TO WHOM SHALL I LEAVE IT? LAND INHERITANCE IN THE BRAZILIAN AMAZON

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1. Introduction

Why do family members get involved in transfers? More specifically, how parents decide to whom they will leave their assets (e.g. land, wealth)? Love and altruism, on one side, and exchange and reciprocity, on the other side, are the main socioeconomic explanations for parental behavior regarding the distribution of family resources. This paper investigates how parents distribute land among their children and what are the motivations involved, studying a traditional setting in the Brazilian Amazon.

The distribution of land in a traditional society is of extremely relevance because it affects the distribution and concentration of wealth (Baker & Miceli, 2005). The traditional models assume wealth distribution as given and they are not concerned on how the transfers were made (Menchik, 1980). Recent evidence for the United States, however, suggests that parents tend to transfer different amounts of wealth and assets among their children (Light & McGarry, 2003). In a traditional setting, such as our study area, it is of great relevance to understand what drives parent's intentions in passing on their property.

There are three competing motives for why parents transfer different resources for different children: altruism, exchange and evolutionary. The altruism model (Becker, 1974) assumes that an unselfish individual has its utility function directly affected by his own consumption level and by the well-being of others around him. The altruist individual can adjust her behavior if one of her close relatives suffers any change in their well-being. The model indicates that parents would like to equalize utility level across all children, making the largest transfer to the least well-off child. Moreover, if the altruism is operative, it should lead to Ricardian equivalence, crowding out the effect of public transfers (Barro, 1974).

The exchange motive (Bernheim, Shleifer & Summer, 1985 and Cox, 1987) assumes that parents make transfers as re-payments for services provided by their children at some point. The model indicates that the child who helped the parents

more often (with household chores, companionship, agricultural tasks and other) would receive the largest fraction of the transfer.

Cox (2008) suggests that parents make transfers to the child that has the better chances to guarantee the survival of the family genes. That is, to the child that has already kids or to the one they believe has more chances to reproduce. Following this argument, Hyrd & Judge (1993) argue that parents invest different resources among their children to maintain the productive capacity of their land. The authors suggest that parents may prefer to leave the largest amount of land to their first child because he/she can maximize the investment in human capital and guarantee the productive capacity of their farm.

The motives for private transfers have regain interest in recent years and a series of theoretical models were developed to understand the observed patterns (Becker, 1974; Bernheim *et. al*., 1985; McGarry, 1999; Stark & Zhang, 2002; Baker & Miceli, 2005). Despite these developments, there are few empirical papers testing the models because of the lack of quality data (Bernheim *et. al*., 1985; Cox and Rank, 1992; Schoeni, 1997), and the few ones are mostly concentrated in developed countries (VanWey & Nellson, 2007; Arrondel & Masson, 2006). Although private transfers play an important role in developing countries where a social welfare system is not yet in place and where families play an important role in financing consumption during the life cycle, little is known about it in Latin America (De Vos, 1987) and, specially, in Brazil (Saad, 1998; Carneiro, 2001; Cebulko, 2006).

In this paper, we contribute to this literature studying a traditional setting and using a novel data from the *Amazon Deforestation and the Structure of Household (*University of Indiana at Bloomington) survey. The data refer to the population living mainly in rural parts of the Brazilian Amazon (for more details see VanWey *et al.*, 2007). The data were collected in 1997/1998 and 2005 and contain longitudinal information on a series of socio-demographic and land use variables, including family transfers and land division plans and expectations. We believe that this rich dataset and the location of the families provide a unique opportunity to understand donor-reported explanations on transfers in a traditional economic and social

setting. We investigated households located in a frontier area, isolated from large urban centers and with less state and market intervention than other areas in the country. In this setting, the family is the primary provider of goods and services.

2. Literature Review

2.1 Background

The human life cycle is characterized by two phases of economic dependency, youth and old age. The transfers made during the economic surplus phase finance the consumption during the dependency periods. There are two main areas that study intergenerational transfers: intergenerational accounting (macro level) and private motives (micro level). Macro level models investigate how economic independent age groups transfer part of their wealth to dependent groups. Those models estimate direction and volume of transfers in a society by mechanism (state, family and market) and what is the relative weight of each institution in the allocation of wealth amongst society members (Cain, 1977; Caldwell, 1976; Lee, 1994; 2003).

Micro level studies focus on the motives and determinants of transfers between family members. Family (or private) transfers are relevant for a series of reasons. In the first place, they act as a way to improve well-being levels among individuals. Second, private transfers can affect public policies outcomes (Barro, 1974) depending on agent's motives (Cox & Jakubson, 1995). Third, private transfers are considered one of the main determinants of fertility behavior in the family (Caldwell, 1976). In fourth place, family transfers can rise or reduce inequality levels among family members. For example, parents can transfer more resources to one child to compensate for different levels of human capital investments across offspring (Becker & Tomes, 1979; Tomes, 1981). In fifth place, private transfers can finance the setting of young household in the absence or limited credit market (Foster & Rosenzweig, 2001). In sixth, family transfers affect saving ratio and wealth accumulation (Modigliani, 1988; Gale & Scholz, 1994), relating part of the origin of people's wealth to bequests (Kotlikoff & Summers,

1981). At last, the private transfers can influence the morbid-morbidity rates (Mendes de Leon *et al*., 1999).

2.2 Motives for Private Transfers

The effects of private transfers on one's well-being and their relations to the public transfers are directly linked to the motives of private transfers. In general, there are four main motives for familial transfers: altruism (Becker, 1974); exchange motive (Cox, 1987); evolutionary (Cox, forthcoming) and reciprocity (Arrondel & Masson, 2006; Gouldner, 1960). In this section, we describe briefly each one of these models and discuss their advantages and disadvantages.

The altruism model (Becker, 1974) assumes that an unselfish individual has its utility function directly affected by his own consumption level and by the well-being of other around him. The altruist individual can adjust her behavior if one of her close relatives suffers any change in their well-being. The model indicates that parents would like to equalize utility level across all children, making the largest transfer to the least well-off child.

Under the traditional altruistic models, child's income must be negatively related to downward transfers. McGarry's model (1999) indicates that the relation depends on the kind of transfer. *Inter vivos* transfers should be negatively associated to child's current income because low-income children are considered to be liquidity constrained. Bequests, on the other hand, hold weak (positive in families who make *inter vivos* transfers) or no (families making no *inter vivos* transfers) relationship with child's current income. According to McGarry, through an updating mechanism, current income informs less about child's permanent income as far as the father approaches to die and pass on the wealth. This permanent income is the key determinant of bequest, according to this altruistic model.

The exchange motive (Bernheim, Shleifer & Summer, 1985 and Cox, 1988) assumes that parents make transfers as re-payments for services provided by their children at some point. The model indicates that the child who helped the parents

more often (with household chores, companionship, agricultural tasks and other) would receive the largest fraction of the transfer.

There is a new field of models based on evolutionary theories. For example, Lee (2003b) and Kaplan (1994) argue that the force of mortality (natural selection) is closely related to reproductive value in each age and also to the level of intergenerational transfers that are made during the life cycle, including post reproductive ages. Following Lee and Kaplan, one's reproductive capacity and longevity are affected by the transfers of resources and knowledge from older to young generations. Cox (2008) suggests that parents make transfers to the child that has the better chances to guarantee the survival of the family genes. That is, to the child that has already kids or to the one they believe has more chances to reproduce and perpetuate the family genes.

The reciprocity perspective introduces a way to explain transmission behavior in three-generational models as well as an alternative view on the equal division puzzle. In anthropology, reciprocity is understood as one of the main principles of exchange, and it is the mechanism that drives exchange between individuals in the same group (Gouldner, 1960). The reciprocity perspective indicates that individuals respond to other's actions (good or bad) even when no material gain is involved. Reciprocity should not be confounded with altruism; while the former is a form of unconditional kindness the latter involves, normally, in-kind response to someone's act. Arrondel & Masson (2006) define reciprocity as a chain of gifts in a full system of obligations.

2.3 Land Inheritance Motives

The distribution of land in a traditional society is of extremely relevance because it affects the distribution and concentration of wealth among its members (Baker & Miceli, 2005). The traditional models assume the distribution of wealth as given and did not worry about how transfers were made (Menchik, 1980). Recent evidence for the United States, however, suggests that parents tend to transfer different amounts of wealth and assets among their children (Light & McGarry, 2003).

In general, rules governing land inheritance among offspring are affected by ecological conditions (Hrdy & Judge, 1993). In other words, land transfers from parents to children will be affected by families' permanent wealth, by the quality of the land and by the role land plays in the family economic conditions. They argue that the evolution of the family and economic modernization, what they call ecological conditions, affect parental decision on how transfers are made.

Baker & Miceli (2005) argue that in the absence of a formal real estate market, fixed rules for land division are more efficient than following alternative motives. They are more efficient because the person who is going to inherit knows what her future wealth will be and can maximize her investment in human capital. For example, if the family decides to leave the largest amount of land to the eldest son (primogeniture) she can invest in agricultural training and this can boost productivity in the present and near future. Furthermore, fixed rule behavior reduces competition among siblings that could affect family's maximization behavior.

However, the existence of a formal market for land undermines the fixed rule behavior because the beneficiary of the transfer could sell the land if this would give a greater return than keeping it (Baker & Miceli, 2005). In this case, the idea of maintaining the farm unit would not exist and parents' behavior regarding resource allocation would be affected. This behavior is also affected by ecological conditions (Hyrd & Judge, 1993) as far as more productive land can induce agents to have a different behavior in the presence and absence of a formal real estate market.

In our study area, there is some evidence of a formal real estate market. VanWey, D'Antona & Guedes (2008) suggests a level of change in land ownership due to selling and buying practices which can affect parent's behavior[1]. In addition to that, land quality varies a lot across our study area. Older farmers own land of better quality and closer to a main road whereas new farmers are pushed to worse quality land, which implies differences in land accessibility and soil quality. Carneiro (2001), studying two farmer colonies in Brazil, showed that different

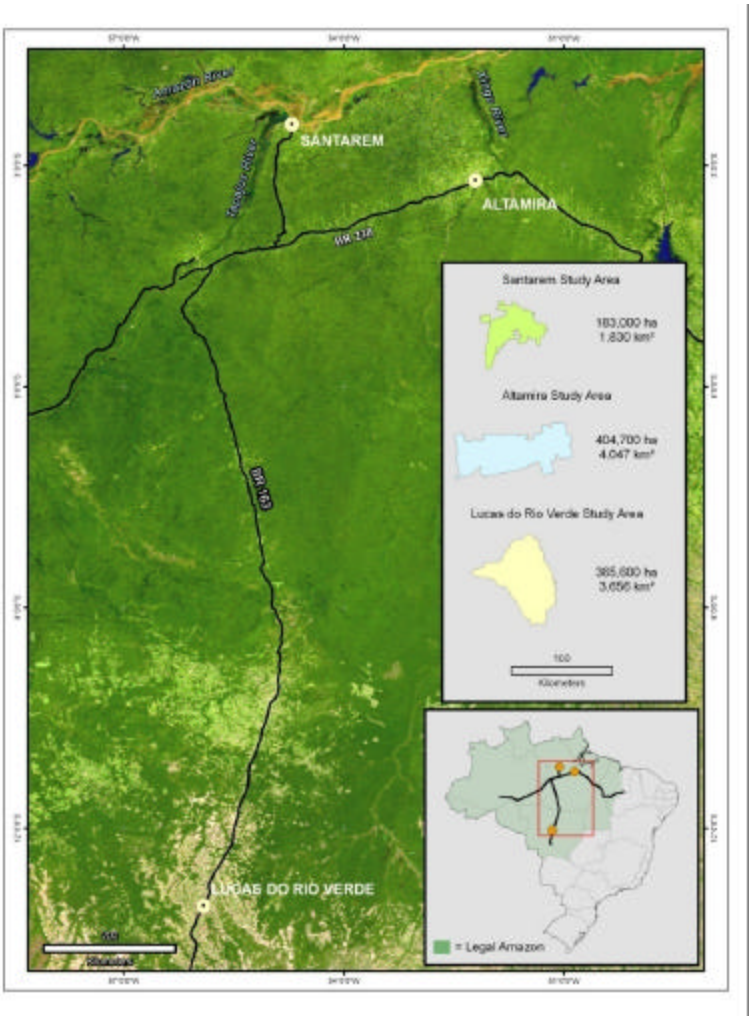
[1] We decided not to include the migration/land turnover variable between 1997/1998 and 2005 in our models because of endogeneity between transfer behavior/intention and moving/selling practices over time.

productive capacity has direct impact on the rules governing resource allocation. Farmers in less productive areas follow equal division of land, whereas those in more productive areas follow a fixed rule behavior.

3. Data

We make extensive use of the *Amazonian Deforestation and the Structure of Households* dataset. The research was conducted by the Department of Anthropology at the University of Indiana at Bloomington. The survey covers three areas in the Brazilian Amazon: Santarém, Altamira e Lucas do Rio Verde (see figure 1).

Figure 1: Three study sites of the project "Amazonian Deforestation and the Structure of Households"



Source: ACT (2008).

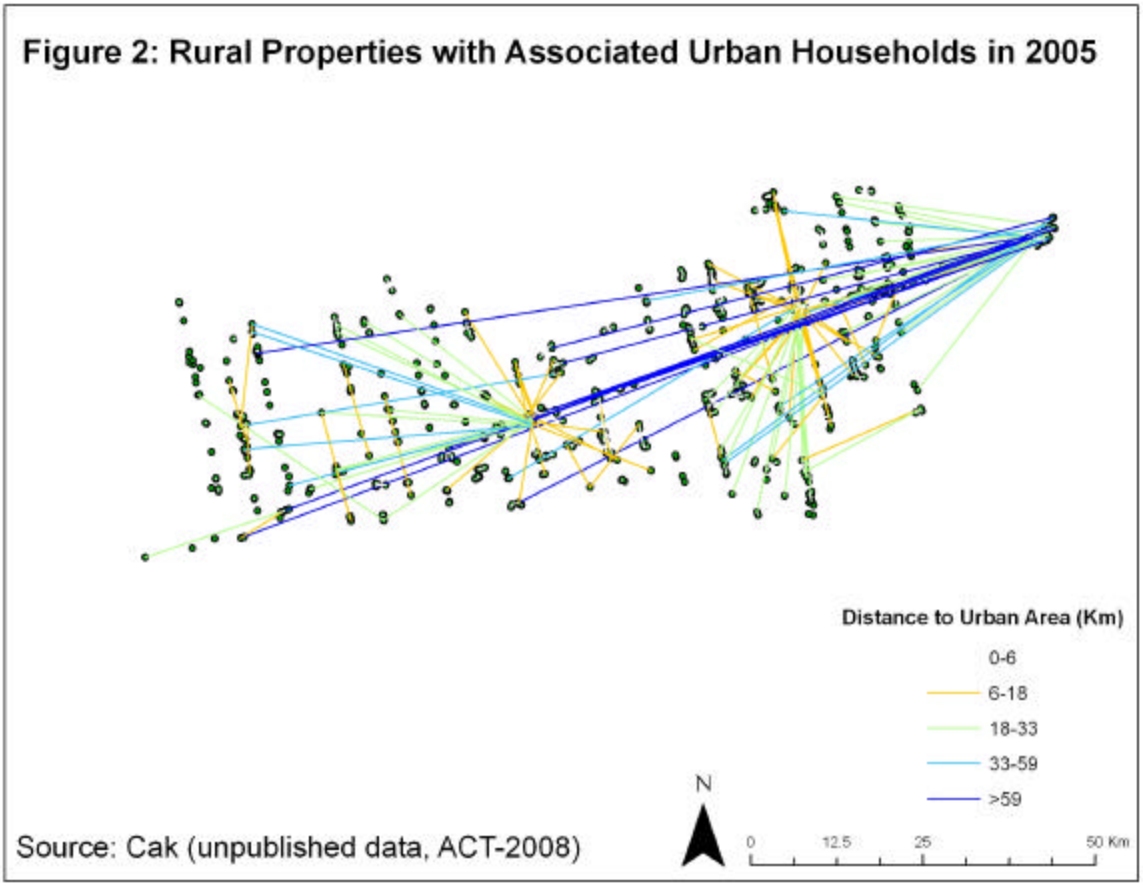
In this paper, we focus on the rural area of Altamira[2], which covers 404.700 hectares. The region is situated in the middle of the Legal Brazilian Amazon and is located 740Km away from Belém, the state capital, and is crossed by the Xingu River from north to south.

The rural area under study has some important characteristics that shall be stressed. Differently from Santarém, the rural area of Altamira is a more recent settlement frontier area. The Brazilian Government, through its National Institute of Colonization and Agrarian Reform (INCRA, in Portuguese), established a grid of small farm units (about 100 hectares) along the Transamazônica Highway. All the properties have their front to a road (called *Travessão*), or to the Transamazônica Highway (VanWey, D'Antona & Brondizio, 2007). The small size units were designed to incentivize family agriculture and small scale cattle ranching.

Altamira region is characterized as an area of high-fertility soil, known as *terra roxa*. Cacao production and cattle ranching are the main activities developed by the farmers. Despite being a successful example of agrarian settlement in Brazil, the area is under influence of market forces, such as large farmers buying small parcels of land and persistent high interest rates for credit (VanWey, Ostrom & Meretsky, 2005). Moreover, the commodities price declined in recent years, mainly because of the increase in the supply of soybeans and related by-products. Many international restrictions to Brazilian meat also contributed to worsen the agricultural/cattle ranching sector in Pará. As a result, families are adopting some strategies to minimize risk. For example, some farmers moved to the urban area or sent their children to study in the city. This spatial diversification reduces the intra-family variance of income, allowing farmers to better deal with agricultural price oscillation and shortage of production due to climatic factors. Figure 2 shows households with urban-rural linkage in the Altamira region study area in 2005[3].

[2] Some farmers moved to urban areas of Altamira, Brasil Novo, Medicilândia, Uruará or another location out of the study area. Others have died. For the ones still alive, it was applied the interview in the urban area of Altamira, Brasil Novo and Medicilândia. Some of them moved after selling the original lot, others held the ownership after moving (VanWey, D'Antona & Guedes, 2008).

[3] In order to de-identify the sampled properties, all the geographical coordinates, roads and grids were dropped.

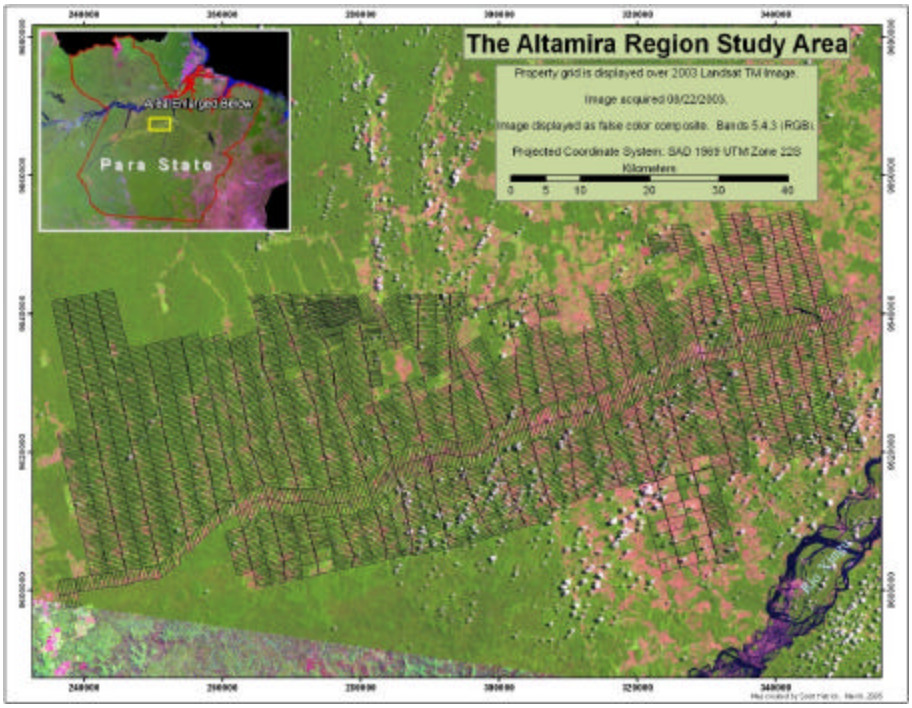


The data in Altamira region study area were first collected in 1997/1998 and a follow-up survey happened in 2005. In the first wave, 402 households in different pieces of land were sampled (see figure 3). The survey interviewed the head of the household, the spouse and any other women in the property aged 15 and over. Males responded a socioeconomic and land use questionnaires, females (spouses or property owners) also answered the socio-demographic and every woman in the household aged 15 and over responded the reproductive history/contraceptive questionnaires.

The 2005 follow-up aimed at three groups present in the first wave: a) same couples interviewed in 1997/98[4]; b) other households located in the same piece of land sampled in the first wave and; c) children of the couples interviewed in 1997/98 who were living in the own households in 2005.

[4] Approximately half of the 402 properties were interviewed in the end of 1997 and the other half in 1998.

Figure 3: The Altamira Region Study Area



Source: ACT (2008).

4. Methods

In order to understand the farmer's behavior related to land transmission, we analyze the group of land owners in 1997/1998 who still held the property title in 2005 as well as their offspring.

In 2005, some of the original lots were divided in two or more, sold or abandoned either because they were sold or because the title was transferred the offspring's former owner. It would not be possible to use land owners in 2005 because the sample would not be representative of the farmers in the area. In addition to that, we would not be able to have longitudinal information about the new owners not interviewed in 1997/1998.

We were able to identify what the property owners intend to do with the land in the future for both waves of data (1997/1998 and 2005). However, the question about future plans for the land differentiates the gender of the recipient if he/she is an offspring were available only in 2005 dataset. Also, it is possible to know how they obtained the land (buying, inheriting, and others). For those who inherited, we

are able to indentify from whom and, in case of from parents, how much was addressed to their siblings[5].

We divided the observations in two groups: **effective bequest** (for the former owners who died between 1997/1998 and 2005 and for the ones who passed on the land over the period of analysis) and **intended bequests** (the future plan for the land reported in 2005). For the group of deceased former owners, we compare what happened with their land after death to their intentions in 1997/1998. We also did the same analysis for the children who effectively inherited the land. The effective bequest was divided in two categories: *formal* - when the former owner transfers the title to his/her offspring and *informal* - when the land use/cover decisions rely on the offspring but the title continues under the former owner's name. For the second group, we selected the former owners who were interviewed both, in 1997/1998 and 2005 and kept the title of the property.

In our analysis we use a one-dimensional space of the quantities of goods, with the latent variable being the property unit. As the property size varies across units, we introduce a standardized measure for property size in the sample. The size is measured in hectares. One hectare corresponds to 10,000 m^2. The amount of land owned by the interviewee is, then, introduced as a control variable in the models.

From the 402 farms interviewed in 1997/1998, 399 had the farm's owner as the responsible for the land. In the other 3 cases, a son was considered the owner. In 2005, 22 out of 399 former owners had died. From the 377 surviving former owners, 315 still held the property ownership, but only 301 of them where interviewed in 2005.

We developed two models to analyze the land inheritance behavior in the region. The first model corresponds to all former owners who held the property title and were interviewed in 2005. This model corresponds to the determinants of the intention to pass on the land to the offspring. 280 out of 301 owners had valid

[5] Unfortunately, the number of farmers who inherited the land in Altamira is quite small, not allowing us to use this retrospective division rule. In a forthcoming paper, we introduce Santarém study area as a cross-cultural comparison. In Santarém, owners who inherited the land are much more prevalent. This is explained by the recentness of Altamira settlement process compared to Santarém.

information about the future plan for the land in 2005. We had to drop one case because of missing observation for area of the lot in 1997/1998 and six additional cases of households with no children. The final sample used in the study had 273 valid cases.

The second model analyzes the determinants of intended unequal land division. From the 280 owners with valid information about the future plan for the land, 180 wanted to pass on it to their offspring. As a division rule is logic only in families with more than 1 child, the final sample was restricted to 161 observations We drop one unit because of missing observation of the land size in 1997/1998, eleven more because of families with less than 2 children and additional 7 cases of absence of information about children's age and education used to create intra-siblings age and schooling variance.

Altruism is observed according to parents' behavior against offspring in need. So, less well-off children are more likely to have parents intending to give them a bigger share of the property in the future. According to McGarry's model (1999), altruistic parents also consider inter-siblings differences in permanent income (educational attainment) and liquidity constrain (age). Non altruistic behavior, on the other hand, is considered here as "extended reciprocity" within the family from children's perspective, the so-called "helping behavior" in social psychology. We assume an extended reciprocity because we use a dummy variable for children helping parents with *inter-vivos* transfer and we are not testing from whom exactly the transfer comes[6]. In doing so, we are just able to say that according to the non-altruistic behavior, parents helped by any of their children are more likely to pass on the land in the future. At the same time, the more children helping their parents, the greater the chance a parent has to divide equally the land.

From parents' perspective, the gift (passing on the land) is considered, from a non-altruistic behavior, a direct reciprocity allocated over their lifetime. It is so

[6] We did not run models at child level, as McGarry (1999) because we would need to know to whom the land was intended to be passed. This is important because to run a fixed effect model at the child's level, each observation contributing to the likelihood function must be a potential recipient as far as at least one sibling is not. In our dataset, this kind of information is not available.

because they are more likely to pass on the land in the future as far as children helped them in the past. The direct reciprocity does not hold from parents' perspective in cases where any specific child is intended to inherit the land. In this study, we are not able to test the reverse reciprocity, which would be possible if we had information about parents' offspring helping each other[7].

Although we cannot observe the direct children's helping behavior within the family (among siblings), the parents' utility function is assumed to incorporate a degree of comparative fairness in contribution, conforming or comparative status in generosity and competitive giving, as discussed by Kolm (2006). The comparative fairness can be part of any social norm regarding the equal division or the enforcement of the civil code.

The social fairness can also be individually motivated (internalization process). This *learning from the outside* process can affect the utility function of the donator. Then, instead of considering the amount bequeathed, the transmission can be a signal of altruism from the parent's perspective[8].

Some studies discuss how local institutional arrangements operate in order to maintain gender differences in land transmission, despite legal restrictions to gender discrimination on inheritance (Ihromi, 1994). As showed by Carneiro (2001), the inheritance rule in some Brazilian peasant communities varies according to the region (unequal division in the south of Brazil and equal division in her study community in the Southeast).

The Brazilian civil law regarding inheritance posits that wealth must be divided equally after parent's death (Pereira, 2004). According to the Brazilian legislation only part of the wealth can be bequeathed. The disposition option relaxes the legal restriction to equally division of wealth. This is important because

[7] The data actually contain information about *inter vivos* transfers in both directions (upward and downward) within the family. However this information is only available in the 2005 wave, what introduces endogeneity bias if used in the model. We actually performed a test, introducing the downward transfers in 2005 in some models (not shown). The coefficient was negative against the probability to pass on the land, despite not statistically significant. We also split the sample for model of intended bequest in the families making or not *inter vivos* transfers. The number of cases in the equation for families transferring in life was extremely small. We run an exact logistic regression for these models, but the results did not differ from the models in table 7.

[8] Some authors discuss that the prevalence of equal division is a result of the increasing disutility with the amount transferred/bequeathed unequally (see, for example, Wilhelm, 2006).

the intention or the effective outcome is not fully enforced or determined by law. In rural areas, the land is the most likely asset to be bequeathed, once the relation of some offspring with the land (including coresidence with parents in the household or on the lot) represents investment in land-specific human capital and creates incentives for parents to divide land unequally, compensating the other children with *inter-vivos* transfers[9].

As far as we are interested in understanding the role of ecological conditions on inheritance rules, we seek to differentiate owners by cohort of ownership and by the amount and quality of land held by them. As discussed above, ecological constraints are said to influence transmission rules.

Using the reproductive history of the woman (spouse), we generate some demographic characteristics of the family. The number of offspring is added in other to understand how family size affects the motive to transfer. We also use the number of sons and daughters separately as well as children's age. The gender division allows us to understand gender preferences in land inheritance. Children's age, on the other side, can be an approximate proxy for young household life-cycle, which represents liquidity constrain. The effect must be reduced in case of co-residence. We also consider occupation and educational attainment of the offspring as proxies of human capital investment. The occupation is especially relevant for it can reveal land-specific human capital investments. This specialization, predicted by the evolutionary and economic models, improves the ability to heir the land. At the same time, children's educational attainment is considered a proxy for permanent income (McGarry, 1999). For age and schooling, we included the inter-siblings variance in order to test if parents consider the relative distribution of their offspring's permanent income when deciding to adopt fixed or unequal rule for intended bequest.

We also use a standardized index of socio-economic status of parents as a measure of the relative sacrifice of the donor to the recipient, implicit in the

[9] This behavior is likely only if substitution of goods (*inter-vivos* and bequest) holds. Most of the articles in the economics of giving assume some degree of substitution between *inter-vivos* and bequests (McGarry, 1999), despite some authors criticize this assumption (see Gouldner, 1960; Arrondel & Mason, 2006).

argument of the utility function of the non-altruistic giver. The index represents the total amount of crop productions on the lot sold in the market measured in 1997/1998 Brazilian currency. The total amount sold is net of the amount of production owned by sharecroppers, if there was any. We also tested the total household income, summing up income from sold production and non-agricultural income. Furthermore, we use measures for household production strategy (area in cacao trees and used as pasture). Finally, we monetized the amount of production for self-consumption as a complementary socio-economic index and because of its relevance for small farmers' consumption.

Some parents' attributes were also used. We controlled for parents' health status and educational level. The owner's place of birth was also used to account for the cultural-spatial differences in land transmission, as argued by Carneiro (2001).

We apply a non linear regression model (binary logistic) in order to test the effect of selected variables on the chance of transferring land (model 1) and land transmission under different rules: fixed or egalitarian (model 2). For model 1, we are especially interested in the source of ownership. As argued by Arrondel & Mason (2006), under the *indirect backward looking reciprocity* motivation, the person who received the land would be more likely to give. As in our sample the number of cases of real inheritance is small, we aggregated the categories *inherited* plus *received from the government* against *bought*.

In model 2, we focus on the ability of upward transfers, children's liquidity constrain[10] and permanent income as well as their inter-siblings variance to influence unequal division. As this model could be biased because we are dealing only with individuals who are planning to pass the land to their children, we performed a two-stage estimation model. The first stage corresponds to the selection equation (give or not the land, as in model 1). Then, we generate the

[10] Unfortunately, we are not able to control for child income. This is a less serious omission bias in bequest models because of the weak relationship between current income and bequest according to the altruistic model proposed by McGarry (1999).

Inverse of Mills Ratio[11] and apply it to the model of unequal intended bequest. In the specification the coefficient estimates are not greatly different from the simple logistic estimation. Additionally, the coefficient of lambda (Inverse Mills Ratio) is not statistically significant in any specification. This provides some evidence that the selection does not bias the results.

5. Results

5.1 Descriptive Analysis

Table 1 shows the ownership status of the landowner and the residence in 2005. We observed that the majority of owners stayed in the same area they were in 1997/1998. Among those who sold their land, the vast majority moved to other areas, either rural or urban. These results suggest a relative well-developed local land market, where the selling practices seem to respond to ecological constrains. According to most of the interviewees, the three major problems which make life difficult in the region are, in order of importance: the low price of commodities, the bad conditions of the roads and the lack of credit/government incentives.

Table 1
Locational and Ownership Status of the Former Owners of the Original Lots between 1997/1998 and 2005 - Altamira Study Area, Pará State,

Ownership Status of the Former Owner in 2005	Locational Status of the Former Owner in 2005				
	Dead	Stayed	Moved Rural	Moved Urban	Total
Deceased	22	0	0	0	22
Still held	0	257	16	42	315
Sold	0	1	23	29	53
Gave to children	0	4	1	3	8
Sold to children	0	0	1	0	1
Total	22	262	41	74	399

Source: Altamira dataset (1997, 1998 and 2005)

[11] The likelihood ratio test indicates that the IMR should be dropped from the model. We realized instability on the coefficients and standard errors. This instability results from two sources: because of the small sample size (one more degree of freedom lost affects the efficiency) and because of multicolinearity.

Table 2 contrasts the future plans of property owner's in 1997/98. The results indicated that the vast majority of owners intended to pass on their land to their offspring (74%). The same question was asked to the same individuals again in 2005 and the results are very similar, more than 60% of the owners still planned to give their land to their children. If just the valid observations are considered, the proportion of respondents intending to pass on the land to their offspring is quite similar over time. The prevalence of equal division of land is consistent with the existence of land market, as argued by Baker & Miceli (2005).

Table 2
Future Plans for the Original Lot Reported in 1997/1998 - Altamira Study Area, Pará State, Brazil

Future plan	Absolute	Relative
Give to children	309	77.44
Sell in the next 4 years	8	2.01
Sell in 5 years or more	2	0.50
Find a person to manage the property and move	3	0.75
Increase the number of properties	37	9.27
Other	36	9.02
Missing	4	1.00
Total	399	100.00

Source: Altamira dataset (1997 and 1998)

Table 3 shows the first striking results of the Brazilian case. We find that 68% of parents plan to divide their land equally among all children (76% excluding missing observations). This finding is consistent with most studies in developed areas, which show that the equal division is the prevailing pattern of estate transmission (McGarry, 1999; Dunn and Phillips, 1997; Menchik, 1980 and 1988). Despite studies of developing areas and small communities have revealed some degree of sex[12] or birth order preferences in land transmission (Estudilloa *et al.*, 2001; Jacobs, 1996; Ihromi, 1994), our results present no clear evidence of birth order preference as discussed in the literature for rural areas. Despite not revealing a birth order preference, the majority of unequal bequests targets male children

[12] According to Estudilloa *et al*. (2001), parents diversify the investment among their children: while males are favored regarding land transmission, daughters receives the largest share of educational inversions.

(about 80% of the cases). Instead of being related to gender discrimination, as in other areas, this sex distinction arises from differences in children's specific human capital, as it will be shown below..

Table 3
Division Rule for the Original Lot Reported by the Former Owners who Kept the Property Title, Intended to Pass on the Land and Were Interviewed in 2005 - Altamira Study Area, Pará State, Brazil

Division Rule	Absolute	Relative
Equal Division	128	68.09
Unequal Division	41	21.81
Missing	19	10.11
Total	188	100.00

Source: Altamira dataset (2005)

In Brazil, the study of Carneiro (2001) suggested a birth order and sex preference among family farmers of a community located in the south region. This community is composed by predominantly German descendents and the agricultural activity is considered highly successful. They use intensive methods based on small-scale production system and are well integrated to important urban centers nearby where they can sell their production. The inheritance system is similar to the one developed among the Toba Batak community in the center of Tapanuli, Indonesia (Ihromi, 1994). Daughters recognize the possibility of indirect inheritance through marriage. The study area of Altamira, however, is a settlement area with the property grid originally organized and distributed by the Brazilian Government (INCRA). The institutionalization of the settlement process associated with the strictness of Brazilian law governing inheritance and succession practices represent clear barriers to unequal division[13].

Table 4 contrasts the future plans of landowners controlling for the way in which the land was acquired. Under the indirect reciprocity motivation hypothesis we would expect that individuals who received their land from the government or

[13] The majority of land owners are from the Northeast of Brazil (the poorest geographic region). There also is a group of owners from the South (the richest area in the country). In some specification during our regression analysis, we introduced the origin of the land owner. The difference in place of birth was not statistically significant though.

other person would be more likely to pass on their land to their offspring. The majority of owners plan to leave their land to the children (see Table 2), but we also observed that the proportion that intends to do that is very similar when comparing those who bought the land with those who received it from someone else.

Table 4
Future Plan for the Land according to the Mode of Acquisition among the Former Owners who Kept the Property Title between 1997/1998 and 2005 - Altamira Study Area, Pará State, Brazil

	Way of acquiring the land		
Future plan for the land	Bought	Received	Total
Other plans	73	24	97
%	75.26	24.74	100.00
Pass on to children	120	56	176
%	68.18	31.82	100.00
Total	193	80	273
	70.70	29.30	100.00

Note: Received = inherited + received from the government
Source: Altamira dataset (1997, 1998 and 2005)

The influence on the ability of upward transfers affecting the way in which landowners intend to divide the land is show in Table 5. We argued before that upward transfers[14] could affect parental decision regarding land division through reciprocity incentives (Arrondel & Masson, 2001 and 2006). We discussed how children who made upward transfers could be more likely to benefit from land division. Interestingly, we find that in general parents intend to divide their land equally in the presence or not of upward transfers. However, it is important to control for other variables and observed how those variables (e.g. number of offspring who help) could affect parental intentions. In our analysis, we are not able to specify a robust test for direct reciprocity because we should perform a fixed effect model of transfers at child level. To do that, we should be able to differentiate

[14] McGarry's model (1999) posits that downward transfers influences the relation between child's current income and bequest through change in distribution of permanent income (starting at the first period, when liquidity constrained children receive *inter-vivos* transfers) and a change in the budget set of parents. In this second period, holding child's income constant, *inter vivos* transfers have marginally decreasing utility. Then, more parents' income is carried over period two, increasing his ability to consume and bequeath. In our dataset, as better discussed in the next section, the downward transfer is endogenous to intended bequest (questions asked in the same year of interview).

a child who is intended to receive land or not within the same family. We do not have this information in our dataset.

Table 5
Divison Rule for the Intended Bequest among the Former Owners who Kept the Property Title between 1997/1998 and 2005 according to the existence of Upward Intervivos Transfers - Altamira Study Area, Pará State, Brazil

Division rule	Upward intervivos transfers		
	No	Yes	Total
Equal division	89	38	127
	70.08	29.92	100.00
Unequal division	31	10	41
	75.61	24.39	100.00
Total	120	48	168
	71.43	28.57	100.00

Note: Upward intervivos transfers reported in 1997/1998.
Source: Altamira dataset (1997, 1998 and 2005)

Finally, we analyze farmer intentions regarding the bequests declared in 1997/1998 to what really happened in 2005. Table 6 shows that in about one-third of the cases in which the owner planed to pass the land to their children, the widow was the beneficiary of the transfer. This result is explained by the Brazilian legislation regarding the division of wealth within the family (Pereira, 2004). The Brazilian law guarantees to the window 50% of the deceased stake, and the other half to be divided equally among children, when a will does not exist.

Table 6
Comparison between effective bequest outcomes in 2005 and original future plan of the old owner in 1997/1998 - Altamira Study Area, Pará State, Brazil

Future plan for the land reported in 1997/1998	Bequest outcome					
	Widow kept	Equal division - Formal	Equal division - Informal	Unequal division - Formal	Unequal division - Informal	Total
Pass on to children	11	8	3	3	2	27
Increase the number of properties	2	0	1	1	0	4
Other	1	0	0	0	0	1
Missing	1	0	0	0	0	1
Total	15	8	4	4	2	33

Note: the difference between formal and informal is the transfer of the title of ownership
Source: Altamira dataset (1997, 1998 and 2005)

5.2 Regression Results

We now turn our attention to the regression models that investigate the determinants of land transmission (Model 1) and the determinants of equal/unequal division (Model 2). We parameterize the model using a non-linear regression model (logistic regression model[15]) on the following binary variables: chance of transferring the land to children (model 1) and rules of transmission (model 2).

5.2.1 *Intended Bequests*

Model 1 considers 252 cases in which valid information about future intentions for the land in 2005 is available. Model 2 considers only those cases in which parents indicated that they planed to pass their land to their offspring (161 valid cases).

Table 7 shows the results for Model 1. The values of more interest here are: children's schooling[16] as well as the form of land acquisition. Younger children are more likely to face liquidity constrains. At the same time, higher schooling represents a higher level of permanent income. Then, we should expect a positive relationship between children's age and bequest among altruistic parents. At the same time, if parents don't know children's education, they are not fully able to determine the permanent income distribution of their offspring. We should observe a negative effect of children's missing schooling and bequest. Children's age revealed a negative effect on bequest, despite not statistically significant. On the other side, the effect of the absence of knowledge about children's permanent income on bequest is significantly negative.

[15] We also used exact logistic regression for the second model. The method is based on appropriate permutational distributions of sufficient statistics and is particularly adequate to small samples and unbalanced binary outcomes (Mehta & Patel, 2007). However, the results did not change and it is more time-consuming. The final results, then, is reported according to the standard logit model.

[16] While *inter-vivos* transfers are related to liquidity constrain (age and current income of children), bequests are related to permanent income (schooling). For a more formal discussion of the mechanisms linking age, income and schooling to private transfers, see McGarry (1999) and Stark & Zhang (2002).

The literature discussed before suggested that individuals who received the land from someone else (government or transfer) would be more likely to make another transfer. In the Brazilian case, we do not find these variables to be important. The intention to pass on the land to the children is not affected by how the land was received or by being or not a beneficiary of upward transfers. The estimated effect of upward transfers is negative, although not significant. This might be a result of parent's previous downward *inter vivos* transfers as a reciprocity response. If we consider *inter vivos* and bequest as substitutes, the negative effect or the absence of relationship between upward transfers and bequest is not surprising.

Table 7
Logit estimates of the probability of intended bequest in Altamira Study Area

	Coeff	Std. Err.[a]
Children's characteristics:		
Mean age	-0.015	0.032
Mean schooling	-0.042	0.069
Schooling missing (count)	-0.230**	0.110
Single/divorced/widow (count)	0.087	0.096
Married (count)	-0.074	0.091
Son with non-agricultural occupation (1/0)	-0.687*	0.410
Daughter with non-agricultural occupation (1/0)	0.523	0.370
Upward transfer	-0.211	0.428
Parent's characteristics:		
Form of land acquisition (1 - won / 0 - bought)	-0.390	0.410
Household income per capita (1.000)	0.005	0.016
Has another property(ies) in the region (1/0)	0.220	0.360
Father health status	-0.191	0.380
Father's age	1.665***	0.490
Mother's schooling	0.002	0.067
Area in pasture (ha)	0.014	0.008
Area in cacao (ha)	0.048*	0.026
Rest of area (ha)	0.016**	0.007
Year of acquisition	-0.033	0.026
Land with good accessibility during rainy season (1/0)	0.130	0.360
Number of observations		235
Mean of dependent variable		0.66

[a] Standard-errors robust to heteroskedasticity
*** p<0.01, ** p<0.05, * p<0.1
Parental characteristics (covariates) not shown: percentage of land with terra roxa, mother health status, father's schooling, monetized production for self consumption (quartiles)
Source: Altamira dataset (1997, 1998 and 2005)

The decision to transfer land to children seems to be affected by the human capital of children. In families that children are not involved in agricultural activities we observed a smaller chance of parents intending to pass on land to offspring, despite the marginal significance. The first model also reveals some interesting characteristics of the study area: health, educational and income variables at the parents' level seem to have very little (or none) importance on the chances of planning to pass on the land to children compared to other alternatives. The quality of land, indicated by the percentage of *terra roxa* and the conditions to reach urban areas during rainy seasons, seems not to be very important to determine the intentions to pass on the property to the offspring, although there is a positive effect of land size on bequest. As in this area the original lots were at the same size (about 100 hectares), the current lots bigger than the original size could be reflecting some family strategy to maintain the land within the same members, operating through previous buying or incorporation practices over time.

5.2.2 *Unequal Bequests*

Table 8 shows the results for Model 2. The model investigates the determinants of intended unequal land division, that is, how parents who intend to pass on their land to children are planning to do it, whether equally or not.

In this model, we introduce some measures of inter-siblings differences[17] regarding to liquidity constrain and permanent income distribution. Since we are interested in capturing some parents' altruistic behavior, we expect that they should take into consideration differences in the distribution of their siblings' needs. According to altruistic behavior, not only income but other children's characteristics matter when the parent is determining the expected child permanent income. We are not able to control for children's current income because of lack of this

[17] We used two distinct measures of inter-siblings differences regarding age and schooling: (1) the difference between the highest and the lowest unit (range difference) and (2) the variance among siblings (dispersion difference). The final specification took into consideration the dispersion difference, but the result did not change significantly using either indices.

information in the dataset. We assume this not to be a serious bias as far as other important socio-economic characteristics of the children which indicate liquidity constrain (e.g. education) and help parents to update the expected child's permanent income are being controlled in the model.

The results indicate that parents seem to consider differences among their offspring in order to transfer unequally. Again, age has a non-expected estimated direction but it is not significant. Children's schooling is positively associated to unequal bequests, but also not significant. In spite of the insignificance of the level, the dispersion is an important determinant of expected unequal bequest. Surprisingly, the effect of schooling variance is the opposite of predicted by the altruistic model. The model predicts that bequests would be used to smooth the heterogeneous permanent income distribution among a parent's offspring. This result reinforces the finding of the importance in land-specific human capital of a child in modeling parent's intention regarding land transmission. In our study area, it is common that the less educated children coreside with parents or live on the lot and manage an important parcel of the land. The previous finding is also supported by the positive effect of children's residential proximity on unequal bequest (in the Heckman selection model).

In this model, the owners who won the land are more likely to divide it unequally among their offspring. According to the reciprocity model, if a person received more, he is more likely to transfer unequally. This behavioral transmission through generations might lead a donor who unequally received a larger share of the family inheritance to act in the same way. Unfortunately, as previously discussed, the number of cases in our sample with donors having inherited the land is very small. This is the reason we aggregated the donors who won, including through inheritance or government donation. The estimated effect of the form of acquisition might be capturing both, unequal transmission behavior and/or some unobserved family heterogeneity.

Land owners with spouses in bad health status are more able to unequally transfer land to their children, although his/her own health status is not relevant.

This might signalize the desire of the donor to adjust the spouse's lifetime well-being after his/her death.

The size of the piece of land is an important determinant of equally distributing land among offspring; as farms get larger the greater the chance of pass on the same amount of land to children. However, land use strategy also matters. The bigger the area used for cacao production and as pasture, the higher the probability of unequal bequest. Household income and parents' educational does not seem to play a role in modeling parent's intention to pass on the land to their offspring.

Table 8
Logit estimates of the probability of unequal bequest in Altamira Study Area

	Logit		Heckman Logit	
	Coeff	Std. Err.[a]	Coeff	Std. Err.[a]
Children's characteristics:				
Mean age	-0.010	0.070	0.056	0.100
Age variance among siblings	0.286**	0.130	0.297**	0.130
Mean schooling	0.101	0.130	0.187	0.150
Schooling variance among siblings	-0.610***	0.220	-0.642***	0.210
Sons with non-agricultural occupation (count)	-0.470	0.290	-0.430	0.280
Daughters with non-agricultural occupation (count)	0.621**	0.310	0.885**	0.390
Single or married (count)	-0.380	0.270	-0.597*	0.310
Divorced or widow (count)	-2.007***	0.750	-2.760***	0.960
Upward transfers (1/0)	-0.691	0.660	-0.572	0.690
Living in the same household (count)	0.591*	0.340	0.770**	0.380
Living on the same lot (count)	-0.352	0.520	-0.201	0.540
Living off the lot (count)	0.699	0.440	0.859*	0.440
Parent's characteristics:				
Total household income quartile				
1st-lowest (omitted)				
2nd	-1.652*	0.990	-1.555	1.040
3rd	-0.837	0.780	-0.300	0.890
4th	0.104	0.960	-0.003	1.030
Monetized production for self-consumption (in R$1,000.00[b])	-0.043	0.050	-0.011	0.060
Has another property(ies) in the region (1/0)	-0.890	0.580	-1.157*	0.660
Year of acquisition	0.106**	0.043	0.159**	0.064
Form of land acquisition (1 - won / 0 - bought)	1.611**	0.680	1.822***	0.690
Land with good accessibility during rainy season (1/0)	-0.143	0.610	-0.180	0.620
Percentage of the land with *terra roxa*[c]	0.003	0.010	-0.001	0.010
Area in pasture (ha)	0.020***	0.007	0.012	0.009
Area in cacao (ha)	0.115***	0.042	0.086*	0.048
Rest of area (ha)	-0.033**	0.014	-0.039**	0.016
Age of the land's owner	-0.307*	0.170	-0.738*	0.420
Age square of the land's owner	0.003*	0.002	0.006*	0.003
Educational attainment of land's owner				
Illiterate (omitted)				
1 to 4 years	0.568	0.690	0.515	0.700
5 or more years	1.383	0.910	1.678*	0.970
Health status				
Land's owner sick (1/0)	0.233	0.640	0.423	0.690
Spouse of land's owner sick (1/0)	1.714***	0.660	1.878***	0.680
Inverse of Mills ratio (bias selection correction)			-14.47	11.800
Number of observations		161		161
Mean of dependent variable		0.24		0.24

[a] Robust standard-errors / [b] Brazilian currency / [c] Highly-fecund type of soil tipical in the region
*** p<0.01, ** p<0.05, * p<0.1
Source: Altamira dataset (1997, 1998 and 2005)

6. Conclusion

This paper addresses private transfers, especially land inheritance, in the Brazilian Amazon. We investigate three competing motives for why parents transfer resources among offspring and what affects the distribution. We concentrated on the distribution of land because it is the main source of wealth in our setting. We were particularly interested in the reciprocity approach that indicates that the beneficiary of a transfer does not give back to the initial donor but make a transfer to a third party (in our case offspring). This model is an alternative approach to the more common used models in economics, altruism and exchange. We also tried to capture some altruistic behavior among the land owners when analyzing the determinants of unequal division.

The results for the group of rural workers in the Brazilian Amazon show that parents in Brazil are more inclined to pass on their land to children whether the land was received or bought. Also, upward transfer to parents does not seem to affect parental decision in allocate the land among their children. The results should be analyzed with caution because Brazilian legislation on inheritance might impose some significant constrains on how parents can pass on their land. In any case.

Our results do not support altruistic behavior regarding bequests. Most of the significant variables for unequal bequest suggest that parents consider land-specific human capital of their children when intending to pass on the land to the next generation. The lack of evidence for altruistic behavior for bequest must be a result of strong constrains arisen from the Brazilian legal system of equal inheritance. Moreover, this paper does not analyse the determinants of *inter-vivos* transfers, which are considered in the literature to be more compensatory.

The predominantly equal division rule found in this area is consistent with the previous literature. We did not find evidence supporting the indirect reciprocity, which tests the chain of transfers linking different generations. In a future work, we compare Altamira and Santarém study areas in order to test the chain reciprocity

model in different cultural contexts and shed more light on intergenerational linkage in rural areas.

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