

Ph.D. DISSERTATION

博士論文

Land Property Rights and Their Impacts on Agricultural Economic
Productivity:
Case Study from Brazil

(土地所有権とその農業経済生産性への影響：
ブラジルにおける事例分析)

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As the final moments of a long adventure draw near, I cannot help but look back and ponder on the many experiences acquired and, from those, the lessons that pave the way to future journeys. In this search, the first realization is that nothing can be achieved by the effort of one individual alone. The often cited but hardly understood lesson of indiscriminately donating oneself arises as necessary condition for advancement. In this adventure, I have received much more than I have been able to offer to others. With such, it is with deep feeling of gratitude that I acknowledge the valuable contribution of the following people and direct my thoughts towards many others who somehow helped to make my way smooth and enjoyable.

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For Mr. Domingos and Mr. Gildeão, from the community of Raposa, Campos Lindos, Brazil. Two individuals for whom life has not been particularly generous, who courageously and anonymously lead inspiring lives.

“Per Aspera Ad Astra”

ABSTRACT

This research investigated agricultural productivity as a function of land property rights (LPR). The main objectives were to understand constraints to agricultural productivity, with an eye on rural development, and propose policy recommendations in order to mitigate these constraints. While this approach carries the primary assumption that land property rights represent an effective constraint to productivity, a more general hypothesis was set. Namely, that certain additional factors are needed in order to enable the impacts of LPR to take place. Literature review and early results hinted at two of such potential factors.

First, it became clear that LPR are not simply implanted in a region by the work of government agencies in a fully exogenous manner. One major driver of the evolution of LPR towards more secure forms is precisely the occurrence of the phenomenon that LPR strives to control: land conflicts. As land becomes scarce, with growing population or commercial interests, there is competition for it and more secure LPR are needed. One particular technology that has such effects in terms of population and commercial interests is transportation, which also attracts attention as one major policy for rural development. It is therefore hypothesized that transportation may constitute a necessary enabling technology for the realization of the impacts of LPR.

Second, it is assumed that LPR, in the quality of an economic institution, has the effect of providing economic incentives which in turn influence agent's behavior. While agents are assumed to make decisions rationally, it became clear that such behavior only stands under specific circumstances, related to factors such as culture, education and traditions. Such circumstances may be particularly absent where farmers are concerned due to their contexts of poverty. Farmer's behavior, termed as mindset, potentially deviating from strict economic rationality has been hypothesized to represent one enabling condition for the impacts of LPR to happen.

This research evaluates these two hypotheses qualitatively and quantitatively. Its uniqueness lies not only in the setting of the hypotheses themselves, but in the data-intensive treatment that is made. The idea of existence of enabling conditions points to a holistic view of what would otherwise be a highly compartmentalized, potentially over-analytical approach to the complex problem of poverty, or rather, human development, here approximated by agricultural productivity. Moreover, in what respects the psychological dimensions involved in the concept of mindset, the quantitative treatment made in line with standard econometric approaches invites reflections about fundamental assumptions of economic theory, especially the postulate of rational decision-making. Both the holistic view of development and the consideration of farmer's mindset could contribute to the crafting of new policies aimed at rural development.

The methods applied include an international comparative analysis, a detailed case study conducted in the Municipality of Campos Lindos, in the State of Tocantins, Brazil and finally, interviews with experts in the field of rural development. Several econometric techniques were utilized in order to address different problems anticipated in different parts of the quantitative analysis. Finally, the study concludes that both transportation and farmer's mindsets have a significant intermediation role on the impacts of LPR on agricultural productivity, as hypothesized. The absence of such factors lead to the impairment of one or more of the mechanisms that connect LPR and productivity. Policy recommendations are finally presented, setting guidelines for future rural development programs. Several questions, however, were raised or remain unanswered and are presented and discussed in the conclusion chapter.

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1. INTRODUCTION

In the year of 2007, human population became predominantly urban. In many countries, the rate of urbanization already exceeds 80% and, taking the world as a whole, is projected to reach 68% by the year of 2050 (UNDESA, 2014). Research and policy-making related to rural areas, nonetheless, remains in order, especially because rural populations are disproportionately affected by poverty. In fact, 76% of world's poor live in rural areas (Development, 2016).

The matter of poverty has been the focus of research for several decades, but pose a persistent challenge to the analytical methods that are common in science. While scientific analysis routinely seeks to decompose complex phenomena into its fundamental factors and explore paths, mechanisms and causalities between variables, Amartya Sen (1976) explained that poverty is innately multidimensional in its causes and consequences, which may point to a diversity of hypothesized mechanisms and measurement procedures, finally leading to a myriad of policy recommendations. General approaches to understanding and mitigating poverty remain to be found, if ever will. Therefore, for practical matters, research currently focus on local contexts, adapting assumptions, hypotheses and measurements to specific locations and only then evaluate the extent to which the findings can be generalized.

Given the context in which the present research is carried out, agricultural productivity was chosen as the main variable of interest. Agricultural productivity has an evident economic appeal as it expresses the adoption of technologies in production and has direct impacts on competitiveness and profitability of agricultural businesses. However, it carries an equally important human appeal. That is because, since agriculture is often the main source of livelihood for rural populations, agricultural productivity may be the most important poverty-related variable that is under the control of farmers, providing them with an autonomous route for escaping poverty. If constraints to productivity can be effectively lifted, farmers may find ways to improve their life conditions by themselves. This choice of variable and thinking places the farmer himself at the center of the solution of the problem of poverty.

The assumption that land property rights represent a relevant constraint to agricultural productivity is also inspired by the context of this research. The most easily observable way land property rights may affect productivity is that rural areas are often the stage for severe land conflicts. Such conflicts may lead to the forceful eviction of farmers and sometimes to life-threatening violence. Such episodes have been widely reported in Brazil, where the case study component of this research was conducted, very often related with the advance of grain production. At one side, there are reports of unprotected land owners being evicted from their land in order to facilitate the expansion of large scale agriculture and at the other side large scale farmers experience invasions in their properties by social movements (Nascimento, 2007; Orellano et al., 2015). Nonetheless, such problems are widespread, especially in the developing world, as pointed out by several international organizations (World Bank, 2005). There have been several reports from Africa and Southeast Asia, for example, where land evictions can be related with the expansion of palm oil plantation, soybean and other large-scale crops. The insecurity caused by such conflicts may harm farmer's livelihoods and discourage investments, thus harming productivity (Gurara & Birhanu, 2012).

Land property rights have been regarded as an institutional arrangement or an economic institution in the sense commonly employed by authors in the New Institutional Economics school, such as Acemoglu, Johnson, & Robinson (2005) and North (1987). In this sense, LPR represent societal norms generating reiterated behaviors that may be

conducive to economic development or not. In particular, LPR determines under what circumstances someone may own land. Land could be, for instance, commonly owned and managed by a community, under the authority of leaders who can be democratically elected or appointed by religious traditions. It could also be treated as a private good, passive of transfers of ownership through free market transactions, regardless of more culturally-linked considerations. Such differences in the way land ownership is regarded have implications not only on the extent to which land conflicts are controlled, providing tenure security, but also on land investments and land transactions, which constitute externalities that may impact agricultural productivity (Feder, Gershon; Feeny, 1991).

Notwithstanding, the present research proposes a wider framework than simply verifying the causal relationships between LPR and productivity. Another possible interpretation of LPR consists on regarding it as a technology that can enhance productivity, in the sense of the growth models illustrated by Solow (1956). Some technologies require certain conditions for their adoption or the pre-existence of other technologies, just like mobile phones would not be possible without knowledge of radio waves. Following a similar reasoning and given the multidimensional nature of poverty, or, in the present context, the multiple factors that may affect agricultural productivity, it is hypothesized that certain factors must be present in order to enable the impacts of LPR on productivity. This assumption expresses the idea that there could be multiple simultaneous constraints to productivity and the elimination of one single constraint, while necessary, may not suffice to increase productivity. In setting the scope of the research to identifying such factors, the regard on agricultural productivity is becomes broader.

Consequently, the main goals of this research have been set as the following:

- a) Identify and describe the determinants of the impacts of LPR on agricultural productivity, qualitatively and quantitatively.
- b) Understand constraints to the impacts of LPR on agricultural productivity from case study in Brazil
- c) Propose policy recommendations to support agricultural productivity in developing countries

As discussed above, however, the context-specific nature of constraints to productivity, could jeopardize the generalization of results. In other words, while in a theoretical level, general constraints to productivity can be identified, in practice each of these constraints may be more or less significant in specific contexts. Therefore, we depart from a general assumption and move towards more specific hypotheses, from the theoretical level, to the reality as observed in the field. In doing so, the possibility for generalization can be carefully and accurately discussed once the results are established.

In recapitulation, the fundamental assumption derives from the identification of the problem of land conflicts in rural areas. It is assumed that LPR are a relevant constraint to agricultural productivity. Then, a reflection on the multidimensional nature of constraints to productivity leads to the hypothesis that there must be additional factors necessary to the realization of the impacts of LPR on agricultural productivity. Then, in the context of this research, two potential factors are identified, each originating one of the main hypotheses of this research.

First, it is noted that LPR tend to evolve over time towards more secure forms, meaning forms that more effectively eliminate land conflicts. The trigger for such evolution is precisely the occurrence of land conflicts, which tend to happen as population in a given area or commercial interests on land increases. Externalities brought by modern LPR in the

form of incentives for investments and land transactions then further reinforce agricultural productivity. It is assumed therefore that technological improvements leading to higher population density or attracting commercial interests to land may constitute enabling factors for the impacts of LPR. Financial innovations, communication technologies and agricultural techniques are examples of such enabling technologies. In the context of the case study carried out during this research, however, the remoteness and accessibility issues justified investigating transportation as one major enabling technology.

Second, in the quality of economic institution, LPR are expected to provide economic incentives and thus influence farmer's behavior. Exactly how farmers react to incentives or the extent to which they react, however, is traditionally determined by rational decision-making theory. Such paradigm, however, is challenged by observation. Farmer's behavior is assumed to deviate from profit maximization due to psychological or cultural aspects dependent on their contexts of poverty. Certain farmers may, for example, let go of investment opportunities due to deeply ingrained beliefs about activities that are proper for poor individuals to engage in. Others may be constrained in their long-term considerations due to years of conditioning to short-term problem-solving in face of material deprivation (Mullainathan & Shafir, 2013). In such cases, the impacts of LPR could be impaired because farmers do not take opportunities created by better LPR. We term such deviations from rational decision-making theory as farmer's mindset and hypothesize it as one enabling condition for the impacts of LPR.

In summary, the two main hypotheses are:

- a) Transportation constitutes one technological requirement for the realization of the impacts of LPR on agricultural productivity.
- b) Farmer mindsets affect agricultural performance, thus constituting an enabling condition for the impacts of LPR on agricultural productivity.

In order to evaluate these hypotheses, their veracity and limitations, three main methods were used. First, an international study was carried out. Data regarding 76 country's agricultural production, LPR and transportation was analyzed using econometric modelling. Then, a detailed case study was conducted in a Brazilian municipality named Campos Lindos, in the State of Tocantins. The case study included recorded interviews with key stakeholders, such as politicians, small farmers and large scale farmers. Quantitative data collection was also conducted utilizing a paper-based questionnaire with questions ranging from socio-economic characteristics of farmers and farms to production decisions and perceptions regarding land tenure. Several econometric models were specified and estimated in order to evaluate a myriad of relationships between variables. Then, in order to issue a policy recommendation stemming from the findings, experts in rural development were consulted.

Finally, this thesis is structured as follows:

Chapter 1 – Introduction: Presents the topic and the motivation to investigate it, explains the objectives of the research and the main hypotheses.

Chapter 2 – Literature Review: Surveys past research in order to identify concerns within the topic and gaps in the existing body of knowledge.

Chapter 3 – Methods: Systematically presents research questions and hypotheses, as well as the meta-methodology and specific econometric techniques employed.

Chapter 4 – International Study: Utilizes data from 76 countries to present a first approach to testing the hypotheses.

Chapter 5 – Case Study: Based on the findings and limitations of the international study, describes a case study conducted in the Municipality of Campos Lindos, Brazil.

Chapter 6 – Productivity in Campos Lindos: Utilizes data gathered in Campos Lindos to verify potential impacts on productivity from LPR and farmer’s mindsets.

Chapter 7 – Land Transactions in Campos Lindos: Further details the findings regarding productivity by investigating land transactions as an intermediate mechanism linking LPR and productivity.

Chapter 8 – Investments in Campos Lindos: Investigates yet another intermediate mechanism linking LPR and productivity.

Chapter 9 – Transportation and Institutional Change: Investigates a hypothesis that transportation may trigger the adoption of land titles by farmers.

Chapter 10 – Policy Recommendations: Based on the findings of all the preceding analysis, issues three policy recommendations for rural development authorities.

Chapter 11 – Conclusions: Presents the final remarks, including limitations of the current study and suggests directions for future research.

Chapter 12 – References: Summarizes the papers and other sources of information consulted and cited throughout the Thesis.

Chapter 13 – Appendices: Provides support materials.

2. LITERATURE REVIEW

Land property rights are one major aspect of how societies organize the economy. As such, LPR are deeply rooted in culture and has wide-reaching economic consequences. This chapter will provide an overview of the definition and possible categorizations of existing LPR systems in the world, investigate the evolution of LPR throughout history, discuss the economic consequences of LPR especially in what concerns agricultural productivity and then discuss the linkages between LPR and the two enabling conditions investigated in this research: transportation and farmer's mindset. Finally, the needs for further studies will be outlined in light of the current literature.

2.1. What are Land Property Rights?

Land property rights are defined as sets of rules regarding who may own land, under which conditions it can be transferred and how ownership and transactions are managed and recorded. The basic function that LPR serve is to confer land tenure security, eliminating risks that farmers may experience of having their lands invaded or entirely expropriated. While the idea of property seems to be intuitive, following from the intuitive right of usufruct of an individual's efforts, property over land is not necessarily so clear. In fact, it is likely that such concept emerged in a precise historical moment, in the turn to the Neolithic period, as agriculture developed and humanity started to switch from hunters and gatherers to permanent settlers. Moreover, its practical interpretation suffered numerous adaptations throughout history, especially because land has long represented power, wealth, religion and has had close ties with politics. The concept of land ownership has been subject to the will of monarchs, feudal lords, national assemblies as well as traditional practices (Chiavari, Lopes, Marques, Antonaccio, & Braga, 2016).

By providing stable rules for the acquisition and transfer of ownership rights, effective LPR are expected to legitimize social recognition of land ownership. Notwithstanding, LPR also include institutions and procedures designed to solve conflicts that arise when two or more stakeholders claim ownership of a certain land parcel, such as courts, police forces and notaries. The combination of the specific rules regarding land ownership and the supporting institutions is termed LPR system or arrangement. These arrangements vary greatly from society to society and can be uneven throughout the territory of a country, which allows a range of possible categorizations to be made. First, a major distinction can be made between private and common land property rights. Second, LPR can be categorized according to the form of social recognition of ownership. Third, LPR can be distinguished according to the types of land recording (DFID, 2014; Feder, Gershon; Feeny, 1991).

Land is considered private property throughout most of the developed world. In this case, each parcel of land belongs to a certain individual. In practice, private ownership consists on a bundle of rights, which combine the right of use the land as the owner sees fit, the right to exclude others from using the land or appropriating its fruits, the right to transfer its ownership through free negotiation and the right to transfer it as bequest to the owner's offspring. Private land displays little differences as compared to other goods for all ownership matters – vehicles, perishables, consumer goods and etc. can be owned by private individuals. (Demsetz, 1967).

Conversely, when a community – which may be defined by diverse factors, such as ethnicity, language, birthplace and etc. – makes use of land collectively, it is said to be common land. In other words, there is no single individual who holds the right to exclusively

use the land or transfer its ownership. Even though formally speaking a king, the state or some sort of high authority could be legal owner of a certain area, if such authority does not exert direct control over the land, it may not be considered private. Typically, common land can be used for pasture for different breeds of domestic animals or for extraction of fruits, roots and other products of vegetable origin. In the case of agricultural production, common land can be temporarily assigned to individuals. In such cases, decisions regarding land use and ownership transfer are not made individually or follow free market negotiations. Depending on the specific case, a religious authority, elected representative or even the community itself through direct vote, among different possible arrangements, is responsible for land management decisions. Traditions and customs play a relevant role in determining such decisions, as land may be regarded not as an asset - differently from private land – but carry intricate cultural meanings. It often constitutes part of the community's identity, embodying the community's connection to its history and ancestors, as it may be used as burial ground, and effectively supporting a style of life (RDR, 2016).

In another dimension, LPR can be classified according the form of social recognition of ownership. Any type of property is generally supported by the social recognition of the right of excluding others of using something, but owners of any good may adopt measures against challengers of their ownership. For practical matters, differently from other goods such as exemplified previously, however, land ownership cannot be easily protected against other claimants. For example, if the object of conflict is perishable, can be easily hidden or transported, the owner can protect it at low costs. Land, however, is not mobile, it is permanent and cannot be hidden, so it can rely only on social recognition or constant threat of use of force as a means to withhold property. While for most goods social recognition is supported solely by unspoken rules, beliefs and principles, accordingly, social recognition of land ownership may be customary, as with other types of goods, but also formal (Demsetz, 1967).

Customary land rights are unrecorded. In this case, a community recognizes someone's right to use land temporarily or permanently in a tacit manner, based on beliefs and principles. The criteria for such recognition may be subjective. For example, outsiders may not be allowed to possess land in a community, unless he marries a member of the community. Or yet, women may not be allowed to possess land, unless they become widowed. In such cases, land transactions could be severely restricted and when they happen, they are often supported by the presence of witnesses that orally confirm that the transaction took place in case doubts arise in the future. Even though customary rights serve the purpose of conferring land tenure security, the continued ownership of a certain land parcel by an individual could also be subject to discretionary rules, influenced by traditional considerations of diverse natures, such as religious or political factors (Guedes & Reydon, 2012).

Alternatively, land rights can be considered formal when they are recorded in some form of legally supported document, typically a land deed or title. The authority that confers legitimacy to such documents is usually the State itself. In granting legitimacy, the State also takes over the responsibility for withholding property in case of conflicting claims. If social recognition is not guaranteed by the existence of the deed or title, police force or the courts can be righteously requested to intervene. Since ownership equates the possession of a valid public document, ownership transfers entail some sort of bureaucratic transaction, such as updating public registries and issuing new deeds or titles. Formally recorded rights explicitly and objectively state to which rights the holder is entitled and to which obligations he must comply (Feder, Gershon; Feeny, 1991).

Finally, the recording of lands itself display specificities across countries as a function of historical and cultural determinants. In fact, recording land is a complex and

costly procedure. It entails several tasks, some requiring legal or other specialized professionals, especially the determination of parcel boundaries, measurement and recording of land characteristics such as inclination, presence of water streams, type of native vegetation and etc. In different countries, different tasks fall under the responsibility of different entities, in a mix of private and public institutions. Finally, there is a particular difference between countries that issue land deeds and countries that issue land titles¹.

In countries where land deeds are issued, the State's primary function is to serve as a depository of the documents. A notary, which may be a private professional, issues a deed for the land claimant, usually under the conditions that witnesses are present. This system, also known as negative certification, does not guarantee that two deeds will not exist for an overlapping area, but carries the advantage that the costs for the State are much lower. In the case of land titles, which characterizes a positive registration system, the State certifies that there is a single rightful owner for a certain parcel before the title is issued. In this system, the existence of a title is sufficient guarantee that a parcel is free of ownership conflict, but the system is significantly costlier for the State (Rabley, 2009).

Most countries display LPR systems that combine, to different extents, characteristics of all the above categorizations. This heterogeneity even within countries is due to a diversity of factors, such as limited state capacity across the territory, colonization by different metropolises, coexistence of different cultures and ethnicities and different demographic and geographic characteristics. Figure 2-1. displays the world distribution of deeds systems and title systems and Table 1-1. summarizes the types of LPR discussed in this section.

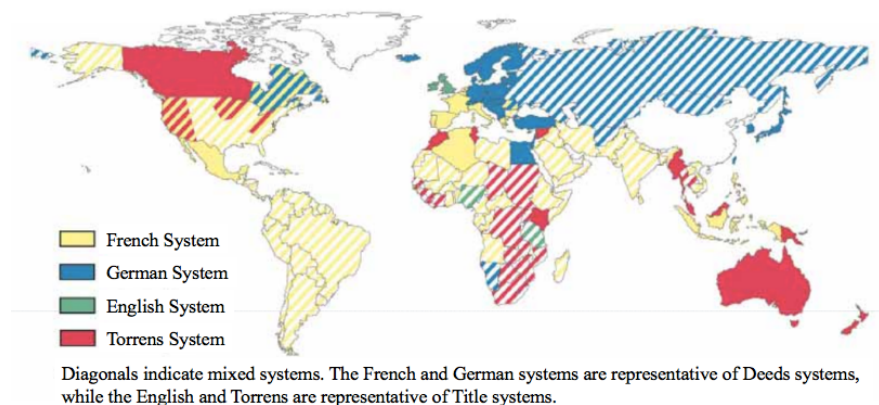


Figure 2-1: Types of LPR in the world. (Rabley, 2009).

It is usually assumed that the most secure form of LPR is where land is deemed as private property, formally recognized the state by means of positive certification, or fully verified land titles. This arrangement, supposedly minimizes the risks of ambiguity in land ownership or forced expropriation. However, under the specific circumstances of each location different arrangements may work just as well in face of the possible sources of ambiguities or expropriation. The conditions under which a certain LPR arrangement may become obsolete or inadequate in dealing with rising sources of conflict will be discussed in the following section.

¹ Despite the technical differentiation between land deeds and titles, very often the term title is indiscriminately used in the literature to express formal and legal recognition of land ownership.

2.2. The Historical Evolution of LPR

As pointed out in the previous section, the concept of owning land is an innovation of which the origins can be traced back to the turn to the Neolithic period, when permanent human settlements became to arise. Because human livelihood became dependent on agriculture instead of hunting and gathering and particularly because the harvests happen months after plantation, it became fundamental to guarantee land tenure for extended periods, if one was to ensure his own nutrition. Even in present days such extended land tenure may be unnecessary in certain communities, for example, indigenous peoples in the American Continent or tribal groups who still display nomadic behavior. In fact, the existence of such groups provides compelling evidence in favor of the previous argument.

In fact, as an economic institution, LPR arise as an equilibrium solution that combines characteristics of both the economy and culture in a certain area. At any point in history and location, if LPR do not successfully fulfil the function of avoiding land conflicts, it can be argued that there must an adjustment process in place in which LPR evolve and adapt to a different environment. Technological shocks and changes in relative prices have been pointed out as the usual reasons why economic institutions may need to change (North, 1987).

As human settlements formed, it is likely that common land rights preceded private land rights. The driving force for the transition from common to private land rights is the increase in potential for land conflicts. In an institutional perspective, such increase in land conflicts is likely to happen due to technological innovations that allow wider areas to be occupied or larger population density which requires smaller parcels of land and larger amounts of food, changing relative prices. Also, as larger communities become more difficult to manage, traditional customs are progressively replaced by impersonal, standardized bureaucratic procedures which support private property (World Bank, 2005).

A more recent account of how technological shocks may trigger changes in LPR comes from the first century after the independence of the United States, as the conquest of the West was in progress. Hornbeck (2010) proposed that the invention of barbed wire had a pivotal role in this process. Barbed wire represented a technology that reduced the private costs of enforcement of LPR, making land parcels safer and keeping animals from feeding on other farmers' crops. Along with passing of the Homestead Acts, which allocated private land to settlers, the expansion to the West rapidly increased over the second half of the 19th century. Before the introduction of such technology, eventual settlers must have used the land as an open access asset, enjoying much less tenure security.

Feder and Feeny (1991) define three ideal types of LPR as a function of the level of scarcity or competition for land, rather than the difficulty to manage large communities, even though both concepts are closely related. First, where human population displays nomadic behavior, open access land is assumed to be prevalent. This is the economically efficient outcome where the supply of land is perfectly elastic. In practice, open access land may have been found in parts of the Pre-Colombian American Continent and, more recently, in remote areas like the Antarctic, especially before the Antarctic Treaty.² Second, as demographic density rises as well as demand for agricultural goods, communal use of land becomes the most efficient form of land management. Finally, for an even higher level of land dispute, where the population became sufficiently large, or in order to tackle conflicts stemming from overuse of natural resources³, private property emerges as the most efficient form of LPR.

² Entered into force in 1961.

³ Problem commonly referred to as the "Tragedy of Commons."

Land conflicts are thus assumed to impose costs to society, so the optimal response changes as these costs increase. The increase in conflict-related costs is also the driving force for the change from customary to formal rights. In fact, the costs of maintaining a private land rights system are considerable higher, because it is supported by several institutions, such as public agencies responsible for land surveys, registry keeping, law enforcement, and the judicial system itself. Thus, societies and individuals choose between different forms of LPR⁴ at each moment in time. Land laws may be negotiated in parliament, providing *de jure* LPR at a national level and heterogeneous adoption of such laws create differing *de facto* LPR across the territory.

Heady & Feeny (1983) presented the case of Thailand to exemplify the idea that LPR changes along with increasing land conflicts. The authors argued that for most of the 19th century, land was abundant and labor was scarce in the country. As a consequence, the legal system supporting land use and transactions was not extensively developed. By the end of the century, however, advancements in maritime transportation favored the insertion of Thailand into international trade routes, promoting intense expansion of rice sales abroad. Agricultural land prices increased as the export rice industry expanded. Population density also increased significantly, and land disputes became widespread. The Government of Thailand was prompted to act and passed legislation in 1892 reforming land rights in the country. In 1901, a formal system of land titling was created.

Finally, on way LPR can change in a region is through external imposition. This has been the case in countries that were colonies. Many regions in Asia, Africa and the Americas inherit public institutions and practices from colonial powers, which affect their current LPR systems. In some cases, the introduction of LPR in the form of the ones existing in the metropolis forced the replacement of indigenous LPR. Differences across countries in terms of the use of deeds of titles, for example, often stem from the usual practices that different colonial powers adopted domestically and transplanted to the colonies. It is likely, however, that the effectiveness of the introduction of imported LPR is to some extent subject to the determinants discussed previously – population density, commercial interests and land conflicts - especially in what respects the transition from common to private land.

2.3. LPR and agricultural productivity

2.3.1. Theoretical Approaches

The main purpose of LPR is to avoid land conflicts, by creating stable rules for land ownership that ensure social recognition. Land tenure insecurity has straightforward impacts on productivity, with the increase in protection costs. However, there are other effects that could be considered externalities arising from secure LPR. The first of such effects is that land of which ownership has been effectively secured tends to have a higher market value. Further on, Brasselle and Platteau (2002) identify three mechanisms explaining how LPR may affect agricultural productivity: assurance effect, realization effect and, collateralization effect.

First, the assurance effect consists on that secured LPR enhances the incentive to make investments since well-defined land property rights protect farmers against

⁴ An early historical example of social choice for private land property rights are the Enclosure Acts, passed by the British Parliament from the 16th to 19th centuries, which converted almost all territory that used to be common land into open fields into private property. The Enclosure Acts are highlighted as enabling the Industrial Revolution in England, as the production of cotton, which later supported the textile industry, increased manifold.

expropriation risks and let them recoup the fruits of their labor. The argument is that, conversely, farmers would feel discouraged to invest in case they found that their work could be lost. This assumes, to some extent, that land is an economic asset that yields a return and thus can be treated as any other asset, such as financial products. It must be noted, however, that while it is safe to assume that investors may reduce their exposition to risky assets, farmers may behave in such a way only to the extent that their livelihood is not threatened. Since agriculture is often the main source of livelihood for farmers and their families, it is possible that even under risk their agricultural activity would not cease. That being said, it is still possible to infer that under high risks of invasion or expropriation, investments beyond the level of subsistence could be heavily discouraged, harming productivity.

Second, the realization effect is the idea that secured LPR improves the functioning of land markets, through land transactions that lead to efficient land use. Secured LPR may favor transactions such as land sales, lease, bequest and contracts in which land is presented as a guarantee, such as partnerships between farmers and trading companies. In the case of land that is effectively protected against expropriation risks, the market for potential buyers, leases and etc. becomes larger. That is because some potential individuals interested in land transactions may be discouraged to hold land whose ownership is uncertain. In this sense, the realization effect can be regarded as an indirect consequence of the assurance effect. The consequences of the realization effect itself are that out of an expanded number of possible transactions, it is more likely that free negotiations will promote the matching of market participants with the highest differential subjective valuations, which maximizes welfare. Also, land use efficiency is expected to increase, because through land transactions each parcel of land tends to be harvested by the farmer with the best set of skills for each particular agro-ecological conditions⁵.

Third, the collateralization effects assume that land titling will remove difficulties in accessing credit because financial institutions do not usually accept untitled land as collateral. The collateralization effect can be partly regarded as a consequence of both the assurance and realization effects. Financial institutions expect to take over ownership of lands belonging to defaulted debtors. In other words, land can be presented as a guarantee in case of default. However, financial institutions may be heavily disinclined to accept insecure land as guarantee, since the institution itself could fall victim of expropriation of its new assets or also because insecure land may not be sold easily, in which case they bank could end up with an insolvent asset instead of an unpaid loan. Finally, difficulties in accessing credit could jeopardize productivity-enhancing investments. Figure 2-2 summarizes these three effects.

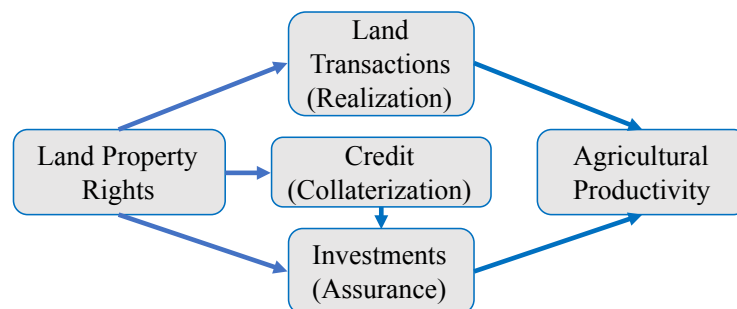


Figure 2-2: Three effects of Land Property Rights on Agricultural Productivity

⁵ Conditions of soil chemistry, mineralogy, ecology and weather, all of which affect natural fertility, crop choices and productivity.

These three effects are expected to follow if LPR is secured. However, the actual impacts of securing LPR may vary according to the types of LPR at hand. Take for example land that is commonly owned by a community and where there is no formal demonstration of ownership. It is possible the ownership is effectively secured by laws, by the presence of law-enforcement agents or simply by a wide social recognition or ownership of certain area by certain community. In this case, it is in fact possible that the assurance effect would be present and farmers in such community would be incentivized to make investment. Nonetheless, land transactions could still be heavily impaired, since such transactions could require a collective decision, subject to potentially slow or complicated decision-making process. In particular, farmers within the community could be impeded of selling or renting out parcels of the community land to outsiders, regardless of the potential increase in welfare that could imply. Moreover, modern financial institutions could find it unfeasible to accept land of which ownership is informal as collateral for lands. Individual farmers within the community or the community itself could find impossible to access financial institutions.

Such considerations lead to the common assumption in the literature that private and formal LPR is the not only the most secure but also the most effective form of LPR in terms of economic consequences. Private ownership implies lower negotiation costs, since individuals interested in any kind of transaction would need to negotiate with one single owner rather than with a group of owners. Formal ownership has even wider benefits. The existence of land titles – or deeds, to a slightly lesser extent - not only guarantee state protection of ownership, which implies stronger assurance, but it also favors transactions because it reduces information asymmetries. Land registries are public records that usually include information about physical characteristics of the land and can be accessed by interested parties who may have not actually visited and seen the parcel in which they are interested.

Finally, it must be noted that a number of assumptions are made in order to support the actual existence of the three effects described above. Even where land ownership is effectively protected and even assuming the existence of land titles, investments, transactions and collateralization require additional conditions to happen. First, there must be investment options that are feasible once land ownership is secured. This depends on several factors, such as access to technology, knowledge and skills, agricultural prices and access to markets to commercialize additional production (Chiara Selvetti, 2014). Second, transactions must be fully unimpeded. Restrictive land management laws, such as those existing in countries with socialist-style governments would impair markets in ways ownership assurances would not correct (Newman, Tarp, & Broeck, 2015). Third, in order for collateralization to happen, the financial system must be in place and be sufficiently developed to offer such mortgage-like products (The Munden Project, 2012). These conditions are often absent in developing rural areas.

2.3.2. Empirical Studies on LPR and agricultural productivity

Several studies have been conducted in the attempt to verify and quantify the three effects – or mechanisms - described in the previous section, as well as the general causality between LPR and agricultural productivity. A major categorization that can be made regarding the existing literature lies in the methodological choice of dealing with either macroscopic or locally-collected data.

Studies that used macroscopic data have evaluated the impact of property rights on economic performance in international datasets. In order to measure the degree of

effectiveness of property rights several indicators that provide country-level measurements have been used. Earlier studies relied mostly on a measure of risk of expropriation as a proxy for secure property rights, which is provided in the International Country Risk Guide (ICRG). More recently, new indicators have become available, such as the International Property Rights Index and The Heritage Foundation's Index of Economic Freedom. Acemoglu et al. (2005) used a dataset of 64 countries and related their gross domestic product (GDP) per capita in 1995 to ICRG's index. The authors employed two-stage least squares regressions in order to address potential problems of endogeneity stemming from reversed causality or omitted variables. Results point to a significant impact of property on GDP per capita. Kerekes & Williamson (2008) confirmed Acemoglu's results utilizing indicators provided both by ICRG and by The Heritage Foundation. Using a range of model specifications, they found that more effective property rights result in improved capital formation and economic growth. Other studies suggest slightly nuanced relationships. Chong & Calderon (2000) suggested that there could be a two-way causality between economic growth and property rights. Bose, Murshid, & Wurm (2012) suggested a non-linear relationship between the two variables, with property rights decreasing marginal impacts as national income grows.

While the use of macroscopic data provides valuable insights into the direction of the relationship between property rights and economic performance, supporting a positive effect, some natural limitations arise. First, the indicators available refer to property rights in a broad sense and the economic performance variables utilized are macroeconomic series which consolidate data from different industries. While it is possible that the more specific relationship between LPR and agricultural productivity follows the same general trend identified at macroeconomic level, this statement would require further demonstration. This is particularly true given that LPR are determined at a very local level, as explained previously. There are specificities and variations even within national contexts, in spite of homogenous legal environments. Moreover, the macroeconomic trends could be disguising important details at the microeconomic level, as individual's behavior might differ from the general trend.

In order to tackle these issues and provide deeper insights, researchers turned their attention to case studies, often relying on data collected *in-situ*. The diversity of contexts studied shed light onto the variety of specific LPR arrangements that have emerged in the world. Research designs vary substantially according to specific local contexts, questionnaire surveys are the preferred method for data collection and questions are adapted to capture relevant information in each location. For example, Goldstein & Udry (2008) utilize data on farmer's government or political affiliation as indicators of land tenure security. Further examples are Linkow (2016) and Ma, Heerink, Feng, & Shi (2017) who used perceived land tenure insecurity as dependent variables, directly asking farmers about their perceptions. Nonetheless, the assumption that land titles are the most effective form of LPR is often made and this is the variable of interest in most studies.

Differently from the studies based on macroscopic data, the findings from the literature based on case studies are mixed, which eliminates the possibility for a unified statement regarding the impacts of LPR on agricultural productivity. In a systematic review of quantitative studies, evidence on the relationship between land tenure security and variables such as productivity, income and investment found markedly disparate results, ranging from statistical insignificance to a wide variation in the magnitude of estimated coefficients across regions and countries (Lawry et al., 2014). For example, K. Deininger, et al. (2011) showed that the productivity of trees in titled plots tend to be higher than that in untitled plots. Benin and Pender (2001) also showed that the redistribution of land property rights has led to an increase in agricultural yields. Lawry et al. (2014) reported that

an intervention to strengthen property rights may lead to an improvement of agricultural productivity by about 40%. Notwithstanding, Place & Migot-Adholla (1998) did not find discernible impacts of titling on crop yields in Kenya. In a more recent study, Bellemare (2013) found similarly discouraging results in a study in Madagascar.

Among researchers that focused on investment variables as outcome indicators, Benin & Pender (2001), for example, studied locations in Ethiopia and found that only 1 out of 15 investment-related variables was affected by their proxy of tenure insecurity. Deininger & Jin (2006), however, also investigated Ethiopian locations and found that expectation of future expropriation has a strong effect on investment. Similarly, Goldstein & Udry (2008), in a study conducted in Ghana, found that lower risk of expropriation leads to longer fallowing of land, which is considered a type of investment. They concluded that, should governments aim at agricultural development, investments in infrastructure would likely be more effective than titling alone. Jacoby & Minten (2007), in a similar study conducted in Madagascar, found that having a title has little effect on farm-specific investment, productivity, and land values.

Other researchers have directed their attention to the realization effect, studying the impacts of LPR on land transactions. Baland, Gaspart, Place, & Platteau (1999), for example, investigated the emergence of land markets in Ugandan locations where land transactions were virtually non-existent. They found that titling programs by the government and foreign aid agencies led to higher number of transactions and diminished land concentration. However, other researchers have found evidence that may suggest otherwise. D. Holden, Otsuka, & Place (2009) and S. T. Holden, Deininger, & Ghebru, (2007) investigated participation in land rental markets in Ethiopia. They found that locations where leasing land was not common before titling remained out of rental markets even after titling. Notwithstanding, they found that villages that did have a history of rental activity increased participation in rental markets. Also in contrast with Baland's study Colin & Woodhouse (2010) noted in their survey of 16 countries that the access to formal land markets may actually lead to unequitable land distribution. The authors noted that this could be caused by distress sales, which are often regarded as undesired efficiency-hampering transactions.

DFID (2014) states that such inconsistency in the results is not only observable across countries but even within countries. Unresponsive investment-related variables may be constrained by underdeveloped financial markets, low educational attainment of farmers, prevalence of traditional techniques, low access to key infrastructures. In fact, a diversity of context-specific variables may interfere with the impacts of LPR on agricultural productivity and thus need to be adequately controlled. Preliminary information from the selected study area pointed to transportation and farmer's mindsets as relevant intervening factors. The following subsections discuss the theoretical underpinnings for such hypotheses as well as the outline of previously attempted studies.

2.4. Transportation as an Enabling Technology

LPR, as an economic institution that can influence people's behavior, can be, itself, regarded as a technology - even if of a social nature - which effects are described in economic growth theory. The expected economic benefits of LPR, as discussed previously, are productivity-enhancing because they imply the reduction in costs related with production. Nonetheless, it is assumed that the behavioral change that is expected to follow the introduction of secure LPR may not happen unless specific technological requirements or pre-conditions are met. (Solow, 1956).

By reducing costs, technologies have the effect of creating opportunities for farmers. In fact, different technologies may represent major constraints in different rural contexts. For example, unstable power supply may hamper the dairy industry, because some dairy products require refrigeration even for short periods of time. In other areas, difficulties in communication, such as lack of telephone coverage, may jeopardize the flow of relevant information for decision-making, such as market prices for products with fluctuating demand. The choice of transportation as an enabling technology to be investigated, therefore is motivated by the specific circumstances of the case study location selected for this research. That is in spite of the general appeal that transportation has for rural development programs.

Most of the lands expected to be included in agricultural production in the next years depend on new transportation systems (Gurara & Birhanu, 2012). As the world population is expected to rise above nine billion people by 2050, demand for food is forecasted to increase by 70% compared to 2010 (FAO, 2009). Investments in transportation are expected to unlock unexplored agricultural potential worldwide.

Even when it comes to rural areas that are already being farmed, transportation is often highlighted as one major restriction to economic development. Especially due to the fact that such regions are often far from urban facilities, inadequate access to transportation, in fact, affects people's livelihoods in direct ways. For example, it may limit access to schools and hospitals. There are, nonetheless, widely reported and investigated economic effects as well. The introduction of an efficient transportation system benefits the agricultural sector directly by diminishing costs for farmers to access markets. Through improved market access, farmers may experience further costs cuts in access to inputs and also gain competitiveness in selling their production. Additionally, all-year transportation, which can be made available by paving dirt roads, for example, favors reliability in the supply of necessary goods. Finally, there may also be travel time reductions, which favor commercialization of perishables in wider markets. Improved market access at lower costs and less travel time can be considered direct effects of transportation on agricultural productivity, but a number of efficiency-enhancing indirect effects may also follow. Given sufficient time for necessary adjustments, access to markets leads to specialization and agglomeration in agricultural production. If the supply of first necessity staple crops is ensured by stable logistic chains, farmers may switch to cash crops according to each region's agro-ecological potential and choose to purchase items for their own consumption from other regions. Similar effects may be achieved with the migration of farmers with a specific set of skills to lands where they can be best put to use. Further on, access to wider markets create opportunities to explore comparative advantages, which in turn boosts investments in land improvement, machinery, seeds, etc., all leading to the final result of increased land values (Fujita, Krugman, & J. Venables, 1999; Rodrigue, 2017; Shamdasani, 2016).

In summary, transportation can create business opportunities for farmers, who then can make use of the possibilities made available to them by secure LPR and effectively increase productivity. Farmers may find it in their best interest to sell or lease their lands to other who may be productive than themselves, or they may obtain loans from financial institutions and make productivity-enhancing investments on their own. Even if such possibilities are present once LPR is secured, farmers could choose not to make use of them unless opportunities for higher benefits were present. In this sense transportation is understood as an enabling technology for the effects of LPR.

One other way transportation may favor LPR follows from the discussion about the historical evolution of LPR, presented in section 2.2. Improvements in transportation have the effects of improving market accessibility and facilitating the migration of labor, which

may cause the increase in competition for land in a certain region. Higher competition for land may create the necessity for improvements in LPR, for example, common land may be converted into private land and owners of untitled land may seek titles to increase land tenure security. Necessity for secure LPR arising from transportation may be observed in increased land conflicts that have reportedly happened especially in developing countries.

In the previously cited example of the American conquest of the west, presented by Hornbeck (2010), one relevant precedent that is often argued to have contributed to the evolution of LPR in the region, was the construction of the Pacific Railroad. In this historical account, the construction of transportation infrastructure caused a significant increase in population density and potential land conflicts caused by increased competition for land. Without the railroad, population would have probably remained scattered in the territory, utilizing land mostly as an open access good. In the example of Thailand, presented by Heady & Feeny (1983), the role of the development of Maritime transportation lines was highlighted as a driver of the development of the institutions supporting formal land ownership in the country.

The example of Thailand is a case in which the concept of private property had been part of the local culture for some time and the transition caused by transportation was from a customary system to a formal LPR system. In general settings, transportation can be assumed to represent technological shocks that may influence not only the benefits of a formal LPR system, based on land titles, but also the costs of obtaining a title. The construction of roads and railways makes agricultural production economically viable, attracting investors and farmers with commercial interests, as well as potential settlers interested in residence. Increased competition for land may lead to conflicting claims, where land is not titled, and risks of expropriation or invasion. Therefore, land owners face higher incentives to acquire titles and seek state protection of their assets. At the same time, if land becomes more accessible, the cost of traveling to the land agency decreases for farmers, which may have a relevant impact on titling, especially if multiple trips are necessary to complete the titling process.

The reasoning presented above has found limited empirical demonstration. This is because in developed countries the transition from customary to formal LPR happened several decades or even centuries ago, so historical accounts are the common method for verifying these ideas. Notwithstanding, quantitative evidence has been presented by Alston et al. (1996). The authors utilized survey data from 1992 and 1993 collected in a location in the Amazon Forest in Brazil, which had been the focus of the Brazilian government's settlement programs in the 1970s and 1980s. In their framework, land titling is a function of the expected increase in land values due to titling, which diminishes as the distance to markets increases. They showed that farmers located closer to important markets were more likely to be titled.

In conclusion, transportation may function as an enabling technology for LPR in two ways: first, transportation may support the LPR arrangement itself, by creating the conditions necessary to the emergence of private and formal systems; and, second, it may create opportunities without which farmers may not make use of LPR in order to increase productivity.

2.5. Farmer's Mindset as an Enabling Condition

The reasoning behind the hypothesis that there must additional conditions in order to enable the effects of LPR relies on one key assumption. Farmers are assumed to behave as *homo oeconomicus*, which is usually referred to as rational behavior. While the extent to

which a certain behavior may be considered rational or not is highly debatable, economic theory employs a specific definition of rationality, much more restrictive than the daily use of the word.

The microeconomic definition of rationality includes the assumption of monotonicity, according to which consumer's preferences are such that individuals will always prefer more consumption, rather than less. For a bundle of consumption x , any bundle y , with more of at least one product; $y > x$, will be preferred to x : $y \succ x$. In the context of farmers, whose livelihoods are dependent on their agricultural productivity, monotonicity would suggest that farmers will seek to expand their production to the limits of available assets – including land - inputs and technology⁶.

However, such assumption has been challenged by past researchers concerned with rural development. Bellemare (2013), for example, studied locations in Madagascar and could not find any significant impact of farmer's status of titling on their investments and productivity. When discussing the reasons for this unexpected result, the author ruled out, for most observations, the usually assumed restrictions of incomplete financial markets, limited educational attainments and problems in market accessibility. So, the author noted that the search for higher productivity, at least beyond a certain level, was not aligned with the community's cultural practices. Farmers did not seem to be interested in producing more, but rather sought to ensure the continuation of their style of life. Such styles of life may be based on timeframes within a year or within the working day that is incompatible with commercial farming, for example.

Further discussing why higher agricultural productivity may not follow from improved property rights, (Ho, 2016a) suggests that land titles may represent a “foreign” device in some communities, given their cultural practices. Land tenure systems accord with several elements of social and economic life, such as social security and family networks. The author exemplifies that in rural China land tenure security may be considered low, given the possibility that government may redistribute land on its own judgment. Nonetheless, such practice meets wide social acceptance, since the government usually redistributes land for the purpose of social security and equality. If a farmer's family member passes away, for example, he may give up a part of his land since he has less dependents. If a farmer passes away and his dependents are transferred to the care of another farmer, the caretaker may receive more land. Incentives for higher productivity, in this case, do not seem to stem from a monotonic decision-making, but again determined by the interest in perpetuating a style of life.

The previous discussion suggests that the drive to expand productivity as much as possible may be absent in many farmers or contexts due to cultural considerations, or else, tradition and attachment to a lifestyle. Such attachment may exist even in spite of what may seem to the external observer as poor material comfort and low resilience to economic fluctuations. In such contexts, it is possible that farmers will overlook opportunities for investments, absorption of higher technologies and, generally speaking, higher profit that may be created by improvements in LPR. Notwithstanding, in addition to these factors, one emerging hypothesis as to why some farmers may be unresponsive to investment opportunities refers to psychological aspects in decision-making.

Authors in the field of behavioral economics provide insights into why there may be different behavioral patterns, especially when the individuals concerned find themselves in situations of poverty. Mullainathan & Shafir (2013) for example, explain that making

⁶ This is subject to another assumption, that farmers do not experience any form of disutility due to additional work. A more detailed model could consider an equilibrium between marginal productivity gains and disutility caused by excess work. However, let us ignore such effect for the time being, since such disutility may be explained, at least partly, by the factors which will be discussed further ahead.

investments is a consideration for the long term. However, such thinking may be out of the time frame of decision-making for poor individuals, who may have an excessive focus on short-term decisions due to a past record of material deprivation. Appadurai (2004) suggests that the poor may have a limited capacity to aspire to higher accomplishments due to social beliefs related to their role in society, which leads them to regard poverty as a natural feature of their lives.

The concept of mindset, regardless of its grounds in the fields of psychology and behavioral sciences remains slightly vague, due to its high level of subjectivity. For the purposes of this study, the concept requires further definition. The mindset is believed to consist on a set of beliefs, that are acquired through education, parenting and social exchange and can be changed through experience as long as the individual autonomously decides to replace these beliefs by others that he or she considers more adequate to their lives. Such beliefs have a relevant bearing on decision-making as they represent principles or values that are constantly referred to in mental processes in order to provide responses to everyday life situations. In particular, beliefs that are related to individual’s motivation are relevant constituents of mindset. The Theory of Planned Behavior proposes a classification of these beliefs in three kinds: attitude, subjective norms and perceived behavioral control. Attitude towards a behavior, which in the case of farmers in this study could be investments or efforts towards higher productivity, capture an intimate will of achieving a certain result. Subjective norms refer to the ways that an individual’s community will react to such behavior, either praising or scolding the individual. At last, the perceived behavioral control is a belief related to the one’s ability to succeed in the planned behavior, so it can be related to education, training, experience and also self-esteem (Ajzen, 1985).

Farmer’s mindsets in the present study have been classified into two: subsistence and commercial. The former have been found to display a full focus on immediate needs and a disregards for investment opportunities. They strive to maintain their conditions of living and that of their family members, displaying characteristics believes related to attitude, subjective norms and perceived behavioral control illustrated in Figure 2-3. These farmers are in contrast with the latter, who display a commercial mindset and thus strive to maximize profits, making investments and efforts to increase production as much as possible. (Ajzen, 1985)

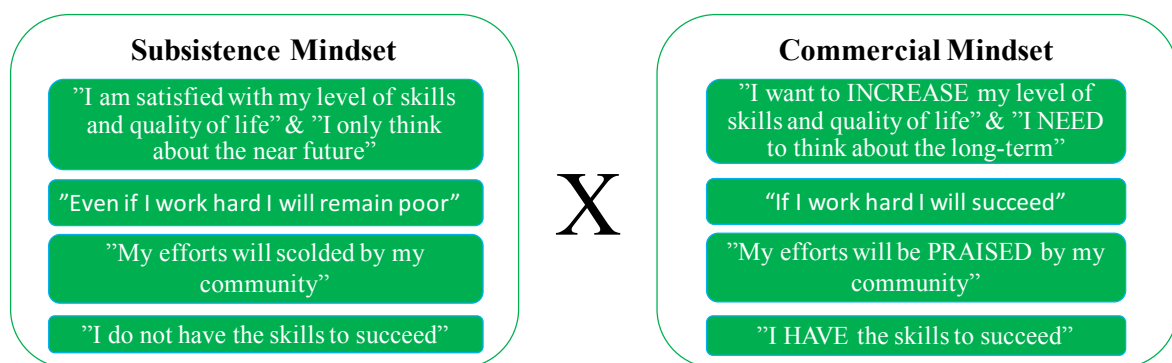


Figure 2-3: Beliefs associated with subsistence and commercial mindsets

Either due to cultural reasons or psychological factors, or potentially both, farmers are assumed to display different mindsets - in particular diverging from the economic rational maximizer mindset - which shapes their decision-making and typical behaviors regarding productive choices. Empirically speaking, little research has been made in order to understand and measure the effect of farmer’s mindsets on agricultural productivity, as

the concept is, to some extent, borrowed from other domains of study. At a theoretical level, however, the concepts discussed above ground the crafting of the hypothesis that farmer's mindsets constitute an enabling condition for the effects of LPR on agricultural productivity. Figure 2-4 illustrated the assumed mechanism through which mindsets are expected to intermediate the impact of LPR on the formation of farmer's incentives.

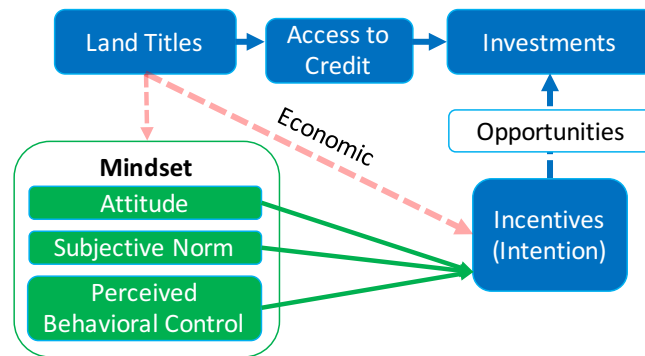


Figure 2-4: Assumed mechanisms of intermediation of mindsets on farmer's incentives

2.6. Conclusion

Previous research has set a detailed theoretical background for understanding the nature, origins, evolution, determinants and effects of LPR. While little disagreement related to the nature of LPR seems to remain, other aspects of it have not been fully clarified and lack empirical demonstration.

As for the origins of LPR, it is challenging to investigate them beyond what has already been achieved through historical accounts. Since many of the critical developments in LPR happened in relatively distant past, there is a natural limitation on quantitative data, so, for the most part, only qualitative descriptions are possible. In fact, this discussion may remain largely within the interests and methods of the domains of philosophy and law.

Regarding the evolution of LPR and, in particular, the determinants of the adoption of private and formal LPR, however, it may still be possible to conduct investigations in a quantitative manner. In fact, many areas in the world, even in developed countries, may be undergoing such processes in recent times. A detailed case study in an adequately selected area may shed light onto the specific mechanisms through which LPR changes into its more secure forms, supporting higher productivity. Such understanding may subsidize the elaboration and implementation of land titling programs, as part of rural development initiatives.

Finally, regarding the effects of LPR, despite the detailed theoretical description of mechanisms through which agricultural productivity can be affected, the empirical literature has not been able to find an unequivocal impact. While many quantitative studies have found a positive relationship between improved LPR and agricultural productivity, this result has not been consensual in the literature. Similar disagreement is observed also when intermediate variables, such as investments and use of credit are investigated. This pointed to the possibility of existence of missing factors in the quantitative analyses. This led researchers to collect and analyze data on a broad range of socio-economic indicators, such as educational attainment and completeness of financial markets in the studies areas as well

as to investigate the specific mechanisms of impacts of LPR on agricultural productivity. Results, however, remained inconclusive.

The present study, therefore, considers these accomplishments and limitations and seeks to further advance the understanding of LPR with a view on issuing policy recommendations for rural development. The hypotheses set for this research incorporate the previous attempts of including a wider range of socio-economic factors but exceed them in the sense that the new factors considered represent a deeper reflection about the functioning of LPR as an economic institution and the extent to which human behavior can be affected by it. First, by considering technological requirements to LPR, the present study probes the determinants and conditions that enable the economic institution to stand and produce its effects. Second, by including behavioral aspects, both cultural and psychological factors are considered, which may subsidize discussions which have not yet been made, but in a speculative manner.

3. METHODS

This chapter offers an overview of the methods utilized in this research. The specific details about data collection and analytical techniques employed will be presented in detail in the analysis chapters that follow, as each specific research question led to the collection of different types of data and, consequently, different analytical techniques. In the following sections, the research question and the hypotheses will be set as a function of the findings of the literature review, the analytical framework will be presented, then the different focuses and scopes that were investigated will be outlined. Finally, a general description of the econometric techniques utilized will be presented.

3.1. Research Questions and Hypotheses

The major motivation for the present research is the prevalence of poverty in rural areas worldwide. In determining the causes for such problem, it is noted that in rural areas the main source of livelihood is often the agricultural production carried out by farmers themselves. Low agricultural productivity is then identified as a major cause for rural poverty. Finally, a major assumption is made: that Land Property Rights represent a relevant constraint for agricultural productivity⁷.

Previous research has already focused on the issue of empirically demonstrating the validity of the major assumption, based on a consolidated theoretical foundation. Results, however, have been mixed, so literature on the matter is inconclusive. In trying to account for the persistence of these mixed results, researchers hypothesized that additional conditions were necessary in order to enable the impacts of LPR. Previously investigated conditions have been related to incomplete financial markets, low educational attainment and limited market accessibility. However, results remained mixed after controlling these conditions. It is necessary, therefore, to expand the search for further additional conditions.

The question that is investigated in the present research is as follows:

What conditions affect the impacts of LPR on agricultural productivity in developing rural areas?

Box 3-1: Research Question

Two main hypotheses were set as tentative responses to the research question, as reflected the boxes 2 and 3:

There could be technology requirements to realize the impacts of LPR on agricultural productivity

Box 3-2: Main Hypothesis 1

⁷ A detail justification for these arguments is made in the introduction.

Farmers' contexts of poverty may pose behavioral constraints to the impacts of LPR

Box 3-3: Main Hypothesis 2

Hypothesis 1 assumes that land property rights can be regarded as a social technology which requires the prior adoption of other technologies as necessary condition. Since the expected impacts of LPR on agricultural productivity are dependent on market transactions, such as the commercialization of surplus production, land ownership transfers and financial operations, technologies that facilitate such transactions are candidates for hypothesized enabling technology.

The presence or absence of specific technologies with the hypothesized enabling effect of facilitating market transactions is highly dependent on local contexts. It could be, for example, that in certain areas, lack of communication between market players could cause information asymmetries that severely limits prospects for higher profit from higher productivity. In other contexts, given the nearly inexistent market power that farmers can exercise, in face of oligopolies or simply due to the high number of farmers, social technologies such as agricultural cooperatives could represent an enabling technology.

One technology that is often pointed out as critical for market access is transportation. As a form of technology, transportation reduces costs and enables transactions with perishable products in a time consistent manner. Due to remoteness, rural areas are often severely constrained by difficulties in transporting agricultural products. Given that such problems are common across rural areas throughout the globe, transportation is chosen as one key technology, thus constituting an overall working hypothesis.

Transportation constitutes one key technology that may enable the impacts of LPR on agricultural productivity

Box 3-4: Overall Working Hypothesis 1

Hypothesis 2 is grounded on the idea that individuals not always behave as strict profit maximizers. In this sense, it challenges the common economic conception of rational behavior, as far as it is based on easily quantifiable variables, such as income or revenue. Rather, it introduces the possibility that farmer's behavior is influenced by factors that are not usually taken into consideration in economic theory. These factors belong to two major categories.

First, there could be cultural aspect that disfavor higher productivity as a desirable goal for farmers, at least beyond a point of satiation. Farmers may be attached to traditional lifestyles, that may be incompatible with the timeframe of commercial farming throughout the year or within the working day. Second, poor farmers may face psychological constraints to decision-making that bias their choices. These constraints take the form of over-concern for short-term issues and disregard for higher aspirations due to beliefs related to the role of the poor in society. The combination of cultural and psychological aspects constitutes farmer's mindsets, which is assumed to be of two kinds.

Some farmers are assumed to have a commercial mindset; they aim to maximize profits in line with rational decision-making theory and are likely to make investments whenever possible. Commercial mindset farmers are expected to make choices and take decisions in an entrepreneurial manner, constantly seeking the most profitable employment

of their assets as well as the expansion of their assets. Other farmers have a subsistence mindset, their goal is to provide for their immediate needs, often overlooking investment opportunities. Subsistence mindset farmers may possess more assets that they actually employ in production. Throughout their lives, the level of effort they exert in production and its betterment is proportional to the needs of their families.

Improvements in LPR may be welcome by both types of farmers, but will be utilized in different ways. Commercial mindset farmers will effectively make use of the possibilities created by land titles, for example, to access financial markets, rent out land and make investments. Subsistence mindset farmers will be content but satisfied in enjoying higher tenure security, which matches their goal of maintaining their style of life. This idealized typical behavior is thought to arise specially in contexts of poverty, so farmer’s mindset is hypothesized as the key aspect of poverty that may constitute an enabling condition for the impacts of LPR

The mindset constitutes one key aspect of farmers in contexts of poverty that may enable the impacts of LPR on agricultural productivity.

Box 3-5: Overall Working Hypothesis 2

The hypotheses evolve from a general starting point to more specific and context-dependent levels. Chapters from 4 to 10 will set specific research questions and consequently high-specificity working hypotheses. With this gradually evolving framework, the limits of generalization of the results can be accurately discussed later on.

3.2. Analytical Framework

In order to quantitatively test the hypotheses outlined in the preceding section, detailed working hypotheses are necessary. These hypotheses are crafted in close connection with the observed and collected data. Figure 3-1 summarizes the analytical framework used in this research, which expresses causal relationships between interest variables. The framework consists of two major components: first, hypothesized mechanisms that relate LPR and agricultural productivity, in line with the theoretical foundations from past literature. These mechanisms are outlined in gray boxes; second, hypothesized intermediation by enabling conditions – transportation and mindset – outlined in the green box.

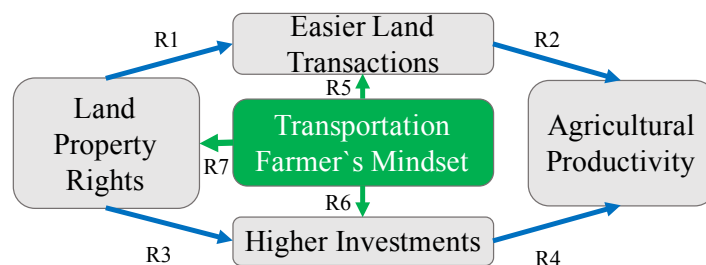


Figure 3-1: Integrated Analytical Framework

For most chapters, the indicator used to express Land Property Rights is the titling status of farmers – titled or untitled. In chapter 4, however, a national-level indicator is employed. The arrows indicate causal relationships, which constitute, each of them, a

tentative working hypothesis to be tested. The reasoning behind each arrow is explained in chapter 2.

Relationship R1 stems from the fact that secured ownership of land expands the market for potential transaction partners. Also, in the case of private and formal land ownership, registration procedures diminish information asymmetries. R2 assumes that if land transactions can be performed unimpededly higher efficiency in land allocation arises, which favors productivity. R3 also stems from the benefits of improved tenure security, which reduces risks for farmers and financial institutions. Access to credit is expected to improve and farmer’s investments, to increase. R4 assumes that such investments will favor the adoption of technologies that will increase productivity. R5 assumes that the enabling conditions facilitate transactions. Transportation may reduce transaction costs and farmers will a commercial mindset actively seek beneficial transactions. R6 assumes that the enabling conditions also favor investments, by analogous paths. Finally, R7 assumes that the enabling conditions may influence LPR itself. Farmers with a commercial mindset may actively seek land titles in order to secure their assets. Transportation is expected to increase the benefits of possessing a land title as well as diminishing the costs of obtaining one.

Due to data collection and study design limitations not all the causal relationships are investigated in this research. Table 3-1 summarizes the specific working hypothesis that are investigated in each chapter. Chapter 5 is a description of the case study location and data collection methods and Chapter 10 is a discussion about policy recommendation, none of which explicitly tests hypotheses.

Table 3-1: Specific Working Hypotheses

	Relationship	Specific Working Hypotheses
Ch. 4	R5 & R6	“The impacts of LPR on agricultural productivity are higher in countries where the quality of transportation is higher”
Ch. 6	R7	“Farmers located near the paved road are more likely to have a land title than those located farther” “Farmers that utilize the railway to transport their production are more likely to have a land title than those located farther”
Ch. 7	R1, R2, R3 & R4	“Farmers who have a land title display higher productivity than untitled farmers”
Ch. 8	R3	“Farmers who have a land title make more investments than untitled farmers” “Farmers who have a land title are more likely to contract loans than untitled farmers”
Ch. 9	R1	“Farmers who have land titles perceive land transactions (sales, leases and bequest) to be conducted more easily than untitled farmers”

3.3. Focus and Scope

Different focuses and scopes are attempted in order to provide a comprehensive approach to the research question. The different focuses refer to different aspects of the relationship between LPR and agricultural productivity as outlined in the analytical framework. Each chapter corresponds to one focus, which translates into one of the specific

working hypotheses outlined in Table 3-1. The different scopes refer to the nature of the data collected and analyzed in each chapter, or the different ways to regard and measure the variables and relationships of interest. Three different scopes are utilized.

First, an international comparison was carried out, which provided a macro-level analysis of the relationship between LPR and agricultural productivity. This analysis is appropriate for the overall validation of the major assumption that was set, that LPR significantly affects agricultural productivity, using a wide scope. The result, therefore is valid at a wide geographical range, covering a diversity of contexts. It also promotes an attempt at measuring the quantitative impact and was designed in a way to consider the intermediation of transportation as an enabling technology. The downside, however, lies on the loss of specificities and variations that may appear within the territory of countries, since the indicators used are aggregated at the country level. It is also not possible to shed light into the mechanisms connecting LPR and agricultural productivity, but rather promotes a “black box” approach.

Second, microdata was collected through a case study conducted in an appropriately chosen Municipality in Brazil⁸. This analysis allows a detailed investigating of behavior at the individual’s or farmer’s level, with the downside of possibly compromising the application of results at more general settings. This case study included a detailed literature review, review of statistical data available from official government sources and, most importantly, a local visit. During this visit, qualitative interviews were conducted with local authorities and key stakeholders, such as the Mayor, elected officials and representatives from the farmers. Also, a household survey was conducted with the use of a paper-based questionnaire. Data from a wide range of socio-economic variables was collected, which allowed for in-depth analyses of the causal relationships outlined in the analytical framework.

Third, expert interviews were carried out with the purpose of subsidizing the elaboration of policy recommendations, which are the final objective of this thesis. Specialists were contacted in Japan International Cooperation Agency, which is concerned with rural development and consulted in order to validate the findings in light of their practice, as well as verify the possibility of incorporating the findings into their work.

Table 3-2 summarizes the focus, scope and method utilized in each of the following chapters. The methods applied vary according to the type of data and rely on regression analysis for the investigation of causal relationships. A detailed description of the econometric methods will be presented in each chapter with reference to the theoretical background employed in the elaboration of each econometric model, but a summary is presented in the next section.

Table 3-2: Focus, Scope and Method by Chapters

	Focus	Scope	Method
Ch. 4	Transportation & LPR	Intl. Comparison	OLS and IV (Data Panel)
Ch. 5	Case Study in Brazil	Microdata	Structured Questionnaire
Ch. 6	Transportation & Titles	Microdata	Logistic Regression and IV
Ch. 7	LPR & Productivity	Microdata	OLS and PSM
Ch. 8	LPR & Investments	Microdata	Logistic Regression and PSM
Ch. 9	LPR & Transactions	Microdata	Logistic Regression
Ch. 10	Policy Recommendations	Expert Interviews	Qualitative Analysis

⁸ The criteria for the choice of the location will be discussed in Chapter 5.

3.4. Summary of Econometric Methods

The main econometric method utilized in this thesis is Regression Analysis, which consists on a set of mathematical processes that are used to identify and quantify – through a model - the causal relationship between variables. The direction of causality is assumed from independent variables to dependent variables. Regression analysis, however, may take several different forms depending on characteristics of the data and assumptions about the nature of the relationships under investigation. This section will briefly explain the crafting and interpretation of regression models estimated by the Ordinary Least Squares (OLS) technique, models with Instrumental Variables (IV), Logistic Regression Models and Propensity Score Matching (PSM), as utilized for the purposes of this thesis.

3.4.1. Ordinary Least Squares

Ordinary Least Squares is the benchmark regression analysis tool, consequently the most commonly used. In regression analysis in general, an equation describing the relationship under investigation is specified. A dependent variable Y is assumed to suffer effects or be influenced by a set of independent variables X , at unknown rates, called unknown parameters β . This equation often expresses a some kind of relationship f between independent and dependent variables, which is often linear but depending on the theory on which the empirical study is grounded, it is possible to introduce quadratic, exponential or relationships of other types. The following equation expresses the general form of regressions equations.

$$E(Y|X) = f(X, \beta) \quad (3.1)$$

If the function f specifies a linear relationship between variables, the extended form of the previous equation will be of the following sort:

$$Y_i = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_n X_{ni} + \varepsilon_i \quad (3.2)$$

α is a constant value. The index i refers to the i th individual unit and the indexes $1 \dots n$ refer to the n th variable and respective unknown parameters. ε represents the different between the observed Y_i and the estimated values of Y , therefore being called error term.

Data for regression analysis studies usually consists on observations of interest variables for individual units, such as persons, farms or countries. Observations express real situations and regression analysis seeks to infer relationships between variables – expressed by the unknown parameters - by simultaneously observing these variables across all observations. The term Ordinary Least Squares refers to the way the unknown parameters are estimated. OLS consists on calculating estimates of the unknown parameters such that the difference between observed dependent variables and their model-predicted values – commonly referred as the error ε - is the smallest possible. If the calculated parameters display statistical significance, the hypothesized relationship for the variable at hand is said to hold. The magnitude of the parameter provides an estimate of the quantitative strength of the relationship.

There are three major ways that data can be organized for regression analysis using OLS. In case there are observations of individual units regarding a number of variables referring to one specific moment time, data will be presented as a cross-section. In case the

data refers to one individual unit over a number of periods of time, data will be presented as a time series. Finally, if data refers to multiple individual units over multiple periods of time, data will be presented as a data panel. The present thesis utilizes both cross-section data and data panel. Each type of data arrangement requires specific procedures.

In order for OLS to work for any type of data, however, some assumptions are made regarding the characteristics of the data used and the hypothesized relationships. In case such assumptions do not hold, adaptations to the OLS method need to be made, which originates the following statistical techniques in the present summary. The six assumptions for the use of OLS are the following:

1. The sample is representative of the population for the inference prediction.
2. The error is a random variable with a mean of zero conditional on the independent variables. $E(\varepsilon | X) = 0$.
3. The independent variables are measured with no error.
4. The independent variables are linearly independent, so it is not possible to express any predictor as a linear combination of the others.
5. The errors are uncorrelated.
6. The variance of the error is constant across observations.

In case assumption 1 is violated, the sample is said to be biased, which may lead to inaccurate estimations of the parameters. Different procedures can be adopted in order to mitigate problems caused by this violation, in particular Propensity Score Matching. Assumption 2 means that the information regarding the dependent variable that cannot be explained by the independent variable is random. The violation of hypotheses 3 and 4 also leads to inaccurate estimations. Assumption 5 will be violated if there is a relationship of causality from the dependent variable to some of the independent variables, while the causality is normally assumed to flow in the opposite direction. This problem is called endogeneity and will be tackled in this thesis using Instrumental Variables. The violation of assumption 6 leads to inaccurate estimators and can be mitigated by procedures for heteroscedasticity. The data collected and analyzed in the following chapter is likely to violate some of these assumption, so three adaptations of the OLS model are used.

3.4.2. Propensity Score Matching

Propensity Score Matching (PSM) is a technique utilized when there are suspicions that sample selection is not perfectly random, which violates assumption 1. The usual context in which it is used is when the objective of the quantitative study is to estimate the impact of a certain binary variable – a treatment – on individual units. A common situation that may lead to biased sample selection arises when the individuals themselves choose to receive the treatment or not, which is commonly referred to as self-selection bias. This choice may be the result of differences in other variables, which may also influence the variable that is expected to be affected by the treatment. In this case, the estimation of the impact of the treatment will suffer a bias.

The method consists on surveying the existing sample and matching each individual unit that has received the treatment with some other individual unit that has not received the same treatment but displays similar characteristics in terms of the other variables. In order to establish the similitude between individual units, two procedures are applied.

First, the probability of receiving the treatment is calculated for each individual unit x_i as a function of the available independent variables, what is called the propensity score

$p(x)$. In the following equation T means the treatment and X refers to the independent variables.

$$p(x_i) \equiv \text{Prob}(T = 1 | X = x_i) \quad (3.3)$$

If $Y(T = 1)$ and $Y(T = 0)$ denote the potential outcomes when the treatment is applied and when it is not applied respectively, the desired situation in which there are no variables that may bias the estimated impacts of the treatment is expressed by the following equation, in which \perp denotes statistical independence.

$$Y(T = 1), Y(T = 0) \perp (T | p(X)) \quad (3.4)$$

Second, for each individual that received the treatment, an individual that did not receive the treatment and whose propensity score is sufficiently near is identified. A rule has to be chosen in order to establish the maximum difference in propensity scores that is tolerated. This maximum difference is called the caliper. Smaller calipers correspond to more strict rules so it may not be possible to find individual units whose propensity scores are sufficiently near. Larger calipers, however, lead to easier matching, but less similitude between units is tolerated.

After the matching is complete, it becomes easier to identify the impact of the treatment, having other variables which may potentially act as confounders under control. At this point, econometric methods such as logistic regression can be applied in order to estimate the impact of treatment.

3.4.3. Instrumental Variables

The Instrumental Variables (IV) approach is utilized when assumption 2 is violated, that is, when some of the independent variables is correlated with the error. This situation is called endogeneity and often arises when there is a two-way causality between the dependent variable and independent variable at hand. Another situation that may lead to endogeneity happens when there is some other variable that has been omitted from the regression equation that affects both the dependent and the independent variable. In this case, the independent variable is said to be endogenous.

The consequence of endogeneity is that the estimated unknown parameters β will be biased, potentially under or overestimating the real causal relationship between the independent and the dependent variable and severely jeopardizing the research work.

Endogeneity can be formally expressed by the following two equations. Instead of utilizing the expectancy operator E and vector representations of the variables as in equation 1, now the regression equation (3.4) is presented in the extended form. E denotes the endogenous variable.

$$Y_{1i} = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 E_i + \varepsilon_i \quad (3.5)$$

$$E(\varepsilon | X, E) \neq 0 \quad (3.6)$$

In order to tackle this problem an instrumental variable needs to be introduced. This variable is able to affect the endogenous variable but has no effect on the dependent variable, which allows the researcher to identify the causal effect of the endogenous variable on the dependent one. Instrumental variables, therefore, need to meet two requirements:

- The IV must be correlated with the endogenous variable, conditional on the others.
- The IV cannot be correlated with the error term in the equation, conditional on the other variables (It cannot, itself, be endogenous, which is known as exclusion restriction).

The procedure then consists on running OLS regressions twice. In the first stage, the endogenous variable is treated as a dependent variable in a regression where all the other independent variables, along with the instruments I, are used as independent variables. The second stage resembles the original regression equation (3.4) with the difference that, instead of directly utilizing the observation of variable E, the predicted values E* obtained from the first stage regression are used.

1st Stage Regression:

$$E_i^* = \gamma + \pi_1 X_{1i} + \pi_2 X_{2i} + \pi_3 I_i + \epsilon_i \quad (3.7)$$

2nd Stage Regression:

$$Y_i^{2nd} = \alpha + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 E_i^* + \epsilon_i \quad (3.8)$$

This procedure is commonly referred to as 2-stage least squares (2SLS). It eliminates the endogeneity in variable E, by discarding it as part of the error ϵ in equation (3.6). In fact, the variations in E_i^* become fully explained by the other independent variables and the IV, in such a way that any influence from the dependent variable will necessarily be left aside in the error term.

3.4.4. Logistic Regression

Logistic Regression is utilized to model the relationship between independent variables and a dependent variable that is categorical, that is, assumes a limited set of values. Possible values are usually binary, such as yes or no, win or lose, and 0 or 1; ordered, such as 1...6 or very easy, easy, difficult or very difficult; or even multinomial, in which case there is not any specific order, such as choices of modes of transportation. In the present research, binary and ordered dependent variables were investigated.

The approach utilized in Logistic Regression consists on taking a dependent variable that may take only limited values and convert it into a continuous one. It is done by calculating the odds of a certain value being taken by the dependent variable and then taking the logarithm of this value. The logarithm of the odds is called the logit of the probability, defined in equation (3.8):

$$\text{logit } p = \ln \frac{p}{1-p} \text{ for } 0 < p < 1 \quad (3.9)$$

The dependent variable Y in a regression model then follows a Bernoulli distribution. Finally, the general model to be estimated is:

$$\text{logit } E(Y) = \alpha + \beta X \quad (3.10)$$

The error component is assumed again to follow the Gumbel distribution.

With such a formulation, it is possible to estimate the impact of independent variables, which may be continuous or categorical, on the likelihood of a certain result be realized. By verifying the statistical significance of the estimated unknown parameters, the relevance of the hypothesized relationship between variables can be established. Finally, in order to calculate the impact in terms of percentage points or percent change, it is necessary to undo the transformation made by the logit function, converting predicted logits into predicted odds. This reversion can be done through exponentiation.

4. TRANSPORTATION, LAND PROPERTY RIGHTS AND AGRICULTURAL PRODUCTIVITY WORLDWIDE⁹

4.1. BACKGROUND

The hypothesis that this chapter intends to investigate is that transportation may be one relevant technology that can enable the impacts of LPR on agricultural productivity. Nonetheless, transportation has an appeal of its own as a tool for rural development. In the US, for example, agricultural production accounts for 30% of all goods transported by all modes, which makes agriculture the largest user of the transportation system (U.S. Department of Transportation, 2010). Agricultural regions are often distant from urban areas, which increases the need for transportation. Meanwhile, inadequate transportation networks, mostly in developing countries, keep access costs to markets high, which limits prospects for economic uplifting.

The introduction of transportation benefits the agricultural sector directly by diminishing costs and time travel for farmers, as well as ensuring access to markets all year round. However, it may also generate indirect efficiency-enhancing effects where access to markets leads to specialization and agglomeration. Additionally, opportunities to explore comparative advantages boosts investments in land improvement, machinery, seeds, etc., which increases land values. This indirect effects are related to LPR to the extent that LPR favors land transactions and investments. (Fujita et al., 1999).

More specifically, this chapter examines a hypothesis that the impacts of improved LPR on agricultural production are higher in countries where the quality of transportation is higher. A panel dataset from 76 countries from 2007 to 2013 is analyzed. A model for agricultural productivity is specified, where both quality of transportation and effectiveness of property rights – measured by international institutions – as components of agricultural total factor productivity (TFP).

4.2. LITERATURE REVIEW

Past researchers have investigated the theoretical relationships between transportation, economic performance, and LPR. For example, Alston, Libecap, & Schneider (1996) provided insights regarding the association between transportation costs and property rights. They presented a framework with a demand curve for land titles, which is dependent on the present value of land net of transportation costs, so that land located near markets is more likely to be titled than land located farther away. By comparing the benefits of titling with the costs involved in titling, such as paperwork costs and lobbying, individuals decide whether or not to apply for titles. It follows from this reasoning that transportation could trigger the expansion of a formal LPR. They also showed that their framework was consistent with experimental data in Brazil.

Many studies have investigated the relationship between effective LPR - where tenure is ensured and transactions are unimpeded - and economic performance. Early works attempted to evaluate the impact of property rights on economic performance by means of

⁹ The contents of this chapter have been published with adaptations, including tables and pictures, under the following reference: Alves, L.B.O and Kato, H. (2018) ‘Transportation and Land Property Rights: Economic Impacts on Agricultural Productivity’ *Transportation Research Record*. Doi.: 10.1177/0361198118775868.

international comparisons. In order to measure the effectiveness of property rights, several indicators that provide country-level views have been used. Earlier studies relied mostly on a measure of risk of expropriation as a proxy for secure property rights, which is provided in the International Country Risk Guide (ICRG). More recently, new indicators have become available, such as the International Property Rights Index and The Heritage Foundation's Index of Economic Freedom. Acemoglu, Johnson, & Robinson (2005) used a sample dataset of 64 countries and related their gross domestic product (GDP) per capita in 1995 to ICRG's index of property rights. They employed two-stage least squares regressions (2SLS) in order to address problems of endogeneity stemming from potential reversed causality or omitted variables. Results show a positive impact of property rights on GDP per capita. Kerekes & Williamson (2008) confirmed Acemoglu's results utilizing indicators provided by both the ICRG and by The Heritage Foundation. Using a collection of model specifications, they found that more effective property rights result in improved capital formation and economic growth. Other studies suggest different possible relationships. Chong & Calderon (2000) argued that there may be a two-way causality between economic growth and property rights. Bose et al. (2012) suggested a non-linear relationship between the two variables, with property rights having diminishing marginal impacts as countries' income increase. It must be noted, however, that these did not focus specifically on Land Property Rights but on property rights in general.

Despite these favorable initial results, studies conducted at the local level that attempted to investigate the specific mechanisms through which LPR influence economic performance have found inconclusive results. Research designs vary substantially according to specific local contexts where questionnaire surveys are often used for data collection. Benin & Pender (2001) studied locations in Ethiopia and found that only 1 out of 15 investment-related variables was affected by their proxy of tenure insecurity. Deininger & Jin (2006), however, also investigated Ethiopian locations and found that expectation of future expropriation has a strong effect on investment. Similarly, Goldstein & Udry (2008), in a study conducted in Ghana, found that lower risk of expropriation leads to longer fallowing of land. Place & Migot-Adholla (1998) studied the effects of titling and land registration in four locations in Kenya and found that the effects on perceived land rights, credit use, crop yield, and land concentration were weak. They concluded that, should governments aim at agricultural development, investments in infrastructure would likely be more effective than titling alone. Jacoby & Minten (2007), in a similar study conducted in Madagascar, found that having a title has little effect on farm-specific investment, productivity, and land values.

DFiD (DFID, 2014) states unresponsive economic performance variables may be constrained by underdeveloped financial markets, low educational attainment of farmers, prevalence of traditional techniques, etc. A diversity of context-specific variables may interfere with the impacts of property rights on economic performance. Finally, generally speaking, the matter of transportation acting as an enabling technology and consequently a potential missing factor that could constrain the impacts of LPR have not received extensive attention.

By adopting the international scope, the present chapter promotes a deepening of the macro-level studies described above and intends to provide an overview of the relationship between transportation, LPR and agricultural productivity at an international scale.

4.3. METHOD

This study sets up a hypothesis that the impacts of LPR are higher in countries where the quality of transportation is higher. This reflects the idea that if transportation is absent, opportunities for farmers to make effective use of the possibilities created by land titles may be absent. In such cases, the expected efficiency-enhancing effects of land transactions and investments may not happen, due to lack of economic attractiveness. An econometric approach employed in this study treats a measure of the quality of transportation and an indicator of effectiveness of property rights as constituents of TFP across a sample of 76 countries¹⁰, which were classified across two dimensions, following a methodology proposed by the World Bank (Deininger, K., Byerlee, D., Lindsay, J., Norton, A., Selod, H. & Stickler, 2010).

Countries are categorized into four types according to their availability of land for further agricultural expansion and the gap between their agricultural yield and a theoretical maximum. The first type contains countries, mostly in Latin America, that tend to be competitive global players in agricultural markets and have suitable land for expansion, low yield gaps, and relatively secure land tenure for investors, although their property rights systems may not be fully effective across their territories. The second type includes countries like Mongolia and Ukraine that have suitable land but display large yield gaps and may experience restrictions to agricultural production in infrastructure, education, or financial markets or even in political situations. The third type covers countries with little land available and high yield gaps. Most are developing countries that can be constrained by a diversity of factors, ranging from the aforementioned to armed conflicts and corruption. Finally, countries with little land available and low yield gaps tend to be very populous countries that use land intensively and/or developed countries, which apply advanced agricultural technologies and face few or none of the aforementioned restrictions. The full sample and their classifications are illustrated in Figure 4-1.

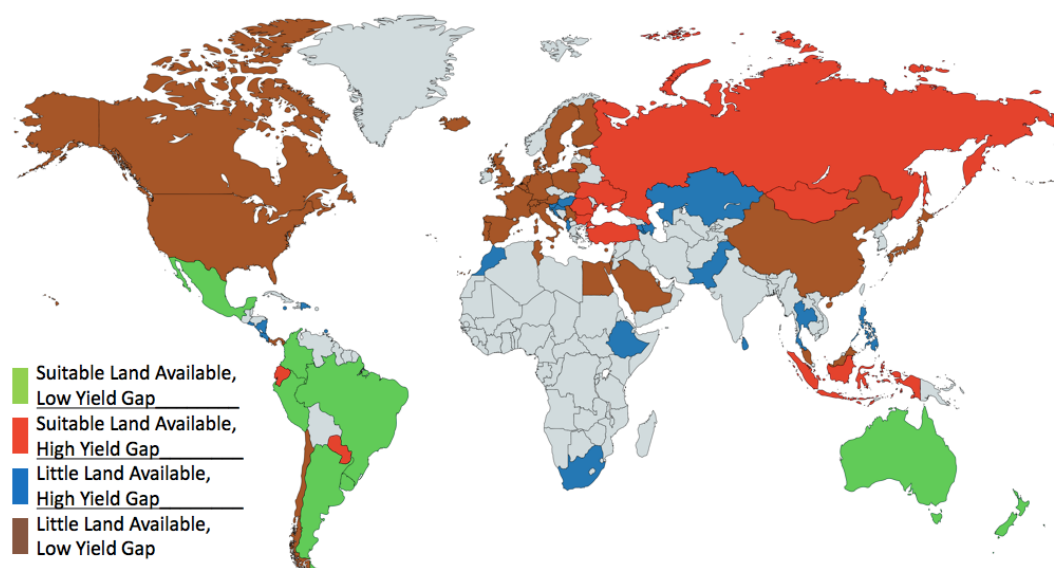


Figure 4-1: Countries in the Sample Dataset and Their Classifications

¹⁰ The sample is the largest possible selection of countries for which all variables were available for at least two consecutive years. This criterion was adopted in order to avoid measurement errors that yielded outliers in the dataset.

The dependent variable – gross agricultural production value – displays considerable variability across countries, due to unobservable factors. This wide variability suggests the adequacy of the fixed effects method. By adopting different intercepts for each country, this procedure allows unobservable country-dependent effects to be captured. This choice is also supported by Hausmann's test.

A Cobb-Douglas agricultural production function is assumed as equation (1) shows:

$$Y_{it} = K_{it}^{\beta_1} L_{it}^{\beta_2} G_{it}^{\beta_3} f(.) \quad (1)$$

where Y_{it} represents the gross agricultural production value in country i and year t ; K_{it} represents the capital of country i and year t ; L_{it} represents the labor of country i and year t ; G_{it} represents the land of country i and year t ; $f(.)$ represents the TFP function; and β_1 , β_2 , and β_3 are unknown coefficients. The TFP function is the portion of agricultural production that cannot be explained by the quantities of the factors of production.

Three types of models are employed in the model estimation using the above production function. The first model specifies the TFP function as

$$f(TQ_{it}, PR_{it}) = \exp(\mu + a_i + \beta_4 PR_{it} + \beta_5 TQ_{it} + \beta_6 PR_{it} \cdot TQ_{it}) \quad (2)$$

where TQ_{it} is the quality of transportation in country i and year t ; PR_{it} is the effectiveness of property rights in country i and year t ; μ is the error component; a_i is the country specific constant in country i ; and β_4 , β_5 , and β_6 are unknown coefficients. By plugging the TFP function in equation (2) into the production function (1) and taking the natural logarithm for both sides of the whole equation, we obtain the expression for the base regression model as:

$$\ln Y_{it} = \mu + \alpha_i + \beta_1 \ln K_{it} + \beta_2 \ln L_{it} + \beta_3 \ln G_{it} + \beta_4 PR_{it} + \beta_5 TQ_{it} + \beta_6 PR_{it} \cdot TQ_{it} + \varepsilon_{it} \quad (3)$$

where ε_{it} is the error component. The main coefficient we are interested in is β_6 , which captures the interaction between effectiveness of property rights and the quality of transportation. Differentiating equation (3) with respect to PR_{it} yields the impact of effectiveness of LPR on agricultural output as:

$$\frac{\partial \ln Y_{it}}{\partial PR_{it}} = \beta_4 + \beta_6 TQ_{it} \quad (4)$$

The estimated coefficient $\hat{\beta}_6$ is expected to have a positive sign, meaning that higher levels of quality of transportation lead the higher impacts of LPR. The first model is estimated using the ordinary least squares (OLS) method.

Next, the second model introduces a proxy for quality of education into equation (2) yielding an expanded model as:

$$f(TQ_{it}, PR_{it}, ED_{it}) = \exp(\mu + a_i + \beta_4 PR_{it} + \beta_5 TQ_{it} + \beta_6 PR_{it} \cdot TQ_{it} + \beta_7 ED_{it}) \quad (5)$$

where ED_{it} represents the quality of education in country i and year t . This procedure is adopted in order to tackle possible biases caused by the omission of relevant variables. Education is strongly correlated with each country's level of development and public institutions, which is also a relevant component of TFP. The second model is also estimated with the OLS method.

Finally, the third model incorporates instrumental variables (IVs) in order to address concerns of endogeneity related to quality of transportation, as described by Arman, Manesh, & Izady (2015). In this case, endogeneity stems from the fact that, while better transportation causes higher output, higher output causes higher transportation quality through greater investments in infrastructure. This double causality may lead to bias in the estimations. Then, the model incorporates the variables that can explain the quality of transportation without direct causality to agricultural output. Each country's rate of savings, gross fixed capital formation, and gross domestic product per capita were selected as instruments for our measure of the quality of transportation¹¹. A regression with quality of transportation as the dependent variable and the instruments as independent variables is specified. The fitted values of the first stage regressions (TQ_{it}^*) described in equation (6) replace the original quality of transportation variable (TQ_{it}) in equation (3), yielding a second stage regression. TQ_{it}^* consists of the original variables cleared from their correlation with the error term ε_{it} .

$$TQ_{it}^* = \pi_0 + \pi_1 RS_{it} + \pi_2 GFKF_{it} + \pi_3 GDPpc_{it} + v_{it} \quad (6)$$

where RS_{it} represents the rate of savings in country i and year t ; $GFKF_{it}$ represents the gross fixed capital formation in country i and year t ; $GDPpc_{it}$ represents the GDP per capita in country i and year t ; v_{it} represents the error component; and π_0 , π_1 , π_2 , and π_3 are unknown coefficients.

4.4. Data and Variables

Table 4-1 summarizes the potential variables used in the model estimation. Observations are annual and span from 2007 to 2013 for most countries, while some years were not available for all countries, yielding an unbalanced panel with a total of 479 entries¹².

Table 4-1: Potential Variables in the Dataset

Variable	Unit	Source	Comments (Span 2007 – 2013)
Gross Agricultural Production Value	US\$ of 2005 (Mil.)	FAOSTAT (26)	Value of production at farm's gate
Agricultural Land	1,000 ha	FAOSTAT (26)	The sum of arable land and permanent crops
Gross Agricultural Capital Stock	US\$ of 2005 (Mil.)	FAOSTAT (26)	
Employment in Agriculture	1,000 People	FAOSTAT (26)	

¹¹ Even though agriculture may represent a low percentage of developed countries' GDP, there is no clear correlation between GDP per capita and agricultural output. In fact, countries with high GDP per capita, such as the United States, Australia, or France, have comparatively high agricultural production, as do countries with a much lower GDP per capita, such as Brazil or China. As for savings and gross fixed capital formation, as macroeconomic variables, they should explain relatively little about agricultural output, especially in countries where agriculture is labor intensive.

¹² If all seven years of observations were available for all countries, the total number of observations would be 532, meaning that 90% of the observations are effectively available. Missing observations are most often either the first or the last years in the series for their countries.

Quality of Railways	Index (1-7)	WEF (27)	WEF's annual Executive Opinion Survey
Quality of Roads	Index (1-7)	WEF (27)	WEF's annual Executive Opinion Survey
Quality of Ports	Index (1-7)	WEF (27)	WEF's annual Executive Opinion Survey
Quality of Transportation	Index (1-7)	WEF (27)	Average of quality of roads, railways and ports
Legal and Political Environment Index (LPEI)	Index (1-10)	IPRI (28)	Indicators provided by the World Bank and WEF
Physical Property Rights Index (PPRI)	Index (1-10)	IPRI (28)	Indicators provided by the World Bank and WEF
Land Property Rights Index	Index (1-10)	IPRI (28)	Average of LPEI and PPRI
Quality of Education	Percentage	World Development Indicators (29)	Rate of enrollment in tertiary education
Rate of Savings	Percentage	FAOSTAT (26)	
Gross Fixed Capital Formation	US\$ of 2005 (Mil.)	FAOSTAT (26)	
GDP Per Capita	US\$ of 2005 (Mil.)	FAOSTAT (26)	

Gross agricultural production value has been compiled by multiplying gross production in physical terms by output prices at the farms' gates, thus leaving aside any industrial processes undertaken by companies other than the farms themselves. The sum of arable land and permanent crops approximates the extension of land effectively used for agricultural purposes for each given country and year. Gross agricultural capital stock and employment in agriculture are estimates produced by the Food and Agriculture Organization of the United Nations (FAO) based on several sources. The indicators of quality of transportation are available in the World Economic Forum's Global Competitiveness Report and are based on surveys carried out annually to assess executives' opinions regarding aspects of the business environment in each country. Indicators of effectiveness of property rights are components of the International Property Rights Index, compiled by the Property Rights Alliance. The Legal and Political Environment Index (LPEI) is based on indicators of judicial independence, rule of law, political stability, and corruption. The Physical Property Rights Index (PPRI) accounts for the protection of physical property rights and ease of access to loans, and also considers the cost and time required to register property. The proxy for education, provided by the World Bank, consists of the rate of enrollment in tertiary education expressed as the percentage of the total population of the five-year age group from secondary school departure on. It is closely correlated with the quality and reach of the primary/secondary educational systems. Rate of savings, gross fixed capital formation, and GDP per capita are obtained from each country's national accounts.

Table 4-2: Descriptive Statistics

	Minimum	First Quartile	Median	Third Quartile	Maximum	Mean	Standard Deviation
Gross. Agr. Prod. Value	4.5E+04	2.0E+06	6.2E+06	2.1E+07	5.8E+08	2.3E+07	7.0E+07
Agricultural Land	9.3	784	5,10	12,10	515,4	43,796	98,973
Gross. Agr. Capital Stock	356	5,672	26,620	61,210	1,005,535	74,482	151,143
Employment	1.8	113	478	2,137	307,310	6,357	33,643
Quality of Railways	1.01	2.53	3.45	4.68	6.8	3.57	1.45
Quality of Roads	1.44	3.30	4.31	5.45	6.72	4.32	1.31
Quality of Ports	2.07	3.68	4.62	5.42	6.79	4.54	1.08
Quality of Transp.	1.93	3.31	4.22	5.28	6.54	4.24	1.16
LPEI	2.56	4.2	5.71	7.46	8.98	5.84	1.84
PPRI	3.16	5.67	6.33	7.2	8.79	6.45	1.11
Land Property Rights Index	3.60	4.95	6.05	7.25	8.87	6.15	1.40
Quality of Education	5.25	39	57.83	72.33	110.26	55.39	21.86
Rate of Savings	-9.99	17.05	21.44	26.76	60.78	22.64	9.98
Gross Fixed Capital Form.	542	7,885	32,462	96,559	3.01E+06	150,147	386,523
GPD Per Capita	212	4,093	8,875	36,183	88,748	19,112	19,500

*Unit of measurement of each variable described in Table 4-1

Table 4-2 presents the descriptive statistics for the indicators of the quality of transportation and effectiveness of property rights for the sample dataset used in this study.

First, this shows a large variability in all macroeconomic variables, which is due to the disparity in terms of size of economy and economic performance across countries. Second, that the mean in the quality of railways is significantly lower than the means in the qualities of roads and ports. This may reflect the difficulties of investment in and/or maintenance of railways. Third, the mean of LPEI is lower than that of PPRI. This may be because the emergence of basic protective mechanisms to property, perhaps diffused social values that are enforceable by community coercion, precedes the development of state institutions, such as representative assemblies and courts. Fourth, all indicators of quality of transportation and property rights display considerable variability across the sample, even

though they tend to be relatively stable for each country over the seven-year timespan employed in this study.

Figure 4-2 displays a correlation plot between the Land Property Rights Index versus Gross Production Value for the year 2013.

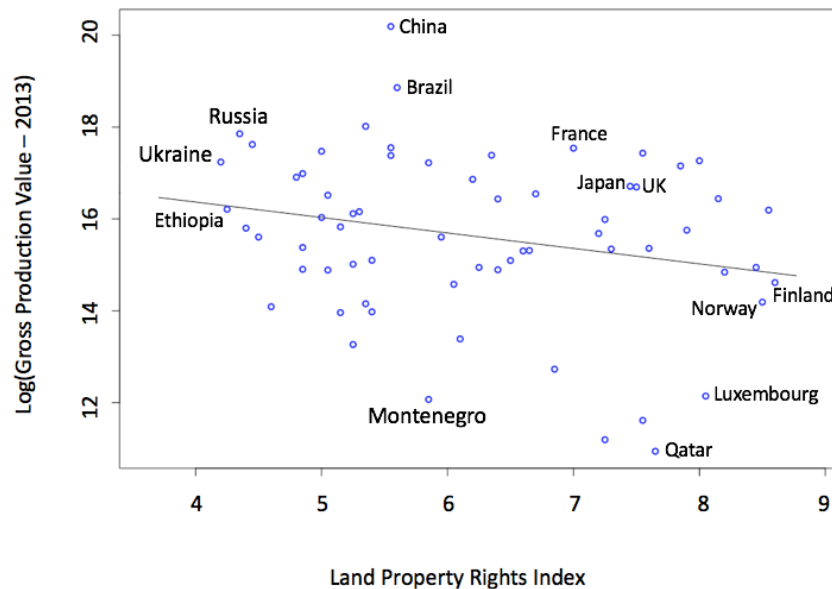


Figure 4-2: Land Property Rights Index versus Log(Gross Production Value – 2013)

At first glance, this unconstrained analysis may show a negative relationship between the variables, expressed by the fitted line, which is consistent for every year. However, further examination of this relationship should be elaborated with the regression analysis since it seems variable across countries.

4.5. ESTIMATION RESULTS

Table 4-3 summarizes the estimation results¹³ for the base and the expanded models using an OLS method and the IV model using two-stage least squares.

¹³ R^2 for most of the regressions are in the 20% to 30% range while the adjusted R^2 tends to be below 5%. At first glance, these results may seem discouraging, however, it is common for these fitness measures in panel data regressions to be comparatively low. This is because R^2 and adjusted R^2 are unable to account for variations in the dependent variable that is explained by the intercepts, while using different intercepts for each cross-section unit is the core of the fixed effects methodology and essential in a dataset that displays stark variations between countries for the dependent variable (Baltagi, 2013).

Table 4-3: Estimation Results of Pooled Models

Method: Fixed Effect Panel Data Estimation						
Dependent Variable: ln (Gross Agricultural Production Value)						
Independent Variables	Base Model		Expanded Model		IV Model (2SLS)	
	Coef.	t-values	Coef.	tvalue	Coef.	tvalue
β_1 ln (G. Agr. Capital Stock)	0.27**	6.28	0.22**	3.99	0.38**	6.70
β_2 ln (Employment)	0.02**	2.86	0.00	-0.30	0.00	0.41
β_3 ln (Agricultural Land)	0.04	1.62	0.34**	4.08	0.04	1.53
β_4 Land Property Rights	0.12**	4.69	0.10**	3.48	0.12**	4.44
β_5 Quality of Transportation	0.14**	3.80	0.11**	2.78	0.13**	3.59
β_6 Prop. Rights x Qual. Trans	-0.02**	-3.77	-0.02**	-2.69	-0.02**	-3.53
β_7 Education		n.a.	0.002**	3.04		n.a.
	n=76 (2-7 yrs) N=479		n=76 (2-7 yrs) N=479		n=76 (2-7 yrs) N=479	
R ²		0.20		0.24		0.21
Adjusted R ²		0.03		0.05		0.04
F-statistic	16.82 on 6 and 394 DF		14.21 on 7 and 393 DF		16.57 on 6 and 394 DF	
	p-value: <0.01		p-value: <0.01		p-value: <0.01	

Source: Author Elaboration. “***”: 1% Significance, “**”: 5% Significance

First, the results show that the measure of agricultural capital stock has a significant influence on the agricultural production in all models, with elasticities varying from 22% to 38%. But the estimated coefficient of employment is significantly positive only in the basic model, with an elasticity of 2%, while that of agricultural land is significantly positive in the expanded model only, with an elasticity of 34%. These results can be understood in light of the fact that there are large cross-country differences in terms of production technology, with the predominance of capital stock, often captured as the level of mechanization in agriculture as the major determinant of productivity.

Second, the results show that the estimated coefficients of land property rights ($\hat{\beta}_4$) are significantly positive in all models while those of their cross-term ($\hat{\beta}_6$) are significantly negative in all models. The marginal effects of the land property rights (PR_{it}) are derived from equations (1) and (2) as $\hat{\beta}_4 + \hat{\beta}_6 TQ_{it}$; thus, the results lead to the land property rights positively influencing the agricultural product when TQ_{it} is lower than 7 in the base model, 5.5 in the expanded model, and 6.5 in the IV model, respectively; otherwise they could have negative impacts. Note that the median of TQ_{it} is 4.22 as shown in Table 4-2. This means that the marginal effects of land property rights may be decreasing as the quality of transportation increases. This possibly reflects the fact that developed countries have advanced transportation systems in place and most of the gains from transportation on agricultural productivity were likely absorbed in the past. This may be an unexpected result.

Finally, even though the estimated coefficient of education is statistically significant in the expanded model, it displays little economic relevance, which may be explained by labor’s low contribution as a factor of production compared to capital and land. Low

economic significance for the proxy of education mitigates concerns of misspecification in the base model.

It should be noted that alternative specifications were tested, including a quadratic term for transportation, in order to account for decreasing impacts as suggested by Adamopoulos (2011) and Canning & Pedroni (2004). Year dummies were also tested in order to isolate potential short-term volatilities and the measures of quality and transportation were replaced by each of their modal components. None of these procedures, however, yielded significantly different results.

Next, Table 4-4 presents the estimation results of regressions for each of the four country categories separately using the base model.

Table 4-4: Estimation Results of Regression Using Subsamples

Method: Fixed Effect Panel Data Estimation: Base Model									
Dependent Variable: ln(Gross Agricultural Production Value)									
Independent Variables	Little Land, Low Gap		Suitable Land, Low Gap		Little Land, High Gap		Suitable Land, High Gap		
	Coef	t-values	Coef	t-values	Coef	t-values	Coef	t-values	
β_1 ln (G. Agr. Capital Stock)	0.34*	6.96	0.38*	3.23	0.14	1.59	0.57	1.69	
β_2 ln (Employment)	0.03	1.40	-0.02 [’]	-2.17	0.04	1.82	-0.03	-0.73	
β_3 ln (Agricultural Land)	0.00	-0.30	0.47*	4.59	0.34	1.57	0.59	1.72	
β_4 Land Property Rights	-0.01	-0.30	0.32*	4.87	0.43*	4.05	0.09	0.44	
β_5 Quality of Transportation	-0.02	-0.64	0.58*	5.04	0.48*	3.45	0.25	0.74	
β_6 Prop. Rights x Qual. Transp.	0.00	0.45	-0.08*	-4.37	-0.10*	-3.49	0.03	-0.35	
	n=37, T=2-7, N=247		n=8, T=5-7, N=50		n=22, T=2-7, N=127		n=9, T=3-7, N=55		
R ²	0.21		0.80		0.29		0.38		
Adjusted R ²	0.03		0.72		0.10		0.17		
F-statistic	8.95 on 6 and 201 DF		23.64 on 6 and 36 DF		6.84 on 6 and 99 DF		4.14 on 6 and 40 DF		
	p-value: <0.01		p-value: <0.01		p-value: <0.01		p-value: <0.01		

Source: Author Elaboration. “*”: 5%Significance. “ ’ ”: 10%Significance

Countries with suitable land for expansion and low yield gaps displayed the highest level of statistical significance for all explanatory variables. Brazil, Argentina, and Uruguay are examples of countries in this category. The highly capital-intensive sort of agriculture performed in these countries, as pointed out by Deininger, K. et al. (2010), may justify the negative coefficient calculated for “employment.” The magnitude of the impact of transportation and negative marginal effects of property rights are higher for these countries than for those with little land for expansion and high yield gaps, even though results for this category of countries must be interpreted with caution, due to the fact that the factors of production were insignificant. Countries with little land for expansion and low yield gap – mostly developed countries – did not display statistical significance for most regressors. The

impacts of LPR, in particular, must have been absorbed long before the timespan of the study, since these countries adopted private and formal LPR decades or even centuries ago and count with efficient public institutions when compared with less developed countries. As for countries with suitable land for expansion and high gap, the insignificance of the coefficients may be explained by the interference of several other constraints. These are, in fact, the poorest countries in the sample, some of which experience armed conflicts, severe poverty, and corruption.

4.6. DISCUSSION AND CONCLUSION

The main finding of our empirical analysis is that the impacts of LPR are lower in countries where the quality of transportation is higher. The findings are contrary to the theoretical framework. Two possible explanations are presented.

First, the result could be explained by the fact that the benefits of improvements in the property rights system are larger in poor countries, which also tend to have lower quality transportation (Bose et al., 2012). This effect may also be consistent with Alston et al. (1996). In this case, it seems necessary to revise the analytical framework. In particular, the view that transportation enables the impacts of LPR by creating opportunities, however theoretically sound, does not seem to meet empirical support. However, transportation may remain relevant as an enabling technology. One possibility is that transportation triggers the replacement of customary systems with formal ones. Before and after this institutional change, marginal improvements in the quality of transportation may have little effects on the impacts LPR. In effect, statistical significance was strongest for countries with suitable land for expansion and low yield gap – middle-income countries mostly in Latin America – where this institutional change may be in progress. In developed countries, this change may have happened long ago, while very poor countries may not be experiencing it yet.

Second, areas with less effective property rights – often land-rich countries – are more likely to house large farms. They may be more productive because they benefit from scale, scope, and perhaps also the presence of sophisticated supply chains, enabling them to tap international markets more easily than family-size farms can once better transportation is put in place. This could have alarming consequences. If higher agricultural output is easier to achieve in areas with less effective property rights systems, transportation projects may lead to land transactions that are not utility-maximizing for certain agents, violating Pareto optimality. For example, large-scale land acquisitions may originate land conflicts and expropriate or impoverish indigenous peoples, peasants, and other social groups currently living under customary property rights systems (Brasselle, Gaspard, & Platteau, 2002; Deininger & Jin, 2006; Fenske, 2011). Our findings were strongest for the land-rich countries in the sample, such as Brazil and Argentina. They displayed the highest impacts of transportation and the largest negative marginal effect of property rights. The prevalence of large-scale farms, along with the adoption of capital-intensive production techniques may explain their global competitiveness, but ineffective property rights systems may be the root of land conflicts and undesirable social outcomes. In fact, regarding these concerns, Gurara & Birhanu (2012) remark that 51.8% of land globally sought after by foreign investors is located in Sub-Saharan Africa, a region that scores very low in International Property Rights Indexes.

From this discussion, two important issues emerge. The first is the possibility that transportation triggers the change from customary to formal land rights. In most settings, this could mean the establishment of institutions and/or the expansion of issuance of land

titles. Such possibility constitutes the overall working hypotheses that will be analyzed in Chapter 9. The second issue refers to the possibility that some countries with low effectiveness of LPR display high agricultural productivity. It is in disagreement with the general assumption that LPR is a relevant determinant of agricultural productivity, thus requiring further investigation. Given the specificities of LPR systems in local contexts, however, it seems unlikely that further macro-level studies will yield the necessary insights. The next chapter, therefore, consists on a locally conducted case-study which is followed by quantitative data analysis in the Chapters 6 to 8.

5. LAND PROPERTY RIGHTS AT THE LOCAL SCALE: CASE STUDY IN CAMPOS LINDOS

5.1. BACKGROUND

The previous chapter presented an analysis of land property rights, the hypothesized intermediating role of transportation and the impacts on agricultural productivity at an international scale, by means of a regression analysis in a dataset of country-level variables. The findings raised two major issues: the first refers to the possibility of a causal relationship between transportation and changes in LPR; the second challenged our analytical framework, due to the finding that countries with low effectiveness of LPR displayed high agricultural productivity. The first issue constitutes a new hypothesis to be tested and the second requires a detailed look into the workings of land property rights, that may not be possible when the wide focus of a country-level study is applied.

High productivity requires capital investment, the use of advanced technologies and the employment of qualified labor, all of which may seem unlikely when the risk of expropriation of the major asset involved in farming – land itself – is present. One possible explanation for the apparent puzzle lies in which the indicators of effectiveness of land property rights employed in the study in chapter 4 were aggregated at country-level. LPR, however, may be sensitive to specific local circumstances, varying at a much smaller scale, perhaps even within one single municipality. One typical reason for such variation is simply the status of titling of farmers. Regardless, however, cultural or traditional norms related to land with certain specific physical characteristics may also influence the level of tenure security. Land along water streams or lakes, for example, may be traditionally regarded as of common use, due to that animal need access to water for hydration. In yet another example, mountains may be considered sacred or the property of some authority.

It must be noted that variations in the level of tenure security and the characteristics of land property rights in local contexts may persist even under a homogenous legal background. While in most countries land related laws and regulations are determined, at least until certain point, at the national level of government and decision-making, the actual effectiveness of such laws and regulations may be subject to several factors. For example, the State may lack the capacity to enforce some of its rulings in parts of the territory. Moreover, some detailed interpretation of the law may be left at the discretion of local authorities.

Such considerations point to the need of a micro-scale case study in order to complement and clarify the issues identified in the macro-scale study in the previous chapter. The setback in this methodological choice is the possible difficulty in generalizing results. Therefore, the present chapter's foremost aim is to provide a detailed description of the study location and data collection techniques. With such information, readers from diverse backgrounds may consider to which extent to results of the analysis conducted in the following chapter are transposable to their own contexts.

5.2. CAMPOS LINDOS, BRAZIL

The chosen location for the present study is called Campos Lindos, a municipality located in the State of Tocantins, Brazil, as shown in Figure 5-1. It is home to an estimated population of 9,795 people according to data from 2017, of which nearly 60% live in an

underdeveloped urban center and the rest is spread out over a vast territory of over 3000 km². The economy of Campos Lindos is centered in agricultural production, so its vast territory, along with favorable agro-ecological potential¹⁴, constitute its major asset. It is at the heart of an extensive agricultural belt, responsible for the mass production of grains, especially soybean and corn. The municipality ranks as the largest grain producer and source of income in foreign currency in its state. Its grains are partly exported to distant consumer markets - notably the European Union and China. The rest of the production is sold

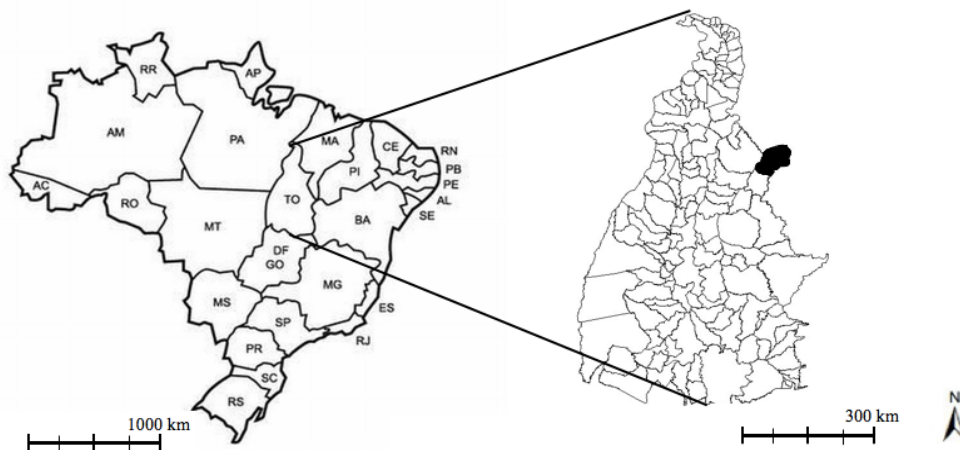


Figure 5-1: Location of Campos Lindos. Source: <http://www.mapasparacolorir.com.br>

domestically and is mostly used for input in the cattle breeding industry. A minor fraction is industrialized for human consumption.

The type of soil found in Campos Lindos is generally deep,azonated, red or yellowish red, porous, permeable, well drained and therefore intensely leached. Regarding its texture, the sand fraction usually predominates, followed by the clay and finally the silt. They are therefore predominantly sandy, sandy-clayey, or, possibly, clayey. Its water holding capacity is relatively low. The organic matter content of these soils is small, generally being between 3% and 5%. As the climate is seasonal, with a long period of drought, the decomposition of humus is slow. Native vegetation is characterized by low height grass coverage with sparse trees with deep roots, thick bark and retorted trunk.

As for chemical characteristics, the soil is quite acidic, with pH ranging from less than 4 to just over 5. This strong acidity is due in large part to high levels of Al³⁺, which makes them aluminotoxic for most plants agricultural activities. High levels of Fe and Mn also contribute to its toxicity. Low cation exchange capacity, low base-sum and high Al³⁺ + saturation, characterize these dystrophic soils and therefore unsuitable for agriculture. Correction of pH by liming (application of limestone, preferably dolomitic limestone, which is a calcium and magnesium carbonate) and fertilization, both with macro and micronutrients, can make them fertile and productive, either for grain culture or of fruit trees. This is what is done in our large soy producing region. Besides soybeans, other grains such as corn, sorghum, beans, and fruit such as mango, avocado, pineapple, orange, etc. are also successfully cultivated. With liming and fertilization, this type of soil has become the great area of agricultural expansion in Brazil in the last decades. The large-scale production of

¹⁴ Favorable conditions of weather and soil, such as adequate regime of rains, temperature, as well as acidity and fertility of the soil. The concept is closely related to the needs of specific crops and breeds.

grains employs sophisticated technologies, with the use of advanced machinery guided by Global Positioning System, developed seeds, and agrochemicals, which make it markedly capital-intensive. Due to this feature, combined with a high agro-ecological potential, the grain farmers display high levels of productivity, which enables them to be competitive at a global scale. Agribusiness multinationals, such as Cargill, Bunge, and Multigreen can be found in the municipality, providing credit or technical assistance, and dealing directly with the farmers. Figures 5-2 and 5-3 display the commercial large-scale agriculture practiced in Campos Lindos.



Figure 5-3: Large Scale Storage Facilities



Figure 5-2: Harvesting in Large Scale Farm

In spite of the wealth that is generated in the grain farms, the municipality has a large number of dispossessed people and poor farmers, often engaging in subsistence agriculture and employing simple techniques in much smaller farms. The subsistence farmers are very unlikely to produce soybeans, since they do not use them directly for domestic consumption. Instead, they grow rice, beans, fruits, and cassava while they breed cattle, pig, and chicken. They may have experiences of tenure insecurity, food insecurity and overall poor resilience against economic fluctuations.

Due to the relatively low level of productivity, lack of agro-industrial processing and insufficiently developed local markets, small-scale farmers engage in limited trade, only selling occasional production surpluses. They may occasionally exchange products with neighbors, but, in any case, most of the production is for self-consumption. This double-edged situation can be appreciated in a number of statistical indicators made available by Brazil's National Institute of Statistics: While the annual GDP per capita in the Municipality in 2015 stood around US\$10,000.00, ranking it in the 87th percentile among all Municipalities in the country, the level of income directly reported by individuals in the 2010 Census was roughly 10 times smaller, at around US\$1,000.00. Since the main source of income in the Municipality is farming, such disparity suggests large differences in productivity. In terms of value of production, soybean and corn accounted for 99% of the agricultural output, with all other crops making up to less than 1%. In terms of Human Development Index, Campos Lindos ranks in the 6th percentile. Only 9.2% of households were considered to dispose of adequate sanitation (Instituto Brasileiro de Geografia e Estatística, 2018). Figures 5-4 and 5-5 illustrate the small-scale farming in Campos Lindos.



Figure 5-4: Small-scale farmer breeds chicken



Figure 5-5: Small-scale farmer breeds cattle

Table 5-1: Socio-Economic Indicators of Campos Lindos*

Indicator	Value	Indicator	Value
Population (2017 - estimated)	9,795 people	Reported Household Income (2015)	US\$1,000.00
Area	3,240 km ²	Human Development Index	0.544 (low)
Population Density	3.02 inhabitants/km ²	Percentile in Brazil:	6th
GDP per capita (2015)	US\$10,000.00	Households with Adequate Sanitation (2010)	9.20%
Percentile in Brazil:	87th	Child Mortality (Before 5 yrs)	18.07%

*Instituto Brasileiro de Geografia e Estatística

5.2.1. Origins of the Municipality and Land Conflicts

One major aspect of the history of Campos Lindos consists on the persistent land conflicts. In fact, the region has been the stage for a number of dramatic episodes, in which farmers clash for the ownership of certain areas. The search for the origins of such conflicts point to the way in which the territory of current days Brazil was occupied, first by Portuguese settlers - before the independence in 1822 - and later by Brazilian settlers or immigrants of other nationalities. From the beginning of colonial times, land had been appropriated mostly in an unsupervised manner, at the margin of the legal system. During most of the colonial period, there was no formal system of land registry. With time, decentralized registries appeared and a number of initiatives to formalize land ownership were taken. The results, however, were incomplete and uneven throughout the vast territory of the country, which, requires extensive resources to be surveyed. As land became scarce in the areas that were settled earlier, especially near the coast of the Atlantic Ocean, people ventured farther and farther west into new lands, claiming ownership in equally informal ways. Thus, the informality in land appropriation and the ensuing tenure insecurity has been perpetuated (Mueller, 2003; Rezende & Guedes, 2008).

The history of Campos Lindos follows a similar logic. The earliest registries of residents in the region are from the late XIX century, as the first settlers moved in from the

eastern states. The following account from a respondent to the survey illustrates the narrative:

I arrived very long ago, around the 1960s. My father brought the whole family from the neighboring state of Maranhão. When we arrived, this region was called a desert. There was nobody here, the land was said to belong to the State Government. Slowly people started coming, nobody had titles in the beginning. Some people eventually got their titles through different government programs that would come and go from times to times.

Respondent 1, 67 years, squatter in the community Raposa

The recent population growth, however, is closely linked with the development of transportation infrastructure in its state. A railway stretching from north to south of the state was gradually constructed, starting in 1987¹⁵. The state of Tocantins itself was founded in 1988, making it the youngest state in the Brazilian Federation. The establishment of the state administration included the foundation of a new city to serve as capital, followed by a network of roads that continues to grow until present days. The closest railway loading station to Campos Lindos was inaugurated in 2008, in the nearby Municipality of Palmeirante.

The railway is a centerpiece for the development of the state and, in particular, to the history of Campos Lindos. It is used almost exclusively with the purpose of transporting the grain production from the farms in the region to the seaports, around 1000km away. Grain production in the region would be uneconomical, should international markets have remained inaccessible. The gradual expansion of the railway throughout the years along with improvements in the networks of roads reduced costs and provided cumulative boosts to the production of grains in the Municipality. Consequently, the evolution of grain production and transportation are closely linked to the history of Campos Lindos. The first experiments with soybean production in the region were conducted in the late 1980s. Then, the Municipality was formally established in 1993. In order to test the hypothesis that transportation could cause changes in LPR, in this case specifically by favoring land titling, quantitative studies in the region may utilize farm-level data in the attempt to control to several possible intervening factors. Figure 5-6 shows the evolution of the transportation infrastructure serving Campos Lindos. The white line marks the railway. The date of the inauguration of the loading stations and their distance to Campos Lindos are indicated. The black line shows the paved road, and the white balloon marks the urban center of Campos Lindos. In Figures 5-7, 5-8, 5-9 and 5-10, the advance of settlement in the area can be appreciated in 4 different moments in time: 1986, before the major developments described above; 1996, the year before the start of the agricultural project; 2006, when most of the settlement had been completed; and 2016, the most recent year for which satellite images are available, shows that large-scale agriculture – characterized by yellowish terrain in contrast with the native green vegetation – started to spill out to the neighboring Municipalities.

¹⁵ First, the Estrada de Ferro Carajás Railway (EF-315) was put into operation in 1986. Subsequently, the Ferrovia Norte-Sul Railway (EF-151) was gradually expanded southwards, from the end point of Estrada de Ferro Carajás.

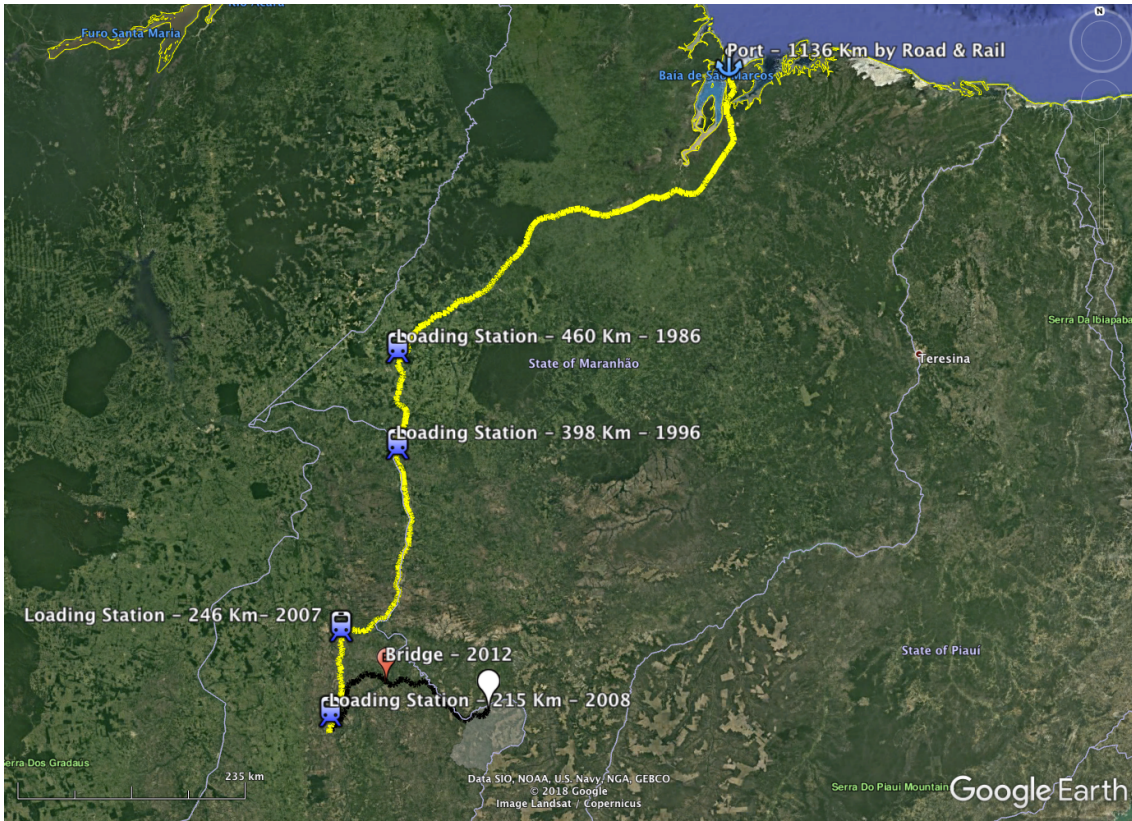


Figure 5-6: Evolution of the Transportation Infrastructure Serving Campos Lindos. Generated by Google Earth Pro Version 7.3.1.4507 (64-bit)



Figure 5-7: Campos Lindos in 1986



Figure 5-8: Campos Lindos in 1996



Figure 5-9: Campos Lindos in 2006



Figure 5-10: Campos Lindos in 2016

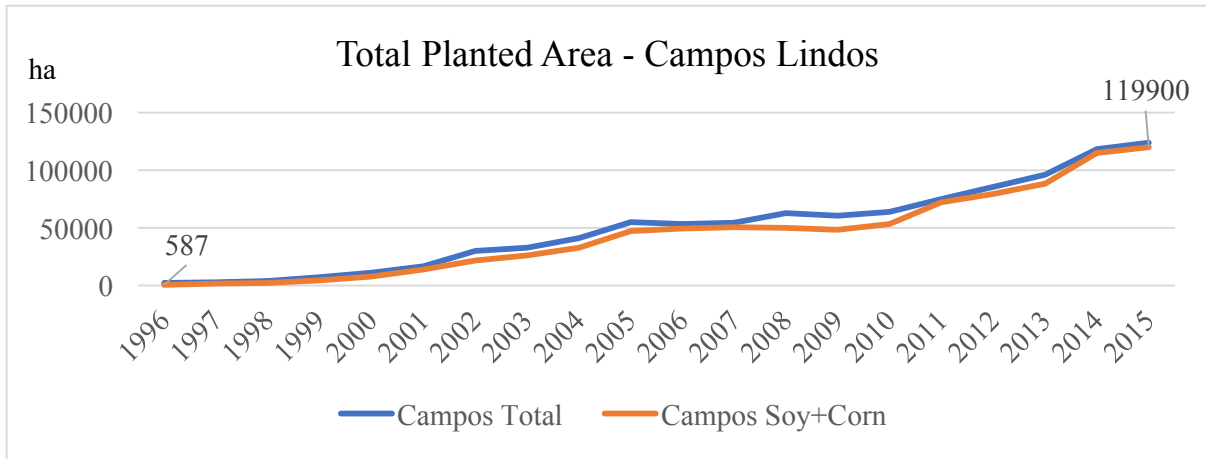


Figure 5-8: Total Planted Area in Campos Lindos for Grains and All Crops. Source: Instituto Brasileiro de Geografia e Estatística

In 1997, one key development began. The state government started a project with the stated purpose of promoting a “modern agro-industrial economy”¹⁶. This agricultural project significantly accelerated the mass production of grains in the Municipality and consisted on the government surveying the land and selling it in plots ranging from 300 to 4000 ha to investors and knowledgeable farmers. Figure 5-11 depicts the evolution of the area effectively used for agriculture in Campos Lindos from 1996 to 2015. It shows that the area dedicated to soybean and corn increased 204 times, while all the other crops occupied a nearly stable area.

A similar pattern can be appreciated in Figures 5-12 and 5-13, that show, respectively, the evolution of the value of agricultural production in Brazil and in Campos Lindos for soybean and corn and for all other crops. Agricultural production in Campos Lindos increased 348 times after the introduction of the agricultural project while for the whole country the increase was only 3.3 times. Nonetheless, in Campos Lindos this result has been concentrated in grains, while the value of other crops remained nearly unchanged.

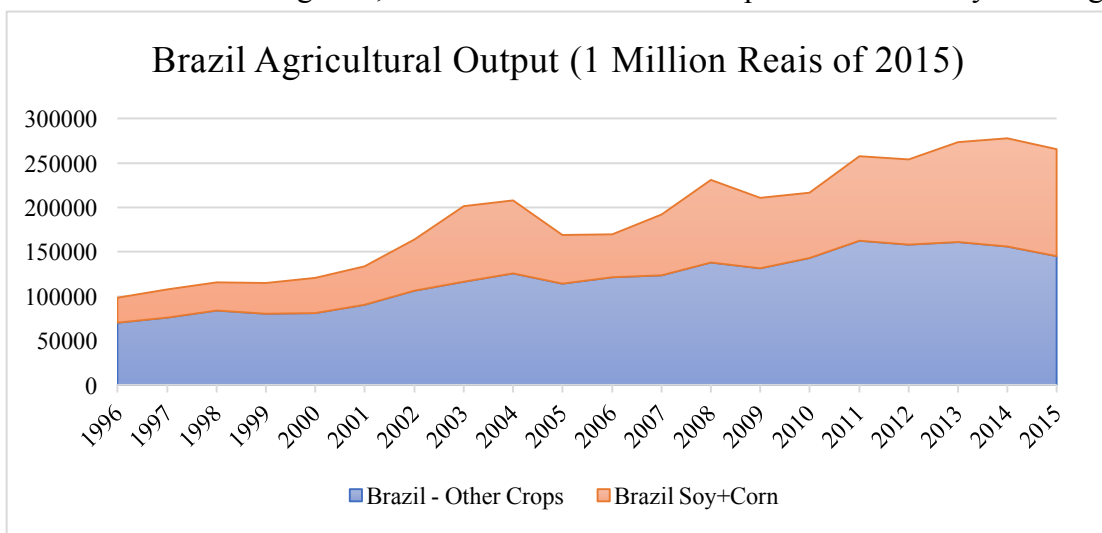


Figure 5-12: Brazil - Agricultural Output. Source: Instituto Brasileiro de Geografia e Estatística

¹⁶ Decree 436/1997 of the State Government.

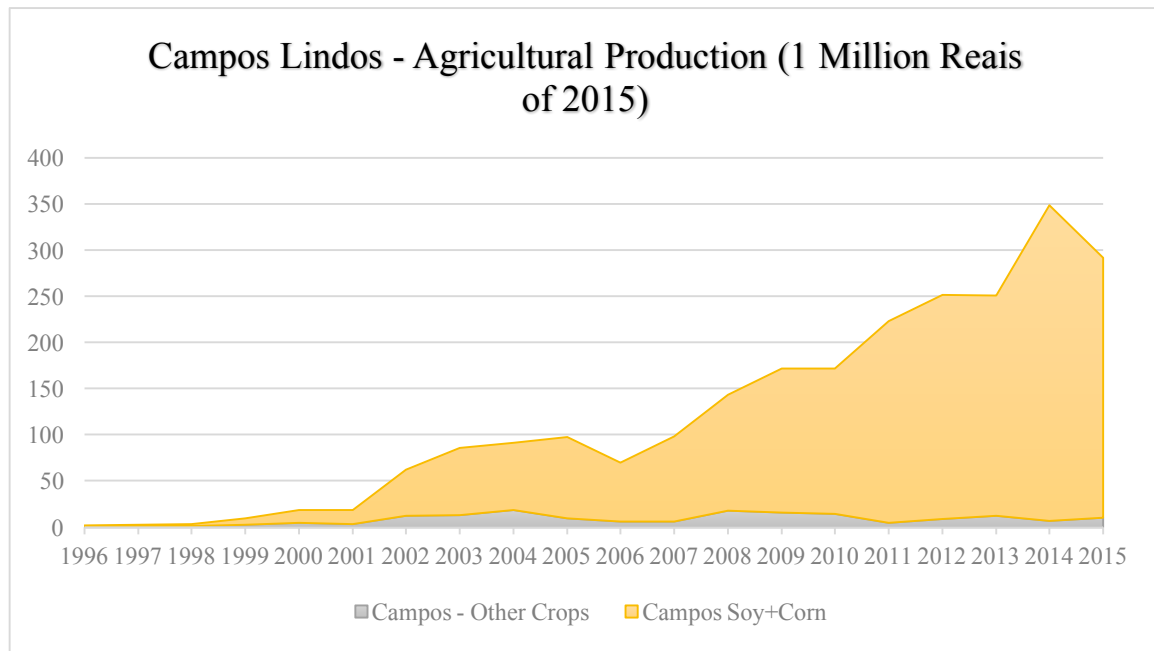


Figure 5-13: Campos Lindos - Agricultural Output. Source: Instituto Brasileiro de Geografia e Estatística

A critical aspect of the agricultural project is that the government did not recognize ownership rights of farmers that had been previously living in the region, since they did not have land titles. While the Brazilian Constitution¹⁷ foresees the possibility of lawful acquisition of land in cases where the squatter occupied a certain plot of land for at least 5 years without contestation, the formalization of such right seldom follows, due to costs and bureaucratic difficulties in issuing land titles.

Therefore, the establishment of large-scale farms in these plots conflicted with the economy that existed until then, based on the common use of land by sparse inhabitants for hunting and cattle breeding. One aggravating factor is that common use of land is poorly recognized in Brazilian land laws¹⁸, which weakened the legal standing of long-term residents in the region and eventually led to the eviction of many of these farmers over the course of the years¹⁹ (Sergio Schlesinger e Silvia Noronha, 2006).

In the economy that predominated in the period ahead of the agricultural project, land was abundant. If conflicting claims became unmanageable thorough negotiation, claimants could migrate and squatter elsewhere without much consequence. In such setting, formal property rights may have been unnecessary, as customary and tacit understandings among neighbors were sufficient to maintain an orderly use of the territory. Nowadays, titled land tenants justifiably regard squatting as an illegal and illegitimate activity, even though some of them may have originally acquired their lands in equally informal ways and later obtained the titles. It is worth of note that even in current days, squatters and people who purchase untitled land from other squatters resort to these informal practices as one of few available means of survival, adding an element of humanitarian distress to the situation.

Social and humanitarian claims strengthen squatter's standing. Courts, however, are bounded by law to recognize titles above other considerations. This leads to the issuance of eviction notes that are executed by the police, often meeting fierce resistance by organized

¹⁷ Article 191 of the Brazilian Federal Constitution.

¹⁸ Rare examples of legal common use of land are based on it being registered in name of a formally established association of farmers, that later autonomously defines rules of use.

¹⁹ In such a way that only very few of these longstanding dwellers remain in Campos Lindos until today.

groups of squatters. Farmers may also purchase lands at low prices from the squatters or may decide to take matters into their own hands and seek the forceful expulsion of squatters by coercive means, including threats or outright violence. Demonstrations and evictions have been recorded in Campos Lindos until present days, as illustrated by the following account:

“I arrived in this land not too long ago, I bought it from the previous owner, who was also a squatter. Some other people have been living here for over 20 years. When the soybean farmers arrived, all the region was already occupied by squatters. [...] Now, they want to expel us without any compensation. Not too long ago, some people came to my house, took all my furniture and appliances, put them on a truck and took them away. That day I was so scared, I hid in the nearby woods with my family, I needed to protect my daughters. They didn’t destroy the house and I believe there was no warrant, I never saw any warrant. This is not the lawful procedure. The usual thing is that if the courts determine our eviction, they notify us in advance. So, this was an act of intimidation orchestrated by the soybean farmers. This happened to some 10 families last year. It is such a terrible situation, I fear for my daughters. It is so unjust, but I don’t give up! Some people already decided to leave, other people do not worry about making their houses better, improving their conditions, but I am not like that. I know there is always a risk, but I don’t give up. I will keep working.

Respondent 2, 37 years old. Squatter in Campos Lindos since 2012. Claims 10ha.

5.2.2. Land Titles in Current Days Campos Lindos

In present days, with the constant risk of land conflicts, some farmers apply for titles in order to secure tenure as well as enable access to credit. The titling process, however, is not simple. If there are no conflicting claims over a given plot, the farmer must apply for the title at the state’s land agency²⁰ located in the State Capital, Palmas. The road distance to Palmas, however, is approximately 570 km. The land agency then proceeds with a land survey, which may take weeks or even several years, due to limited budget, insufficient staff, or lack of political will. The titling process, therefore, may include several trips to the land agency. Notwithstanding, it is possible for farmers to conduct this land survey at their own expense by hiring qualified personnel. This means that wealthier farmers are more likely to apply and succeed in the titling process.

In deciding whether or not apply for titles, farmers may evaluate the costs and benefits. Farmers whose land is more valuable due to its agro-ecological potential, proximity to the city, or market accessibility may perceive higher risks of expropriation. Depending on their intentions regarding agricultural production, they may also wish to obtain credit for investments, and thus feel more inclined to face the costs of titling. Additionally, transportation itself to the land agency may represent a cost consideration, especially for poor farmers.

²⁰ Itertins – Instituto de Terras do Tocantins.

5.3. SURVEY

A study team including the authors implemented local surveys in Campos Lindos from October 4th to 15th, 2017. They consisted of two stages. In the first stage, executed between October 4th and 8th, preparatory interviews with key stakeholders were held using a questionnaire sheet and recorded for later transcription. The questionnaire sheet consists of qualitative and quantitative questions. The quantitative part was subjected to the scrutiny of local stakeholders and applied to a test sample, with the purpose of examining the adequacy of the questions in the local context and identifying relevant factors that had been overlooked. Incorporating the observations from the first stage, the revised version of the questionnaire sheet was prepared. In the second stage, executed between October 12th and 15th, interviews with local individuals were implemented using the revised questionnaire sheet. The interviewees in the first stage included representatives of the Municipal Government, especially the head of the Chamber of Representatives and the Mayor. Representatives of two relevant interest groups were also interviewed: small farmers, mostly engaging subsistence agriculture and large-scale farmers, mostly engaging in grain production. The interviewees in the second stage were farm managers or heads of households, above 18 years old, across the rural area of the municipality. First, the surveyors visited potential respondents and requested them to participate in the surveys, explaining the objectives of the study. All of them agreed to participate in the study voluntarily. A total of 232 respondents answered the questions, which accounts for 31.4% of the total 740 rural households surveyed in the 2010 Census. This represents the municipality's rural population at a level of confidence of 90% and sample error of 5%. All data is geocoded, enabling a spatial analysis. Figures 5-14 and 5-15 illustrate some of the qualitative and quantitative interviews respectively.



Figure 5-14: Meeting held at the City Hall for collection of qualitative remarks



Figure 5-15: Team prepares to set off for household survey

In order to avoid sample biases as much as possible, the surveying strategy considered the geographical features of the municipality and the days of the week in which the questionnaire survey was implemented, containing two weekdays and two weekend days. One paved and four unpaved roads stem from the urban area of Campos Lindos. The roads bifurcate into several branches. On one weekday and one weekend day, the surveying team started visiting households that were closer to the urban center and moved to the more distant ones, covering all five roads simultaneously. On the other weekday and weekend day, the surveyors started from randomly selected branches of the roads and started surveying residents from the farther reaches of the municipality and moved towards the urban center.

When the surveyors covered a road that had already been covered in a previous day, they started from the point where they stopped previously, which allowed them to visit almost the entirety of the municipality.

The questionnaire sheet includes questions categorized into three subgroups: socio-economic information of the respondents and their households or farms, their status of land property rights, and their production and investment decisions. The socio-economic information is divided into characteristics of the household head and those of the farms. The characteristics of the household head includes age, gender, and years of schooling. The characteristics of the farm includes size of the farm, usage ratio for cultivation, distance to the city center, and the year of acquisition. Next, the status of land property rights includes whether, when and how they have acquired property rights for their lands. It also includes the status of titling, perceived level of insecurity due to possible invasions or evictions, duration and cost of titling procedures and reasons for not being titled. Among them, the main explanatory variable in this paper is a binary response to the question “Is your farm is secured by a property title (Yes/No)?” Finally, the information related to production and investment decisions include farmers’ perception on the easiness of performing transactions, experiences of accessing credit, intentions of major types of investment, and purpose of agricultural production. First, as for the farmer’s perception on the easiness of performing transactions, the respondents were asked “Do you think it is easy and safe to a) sell your property, b) lease it, and c) bequest?” in 6-point Likert scale, in which 1 means “very difficult” and 6 means “very easy”. This measures the easiness and safety of administrative procedures, finding buyers/leasers and negotiating a fair price. Second, as for the experiences of accessing credit, the respondents were inquired “In the past five years, have you obtained any form of funding (loan) for the production?” The loan assumes the funding from public banks, private banks or agribusiness multinationals. Third, as for the investment intentions, the respondents were inquired “In the next five years, do you intend to make investments in modified seeds, soil improvement, fence, machinery, irrigation, and fertilizer?” Finally, as for the purpose of agricultural production, the respondents were asked “Is your production mostly for self-consumption or is it commercialized (or both)?” and “Why did you choose the products you cultivate, profit, personal taste, or tradition?” These two questions were introduced because we found that local farmers were expected to have various purposes in their agricultural activities from the first stage survey. Whenever they expressed the intention of selling the production and profit-motivated crop choices, it was considered that they consistently displayed a commercial mindset.

5.4. PRELIMINARY FINDINGS

Table 5-2 presents the descriptive statistics for the main variables collected through the survey, referring to the socio-economic information of the respondents and their households or farms, their status of land property rights, and their production and investment decisions.

The majority (71%) of the respondents were men, with an average age of 48 years (s.d.=14.7 years). The relatively high average age may reflect a trend of rural-urban migration of younger generations. Educational attainment in the sample is low. The average years of schooling is 4.77 years (s.d.=4 years) and some respondents are illiterate. Access to higher educational achievements along with an inclination towards an urban lifestyle may discourage the young to remain in rural areas.

Table 5-2: Descriptive Statistics - Main Socio-Economic Variables

	Mean	Median	Standard Deviation	Min	Max
Socio-economic Information					
0/1 Gender (Male=1)	0.71	1	0.45	0	1
Age of Household Head	48	49	14.7	14	85
Years of Schooling	4.77	4	4	0	17
Size of the Farm (ha)	262	52.5	885	0.5	7,000
Value of Land (BRL/ha)	5550	5000	4728	500	30,000
Distance to the City Center (km)	23.0	17	12	0.9	77
Usage Ratio (%)	45	34	44	0	150
Year of Acquisition	2001	2005	15.2	1932	2017
0/1 Commercial Mindset	0.12	0	0.33	0	1
Status of Land Property Rights					
0/1 Titling	0.56	1	0.49	0	1
Length of Titling Process (Days)	450	150	613	1	2555
Date of Titling	2005	2005	6.38	1986	2017
Production and Investment Decisions					
Easiness of Sales	3.61	4	1.45	1	6
Easiness of Leasing	2.70	2	1.71	1	6
Easiness of Bequest	4.80	5	1.36	2	6
0/1 Loan Contracts 1 year	0.15	0	0.36	0	1
0/1 Loan Contracts 5 years	0.33	0.03	0.47	0	1
Number of Intended Investments among 6 types (Ordinal)	1.34	1	1.4	0	6
0/1 Use of Fertilizers	0.34	0	0.47	0	1
0/1 Use of Tractors	0.52	1	0.50	0	1

Source: Household Survey

Farms varied greatly in terms of size, ranging from a half hectare to 7000 ha with the median farm size of 52.5 ha (s.d.=885 ha). Farms at the magnitude of several hundreds or thousands of hectares were likely to be categorized into corporate farms, displaying a management style more in line with those of an enterprise. The median distance to the city center was 17 km with a maximum of 77 km (s.d.=12 km), characterizing the sparsely populated rural area. Especially because most roads are unpaved, market accessibility may be very difficult for respondents in the farther areas. The percentage of the area of farms that is effectively used for production is surprisingly low, with a median of around 1/3 (s.d.=0.44). That means that many farms in the region have a much lower level of production than its area can accommodate. Nonetheless, some farms display a usage ratio of over 100%, which means more than one harvest is conducted annually. This suggests that some farms are intensely used.

These farms also tend to employ high technology in production and display commercial characteristics. Farms with a low usage ratio tend to correspond to farmers who are concerned with their subsistence only, not expanding the production further than what

is necessary to meet the food consumption of the family. The majority of respondents acquired their state around the year 2005, even though some individuals have been living in the region for several decades. This may capture descendants of older inhabitants that acquire their own farms, which happens both formally through the acquisition of titled farms and informally through squatting and acquisition of untitled farms. As for the status of land property rights, only 56% were in possession of land titles for their farms. For those who have titles, the duration of the titling process varied significantly, with a median time of 5 months with a standard deviation of 20 months. Some respondents took several years to obtain their titles, which points to the difficulty in acquiring titles. The earliest title was issued in 1986, even though there were farms in the region even several decades before. This year also marks the beginning of the operation of a major railway in the region, which increased considerably market accessibility for producers in Campos Lindos. Before 1986, the lower level of competition for the land may have prevented significant land disputes, diminishing farmer's interest for titling. Untitled farmers were asked about the reasons for which they are did not have titles. Results are shown in Figure 5-16.

The high cost was pointed as the reason for not having a land title by the majority of respondents. The occurrence of conflicts with other private claimants was the second most frequent response. Especially in what concerns the cost, this result suggests that there could socio-economic biases in the allocation of land titles in the Municipality, which seems to be supported by the historical accounts described previously.

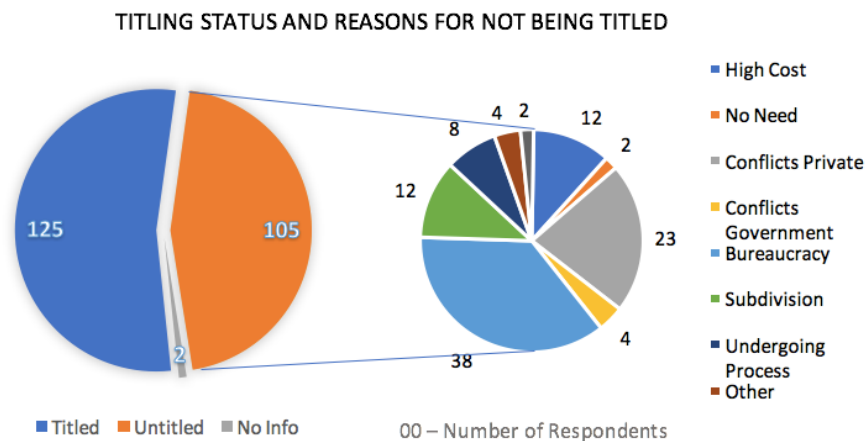


Figure 5-9: Titling status and reasons for not being titled – Source: Household Survey.

As for the easiness of performing land transactions, the average perceived level in a Likert scale from 1 to 6 was 3.6 for sales (s.d.=1.45), 2.7 for lease (s.d.=1.71), and 4.8 for bequest (s.d.=1.36) respectively. Transfers as bequest seem to be type of land transaction perceived as the least complicated to be performed, since the average is the highest and the standard deviation is the lowest. The respondents who contracted loans in the past one and five years account for 15% and 33% respectively, potentially indicating poor access to credit, despite the presence of financial institutions. Finally, the average number of intended investments among six types was 1.36 with a standard deviation of 1.4, indicating that most farmers intended to make a low level of investments or even no investments at all in the following five years.

Figure 5-17 illustrates the geographical distribution of the farms surveyed. Green markers indicate titled farms while red markers indicate untitled farms. The balloon shows the location of the urban area. A relatively large number of small farms cluster within a 20 km radius of the urban area, where they also benefit from the proximity to the paved road that connects Campos Lindos with the rest of the State. Within this group, the majority of

the farms tend to be titled, potentially due to the proximity to public institutions and relatively higher economic means of farmers, which favors application for titling. Proximity to the paved road that connects Campos Lindos with other cities may favor market access and generate incentives for titling and for agricultural productivity. Large-scale grain farms can be found mostly to the southeast of the urban area and the majority of them are titled. They stand out in the map by the light colors and geometric limits. At the distant outskirts of the Municipality, from 50 km to 77 km from the urban center, the proportion of untitled farms is higher, potentially indicating high level of tenure insecurity. The incidence of poverty in this area is also comparatively higher.

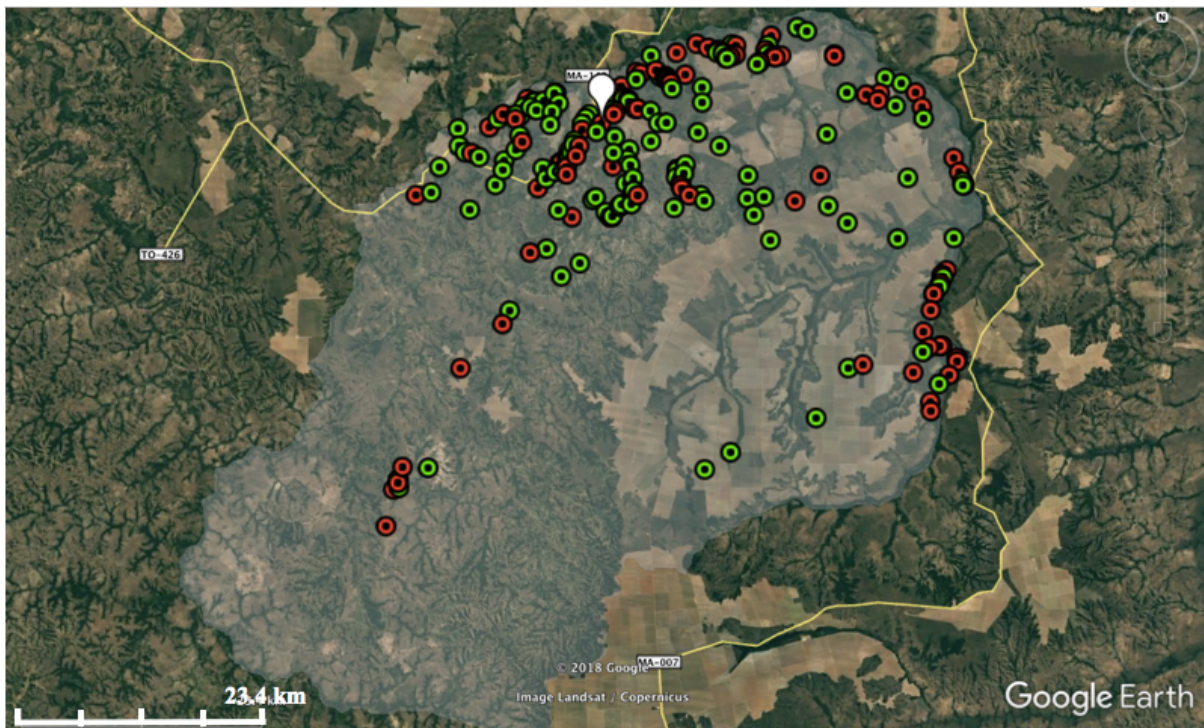


Figure 5-10: Location of farms, titling status and location of urban area. Generated by Google Earth Pro Version 7.3.1.4507 (64-bit)

As potential restrictions to agricultural productivity were being considered, some respondents provided insightful ideas. The Mayor, the Head of the Chamber of Representatives and some farmers average often resorted to ideas such as “lack of vision”, “lack of ambition” or yet “lack of a commercially-oriented thinking” in order to account for this anti-economical behavior. The Mayor illustrated this idea with the difficulties faced by a Municipal “buy local” program, designed to direct local demand to local producers:

“I wish we could involve small farmers more actively in the economy of our city. If we succeeded, I believe the living conditions in the city would improve quickly. We have some projects already. Like the “compra direta” (buy local) program which consists on the city government purchasing the agricultural production from small farmers to supply local schools. The city government buys flower, milk, fruits meat. But there is a problem in the supply that proved difficult to overcome. Farmers cannot supply goods throughout the whole year. They do not adjust their production to the client’s needs. Besides, we don’t have the products of sufficient quality. If local

farmers produced more, better and reliably, there would be no need for local shops to purchase supplies from other municipalities. “Compra direta” is an example of a great opportunity that our farmers let go of.”

City Mayor, 54 years old

It is worth of note that the remarkable development of large-scale agriculture in the Municipality was led not by local farmers but by farmer-investors that relocated to Campos Lindos in tandem with the development of infrastructure and markets described in the previous session. Local farmers may have remained oblivious to the developments that were taking place around them. The following account by a titled farmer illustrates the situation:

“I struggled for many years and payed a sizeable amount of money to acquire my title and secure ownership of my farm. It has approximately 100 hectares of area, but nowadays we only use around 25. With just a few dozen cattle and a small plantation of vegetables, we have enough for myself and my wife. When our sons and daughters were young, we worked much harder, cultivated almost the whole area of the farm in order to feed them, but now our children have moved out. Our life is comfortable as it is”

Respondent 3, titled farmer, 59 years old.

Such opinions suggest that farmer’s mindset in Campos Lindos may represent a constraint to agricultural productivity in the region. Respondent 3’s account suggests that even after titling, which happened concomitantly with the development of transportation infrastructure in the region, productivity was kept low on the convenience of the farmer. Only 12% of the respondents in the sample were categorized as commercial mindset farmers, which may be one cause for the persistence of poor social indicators in the Municipality. The hypothesis that farmer’s mindset represents a relevant enabling condition for the impacts of LPR can be tested using farm-data from Campos Lindos. Figure 5-18 shows the cross-distribution of farmers according to their mindset and key variables, such as status of tiling and farm area usage ratio. Subsistence farmers are less likely to be titled and the average usage ratio is significantly lower than commercial farmers. A careful testing of this hypothesis, however, would require regression analysis that controls for multiple intervening factors simultaneously.

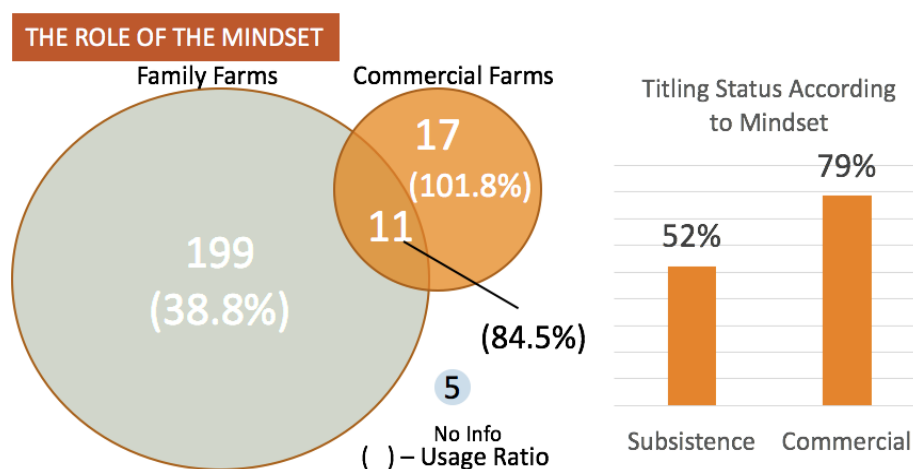


Figure 5-11: The Role of the Mindset

5.5. CONCLUSION

Campos Lindos was chosen as the location for the present case study due to three major factors: first, its development is closely related to the evolution of transportation infrastructure in the region, which favors the verification of the first main hypothesis; second, the matter of farmer's mindset is often mentioned by respondents even if not prompted to as one reason for low productivity in the region; and third, the persistence of land conflicts and the unequal allocation of land titles across stakeholders suggest the partial ineffectiveness of the LPR system in the region and the existence of sufficient variation in key interest variables, which is expected to facilitate the identification of causal relationships. As for the preliminary findings in this study, one aspect is particularly salient.

If farmers are taken individually and their economic behavior is considered, the fast-paced increase in productivity observed in the region did happen in titled farms, in line with the theoretical expectations. In fact, large-scale commercial agriculture is dependent on land titles not only for tenure security reasons, but also because the sizeable capital investments usually cannot be made without credit from financial institutions, for which titles are indispensable in the region. Additionally, the agreements that are often signed between farms and agricultural trading companies require land titles to be legally recognized. Also, if the region is taken as a whole, it can be said that LPR improved significantly from 1997 to the present, since the amount of titled land and the number of farms that have a land title increased significantly.

Nonetheless, the improvement in LPR in Campos Lindos did not have the expected impacts on all stakeholders. The conversion of common lands into private land was not a peaceful process, instead, a number of long-term residents in the region were evicted from their farms. Other farmers who were not directly affected by eviction and remained in the region not necessarily acquired land titles and remained subject to tenure insecurity and blocked from access to credit. Several farmers pointed the cost in obtaining title and bureaucratic difficulties as the major reasons for not being titled, which implies that given more favorable conditions, they would desire to have a land title.

The improvement of LPR in the region, therefore, may have had the effect of deepening social inequalities and hardly improving the situation of poverty for many stakeholders. This result holds despite of the remarkable growth in productivity of grains. Such finding provides some insight into the reason why the macro-level study presented in Chapter 4 yielded the unexpected result that countries with low quality of transportation displayed high impacts of LPR on agricultural productivity. As quality of transportation seems to be closely correlated with low effectiveness of LPR, marginal improvements in these variables tend to have large impacts on productivity. In practice, what happened in Campos Lindos was the transfer of ownership of land from untitled low-productivity farmers to titled high-productivity farmers. These transfers may not happen in mutually beneficial ways to the parties involved, but rather happen in forceful manners, to the loss of untitled farmers. While improvements in agricultural productivity are necessary, it may be the case that rural development authorities must consider ways to protect the interests and rights of poor farmers, who may not have the financial means and the ability to access public institutions and apply for titles. Otherwise, desired effects of LPR on poverty reduction may be compromised.

6. IMPACTS OF LPR AND FARMER'S MINDSETS ON AGRICULTURAL PRODUCTIVITY IN CAMPOS LINDOS

6.1. BACKGROUND

The case study conducted in the Municipality of Campos Lindos included the collection of quantitative data concerning variables such as socio-economic information of farmers, land tenure status and some of their economic decisions. This information allows extensive quantitative analysis regarding several causal relationships assumed in the analytical framework presented in Chapter 3.

The first relationship assumed is causality between better LPR and higher agricultural productivity. This relationship, however, did not hold in the macro-level study presented in Chapter 4, where countries with low levels of LPR displayed high agricultural productivity. A preliminary finding of the case study described in the previous chapter suggests that such result may hold because when LPR is ineffective in ensuring tenure security it is possible that land ownership is transferred from low-productivity untitled farmers to high-productivity titled farmers.

In spite of the undesired social consequences for untitled farmers, such reasoning justifies the assumption by suggesting that LPR remained as a causal factor for higher productivity. The aim of the present chapter is to quantitatively test the hypothesis that titled farmers are more productive than untitled farmers. In the context of Campos Lindos, this hypothesis verifies if the status of titling does hold a fundamental role in supporting higher productivity or if other causal factors should be considered. Additionally, farmer's mindset is included as one potentially missing factor in previous studies, that may have a significant role in intermediating the impacts of LPR.

6.2. LITERATURE REVIEW

Previous studies that investigated empirically the relationship between LPR and agricultural productivity have found mixed and inconclusive results regarding the existence of a causal impact. Several researchers failed to observe any significant relationship. Place & Migot-Adholla (1998), for example, did not find discernible impacts of titling on crop yields in Kenya. More recently, Bellemare (2013) found similarly discouraging results in a study in Madagascar. However, Deininger et al. (2007) showed that the productivity of trees planted on farms that were secured by land titles was significantly higher. Another study that found positive results was presented by Benin and Pender (2001). The authors found that the allocation of LPR led to an increase in the agricultural yields of farms. Also, interventions to strengthen LPR contributed to improvement of agricultural productivity by about 40% in the study conducted by Lawry et al. (2014).

In terms of methodology, all the studies surveyed coincided in the use of regression analysis with the purpose of identifying the specific causal impact of LPR on productivity. Most studies relied on the status of titling as indicator of LPR, but according to local circumstances, there have also been studies which gauged tenure security utilizing other proxies. Goldstein & Udry (2008), for example, assumed that farmers who held or had held positions in the public administration enjoyed higher tenure security than those who did or had not. This is because positions in the administration indicate social prestige and the capacity to access the authorities more easily than others. Place et al. (1995) used farmer's

perceptions regarding tenure security as well as the titling status and conducted multiple regressions in two regions of Zambia. Finally, in a detailed study, Brasselle, Gaspart, & Platteau (2002) defined nine different rights related to land, which reflect farmer's possession of different combinations of rights in the typical bundle of rights commonly equated to LPR, for example, the right to choose crops or to freely dispose of the harvest. Regarding possible indicators of productivity, different approaches have been utilized, from more restrictive to more general measures. Deininger et al. (2007) measured the productivity of trees, thus exemplifying a restrictive measure of productivity, focused on one single product. Bellemare (2013), however, utilized the more general measure, by estimating agricultural production functions.

The persistence of diverging results remains a puzzle in the literature. DFID (2014) offers one possible explanation, appealing to the high specificity of LPR to each local context. A critique to this explanation consists on which it fails to effectively name which local factors may be missing in past studies. While it is true that culture and traditions likely interferes with the impacts of LPR, it is necessary to clearly specify which elements within local cultures and traditions are responsible for such interferences. In the present Chapter, farmer's mindset will be introduced as one additional control variable, in the attempt of finding such missing factors.

6.3. METHOD

This study sets up a hypothesis that titled farmers are more productive than untitled farmers. This reflects an assumption that if property rights are effective, risk tolerance of farmers is increased, access to credit and efficiency-enhancing land transactions are facilitated. The approach selected for the analysis in the present chapter is based on the estimation of an agricultural production function.

The data employed in this chapter was collected in Campos Lindos, Brazil, as described in detail in Chapter 5²¹. Table 6-1. shows the descriptive statistics for some variables that are only used in the present chapter.

Table 6-1: Descriptive Statistics

Variables	Min	Mean	Max	Median	Std. Dev.
Number of Workers	0	3.4	30	2	3.55
Area used in Agriculture (ha)	0	276.9	13000	15	1130.29
Lease in the past 5 years	0	0.05	1	0	NA
Partnership in the past 5 years	0	0.07	1	0	NA
Production					
Soy	0	0.10	1	0	NA
Grain	0	0.16	1	0	NA
Corn	0	0.15	1	0	NA
Pig	0	0.06	1	0	NA

²¹ Refer to chapter 5 for descriptive statistics of the variables utilized in the present Chapter that are also used in other Chapters.

Cattle	0	0.43	1	0	NA
Chicken	0	0.06	1	0	NA
Cassava	0	0.27	1	0	NA
Beans	0	0.15	1	0	NA
Rice	0	0.39	1	0	NA
Capital					
The total amount of Capital	0	1.06	3	1	1.14
Tractor	0	0.52	1	1	NA
Fertilizer	0	0.34	1	0	NA
Agro-chemicals	0	0.22	1	0	NA
Past Investments					
Machinery	0	0.11	1	0	NA
Soil	0	0.26	1	0	NA

A household survey was conducted with the use of a paper-based questionnaire. 232 farmers in the rural area of Campos Lindos were interviewed. Farmers were requested to inform the volume of the production and the estimated price per unit for each product. Only the three major crops in each farm were considered. Other crops were assumed to be of low value and left aside. The value of production in Brazilian Real (BRL) in each farm was calculated by multiplying the volume of production of each of the three major crops as informed by farmers by the price, which was calculated as an average of all informed prices for the same product.

A Cobb-Douglas type of function of agricultural production value is assumed, in line with similar studies in the literature. For example, Yuan (2011) analyzed the temporal and spatial variations of agricultural input-output and the relationship between output and input using a Cobb-Douglas production function in Hebei Province, China.

The agricultural production function is specified as shown in equation (1):

$$Y_i = K_i^{\beta_1} L_i^{\beta_2} f(.) \quad (1)$$

where Y_i represents the agricultural value of household i in Campos Lindos; K_i represents the capital of farmer i ; L_i represents the labor of farmer i ; $f(.)$ represents the total factor productivity (TFP) function and β_1 and β_2 are unknown coefficients. The TFP function represents the portion of productivity that cannot be explained by the quantities of the factors of production, thus capturing unobserved technological, institutional and behavioral aspects.

L_i , represents labor, which is explained by the number of workers in each farm. K_i – the measure of capital employed in production - is explained by C_i and G_i . The former is a variable that takes the values 1, 2 or 3, as the result of the addition of three dummy variables representing farmer's usage of tractors, fertilizers and agro-chemical. The latter is the land area effectively employed for agriculture (thus not coinciding with farm size). Equation (2) shows how K_i is calculated.

$$K_i = G_i^{\beta_3} \exp(C_i) \quad (2)$$

Equation (3) shows the specification of the TFP function.

$$f(PR_i, ED_i, AG_i, GE_i) = \exp(\mu + \beta_4 PR_i + \beta_5 ED_i + \beta_6 AG_i + \beta_7 GE_i) \quad (3)$$

where PR_i represents the household i 's land property rights, expressed as a dummy variable that takes up value 1 if farmer i has a land title and 0 otherwise; μ is the error component; ED_i is the years of schooling achieved by the head of each farm; AG_i represents his/her age and GE_i is the respondent's gender. ED_i , AG_i , GE_i represent the characteristics of head of the household. By plugging the TFP function (3) and equation (2) into the production function (1) and taking the natural logarithm for both sides of the whole equation, the base regression model is obtained:

$$\ln Y_i = \mu + \beta_1 \beta_3 \ln G_i + \beta_1 C_i + \beta_2 \ln L_i + \beta_4 PR_i + \beta_5 ED_i + \beta_6 AG_i + \beta_7 GE_i + \varepsilon_{i4} \quad (4)$$

where ε_i is the error component. The main coefficient of interest is β_4 , which captures the causal relationship between LPR and the agricultural productivity in the sample. The estimated coefficient β_4 is expected to be positive, meaning that having title leads to improved agricultural productivity.

Next, farmer's mindsets were captured by a dummy variable that takes the value 1 if farmers are considered to have a "commercial" mindset and 0 otherwise. Some farmers seem to focus on selling their production while others are satisfied with maintaining their living conditions. This means that they do not intend to expand their production beyond their own consumption needs. For the purposes of this study, specific questions were included in questionnaire applied in Campos Lindos. Commercial mindset farmers are those who responded that their crop choice is motivated by profit (not taste or tradition) and that the production is mostly for sale (not for self-consumption). An alternative way to approximate farmer's mindset that was also employed in this analysis consisted on introducing the variable "Usage Ratio". This variable takes a continuous value from 0 to 1.5. This represents the proportional of a farm's total area that is actually employed in agriculture. It is assumed that farmers who have a commercial mindset will effectively use almost the entirety of the area available for them, as they rationally seek profit-maximization. Conversely, subsistence mindset farmers are assumed to employ smaller proportions of their farms into actual production, as they tend to limit their scale to the minimum necessary for the maintenance of their living conditions. Each of these two variables is employed separately as one additional factor in the TFP function, yielding an new regression equation for an expanded model, as shown in (5), where MS represents farmer's mindset and alternatively assumes the variables "Commercial Mindset" of "Usage Ratio".

$$\ln Y_i = \mu + \beta_1 \beta_3 \ln G_i + \beta_1 C_i + \beta_2 \ln L_i + \beta_4 PR_i + \beta_5 ED_i + \beta_6 AG_i + \beta_7 GE_i + \beta_8 MS_i + \varepsilon_{i5} \quad (4)$$

Concerns regarding the possibility of observing self-selection biases arose during the qualitative interviews in Campos Lindos. The process of obtaining a land title in Campos Lindos is not random, in such a way that titled farmers may display socio-economic characteristics that imply that they will be more productive regardless of the effect of titling itself. The titling process starts at the initiative and expense of farmers. Provided that there are no ownership conflicts, farmers must apply for titles at the state's Land Agency located in the state capital, Palmas, 570 km away. The Land Agency must then proceed with a land survey, which may also take several months or even years, usually due to lack of budget or staff. However, farmers may conduct this land survey at their own expense, by hiring qualified personnel. Wealthier farmers and those who intend to make a commercial use of the land are more likely to actually acquire titles while, at the same time, may also enjoy

advantaged in access to credit and may dispose of sizeable capital for initial investments in high-technology agricultural production. In order to address possible biases introduced by the titling process, propensity score matching is employed.

The propensity score method is employed for accurately assessing the impact of title on agricultural productivity. In the present study, the propensity score can be defined as the probability of participants receiving a treatment based on observed characteristics. This probability is expressed in equation (9):

$$p(x) = \Pr(T = 1|X = x) \quad (9)$$

where T represents the Titling Status, which takes the value 1 if a farmer is titled and 0 otherwise; X is a set of appropriate confounders. The propensity score is estimated using a logistic regression model. The propensity score is estimated through a logistic regression model, as shown in equation (10).

$$\Pr(t_n = 1) = \frac{1}{1 + \exp(-\sum \rho_h s_{nh})} \quad (10)$$

s_{nh} represents the h th confounder for farmer n , and ρ_h represents the unknown coefficients. Two different sets of confounders are utilized. The first set includes the most general possible set of variables. Some variables in the dataset were not included due to limited number of observations. Farmer's level of investments, distance to city center, use of tractor, breeding of cattle, performing leases and partnerships in the past 5 years (off-taker contracts, technical assistance and technology transfer from agricultural trading companies), investment in soil improvements and in machines are assumed as relevant confounders in the first set. All variables are dummies. Distance to city center was converted into a dummy variable, with observations that exceed the average distance taking the value 1.

The second set of confounders - a more restrictive one - included only variables that have a direct causal relationship with the status of titling. The second set of confounders was specified in order to reduce the loss of observations. Total sample size in this study is 232, however, this number is reduced to around 112 when the first set of confounders is used and to 154 in the case of the second set. This reduction happens after observations with missing values for some variables are excluded, which is a technical requirement for matching. The confounders in the second set are age, gender, years of schooling, area of agricultural production, number of workers, capital and usage ratio.

Then, observations are matched based on the calculated propensity scored. This procedure consists on assigning one observation of untitled farmer to each titled farmer in the sample, observing that their propensity scores are sufficiently similar. Three rules for similarity are applied: The calipers are set to 0.25, 0,10, and 0.01. Smaller calipers mean a stricter rule for matching, which leads to a higher degree of similarity between the observation with a land title and the observation without a land title. However, they also imply a higher likelihood of unsuccessful matching of some titled farmers, which means that the sample size will be smaller.

6.4. ESTIMATION RESULTS

First, the results for the base model and for the extended model are presented in Table 6-2.

Table 6-2: Result of the Estimations Before Matching

Variables	Base Model			Extended Model		
	Coef.	S.E.	t-stat.	Coef.	S.E.	t-stat.
Constant	2.75**	0.23	12.21	2.82**	0.22	12.62
β_1 Capital	0.13**	0.05	2.65	0.10**	0.047	2.14
$\beta_1\beta_3$ ln (area used in agr.)	0.68**	0.06	11.26	0.62**	0.064	9.66
β_2 ln (number of workers)	0.16	0.16	1.05	0.11	0.16	0.68
β_4 Status of Titling	0.22*	0.10	2.08	0.21*	0.10	2.08
β_5 Education	0.01	0.01	0.40	0.016	0.014	0.12
β_6 Age	0.00	0.00	0.82	0.0032	0.0037	0.88
β_7 Gender	0.22	0.11	1.94	0.24*	0.11	2.06
β_8 Commercial Mindset				0.40*	0.17	2.45
Adj. R-Squared	0.66			0.67		

Source: Author Elaboration. “***”, 1% Significance, “**”, 5% Significance, and “.”; 10% Significance

The results shown in Table 6-2 point to a preliminary acceptance of the hypothesis that titled farmers are more productive than untitled farmers. The coefficient β_4 displayed a positive and statistically significant impact of the status of titling on the estimated agricultural productivity of farmers in Campos Lindos. This result remained in both models, demonstrating robustness to the inclusion of the new control variable – commercial mindset. Nonetheless, this result must be taken with caution, given the possibility of biases being caused by self-selection in the allocation of titles. Also, it must be noted that in terms of the magnitude of the impact, status of titling displayed a low coefficient when compared to other explanatory variables, pointing to a potentially insignificant impact from an economic perspective.

Surprisingly, the coefficient for labor, captured by the number of workers in each farm did not show statistical significance. This result may point to the fact that labor productivity is highly disparate across farms in the region. Some farms employ labor intensive technologies, while others are heavily capital intensive, particularly the most productive ones. This must have reduced the explanatory power of labor in the production function. Capital and land displayed high statistical significance.

Finally, the inclusion of the new control variable – farmer’s mindset – not only did not reduce the significance of the factors of production in the function, but it also improved marginally the quality of fitness and turned gender into a significant variable. This results points to that farms headed by male farmers are more productive than those headed by female farmers, but the coefficient was low.

In order to obtain results that are robust to self-selection bias, propensity score matching analysis is required. First, Table 6-3. displays the results of the logistic regression that explains the probability of farmers having a title as a function of the first set of confounders. Then, Table 6-4. analyses the quality of the matching.

Table 6-3: Result of the Estimation of Propensity Scores (1st set of confounders)

Variables	Coefficients	Standard Error	z-value	
Constant	1.12	0.73	1.53	
Level of investments (0 – 8)	-0.60	0.25	-2.33	*
Distance to City Center	-0.02	0.01	-1.76	.
Use of Tractor (0/1)	-0.82	0.58	-1.42	
Cattle Breeder (0/1)	1.95	0.65	2.98	**
Lease in the past 5 years (0/1)	1.51	1.19	1.27	
Partnership in the past 5 years (0/1)	2.06	1.21	1.70	.
Investment soil in the past year (0/1)	1.08	0.78	1.40	
Investment machine in the past year (0/1)	2.49	1.08	2.31	*

Source: Author Elaboration. “***”; 1% Significance, “**”; 5% Significance, and “.”; 10% Significance

The confounders that displayed a significant impact on the probability of farmers having land titles were the amount of investment, distance to city center, whether the farmer is a cattle breeder or not, whether farmer executed partnerships in the past 5 years or not, and whether the farmer invested in machines in the past year or not. Since most variables were significant, the regression is considered adequate for matching purposes.

Table 6-4: Balance of Variables Before and After Matching (1st set of confounders)

Variables	Before Matching			After Matching		
	Mean Treat.	Mean Control	St. mean diff.	Mean Treat.	Mean Control	St. mean diff.
Level of Investment (0-8)	2.34	2.17	13.33	2.17	2.12	2.73
Distance to City Center	19.47	31.00	-71.74	21.83	21.13	3.96
Tractor (0/1)	0.66	0.75	-19.27	0.69	0.71	-4.07
Cattle breeder (0/1)	0.67	0.44	47.91	0.64	0.48	33.12
Lease in the past 5 years (0/1)	0.092	0.028	22.10	0.038	0.00	19.62
Partnership past 5 years (0/1)	0.16	0.028	35.45	0.057	0	24.26
Investment soil past year (0/1)	0.41	0.28	26.30	0.31	0.34	-8.14
Investment machine past year (0/1)	0.22	0.11	26.83	0.15	0.28	-36.54

Source: Author Elaboration. “***”; 1% Significance, “**”; 5% Significance, and “.”; 10% Significance

Table 6-4 presents the balance of covariates before and after the propensity score matching. It allows an appreciation of how effective the matching procedure was in reducing

the difference in the means of explanatory variables between treatment units - titled farmers -and control units - untitled farmers (Dongsheng & Jarrod, 2012). Regarding cattle breeder, partnership, lease, and investment machine, there are only few samples where farmers do not have a title, therefore it is difficult to improve the balance any further. Regarding the other variables, the propensity score matching works well for controlling the effects. The matching results are therefore considered adequate.

Finally, Table 6-5 presents the average treatment effect (ATE) in the estimations conducted under the three different calipers. ATE represents the impact of having a title on agricultural productivity, after the other variables have been adequately controlled. This means that the effect of titling is estimated by comparing one titled farmer with an untitled farmer that have sufficiently similar characteristics when the variables in the first set of confounders are considered. The average effect estimated when the caliper was set to 0.25 is -0.317 with p-value of 0.20, which is not statistically significant. This means that land titles did not significantly influence agricultural productivity. When the caliper was set to 0.10, the estimated effect is 0.072 with p-value of 0.55, which yields the same interpretation. Finally, the ATE estimated when the caliper was set to 0.01 was 0.10 with p-value of 0.002, which suggests a significant effect of title on the production value per household. However, the number of matched observations in this case was excessively low, standing at only 17. This sheds significant doubts to this last result, and strongly suggest that the actual effect of titling on agricultural productivity in Campos Lindos is insignificant.

Table 6-5: Average treatment effects across 3 calipers (1st set of confounders)

Model	Average Treatment Effects	T-stats.	p-value	Number of Matched observations (out of 112)
Caliper = 0.25	-0.317	-1.27	0.20	53
Caliper = 0.10	0.072	0.58	0.55	37
Caliper = 0.01	0.10	3.03	0.0025	12

Next, the same procedure is executed using the second set of confounders. Table 6-6. shows the logit regression estimation results, when the probability of receiving the treatment – status of titling – is explained by different confounders. In this case, the sample size is larger than when the first set of cofounders was used, standing at 154.

Table 6-6: Result of the Estimation of Propensity Scores (2nd set of confounders)

Variables	Coefficients	Standard Error	z-value	
Constant	-0.20	0.80	-0.25	
Age	0.0092	0.014	0.68	
Gender	-0.17	0.42	-0.40	
Years of Schooling	-0.010	0.050	-0.21	
Usage Ratio	-0.82	0.57	-1.44	
Log of Area of Agricultural Production	0.82	0.29	2.84	**
Capital (0-3)	-0.096	0.17	-0.56	
Log of Number of Workers	0.21	0.60	0.36	

Source: Author Elaboration. “***”; 1% Significance, “**”; 5% Significance, and “.”; 10% Significance

Table 6-6 shows that only the area of agricultural production displayed a significant coefficient, suggesting lower quality in the calculation of the propensity scores, which is not expected to interfere fatally with the analysis.

Table 6-7 shows the balance of covariates before and after the propensity score matching. The absolute value of the standard mean difference is within 10%. This means matching balance is adequate.

Table 6-7: Balance of Variables Before and After Matching (2nd set of confounders)

Variables	Before Matching			After Matching		
	Mean Treat.	Mean Control	Standard mean diff.	Mean Treat.	Mean Control	Standard mean diff.
Age	49.24	46.69	17.39	49.53	47.84	11.00
Gender	0.76	0.722	8.80	0.76	0.80	-7.55
Years of Schooling	4.58	4.5	1.73	4.30	4.78	-12.69
Usage Ratio	0.51	0.46	11.12	0.49	0.54	-11.15
Log of Area of Agricultural Production	1.39	0.95	43.73	1.37	1.47	-12.21
Capital (0-3)	1.32	1.24	6.82	1.28	1.39	-9.47
Log of Number of Workers	0.46	0.41	14.17	0.44	0.40	10.42

Source: Author Elaboration. “***”; 1% Significance, “**”; 5% Significance, and “.”; 10% Significance

Finally, table 6-8 shows the results estimated when matching was conducted with each of the three calipers considered previously. The estimated average treatment effect when calipers were set to 0.25 and 0.10 are 0.14 with p-value of 0.42, and 0.15 with p-value

of 0.40, respectively; the number of matched observations is considered enough. These results suggest that land titles do not statistically impact agricultural productivity in Campos Lindos. The last caliper displays the possibility of a positive impact of titling status, where the estimated treatment effect is 0.22 with p-value of 0.0037. However, the small sample size restricted by the matching procedure implies that this result is unreliable.

Table 6-8: Average treatment effects across 3 calipers (2st set of confounders)

Model	Average Treatment Effects	T-stats.	p-value	Number of Matched observations (Out of 154)
Caliper = 0.25	0.14	0.81	0.42	94
Caliper = 0.10	0.15	0.85	0.40	92
Caliper = 0.01	0.22	2.91	0.0037	29

6.5. DISCUSSION AND CONCLUSION

Even though the status of titling had a significant coefficient in our baseline model and in the extended model, that includes farmer’s mindset as an additional control variable, this result did not remain after the introduction of Propensity Score Matching. This procedure is deemed necessary due to significant concerns that titling is not random in Campos Lindos. Instead, wealthier farmers, who are also more likely to obtain loans and have the financial capacity of making investments, are more likely to be titled. This may have severely biased the estimation in the first two models in favor of a positive impact of titling.

The rejection of the hypothesis that titled farmers are more productive is in disagreement with the analytical framework assumed in this study as well as with a sizeable portion of the past literature. The present chapter, however, has also demonstrated that commercial mindset farmers are significantly more productive, tentatively establishing one potential reason why titling fails to increase investments. This statement implied that titling alone does not change farmer’s behavior as much as expected, if theories of economic institutions are taken into consideration.

The failure of titling status in robustly affecting agricultural productivity, apart from the behavioral consideration related to farmer’s mindset, also raises the possibility that some or all the mechanisms assumed to connect titling and productivity are impaired. Namely, land titles may fail to facilitate land transactions, which may cause inefficient land use patterns to persist, or titles may fail in increasing investments by farmers. Identifying whether and which of these mechanisms is not functional is important to indicate which policies may improve the impacts of titling.

7. LPR, MINDSETS AND PERCEPTIONS ABOUT THE EASE OF CONDUCTING LAND TRANSACTIONS IN CAMPOS LINDOS

7.1. BACKGROUND

The previous chapter unveiled results that shed significant doubts on the assumed impact of land titles on farmer's productivity. Despite the fact that land tenure security may be and end in itself, unresponsive agricultural productivity is discouraging result for authorities involved in rural development. A broad support for rural development, therefore, requires a clear identification of the reasons why land titles fail to support productivity as economic theory strongly suggests.

The approach adopted in the present study consists on verifying the potential intermediation of missing factors as compared to previous research while simultaneously investigating which mechanisms connecting LPR and productivity are impaired. The present chapter focuses on the mechanism related to land transactions. The assumption is that if LPR are secured, efficiency-enhancing land transactions become unimpeded, which has direct effects of productivity. This may happen because the most capable farmers, who in market terms are those who have the highest subjective value for a certain plot of land, become the ones who effectively farm it. Or yet, each plot of land switches to the production of the most productive crop given its agro-ecological potential. This has been referred to in previous research as "realization effect" (Brasselle, 2002).

The present chapter also introduces a novel approach to gauging the efficiency of market transactions. Rather than trying to observe actual transactions, which may be subject to fluctuating market conditions and measuring efficiency, which is a relative concept, difficult to objectively quantify, this chapter focuses on farmer's perceptions. The hypothesis is that farmers who have land titles perceive conducting land transactions to be easier than farmers who do not have land titles. Farmers were inquired about their perceptions of land sales, leases, and bequest, which were measured using a Likert scale. Subsequently, models related to the farmer's perceptions were formulated with their titling status and a set of control variables and estimated using the logistic regression analysis for each of the three types of transactions considered. The indicator of farmer's mindset is once again introduced as a control variable.

7.2. LITERATURE REVIEW

7.2.1. Theoretical Approaches

Land titles represent the modern form of legal recognition of land ownership and, as such, constitute a key element of a region's property rights system. If a farmer has a land title, then it would imply that the farmer follows a set of rules and regulations regarding land transactions and enjoys state protection of contracts related to land. The absence of land titles may be related to cultural aspects of a certain population or region, in which case restrictions to transactions may follow automatically.

The cultural restrictions refer to the way land is regarded in a certain community. In traditional communities, for example, land may be less important as an economic asset that is capable of generating a flow of revenue when compared to its significance as a burial ground, base of a lifestyle, or even part of the identity of the group. In such societies, land titles are often absent because the idea of private ownership of land is not fully accepted. Transactions like transfers of ownership or land lease may be severely restricted to members

of the community or even prohibited. Moreover, in other places, land management decisions are made entirely by the government, instead of following market mechanisms, which may also introduce restrictions to efficiency-enhancing transactions (Ho, 2014).

However, even where private property is considered an integral part of the local culture, farmers may not have land titles. This is because, in some places, the legal system does not offer provisions for titling or, more often, because low state capacity or high costs in issuance prevents many farmers from obtaining their titles. In such cases, farmers who own land that is not titled may suffer from tenure insecurities, which may restrict their transactions. Potential buyers may regard untitled land as subject to risks of expropriation, and thus reject deals that would otherwise be advantageous. Additionally, landlords that consider renting land may fear squatters. Some landlords may feel that they must constantly occupy their land themselves as a means of ensuring tenure (Goldstein & Udry, 2008).

If land ownership can be transferred to buyers or temporarily to lessors at a low transaction cost, without significant tenure security risks, and if the existence of free and competitive land markets can be assumed, then an efficient allocation outcome can be achieved, as per the first theorem of welfare. In practice, this could mean that each plot of land will be farmed by the most skilled farmer, who will make the best crop-selection choices and will raise productivity to the highest possible level, given the current technology.

Additionally, apart from land sales and leases, transfer by bequest is also a relevant transaction that may impact efficient land use by farmers, if restricted. It is assumed that farmers may have diminished incentives to make long-term investments, on the land, such as irrigation works, if they are not ensured that their offspring will benefit from such investments after their death. The effect of having titles, however, in this case, depends on the cultural setting. In places where a bequest is an institution that is accepted and respected by the community, regardless of the land being titled, having a title may negatively impact the introduction of bureaucratic costs for the transfer of ownership. Nonetheless, the aforementioned disincentive for farmers may be significant in places where the residual owner of land is the government. In such cases, farmers may be uncertain of the transfer of land to their heirs after their death (Ho, 2014; Newman et al., 2015).

7.2.2. Empirical Research

Past research has sought to investigate these theoretical relationships empirically. Baland et al. (1999) investigated the emergence of land markets in Ugandan locations where land transactions were virtually non-existent. They found that titling programs by the government and foreign aid agencies led to higher number of transactions and diminished land concentration. However, other researchers have found evidence that may suggest otherwise. D. Holden, Otsuka, & Place, (2009) and S. T. Holden et al. (2007) investigated participation in land rental markets in Ethiopia. They found that location wherein leasing land before titling was an uncommon practice remained out of rental markets even after titling. Notwithstanding, they found that villages that had a history of rental activity increased participation in rental markets. Additionally, unlike Baland et al. (1999), Colin & Woodhouse (2010) noted in their study of 16 countries that the access to formal land markets may lead to unequitable land distribution. The authors noted that this could be caused by distress sales, which are often regarded as efficiency-hampering transactions.

Holden's result that villages without a history of rental market participation did not increase their participation after titling cannot be immediately interpreted as an indication that land titles failed to facilitate efficient transactions. It can be inferred that, before titling, an efficient allocation of land had already been reached, which justifies the history of low

market participation. Additionally, it can be argued that opportunities for new efficient transactions did not arise. Colin & Woodhouse (2010)'s result, in turn, suggests that an increase in the number of transactions does not imply efficiency. This discussion indicates that measures of the number of transactions and market participation are imperfect proxies for market efficiency and that some control for "fairness" in transactions is necessary to ensure that there are mutual benefits.

As per Pareto's definition, efficiency is a state of allocation of resources from which it is impossible to reallocate so as to make any individual better-off without making at least one individual worse-off. In reality, to state that a given transaction is Pareto-efficient, at least the following conditions should be observed: a) all potential buyers and their preferences should be known, b) all preferences should be unequivocally comparable, and c) the transaction should have actually taken place. Limited information and subjective preferences make such assessment impossible. Finally, in case a transaction has not taken place, nothing can be concluded about the efficiency of such a situation because diverse restrictions to a hypothetically efficient transaction may or may not be active. Therefore, assessing the efficiency of transactions remains a speculative work.

In order to circumvent the problem that the absence of transactions does not imply inefficiency and their presence does not imply efficiency, we focus on the farmer's perception about the ease of conducting transactions. Researchers in the field of psychology such as Ajzen (1985)²² have stressed that perceived behavioral control, defined as the perception of ease or difficulty in executing a particular behavior, determines people's willingness to engage in such behavior. This perception is based on factors that potentially affect the odds of successfully achieving an outcome because of implementing the behavior. Several subjective or objective factors may influence the perceived behavioral control; educational levels and inherent self-confidence may be regarded as subjective factors, and actual levels of difficulty in attaining certain outcome would constitute an objective factor. In empirical research, perceived behavioral control is often measured by questions in Likert scale such as "from 1 to 6, how likely to succeed in performing action X do you believe you are?"

Recent land-related studies have employed the notion of the farmer's perceptions as a driver for agricultural performance. Linkow (2016), for example, surveyed farmers in Burkina Fasso to identify the sources of perceived land tenure insecurity. The author found that factors such as wealth and social exclusion significantly affected the perceived insecurity. Ma et al. (2017) found that, in China, the perceived tenure security created by titles had a negative impact on land use efficiency because it encouraged migration, which left land idle. On the other hand, land use efficiency was maximized in areas wherein farmers expected land reallocations in the future, perceiving risks to tenure security, because migration was discouraged.

In the context of evaluating the effect of land titles on facilitating efficient land transactions, the farmer's perceived behavioral control related to successful selling, leasing, or transferring land by bequest may be plausibly affected by their status of titling. The effect of titling can be identified if relevant variables capturing independent influences on perceptions are controlled. As titles attach value to land and contribute toward public protection of contracts, farmers may perceive land transactions to be conducted with lesser impediments, especially as negotiations with counterparts become balanced and actors become more likely to abide by the terms of the contracts in the long-term. In such a setting, even if transactions do not actually take place (i.e., due to the absence of effective

²² Proponent of the Theory of Planned Behavior.

opportunities), it can be argued that farmers will be more inclined to engage in such transactions once the opportunity arises, enabling future efficiency gains.

7.3. LAND TRANSACTIONS IN CAMPOS LINDOS

In Campos Lindos, grains are produced in large-scale in farms that are managed in conformity with corporate practices and therefore tend to be titled. Often, the landowner is not the farmer and is not directly involved in the management of the farm, but rather an investor who leases the land to professional farmers who possess the technical skills necessary to keep productivity at the highest. Investors may buy and sell land plots following business considerations, in which case the transfer of land titles becomes indispensable to ensure security to transactions. Additionally, agribusiness multinationals, such as Cargill, Bunge, and Multigreen have offices in the municipality and routinely negotiate contracts with farmers for the provision of credit, off-taker agreements, technical assistance, and technology transfer. Figures 7-1 and 7-2 illustrate the presence of such companies in the municipality. Land purchases, leases, and other efficiency-enhancing contracts may be restricted in the absence of land titles.



Figure 7-1: Agricultural Multinational Algar in Campos Lindos



Figure 7-2: Agricultural Multinational Bunge in Campos Lindos

Unlike the large-scale grain farms, the Municipality houses several untitled farmers. Farming, in this case, tends to employ traditional techniques because farmers have restricted access to credit and low possibilities for technology transfer. These disadvantages lead to low productivity levels and a high incidence of poverty. Untitled land may be subject to ownership disputes, and hence it is less likely to attract investors and have lower market prices. Potential buyers of untitled land tend to be dispossessed farmers in search for a source of livelihood. Land leases can be conducted without formal contracts, especially between farmers who need pasture for their cattle and farmers who specialize in cultivating species that are suitable for cattle nutrition. However, this sort of informal land lease, unlike the commercial sort practiced between investors and professional farmers, does not seem to be common in the region. This may be due to the fact that up to around 20 years prior to the survey, population density was very low, and hence land was commonly used for pasture. Moreover, untitled farmers may be unwilling to lease land to landlords who may have concerns that their tenant would claim ownership afterwards, especially if investments have been made.

Finally, both titled and untitled land may be transferred by bequest. In the case of titled land, the process usually entails hiring a lawyer to conduct all the necessary procedures, which may incur costs that some farmers may not prefer to bear. In the case of untitled land, the transfer may be conducted by oral agreements between the heirs and their ancestors, without any further formalization. In such a case, however, the tenure insecurity that was already present and even potential ongoing ownership disputes may also be inherited. Therefore, both untitled and titled farmers may perceive such transactions as difficult—the former due to costs or paperwork and the latter due to tenure insecurity.

7.4. METHOD

The questionnaire sheet included questions comprising socioeconomic information of the respondents and their households or farms, their status of land property rights, and perceptions regarding land transactions. The socioeconomic information included characteristics of the head of household and of the farms, such as age, gender, years of schooling, size of the farm, usage ratio for cultivation, and distance to the city center. Next, the data on the status of land property rights consisted of the status of titling, expressed as the binary response to the question “Is your farm secured by a property title (Yes/No)?” Finally, the farmer’s perceptions on the ease of performing transactions were measured using a six-point Likert Scale. Respondents were asked the following question, “Do you think it is easy and safe to a) sell your farm, b) lease your farm, and c) transfer your farm by bequest at a fair price?” The possible answers were 1- Impossible, 2- Very Difficult, 3- Somewhat Difficult, 4- Somewhat Easy, 5- Easy, and 6- No Difficulty. This phrasing was chosen in order to allow a comprehensive interpretation. Fair prices were mentioned to ensure, for example, that the farmer considered mutually beneficial transactions, instead of forced or distress sales. Surveyors were instructed to clarify whether respondents can consider possible difficulties regarding administrative procedures, finding potential buyers/leasers, and negotiating a fair price.

Table 7-1 shows the descriptive statistics for the major potential variables in the model²³. 56 % of farmers had a land title. The usage ratio, defined as the proportion of a farm that was actually used for production in the year up to the day of the survey, averaged at only 45%. This may indicate that many farms in the region do not use their land endowment efficiently and suggest that there may be scope for efficiency-enhancing transactions. Respondents living in flatlands accounted for 70%, and 77% had water streams running inside the farms, which increase the attractiveness of these farms as agricultural land.

Regarding the farmer’s perceptions, leasing was perceived as the most difficult transaction, while a bequest was perceived as the easiest. The respondents did not report that transferring land by bequest is “1-impossible,” and the indicator averaged between “somewhat easy” and “easy.” This finding shows a significant variation in perceptions, especially related to land sales and leases.

²³ Refer to chapter 5 for the descriptive statistics of the whole dataset.

Table 7-1: Descriptive Statistics - Potential Variables in the Model

	Mean	Median	Standard Deviation	Min	Max
Status of Land Property Rights and Land Features					
Titling (D)	0.56	1	0.49	0	1
Flatness (D)	0.70	1	0.45	0	1
Water Stream (D)	0.77	1	0.42	0	1
Usage Ratio	0.45	0.34	0.44	0	1.5
Size of Farm (ha)	262	52.5	885	0.5	7000
The Farmer's Perceptions					
Ease of Sales	3.61	4	1.45	1	6
Ease of Leasing	2.70	2	1.71	1	6
Ease of Bequest	4.80	5	1.36	2	6

(D) - Binary Variable

The present study tests the hypothesis that farmers who have land titles perceive conducting land transactions as easier than farmers who do not have land titles. Therefore, the farmer's perceptions regarding the three types of land transactions were modelled as a function of the status of titling as well as three different sets of plausibly correlated control variables. The first set comprises variables that may have psychological or cognitive influences on the farmer's perceptions, namely years of schooling, age, years from acquisition of the farm, participation in a poverty alleviation program, and commercial mindset. The second set of control variables capture physical characteristics of the land that may affect its attractiveness, specifically, factors like the distance to the city center, the ratio of land use, flatness, the presence of water stream, and the size of the farm. Variables in the first set subjectively affect perceptions, while the second set consists of variables that objectively affect the perceptions. Finally, the third set combines the two previous sets into an extended model. Continuous variables were converted into binary indicators that take the value 0 if the observation is smaller than the mean of the variable and 1 otherwise.

An ordered logit model is assumed with a latent variable in a linear function:

$$y_n^* = \sum \beta_j z_{nj} + \tau t_n + v_n \quad (1)$$

where y_n^* represents the latent variable measuring the farmer n 's perceptions, z_{nj} represents the j^{th} control variable for the farmer n , β_j and τ represent unknown coefficients, and v_n is an error component. The error component is assumed to follow the i.i.d. Gumbel. Then, the farmer's perception y_n is determined from the model as follows:

$$y_n = \begin{cases} 1 & \text{if } -\infty \leq y_n^* \leq \vartheta_1 & \text{(Impossible)} \\ 2 & \text{if } \vartheta_1 \leq y_n^* \leq \vartheta_2 & \text{(Difficult)} \\ 3 & \text{if } \vartheta_2 \leq y_n^* \leq \vartheta_3 & \text{(Somewhat Difficult)} \\ 4 & \text{if } \vartheta_3 \leq y_n^* \leq \vartheta_4 & \text{(Somewhat Easy)} \\ 5 & \text{if } \vartheta_4 \leq y_n^* \leq \vartheta_5 & \text{(Easy)} \\ 6 & \text{if } \vartheta_5 \leq y_n^* \leq \infty & \text{(No Difficulty)} \end{cases} \quad (2)$$

where $\vartheta_1 \dots \vartheta_5$ represent estimated threshold parameters. The probabilities of each response are expressed by the following equations:

$$Q_{1n} = Pr(y_n^* \leq \vartheta_1) = \frac{1}{1 + \exp(\vartheta_1 - \sum \omega_j z_{nj} - \tau t_n)} \quad (3a)$$

$$Q_{2n} = Pr(\vartheta_1 \leq y_n^* \leq \vartheta_2) = \frac{1}{1 + \exp(\vartheta_2 - \sum \omega_j z_{nj} - \tau t_n)} - \frac{1}{1 + \exp(\vartheta_1 - \sum \omega_j z_{nj} - \tau t_n)} \quad (3b)$$

$$Q_{3n} = Pr(\vartheta_2 \leq y_n^* \leq \vartheta_3) = \frac{1}{1 + \exp(\vartheta_3 - \sum \omega_j z_{nj} - \tau t_n)} - \frac{1}{1 + \exp(\vartheta_2 - \sum \omega_j z_{nj} - \tau t_n)} \quad (3c)$$

$$Q_{4n} = Pr(\vartheta_3 \leq y_n^* \leq \vartheta_4) = \frac{1}{1 + \exp(\vartheta_4 - \sum \omega_j z_{nj} - \tau t_n)} - \frac{1}{1 + \exp(\vartheta_3 - \sum \omega_j z_{nj} - \tau t_n)} \quad (3d)$$

$$Q_{5n} = Pr(\vartheta_4 \leq y_n^* \leq \vartheta_5) = \frac{1}{1 + \exp(\vartheta_5 - \sum \omega_j z_{nj} - \tau t_n)} - \frac{1}{1 + \exp(\vartheta_4 - \sum \omega_j z_{nj} - \tau t_n)} \quad (3e)$$

$$Q_{6n} = Pr(\vartheta_5 \leq y_n^*) = 1 - \frac{1}{1 + \exp(\vartheta_5 - \sum \omega_j z_{nj} - \tau t_n)} \quad (3f)$$

where Q_{ln} represents the probability associated with the response l for the farmer n .

7.5. ESTIMATION RESULTS

Tables 7-2, 7-3, and 7-4 summarize the results for the three models on the farmer's perceptions of land sales, land leases, and bequest, respectively. Except for Model I, with the land lease as the dependent variable, the results show that the fitness of all models, measured by McFadden's Pseudo R^2 , falls within the accepted limits of 0.15 and 0.40 (Wooldridge, 2012).

Table 7-2 - Models of Perceptions about Land Sales

Method: Ordered Logistic Regression								
Dependent Variable: The Farmer's Perceptions about Land Sales								
		Model I		Model II			Model III	
Independent Variables		Coe	t-value	Coe	t-value	Coe	t-value	
τ	0/1 Title	0.79	2.81 **	0.57	1.81 '	0.65	1.96 '	
β_1	0/1 Years of Schooling	0.31	1.03			0.01	0.14	
β_2	0/1 Age	0.29	-0.95			-0.36	-1.05	
β_3	0/1 Years from Acquisition	0.34	1.21			0.29	0.86	
β_4	0/1 Poverty Program	0.06	0.21			0.04	0.14	
β_5	0/1 Commercial Mindset	0.61	1.32			0.37	0.63	
β_6	0/1 Distance to Center			0.02	0.05	-0.11	-0.30	
β_7	0/1 Ratio of Land Use			0.62	2.09 *	0.50	1.46	
β_8	0/1 Flat Land			0.63	2.00 '	0.61	1.74 '	
β_9	0/1 Land with water stream			0.16	0.49	0.15	0.41	
β_{10}	0/1 Size of farm			-0.16	-0.55	-0.24	-0.71	

		Intercepts								
ϑ_1	Impossible/Difficult	-2.34	-5.14	**	-2.15	-3.91	**	-2.24	-3.37	**
ϑ_2	Difficult/Sw. Difficult	-0.20	-0.56		0.13	0.30		0.06	0.10	
ϑ_3	Sw. Difficult/Sw. Easy	0.69	1.92	'	1.11	2.45	*	1.00	1.74	'
ϑ_4	Somewhat Easy/Easy	1.37	3.70	**	1.83	3.94	**	1.75	2.99	**
ϑ_5	Easy/No Difficulty	2.91	6.85	**	3.45	6.66	**	3.26	5.19	**
		n=180			n=170			n=148		
Pseudo R2 (McFadden):		0.15			0.20			0.30		
AIC:		615.84			575.24			514.10		
**: 1% Significance; *: 5% Significance ' : 10% Significance										

The results show that the status of titling had a significantly positive effect on the farmer's perception regarding sales. This effect was significant across the three estimated models. Titled farmers may perceive sales to be more easily conducted than untitled farmers because there may be more potential buyers for titled land than for untitled land and the market price would be higher. In other words, the market for the titled land is larger; this factor increases the opportunities for efficient transactions, as buyers with higher surplus values are attracted. The variables in the first set, which express subjective influences on perceptions, were insignificant. This result may point toward the status of titling as a major determinant of perceived behavioral control in this case. Regarding variables that may objectively influence perceptions, the ratio of land use and the indicator of the flatness of the land, which approximate past investments and the physical suitability of the land for commercial agriculture, also displayed significant coefficients in Model II. However, only the flatness of the land remained significant even in Model III. Both these features may increase the attractiveness of the land for buyers.

Table 7-3 - Models of Perceptions about Land Leases

Method: Ordered Logistic Regression									
Dependent Variable: The Farmer's Perceptions about Land Leases									
		Model I		Model II		Model III			
Independent Variables		Coef	t-value	Coef	t-value	Coef	t-value		
τ	0/1 Title	0.49	1.48	-0.16	-0.43	-0.13	-0.31		
β_1	0/1 Years of Schooling	0.78	2.23	*		0.03	0.48		
β_2	0/1 Age	-0.19	-0.56			-0.54	-1.32		
β_3	0/1 Years of Acquisition	0.02	0.07			0.05	0.11		
β_4	0/1 Poverty Program	-0.09	-0.28			0.41	1.01		
β_5	0/1 Commercial Mindset	0.87	1.51			1.59	1.88	'	
β_6	0/1 Distance to Center			-0.68	-1.81	'	-1.24	-2.77	*
β_7	0/1 Ratio of Land Use			0.43	1.15		-0.34	-0.75	
β_8	0/1 Flat Land			0.77	2.02	*	0.52	1.26	
β_9	0/1 Land w/ water stream			0.36	0.87		0.81	1.66	
β_{10}	0/1 Size of farm			0.70	1.97	'	0.76	1.82	'

		Intercepts								
ϑ_1	Impossible/Difficult	-0.30	-0.74		0.30	0.51	-0.12	-0.15		
ϑ_2	Difficult/Sw. Difficult	0.75	1.83	'	1.44	2.41	*	1.09	1.38	
ϑ_3	Sw. Difficult/Sw. Easy	1.25	3.02	**	1.93	3.17	**	1.66	2.07	'
ϑ_4	Somewhat Easy/Easy	1.60	3.79	**	2.30	3.73	**	2.05	2.54	*
ϑ_5	Easy/No Difficulty	3.39	6.46	**	3.91	5.54	**	3.79	4.28	**
		n=135			n=121		n=104			
Pseudo R2 (McFadden):		0.14			0.26		0.36			
AIC:		449.01			391.96		352.58			
**: 1% Significance; *: 5% Significance ' : 10% Significance										

Perceptions regarding land leases seemed unaffected by the status of titling. The number of respondents was lower when compared to the other two transactions. This may be explained by the fact that the practice of leasing land, if not for professional farmers, by investors is not common in the municipality. This implies that many farmers may not have experience of such type of transaction, which may have interfered with their perceptions. This result may indicate that titling has a limited effect in terms of providing stimulus for new types of transactions to occur. Years of schooling had a significant positive result in Model I, indicating that educated farmers display a higher perceived behavioral control possibly due to better negotiation skills. However, the age and number of years since acquisition, which were expected to affect perceptions similarly, were insignificant. Considering that these variables average at 49 and 16, respectively, the insignificance of the coefficients may be because, at the given age and time, after an acquisition, farmers would have absorbed the necessary experiences to conduct transactions successfully. Next, distance to the city center and size of the farm had consistently significant indicators across Models II and III. Flatness only displayed a significant result in Model II. The significance of objective-influence variables and their higher explanatory power, when compared to subjective-influence variables, reinforces the commercial nature of lease transactions in the study area because it indicates rational decision-making by negotiators. A distant land may not be preferred for leases, especially if the tenant intends to use the land for residential purposes and farming. Additionally, larger farms may display benefits of scale, which would improve their attractiveness and, consequently, their perceived ease of leasing.

Table 7-4 - Models of Perceptions about Land Transfers by Bequest

Method: Ordered Logistic Regression								
Dependent Variable: The Farmer's Perceptions about Land Transfers by Bequest								
		Model I		Model II		Model III		
Independent Variables	Coef	t-value		Coef	t-value	Coef	t-value	
τ 0/1 Title	0.10	0.35		0.41	1.25	0.39	1.13	
β_1 0/1 Years of Schooling	0.11	0.36				0.03	0.67	
β_2 0/1 Age	-0.24	-0.79				-0.05	-0.15	
β_3 0/1 Years of Acquisition	0.68	2.35 *				0.54	1.59	
β_4 0/1 Poverty Program	-0.12	-0.41				-0.30	-0.88	
β_5 0/1 Commercial Mindset	-0.17	0.38				0.26	0.42	
β_6 0/1 Distance to Center				0.73	2.14 *	0.53	1.42	
β_7 0/1 Ratio of Land Use				-0.25	-0.80	-0.42	-1.17	
β_8 0/1 Flat Land				-0.05	-0.17	-0.08	-0.22	
β_9 0/1 Land w/ water stream				0.60	1.73 ' ,	0.55	1.42	
β_{10} 0/1 Size of farm				-0.06	-0.21	-0.16	-0.45	
Intercepts								
ϑ_1 Impossible/Difficult								
ϑ_2 Difficult/Sw. Difficult	-2.09	-5.14 **		-1.52	-3.07 **	-1.53	-2.38 *	
ϑ_3 Sw. Difficult/Sw. Easy	-0.91	-2.54 *		-0.39	-0.85	-0.34	-0.55	
ϑ_4 Somewhat Easy/Easy	-0.56	-1.61		0.01	0.02	0.02	0.04	
ϑ_5 Easy/No Difficulty	0.61	1.77 ' ,		1.13	2.42 *	1.22	1.97 ' ,	
		n=179			n=167		n=145	
Pseudo R2 (McFadden):		0.14			0.20		0.31	
AIC:		515.19			480.11		425.91	
**: 1% Significance; *: 5% Significance ' : 10% Significance								

Regarding transfers by bequest, the status of titling did not significantly affect the farmer's perceptions in any of the three models. An intermittent significance was demonstrated by the years from acquisition, the distance to the city center, and the binary indicator of the presence of water streams in the farm, indicating a weak effect. These last two variables, which captured different aspects related to the land's attractiveness, surprisingly displayed conflicting results. A distant land is expected to be less attractive, and land with water streams is expected to be more attractive. However, both display positive impacts on farmer's perceptions. This may imply that a land's attractiveness does not have a clear impact on the possibilities and difficulties of transferring land by bequest. In summary, the insignificance of the status of titling and the weak impact of explanatory variables indicate that, in the context of Campos Lindos, related bureaucratic procedures are neither excessively costly nor complicated for titled farmers. Untitled farmers who will not seek formal transfer of ownership by bequest also regard the transaction as easy because it is simply negotiated within families and widely recognized by the society. Finally, the favorable perception regarding the ease of transferring land by bequest is likely to be general in the region, regardless of the attractiveness of the land.

7.6. DISCUSSION AND CONCLUSION

Our empirical analysis yielded two main findings: a) farmers who have titles perceive land sales to be more easily conducted than farmers who do not have titles; b) Perceptions regarding land leases and transfers by bequest, however, are unaffected by the status of titling. The first result is in line with the theoretical expectation and may have implications for land use efficiency because it partially confirms the realization effect. However, as Colin & Woodhouse (2010) clarified, it must be noted that it is possible that facilities employed in selling a land may have a detrimental social impact in the form of causing distress sales. In this case, efficiency can be jeopardized, and inequitable land allocations may arise. The conditions under which distress sales could arise, however, need further elaboration. Concerning the second finding, it unexpectedly sets limits to the effectiveness of land titling. It provides one potential reason why several past studies, such as Place & Migot-Adholla (1998) and Bellemare (2013), did not find the expected impact of titling on agricultural productivity. This is because the finding indicates a partial impairment of the realization effect. This raises two important considerations.

First, it must be noted that perceptions may be subject to local culture and traditions. For example, S. T. Holden et al., (2009) and S. T. Holden et al. (2007) found that locations where leasing land was not common before titling remained out of rental markets even after titling. Our result regarding land lease may be in line with Holden's findings. In the case of Campos Lindos, a lack of past experience or, generally speaking, cultural aspects such as the common use of land and the use of land as burial ground may explain why perceptions are unresponsive to institutional changes and restrict transactions. Ho (2016) explained that land management may follow traditional procedures that exist to meet specific purposes in different communities, and hence land titles may be considered "foreign devices," rather than deeply rooted cultural aspects that undergo change. This implies that the expectation that land titles can immediately impact perceptions may be exaggerated.

Second, it may be argued that, while perceptions are in fact relevant determinants of behavior and decision-making, individuals may sometimes base their decisions on inaccurate or biased perceptions. Mullainathan & Shafir (2013), for example, stated that individuals in contexts of poverty may overestimate future risks (i.e., the risk of a tenant not returning the land to the landlord upon request). According to the author, long-term material deprivation may cause individuals to have an excessive concern for short-term considerations. Perceptions related to land transactions, in this case, may be biased. In our study, however, the indicator of poverty was participation in a poverty alleviation program, which yielded insignificant results. This may be attributed to the fact that the program effectively mitigates the psychological effects of poverty. Moreover, in addition to improved negotiation skills, education can also reduce potential biases in perceptions through a more accurate understanding of the surrounding world. In the case of land leases alone, our indicator of educational achievement was significant. However, this bias may have been prevalent as the average years of schooling in the sample was only 4 years. Finally, farmer's mindsets yielded a significant result in the case of land leases, indicating a potential relation between mindsets and perceptions.

The partial impairment of the realization effect indicates directions for potential policy recommendations aimed at fostering rural development that will be discussed in Chapter 10. The potential interdependency between farmer's perceptions and the determinants of mindset may also indicate directions for further explorations. The next step in this study, however, consists on verifying the functioning of the investment related mechanisms, also referred as collateralization and assurance effects.

8. IMPACT OF LPR AND MINDSETS ON FARMER'S INVESTMENTS IN CAMPOS LINDOS

8.1.BACKGROUND

The results in Chapters 6 and 7 pointed, first, to the rejection of the assumption that land titles increase agricultural productivity and, second, to the more specific finding that land transactions do not become easier in case a farmer has a land title, which may explain the first finding. In further discussing potential reasons for the second finding, it becomes apparent that psychological aspects that can have a bearing on determining farmer's perceptions may be at play. The present chapter advances this discussion by introducing farmer's mindset as one additional control variable potentially related to investments made by farmer.

Titles are commonly hypothesized to favor investment in two ways: first, titled farmers experience higher tenure security compared to untitled farmers, which reduces risks and thus creates incentives for investment; second, titled farmers have easier access to credit compared to untitled farmers, since financial institutions, such as public or private banks, may require farmer to possess formally recognized land as collateral for loans. The first way has been referred to as assurance effect, and the second, as collateralization effect (Brasselle, 2002).

In order to explain the mixed results obtained by the empirical literature, context specific conditions that may affect the impacts of titling on investment have been pointed out as intervening factors. Commonly identified restrictions include failures or incompleteness in financial markets (Brasselle et al., 2002); insufficient technical training or educational achievement by farmers (DFID, 2014); and insufficient incentive for higher productivity due to low market accessibility (Alston et al., 1996).

The emerging idea that is proposed in this study is that farmer investment behavior may be determined by traditional or psychological factors that influence a farmer's willingness to engage in commercial agriculture instead of agriculture focused on subsistence, which we term "mindset" (World Bank, 2015). Farmers with a subsistence mindset aim to provide for the basic needs of themselves and their families, typically passing up opportunities to expand production beyond the minimum required for subsistence. They display attachment to traditional production techniques and life-style. Conversely, commercial farmers aim for profit-maximization, thus they seek to expand production as much as possible, undertaking investments whenever feasible. These differing mindsets may be persistent over time, similar to social beliefs and institutions, as suggested by Acemoglu, Johnson, & Robinson (2005) so that they could be treated as an exogenous factor in a cross-section analysis. The present study explores data that identifies farmers' mindsets, in order to verify the potential causal effect of titling on access to credit and investments.

Two hypotheses are tested: first that titled farmers are more likely to contract loans than untitled farmers, and second, that titled farmers make more investments than untitled farmers. Baseline regression analyses are conducted with a binary indicator of access to credit and a categorical indicator of levels of investments as dependent variables. Then, farmers are matched using the Propensity Score Matching (PSM) approach, which improves the comparability of titled and untitled farmers. Finally, the effects of titling on the indicators of access to credit and level of investment are investigated in the matched sample.

8.2. LITERATURE REVIEW

Private property of land is often considered to be the form of property rights most conducive to agricultural investments (Demsetz, 1967). Private ownership is usually supported by titles. Where land is titled, land tenure is expected to be secure, which creates incentives for investments, originating the assurance effect. Additionally, access to credit is facilitated, because land can be used as collateral for loans, originating the collateralization effect (Brasselle et al., 2002).

In order to verify these theoretical relationships, extensive empirical research has been conducted. Researchers have typically gathered data on socio-economic variables, investment/production decisions, titling, and land tenure indicators at the farm level. The preferred countries for these studies have been in the African continent. A large number of studies have been produced, reflecting the interest of donor institutions in assessing the effectiveness of development programs and motivations related to poverty mitigation. However, results have been inconclusive (Brasselle et al., 2002; DFID, 2014).

A frequent methodological concern in the literature refers to the possibility of titling being endogenous, depending on the specific allocation process. When titling depends on decisions made by farmers themselves, cost-benefit considerations may lead to the conclusions that wealthier farmers are more likely to acquire titles, and titles also increase their wealth by eliminating investment constraints. PSM may be an adequate approach in this case, as exemplified by Bellemare (2013). Also, past investments may improve land tenure security by strengthening ownership claims, in which the use of Instrumental Variables may be in order, as illustrated by Baland, Gaspard, Place, & Platteau (1999). When the titling can be plausibly considered exogenous, due to comprehensive government intervention in a region, for example, a differences-in-differences approach may prove to be the most adequate (The World Bank, 2016).

As for the findings, on one side, a number of researchers found no significant evidence of positive relationships between titling and access to credit or investments. Benin & Pender (2001) found that only one out of 15 investment categories was affected by a proxy for tenure security in Ethiopia. Place & Migot-Adholla (1998) found titling failed in changing perceived land tenure security and credit use in Kenya. Jacoby & Minten (2007) found no effects on farm-specific investments in Madagascar. More recently, and also in Madagascar, Bellemare (2013) confirmed Jacoby and Minten's result. On the other side, illustrative works from the literature that do find evidence of a positive impact include Deininger & Jin (2006) who found that the expectation of future expropriation – a proxy for land tenure security – has a strong effect on investment in Ethiopia. Moreover, Deininger et al., (2010) and Holden, Deininger, & Ghebru (2007) also investigating locations in Ethiopia, find that titling positively impacts access to credit. Finally, Goldstein & Udry (2008) found that lower risks of expropriation lead to longer fallowing of land, one indicator of investment, in Ghana.

Several local-specific factors may interfere with farmer investment and lead to the mixed results found in the literature. These include incomplete financial markets (Brasselle et al., 2002), low educational achievements (DFID, 2014), and low market accessibility (Alston et al., 1996). In order to account for these, survey designs capable of capturing a comprehensive set of explanatory factors are required and the study location must provide sufficient variability in observations.

In addition to these factors, one emerging hypothesis as to why some farmers may be unresponsive to investment opportunities refers to behavioral aspects in decision-making. Farmer behavior may be grounded in long-standing circumstances and established beliefs, which may be persistent. Changing *de jure* institutions, such as providing titles, may be

ineffective in changing actual behavior. Such persistence has been suggested by authors such as Acemoglu et al., (2005) and, more recently and specifically related to land issues, by Ho, (2014)

Some farmers are assumed to have a commercial mindset; they aim to maximize profits in line with rational decision-making theory and are likely to make investments whenever possible. However, other farmers have a subsistence mindset, their goal is to provide for their immediate needs, overlooking investment opportunities. Farmers' mindsets may also influence their choice of acquiring land titles. Consequently, commercial farmers tend to attach more importance to titles since they provide security and access to credit, while subsistence farmers may value titles exclusively for security purposes.

Authors in the field of behavioral economics provide insights into why there may be two different behavioral patterns, or mindsets, especially when the individuals concerned find themselves in situations of poverty. Mullainathan & Shafir (2013) for example, explain that investments are considerations for the long term, which may be out of the time frame of decision-making for poor individuals, who may have an excessive focus on short-term decisions due to a past record of material deprivation. Appadurai (2004) suggests that the poor may have a limited capacity to aspire to higher accomplishments due to social beliefs related to their role in society, which leads them to regard poverty as a natural feature of their lives. Additionally, despite poor material comfort and resilience to economic fluctuations, some farmers may display attachment to their current life style, passing by opportunities for economic uplifting.

The study in this Chapter investigates the potential impacts of titling on access to credit and investments through data obtained in Campos Lindos, Brazil as described in Chapter 5, accounting for farmer mindsets and potential intervening factors identified in previous research.

8.3. METHOD

Table 8-1 displays the descriptive statistics for the main variables in the models²⁴

Table 8-1: Descriptive Statistics: Potential Variables of the Models

	Mean	Median	Stand. Dev.	Min.	Max.
Characteristics of the Household Head					
0/1 Titling	0.56	1	0.49	0	1
0/1 Commercial Mindset	0.12	0	0.33	0	1
0/1 Poverty Program Participation	0.45	0	0.49	0	1
0/1 Soy Producer	0.1	0	0.3	0	1
Age (year)	48	49	14.71	14	85
Educational Achievement (year)	4.77	4	4	0	17
Characteristics of the Farm					
Size of Farm (ha)	261.6	52.5	884.59	0.5	7000
Percentage of Land used for Agriculture (%)	0.45	0.34	0.44	0	5
Distance to Paved Road (km)	21.19	14	21.61	0.01	77
0/1 Land Acquisition by Squatting	0.16	0	0.36	0	1
Year of Land Acquisition	2001	2005	15.18	1932	2017
Duration of Titling Process (day)	450	150	613	1	2555
Access to Credit and Level of Investments					
0/1 Access to Credit	0.33	0.03	0.47	0	1
1/2/3 Level of Investment	1.54	2	0.55	1	3

²⁴ Refer for Chapter 5 for descriptive statistics of all the dataset.

One of the salient features of the dataset is the duration of the titling process, which is in average 450 days long, with a standard deviation of 613 days. The process usually starts at the initiative and expense of farmers. Provided that there are no ownership conflicts, farmers must apply for titles at the state's Land Agency²⁵, located in the state capital, Palmas, 570 km away. The Land Agency must then proceed with a land survey, which may also take a long time, usually due to lack of budget or staff. However, farmers may conduct this land survey at their own expense, by hiring qualified personnel. In evaluating the costs and benefits of acquiring the titles, wealthier farmers and those who intend to make a commercial use of the land, those with access to credit, are more likely to actually acquire them.

In order to define the indicator of mindset, respondents were asked whether most of their production was intended for sale or for self-consumption and also whether their current crop choice was motivated by profit, personal taste, or tradition. Respondents who expressed the intention of selling the production and profit-motivated crop choices, were considered to display a consistent commercial mindset, making up 12% of the sample (28 respondents). Commercial mindset respondents include large-scale grain farmers (17 respondents) as well as smaller scale family farmers (11 respondents). The relatively low average percentage of farm area actually being used for production, at 45%, may be correlated with farmer mindset. The commercial farmers tended to use close to 100% of the available area for production, while the subsistence farmers tended to use much lower percentages, keeping large areas unproductive. 33% of respondents contracted loans in the five years preceding the survey, either from public or private banks. Finally, respondents were asked if they had made any of six different categories of agricultural investment in the five years prior to the survey. The categories of investment were: shift to improved seeds, soil improvement, machinery, irrigation, drainage, and others. Farmers were then divided into three groups according to the number of categories invested in. Group 1 consists of those who did not make any investment. Group 2 consists of farmers who invested in between one and three categories, considered a low level of investment. Group 3 consists of farmers who invested in between four and six categories, making a high level of investments. This procedure is justified by the complementarity between the investment categories. Some farmers display a consistent investment behavior, making investments in most categories periodically, while other farmers invest sporadically or inconsistently in fewer categories, especially the cheaper ones, like purchase of improved seeds.

The present study tests the two hypotheses: titled farmers are more likely to contract loans from financial institutions than untitled farmers and titled farmers make more investments than untitled farmers.

First, two baseline models are estimated for the two hypotheses, respectively. A binary logit model is employed for the loan contract, while an ordered logit model is employed for the investment. As our main concern is the potential impact of titling status on the loan contract or investment, one of the explanatory variables in the above two models should contain the titling status: titled or not.

The binary logit model assumes that a farmer maximizes his/her utility function. Let U_{in} represent an indirect utility of farmer n under the condition of i ($i=1$: contract the loan during the past five years, and $i=2$: otherwise). The difference between the indirect utility function under a loan contract and that under no loan contract is assumed to be a linear function, shown as:

²⁵ Itertins – Instituto de Terras do Tocantins.

$$U_{1n} - U_{2n} = \sum \delta_k x_{nk} + \delta_t t_n + \varepsilon_n \quad (1)$$

where x_{nk} represents the k th variable pertaining to the farmer n or his/her farm; t_n represents the titling status where t_n is 1 if the farmer n owns a title, and 0 otherwise; δ_k and δ_t represent unknown coefficients; and ε_n represents an error component. The error component is assumed to follow the i.i.d. Gumbel. Then, a probability of a loan contract is derived as:

$$P_{1n} = \frac{1}{1 + \exp(-\sum \delta_k x_{nk} - \delta_t t_n)} \quad (2)$$

where P_{1n} represents the probability of accessing credit for the farmer n . The unknown coefficients are estimated by maximizing a likelihood function.

The ordered logit model is assumed in a framework of latent variable with a linear function shown as:

$$y_n^* = \sum \omega_j z_{nj} + \omega_t t_n + v_n \quad (3)$$

where y_n^* represents the latent variable measuring the level of investment for the farmer n ; z_{nj} represents the j th variable for the farmer n ; ω_j and ω_t represent unknown coefficients; and v_n is an error component. The error component is assumed again to follow the i.i.d. Gumbel. Then, the observed category of investment y_n is determined from the model as follows:

$$y_n = \begin{cases} 1 & \text{if } -\infty \leq y_n^* \leq \vartheta_1 \text{ (No Investment)} \\ 2 & \text{if } \vartheta_1 \leq y_n^* \leq \vartheta_2 \text{ (Low Investment)} \\ 3 & \text{if } \vartheta_2 \leq y_n^* \leq \infty \text{ (High Investment)} \end{cases} \quad (4)$$

where ϑ_1 and ϑ_2 are threshold parameters to be estimated. The probabilities of associated responses are expressed as:

$$Q_{1n} = Pr(y_n^* \leq \vartheta_1) = \frac{1}{1 + \exp(\vartheta_1 - \sum \omega_j z_{nj} - \omega_t t_n)} \quad (5a)$$

$$Q_{2n} = Pr(\vartheta_1 \leq y_n^* \leq \vartheta_2) = \frac{1}{1 + \exp(\vartheta_2 - \sum \omega_j z_{nj} - \omega_t t_n)} - \frac{1}{1 + \exp(\vartheta_1 - \sum \omega_j z_{nj} - \omega_t t_n)} \quad (5b)$$

$$Q_{3n} = Pr(\vartheta_2 \leq y_n^*) = 1 - \frac{1}{1 + \exp(\vartheta_2 - \sum \omega_j z_{nj} - \omega_t t_n)} \quad (5c)$$

where Q_{ln} represents the probability associate with the response l for the farmer n .

Next, let us consider the titling status. Whether a farmer applies for a title or not is dependent on the characteristics of the farmer and his/her farm, thus the decision of the farmer to choose to apply for a title is based on each farmer's self-selection instead of random assignment. If the treatment assignment is not random, the baseline estimations with the observed sample dataset could lead to biases. Consequently, this paper employs the PSM approach in order to improve comparability among observations and the identification of the impacts of titling. For the purpose of matching, propensity scores, defined as the probability of farmer n being titled, are formulated using a logit model as follows:

$$Pr(t_n = 1) = \frac{1}{1 + \exp(-\sum \rho_h s_{nh})} \quad (6)$$

where s_{nh} represents the h th explanatory variables for the farmer n , and ρ_h represents an unknown coefficient. For each given titled farmer, potential candidates for matching are sought among a subgroup of untitled farmers that display propensity scores within a given range from the propensity score computed for the given titled farmer. Three ranges – calipers – are tried: 25%, 10%, and 1%. Smaller calipers indicate a stricter matching rule,²⁶ meaning that a higher level of similitude between farmers is required for matching. Within the range determined by the caliper, the untitled farmer with the nearest propensity score is chosen for matching (nearest neighbor). Smaller calipers, however, diminish the degrees of freedom in subsequent regression models, since suitable matches cannot be found for all titled farmers. Once the matching is completed, a balance analysis is conducted to determine if the comparability between groups of titled and untitled farmers is satisfactory across the calipers utilized. Models are finally estimated with the matched subsamples, using the same equations (2) and (5) described above.

8.4. ESTIMATION RESULTS

Table 8.2 shows estimation results of the baseline models for loan contracts and investment, in which Model 1 is the binary logit model for loan contract choice while Model 2 is the ordered logit model for level of investment. The results show that the model fitness as measured by McFadden’s Pseudo R^2 , lies within the usual limits of 0.15 and 0.40 in both models (Wooldridge, 2012).

Table 8-2: Estimation Results of the Baseline Models

Independent Variables	Model 1 (Loan contact)		Model 2 (Investment)	
	Coefficient	t-stat.	Coefficient	t-stat.
Intercept	-1.86 **	-3.64		
0/1 Titling	0.96 **	2.48	0.18	0.55
0/1 Commercial Mindset	1.09 *	2.08	1.40 **	2.54
Educational Achievement	0.03	0.73	0.09 *	2.05
Distance to Paved Road	-0.55	-1.51	-0.57 '	-1.77
Size of Farm	0.95 *	2.48	1.35 **	3.85
Age	0.27	0.75	0.01	0.03
0/1 Land Acquisition by Squatting	-0.88	-1.55	-0.13	-0.30
0/1 Poverty Program Participation	-0.31	-0.86	-0.16	-0.50
No Investment Low Investment			0.90 '	2.36
Low Investment High Investment			5.78 *	6.88
Number of observation	207		211	
Pseudo R^2 (McFadden)	0.23		0.21	
AIC	234		304	

Note: **: 1% Significance; *: 5% Significance; and ': 10% Significance

The estimation results of Model 1 indicate that titled farmers are significantly more likely to contract loans than untitled farmers. They also show that commercial farmers were

²⁶ For example, if the caliper is defined at 10%, untitled farmers with propensity scores up to 5% lower or 5% higher than each titled farmer will be considered for matching.

also more likely to contract loans compared to subsistence farmers, and this effect is larger in magnitude than that of titling. Among the control variables, only the size of farm is significant, indicating a possible wealth effect, which potentially favors collateralization or improves risk perception by financial institutions.

The estimation results of Model 2 suggest the unexpected finding that titling had no effect on the level of investments. This may indicate that even without access to credit, untitled farmers conduct investments with their own resources to some extent. An alternative interpretation is that despite enabling farmers to contract loans, titles fail to generate sufficient incentives for farmers to invest. The coefficient of farmer mindset is estimated to be significant, suggesting that commercial farmers are more likely to make investments. This may provide an explanation as to why titles were effective in enabling access to credit but not increasing the level of investments. The size of farm has a significantly positive impact, indicating possible economies of scale in investments. Educational achievement had only a modest positive impact in the model for level of investments, which may mean that even without several years of formal education, farmers may be able to manage investments effectively. Finally, distance to the paved road had the expected negative effect on the model for investments, which may capture low incentives to investments due to poor market accessibility.

Then, we perform the PSM for mitigating the self-selection bias. First, for estimating the propensity score, we specify the explanatory variables in equation (6), which affects the choice of titling. They are Size of farm, 0/1 Poverty Program Participation, Educational Achievement, Distance to Paved Road, 0/1 Commercial Mindset, and Age. They capture farmer wealth, which is correlated with incentives to seek titles and capacity to cover the costs of titling; education, which captures the ability of to deal with paperwork and negotiate with government officials; distance to the paved road adds to the cost of titling; and finally, mindset and age determine the subjective value attached to titling by each farmer.

Figure 8-1 displays a comparison of the distribution of titled and untitled farmers, before and after matching, when the 0.25 caliper was applied. The distributions when the 0.10 and 0.01 calipers were applied display similar patterns. The similarity of the histograms for titled and untitled farmers after matching suggests that matching successfully reduced

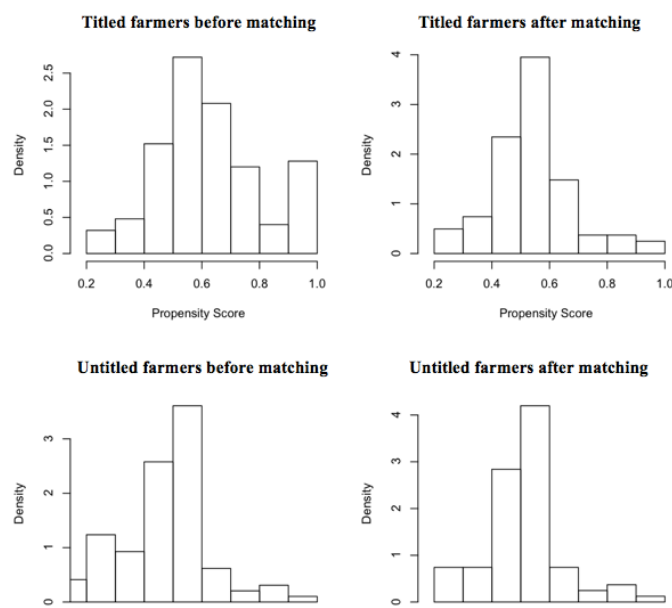


Figure 8-1: Distribution of Titled and Untitled Farmers Before and After Titling

the differences observed before matching. It must be noted, in particular, that several titled farmers with the highest propensity scores were left unmatched.

Table 8-3: Balance of Matching

Variables	Before Matching			After Matching					
	Mean Titled	Mean Untitled	Mean Diff.	Mean Diff.			Percent Balance Improvement		
				0.25 Calip.	0.10 Calip.	0.01 Calip.	0.25 Calip.	0.10 Calip.	0.01 Calip.
Propensity Scores	0.63	0.48	0.15	0.03	0.01	<0.01	82.2%	95.2%	99.8%
Size of Farm	427.3	63.76	363.6	93.43	11.91	-7.62	74.3%	96.7%	97.9%
0/1 Poverty Program Participation	0.38	0.5	-0.12	-0.02	0	0	79.2%	100%	100%
0/1 Land Acquisition by Squatting	0.1	0.25	-0.15	-0.02	0	-0.05	83.7%	100%	65.2%
0/1 Commercial Mindset	0.18	0.06	0.12	0.01	0	-0.03	89.2%	100%	77.0%
Education Achievement	4.93	4.55	0.38	0.35	0.59	0.4	9.4%	-54.2%	-3.4%
Age	48.59	46.08	2.51	0.31	-2.09	-2.03	87.7%	16.8%	29.2%
Distance to Paved Road	18.75	23.94	-5.19	0.11	3.58	1.22	97.8%	50.3%	76.4%

A further assessment of the quality of the matching procedures, the means of each matching variable before and after matching are compared, is shown in Table 8-3. Before matching, the mean differences between titled and untitled farmers were particularly high for the size of farm. This difference was reduced from the 0.25 caliper to the 0.10 caliper with a marginal improvement in the 0.01 caliper. The mean differences in Poverty Program Participation, Land Acquisition by Squatting, and Commercial Mindset were completely eliminated in the 0.10 caliper and sufficiently controlled in the other two calipers. Educational Achievement and Age displayed relatively small differences even before matching. The number of matched farmers across the three calipers is respectively 81, 68, and 38 out of a total of 125 titled farmers in the full sample. Tables 8-4 and 8-5 show the estimation results of the models after matching for loan contracts and for level of investments, respectively. First, Table 8-4 unveiled that, even after the introduction of PSM in order to address possible self-selection bias, titling still has a significant effect on the likelihood of farmers contracting loans, consistent across the three calipers. It could be argued that the 0.10 caliper provides the most accurate depiction of the real model, given the relative improvement in mean differences shown in Table 8-3, the number of matched observations and the model fitness (Pseudo R²), which is the highest of the three. The results also show that the estimated coefficient regarding the Commercial Mindset remains significant, even though it loses significance in the other two calipers. Size of Farm also remained significant, while both Poverty Program Participation and Distance to Paved Road have a significantly negative impact on loan contracts, as expected.

Table 8-4: Estimation Results of Loan Contract Model: Matched Subsamples

Variables	0.25 Caliper		0.10 Caliper		0.01 Caliper	
	Coef.	t-stat.	Coef.	t-stat.	Coef.	t-stat.
Intercept	-1.57 **	-2.68	-1.33 *	-2.05	-1.10	-1.27
0/1 Titling	1.13 **	2.67	1.63 **	3.20	1.25 '	1.95
0/1 Commercial Mindset	0.97	1.46	1.23 '	1.68	1.27	1.08
Size of Farm	1.22 **	2.76	1.57 **	3.04	1.04	1.54
Educational Achievement	-1.00	-0.24	-0.05	-0.78	0.03	0.33
0/1 Poverty Program Participation	-0.36	0.41	-0.87 '	-1.82	-0.78	-1.28
Distance to Road	-0.83 '	-1.83	-1.19 *	-2.22	-1.77 *	-2.27
0/1 Land Acquisition by Squatting	-1.25 '	-1.76	-1.28	-1.63	0.47	0.47
Age	-0.21	-0.47	-0.63	-1.20	-1.02	-1.53
Number of observation	162		136		76	
Pseudo R ² (McFadden)	0.16		0.27		0.24	
AIC	174		134		86	

Note: **: 1% Significance; *: 5% Significance; and ': 10% Significance

Table 8-5 shows that the cases of calipers 0.25 and 0.10 have lower Pseudo R² than the case of caliper 0.01, which sheds doubts on the reliability of the estimations. The results also unveil that the estimated coefficients both for Titling and Commercial Mindset are insignificant. This adds robustness to the interpretation that titling fails to generate incentives for investment. The loss of significance in Commercial Mindset may be attributed to the fact that it is correlated with titling or to the fact that most commercial farmers displayed high propensity scores and could not be matched, being left out of the subsamples. This is in accordance with the criticism presented by Pearl, (Pearl, 2009) that PSM might sometimes introduce new biases to the subsamples. Size of Farm, Educational Achievement, and Distance to Paved Road display significant coefficients with the expected signs.

Table 8-5: Estimation Results of Investment Model: Matched Subsamples

Variables	0.25 Caliper		0.10 Caliper		0.01 Caliper	
	Coef.	t-stat.	Coef.	t-stat.	Coef.	t-stat.
0/1 Titling	-0.02	-0.06	0.04	0.09	0.14	0.26
0/1 Commercial Mindset	0.89	1.34	0.68	0.99	0.50	0.4
Size of Farm	1.24 **	3.11	1.55 **	3.44	1.24 '	1.96
Educational Achievement	0.09	1.78	0.06	1.25	0.21 *	2.69
0/1 Poverty Program Participation	-0.21	0.34	-0.40	-1.07	-0.67	-1.27
Distance to Road	-0.47	-1.26	-0.83 '	1.98	-1.06 '	-1.77
0/1 Land Acquisition by Squatting	-0.16	-0.30	-0.52	-0.89	0.05	0.06
Age	-0.20 '	-0.55	-0.27	-0.65	0.29	0.52
No Investment Low Investment	0.77	1.56	0.44	0.85	1.14	1.44
Low Investment High Investment	5.31 **	5.99	4.97 **	5.53	6.21 **	4.45
Number of observation	162		136		76	
Pseudo R ² (McFadden)	0.09		0.12		0.18	
AIC	239		200		113	

Note: **: 1% Significance; *: 5% Significance; and ': 10% Significance

8.5. DISCUSSION AND CONCLUSION

The above analyses unveiled two main findings: first, titled farmers were consistently and significantly more likely to contract loans than untitled farmers; and second, titling had no effect on the level of investments made by farmers. This result can be regarded as even stronger than the result in Chapter 7, which unveiled a partial rejection of the realization effect. The present analysis may indicate that only some farmers may actually respond to titling increasing investments.

Regarding the first finding, it must be noted that the study location has long been served by financial institutions offering products for diverse rural clients, ranging from small-scale family farmers to large-scale corporate borrowers. Past results that did not find positive impacts of titling on access to credit, such as Place and Migot-Adholla, (Place & Migot-Adholla, 1998) may have been conducted in areas where financial markets were less developed or farmers faced other restrictions in obtaining credit, such as illiteracy or physical accessibility issues. Nonetheless, it is possible that in such areas a better clarification and formalization of land rights through titles may contribute to the long-term development of financial markets, constituting an externality of titling initiatives, as suggested by Feder and Feeny. (Feder, Gershon; Feeny, 1991)

As for the second finding, it may indicate that titles failed to generate sufficient incentives for investments. Even though farmers may demand titles in order to secure their tenure, subsistence farmers may not increase investments due to attachment to their traditional life-style or psychological constraints in terms of long-term thinking or higher aspirations, as discussed by Mullainathan and Shafir (Mullainathan & Shafir, 2013) and Appadurai. (Appadurai, 2004) The findings of Holden et al. (Holden et al., 2007) in Ethiopia, that titles increased rental market participation only in villages that had a history of active land rentals, provide a possible illustration of farmers' attachment to traditions. Further discussing why titles may fail in generating incentives, Ho (Ho, 2014, 2016a) suggests that titles may represent a foreign device in some communities, given their cultural practices. Land tenure systems, regardless of the use of land titles, accord with several elements of social and economic life, such as social security and family networks. Thus, the introduction of titles alone must not be expected to influence people's behavior extensively. Accordingly, the present study suggests that behavioral aspects of farmer decision-making may interfere with the expected impacts of titling. Even though, after matching, our indicator of mindset was statistically significant only in the models for access to credit, but not level of investments. This may have been due to the limited sample size.

The main finding in the present analysis, therefore, suggests that behavioral aspects of farmers, who may display either subsistence or commercial mindsets, may interfere with their investment decision-making. The same indicator of farmer's mindset also displayed significance in the analysis conducted in Chapter 6, in which the dependent variable was agricultural productivity. In Chapter 7, farmer's mindsets turned out significant in only one of three models, but the discussion was permeated by psychological considerations which may influence the formation of farmer's perceptions. The discussion in these three chapter jointly suggest directions for policy recommendation which will be detailed in Chapter 10.

9. TRANSPORTATION AS AN ENABLING TECHNOLOGY – DRIVER OF INSTITUTIONAL CHANGE

9.1. BACKGROUND

Two major hypotheses were set to guide this study: the first was that transportation could represent a relevant technological requirement for the impacts of LPR, and the second referred to the possibility of farmer's mindset having a similar role. Chapters 6, 7 and 8 focused on the second hypotheses directly and transportation had a minor role in some of the models, as variables such as distance to city center can be related with it. The present Chapter shifts the discussion back to the first hypothesis, investigating the role of transportation directly, but with a slightly different approach as compared to the previous Chapters.

The three previous chapters introduced farmer's mindset as an additional control variable to regression models which sought to explain agricultural productivity and the intermediating mechanisms of land transactions and investments by farmers. This approach assumes that LPR, in the form of land titles, is exogenously given and then conditions for its impacts are investigated. Regarding transportation, however, Chapter 4, which analyzed data from international datasets, set the result that countries with lower quality of transportation displayed higher impacts of transportation. Given this finding, it became apparent that potential positive intermediating effects of transportation were outweighed by other factors, such as farmer's mindset itself, for example. Therefore, a new type of relationship is assumed, in which LPR becomes endogenous and transportation is assumed to be one of its causal determinants.

Access to transportation has long been regarded as a critical condition for economic development. The most straightforward impacts of transportation are diminished costs and travel time, which enable access to broader markets, increase profit margins, and reduce prices for consumers. Beyond these direct impacts, there is an extended discussion regarding potential indirect impacts (Fujita et al., 1999). Frequently discussed indirect impacts include: the emergence of spatial patterns, such as agglomeration and specialization of economic activity; creation or destruction of jobs, leading to labor migration; technological innovation, as better connectivity favors the inflow of ideas along with travelers (Lakshmanan, 2011; Möller, Zierer, Möller, & Zierer, 2014). This Chapter investigates whether transportation has an impact on yet another aspect of the economy, its institutions, defined as socially accepted rules and norms of behavior governing human interaction (North, 1987).

Transportation is assumed to reinforce incentives for land titling because it increases competition for land, creating tenure risks for farmers. Transportation also creates business opportunities, so farmers may become interested in land titles to enable access to credit for investments. Additionally, transportation may reduce costs related to the titling process, as farmers may need to travel frequently to the land agency.

The municipality of Campos Lindos experienced rapid development of its agriculture following the construction of a major railway and a paved road. Many farmers in the region subsequently sought land titles. Two hypotheses are established: first, farmers whose produce is transported by railway are more likely to have land titles than those whose produce is not; second, farmers located closer to the paved road are more likely to have land titles than those located further away. The choice of titling is modelled as a function of two indicators of access to transportation and a set of relevant control variables for testing the

hypotheses. Instrumental variables (IV) are introduced to treat anticipated endogenous problems regarding the price of land.

9.2. LITERATURE REVIEW

Land property rights have evolved over time as different societies faced challenges related to land disputes. Feder & Feeny (1991) define three ideal types of LPR as a function of the level of scarcity or competition for land: First, open access land is assumed to be prevalent in times and places where the supply of land is perfectly elastic, or land is abundant in relation to land claims. Second, as land claims increase, due to factors like increase in population density or demand for agricultural goods, communal use of land may be the most efficient way to manage land disputes. In this case, laws and regulations may be customary and decisions may be taken by some form of community authority, democratic or not, such as priests or elected representatives. Third, for an even higher level of land dispute, where the population increased to large numbers, or in order to tackle conflicts stemming from overuse of natural resources²⁷, private property may emerge as the most efficient form of LPR, based on bureaucratic agencies, such as land registries, that provide tenure security and support efficiency-enhancing land transactions (Feder, Gershon; Feeny, 1991; World Bank, 2005).

More complex forms of LPR, however, come at increasing private and social costs. Private ownership of land in modern states is supported by public agencies responsible for land surveys, registry keeping, law enforcement, and the judicial system itself, for the resolution of disputes. Thus, societies and individuals may have to choose between different forms of LPR. Land laws may be negotiated in parliament, providing *de jure* LPR at a national level. The choice of applying for titles, nonetheless, is often at the discretion of farmers, who may consider the costs and benefits of doing so. A farmer's decision not to apply for the titles may create *de facto* LPR that are not homogenous across the territory of a country, even under the same land laws (Alston et al., 1996; Feder, Gershon; Feeny, 1991).

Alston (2010) stated that the benefits of titling, captured by the difference in the value of titled and untitled land, decreases as the distance to markets increases. This effect is because more distant land may be less attractive for residence and production, given the higher transportation costs, therefore, risks of expropriation or encroachment, which farmers might want to mitigate with land titles, are low. Feder and Feeny (Feder, Gershon; Feeny, 1991) argued that while individuals may value tenure security highly, the social marginal cost of extending LPR may prove prohibitive, making governments unresponsive to requests to open new branches of the land agency or conduct land surveys.

Improvements in access to transportation are assumed, therefore, to represent a technological shock that may influence both benefits and costs of titling. The introduction of transportation infrastructure, such as roads and railways, makes land more attractive to potential settlers interested in residence. Agricultural production may become economically viable, attracting investors and farmers with commercial interests. Increased competition for land may lead to conflicting claims, where land is not titled, and risks of encroachment, therefore land tenants face higher incentives to acquire titles and gain state protection of their assets. At the same time, if land becomes more accessible, the cost of traveling to the land agency decreases for farmers, which may have a relevant impact on titling, especially if multiple trips are necessary to complete the titling process.

²⁷ Problem commonly referred to as the "Tragedy of Commons".

However, it is difficult to empirically verify these ideas. In most of the developed world, private ownership was established centuries ago, so past research has relied on historical records as evidence. In developing countries, LPR may still vary across territories, with certain areas displaying higher levels of formalization through land titles and sufficient tenure security, while others experience land conflicts, incomplete titling, and coexistence of communal and private LPR. Nonetheless, exogenous titling initiatives carried out by governments and international institutions introduce significant difficulties in identifying non-political determinants of LPR (Holstein, 1996; Willy, 2008).

Hornbeck (2010) is an example of past empirical research highlighting a technological shock triggering a change in LPR. The author proposed that the invention of barbed wire contributed greatly to the settlement of the American West. Barbed wire reduced the private costs of enforcement of property rights, making estates more secure and keeping animals from feeding on other farmers' crops. Along with the construction of transportation infrastructure, illustrated by the Pacific Railroad and the passing of the Homestead Acts, which allocated private property rights to settlers, the expansion to the West rapidly increased over the second half of the 19th century. In this case, the concept of private property and its supporting institutions was already ingrained in society, and the technological shock represented by barbed wire was responsible for an improvement in the enforcement of LPR.

Heady and Feeny (Heady & Feeny, 1983) presented the case of Thailand as one example of changes in LPR related to transportation. The authors argued that for the majority of the 19th century, land was abundant, labor was scarce, and the legal system supporting land use and transactions was not extensively developed. By the end of the century, however, advancements in maritime transportation favored the insertion of Thailand into international trade routes, promoting intense expansion of rice sales abroad. Agricultural land became more valuable as the thriving export rice industry expanded, population density increased, and land disputes became widespread. The Government of Thailand was forced to pass legislation in 1892 reforming land rights in the country. Finally, in 1901, the country created a formal system of land titling.

More recent quantitative evidence regarding the determinants of titling has been presented by Alston et al., (1996). They used survey data from 1992 and 1993 collected in a location in the Amazon Forest in Brazil, which had been the focus of the Brazilian government's settlement programs in the 1970s and 1980s. In their framework, titling is a function of the expected increase in land values due to titling, which diminishes as the distance to markets increases. They confirmed the expectation that farmers located closer to important markets were more likely to be titled. The expected increase in land value was first simulated for each observation in the sample, which allowed the authors to address the issue of two-way causality between the status of titling and land value using a system of equations.

However, a limited number of papers use quantitative data to test the hypothesis that transportation may increase land titling, highlighting the need for additional studies. Locations must be selected in areas that recently experienced or are currently experiencing changes in LPR that are plausibly related to improving conditions of access to transportation.

9.3. TRANSPORTATION AND LAND TITLING IN CAMPOS LINDOS

Large-scale grain production employs advanced technologies and is performed by skilled farmers, regularly using financial products and adopting an entrepreneurial

management style on their farms. Nonetheless, the municipality also houses a number of dispossessed farmers who engage in traditional subsistence agriculture, displaying low productivity, low market participation, and generally impoverished conditions. Despite the wealth created on large-scale farms, the municipality ranks among the poorest in Brazil.

In parts, the stark inequality observed in Campos Lindos relates to the fact that LPRs are incompletely allocated in the region, so many farmers still do not have their land titles. Poor, landless farmers have routinely immigrated from neighboring areas and squatted on untitled public land or even titled private land. Titled land owners may also encroach, extending the limits of their farms beyond the rightful boundaries. Conflicts ensue and are sometimes dealt with by eviction notes issued by the Courts. Evictions create humanitarian distress, since the land is sometimes the only source of livelihood for some families and the risk of eviction may curb investments by farmers (DFID, 2014).

In the previous decades, Campos Lindos had been sparsely populated by squatting early settlers. The economy was mostly based on cattle breeding in open fields. Almost none of the early settlers had land titles, even though the Brazil's legal framework for land ownership had been in place for several decades (Sergio Schlesinger e Silvia Noronha, 2006). The event that seemingly increased interest in land titles was the inauguration of a major railway²⁸ in 1986, which was, subsequently, gradually expanded towards the municipality in the following years.²⁹ The completion of the railway, paving of roads, and construction of bridges made grain production in the region economically viable, as international markets became accessible at lower costs.

Concomitantly, land conflicts increased, leading to occasional violent demonstrations, with many farmers applying for titles to secure tenure and enable access to credit. The titling process, however, is not simple. If there are no ownership conflicts over a land plot, the farmer must apply for the title at the state's land agency³⁰ located in the State Capital, Palmas, 570 km away. The land agency must then proceed with a land survey, which may take from weeks to several years, due to lack of budget, staff, or political will. The process may include several trips to the land agency. It is possible for farmers to conduct this land survey at their own expense by hiring qualified personnel, so wealthier farmers are more likely to apply and succeed in the titling process.

Farmers may evaluate the costs and benefits of applying for titles. Farmers whose land is more valuable due to its agro-ecological potential, proximity to the city, or market accessibility may perceive higher risks of expropriation or encroachment, wish to obtain credit for investments, and thus feel more inclined to face the costs of titling. Additionally, transportation to the land agency may represent a cost consideration, especially for poor farmers. It is thus hypothesized that access to transportation may increase titling through higher incentives for titling and lower costs in the titling process.

9.4. METHOD

The questionnaire includes questions regarding farmers' titling status and socio-economic information, as summarized in Table 9-1.

²⁸ Estrada de Ferro Carajás (EF-315), later connected with Ferrovia Norte-Sul (EF-151).

²⁹ The nearest loading station was inaugurated in 2008, around 215 km from the center of Campos Lindos. Despite the seemingly large distance, the use of the railway represents a significant reduction in cost compared to the cost of hauling grains for nearly 1000km by road to port.

³⁰ Itertins – Instituto de Terras do Tocantins.

Table 9-1: Descriptive Statistics: Potential Variables of the Models

	Mean	Median	Stand. Dev.	Min.	Max.
0/1 Titling	0.56	1	0.49	0	1
0/1 Poverty Program Participation	0.45	0	0.49	0	1
Educational Achievement (year)	4.77	4	4	0	17
Size of Farm (ha)	261.6	52.5	884.59	0.5	7000
Value of Land (BRL/ha)	5550.75	5000	4728.47	500	30000
0/1 Flat Land	0.70	1	0.46	0	1
0/1 Use of Fertilizers	0.34	0	0.47	0	1
0/1 Use of Tractors	0.52	1	0.50	0	1
Percentage of Land used for Agriculture (%)	45	34	44	0	150
0/1 Main source of Income: Own Farm	0.82	1	0.38	0	1
Distance to Paved Road (km)	21.19	14	21.61	0.01	77
Distance to City Center (km)	23.34	17	20	1	77
0/1 Use of Railway	0.10	0	0.30	0	1
0/1 Land Acquisition by Squatting	0.16	0	0.36	0	1
Year of Land Acquisition	2001	2005	15.18	1932	2017
Duration of Titling Process (day)	450	150	613	1	2555

Among respondents, 56% had already secured their land titles and 45% participated in a poverty alleviation program that dispenses monthly stipends for families with income below a given poverty line. Educational achievement is generally low, averaging only 4.77 years of formal education, while some respondents were illiterate. The size of farm varied significantly, showing the inequality between large-scale farming and traditional farming. A total of 70% of respondents resided in farms with sufficiently flat land for use of heavy agricultural machinery, indicating that agro-ecological potential for large-scale farming in most of the farms surveyed. Nonetheless, the percentage of land actually in use for agriculture on each farm was surprisingly low, averaging 45%, possibly indicating insufficient access to markets or restrictions on access to credit for investments, among other things, despite the fact that 82% of respondents rely on agriculture at their own farms as a main source of livelihood. The average distances to the city center and to a paved road are 21.2km and 23.3km, respectively, which indicates considerable dispersion of population in the area of the municipality, and limitation in market accessibility for many respondents. As for the railway, only 10% of respondents use it to transport their produce, almost exclusively large-scale grain farmers. A total of 16% of respondents declared they had acquired their farm through squatting, indicating the weakness of LPR currently in place. The average year of acquisition of the land was 2001, but some respondents have resided in the region for several decades, regardless of titling status. Finally, the length of the titling process averaged 455 days, but ranged from one day, in the case of simple transfer of an already existing land title, to 2,555 days, where land disputes likely took several years to be resolved by the courts.

A visual, unconstrained analysis of Figure 5-13 which displays the spatial distribution of titled and untitled farmers across the Municipality, suggests a slightly higher prevalence of farmers without land titles in the outskirts of the municipality. Most of the large-sized grain farms, generally located to the southeast of the urban center, have the titles. The concurrence of multiple factors in determining farmers' choices in acquiring titles, however, points to the need of multiple regression analysis.

This Chapter tests two hypotheses: farmers located closer to the paved road are more likely to have land titles than those located further away; farmers whose produce is transported by the railway are more likely to have land titles than those whose production is not.

The first hypothesis is based on the idea that farmers with better access to transportation face higher incentives for titling, because transportation leads to more competition for the land. Also, the access to transportation creates business opportunities that farmers may wish to seize and thus they require titles, in order to access credit. Additionally, proximity to the paved road diminishes the costs of trips to the land agency. Since the railway is not used for passenger transportation and cannot be used to travel to the land agency, the second hypothesis tests only the idea of higher incentives for titling due to competition for the land and farmers' desires to seize business opportunities.

First, a baseline model is estimated. A farmer's choice of acquiring titles is formulated with a binary logit model. Since we are interested in identifying the impact of access to transportation on the decision of acquiring titles, the distance to the paved road and a binary indicator of use of railway are included as explanatory variables. The binary logit model assumes that farmers maximize their utility level. Let U_{in} represent an indirect utility of farmer n under the condition of i ($i=1$: farmer has land title and $i=2$: farmer does not have land title). The difference between the indirect utility function for titled farmers and that of untitled farmers is assumed to be a linear function, shown as:

$$U_{1n} - U_{2n} = \sum \delta_k x_{nk} + \delta_v V_n + \delta_d D_n + \delta_r R_n + \varepsilon_n \quad (1)$$

where x_{nk} represents the k th variable pertaining to the farmer n or his/her farm; V_n represents the value of land per hectare, where V_n is 1 if the value of land of farmer n is higher than the mean price in the sample and 0 otherwise; D_n represents the distance to the paved road, where D_n is 1 if the farmer n is located further away than the mean distance in the sample and 0 otherwise; R_n represents use of the railway, where R_n is 1 if farmer n 's production is transported by the railway and 0 otherwise; δ_k , δ_v , δ_d , and δ_r represent unknown coefficients; ε_n represents an error component. The error component is assumed to follow the i.i.d. Gumbel. Then, a probability of having a land title is derived as:

$$P_{1n} = \frac{1}{1 + \exp(-\sum \delta_k x_{nk} - \delta_v V_n - \delta_d D_n - \delta_r R_n)} \quad (2)$$

where P_{1n} represents the probability of having a title for the farmer n . The unknown coefficients are estimated by maximizing a likelihood function.

The price of land per hectare provides a measure of the level of competition for the land, as land that is attractive to settlers and investors is expected to be more expensive. However, the price of land increases when the farmer acquires a title, so a problem of two-way causality emerges. The status of titling may be correlated with the error term ε_n , raising endogenous concerns that may compromise the identification of the effect of this variable on the probability of titling. Additionally, endogeneity may also be present with regards to the use of the railway. That is because a large production scale is required to make use of the railway viable. Given a sufficiently large farm with adequate agro-ecological features, obtaining a title may be critical to allowing production to reach the minimum required scale.

In order to tackle the endogeneity problem, IVs are introduced into a first stage regression designed to express the price of land per hectare as a function of its characteristics other than status of titling:

$$V_n^* = \pi_0 + \pi_1 S_n + \pi_2 F_n + \pi_3 UR_n + \pi_4 DC_n + v_n \quad (3)$$

where π_j with $j = 0 \dots 4$ are unknown coefficients; S_n represents the size of farm n . Larger farms may be worth more per hectare due to economies of scale; F_n is 1 if the land

of farmer n is flat and 0 otherwise. Flat lands allow the use of heavy machinery and are adequate for the production of the most productive crops – soybean and corn – given the agro-ecological features of the region; UR_n captures the percentage of farm n that is actually used for production. Higher usage ratios capture good quality of land throughout the extension of each farm and farmer’s commercial use of it, which is correlated with past investments in soil improvement and irrigation, and other investments that attach value to the land; DC_n is the distance to the city center, which captures the attractiveness of the land for residential purposes; v_n represents the error term, where the effect of titling is expected to be present.

Regarding the use of the railway, a similar first stage regression is estimated:

$$R_n^* = \gamma_0 + \gamma_1 S_n + \gamma_2 F_n + \gamma_3 FZ_n + \gamma_4 Tr_n + \epsilon_n \quad (4)$$

where γ_j with $j = 0 \dots 4$ are unknown coefficients; S_n represents the size of farm n . In this case, economies of scale may be critical to enabling the use of railway; similarly, F_n is 1 if the land of farmer n is flat and 0 otherwise. FZ_n is 1 where farmer n uses fertilizers and 0 otherwise; Tr_n is 1 if farmer n uses tractors in production and 0 otherwise. These latter two variables capture a farmer’s capacity to attain the necessary production scale; ϵ_n represents the error term, where the effect of titling is again expected to be present.³¹

Then, three versions of a second stage regression are estimated. The fitted values of V_n^* and R_n^* in Eqs. (3) and (4) replace the original variables V_n and R_n in Eqs. (1) and (2) alternately for robustness, respectively. These fitted values represent the original variables cleared from their correlation with the error term ϵ_n .

9.5. ESTIMATION RESULTS

Table 9-2 summarizes the results of the estimations for the baseline model and the 2-Stage models, in which the first stage was estimated with the Ordinary Least Squares or Logit, depending on the case, and the second stage is a logit model estimated with likelihood maximization.

First, regarding the quality of fit, the baseline model and the 2-Stage model, in which only use of railway receives instrumental variables, displayed Pseudo R^2 s within the conventional limits of minimum 0.15 and maximum 0.40. The higher AIC (Akaike Information Criterion) displayed by these two models may also suggest that they depict a more precise reality compared to the other two.

³¹ Angrist and Pischke (Angrist & Pischke, 2008) explained one additional reason why a second first-stage equation should be estimated. The IVs introduced to explain Price of Hectare may be closely related to another explanatory variable, namely, the use of railway. In this case, there may be a violation of the exclusion restriction, which calls for the introduction of IVs for the use of railway as well.

Table 9-2: Estimation Results

Independent Variables	Baseline Model		IV Model 1 (Price of Hectare)		IV Model 2 (Use of Railway)		IV Model 3 (Both)	
	Coef.	z-value	Coef.	z-value	Coef.	z-value	Coef.	z-value
δ_0 Intercept	-1.15	-2.01 **	-0.46	-0.67	-1.37	-2.27 *	-0.64	-0.94
δ_v Price of Hectare	0.28	0.77	-0.28	-0.63	0.24	0.64	-0.07	-0.17
δ_d Distance to Paved Road	-0.69	-1.71 ’	-0.92	-1.91 ’	-0.52	-1.28	-0.58	-1.20
δ_r Use of Railway	2.01	1.80 ’	2.12	1.88 ’	1.18	2.21 *	1.34	2.40 *
δ_1 Educational Achievement	0.37	1.01	0.38	0.96	0.42	1.13	0.29	0.72
δ_2 Participation in Poverty Program	-0.15	-0.45	-0.32	-0.87	-0.07	-0.19	-0.27	-0.72
δ_3 Years since Acquisition of State	0.04	2.97 **	0.04	2.82 **	0.03	2.37 *	0.03	2.36 *
δ_4 Acquisition by Squatting	-1.41	-2.67 **	-1.54	-2.86 **	-1.91	-3.26 **	-2.14	-3.50 **
δ_5 Income from own farm	1.04	0.48 **	0.92	1.62	1.22	2.46 *	0.89	1.58
Number of Observations	173		155		168		152	
Final Log-Likelihood	-102.06		-90.28		-98.6		-88.18	
Initial Log-Likelihood	-157.14		-157.14		-157.14		157.14	
Pseudo R ² (McFadden):	0.35		0.43		0.37		0.44	
AIC	222.12		198.57		215.19		194.35	

** : 1% Significance; * : 5% Significance ’ : 10% Significance

Second, Table 9-2 shows that the coefficient δ_r was significant across all four models, even after endogeneity treatments, along with expectations. This suggests a strong effect of the use of railway over the probability of farmers having land titles. The coefficient δ_d was significant in only two models. The impact of distance to the paved road, therefore, may be weaker than that of the railway. This may indicate that restrictions imposed by difficulties in the physical accessibility to the land agency by farmers are less significant than hypothesized. Also, the extent to which the paved roads favor market accessibility may be less than that of the railway. In fact, by connecting Campos Lindos to a port, the railway opens up international markets and enables potentially high profits. The variable that captures years since acquisition of state had a positive impact, indicating the expected result that farms established earlier are more likely to have a title. This result owes to two factors: first, given the extended length of the titling process, recently established farms may not have had enough time to finish the process; second, earlier untitled settlers may have been evicted or forced to vacate their land due to land conflicts, and thus have not been included in the sample. Farmers who originally acquired their land by squatting are less likely to have a title. Since squatters tend to be poor farmers, it is likely that they lack financial means to incur the costs of titling, or they may have settled on land with pre-existing claims.

Third, participation in the poverty alleviation program, surprisingly, did not turn out significant in any of the models. While participation in the program indicates a condition of poverty, this result may have been because the stipends disbursed to the participants may have alleviated poverty to the extent that many participants may have been able to acquire titles. Also, diverging from expectations, the value of land per hectare does not show statistical significance in either of the models. It was expected that higher value land would be more likely to be titled, since higher values indicate higher competition and, thus, higher risks of expropriation or encroachment. This result may be explained by the fact that the price mechanism may not function as expected for untitled land, so higher competition does not necessarily translate into higher prices. Where land can be appropriated by squatting, encroachment and earlier settlers can be removed by force, thus eliminating monetary transactions, and the very lack of property rights may impair the functioning of the price mechanism.

9.6. DISCUSSION AND CONCLUSION

The main finding of this Chapter is that access to transportation influences the probability of farmers having land titles, which confirms the hypothesis that transportation constitutes a technological requirement enabling the impacts of LPR. Farmers located closer to the paved road and who use the railway to transport their produce are more likely to have titles than those who are located further away and do not use the railway. Access to transportation is assumed to create incentives for titling, as farmers seek protection against higher competition for their lands, seek access to financial markets to seize new business opportunities brought by transportation, and face lower costs in the process of titling. This result may have a significant policy implications that will be discussed in Chapter 10.

Given that the incentive for titling increases with transportation, improved LPR could be considered one additional indirect impact of transportation in developing rural areas. Also, considering that the impact of the use of the railway was statistically stronger than that of distance to the paved road, the likelihood of titling probably does not decrease linearly with distance and is not the same across different modes of transportation, differing from the framework proposed by Alston et al. (1996). Commodities produced and geography could also interfere with the impacts. As the incentive for titling is related to level of attractiveness and competition for land, considerations regarding the agro-ecological potential of each area, the most profitable crops or breeds, and the appropriate scale of production and transportation to markets should help identify the areas that will experience higher competition, potential for conflicts, and incentive for titling.

Finally, it must be noted that the result of this study was achieved in a setting where the legal framework for private property has already been established, and the concept of private property was likely ingrained in the local culture. The provision of access to transportation in this setting had the effect of strengthening the formalization of private ownership through land titles. Differently, one of the historical accounts presented in the literature review – the case of Thailand – suggests an even stronger impact of improvements in transportation. Increased land conflicts spurred the government to put in place legislation and public agencies to support private property, which did not exist before. Ho (Ho, 2016b), however, suggests that such a deep change in LPR may not always happen, as private property and land titles may represent foreign devices in traditional communities and may, therefore, face poor social acceptance. It is likely that the impact of transportation on LPR will be more directly observed in countries that already have the legislation and public agencies in place. Areas where traditional customary land management systems are prevalent could experience land conflicts, but the transition to a formal private property system may not follow immediately.

10. FINDINGS AND POLICY RECOMMENDATIONS

The previous chapters set two main hypotheses: the first concerning the possible existence of technological requirements for the realization of the impacts of LPR and the second concerning potential constraints to farmer's behavior stemming from their contexts of poverty. Then, given the situation observed in the chosen study location, the Municipality of Campos Lindos, transportation and farmer's mindset were identified, respectively, as key technology and key element of context of poverty. These two factors constituted the overall working hypotheses which were designed in order to gather evidence related to the main hypotheses outlined above. Several types of analyses were conducted, leading to a myriad of partial results which are now consolidated into 3 main findings. These findings are discussed, especially with regards to the possibility of generalization to other settings. Finally, the ultimate goal of the study is the issuance of policy recommendations with the purpose of supporting agricultural productivity in developing countries, therefore, the present chapter presents the recommendations as a consequence of the findings that motivate them.

10.1. Improvements in LPR may have negative impacts on some stakeholders

The first finding stems from a reflection regarding the evolution of LPR in Campos Lindos, based on qualitative remarks presented in Chapter 5 and data analyses developed later on. Even though it can be said that taking Campos Lindos as a whole, the situation of LPR improved significantly over the course of the past decades, in particular after 1985, due to the extensive titling of the land area of the Municipality, a detailed analysis of the specific impacts on different groups of stakeholders unveils that impacts were uneven or negative in some situations. Figure 10-1 shows the timeline of Campos Lindos, highlighting the major events in the past decades.

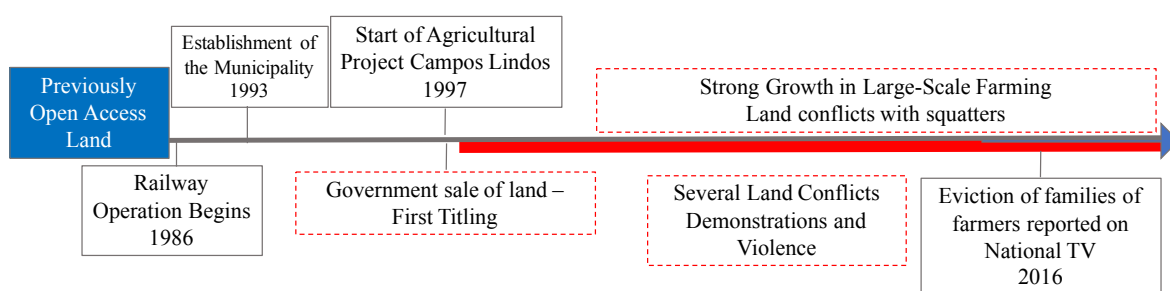


Figure 10-1: The Timeline of Campos Lindos

While the most productive farmers in the sample invariably possessed land titles and reported to make effective use of them to support their agricultural activity, in line with theoretical expectations, the titling of the region happened at the expense of some stakeholders. Interviewees reported that many farmers that lived in Campos Lindos prior to the developments that led to the expansion of large-scale farming eventually suffered evictions, either through court rulings or by extra-judicial and illegitimate practices, such as coercion and forceful expulsion. These farmers did not, in fact, enjoy legal protection for

the area in which they lived. Most of them had been using part of the land as a common, allowing cattle and other animals to use the land as natural pasture. Hunting and gathering were also common sources of livelihood at the time, as reported by interviewees who had experienced life in Campos Lindos before 1986. Many farmers who underwent such difficulties were nowhere to be found in Campos Lindos, as some reportedly emigrated to other regions or sought employment in larger urban areas. Some others did remain in Campos Lindos and were able to narrate these stories.

Some farmers who stayed in Campos Lindos, however, and in spite of their efforts, have been able to acquire land titles and thus still experience severe tenure insecurity. At one side, therefore, farmers who have secured their land titles enjoy better possibilities of achieving higher productivity and, generally speaking, improving their conditions of living. At the other side, many farmers endure situations that may, at times, escalate to the extreme of becoming life-threatening. In such situations, increasing agricultural productivity may be completely out of the scope of decision-making, since farmers may need to take provisions for their own survival.

In summary, the situation of LPR in Campos Lindos has evolved from one in which nearly no farmer had land titles but not necessarily experienced tenure insecurity to one in which some farmers do have land titles and are generally safe while others experience severe insecurity. This increase in tenure insecurity for some farmers have not come at the expense of agricultural productivity, on the contrary, the development of large-scale farming would have been unlikely to succeed without access to credit and modern contracts enabled by land titles. Considering large-scale farmers, therefore, improvements in LPR in Campos have been successful in supporting high productivity.

Nonetheless, in a report from the World Bank (2016) which reviews land titling programs carried out or supported by the Bank, national governments and authorities explicitly state poverty mitigation as one major motivation. Our finding therefore sets a clear limit to the impacts of land titling or projects aimed at improving LPR in general. There seems to be no guarantee that simply by increasing the land area that is recorded and protected by land titles, poverty mitigation results will follow.

Should governments set poverty mitigation as explicit objectives in titling programs, therefore, targeting poor farmers for preferential or priority titling stands out as an indispensable strategy. In fact, Zevenbergen et al., (2013) states that titling programs that are based simply on applicant's initiative are very likely to be captured by those farmers who can dispose of higher financial resources or who have government connections. Considering the reasons why some farmers do not to have titles, respondents often cited high cost and difficulty in handling bureaucratic matters, which may be related to illiteracy issues. Others cited pre-existing land conflicts that need to be solved. Pro-poor prioritization could consider difficulties such as these, even though it is possible that each local context displays specific difficulties to be tackled by poor applicants for titles. Rural development authorities should consider such difficulties and dispense time and resources to tackle them on behalf of the poor.

10.2. Transportation may trigger changes in LPR

The overall hypothesis that transportation constitutes a key technological requirement for the realization of the impacts of LPR was accepted subjected to some reinterpretation regarding the mechanisms assumed to intermediate the relationship. In presence of transportation, the impacts of LPR were originally expected to be higher because farmers would enjoy better market access, which would create business opportunities that they could seize. It turns out, however, that, while this effect may still exist, the analysis in

Chapter 4 suggests that it may have been outweighed by productivity gains obtained simply by exploring the agro-ecological potential that remained unexplored in regions with poor transportation. This explains why countries with low quality of transportation displayed high impacts of LPR on agricultural productivity.

The realization, however, that there is a correlation between improvements in transportation and improvements in LPR among countries motivated that hypothesis that there could be a causal relationship between transportation and LPR. This hypothesis was investigated in Chapter 9 and effectively implies a reinterpretation of the original overall hypothesis. Transportation is no longer regarded as a technology that intermediates the impacts of LPR, but a technology that triggers the adoption of private and formal LPR in the form of land titles, thus constituting a technological requirement. In line with the hypothesis, Figure 10-2 illustrates the estimated relationship between distance to the paved road as well as use of railway, the two indicators of transportation employed in the analyses, and the calculated probability of farmers possessing land titles.

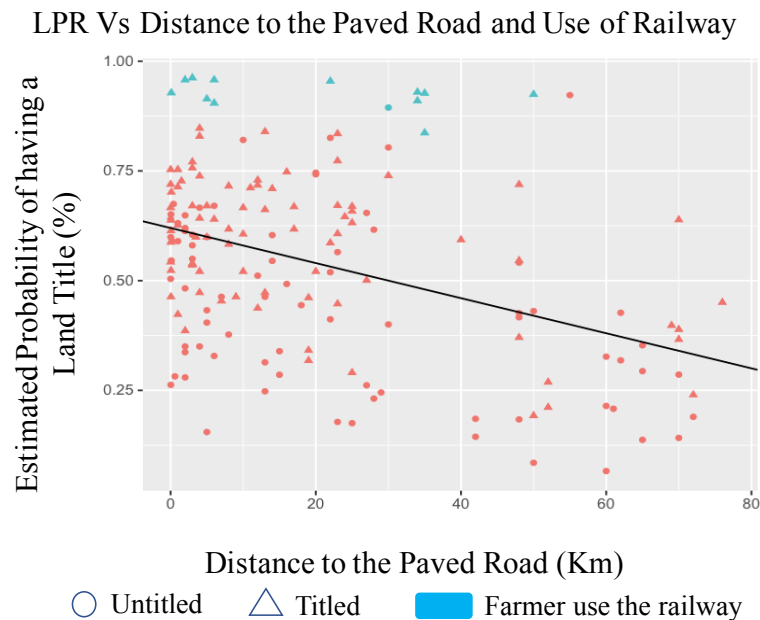


Figure 10-2: Effects of transportation on land titling

In the framework assumed in Chapter 9, the idea of a required enabling technology lies in which regions that are not served by transportation, regardless of agro-ecological potential, do not experience competition for the land and therefore does not require land titles. In such setting, land conflicts may be rare or absent, as seemed to be case in Campos Lindos before 1985. In spite of the absence of land conflicts, nonetheless, farmers in such regions lack access to credit, transactions and modern contracts, which would limit their agricultural productivity.

This discussion has one relevant implication: improvements in LPR, through the adoption of land titles, constitutes itself a previously overlooked indirect impact of transportation. While agricultural productivity would be expected to increase as a direct consequence of transportation, through lower costs and travel time, if farmers adopt land titles as a consequence of transportation, their productivity may rise even further. Such result may be considered by authorities as one additional motivation for rural transportation projects.

Figure 10-2, however, suggests that land titling in different regions may respond differently to different modes of transportation. Chapter 9 showed that the percent increase in the probability of having a land title was more strongly affected by the use of railway than by distance to the paved road. The use of railway is correlated with characteristics such as farm size, as the railway enables access to international markets. Land that is suitable for large-scale farming, therefore, is more likely to be directly affected by railway projects such as the one experienced in Campos Lindos, also because such farmers may be wealthier and more inclined to access financial institutions and thus require land titles. Access to the paved roads may imply lower costs to access local food markets, which may be goal of small-scale farmers, which may also be less wealthy and display a smaller production scale.

Having such considerations in mind, a recommendation can be issued: rural development authorities may consider integrating transportation and land titling projects. Mutually reinforcing benefits are likely to exist. As discussed previously, the impacts of transportation on productivity are likely to increase if LPR are effectively protected in a region. Conversely, the effectiveness of titling programs may increase in case the titling area is located within the influence of transportation projects, since these areas are more likely to undergo conflicts that would spur farmers to apply for land titles. The relevance of such recommendation can be illustrated by one of the land titling programs surveyed by the World Bank (2016). Lao PDR's Second Titling Program, started in 2003, was considered unsatisfactory because local farmers were not receptive to the land titles. Shortly after the acquisition of titles, land transactions were performed without the proper recording and land registry quickly became obsolete. Surveyors found that local farmers did not recognize the importance of land titles, since the area did not experience relevant land conflicts. The identification of areas that are likely to undergo land conflicts, such as those located near transportation projects, represent a relevant strategy to reinforce the effectiveness of titling programs.

Regarding the feasibility of this recommendation, experts at the Inter-American Development Bank were consulted on January 15th 2019. The main finding during this consultation was the identification of political determinants behind the selection of priority areas for titling, as political actors may choose to favor their constituents in such programs, rather than follow technical considerations. Nonetheless, in the crafting of new projects from a technical point of view, it has been considered feasible to prioritize areas along transportation, which could also diminish surveying costs.

10.3. Farmer's mindset affect the impacts of LPR

The finding that farmer's mindset affects their willingness to effectively use the possibilities introduced by land titles, such as access to credit and making investments at lower risk, may seem intuitive but has relevant policy implications. In fact, just recently, due to findings in the field of behavioral economics, such psychological and cultural aspects as the ones represented by the mindset have begun to attract attention of researchers. Chapters 5 to 8 described different types of analyses that suggest – especially in a quantitative manner – that farmer's mindset's significant impact could qualify it a relevant policy variable. Figure 10-3 summarizes the data analyses conducted earlier by demonstrating that farmers who displayed the highest productivity were almost invariably those who had the commercial mindset.

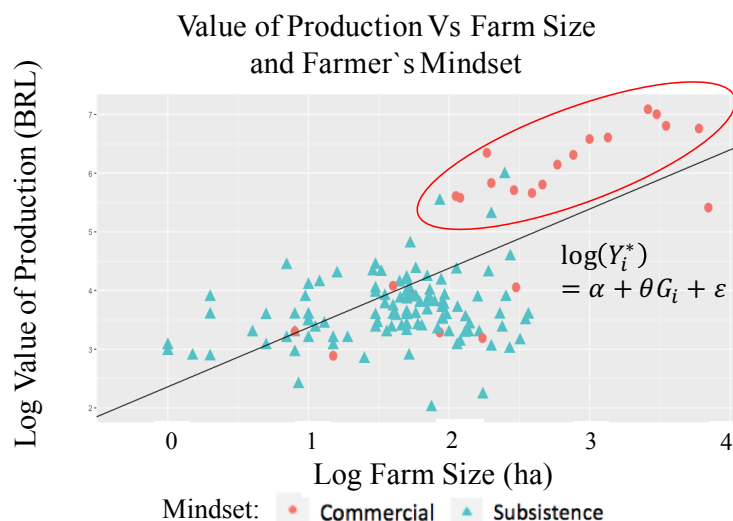


Figure 10-3: The effect of mindset on productivity

A tentative general recommendation would be to nurture the commercial mindset in farmers. Recently a Japan International Cooperation Agency (JICA) sponsored program named SHEP Approach has explicitly included the key concepts “commercially-oriented farming” and “farming as a business” as objectives. Interviews with the experts behind SHEP were conducted on September 7th 2018 with the purpose of exploring similarities between SHEP and the concept of farmer’s mindset. Interestingly, JICA experts found a close relationship between their approach and farmer’s mindset, but with a major difference that their program is aimed at farmers that wish to engage in commercial agriculture, thus, they already display a commercial mindset and only lack training to understand and effectively use market mechanisms.

The matter of nurturing the commercial mindset in a positive way, however, remains mostly untouched and poses challenges of ethical nature. While it may appear to the external observer that a commercial mindset is more conducive to agricultural productivity and thus preferable to a subsistence mindset, the intimate nature of mindset could imply that any interference would be an unjustified intervention in the realm of individual freedom of choice.

Such consideration must be weighed against the observation that influencing individual’s mindsets is an integral part of education policies and thus subject to guidelines approved at political, community and family levels. When it comes to adult individuals, a compromise between both consideration may be found in crafting policies that are mandatory, but rather offer ideas in an attempt to freely convince farmers of the convenience of adopting the commercial mindset. There may some farmers who strongly oppose commercial mindsets while others who spontaneously embrace it. Finally, changing the underlying beliefs that ground the mindset must be left for the individual to decide.

The specific ways to nurture commercial mindsets may include the provision of role models – publicize stories or testimonies of farmers who prospered as a consequence of adopting a different behavior – and include motivational contents in rural extension projects aimed at reinforcing farmer’s self-esteem and sense of self-improvement. Promotion of entrepreneurship may also be presented as an alternative for farmers. In summary, as discussed in Chapter 2, since the mindset consists fundamentally on a set of ideas, rural development authorities must identify which ideas that are prevalent in a region may have negative consequences for farmer’s economic performance and thus devise strategies to softly persuade farmers to change them.

11. CONCLUSION

The present study sought to respond the question “What conditions affect the impacts of LPR on agricultural productivity in developing rural areas?” with the ultimate goal of issuing policy recommendations to support agricultural productivity in developing countries. In order to investigate this question, gather evidences and achieve the goal, three types of methods were applied, namely a comparative international study, a case study in a rural Municipality in Brazil and interviews with experts in rural development. Numerous types of analyses were conducted and the findings led to three broad policy recommendations.

The first major finding is that, adding detail and specificity to the commonly assumed theoretical relationship, improvements in LPR in a region may have negative impacts on some stakeholders. That is because access to land titles, which depends on administrative procedures carried out by governments, is not guaranteed for all stakeholders. In particular stakeholders with lesser economic means and who use the land as a common may face difficulties in applying for land titles. As other stakeholders with higher financial availability lobby government agencies or take the lead in applying for titles, ownership claims by the latter may be systematically ignored, leading to potentially dramatic social consequences, in spite of productivity gains. The policy recommendation that stems from these first finding is related to the stated objective of governments and rural development authorities of mitigating poverty. In order to ensure that this goal is met, it is important to design titling programs in ways that prioritize poor farmers, for example, easing the financial burden involved in titling and actively reaching out for these stakeholders. The strategy of passively waiting for applications, while plausibly motivated by economic efficiency considerations – that is, the assumption of those who attach a higher subjective value to titling will be those who apply first – may imply that poor individuals are routinely underprivileged in terms of access to land titles.

The second major finding refers to the way that transportation, as an enabling technology, may influence the impacts of LPR. The analyses unveiled that there is in fact a causal relationship between transportation and private and formal LPR in the form of land titles. This finding has two implications. The first is that improvements in LPR may be considered an indirect impact of transportation that seemingly has not been highlighted in the literature so far. The second is that there are mutually reinforcing effects between transportation policies and LPR policies. The recommendation therefore consists on integrating transportation and LPR policies. Areas for titling programs may be selected along transportation projects, as they are more likely to experience land conflicts and at the same time, the benefits of transportation should be enhanced by the possibilities created by land titles, such as access to credit and efficient land transactions.

The third major finding refers to the relevance of farmer’s mindset as an enabling condition for the impacts of LPR and, broadly speaking, for farmer’s economic performance. Analyses unveiled that farmers who display the commercial mindset are significantly more productive than those who display the subsistence mindset, while titling alone was not significant. Farmer’s mindsets also have a larger quantitative impact than titling itself in analyses regarding investments, which provides an explanation for the latter result. In other words, land titles may be ineffective in changing farmer’s behavior as would have been expected given that titles are commonly understood as a form of economic institution. Nevertheless, farmer’s mindset does have a significant impact on productivity, and may be partially unrelated to traditionally considered economic incentives, but determined but psychological and cultural aspects. Nurturing commercial mindsets, therefore, may require

interventions on deeply rooted beliefs, which might be considered unethical if conducted in an imposing way. The policy recommendations that stems from this finding therefore consists on nurturing commercial mindsets in soft ways, so that changing mindsets remain as a prerogative of the individual. Such effect may be achieved by exposing farmers to role models with inspirational stories and otherwise supporting ideas of entrepreneurship, self-improvement and self-esteem.

The final reflection is that while agricultural development – or rather development in general – does require a number of improvements in infrastructure and institutions, as represented in this study by transportation and LPR, there is an intimate and subjective dimension to development that requires attention. Mindsets capture inner beliefs and attitudes regarding individual's vision of what their lives should be like, in other words, they capture individual's conception of development. On the one hand, this reflection implies that individuals must have the autonomy to decide what development means, but on the other hand, development efforts may try to encourage individuals to broaden their perspectives and aim high. Governments, international institutions and all those concerned with development must bear in mind that development is a concept that must be defined at the level of individuals, considering their aspirations, but at the same time, individuals can be encouraged to become the best that they can be.

The present study presents some limitations in spite of my best efforts. Concerns have been raised regarding the appropriateness of making causal statements regarding the relationship between transportation and land titling as well as farmer's mindset and agricultural productivity. The results presented in Chapters 4 to 9 unequivocally authorize discussions based on correlations among these variables, from which the policy recommendations follow. A robust and rigorous demonstration of causal relationships would require resource intensive study designs such as Randomized Control Trials (RCT), which unfortunately were beyond the scope of the present research. Studies based on RCT are therefore encouraged as future research. Additionally, even though the analytical framework assumed throughout this study, presented in Chapter 3, did not appreciate the evolution of the variables over time, it is very likely that some effects can be observed more accurately in the long term. For example, farmer's mindsets could respond to changes in the economic environment, such as the introduction of land titles, or the start of transportation projects. It was not possible to verify such long-time effects quantitatively, given the cross-sectional nature of the dataset.

Finally, in addition to these limitations, some issues remain to be further investigated by future research. The matter of the mindset itself may benefit from more sophisticated descriptions of the complex psychological and cultural mechanisms behind its formation. More accurate understanding of how mindsets are determined may indicate effective strategies to nurture changes in ways that respect individual's autonomy. A possible relationship between land titles and mindsets may also be the object of future research. A potential mechanism could be that tenure security could relieve farmers from short-term concerns, enabling them to shift attention to long-term considerations. At last, the matter of farmer's perceptions, their relationship with mindsets and the joint effect on economic behavior could constitute an innovative research agenda. Contexts of poverty could, for example, bias perception formation similarly to what the present study assumed that could happen with farmer's mindsets. There may be relevant implications for development policies in rural areas or for development policy in general.

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13. APPENDICES

13.1. Questionnaire Sheet – English Version



東京大学
THE UNIVERSITY OF TOKYO


QUESTIONNAIRE – CAMPOS LINDOS - ENGLISH VERSION

Interviewer: _____ Number of Questionnaire: _____
Date of Interview: ____ / 10 / 2017

1	Name/Head?)/age/gender	Hd.: Y/N____years		M/F				
2	Name of community/farm. Type	Family/Commercial						
3	Distance to the center of Campos Lindos	Km						
4	How many people live in the estate How many work?	Live:	Work:					
5	How many people work in the estate in agriculture? And in agriculture, but in other estates	In Est.:	Other. Est.:					
6	What is the main source of income in the estate?	a) Agriculture b) Salary work in other properties c) Salary work out of agriculture d) Other						
7	What is the level of schooling of the head of the estate/manager?	a) Incomplete Primary School b) Complete Primary School c) Complete Secondary School d) Complete Tertiary Education e) Post-Graduate						
8	Beneficiary of conditional cash transfer program?	YES / NO		NA				
9	Is there a water stream inside the estate? What distance?	YES / NO	YES / NO					
10	How did you obtain the ownership of your estate?	a) Purchase b) Government Program c) Inheritance d) Squatter`s Right e) Donation f) Other						
11	When did you obtain the ownership of your estate?	Year: _____	Month: _____					
12	Is your farm secured by a property title? (In whose name?)	YES / NO		M/F				
13	If yes, when did you obtain the title?	Year: _____	Month: _____					
14	If yes, how much did it cost to conclude the procedure? How long did it take?	R\$	Days/Months/Years					
15	If not titled, why?	a) High Cost b) No Necessity c) Ambiguous ownership d) Procedure is complex e) Other						
16	Considering the titling status of your property, do you think it is easy to A) sell your property at a fair price b) lease it at a fair price c) bequest (1- Impossible 2- Very Difficult Very Easy)	A)	1	2	3	4	5	6
		B)	1	2	3	4	5	6
		C)	1	2	3	4	5	6
17	For a estate with similar characteristics as yours, what is the price of one hectare of land in the Municipality?	R\$						
18	Would you like to obtain the title for your estate in the next 5 years?	YES / NO		NA				
19	What do you usually produce?	1st) _____	2nd) _____					
20	What is the size of your estate and how much is used for agriculture? Estate: _____ Cp 1: _____ Cp 2: _____	Ha / m2 / Acre /						
21	Your production is mostly for self-consumption or is it commercialized? Or both?	a) Self-Consumption b) Commercialize c) Both						

22	Why did you choose this products? If you could, would you choose a different product? Which?	a) Low cost of inputs b) Easy to sell c) Tradition d) Personal taste e) profitability f) Easy to grow g) Other	YES/NO	Which?			
23	How much was produced in the previous year?	Cp1Kg	Cp2Kg				
24	For how much does one kilo/unit can be sold nowadays?	Cp1 R\$/Kilo	Cp2 R\$/Kilo				
25	What is the monthly income coming from agriculture in the estate?	a) None b) < R\$100,00 c) <R\$500,00 d) <R\$1000,00 e) <R\$3000,00 f) <R\$5000,00 g) <R\$50K h) <R\$100K i) <R\$1 Million j) >R\$1 Million					
26	What is the monthly income coming from other sources in the estate?	a) None b) < R\$100,00 c) <R\$500,00 d) <R\$1000,00 e) <R\$3000,00 f) <R\$5000,00 g) <R\$50K h) <R\$100K i) <R\$1 Million j) >R\$1 Million					
27	Where is the production normally sold? How long does it take to the marketplace?	_____hours NA					
28	Do you use the railway to transport your production?	YES / NO					
29	In the past year have you obtained any form of funding (loan) for the production? And in the past 5 years?	YES / NO		YES / NO			
30	If yes, from which source?	a) Public bank b) Private Bank c) Traders d) Friends c) Others					
31	In the past year, have you leased or rented your estate for some other producer? And in the part 5 years?	YES / NO		YES / NO			
32	If yes, was there a written contract or only a spoken agreement?	a) Contract b) Agreement NA					
33	In the last 5 years have you signed any partnership contract involving your farm? (Technical Support, Technology Transfer, Off-Taker Contract)	YES / NO					
34	Do you use Tractors? Fertilizers? Agro-chemicals?	YES / NO	YES / NO	YES / NO			
35	In the past 5 years have you made any investments in the estate? Which?	YES / NO	a) Purchase seeds b) Soil Improvement c) Fencing d) Machinery e) Security f) Well g) Irrigation h) Drainage i) Fertilizers j) Manuring l) Other				
36	In the next 5 years do you intend to make investments? Which?	YES / NO	a) Purchase seeds b) Soil Improvement c) Fencing d) Machinery e) Security f) Well g) Irrigation h) Drainage i) Fertilizers j) Manuring l) Other				
37	Are you aware of nearby farms that were invaded in the last year? And in the past 10 years?	YES / NO		YES / NO			
38	In a scale from 1 to 6 in which 1 is the least serious and 6 is the most serious, how much are you concerned that your farm could be invaded?	1	2	3	4	5	6
39	Are you aware of anyone in the rural area who has been forcefully expelled or evicted by judicial order from his estate in the past year? And in the past 10 years?	YES / NO		YES / NO			
40	In a scale from 1 to 6 in which 1 is the least serious and 6 is the most serious, how much are you concerned that you might be forcefully expelled or evicted?	1	2	3	4	5	6

13.2. Questionnaire Sheet – Portuguese Version

Questionário - Campos Lindos - Versão em Português									
		東京大学 THE UNIVERSITY OF TOKYO		Entrevistador: _____					
			Número: _____	Data: _____ / 10 / 2017					
1	Nome do Respondente/Chefe?/Idade/Sexo	Ch.: S/N _____ anos		M/F					
2	Nome da Comunidade/Fazenda. Tipo.	Familiar/Empresarial							
3	Distância ao centro de Campos Lindos	Km							
4	Quantas pessoas vivem na propriedade? Quantas trabalham?	Vivem: _____	Trabalham: _____						
5	Quantas pessoas trabalham regularmente na agricultura na propriedade? E na agricultura em outras propriedades?	Dentro: _____	Fora: _____						
6	Quais as principais fontes de renda na propriedade?	a) Agricultura Própria b) Trabalho em fazendas alheias c) Trabalho assalariado fora da agricultura d) Outro							
7	Qual o nível de escolaridade do chefe da família/administrador da propriedade?	Série/Ano	a) Fundamental Incompleto b) Fundamental Completo c) Médio Completo d) Superior Completo e) Pós-Graduação Completa						
8	Houve beneficiários do Bolsa Família nos últimos 5 anos?	SIM / NÃO NA							
9	A terra é plana? Há algum curso d'água na propriedade? Distância?	SIM / NÃO	SIM / NÃO	Metros					
10	Como você obteve a sua propriedade?	a) Compra b) Programa do Governo c) Herança d) Usucapião e) Doação f) Outro							
11	Quando você obteve a propriedade?	Ano: _____ Mês: _____							
12	A propriedade possui título? Em nome de quem (relação)?	SIM / NÃO		M/F					
13	Se sim, quando o título foi obtido?	Ano: _____ Mês: _____							
14	Se sim, quanto custou obter o título? Quanto demorou do início ao fim do processo?	R\$	Dias/Meses/ Anos						
15	Se não, por que não possui título?	a) Alto custo b) Não há necessidade c) Conflitos com outros proprietários d) Processo Complicado e) Conflito com governo f) Outros							
16	Considerando a titulação da propriedade, você pensa que é fácil a) Vender a preço justo b) Alugar a preço justo c) Transferir como herança? (1 -Impossível 2-Muito Difícil 6 -Muito Fácil)	A)	1	2	3	4	5	6	
B)		1	2	3	4	5	6		
C)		1	2	3	4	5	6		
17	Para uma propriedade com as características da sua, qual o preço médio do hectare da terra no município?	R\$							
18	Você gostaria de obter o título para sua propriedade nos próximos 5 anos?	SIM / NÃO NA							
19	O que é normalmente produzido na propriedade?	1) _____ 2) _____ 3) _____							
20	Qual é o tamanho da propriedade e quanto é usado para a produção?	Propriedade	Produto 1	Produto 2	Produto 3				
21	A maior parte da produção é para consumo próprio ou para venda?	a) Consumo próprio b) Venda							
22	Porque esses produtos foram escolhidos? Se pudesse, você escolheria outro produto? Qual?	a) Lucratividade b) Tradição c) Gosto/Preferência como Alimento				Qual? SIM / NÃO			

23	Qual foi o volume de produção aproximadamente no último ano?	Produto 1	Produto 2	Produto 3	KILOS / UNID / SACAS		
24	Por quanto um quilo ou unidade da produção pode ser vendido atualmente?	Produto 1	Produto 2	Produto 3	R\$ por Kg/UNI/Sacas		
25	Qual é aproximadamente a renda/receita proveniente da agricultura na propriedade? (Mensal/Anual)	a) Nenhuma b) < R\$100,00 c) <300,00 d) < R\$500,00 e) < R\$1000,00 f) < R\$3.000,00 g) < R\$5.000,00 h) <R\$50.000,00 i) < R\$100.000,00 j) < R\$1 Milhão k) Mais de R\$1 Milhão					
26	Qual é aproximadamente a renda/receita proveniente de outras fontes na propriedade? (não agricultura)	a) Nenhuma b) < R\$100,00 c) <300,00 d) < R\$500,00 e) < R\$1000,00 f) < R\$3.000,00 g) < R\$5.000,00 h) <R\$50.000,00 i) < R\$100.000,00 j) < R\$1 Milhão k) Mais de R\$1 Milhão					
27	Onde a produção é normalmente vendida? Quanto tempo leva para chegar ao local da venda?	_____ horas NA					
28	A produção da propriedade é transportada por ferrovia em algum momento?	SIM / NÃO					
29	Ao longo do último ano, você obteve algum tipo de financiamento para a produção? E nos últimos 5 anos	SIM / NÃO	SIM / NÃO				
30	Se sim, qual foi a fonte do financiamento?	a) Banco Público b) Banco Privado c) Traders d) Amigos e) Outros f) NA					
31	Ao longo do último ano, você arrendou ou alugou sua propriedade para outro produtor? E nos últimos 5 anos?	SIM / NÃO	SIM / NÃO				
32	Nos últimos 5 anos você realizou algum acordo de parceria envolvendo sua propriedade? (Acompanhamento técnico, transferência de tecnologia, compra antecipada ou garantia)	SIM / NÃO					
33	Você utiliza tratores? Fertilizantes? Defensivos Agrícolas?	SIM / NÃO	SIM / NÃO	SIM / NÃO			
34	Nos últimos 5 anos, houve algum investimento na propriedade? Qual?	SIM / NÃO	a) Compra de Sementes b) Melhoramento de Solo c) Cercamento d) Máquinas e tratores e) Equipamentos de Segurança f) Poço g) Irrigação h) Drenagem i) Compra de Fertilizantes j) Outro				
35	Nos próximos 5 anos, você pretende fazer algum investimento na propriedade? Qual?	SIM / NÃO	a) Compra de Sementes b) Melhoramento de Solo c) Cercamento d) Máquinas e tratores e) Equipamentos de Segurança f) Poço g) Irrigação h) Drenagem i) Compra de Fertilizantes j) Outro				
36	Você tem conhecimento de propriedades rurais no município que tenham sido invadidas ao longo do último ano? E 10 anos?	SIM / NÃO	SIM / NÃO				
37	Numa escala de 1 a 6 em que 1 significa despreocupado e 6 significa muito preocupado, quanto você está preocupado com a possibilidade de sua propriedade ser invadida? (Mov_Soc; Outros)	1	2	3	4	5	6
38	Você tem conhecimento de pessoas na zona rural que tenham sido despejadas por ordem judicial ou expulsas à força de suas terras ao longo do último ano? E nos últimos 10 anos?	SIM / NÃO	SIM / NÃO				
39	Numa escala de 1 a 6 em que 1 significa despreocupado e 6 significa muito preocupado, quanto você está preocupado com a possibilidade de ser despejado ou expulso?	1	2	3	4	5	6
40	Numa escala de 1 a 6 em que 1 significa insatisfeito e 6 significa muito satisfeito, quanto você está satisfeito como agricultor proprietário/posseiro? E com a sua condição de vida em geral?	1	2	3	4	5	6

13.3. Transcription of Interviews

CASE STUDY – CAMPOS LINDOS, BRAZIL

TRANSCRIPT OF AUDIO RECORDINGS

MEETING WITH AUTHORITIES – CAMPOS LINDOS CITY HALL MORNING OF OCTOBER 5TH

Councilwoman Isalene Ramos Torres (Preta)

“We have experienced several land conflicts over the course of the years. We have been trying to develop a number of projects to help solve this stark inequality. Those who hear about Campos Lindos’ economy think it is an incredible place, but when they come and visit, they find a completely different reality. There are several farmers, however small, that may even have the right to their lands guaranteed with titles, but they don’t know how to develop their production. They face many difficulties. The Municipal Government hasn’t yet been able to provide adequate assistance for these farmers. Farmers who may have around 50 ha of land, around 40 or 38 cattle, but still cannot provide enough for themselves. They depend on extra earnings, some job at the city hall, some informal jobs. They are also very wary about making investments. I think they lack training. And there are, of course, those who do not have the land, they live in the land, but we can only say they really own the land if they have the titles. Then, lots of conflicts happen between farmers who acquire titles in lands where these people live, so there is a dispute over who actually owns the land. Some of these communities are Sítio, Mirante, Rancharia. They are experiencing conflicts with the large-scale farmers. Just recently a new farmer arrived in one community with a title, demanding that the families vacate their houses. I had to find a lawyer to defend 16 families in this community. The courts always support farmers with the titles. We can see that there are many people with legitimate claims, for the amount of time that they live in the land, many people were born and raised in the region, but they don’t have the definitive title. A big farmer comes, buys the land, obtains the title. Days later a judicial eviction order comes. These are terrible conflicts. We already experienced so many situations. Once I was watching an eviction operation, there was a 90 years old man... The way they expel people from their houses is terrible.

What we really wanted is that everybody had his own little land, so that they could work without fear. There are lots of people who do not want to make investments because they can lose the fruits of their work at any time. Recently there was an eviction, for example. It was a very organized small farm, with tanks for fish. They lost everything. They (State Police) come with trucks, put all the possessions on it and throw them anywhere. Sometimes they open the gates of the farms, the cattle runs away and that is how it happens. Very sad.”

“There is one farm around here. The farmer arrived some years ago, there were 50 families living there. After years of conflict, now there are only 5 families left. They live in very poor condition, they don’t even have electricity, because the farmer doesn’t allow the electricity company to build the poles inside his property.”

“The police come well prepared to execute eviction orders. Many officers, trucks, tractors to destroy the houses, chainsaws... In the community Mirante, the eviction did not

happen people the affected families created lots of traps to prevent the police from reaching the community. They burned bridges, put pieces of wood with nails to pinch the tires of the police cars. The police didn't manage to get to the community, but they suffered a lot. The judge granted a period for recourse and they are still living there. I used to work there at the local school, so I watched very closely all the struggle. Many of them actually gave up, sold their lands to the farmers and left the municipality. Sometimes the judge determines some sort of settlement between farmers and squatters, the farmers buys the land... well, they don't buy, they pay some very low price”

Lucas: What is the most important thing small farmers need?

“I think it is the issue of technology. They are not prepared to make a more sophisticated production. If a plague comes, for example, they cannot handle it. In case of cattle breeders, they may need vaccines or things like this, they have no access to these things. They are very unprepared.”

Lucas: What about access to credit?

“Sometime ago the mayor negotiated a lot to get some sources of credit for the municipality, but many small farmers that managed to get some loans, ended up indebted. Investments failed and they couldn't pay back. Nowadays banks have their doors closed to small farmers. Sometimes it is possible for small farmers to get some small amounts, but if it is a larger amount, banks always demand the title as a guarantee”

“The most important issues for us is to provide titles for untitled farmers and also provide training. We want them to be more independent.”

What are the procedures for titling?

“The agency responsible for titling is Itertins, but the problem is that we know there is a lot of politics involved. So many arrangements. Some rich people have it easier, the small farmers need to wait for the good will of the government. Rich people have a lot of power over the agency. Even the roads are always so well maintained around here because rich people can easily get what they want from the government”

“Campos Lindos is a very promising city. If we could involve the small farmers so that they get a different vision, I believe the situation in the city can change very fast. We have some projects already. Like the “compra direta” which consists on the city government buying the agricultural production from small farmers to supply schools. The city governments buys flower, milk, fruits meat. But there is a terrible problem in the supply. Farmers cannot supply goods throughout the whole year. Unfortunately, we don't have the quality products that we need. If the local farmers produced more, there would be no need for the local shops to buy supplies from other municipalities.”

What are the conditions for the producer to join “compra direta”?

“They need to be titled, they need to prove they are the owners of the land. Squatters cannot join”

“The municipality has just been contemplated with the project of a slaughterhouse.”

“Another big challenge for our Municipality nowadays is education. It also affects inequality. Not necessarily related to the training of farmers, but other professionals in our municipality also need better education. We have very low performance in all the evaluations, in the last assessment we dropped 9 points. It is a big concern”

“There is a Russian Colony in the Municipality. They are very prosperous farmers. They even keep many of their traditions, their language. Most of them are titled farmers, locate near the urban area. Hard workers, some of them produce soybeans, but also other things.”

Lucas: How does the construction of the loading station nearby benefit the Municipality?

“If there is any benefit that is only to the export of grains, but I cannot see any benefit to the family farmers... also something that I see is that the taxes collected from soybean production does not stay in the Municipality.”

“Another issue that is relevant to us is related to the agro chemicals that is sprayed from the airplanes. It damages our health.”

First Lady Luciana

Lucas: How did the Municipality evolve since you arrived?

“In 1999 when I arrived, there were very few paved streets. There was no telephone coverage. Most houses were made of clay with thatched roofs. There has been some improvement.”

Lucas: And what are the main issues that affect the Municipality today?

“Education and Health. Not only in the Municipality but all over the country. There is a lot of money here, but it is very unevenly distributed. Only very few people hold most of the wealth.”

Mayor Jessé

“In some areas around the Municipality there is Japanese money invested. I understand Japan invests in countries that produce food, because this increases the supply and lowers the price of their imports. But development comes slowly. Our municipality advances at a steady pace. Things don't happen overnight. There is no sense in trying to convert a poor Brazilian from the countryside into a Japanese. Things change slowly.”

“It is fundamental that we develop our economy, otherwise there will be no resources for us to invest in social programs”

“The main factors that explains why soy is so profitable in the Municipality are the features of our soil. Apart from this, we need money from outside, like Jica's funding, money from the development banks, because this is a frontier region”

“Perhaps around 90% of the soybean production is exported. A little portion of it stays here, there are a couple manufacturing facilities in the State producing oil and powder from soy. These elaborated products can be used for human and animal consumption. But a higher proportion of corn tends to stay in the State, it is a product that has more applications both in animal and human consumption. But corn is less valuable, also its price is more volatile. Soy is a more secure crop.”

“I think the Municipality has potential for the expansion of production of meat and perhaps milk. We usually say that the good breeder of tomorrow is the good cropper of today. That is because usually cattle breeders do not have enough training, but croppers have access to technology, advanced techniques, funding. They can engage in a very profitable style of cattle breeding”

“One issue that constraints the development of other types of agriculture in our Municipality is the absence of irrigation. It increases productivity substantially... products like rice and tomatoes benefit a lot from irrigation. But irrigation requires investments that many farmers cannot make. Also, we worry

“Titles are important for our farmers for several reasons. Starting with security, then, access to credit. There is a federal program to lend money to farmers without titles. In the beginning, it was not so complicated, but nowadays most requests are denied. Maybe because many people did not pay back the loans. Banks normally demand titles as a guarantee”

“The matter of tenure security is very serious. There are squatters who have been living in the region for several decades, but a part of these land has titles in name of people from other regions that we never met. As the land value increases, the owners come and claim their lands. Of course, conflicts arise. Fortunately, people around here are peaceful, but sometimes we experience some tricky situations.

“The cultural matter is a powerful factor. In the past, people didn’t place much importance on titles. There are people whose titles have already been processed, they are available in the State land administration (Itertins) but because they need to pay a certain amount of money, they simply don’t finalize the process. Even though it is expensive, many farmers can afford it, but they don’t think about it. One more example regarding this cultural matter. We struggle to understand it, but there are farmers who live in 100 or 200 ha and still cannot provide for themselves. That is not because they lack the resources, maybe they lack training, but they definitely lack the mentality”

CASE STUDY – CAMPOS LINDOS, BRAZIL

TRANSCRIPT OF AUDIO RECORDINGS

MEETING AT CITY HALL – CAMPOS LINDOS CITY HALL
AFTERNOON OF OCTOBER 5TH

Lucas: Do you believe the story of the Municipality is successful or not so successful?

Jessé Mayor: In my understanding, it is a very successful story. If we consider since 1993, I am sure Campos Lindos is one of the cities that grew the most, as well as the State of Tocantins itself.

Domingos Alves da Silva, from the community Raposa: I have been living in this region since 1974, before the creation of the State, way before the creation of the Municipality. With the creation of the State there has been some progress, but development has been disappointing for some parts of the population. I agree that we had some development, but we also need a more sustainable development, especially having in mind the small farmers, so that they can find a way to provide for themselves. With the large production of grains, I think the country develops a lot, it is important for the country and for the States, but we also see the oppression of small farmers. I want to make clear that I am not against progress, but I believe everyone should benefit. In my community, there are around 50 families. Squatters face a very big risk. I consider I am the owner of my land, I don't have the title, because the government never finished the titling process, some people received their titles, some people did not.

Pedro Alves dos Santos, from the community Sussuarana: I have been living for 18 years. I was born in the State of Piauí (to the east). I am not a traditional resident, but have been living here for a long time. When I arrived in this region I started hearing stories about development, I do think there is development, but it lacks sustainability. Investors do not care about life, they only care about money. We know the municipality has a very large production, but there are several environmental impacts: the rivers are dying; the sources are disappearing; they don't respect the riparian forest. The biodiversity is disappearing due to the production of soybean. We cannot drink the water in the times of planting. It is a very high price, sometimes even bloody. I am in favor of the production of all different products, rice, beans, soybean... everything, but I am against poisoning. Apart from this, many people have been expelled from their land, from their house when soybean crops come and are pushed to the periphery of the larger cities, living in poor conditions. The Sussuarana Farm, where I live, used to house 36 families. There are only 6 left, still resisting. I think this people from other countries, when they invest, they must not only seek the government, because the government only cares about itself, they must come here and understand what is going on”

Vikol Kuznetsov: “Part of my land is titled and part of it is not. The process is very slow. I went several times to Palmas (State capital) to try and find out why everything is so slow and I never get satisfactory answers. There are several separate departments involved, some belong to the State Government (Itertins), others belong to the Federal Government (Incra). They won't even let me pay for the surveying cost from my own pocket, because there is a confusion regarding competency over the land.”

Lucas: In your opinion, what is the most important challenge for the future of the Municipality?

Hélio Lopes, squatter: “I believe both education and inequality are the biggest problems. I think the Federal and State Governments should help the Municipal Government with resources. And as a farmer, I lack resources to expand the production. I am a squatter and I would like to obtain the title. The difficulty is that some time ago a company showed up claiming to have the title, they had never come here, but when they heard that the road

would be paved, they came with the police and tried to expel all the 60 families. Titled farmers do not experience these problems. The Municipality makes some effort, offers tractors, machines, but it is not enough for the small farmers. We need more support from the higher spheres of government. Apart from this, the Municipality also tries to support small farmers with Programa Compra Direta (purchases local production to supply school meals), but we don't see farmers taking this opportunity.”

José Xavier de Souza, squatter in the community Sussuarana: “I want to explain why some people don't have titles. The squatter votes for the authorities, but the authorities forget who elected them. Many people have the right to the title but they never obtain it, because the lands are very demanded. Rich farmers get the titles much more easily. There are people who have been living here for so many decades, everything they built throughout their lives is in their land, but they don't have the right to them.”

Domingas, councilwoman: “Not everyone experiences ambiguities in ownership that prevent them from obtaining the titles, many people do not have it because it is expensive to get the title and sometimes we have to go all the way to Palmas. As for the matter of production itself, I know places where people with small farms, around 5 or 8 ha manage to produce enough for themselves, their families and even send their children to college. But in Campos Lindos it is not like that. People with much larger farms cannot provide for themselves, even when they are titled. There is no market for them to sell their production, there is no technical assistance to teach them better techniques. There are people with 200 ha and when you visit their lands you find a little more than a few chicken and pigs. I think they lack education to invest in their production.”

Vanderlei, School Director: “I think the situation in the municipality is actually much more complex. There has been an impressive progress and everything follows from the Agricultural Project Campos Lindos. There would be no Campos Lindos if it wasn't for this project. When I arrived in Campos Lindos, 18 years ago, it took 48 hours to travel from Araguaína (247 km). Now it takes little over 2:30 hours, with the bridges and the paved roads. So, there has been an impressive progress. This is all thanks to the agricultural production. But the State Government made many mistakes. Until very recently we didn't have even an office of the public rural technical assistance or an office of the State land administration. All this should have been supplied since the beginning. So, this is part of the reason why we have one of the highest levels of income per capita in the country but so much poverty, this social disaster. I don't take sides, what I think is the project was poorly implemented, not having in mind all the impacts, including the environmental ones, that would follow. Now we suffer some sequels, some open wounds that come from the first mistakes. The Municipality grew with the projects that it received, what we need is to adjust all these aspects that haven't been properly dealt with from the beginning.

Kalim Kusnetsov: “Here in the Municipality, small producers face several difficulties. There is no company, no co-op that purchases the production, so if you produce milk, for example, who will you sell it to? There have been attempts to provide funding, for example. Pronaf (federal program to improve access to credit), initially, it was not necessary to show your title. Untitled people could have access to credit, but many people got loans and did not invest, when the time to pay back come, they couldn't pay. The bank stopped providing loans for untitled people. Some people probably tried to make investments, but without technical assistance, these investments weren't successful.

Lucas: What kind of contracts can be signed between the traders and the soybean producers?

Kalim Kusnetsov: “Sometimes the traders buy our production in advance. Before the harvest, the production is already sold. They offer some price, which is a bit lower than we would normally obtain in the spot market, we negotiate a quantity and after the harvest I deliver the grains.

Jessé Mayor: “There are actually several ways. Always sharing the risks between farmers and traders”

Lucas: Is it a common practice to lease lands?

Jessé: Not for squatters. Untitled farmers have it impossible to lease their lands.

Kalim Kusnetsov: The banks, the traders, no one usually makes business with people without titles.

Lucas: What about bequest?

Domingas: It is expensive to do all the bureaucracies to transfer ownership when someone dies. Many people decide not to do it. That is, people with titles. People without titles simply transfer their ownership to their children following the tradition.

Lucas: Why small farmers do not produce soybean?

Jessé: Some people say the equilibrium for soybean production is above 1000ha. Because the machinery is very expensive. Unless there is some sort of co-op that buys the machinery for the use of several farmers. It doesn't make sense to acquire all this machinery for the use in small farms. This is actually something that we really need in the Municipality. You combine the strength of 5, 10, 15 people and together there is more negotiation power.

Domingas: There are regions in the south of the country where the co-ops are so successful that the multinational traders don't manage to enter those markets, unless they buy the production from the co-ops.

CASE STUDY – CAMPOS LINDOS, BRAZIL

TRANSCRIPT OF AUDIO RECORDINGS

RESIDENTIAL VISIT – MR. ALFREDO MORAES DA CRUZ, 58 AND MS.
LUZENI RAMOS TORRES

AFTERNOON OF OCTOBER 6TH

Farmers – No other source of income, 23 Km from Campos Lindos. Children help in farming. Mr. Alfredo had two years of formal schooling. Mr. Alfredo received the land from his father, who was a squatter. Given the informal nature of his tenure, the states that he ensured his ownership but building a fence and planting different types of vegetables to base his claim. Eventually he acquired the title.

Mrs. Luzeni: One big difficulty that we have is that the merchants around here are not interested in buying our production. We need to take it to Balsas or to Araguaína, very far away.

Mr. Alfredo: We have seen a great improvement around here. There are so many things we now have the possibility of acquiring. Before, you see... it was very difficult to travel to the bigger cities in the raining season. The river wouldn't let anybody pass. Sometimes we were low on salt or maybe if we needed something like a shoe, we had to wait many weeks until we could cross the river. There was no bridge.

Mr. Alfredo: Around the year 1998 the government sent teams to survey the region, define the limits of the farms. We had to pay for our title and it was a very long process. Nowadays the land is worth a lot more than before, I wouldn't be able to acquire the title at today's prices. The government, at that time, sent the titles to deliver the owners, but it was a very slow process. In total, it took around 4 years since the arrival of the survey teams until we finally received the title. Many people didn't want to get the titles, because they wanted to receive them for free. People didn't understand that they would risk losing their lands if they didn't get the titles, this is why I spent so much money to get mine. In order to pay for the last installments, I had to sell half of the cattle that I had. I almost couldn't afford it in the end.

CASE STUDY – CAMPOS LINDOS, BRAZIL

TRANSCRIPT OF AUDIO RECORDINGS

RESIDENTIAL VISIT – MR. PEDRO ALVES

AFTERNOON OCTOBER 6th

Mr. Pedro has less than one year of formal schooling. He can do little more than writing his name and reading simple pieces of text. He lives with his wife and 8 children, but actually

Mr. Pedro: I used to live in the State of Piauí (East of Tocantins), but the land was becoming too crowded. My grandfather divided it to his children, who later divided it to their children. Since my grandfather all of us have been squatters, we never owned any land formally I was living in my uncle's parcel, so one day I decided to look for a new place to live. In 1998, a number of families formed an association to pressure the government to give us this land, as form of a land reform program. The previous owner intended to sell the land to the government, it would be divided and given to small farmers. This division actually never happened, the government stopped supporting us. I arrived in 1999, joined the association and started building my house. Later on, another group of people, not members of the association, took hold of parts of the original farm, so we got together and expelled them ourselves. I don't know where the original owner was at this time, but some time later another person appeared claiming to be the legal owner. I don't know if this second owner bought the title from the original owner. This second owner sued us. We had to go to the court and finally signed an agreement in which the government promised to find another land for us. But, again, the government didn't take action and the owner started threatening and intimidating the members of the association. He used to block the roads to people's

farms, he wouldn't allow the construction of electricity poles to connect people's farms to grid and sometimes threatened to expel people by force. We were 36 families in the beginning, most of them decided to abandon the land, some of them even got some kind of small compensation from the owner. Now we are only 5 families resisting. We don't intend to leave this land, this is our home, this is where I raised my children.

Mr. Pedro: Selling land without title sometimes is difficult, because many people don't feel safe, buyers prefer land with title. Those who can afford it, usually prefer land with titles. About transferring land as bequest, there is no difficulty, because the person already lives in the land, so after the parents pass away, they just keep living in the same place. The children decide among them how to divide their parents land.

Mr. Pedro: My wife sometimes complains to me. She says that if we don't work, we will starve. But I tell her there is no point in working if we may lose everything in the future. We never know, so I spend most of my time fighting to get the land. Sometimes I travel for weeks and weeks all the way to Brasilia to join the protests. If a new judicial process comes, we never know what decision the judge will take.

Councilwoman Isalene: The judge that is currently in charge of this jurisdiction is very understanding and kind, but he told me in person that he will only consider that someone is the lawful owner of the land if there is a title in name of this person. I cannot say that he is wrong, but I think maybe there should be a bit more sensitivity regarding the situation of the peasants.

Mr. Pedro: What I think is that the judge should consider not only the title, the title is just a piece of paper that anyone can falsify. The judge should consider the conditions of people who are actually living in the land. This is a matter of humanity.

*** A deep clash between law and reality is at the heart of land conflicts in Brazil, which origins can be traced back 500 years into the past, in the disorderly way the territory has been occupied since the start of colonization ***

Mr. Pedro: Our first line of defense against eviction orders is the NPO Comissao Pastoral da Terra³². They provide us legal assistance, help us find financial assistance when necessary. Apart from this, sometimes we organize protests and if the police come, we face them ourselves. We have our own association of peasants too.

CASE STUDY – CAMPOS LINDOS, BRAZIL

TRANSCRIPT OF AUDIO RECORDINGS

RESIDENTIAL VISIT – MR. GABRIEL KUZNETSOV

EVENING OF OCTOBER 6th

The Russian descendants are famous for being very hard working and for having conquered a considerable level of comfort out of their efforts. While other people were available to speak with us at any time of the day, the Russians were only available in the evening. They greeted us offering sunflower seeds, a typical Russian snack.

³² NPO linked to the Catholic Church in Brazil.

Mr. Gabriel studied only 1 year, but is a skilled farmers, manages middle sized farms utilizing machinery and high technology tools, as well as negotiating with multinationals and signing partnership contracts. Despite the lack of formal education, Mr. Gabriel mastered the intricacies of his industry. He produces the very productive crops – soy and corn – but also produces a diversity of other goods for the consumption of his family and to supply the local markets – rice, beans, watermelon, among others. He intends to start breeding cattle in the near future, due to its profitability.

Mr. Gabriel Kuznetsov: The Russian descendants moved to the region of Campos Lindos in search for opportunities and cheap lands. The current generation used to live in the south of Brazil, where there is a higher level of development in every measure, but land is becoming scarce. The previous generations consisted of farmers who moved first to China in an attempt to flee communism and eventually, when communism reached China too, Mr. Gabriel's grandfather moved to Brazil with the help of the Red Cross, around 1950. When we arrived in the region of Campos Lindos, around 1997, some of our family members experienced severe land conflicts. A cousin of mine acquired a farm and the payment was supposed to be made in installments over 6 years, but they were expelled from their land from a rich landowner, the same person who sold the lands to them. It was a scam. Nowadays, I have two farms, one of them is titled, around 300 ha and another one is not titled yet. But it is very difficult to acquire the title for this second farm, because other farmers claim it is theirs, there is dispute. What happened is that the large-scale soybean farmers suppressed all the native vegetation in theirs farms, but that is against the environmental laws, they were supposed to keep a certain percentage of their farms as a conservation area. So, in order to comply if the law, they started claiming this land where my second farm is located in order to present it as the conservation area that they need. If they do not comply if they law, they may have difficulties in getting loans and other legal sanctions.

Mr. Gabriel: I spent around 8000 reais in order to obtain the title for farm and it took around 15 days. It was relatively easy because it was a transfer of title, that means the title already existed. If the title did not already exist, it would take years to get it. Since 2004 I am trying to get the title for may second farm, one of 79 ha. They require loads of documents, it is necessary to go to Palmas (state capita) sometimes. A land survey need to be conducted and if too much passes since the survey, it loses its validity and a new one needs to be conducted. It is very complicated.

Mr. Gabriel: About selling the land, it is complicated when it is not titled, we cannot get a good price. The titled farm would be sold a fairer price if we wanted to sell it. We don't have this custom of leasing the land. I think it is not very common around this area. Transferring the land as bequest sometimes takes many year for titled land, we need to hire lawyers, prepare the inventory of the deceased's properties. It is a bit complicated.

CASE STUDY – CAMPOS LINDOS, BRAZIL

TRANSCRIPT OF AUDIO RECORDINGS

RESIDENTIAL VISIT – MR. DOMINGOS

AFTERNOON OF OCTOBER 17th

Domingos: I arrived very long ago, around the 1960s. My father brought the whole family from the neighboring state of Maranhão. When we arrived, this region was called a desert. There was nobody here, the land was said to belong to the State Government. My father thought we could thrive here. He started planting different things for our own consumption. Slowly people started to arrive, nobody had titles in the beginning. Some people eventually got their titles through different government programs that would come and go from times to times. After I grew up, I got my own part of the land from my father. That was in 1973. Around 1990 the government decided to start an agricultural project here which consisted on giving land to big farmers. The government didn't care to come and check who was already occupying the area, they just ignored us and gave the land to the soybean farmers. This is how the soybean production grew so fast. Now the big farmers claim that we are the invaders. I have been living here for 45 years! For longer than some of these people's lives! And you see... I am not against soybean, against progress, any sort of development. My problem is the disrespect towards me and my neighbors. I cannot rest when I see these injustices. If we have to leave our lands, I don't know what would happen to me. I did not have the chance to study, like you did... I lived my whole life in a rural setting, I don't have much knowledge. I cannot move to a city.

Domingos: Some time ago I become a councilman. Because I had been involved in these struggles for the land, I helped lead the community in moments in which we had to resist eviction orders and organize protests, lots of people knew me, so some of them encouraged me to run in the elections, I did and won. But that was only for one term. The second time I ran, I got 180 votes, but I needed around 210 to win. I think the reason I lost is that people think councilmen are very powerful, they expected a lot from me, they expected me to solve their land struggles at last. But unfortunately, councilmen are not that powerful. The best I could do was share my salary with our community. So, whenever somebody needed to buy some medicine, buy a bus ticket to go to a larger city and solve some problem, I helped. So, this is why I didn't make any fortune out of politics.

Domingos: This is our struggle. As I said, I have nothing against agribusiness. We only want to be able to live our lives as we have for so long. This is the life that we know and love. I think there is enough space for everyone.

CASE STUDY – CAMPOS LINDOS, BRAZIL

TRANSCRIPT OF AUDIO RECORDINGS

RESIDENTIAL VISIT – MR. GILDEÃO

EVENING OF OCTOBER 17th

Mr. Gildeão – I arrived in this land not too long ago. Some other people have been living here for over 20 years. When the soybean farmers arrived, all the region was already occupied by peasants (squatters). Now, the situation is this: the soybean farmers cut off all the trees in their farms and, in order to comply with environmental laws, they need to keep some conservation areas. The area they are claiming to be their conservation area is the area where my family and our neighbors live. Our land is close to rivers, it is not so flat, otherwise they would have taken them long ago and converted them into soybean plantation. Now,

they want to expel us without any compensation. Not too long ago, some people came to my house, took all my furniture and appliances, put them on a truck and took them away. That day I was so scared, I hid in the nearby woods with my family, I needed to protect my daughters. They didn't destroy the house and I believe there was no warrant, I never saw any warrant. This is not the lawful procedure. If the courts determine our eviction, they notify us in advance. So, this was an act or intimidation orchestrated by the soybean farmers. This happened to some 10 families last year. It is such a terrible situation, I fear for my daughters. It is so unjust! I don't understand much about the laws and all that, but I cannot believe any judge would sign an order to kick my whole family out of our house without any kind of support or compensation! But I don't give up! Some people already left, other people do not worry about making their houses better, improving their conditions, but I am not like that. I know there is always a risk, but I don't give up. This is why my house is the best around here, I always make some kind of improvement. We have our rice, our beans, our cassava, some chicken and pork. And I will keep working. Apart from this, there are so many problems. Because of the agrochemicals, the fish disappeared from the rivers, so many animals we could hunt in the past are not be found anymore. Even the river is dying, it is becoming narrower each year.

Lucas: Would you still say your life is good?

Gildeão: I cannot say my life is bad. I have my family, my daughters... I have everything I need. This situation is very unfair but I have faith. If we lose faith we lose everything.
