of the others. The decomposition in terms of age does not present a clear pattern, while there is also some heterogeneity with respect to the head's schooling.

⁷As in the previous section, it is assumed that $\log(0) \cdot 0 = 0$ in the interpretation of Equation (4) for the sake of simplification.

Table 9: Effect of land reform on the size of landholdings

Dependent variable: log(Area of the household landholdings)

Panel (i): OLS estimates

	Without controls	With controls	Decomposition of the effect with respect to:		
	(1)	(2)	income (3)	age (4)	schooling (5)
Dummy (positive disappropriation until the previous year=1)	-0.300*** (0.077)	0.573*** (0.082)	-0.458*** (0.143)	0.192 (0.198)	0.071 (0.125)
Dummy (positive disappropriation) x dummy (2nd quintile)			0.876*** (0.207)	0.314 (0.252)	0.482*** (0.186)
Dummy (positive disappropriation) x dummy (3rd quintile)			1.171*** (0.226)	0.397 (0.243)	1.175*** (0.174)
Dummy (positive disappropriation) x dummy (4th quintile)			1.464*** (0.233)	0.597** (0.245)	
Dummy (positive disappropriation) x dummy (5th quintile)			2.118*** (0.221)	0.452 (0.285)	
log(disappropriated area per rural household)	-0.002 (0.007)	0.075*** (0.008)	-0.029** (0.014)	0.033* (0.019)	0.028** (0.012)
log(disappropriated area per rural household) x Dummy (2nd quintile)			0.099*** (0.020)	0.031 (0.025)	0.047** (0.018)
log(disappropriated area per rural household) x dummy (3rd quintile)			0.123*** (0.022)	0.049** (0.024)	0.113*** (0.017)

log(disappropriated area per rural household) x dummy (4th quintile)			0.147*** (0.023)	0.068*** (0.024)	
log(disappropriated area per rural household) x dummy (5th quintile)			0.201*** (0.021)	0.044 (0.028)	
Household head, spouse and household characteristics	no	yes	yes	yes	yes
Constant	11.389*** (0.016)	8.424*** (0.197)	8.286*** (0.200)	8.484*** (0.209)	8.466*** (0.200)
Year dummies	yes	yes	yes	yes	yes
Observations	52031	35652	35652	35652	35652
R-squared	0.00	0.27	0.29	0.27	0.28

Panel (ii): Quantile regressions

	10%	30%	50%	70%	90%
Dummy (positive disappropriation until the previous year=1)	-0.585*** (0.099)	-0.649*** (0.088)	0.071 (0.085)	1.132*** (0.106)	1.663*** (0.120)
log(disappropriated area per rural household)	-0.034*** (0.009)	-0.041*** (0.008)	0.028*** (0.008)	0.126*** (0.010)	0.174*** (0.011)
Household head, spouse and household characteristics	yes	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes	yes
Observations	35652	35652	35652	35652	35652

Notes: Terciles rather than quintiles were considered for the case of years of schooling due to the large proportion of heads with 1 year of schooling or less. Robust standard errors in parentheses. *significant at 10%; **significant at 5%; ***significant at 1%.

Source: IBGE, National Household Surveys (PNAD) (various).

Figure 4: Quantile estimates of the effect of land reform on the size of landholdings

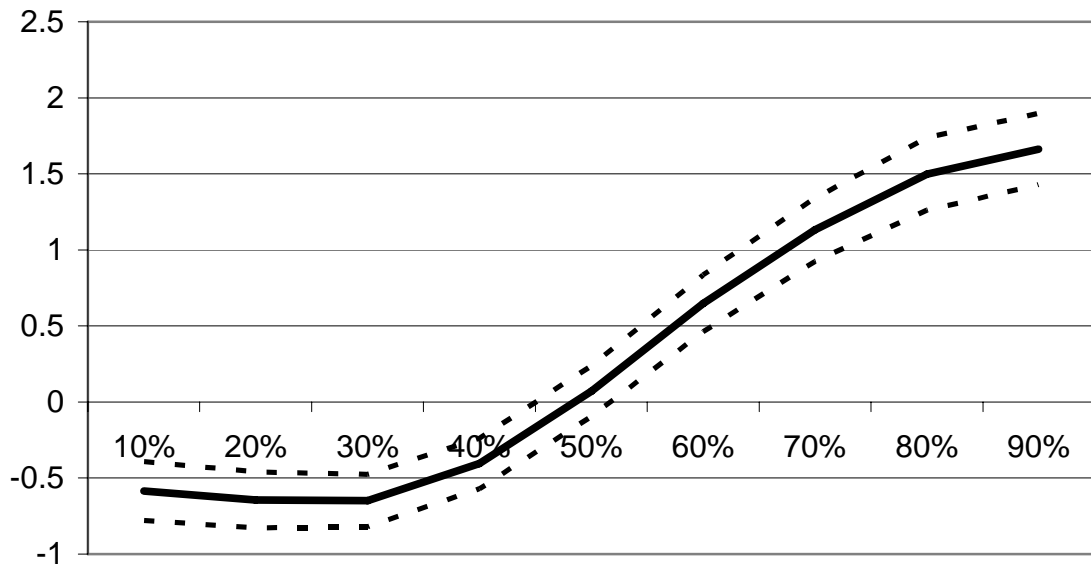
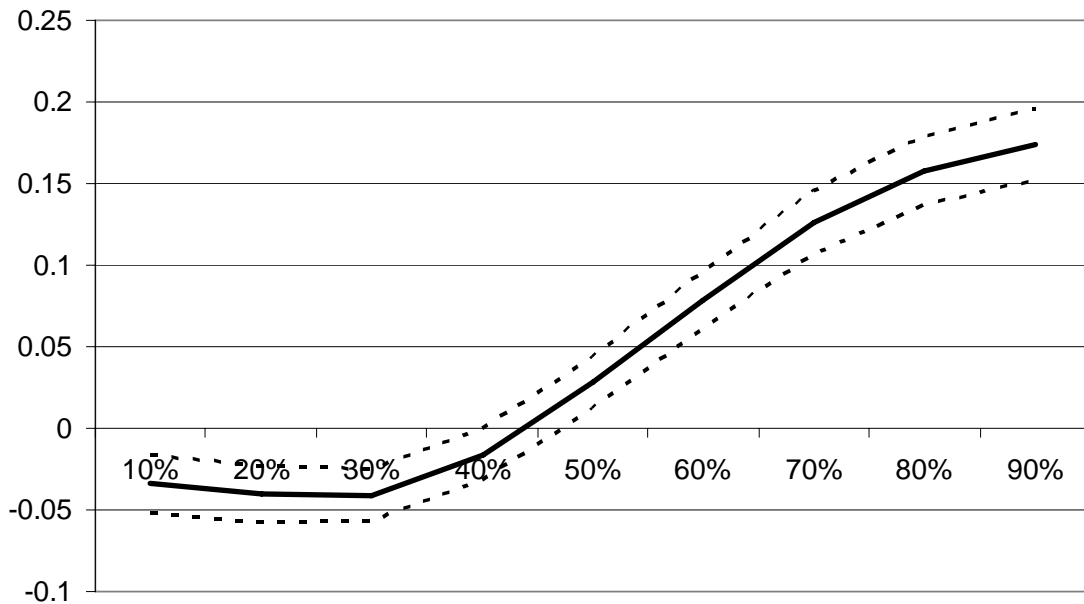


Figure 5: Quantile estimates of the effect of the disappropriated area on the size of landholdings



Thus, this first set of results suggest that land reform has increased the average size of the landholdings, but this effect is not homogeneous with respect to the household per capita income—poorer households experienced a reduction while richer households experienced an increase on the average farm size. Comparing these results with those of Section 4, in which land is highly correlated with income, Table 9 indicates that land reform increases the inequality in the distribution of land. In order to address this question in a more systematic way, quantile regressions are estimated. The specification

presented in Equation (4) is estimated to each decile of the land distribution. Results for 10, 30, 50, 70 and 90 percentiles are depicted in panel (ii) of Table 9, and the coefficients ϕ and λ are plotted in Figures 4 and 5, respectively.

The results suggest that Brazilian land reform have, surprisingly, increased the inequality of the land distribution. Land reform has negative effects on holdings with size below the median and positive effects on holdings above the median of the land distribution.

8 Conclusion

Throughout the Brazil's history, wealth is highly associated with land ownership. In this sense, this study looks at the recent Brazilian experience with redistributive land reform in order to shed light on its effect on the distribution of wealth in rural areas. After presenting the historical determinants of land concentration and the institutional background to the land reform in Brazil, the study evaluates the impact of land disappropriation on land ownership and land distribution.

Two main conclusions arise from the investigation of the impact of land disappropriations on the fraction of the rural families with landholdings. First, land reform does not increase land ownership in rural areas, at least from an aggregate perspective. Second, the decomposition of this impact according to household income and education of the household head reveals important differences. There is an increase in landownership among the poorest households and those for which the head has no more than one year of schooling. For all other household classes there is a reduction in the percentage of landowners. Thus, considering the whole rural population, land reform points towards a less unequal distribution of assets, since it increases land ownership among poor households and reduces land ownership among rich households.

Interestingly, the analysis of the effect of land reform on the distribution of land among landowner households suggests the opposite. Both the quantile regressions and the decomposition of the impact according to income indicate an increase in the inequality of the holdings. Land reform reduces the size of the holdings of poor families and those with smaller tracts of land. Concomitantly, it increases the farm size of rich families and those with larger holdings.

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