

## ABSTRACT

Title of Dissertation: TENURE SECURITY, LAND MARKETS, AND HOUSEHOLD INCOME: PROCEDE AND THE IMPACT OF THE 1992 REFORM IN MEXICO

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In 1992, the Salinas administration launched a major reform liberalizing several aspects of Mexico's ejido sector. The reform is to be understood as a major effort at introducing and enforcing clearly defined property rights in Mexico's agrarian landscape. Compared to the private sector, the ejido sector was characterized by a higher rate of poverty and a higher labor to land ratio. A basic proposition is that weak property rights were an underlying cause of that gap.

As an implementing tool, a program of land rights certification and registration, Procede, was launched in 1993. A key objective of the reform was to improve the efficiency of the ejido factor markets, raise farm productivity, and increase household income. Activation of land markets was instrumental in the short term to that objective while out-migration from ejido communities was seen as an inevitable outcome of the adjustment process. This research analyzes the Procede's impact on the ejidos' land rental markets and on the sources of household income.

The empirical analysis starts by examining how the program was delivered to the ejido communities and its acceptance by the ejidatarios. It then studies participation in

land leasing markets and the Procede's influence on the amount of land transacted in the rental market. The impact that the Procede has had on farm, non-farm, and agricultural labor household income is then estimated.

It is found that although the Procede has indeed helped ejido land markets to work better, several institutional factors are still a limiting factor in transferring land from less to more productive farms. Ejido households have begun a process of diversification of their income sources as a result of the Procede, signaling that improved tenure security has raised the return to uses of labor off the farm relative to on farm uses. Local agricultural labor markets have become a more important source of income, as well as non-farm employment in non-agricultural activities. Finally, it is found that the criteria followed in delivering the Procede to the ejido communities responded more to the interests of the bureaucracy entrusted with the program than to social welfare concerns.

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To Gladys, Valeria, and my parents.

Thank you for your unconditional love, support, and patience.

This is our thesis

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## Introduction

### The issue

In 1992 the Salinas administration launched a major reform with the aim of deregulating markets in Mexico's mainly rural ejido sector. The reform is to be understood as a major effort at introducing and enforcing clearly defined property rights in Mexico's agrarian landscape. As an implementing tool, a program of land rights certification and registration, Procede, was launched in 1993. A key long-term objective of the reform was to improve the efficiency of the ejido farms, raising their productivity, by raising investment and farming intensity. The content and rationale of these reforms are explored in chapter 1, along with a review of the salient features of the ejido sector. One of these key features, induced among other factors by tenure insecurity, was the ejido sector's higher labor to land ratio relative to the private agricultural sector<sup>1</sup>. This difference in factor intensity epitomizes the welfare gap that exists between the two agricultural sectors, the dualism inherent in Mexico's agricultural sector, and the backwardness of the ejido sector at the onset of the 1992 Agrarian Reform.

### Research goals

The economic literature on land titling suggests that the main benefit that farm households derive from stronger property rights to land rests in the increase in farm productivity that follow from two key channels. First, better defined and enforceable property rights improve access to credit, thereby favoring investment in land

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<sup>1</sup> Computation based on the 1991 agricultural census.

improvements. Moreover, as these investments are mostly attached to land and therefore unrecoverable in the case of eviction, stronger property rights will reduce the risk of losing the investment after some time. Second, by increasing investment in land improvements, the marginal productivity of other movable factors will rise. We refer to these as long-term effects of land titling in a system of enforceable rights. In the short run other effects should show up as well. Activation of the land rental market is one. Land transactions should present fewer risks to land owners and one would expect the supply of land to increase as a result. In addition, households will reallocate labor across activities if this is used in order to reduce the chance of eviction. The latter effect may have important implications in terms of household income depending on the extent to which households would increase their supply of labor to non-farm activities and reduce the time allocated to on-farm activities in those instances in which eviction risk causes the marginal productivity of labor to fall below the market wage rate. We shall focus on the analytics of these two short-term effects in chapter 3, after a brief review of the literature on land titling in chapter 2.

In chapter 4, we explore in detail the process by which some ejidos were certified and others not by the end of 1997. The latter point is an important one as it addresses one of the key empirical issues faced when examining the selection process underlying many land titling programs. The research analyzes then in chapter 5 the Procede's impact on the ejidos' land rental markets. The key question this chapter intends to address is whether the Procede has unlocked a process by which ejido land can be transferred from less to more productive farmers, thereby raising total agricultural production. Chapter 6 focuses on the participation by ejido households to non-farm and off-farm activities. In

that chapter we also attempt quantifying the impact of the Procede on household income. We do that by estimating household income functions in a context in which stronger property rights affect the shadow price of factors of production, thereby causing households to shift 'regime'. Panel data from two ejido surveys conducted in 1994 and 1997 are used in constructing and presenting the empirical evidence.

### Contribution to the literature

The analysis undertaken in this research intends to add to the existing literature on land titling on three accounts. First, it intends to assess the extent to which land titling programs such as the Procede are effective at activating land markets in areas where land rental activity is traditionally low. Is such inactivity a result of weak property rights? Or do other factors impede land transactions? Second, when rural factor markets are imperfect, changes in property rights regimes may affect the productivity of household assets and consequently the household's allocation of labor across activities. In that context, does the supply of labor to off-farm activities represent an important aspect of the overall impact on household income? Could increased participation in off-farm income activities represent a major source of gain for the household from land titling programs? Ultimately, these answers might allow uncovering aspects and effects of land titling programs that have been overlooked in the literature and that might in fact represent important sources of economic gains and losses.

## Chapter 1: The Ejidos<sup>2</sup> in the context of Mexico's agrarian development.

### 1.1. Introduction.

Over half of Mexico's land and almost two thirds of its cropland belong to *ejidos* and *comunidades*, which together conform what is known as the social property sector. These institutions were the result of an eight-decade long process of land distribution that followed the Mexican revolution of the early twentieth century. Under this form of tenure, rights to land use were strongly regulated, limited, and to a certain extent insecure. Such a state of affairs is at the root of the technological stagnation, low labor productivity, and widespread poverty characterizing the ejidos. The 1992 reforms, in the broader framework of market liberalization in agriculture, sought to establish a tenure system where factor markets could work more efficiently in the context of enhanced security. The reform was seen as a necessary precondition for inserting half of Mexico's agricultural sector and three quarters of its farms into a process of trade liberalization that two years later would culminate with the signing of the NAFTA treaty. The reform is to be understood as a major effort at introducing clearly defined property rights in Mexico's agrarian landscape and was built on the assumption that tenure insecurity was indeed a major obstacle to productivity growth in Mexico's agricultural sector. A land registration and certification program, the Procede, was launched with the objective of enhancing

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<sup>2</sup> One important clarification is needed. Rather than resorting to the term social sector or agrarian communities, which in legalistic terms appropriately describe those forms of tenure that have emerged as a result of the long process of land distribution in Mexico, we shall from now on refer to the term ejidos, confounding by so doing both ejidos and comunidades. Given that the former represent over 85% of the agrarian communities, we feel somewhat excused. When the need arises of distinguishing between comunidades and ejidos we shall do so explicitly.

tenure security, while favoring a gradual process of privatization of land rights in the ejidos.

The next section will briefly review the salient economic, historical, and legal characteristics of the ejidos before the 1992 reforms, in particular the meaning of tenure insecurity among ejidatarios. Section 3 explains the legal changes introduced by the reforms of 1992 and their impact on the institutional functioning of the ejidos. Section 4 discusses the Procede, while section 5 reviews preliminary evidence regarding the acceptance of Procede among ejidatarios and how these perceived the program. Key descriptive statistics based on a panel of 1281 ejido households surveyed in 1994 and 1997 are reported in section 6 in order to prepare the background for the analytical work that will follow. Finally, section 7 examines briefly the policy context in which the 1992 reforms were introduced.

## 1.2. The Ejidos before the 1992 reforms

Before the revolution, cultivable land in Mexico was concentrated in a few large private properties. The post-revolutionary ideology favored the idea of redistributing land to agricultural laborers, away from large landowners. Landless households formerly employed on the *haciendas* would get access to land and form an ejido. In terms of land use, the typical ejido would consist of a portion of land devoted to individual cultivation by ejidatarios, a common land where animals could be grazed, firewood collected, and other economic activities carried out, and finally an area for dwellings.

Historically, the process of land distribution has not been smooth and its nature and scope has changed considerably with historical circumstances. The major impulses in



the process of land distribution corresponded to the periods immediately following the end of the revolution and the promulgation of the 1917 constitution and that coinciding with the Lazaro Cardenas presidency of the late '30s. The majority of the ejidos, and in particular those endowed with land of better quality, were formed in those years. The following decades were marked by a process of land distribution that languished for long periods, peaked in others, often following the election cycle (Sanderson, 1984). The dominant party, the *Partido Revolucionario Institucional* (PRI), would become more and more interested in using land distribution as a mean of consolidating its influence and perpetuate its power. In addition, ejidos came to be seen as a tool for directly controlling the process of food production and distribution at controlled prices as part of the Mexico's food self-sufficiency strategy. Central authorities would determine which crops were to be produced and their selling prices. Production credit was channeled to the ejidatarios through the official credit system and under the control of the ejido authorities. Inputs were delivered at subsidized prices and crops insured on favorable terms.

During the late '70s and early '80s the process of land adjudication became more and more dominated by the petitions of landless households and land poor farmers (Sanderson, 1984). With the steaming-off of the ideological push behind land redistribution, the process of adjudication became less easy and more fraught with risks and tensions. Land invasions were a common way of pressing authorities to recognize the claims.<sup>3</sup> In the meantime, petitioners often squatted on the lands under reclamation. In the context of weak law enforcement it was not uncommon for violence to break out between occupants and former owners. All of this represented of course a considerable

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<sup>3</sup> This is very much akin to the process of land distribution and violence documented by Alston et al (2002) in the case of Brazil.

source of tenure insecurity. Yet, even when land was finally adjudicated, tenure security was often weak. First, ejidos' borders were often poorly demarcated, nor were the assignment of individual parcels within the ejido clearly identified. Ejidatarios, at best could receive a certificate recognizing their status and the number of hectares on which they had the right of usufruct. Parcel borders were not clearly indicated, but only recognized by the community at large and as such respected.

With time, such a system of informal security was put under pressure by a growing ejido population and the 'turnover' of ejidatarios that coincided with an informal process of land sales and subdivision by inheritance. A growing population, by necessity tied to the local economy of the village, sought access to increasingly scarce land. Where possible, ejidos resorted to petitions for enlarging their areas at the expense of neighboring properties. In other instances, encroachment on common lands, where feasible, would be considered as a way of endowing the landless households.

Conflicts concerning land rights were common and widespread among ejidatarios. One important source of conflicts was the legal prohibition to inherit usufruct rights to more than one son. In practice, this provision was largely ignored, leading to an ever-increasing atomization of land rights (*minifundismo*). This meant that an increasing number of second-generation ejidatarios did not obtain a formal title to their lands and therefore were left in a legal limbo in which the community informally recognized their rights. Along this group of 'quasi' ejidatarios were the *poseisionarios*, land possessors who only had an informal recognition by the community. They were typically refused access to the ejido's common lands and had no power of say over the internal affairs of the ejidos. Thus, to properly understand the tenure security argument ascribed to the

1992 reforms it is important to appreciate the fact that illegal land sales, illegal bequests of usufruct rights, and illegal appropriation of common lands gave rise to a wide number of farmers that lacked a formally recognized right to land. Moreover, it was not uncommon for legally entitled ejidatarios to be left without a title due to a faulty bureaucracy.

Conflicts related to access to land were increasing also due to the mounting demographic pressure within the ejidos. Relatives of the ejidatarios (independently of whether these were ejidatarios with a formal or informal title) and other residents that had a loose familiar relationship to the ejido members constituted the class of the *avecindados* (neighbors). These had no right to purchase or rent the ejido land before the 1992 reform and were also not awarded a formal right to access the common lands. A key innovation of the 1992 reform was the recognition of such rights to the *avecindados*. One would therefore expect that the removal of the restrictions on land rental, however imperfectly observed and enforced, would have led to an increase in the demand for ejido lands by these otherwise landless group of farmers. The number of *avecindados* before the 1992 reforms is not known. According to the information provided by the Procede (discussed below) in a sub-sample of almost 16,000 ejidos the number of *avecindados* amounted to roughly 490,000 as compared to 1,212,000 ejidatarios and 173,000 posesionarios (Secretaría de la Reforma Agraria, 1998).

An important question is the extent of tenure insecurity among ejidatarios (whether formally or informally recognized as such). Ejidatarios were not squatters on state-owned lands. Nor was tenure insecurity a result of complicated norms as one would for example find in many areas of Africa, where different rights overlap over a parcel

(Bruce and Migot-Adholla, 1994). The lack of formal certificates would weaken the position of an ejidatario under some specific circumstances. In effect, a continued presence of the ejidatario on his lands was enough to ensure that no one would challenge his right to that land (Finkler, 1978). Instead, insecurity tended to be related to the legal restrictions that the ejidatario faced when employing on the farm labor other than the family one or when renting the land out. In effect, land rentals and the hiring of labor were widely practiced, albeit illegal. The question hinged more on how illegal actions were tolerated within the community. In communities that were created out of the ideology that land should be tilled by those that needed it, the risk of being expropriated was always present and no one could guarantee that a decision to hire labor or rent land would be interpreted as a signal of privilege in societies with a strong egalitarian culture. Thus, to rent the land ejidatarios needed to secure the support of their community or of the ejido authorities. In those instances where the local leadership was particularly strong, the consent of their local authorities was essential in order to minimize the risks of expropriation. In some instances, though, ejidos had enough internal cohesion, to generate cross support among ejidatarios. This could occur due to close family ties among ejidatarios or to a relatively homogeneous structure of the community, whereby most ejidatarios would share the same needs<sup>4</sup>.

Finally, local government representatives were very well aware that illegal sales, rentals, and hiring of labor were practiced in the ejidos under their supervision, but both due to a sense of realism or because of a culture of corruption (or because of both

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<sup>4</sup> For example, many ejidos located in the North and endowed with good quality lands would rent in mass their lands to large private farmers.

reasons) they would not generally intervene, except when explicitly instigated by the ejido authorities.

Thus, one could argue that in general terms, rights to land were understood by the ejidatarios as something more than simple rights of usufruct. Ejidatarios had informal rights of use and transfer that in some instances were subjected to restrictions by the local community or by their *caciques*. Were fully recognized by their community, ejidatarios' land rights approached something very near to fully individualized land rights. This situation suited very well the need of those communities that were a relatively high degree of cohesion, nor much inserted into dynamic markets, and where the local system of informal safety nets and reciprocity in transactions were strong. In these auto-referenced communities, the demand for fully defined property rights was still weak and local institutions served much better the function of ensuring the ejidatarios' rights to land than the local official authorities. Land rights were mostly circulated locally and costs of transaction could be kept low by relying on social networks.

On the other hand, where producers were connected to markets and where a strong sense of individual entrepreneurship was already widespread and where reliance on access to factor markets was a key ingredient in the ability to adjust to evolving external conditions, the system of property rights represented by the pre-1992 Agrarian Law was probably unsatisfactory. It is among those types of ejidos, those located in the most dynamic rural areas where one would expect to find the strongest demand for better-enforced individual rights if not complete property rights.

To illustrate the conditions of the agricultural sector in Mexico before the 1992 reforms, it is useful to compare the ejido and the private sector, which together accounted

for over 98% of the agricultural land. As table 1.1 shows, there were stark differences between the ejido and the private sector in 1991, just before the reforms of article 17 of the constitution. With over two thirds of Mexico's agricultural producers being ejidatarios and with almost seven tenths of the labor force in the rural sector concentrated in the ejidos, the latter sector had a much higher ratio of labor to land than the private one. In terms of non-land assets, private farmers enjoyed twice the number of tractors and thrice the number of cattle and landholdings owned of their ejido counterparts.

The differences in factor endowments helps in understanding why poverty in the ejido sector is much more widespread than among private farmers. Comparing the percentage of overall households earning less than a minimum wage with that of ejidatarios below this threshold (see table 1.2), one can safely conclude that average income in the ejido sector is much below the average income of the rest of the agricultural sector. Thus, Mexico's rural sector can be characterized as a dual sector, in which ejidos and private farmers possess substantially different relative factor endowments and where labor productivity gap can be clearly identified with differences in tenure. Labor immobility in the ejidos was a consequence of the land tenure insecurity induced by the existing legal framework. These gaps together with the overall low productivity of Mexico's agricultural sector were the main motivations behind the policy reform of the agricultural sector and of the 1992 reform of Article 27 of the Constitution in particular. To these we now turn.

### 1.3. The reforms of Art.27: context and content

During the early 1990s, the ejido sector underwent significant changes on two fronts. While agricultural policy reforms were meant to move the whole agricultural sector out of stagnation, the 1992 agrarian reforms were seen as a precondition for the most backward ejido sector to step into the path towards modernization. The need to devise a specific policy for the ejido sector rested on two basic considerations. First, further land for redistribution was becoming increasingly scarce. Second, the ejido institutional structure itself was deemed incompatible with the goals of modernization, productivity growth, and poverty reduction. In the early nineties, the debate was centered on the extent to which land rights in the ejido sector should be privatized. In particular, there was an intense discussion as to whether common lands should be maintained as such or whether they should be divided among ejidatarios or even opened to a full-fledged privatization. The cultural resistance from below, organized by the National Peasant Confederation, explains why the 1992 reform fell short of the complete dissolution of the ejidos and provides an interpretation of why some key restrictions on land rights have remained in place. Nevertheless, we shall show in the course of this research, that in fact a large share of the common lands were appropriated by the ejidatarios who correctly anticipated that any *de facto* variation would be regularized through the process of certification contemplated by the reforms (see Muñoz et al. 2003 for a discussion of the appropriation of common lands during the implementation of the 1992 reforms).

The 1992 reform sought to de-politicize the administration land rights in both ejido and private sectors. The intent was to create a legal environment in which property

rights would be defined, recognized, and enforced. The first step towards that direction was to create three institutions with the function of enforcing and administering the emerging configuration of ejido rights over individual and communal lands. The Agrarian Attorney office (PA) was to act as an *ombudsman* ensuring under all circumstances the respect of the law. An independent system of agrarian tribunals was instituted to serve as an ultimate instance for conflict resolution. Finally, the National Agrarian Registry (RAN) was created with the purpose of certifying the rights that would be registered through a land titling and certification program, the Procede, soon to be launched.

The second step was the recognition of a juridical personality of the ejidos. Marking an important change from the pre-1992 ideology, the ejidos became legal entities, while the ejido assembly acquired exclusive powers over all of the ejido's internal affairs, thereby diminishing substantially the role played by the ejido authorities. Moreover, the ejidatarios as well as recognized posesionarios had complete autonomy over the management of their land endowments, meaning that land could be freely rented and labor hired. While the ejido assembly regulates those aspects that concern important aspects of the community life, such as the use of the common lands, it has no right over the ejidatarios individual land. It has been argued that the 1992 reform, by recognizing the juridical personality of the ejidos, in effect configured a new type of rights in the ejido sector. These rights lay between the simple right to usufruct and complete private property rights. For example, while the individual ejidatario is assured protection from the ejido's interference in the administration of his land, the Law still prohibits the sale of



land to outsiders, but not to the ejido insiders<sup>5,6</sup>. Thus, the right to alienate the property was recognized but restricted.

With respect to *avecindados* and *poseisionarios*, the LA contains provisions that allow the assembly to formally recognize their rights. Posesionarios are not given the right to vote but the ejido assembly cannot affect their holdings. Avecindados, as a result of the 1992 reforms, are allowed to purchase and rent ejido land and have been granted the right to participate to the assembly that regulates the matters concerning the urban areas of the ejido.

#### 1.4. Procede and the implementation of the 1992 reform

For the 1992 reforms to become effective, the new set of rules and provisions had to become common knowledge among its intended beneficiaries. Widespread illiteracy among ejidatarios, and the often-legalistic wording of the new Agrarian Law, made an autonomous and diffused process of learning and understanding the meaning and scope of the reform problematic<sup>7</sup>. Moreover, recognition of several new rights (such as the right to sell land within ejidos or to acquire full rights to land) depended on having the ejido communities explicitly recognizing them in an assembly, which in turn had to be officially sanctioned to be valid. In addition, in an environment characterized by diffuse

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<sup>5</sup> Needless to say, ejidatarios find their way around this restriction by employing traditional pre-1992 illegal methods.

<sup>6</sup> Other important changes consisted in that ejidatarios have been allowed to form associations for marketing products or buying inputs and to use their lands to participate in joint ventures with private firms.

<sup>7</sup> The case of West Bengal is still another example of the importance of implementing in the field the legal provisions of the reforms (see Banerjee *et al.*(2002)).

illiteracy, the new rules could be misinterpreted and/or used to the advantage of those better off within the ejidos.

To implement the reforms on the ground, a certification and regularization program, the *Programa de Certificación de Derechos Ejidales y Titulación de Solares Urbanos* (Procede), was launched officially in January 1993. The program would initially target ejidos, while comunidades were to be left out during its first phase and were to be approached only at the end of 1996.

Procede officially certifies and titles the land holdings of the ejidatarios. Titles indicate the size of the plots, name of adjoining farmers, and are attached to a cadastral map. The ejidatarios' right to share the benefits from the use of the commons is also reported in the titles. Moreover, ejidos may also request to have urban plots in the dwelling areas being certified and titled. The Agrarian Registry (RAN) inscribes the certificates in the Register and provides copies of the general plan of the ejido. The ejido plan is important for two reasons. First, it precisely draws the internal boundaries and is available to the whole community for consultation. Thus, it can be used locally as a mean of solving border disputes that may arise after the Procede is concluded. Second, should the ejido decide in the future to formally assign new rights over parts or all of the common lands, this will be done on the basis of the newly existing documentation.

In spite of being administered by the officials of the Agrarian Attorney Office, the Procede is meant to be participative, democratic, and transparent. The program is formally voluntary at the ejido level, but mandatory at the household level once a majority of ejido members agreed to adopt and implement the program. Ejidatarios decide, on a majority basis, whether to join the program. During the program the ejido

assembly is empowered to subdivide and/or reclassify the community's lands as common lands, individual parcels, and settlement area<sup>8</sup>. The assembly is at the center of the process and the modalities it has to follow, rigidly specified by Law, are intended to make the process as transparent and democratic as possible. A representative of the Agrarian Attorney fully supervises the process in order to certify that the whole procedure mandated by the Law is completely respected. The typical operative process that characterizes the Procede is organized in ten successive steps:

1. The program's administrators select specific areas where the promotion of the program will be carried out more intensively among ejidatarios;
2. Ejidos are then screened on the basis of available historical legal information. The program administrators determine whether the ejido are worth being approached;
3. The objectives and modalities of the Program are first explained to the ejido's governing bodies. If these consent, a first assembly of ejidatarios is summoned;
4. If the assembly approves, a committee of ejidatarios is formed in order to help in the implementation of the program's following steps;
5. The committee and the teams from Agrarian Attorney and INEGI (the National Geographic Office, responsible for the material measurement of land) determine how the ejido lands are divided and trace out the demarcations between plots, between common, urban, and parceled lands, as well as the ejido's limits. This work presupposes the consent and collaboration of all the ejidatarios that own the plots. During this process, records on land occupancy by subjects without a formal title are also collected;

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<sup>8</sup> Other types of assignments are also possible, but we omit them here for simplicity, as they are minimal.

6. The results and materials obtained during the previous phase are presented to a second assembly for approval;
7. At this point, plots, common lands and settlement areas are measured and maps are produced together with individual files reporting the information collected until then;
8. A third assembly is then summoned. This is the most important assembly of all, as ejidatarios, avecindados, and posesionarios are required to participate and approve all of what has been so far achieved, including the resolution of internal and external conflicts over the land;
9. If the assembly approves, the PA delivers the request for inscription to the RAN, which then proceed to print titles and all other legal documentation;
10. Finally, RAN delivers the titles to the by now certified ejidatarios.

While the program fell well behind its initial aim of completing the certification and titling of all ejido lands by 2001, the Procede has nevertheless produced impressive results. Overall, 2.9 million agrarian subjects (*ejidatarios* and *comuneros*) received their titles and certificates and 57.2 million hectares of land have been measured and mapped (an area almost twice the size of Spain). As of December 2000, 100% of the 29,932 ejidos and comunidades had been approached, 86% joined the Procede. 76% of the communities have been titled and certified.

#### 1.5. Procede's advance and its perception by the ejidatarios

Throughout our work, we shall use data collected from two representative surveys conducted in 1994 and 1997, covering 288 ejidos and over 1600 individual households (see section 1.7 for more details on the surveys). We use information on ejidatarios'

opinions concerning the Procede to draw some preliminary suggestions concerning the program's impact in certified ejidos and its acceptance among the uncertified ones. While this data reflects subjective evaluations and should be taken with some care, it offers an insight into the non-randomness characterizing the process of certification and acquisition of titles.

According to the information contained in the 1997 survey, almost 50% of the ejidos in the survey had completed the Procede and had received their titles, while another 25% of the ejidos had the program in process. As tables 1.3 and 1.4 show, by the end of 1997 the Procede had advanced in all regions of Mexico, but in some regions more than others. The highest share of certified ejidos was located in the North Pacific and Gulf regions, while the slowest advance, in relative terms, had taken place in the South Pacific (i.e. Chiapas, Oaxaca, and Guerrero)<sup>9</sup>. As we shall argue in chapter 3, the advance of the Procede was not random and ejidos were targeted according to specific characteristics in order to maximize the number of certified ejidos within the initial years of the program's operations. For example, the *comunidades*, mainly located in the South Pacific, were excluded from the Procede until late 1996 due to their institutional specificity requiring a tailored approach to titling.

The 1997 ejido survey included questions on the attitude of the ejidatarios towards the Procede and on the major effects the program had on their communities in their view. As reported in table 1.5, 52% of the ejidatarios in uncertified ejidos (which include ejidos that rejected the program or that had not been contacted yet) opposed the program on principle. On the other hand, a great majority of ejidatarios belonging those

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<sup>9</sup> Although the 1994 survey did not include Chiapas, the figures reported on Procede's advance are drawn from the 1997 survey, which in fact included Chiapas.

ejidos that had been certified or were in the process of so doing had a positive opinion about the program. Although many ejidos had not yet been contacted by the end of 1996, these figures suggest that indeed some selection had in fact been taking place at the ejido level. In addition, the opposition displayed by many non-certified ejidatarios implies that the program by the end of 1997 was about to enter a phase in which it would prove much harder to entice ejidos into joining.

Table 1.6 reports the motivations for opposing or favoring the Procede. Among those that opposed the program, the fear of land taxes and distrust of the government were the prominent motivations, while the risk of losing the land was also important for one opponent out of six. Among supporters, the desire to acquire tenure security was the overwhelming motivation. Resolution of border conflicts and the possibility of using the land as a mean of accessing credit were the two next most important reasons, although not among the majority of the interviewed. The same type of information was received by ejido authorities when answering community questionnaires (table 1.7). Notice that 35% of the ejidos that were not certified nor participating to the program reports not having been contacted yet.

Concerning perception about impacts, table 1.8 shows that the great majority of ejidatarios in certified ejidos felt that no significant changes had followed as a result of the program. This is to be expected given the short time that had elapsed since completion of the program for many of the surveyed certified ejidos. Only 5% of the interviewed, matched by a 5% with an opposite view, thought that more investment took place as a result of the Procede. A significant minority of ejidatarios felt nevertheless that the program had some impact in terms of land markets. In assessing these replies, one

should bear in mind that by 1996 a major credit crunch had occurred and that the ‘Tequila crisis’, together with the signature of the NAFTA had created an environment of uncertainty around the future of agriculture. Many ejidatarios felt also that the quality of cooperation within the ejidos has in fact improved since the program’s completion.

It is interesting to notice that the survey did not include ‘increased participation in non-farm activities’ among the list of alternative choice offered to respondents. In this research we shall examine this issue closely and we shall argue that in fact this possibility is an important ‘side-effect’ of land titling programs.

Among certified ejidatarios, only one out of four expressed interest in achieving the *dominio pleno*, i.e. full property rights (table 1.9). This could reflect the fact that under the new legal system, land rights were felt as enough secure and that in fact tenure security had been largely achieved as a result of the Procede. By taking advantage of the existing loopholes, ejidatarios had in fact the ability to sell land even to outsiders, possibly more easily and cheaply than by going through the legal process of adopting the *dominio pleno* and then register the sale. Thus, while a desire for stronger tenure security had been widespread among most ejidatarios, this did not reach the point of requesting full property rights. The latter would in fact imply a complete severance from the entitlements attached to the status of ejidatario, such as avoiding land taxes, access to common lands, and belonging to a well defined social network in spite of the limitation to rights that the status of ejidatario itself implied.<sup>10</sup>

Finally, table 1.10 shows how the advance of the Procede has resulted in a lower intensity of conflicts over ejido and individual boundaries, as well as over illegal

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<sup>10</sup> The latter observation suggests that in tightly knit rural communities rights to land belong in fact to a more complex bundle of rights and that some sort of substitution among rights is at work, whereby linear combinations of rights are preferred to extremes.

encroachment on common lands. It is interesting to notice that encroachment on common lands was more likely among uncertified ejidos and ejidos in process of being certified. But ejidos in process had a relatively higher share of encroachers coming from outside the ejido, while in uncertified ejidos the commons were mostly invaded by community members. This observation is consistent with the different attitude towards the Procede and with the fact that many uncertified ejidos were in fact *comunidades*. Lands forming the *comunidades* is typically commonly managed in a slash and burn type of agriculture (see Muñoz *et al*, 2003). Access to these lands is strongly regulated by social traditions and members and their off-springs are allowed to encroach when the community feels they are entitled to do so. This would therefore further support the hypothesis that the advance of the Procede did in fact successfully select those ejidos where the latent demand for tenure security was strongest while leaving aside those where the latent demand for more tenure security was weakest.

#### 1.6. Key agricultural policies and programs of the '90s

Before reviewing the evidence from the ejido surveys, it is useful to briefly describe the key programs that accompanied the transition of Mexico's agriculture towards trade liberalization and NAFTA. This will help better understanding some aspects of the empirical work in the next chapters.

The credit market in rural areas has undergone significant changes since the late eighties as a consequence of the withdrawal of the state from direct intervention in agricultural input and output markets and of the 1994 Tequila crisis. The 1992 reforms abolished the previously established system of channeling credit through the ejido and



have *de facto* individualized the process. The system has been re-planned since the early '90s so that producers, now classified according to repayment history and regional agronomic conditions, self-select into different markets (Mhyre, 1998). The majority of ejidatarios deemed to have a potential as producers, were included among the clientele of the newly restructured Banrural, the official lending institution. Banrural dramatically restructured its mode of operations, reflecting the segmentation of the market. Regional branches were slashed by almost 50%, thereby increasing the transaction costs that perspective borrowers living in remote areas have to sustain in order for applying. Moreover, in real terms the size of loans has been also drastically reduced, while interest rates have increased to reflect the higher cost of money following the Tequila crisis. Those ejidatarios that were considered as subsistence producers with little commercial orientation were instead considered as the clientele of Pronasol, a program designed to provide credit without collateral nor obligation to repay in case of a drought or other natural calamity affecting harvest. Generally, Pronasol loans were small and barely enough to finance consumption needs between planting and harvest.

There have been two important government programs designed to modernize the agricultural sector and support farmers during the process of trade liberalization. Since 1994 farmers producing cereals, mainly grains, began receiving payments from the Procampo program. These payments were on a per hectare basis and were conditional on cultivating crops belonging to a list mainly including grains. Procampo was launched to compensate farmers for the reduction in guaranteed prices that had coincided with the signature of the NAFTA treaty. In spite of falling short of covering the costs of fertilizers and other variable inputs, Procampo was nevertheless a significant source of cash

considered the overall situation of scarcity of liquidity (Sadoulet *et al.* 2002). Over 80% of the farmers in our sample received Procampo during the 1996/97 crop year (and none during the 92/93 crop year).

### 1.7. Descriptive evidence

The evidence on which most of this dissertation is based draws from two household surveys (ejido surveys in short) that were undertaken in 1994 and 1997. The first survey covered the 1992/93 crop year, while the second survey covered the 1996/97 crop year<sup>11</sup>. The sampling plan of the 1994 survey was based on a previous survey conducted in 1990 by Mexico's *Secretaria de Agricultura y Recursos Hidraulicos* (SARH)<sup>12</sup> and the Economic Commission for Latin America and the Caribbean (ECLAC) of the United Nations. That survey covered 5,007 ejidos from the whole of Mexico and 35,090 ejidatarios. The ejidos were surveyed in a first stage by using the frame of the 1988 Ejido Census. In the second stage, 6% of the ejidatarios within each ejido were selected, with a minimum of 5 per ejido. The survey was designed to be representative at the district level. The 1994 survey was conducted jointly by Mexico's *Secretaria de Reforma Agraria* (SRA), ECLAC, and the University of California at Berkeley. It included 1,342 ejidos households and 275 ejidos. These ejidos were randomly selected from those included in the 1994 survey and also this time ejido households were selected randomly from the list of ejidatarios typically held by ejido authorities. This sampling strategy is a key point for the analysis that follows. As we saw, besides ejidatarios recognized as such by the ejido authorities, the ejido social structure included the

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<sup>11</sup> In the text we shall refer to the two surveys as the 1994 and 1997 surveys.

<sup>12</sup> SARH became then SAGAR under the Zedillo presidency and changed its name again to SAGARPA with the advent of the Fox presidency.

*posesionarios* (farmers without a recognized title to their land, yet recognized as legitimate possessors by the local ejido authority) and the *avecindados*, typically family members of ejidatarios or members of families that were living in the ejido urban area but that did not have access to land. A central hypothesis of this research is that the 1992 reforms improved the right to land access of these two groups, affecting the modality of participation in the land rental market by the ejidatarios proper. As households in the 1994 survey were randomly drawn from the population of ejido households, we do not have information on *avecindados* and *posesionarios* households. This is a detail that will be of relevance in explaining the results to come. Overall, the 1994 survey was designed to be representative at the regional level. The state of Chiapas was excluded due to the political turbulence predominating at that time in Southern Mexico.

The 1997 survey was the third survey conducted on the ejido sector. It was a joint effort of the SRA, of the *Instituto Nacional de Desarrollo Agrario* (INDA) with the support of the World Bank and the University of California at Berkeley. It covered 1,665 households from 286 ejido. Out of that sample, 1,287 households had been interviewed in the 1994 survey. Although, this gives the opportunity to construct a panel of households, the different methodology used in collecting information on household income and the absence of information on production costs, do not allow to use the panel structure of the data, forcing the analysis to a cross section approach in most cases. Nevertheless, we shall exploit the panel structure of the data whenever possible.

Finally, both surveys did collect information at the community level, providing a reasonably rich picture of the certification and titling process represented by the Procede.

Tables 1.12 and 1.13 report descriptive evidence regarding changes in relevant ejido level and household variables between the crop year 1993/94 and 1996/97. As table 1.12 shows, certified ejidos appear to be smaller in terms of area (not necessarily in terms of population), nearer to urban areas, endowed with better public infrastructure and more productive, if average corn yields is taken as a reliable indicator<sup>13</sup>. Certified ejidos are more densely populated and fewer of these have common lands. The data suggest that in selecting the ejidos to be certified, the Agrarian Attorney's office has been 'queuing' ejidos on the basis of a set of criteria. Interestingly enough, the pattern of selection followed is similar to the one that would be expected to emerge if the Procede were to be a demand-led titling program. In fact, one would expect the demand for stronger and better-defined land rights to emerge in areas where land is scarcer, of better quality, and where more outside opportunities exist. This in fact matches the characteristics displayed by certified ejidos (and 'in-process' as well), the information contained in table 1.12 seems to be consistent with the hypothesis that the most productive ejidos have been selected first.

Table 1.13 examines information at the household level. Households have been grouped into certified, uncertified, and 'in process' and data for 1994 and 1996 are shown next to each other. Certified households have a higher per capita income than both uncertified and in- process ejidatarios. Farm income includes agricultural profits, from both crops and livestock, plus government transfers under Procampo and Alianza and net land rental income. In-process households display a relatively higher share of their income from agriculture. Looking at household size, one notices that both certified and

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<sup>13</sup> In fact the latter could also signal better land quality. Notice that average corn yields are higher in both survey periods, implying that higher yields in the 1996/97 crop year need not necessarily be associated with the adoption of the Procede.

uncertified households have fewer members than in-process households. As household size is not expected to vary systematically by Procede status, this may signal that both certified and uncertified households have had more migration relatively to in-process ejidos.

Figures in table 1.14 show that corn production is central to the agricultural economy of the ejidos and, in spite of a slight decline between 1993 and 1996, it continues to be the key crop for many poor ejidatarios. Revenues of annuals (mainly corn and other grains) per hectare of cultivated land were higher for certified households in both years so that any higher productivity in terms of yields may in fact be more systematic rather than tied to Procede. Things are less clear-cut in the case of perennials, but differences, as in the case of grains may be more a reflection of diverse agro-ecological characteristics.

Except for technical assistance, which declined considerably between 1994 and 1996, use of commercial inputs appears to have remained quite stable. Among ejidatarios, though, those located in certified and in process ejidos make more use of improved seeds and chemical inputs. Per hectare cost of inputs is almost twice in certified versus uncertified ejidos. We do not have data on input expenditures for the 1992/93 crop year, so that we can only rely on percentages of farmers using a given input. These show that the differences in the use of commercial inputs between certified and uncertified ejidos have a structural component that is unrelated to Procede. This does not imply that Procede has had no impact in terms of increasing the use of commercial inputs, as differences in means may be driven by other factors that are correlated with the adoption of the Procede.

Access to credit changed dramatically between 1993 and 1996 (table 1.15). In 1996 only 12% of the ejidatarios borrowed from a formal source, compared to the 29% in 1993. Moreover, almost 30% of these loans were from Pronasol, a government program disbursing interest-free loans. Pronasol loans were small and insufficient to finance the purchase of fertilizers and other commercial inputs. Interestingly enough, though, the fall in the percentage of farmers having a formal loan is driven by the fall in Pronasol's loans. On the other hand, Banrural increased its coverage. Yet, the average size of Banrural's loans decreased considerably between the two crop years. In terms of liquidity injected into the ejido sector, it should be noticed that in 1994 over 80% of the ejidatarios began receiving Procampo payments. The increase in the use of crops as a guarantee is a reflection of the diminution of Pronasol's loans (which did not require collateral) and of the increased share attributable to Banrural. Comparing the amount of Procampo payments and the average Banrural loan, both expressed in per hectare of cultivated land, show that the two are quite comparable. Considering that the percentage of farmers receiving Procampo is very high, it is plausible to hypothesize that as a result of the Procampo and higher interest rates in 1996, farmers have reduced their demand for formal loans. At the same time, Procampo may have made it more rational for Banrural to focus its clientele towards a specific type of producer, for whom the return to capital would be higher. That this is a plausible explanation is suggested by the fact (not shown in table 1.15) that only a handful of surveyed households that applied for a formal loan were in fact rejected.

Whatever the rationale of the borrowing behavior of the ejidatarios, titled land is not used as a collateral for formal loans. Only a small percentage of farmers in certified

ejidos have been required to use land as a collateral<sup>14</sup>. This is not surprising in view of the fact that use of land as a guarantee continues to be prohibited under the new Agrarian Law.

Table 1.16 shows the changes in farm size and in farmland use. The average size of farms has increased by 3.5 hectares between 1994 and 1996. This reflects the increase in farmland assets in table 1.13 above. The increase in farm size involves both an increase in cultivated land (from 7.5 to 8.8 hectares) as well as an increase in pasture land (3.1 to 4.4 hectares) and forest land (0.8 to 1.7 hectares). Of the 1.3 hectares of average increase in cultivated land, 0.8 hectares are left fallow. On average fallow land increased from 17% to 20% of the cultivable land and it happened mostly in certified ejidos. If land fallowing can be interpreted as investment in land improvement, then this might be a first signal of a land investment effect of the Procede. Indirect information about the appropriation of common lands comes from the increase in pasture and forest land. The increase was generalized across ejidos, yet the increase in certified ejidos seem to have been slightly greater than in other ejidos.

The information on farmland use can be matched with that on changes in land by type of tenure in table 1.17. The information in the table is organized both by Procede status as well as farm size classes, according to which farms are collected in three classes: 0+ε to 5 has; 5+ε to 15 has; and larger than 15 has. We notice the following points. First, increases in average farm size were dramatic for small and medium size farms, while larger farms were almost unchanged on average. Second, on average the greatest increase in farm size took place in uncertified and in-process ejidos than in certified ejidos. Third,

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<sup>14</sup> Titled land may include both certified ejido land, as well as private land. This explains the fact that 5% of the loans among uncertified ejidatarios have titled land as a guarantee.

in all ejidos, the increase farm corresponds mostly to lands that are reported as communal and private. The increase in communal land is much greater in uncertified and in-process ejidos than in certified ejidos. The latter two aspects might be a reflection of either a difference in communal land endowments between certified and uncertified ejidos or a result of the fact that where the Procede has arrived first, the process has been somewhat slowed down and that communal land that has been appropriated in certified ejidos has changed tenure formally as a result of the Procede. Fourth, even in certified ejidos the share of communal lands in total farmland is not trivial. Thus, if the perspective of adopting the Procede is a catalyst in the process of subdivision of communal land, it is not necessarily true that no more subdivision takes place after. Finally, there is a small change in private land in uncertified and in-process ejidos relative to the certified ones. This is mostly a result of the privatization of ejido land (which can be done only after certification), which was much more common among middle sized and large farms.

The next two tables (1.18 and 1.19) look at participation in the land rental market. Table 1.18 reports participation by farm size class and does not separate between different types of contractual arrangements (i.e. fixed rent, sharecropping, and loaning). The first observation one draws from the table is that land rental markets have become much more active by 1996 in terms of participation by ejidatarios. Second, participation to the land rental market is much greater among large farmers both in terms of leasing land in and out. Third, land markets are more active in certified ejidos during both survey periods. This may indeed be another indication of a structural difference between ejidos that successively would differ by participation in the Procede. An important caveat of these figures is that the information reported in the ejido surveys concerns ejidatarios



only. As we previously explained, the 1992 reform did in fact open the possibility of *avecindados* entering the land market. This implies that the information on land rental markets as revealed through the decision to participate by ejidatarios might grossly under-estimate the total effect that would account for the participation by the *avecindados*.

Yet, there are other features that distinguish certified from uncertified ejidos that might be partly obscuring the role played by the Procede. Table 1.19, which organizes the information by type of contractual agreement, shows that fixed rent contracts have become more important in 1996 compared to 1994 and that they are slightly more important in in-process ejidos.

In terms of land sales and purchases, only 8% of the ejidatarios were involved in these types of transactions between 1994 and 1996. This is a very low percentage (on average 3% of the ejidatarios bought or sold land in any year between 1994 and 1996) that can be related to the difficulty of accessing long-term credit. Olinto (1999), working on the same data, showed that buyers had more land in 1993 than sellers and that participation to the land rental market decreased the probability of selling or purchasing land. Finally, almost all transactions that took place with certified land were informal, i.e. not registered by the Registro Agrario Nacional<sup>15</sup> (RAN). The number of transactions is too small to make any generalization, but other fieldwork in Mexico (Deininger and Bresciani, 2001) confirms that informality of transactions still dominates in spite of the Procede. This poses a serious problem in that the results of the Procede may be undone as time passes by and land changes ownership.

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<sup>15</sup> National Agrarian Registry

The data just reviewed seems to point to the conclusion that ejidos that have been certified and those that are in the process of having Procede finalizing its work, are more dynamic and commercially oriented than those that have still to be contacted or that have rejected the program. This difference may in fact be not ascribable to the Procede per se and it might have persisted even if the Procede had never been launched. Drawing conclusions on the basis of descriptive statistics may be deceptive, as several other factors have affected production decisions in the ejido sector. Relative prices of commodities have changed, especially that of corn, which is more commonly cultivated among uncertified ejidatarios. On the other hand, access to credit seems to be easier for certified ejidatarios and, when liquidity is a binding constraint, this may have an impact on the decision to rent land out as a mean of financing the purchase of inputs. The importance of liquidity constraints in affecting land rental decisions is examined in chapter 3, which articulates the theoretical and econometric framework of this research. Here we simply point out that 75% of the land transactions registered in Mexico by the Procede staff (i.e. based on the universe of certified ejidos as of late 1998) required an advanced payment. Thus, it is highly probable that the high cost of borrowing following the Tequila crisis and the restructuring of the official credit market may in fact have had a severe effect on land transactions and that simple averages may be unable to capture the role played by the Procede in developing land markets by enhancing tenure security.

### 1.8. Conclusions

The new agricultural programs together with the 1992 reforms and the Procede have sought to enhance tenure security. The evidence on ejidatarios perceptions regarding

the Procede suggest that the program may in fact have been successful at targeting ejidos were the latent demand for the program's services was in fact highest. A relevant question is which structural factors determine such latent demand for property rights. Several theories have been advanced in regard to how property rights evolve. In the next chapter we shall review some of the key predictions emerging from the literature on property rights, their evolution, and the economic role played by titling and certification. In particular, given our focus on the impact of Procede on land markets, we are interested in understanding how participation in land markets may interact with the process of land titling. Chapter 3 will then examine more in detail the interplay between production decisions, land rentals, labor supply, and liquidity constraints. This will then pave the way for the empirical analysis that will follow.

Table 1. 1: Comparing the private and ejido sectors

	Private	Ejidos
Total area (has)	108,346,084	103,290,099
No of producers	1,006,193	2,655,129
Total labor force	3,112,071	7,252,811
Labor per 100 ha	2.87	7.02
No of tractors	149,513	146,849
Area per producer	107.68	38.90
Share of subsistence producers	49.2%	44.5%
Cattle herd per producer	34.59	11.48
Wood production (m3)	3,431,824	9,721,321

Source: 1990/91 Agricultural Census

Table 1. 2: Share of households with income below one minimum salary, 1990

	National	North. Pacific	South. Pacific	Gulf	North	Center
Income Ejidatarios (% < 1 min wage)	53	25	79	65	60	52
Income all farms (% < 1 min wage)	26	15	49	33	25	24

Source: 1990/91 Population Census

Table 1. 3: Advance of the Procede in 1997, by region

Region		Status			Total
		Un-certified	In process	Certified	
North	# of ejidos	29	7	29	65
	(%)	44.62	10.77	44.62	100
N. Pacific	# of ejidos	4	10	22	36
	(%)	11.11	27.78	61.11	100
Center	# of ejidos	23	15	38	76
	(%)	30.26	19.74	50.00	100
Gulf	# of ejidos	8	9	27	44
	(%)	18.18	20.45	61.36	100
South Pacific	# of ejidos	33	10	22	65
	(%)	50.77	15.38	33.85	100
Total	# of ejidos	97	51	138	286
	(%)	33.92	17.83	48.25	100

Source: 1997 Ejido Surveys

Table 1. 4: Regional distribution of ejidos, by Procede status

Region		Status			Total
		Uncertified	In process	Certified	
North	# of ejidos	29	7	29	65
	(%)	29.9	13.73	21.01	22.73
N. Pacific	# of ejidos	4	10	22	36
	(%)	4.12	19.61	15.94	12.59
Center	# of ejidos	23	15	38	76
	(%)	23.71	29.41	27.54	26.57
Gulf	# of ejidos	8	9	27	44
	(%)	8.25	17.65	19.57	15.38
South Pacific	# of ejidos	33	10	22	65
	(%)	34.02	19.61	15.94	22.73
Total	# of ejidos	97	51	138	286
	(%)	100	100	100	100

Source: 1997 Ejido Surveys

Table 1. 5: Distribution of supporters and opponents

	Uncertified	In process	Certified	
Opposed	52	11	2	20
In favor	48	89	98	80
	100	100	100	

Source: 1997 Ejido Surveys

Table 1. 6: Motivations for opposing or favoring Procede

	All Ejidos	Uncertified	In process	Certified
Opposed:				
Land taxes	51	52	48	53
Ejido disappears	10	10	11	18
Land could be lost	13	14	19	0
Does not trust	45	49	26	18
People will sell	7	6	0	18
Not necessary, no rental	5	5	4	0
Informal rental common	4	4	4	0
In favor:				
Tenure security	92	91	93	92
Solve border problems	32	36	38	28
Rent or sell land	8	7	6	9
Use land as collateral	14	15	12	13
Associate	2	2	2	2

Source: 1997 Ejido Surveys

Table 1. 7: Motivations for ejido participation or non participation to Procede

Reasons for ejido to participate	
Tenure security	85
Government requirement	15
Solve border problems	27
Rent or sell land	9
Have access to credit	11
Have access to Procampo	4
Invest more in land	1
Reasons for the ejido to not participate	
Lack of information	35
Were not convened	2
Lack of documentation	5
To avoid taxes	13
To avoid land transactions	2
No interest in land rentals or sales	1
Border problems	16
Avoid conflicts among ejidatarios	7

Source: 1997 Ejido Surveys

Table 1. 8: Opinions on Procede's effects in certified ejidos

	More	Less	Same
Tenancy problems	5	27	67
Social cohesion of the ejido	22	12	66
Credit access	12	9	78
Investment	5	5	91
Migration	16	8	76
Land rentals	19	12	69
Land sales	24	11	65
Land compacting	3	2	95
Associations	5	4	90
Land divisions	4	2	93

Source: 1997 Ejido Surveys

Table 1. 9: Interest in full property rights

	Uncertified	In process	Certified	Total
No	90	82	77	83
Yes	10	18	23	17
	100	100	100	

Source: 1997 Ejido Surveys

Table 1. 10: Conflicts before and after the Procede  
(percent ejidos)

	Certified	Not certif.
Conflicts on ejido borders		
Yes	25.0	46.8
Partially	1.5	1.5
Procede solved		
Yes	71.4	-
Partially	11.4	-
Conflict after Procede		
Yes	9.9	-
Partially	3.0	-
Conflicts on individual borders		
Yes	23.5	20.0
Partially	4.6	2.2
Procede solved		
Yes	54.1	-
Partially	21.6	-
Conflict after Procede		
Yes	11.4	-
Partially	1.5	-
Conflicts on ejidos commons		
Yes	10.0	10.3
Partially	-	-
Procede solved		
Yes	36.4	-
Partially	18.2	-
Conflict after Procede		
Yes	7.0	-
Partially	1.0	-

Source: 1997 Ejido Surveys



Table 1. 11: Encroachment on commons and propensity to regularize

	In		
	Uncertified	process	Certified
With commons occupied	33	32	11
Occupants			
Ejido members	54	42	42
Avecindados	32	42	50
Outsiders	14	33	25
Would recognize rights	61	42	33

Source: 1997 Ejido Surveys

Table 1. 12: Relevant ejidos characteristics

	Status			
	All ejidos	Uncertified	In process	Certified
Km from nearest urban center	25	31	21	22
Travel time to nearest urban center	50	65	44	42
Average ejido population	1,442	1,625	2,227	1,017
Average area	3,453	4,300	3,114	2,983
Common pastures (has)	1,286	2,063	736	944
% ejidos with common pastures	61	76	53	54
Population density (hab/hect)	2.30	0.97	2.00	3.31
% households with light	82.0	78.3	81.6	84.7
ejidos with telephone line	53	49	49	58
Yearly frequency of assembly	8.45	8.50	8.55	8.37
% ejidatarios assisting assembly	63	64	60	63
% with irrigation structures	33	23	33	40
average corn yield (where cultivated)	1.18	0.96	1.11	1.37
average corn yield in 1994	1.04	0.90	1.09	1.12

Source: 1997 Ejido Surveys

Table 1. 13: Household characteristics

	Un- certified	In Process	Certified	Total
Per capita income, 1997	6,205	5,015	6,953	6,353
Share of household income from agriculture, 1997	57%	71%	60%	61%
Household size, 1994	5.44	5.48	5.02	5.25
Household size, 1997	5.59	5.93	5.41	5.56
Per capita land assets, 1994	2.35	2.24	3.43	2.85
Per capital land assets, 1997	2.95	2.35	3.68	3.19

Source: 1997 Ejido Surveys

Table 1. 14: Input use, by Procede status

	Uncertified		In process		Certified		Total	
	1993	1996	1993	1996	1993	1996	1993	1996
Annuals, revenues per hectare*	1522	1994	2127	2191	2967	2395	2303	2212
Perennials, revenues per hectare*	4767	4695	6799	5736	8542	4947	6827	5091
Input expenditure per hectare	n.a.	479	n.a.	596	n.a.	909	n.a.	704
% corn producers	95%	90%	89%	80%	83%	76%	88%	81%
% perennial producers	26%	25%	41%	34%	28%	24%	30%	26%
% horticulture producers	13%	8%	15%	10%	23%	16%	18%	12%
% grain producers	96%	92%	92%	82%	93%	83%	94%	86%
% using improved seeds	11%	16%	22%	22%	27%	24%	21%	21%
% using traditional seeds	89%	84%	84%	72%	78%	72%	83%	76%
% using manure	4%	7%	3%	6%	4%	12%	4%	9%
% using fertilizers	42%	45%	56%	51%	54%	51%	50%	49%
% using herbicide	28%	28%	45%	40%	33%	37%	34%	35%
% using insecticide	25%	25%	42%	35%	35%	33%	33%	30%
% using technical assistance	6%	3%	15%	4%	12%	5%	11%	4%
% using tractor	5%	6%	4%	9%	10%	9%	7%	8%
% using truck/pick-up	15%	9%	15%	13%	21%	13%	18%	12%

\*1996 Pesos, 1993 prices adjusted with Food Price Inde

Source: 1997 Ejido Surveys

Table 1. 15: Access to credit, by Procede status

	Uncertified		In process	
	1994	1996	1994	1996
Had formal loan	25%	9%	29%	14%
Had informal loan	2%	9%	6%	14%
Among formal borrowers:				
Avg. Loan	7,058	9,765	5,712	27,626
Avg. Loan from Banrural*	18,823	21,011	17,044	18,638
Avg. Loan from Sedesol*	1,572	1,050	1,636	1,300
Avg. Loan per hec of cultivated land*	860	2,188	811	3,338
Avg. Loan from Banrural per hec cult. land*	1,085	3,792	1,787	1,665
% farmers receiving Procampo	-	84%	-	82%
Procampo payment per hec of cultivated land	-	2,052	-	2,196
% loans from Banrural	8%	30%	28%	47%
% loans from Pronasol	70%	30%	75%	13%
% loans from commercial bank	12%	8%	0%	6%
% short term loans	90%	62%	96%	78%
% loans with crop as guarantee	9%	62%	7%	38%
% loans with untitled land as guarantee	1%	3%	6%	9%
% loans with titled land as guarantee		5%		0%
% loans with gov't payments as guarantee		16%		13%
Among informal borrowers:				
Avg. Loan	3,850	3,248	4,888	1,340

Source: 1997 Ejido Surveys

\* Expressed in 1996 Pesos

Table 1.15 (continued)

	Certified		Total	
	1994	1996	1994	1996
Had formal loan	31%	14%	29%	12%
Had informal loan	4%	9%	3%	10%
Among formal borrowers:				
Avg. Loan	10,103	18,065	8,404	18,057
Avg. Loan from Banrural*	30,316	35,378	25,308	28,324
Avg. Loan from Sedesol*	2,100	1,379	1,858	1,290
Avg. Loan per hec of cultivated land*	1,530	2,401	1,199	2,544
Avg. Loan from Banrural per hec cult. land*	3,713	3,612	2,840	3,142
% farmers receiving Procampo	-	81%	-	83%
Procampo payment per hec of cultivated land	-	2,625	-	2,344
% loans from Banrural	23%	37%	19%	37%
% loans from Pronasol	70%	33%	71%	28%
% loans from commercial bank	4%	5%	5%	6%
% short term loans	87%	78%	90%	74%
% loans with crop as guarantee	12%	56%	10%	54%
% loans with untitled land as guarantee	5%	9%	4%	8%
% loans with titled land as guarantee		2%		3%
% loans with gov't payments as guarantee		11%		13%
Among informal borrowers:				
Avg. Loan	5,592	2,036	5,055	2,229

Source: 1997 Ejido Surveys

\* Expressed in 1996 Pesos

Table 1. 16: Farmland use, by Procede status

Land use	Uncertified		In process	
	1994	1996	1994	1996
Farm size (has)	10.6	14.6	9.4	11.4
Cultivated land (has)	7.3	9.1	6.8	8.3
annuals (has)	4.0	4.7	4.0	4.7
perennials (has)	0.7	0.7	0.8	0.9
improved pastures (has)	1.5	1.9	0.8	0.8
fallow (has)	1.2	1.7	1.2	1.9
Natural pastures (has)	2.7	4.0	2.2	2.9
Forest land (has)	0.6	1.5	0.4	0.3
Cultivated land (% of farm)	88%	88%	83%	84%
% cultivated land with irrigation	10%	11%	17%	18%
% cultivated with annuals	73%	68%	71%	63%
% cultivated with perennials	8%	7%	14%	14%
% cultivated with impr.pastures	5%	7%	4%	4%
% cultivated fallow	17%	17%	17%	20%
Natural pastures (% farm)	11%	10%	16%	15%
Forest land (% farm)	1%	2%	1%	1%

Source: 1997 Ejido Surveys

Table 1.16 (continued)

Land use	Certified		Total	
	1994	1996	1994	1996
Farm size (has)	12.5	16.2	11.3	14.8
Cultivated land (has)	7.8	8.7	7.5	8.8
annuals (has)	4.6	4.5	4.3	4.6
perennials (has)	0.5	0.5	0.6	0.6
improved pastures (has)	1.4	1.2	1.3	1.4
fallow (has)	1.3	2.5	1.3	2.1
Natural pastures (has)	3.7	5.2	3.1	4.4
Forest land (has)	1.0	2.3	0.8	1.7
Cultivated land (% of farm)	81%	80%	84%	83%
% cultivated land with irrigation	19%	23%	15%	18%
% cultivated with annuals	75%	65%	73%	66%
% cultivated with perennials	6%	6%	8%	8%
% cultivated with impr.pastures	7%	7%	6%	7%
% cultivated fallow	18%	22%	17%	20%
Natural pastures (% farm)	16%	16%	14%	14%
Forest land (% farm)	3%	4%	2%	3%

Source: 1997 Ejido Surveys

Table 1. 17: Farm land tenure, by Procede status

	All ejidos									
	1994					1996				
	Average farm size (has)	Ejido land	Com- munal land	Pri- vate	Other	Avg. farm size (has)	Ejido land	Com- munal land	Pri- vate	Other
0-5 has	2.7	2.2	0.4	0.1	0.0	5.8	3.4	2.3	0.1	0.0
5-15 has	8.3	7.8	0.3	0.1	0.0	12.7	7.8	3.5	1.4	0.0
15+ has	31.4	27.9	1.0	2.3	0.0	30.0	20.8	6.7	2.5	0.0
Total	11.7	10.6	0.5	0.6	0.0	14.4	9.3	3.8	1.2	0.0

Table 1.17 (continued)

	Uncertified ejidos									
	1994					1996				
	Average farm size (has)	Ejido land	Com- munal land	Pri- vate	Other	Avg. farm size (has)	Ejido land	Com- munal land	Pri- vate	Other
0-5 has	2.3	1.3	1.0	0.1	0.0	5.3	1.9	3.4	0.0	0.0
5-15 has	8.0	7.1	0.6	0.2	0.0	15.4	6.3	6.9	2.2	0.0
15+ has	33.5	28.5	2.1	2.9	0.0	30.5	18.0	12.3	0.2	0.0
Total	10.6	8.9	1.0	0.7	0.0	14.4	6.8	6.6	1.0	0.0

Source: 1997 Ejido Surveys

Table 1.17: (continued)

	Ejidos in process									
	1994					1996				
	Avg farm size (has)	Ejido land	Com-munal land	Pri-vate	Other	Avg farm size (has)	Ejido land	Com-munal land	Pri-vate	Other
0-5 has	3.0	3.0	0.0	0.0	0.0	5.5	3.9	1.5	0.0	0.0
5-15 has	7.9	7.6	0.2	0.1	0.0	9.0	7.2	1.5	0.3	0.0
15+ has	25.3	24.3	0.4	0.1	0.0	25.8	15.8	8.8	1.2	0.0
Total	9.7	9.3	0.1	0.1	0.0	11.2	7.8	3.0	0.4	0.0

Source: 1997 Ejido Surveys

Table 1.17: (continued)

	Certified ejidos									
	1994					1996				
	Avg farm size (has)	Ejido land	Com-munal land	Pri-vate	Other	Avg farm size (has)	Ejido land	Com-munal land	Pri-vate	Other
0-5 has	2.8	2.6	0.0	0.1	0.0	6.5	4.5	1.7	0.3	0.0
5-15 has	8.6	8.5	0.1	0.1	0.0	12.2	9.1	1.8	1.3	0.0
15+ has	31.5	28.0	0.7	2.7	0.0	30.9	23.4	3.5	3.9	0.0
Total	13.1	12.1	0.2	0.8	0.0	15.6	11.6	2.3	1.7	0.0

Source: 1997 Ejido Surveys



Table 1. 18: Land market participation, by certification status and farm size, 1994-96

Procede status	Leasing decision	0-5 has		5-15 has		15+ has	
		1993	1996	1993	1996	1993	1996
Uncertified	In	1%	5%	7%	11%	11%	6%
	Out	3%	5%	3%	4%	6%	16%
In process	In	3%	6%	11%	10%	7%	24%
	Out	4%	9%	9%	7%	7%	9%
Certified	In						
	Out	2%	8%	7%	10%	16%	14%
	In	3%	6%	12%	14%	8%	19%
Total	Out						
	In	2%	6%	8%	10%	13%	13%
	Out	3%	6%	8%	9%	8%	16%

Source: 1997 Ejido Surveys

Table 1. 19: Land rental market participation, by certification status

	Non cert.		In process		Certified		All	
	1993	1996	1993	1996	1993	1996	1993	1996
Rent in	3%	4%	4%	7%	4%	5%	3%	5%
Loaned in	2%	3%	2%	4%	4%	3%	3%	3%
Sharecropped. In	1%	2%	1%	2%	1%	3%	1%	3%
Total lease in	6%	8%	7%	11%	8%	11%	7%	10%
Rent out	1%	3%	3%	4%	5%	7%	4%	5%
Loan out	2%	2%	3%	2%	2%	2%	2%	2%
Sharecropped. Out	0%	2%	0%	1%	1%	4%	1%	3%
Total lease out	3%	7%	7%	8%	8%	13%	6%	10%

Source: 1997 Ejido Surveys

## Chapter 2: Tenure security and the economic benefits of land titling: a review of the literature

### 2.1. Introduction

Before entering into the discussion of what theory would predict to be the welfare impact of titles and their registration, it is useful to define more clearly what is meant by tenure insecurity and how the case of Mexico's ejidos before and after the 1992 reforms, in terms of land rights, fits into that definition. This is done in sections 2 and 3. Section 4 reviews the main findings of the empirical research on the effects of land titling, looking at which of the various channels the literature has shown to be most important in linking tenure security to higher incomes and farm productivity. Section 5 reviews the available literature on the impact of titling programs on land markets (land rental markets more specifically) and on the allocation of household labor. It is argued that the literature, mainly focused on long-term increases in agricultural productivity, has overlooked the importance of land rental markets and of the reallocation of household labor to off-farm activities as a result of stronger property rights. The final section summarizes the previous discussion by referring to the specific case of the Procede and the ejido sector in Mexico. In particular it discusses the contributions and limitations of the present research to the existing literature.

## 2.2. Land rights and tenure security

The role of land rights is central to the process of agricultural development. The allocation of land rights affects both farm productivity as well as household income. From now on, we shall refer to farm productivity as the value of profits per hectare of farmland, where the latter includes cultivated land, pastures, as well as fallow land. Land rights evolve in accordance with the social system within which they are structured and their trajectory is of considerable interest in understanding how the benefits of economic growth are redistributed in society and among successive generations. As a means of strengthening land rights and raising farm productivity, titling programs have acquired substantial interest during the past two decades. Considerable effort has been placed in identifying channels through which tenure security affects farm productivity and in measuring quantitatively its impact.

As the effectiveness of land titling programs depends in turn on the structure of pre-existing land rights and their influence on insecurity as perceived by the land holder, a definition of what tenure insecurity (or security) means will help us in better articulating the discussion that follows. According to Place et al. (1994, p.19) “land tenure security can be defined to exist when an individual perceives that he or she has rights to a piece of land on a continuous basis, free from imposition or interference from outside sources, as well as ability to reap the benefits of labor and capital invested in that land, either in use or upon transfer to another holder.” There are basically three different levels from which the issue of tenure security can be considered: which rights (i.e. their breadth), their duration, and their degree of assurance (i.e. degree of enforcement).<sup>16</sup>

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<sup>16</sup> The role of government in the assurance of property rights can be ambiguous. Leaving aside the case of dictatorial governments, even in modern democratic societies the government can enhance assurance by

The breadth of rights refers to a different dimension, specifically rights of *use*, of *transfer*, and of *exclusion*, all of which contribute to define the bundle of rights attached to a specific unit of land that can be claimed by a given individual. Rights of use regulate the type of economic activities that can be undertaken and more generally are the basis on which the residual claimant to profits generated by the use of land is identified.

Transfer rights are particularly important for the following reasons. First, the ability to freely transfer the possession of land, with annexed rights of use, is the basis on which members of a society can self-select into those activities in which they are most productive. If a landless worker whose abilities are better rewarded in farming rather than by working as a petty trader wants to purchase or lease farm land, the ability to do so will improve her income prospects, as well as those of society at large. Conversely, a farmer that would enjoy a better return to his labor endowment by working off-farm or by migrating could benefit from selling or renting his land to that landless worker. If land cannot be transferred freely, this process will be blocked and efficiency losses will result. Second, inability to transfer land ownership even when tenure is assured (i.e. there is no risk of expropriation) will depress investment in land. In fact, when future returns from farming are uncertain, the inability to recover the costs of the initial investment in land improvement through higher prices or rents will make those investments irreversible. For example, if a farmer considers the possibility of migrating to an off-farm job that will yield substantially higher payoffs as compared to farming, it will matter a great deal in deciding over a land attached investment whether in the future, should the decision to

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extending protection to private owners against arbitrary dispossession by other individuals; or it can dispossess private owners of their land to achieve a social objective. The latter takes place through expropriation. Views differ sharply on the right of the State, through government action, to expropriate private land.

migrate become effective, the cost of that investment may be recouped by selling the land at a price that will account for that same improvement. From this point of view, land rental markets are potentially even more important than land sales markets. In fact land sales markets are characterized by substantial transaction costs as compared to land rental markets, thereby offering less scope for accessing or exiting farming.

It should be remarked that transfer rights can be permanent or temporary: the right to sell and purchase land are permanent transfers rights, whereas temporary transfer rights are associated with the right to rent land. It is common to find in developing countries that temporary transfer rights are accepted while permanent ones are forbidden. Finally, transfer rights may be complete or limited. By complete we mean that the holder of the right has full freedom in choosing to whom he will transfer the rights of use. For example, ejidatarios have limited permanent transfer rights (ejidatarios can sell only to other ejidatarios of the same nucleus), while temporary transfer rights (i.e. rentals) have been completely liberalized. Before the 1992 reforms, both temporary and permanent transfer rights were formally nonexistent except for the right of inheriting and that of donating the usufruct right.<sup>17</sup>

The right to *exclude* others from the benefits generated through the use of owned assets is central to economic efficiency. In relation to farmland, the holder's right to exclude others from harvesting greatly improves the incentives to maximize net returns. The inability to exclude others depresses the incentive to invest in land improvements, as substantial uncertainty will exist concerning the present discounted value of the flow of returns. It is important nevertheless to qualify the argument as many resources, including

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<sup>17</sup> Note that the donation was in fact the *escamotage* that ejidatarios adopted in order to illegally sell their land usufructs.

land, are often administered as common properties. In those cases, the right to exclude is awarded to a community rather than to a single individual. The community is entitled to exploit that resource in solidarity or according to some specific rules that can be either codified or can be determined autonomously within the same community. In such a case, the right of exclusion awarded to each member is limited, in the sense that he cannot exclude other members of the community but can exclude outsiders. Regulations and incentives may be such that the resource is administered efficiently (e.g. Baland and Platteau, 1996). There are many instances though where regulations are ineffective and lead to an inefficient use of the resource.

The issue of *duration* is also an important one when analyzing the impact of tenure security on investment and farm productivity. While certainty about the duration of use and transfer rights indeed has relevant effects on investment incentives and overall long-term farm productivity, the impact of uncertain duration is likely to be even more perverse. Land tenure legislation in several countries (e.g. Ethiopia, China in some areas) allows for periodic redistribution of lands among households of the community. The purpose of these provisions is generally that of ensuring an equal redistribution of land among households according to their sizes and to allow new households to access the village land. Several studies have investigated the impact of effect of land redistributions on incentives to invest in land improvements and have found their impact to be substantially negative.

Limited (and uncertain) duration affects also the supply of land on the land rental market as the leasing of land signals to the community that the household has more land than it needs to support its necessities. In densely populated communities, and especially

in those that have been created out of an ideology that supports the transfer of use rights to those that till the land, this type of signal gives rise to claims by other households of the same community that might claim their holdings to be insufficient. These types of tensions affect the likelihood of being negatively affected should land redistribution occur in the future. Limited duration, coupled with uncertainty, will therefore contribute to an inefficient use of land as well of other resources such as household labor. When duration depends on manifesting a high labor to land endowment ratio, the incentives are to forego off-farm income opportunities, thereby reducing household income.

Finally, the issue of *assurance* is key to the argument of tenure security. Both national laws and community regulations are meaningless in defining and assigning land rights unless these are enforced. Disputes, conflicts, and lack of social recognition of rights claimed by a farmer obviously imply weak tenure security. Moreover, disputes and conflicts are costly to manage and reduce resources available for productive investments.

Typically two options are available to a society. One is to enforce rights privately. This can be socially inefficient if lack of coordination leads to over-investing in enforcement (see de Meza and Gould, 1992). The other is to entrust the enforcement of rights to the government or some recognized entity. The reason for doing so being that law enforcement is a clear case of a public good. Motivation for doing so may lie in the fact that there are economies of scale that can be achieved by assuring rights at the collective rather than individual level. The threat of sanctions against violators may be more effective (although maybe less credible) if delivered at the community level rather than individually. Where enforcement of rights is costly to deliver, individuals may still

prefer to enforce privately their rights (e.g. by raising fences around a field with improved pasture).

### 2.3. Tenure security in Mexico's ejidos

On the basis of the previous discussion, the question arises regarding the extent to which tenure is insecure in the context of Mexico's ejidos and in which respects has the *Procede* affected the breadth, the duration, and the assurance of land rights. The discussion in section 2.2 will allow us to better understand the changes introduced by the 1992 reforms in Mexico's ejidos. A review of the main legal changes and of their effective reception by the ejidatarios will help us to better understand the sense of using a number of variables that reflect different aspects of the ejidos land rights in the empirical analysis of chapters 4 to 6.

First of all, we should remark the great change that the 1992 reform brought in terms of the juridical autonomy of the ejidos from the political control of the State<sup>18</sup>. In addition, ejidos as such cannot interfere with the individual decisions over the use of individual lands. These two aspects are the cornerstones of the new set of rights that the 1992 reform has 'enshrined' upon the ejidatarios.

Use rights are now completely liberalized. Ejidatarios can freely hire on-farm labor. Notice that before the reform ejidatarios in fact evaded these restrictions. So doing involved bribes, reciprocal favors, and risks, all of which altered the shadow price of labor and therefore its efficient use.

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<sup>18</sup> By juridical autonomy, we mean that ejidos were recognized as an entity entitled with rights and obligations towards the state and their individual members. The ejido commissioners are the representatives of the ejido in front of the State.



Transfer rights have been increased with the reforms to the advantage of both the single ejidatario as well as to that of the ejido as a whole. Land rental is completely liberalized and can be undertaken also with non-ejidatarios or with farmers that are members of other ejidos. The right to sell the land is recognized by the law. While it is limited in the sense that the ejidatario cannot sell the land to outsiders and must give the right of purchase first to his family members, now ejidatarios can ask the assembly to be granted the status of *dominio pleno*, becoming to all effects private farmers<sup>19</sup>. The same type of limitation arises from the legal requirement of inheriting the land to one son only (a limitation of permanent transfer rights). Again, the restriction is removed once the ejidatario becomes a private farmer.

Communal lands, where they exist, are regulated differently. First of all, the ejido assembly has the say over their uses. The ejido is entrusted with rights of use and transfer, the latter limited to land rentals. In fact, the ejido has more than simple rights to rent communal lands. These lands can now be conferred as capital in joint ventures that can involve private firms or any type of outsider. Typical cases are joint ventures for the exploitation of forests and woods, or livestock grazing on common lands. More importantly, ejidatarios now have the right of converting the use of communal lands by assigning these permanently to individuals. Before the reforms, communal lands were often used as a source of land for distribution to the new generations. Yet, mere possession of communal lands lacked any formal right and tenure insecurity could be substantial for the holders. The implementation of the Procede now formally provides the community with the right to reassign lands into new uses and to certify the claims that emerge as a result. Previously distributed communal lands have therefore been titled and

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<sup>19</sup> Yet, acquiring the status of private farmer implies losing the entitlement to access common lands.

certified as ejido lands and their possessors recognized as ejidatarios. In the future, further redistributions can take place, the difference being that Procede would not be expected to newly undertake the measurement and registration of ejido lands. This means implicitly that either the ejidos will pay for these services, or that new redistributions of common lands will go unregistered, further contributing to the ‘erosion’ of the cadastre produced by the Procede.

The duration of the newly acquired rights is now unlimited, except for the case in which land is abandoned and left uncultivated for six years or more and is then claimed by a new holder.

Assurance of rights is likely to be the key challenge that the new agrarian system faces in Mexico. As discussed in chapter one, the 1992 reforms aimed at creating a system of institutions that would implement and support the newly defined land rights. Agrarian courts, the Agrarian attorney, and the National Agrarian Registry were geared towards the creation of a system of agrarian justice that would provide lawful assurance of rights. As Zepeda (2000) points out, the system of agrarian justice is becoming increasingly overloaded with the result that disputes are becoming increasingly difficult to solve within a reasonable amount of time.

It is against this background that the relevance of the Procede needs to be assessed. The Procede was not only a certification program that would register measure and certify land rights. The Procede was also intended to bring to an end disputes and conflicts over land in a democratic and participatory way, allowing at the same time the new system of agrarian justice to start with the right foot. Through its *modus operandi* the Procede was supposed to actually implement the spirit of the 1992 reforms in the field.

Mutual recognitions of rights, resolution of border disputes, measurement of land, and formal recognition of the rights of *avecindados* and *posesionarios* went hand in hand with the dissemination of the provisions of the 1992 reforms, including the new system of agrarian justice and the end of the process of land distribution as mean of redistributing land in Mexico.

In closing this section, we need to spend few words concerning *posesionarios* (permanent holders without ownership) and *avecindados*. The former have a recognized right to use the land they operate, less clear being their right to temporarily transfer it. In addition, *posesionarios* do not have an automatic right to access common lands. The Agrarian Law, when mentioning the right to sell the land, refers only to *ejidatarios*, not to *posesionarios*. Legally, these live in a sort of limbo so that the extent of their rights is ultimately dependent on the practices and understandings prevailing within the communities in which they reside. *Avecindados*, in addition to having been awarded the right to decide over the administration of the urban area of the ejido, are allowed to purchase and rent ejido parceled land and are also granted the right to use communal lands.

Throughout the analysis, we shall refer to a *Procede* dummy that will signal the completion of the program in a given community. Intuitively, that dummy is assumed to imply that in certified communities (i.e. communities that have completed the *Procede*) tenure is more secure. How legitimate is the use of such indicator rather than recourse to alternative forms of indexing tenure security?

Where land rights are complex (i.e. the bundle of rights is quite extended) and where substantial variation in terms of rights exists among different populations, it might

make sense to look for alternative operative notions of tenure security. In a series of important studies on indigenous land tenure in Africa (reported in Bruce and Migot-Adholla, 1994; see also Place and Hazell, 1993), it was sought to determine the strength of rights to land by ordering these hierarchically according to the holder's ability in circulating such rights so that for example transfer rights were regarded as superior to the rights of use. Among transfer rights, rights to permanently transfer land were considered stronger relative to the rights of temporal transfer. In turn, permanent transfer rights were arranged in order of increasing strength as right to bequeath, the right to give, and the right to sell. This lexicographic ordering allowed defining three broad and mutually exclusive categories of rights: *complete* transfer rights (which allow the operator to sell the land), *partial* transfer rights (which select those that can receive the land upon bequest or gift) and *limited* transfer rights (which include all the rest).

The data we use does not allow this type of approach. But in the case of Mexico, it is doubtful that the approach would be superior to the one of using a dummy to signal more security in tenure. Mexico is indeed a complex society and a mosaic of many different ethnic groups. But the variation of individual land rights is not comparable to the one existing in sub-Saharan Africa. Seventy years of centrally based agrarian reform have created a situation where uniformly defined legal land rights are matched by community-specific divergences in terms of effective rights that are not too wide. Nevertheless, there are some differences that need to be accounted for in the analysis. First, indigenous communities need to be distinguished from the rest of the ejidos. This distinction in the end is predictable on the basis of the Procede indicator because indigenous communities were intentionally excluded from the Procede until the end of

1997. Second, ejidatarios often own bundles of rights under different type of tenure. Private land, ejido land, and communal lands can be owned or possessed simultaneously by a given ejidatario. As different types of tenure involve a different degree of security or bundle of rights, it makes sense to account for their presence.

#### 2.4. The literature on the economics of land titling: channels and welfare impacts

While the reduction of land-related conflicts and disputes is a measure of the success of the Procede, from an economic point of view the question is quite different. What does then the theory predict to be the welfare impact of land titles and registration, when tenure insecurity is indeed a constraint?

To see how this question has been addressed in the literature, we begin by distinguishing short from long-term effects. Both type of effects have distributive implications, which in some circumstances might be non trivial. The impact on land rental markets, which is our ultimate interest, is treated as part of the former set of effects.

Long-term effects of titling programs are mainly two. First, by reinforcing tenure security, titles enhance the incentives to invest in land related improvements. Second, titles allow land to become a better collateral for accessing credit. The latter effect is itself a manifestation of tenure security but to be meaningful it needs a legal system effectively backing transfer rights. Tenure security without transfer rights, or even with limited transfer rights, will not generally result into the use of land as a collateral.

Two of the first studies to measure rigorously the impact of land titles on investment, access to credit, and farm productivity were those by Feder et al. (1988) and

Feder and Onchan (1987). Examining the different performance of Thai farmers with titled land and farmers squatting on lands in forest reserves, the studies were able to assess how tenure security had contributed to a higher rate of investment on titled lands. It was found that land titles eased access to institutional farm credit. The higher level of land-attached capital had a positive effect, through complementarity relationships, on the demand for commercial inputs that were more accessible by titled farmers as a result of easier access to credit. Overall, the combination of these effects was to raise farm productivity, in turn leading to higher social land values, once distortionary effects of subsidies on credit were controlled for. Moreover, the study showed that the price of untitled land was below its social value as tenure insecurity commanded a discount in order for land to be purchased by risk averse farmers. Overall, the cost of titling land was amply compensated by substantial social benefits.

Since the Thai studies reported above, a sizeable amount of research has investigated the relationship between investment and tenure security and/or land titles. In an important paper, Besley (1995) argued that there were three main channels through which tenure security would raise the marginal productivity of land-attached capital<sup>20</sup>. First, tenure insecurity acts analogously as a depreciation factor that is taken into account by the farmer when discounting the flow of returns from a given investment. Second, tenure security increases the size of the land sales market (but one could apply the reasoning to the land rental market) and therefore raises the expected reward from improving the quality of land if the latter is reflected in a higher price of land (or rent). Thirdly, tenure security allows land to be used as a collateral for commercial or

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<sup>20</sup> This is different from the issue of marginal productivity of commercial inputs that arises once land attached capital accumulates as a result of improved tenure security.

institutional credit. One of the key findings is that tenure security may in fact be endogenous with respect to investment. In other words, investing in land-attached capital may in some societies (e.g. cocoa trees in the forest zone of Ghana) actually be a way of reinforcing security of land rights recognized by custom. With respect to titling programs, there are two important implications deriving from Besley's study (which was not evaluating titling programs but only comparing different systems of customary land rights). First, the link between tenure insecurity and investment incentives needs to be clearly identified before arguing that a titling program will increase farm productivity through its investment effect. For that purpose, it is important to have a correct assessment of whether existing local customary land rights are enough to ensure that investment incentives are in place. Second, the activation of the land market may be the key channel through which titling, by improving tenure security, may exert its strongest effect on the incentives to invest. Again, the source of tenure insecurity needs to be clearly identified by referring to which sub-bundles of land rights are weak. Tenure insecurity may arise only when land is supplied to the market and may not be an issue otherwise. In that case, insecurity does not act so much as a discount factor. Instead, it is the lack of the opportunity to supply in the future the land to the market and reap the benefits of previous investment that may in fact depress the incentive to invest.

Further studies that have found a strong relationship between tenure security and investment are those by Hayes *et al.*(1997) in Gambia, and more recently Brasselle *et al* (2002) on Burkina Faso. These studies, together with that of Place and Hazell (1993) and Migot-Adholla *et al.*(1994), reinforce the previous findings by Migot-Adholla *et al.* (1993) and Besley (1995) on the relationship between tenure security and investment in

sub-Saharan countries. In these societies existing customary land rights are enough strong and able to manage the actual demographic pressure on land. Thus, investment incentives do not seem to be overly affected by lack of clearly defined and legally backed property rights. In those societies, land titling will not generate major benefits in terms of increased investment and higher farm productivity (see Firmin-Sellers and Sellers, 1999). In addition, credit markets may still be too underdeveloped for land titles to make any difference in terms of access to credit. Given the high costs typically involved with land titling programs, it might be preferable to postpone them and employ instead those resources in other more socially relevant policies. As an alternative to individual titling, programs that would focus on group titling (i.e. a formal recognition of common property) may be preferable. This consideration is reinforced by the fact that where individual titling is introduced into areas where communal lands are important and different bundles of rights held by more than one person coexist on the same land, conflicts and social tensions may increase rather than diminish (Atwood, 1990). Exceptions are of course represented by those situations where population pressure has presently achieved such a high level that conflicts over land are becoming endemic, to the point of threatening social stability. The latter is the case considered by André and Platteau (1998) in the case of Rwanda.

Recent work by Alston *et al.* (1996) on the frontier of the Brazilian Amazon region shows that land titling has had a significant effect on farm investment and has increased the price of land. The authors confirm their hypothesis that the impact of secure property rights through titling will be stronger the nearer the farm land to major urban areas. This inverse relationship between the value of land titles and distance from major



urban areas can be imputed to the lower cost of enforcing land rights as backed by formal titles when land is located near administrative centers, the increased commercial value of agricultural land located near markets, and the higher costs of private enforcement of individual rights which are caused by the higher intensity of conflicts and disputes, these in turn being a function of the value of land. We shall refer to this study when looking at the 'certification path' followed by the bureaucracy implementing the Procede program in their selection of the ejidos to be approached for registration.

Besides its effect on the investment incentive, titles may affect the composition of capital assets, especially the mix between attached and non-attached capital. In a recent study on land titles in Paraguay, Carter and Olinto (2003) have investigated the issue in an environment where small farmers are constrained in their access to formal credit. Farmers that do not experience an improved access to credit may reduce their investment in movable capital in order to finance their increased demand for land-attached capital. On the other hand, large farmers that fully benefit from the credit effect of land titles may adjust their capital portfolio fully. The bottom line is that the credit effect may take place only to the advantage of large farms in a context characterized by substantial inequality in land holdings. Land titles may in fact accentuate that inequality. The study, though, does not estimate the impact of changes of the capital mix on farm productivity so that it is difficult in the end to separate the level effect attributable to more investment from the composition effect due to the internal adjustment of capital among its attached and non attached components.

The efficiency effect of changes in capital mixes is analyzed more in detail by Deininger and Chamorro (2002) in the case of Nicaragua. A key finding of the study is

that the marginal returns of land-attached capital assets and other assets (i.e. machinery and livestock) differ systematically. Thus, land titling in Nicaragua will have the effect of (a) raising farm productivity in the long run both by raising the mean level of investment, which will include investment in both attached and non attached capital; and (b) by favoring the adjustment in the mix of the two types of assets. The authors also find a significant impact of formal titles on the value of the land. The titling program undertaken in Nicaragua had a substantial payoff as it focused mostly on those areas where tenure insecurity was greatest and where the returns to titles would have been highest (as in fact it proved to be).

The extent to which access to credit may be facilitated by holding a clearly defined title is indeed a central question in the economics of land titling. Often the accent has been placed on the ability of accessing long-term credits that would in turn facilitate investment in lumpy and sizeable investments. Yet, one aspect often overlooked is the importance of accessing short-term credit in affecting the ability of liquidity constrained farmers to finance long term investments, independently from long-term credit or land related investment. Typically, (e.g. Feder et al., 1988) increased use of commercial inputs is expected to follow from their higher marginal productivity as caused by the higher level of capital that land titles bring about over the long-run through investment. In fact, when commercial inputs are on average restricted by liquidity constraints, the impact of land titles on their use may be substantial, provided that institutional lenders are more prone to accept titled land as a collateral. Moreover, the ability to raise steadily average net household revenues allows cash constrained farmers to self-finance farm investment. Thus, it may very well be that investment follows a higher adoption of commercial inputs

rather than having commercial inputs adoption follow land-attached investments as implied by Feder et al (1988).

Even where no additional investment was to materialize, the benefits may be substantial in terms of household income and higher farm productivity. This is a central result in a study by Lopez (1996) on the impact of land titles in Honduras. The results of that study show that (a) land titling had on average a strong and positive effect on relaxing liquidity constraints, in turn allowing farmers to increase their allocative efficiency<sup>21</sup>; and (b) higher farm income did not translate one to one into higher *household* income. This is a key aspect of the analysis that is lacking in most studies evaluating the welfare impact of land titling or land rights. The reason for linking farm income *per capita* (and not farm income per hectare as a land productivity approach would suggest) lies in the diversification of income sources that rural households normally achieve. If land titles increase the marginal return to on-farm labor, this implies an internal reallocation of household labor towards on-farm activities. The reallocation of labor endowment across on farm and off-farm activities implies that it would be erroneous to take farm income as the measure of the welfare impact of land titles. This observation raises the issue of which indicator is the one that matters when evaluating the impact of farm programs. Looking at the literature one has the feeling that the concern with farm productivity has somewhat obscured the importance of land titling programs, which is not that of raising yields or farm productivity per se, but instead that of raising household welfare, independently of whether the latter comes from farming or off-farm activities.

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<sup>21</sup> The impact on farm income through investment was positive but did not represent the major channel through which benefits materialized. Overall, Lopez estimates the rate of return of the titling project in Honduras as roughly 17%.

The consideration that titles may favor a structural reallocation of household labor among on and off-farm activities suggests yet another route through which a higher use of commercial inputs may be induced by more tenure security. A situation of that kind would occur in those instances in which family labor migrates and production techniques become more capital intensive as a result<sup>22</sup>. Under which conditions would a demand led credit effect arise? When tenure insecurity is mitigated by the amount of land per family labor, titling of land rights might give rise to such type of event. There are various examples of countries where land policies may deeply affect the allocation of labor across activities. In China and Ethiopia assignation of communal lands is based on family needs (e.g. Ethiopia). But pre 1992 reform Mexico also offers a good example as often competition for land within the ejidos was based on the size of the family. The absence of studies on the impact of land titles on farm households' labor supply is quite striking.

The distributive impact of land titles has been a subject of concern in many studies and words of caution have been raised in that respect. One argument is that land titling may exacerbate inequality by facilitating distress sales of land or by lowering the cost of exiting farming (e.g. the case of exclusionary agro-export booms discussed in Carter and Mesbah, 1993; and Carter and Barham, 1996). The argument though is weakened by the fact that distress land sales occur also in the absence of titles, and perhaps to an even greater disadvantage of the seller. In fact the ability of using land as a collateral once titled may offer better prospects for relying on consumption credit to smooth income shocks. But even if the argument were fully valid, if titles raise land

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<sup>22</sup> For this to happen it would also be necessary for failure in the labor market to exist. Monitoring costs and imperfect substitutability of family with hired labor may be one source of such failure. Alternatively, that failure would also arise when the disutility of farm labor differs from that of off-farm labor (see Lopez, 1986).

values farmers selling for distress may actually reduce their losses by selling at a higher price.

The distress sale argument is similar to the one that holds that in dualistic agrarian systems small holders face a competitive gap with respect to larger and more commercially oriented farmers and that in the end they will sell their lands, thereby increasing land ownership concentration. This case may be typical of agro-export booms, when land values can increase substantially (again Carter and Mesbah, 1993; and Carter and Barham, 1996). Yet, by taking advantage of high land values small farmers may actually be benefiting from land titles by being able to exit farming at a moment of high prices<sup>23</sup>. Of course, it is difficult to state that this is an undesirable effect if no information is provided regarding the welfare of the household after exiting farming. Moreover, agro-export booms typically spur investment in local processing and packaging of fruits and vegetables. Thus local off-farm labor markets tend to develop and offer considerable opportunities to be employed on a more stable basis. If this is correct, one should not be surprised to observe the exit from farming of many small producers.

A serious concern raised by some authors (e.g. Atwood, 1990, and Firmin-Sellers and Sellers, 1999) regards the possibility that in communities undergoing titling programs those with more power or better connections might benefit, especially by being able to consolidate holdings previously appropriated illegally. This is especially risky in the case of societies where substantial inequality exist from the outset, where vast extensions of lands are under communal tenure, or where civil conflicts have led to expulsion of households from large tracts of lands (e.g. Colombia during the last decade). Where

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<sup>23</sup> According to Carter and Barham (1996), in Chile's Central Valley the value of land rose to the level of that of California as a consequence of the fruit boom of the eighties.

corruption is rampant, this may be especially problematic. Tilting programs may in those cases lead to social tensions and disruptions and therefore increase rather than reduce tenure security.

Finally, where titling programs are *voluntary* and available on a fee basis, better-off farmers are able to reap the benefits of land titles (e.g. easier access to credit) while small poor farmers continue to be excluded and perpetuate their lack of security. Over the long run, this may generate an increasing differentiation within the farm sector (or the farming areas targeted by the voluntary program). Thus, it is often argued that mandatory titling programs may be more ‘just’ by leveling the field among farmers independently of their ability to pay. Nevertheless, mandatory programs have an important drawback in that some beneficiaries do not value the importance of titles (i.e. their willingness to pay is low even in absence of liquidity constraints). A weak latent demand for stronger tenure security is often revealed *ex post* by the fact that transactions of titled land go unrecorded. As a result, the initial investment incurred in setting up the program and registering titles is lost within one or two decades.

#### 2.5. Land titles, land markets, and the allocation of household labor.

In spite of the many titling programs that have been implemented worldwide and of the importance of land rental markets in potentially favoring the access to land by small farmers (besides improving efficiency in production), very few studies have looked at the relationship between the two. Recently, Deininger et al. (2003) have found evidence that land titles in Nicaragua have contributed to improving the functioning of land rental markets by reassigning land from large and low-productivity farmers to small

and high-productivity farmers. Interestingly, the authors find that land titles have had a very little impact on the functioning of land sales markets and that these continue to transfer land from small to large farms. This direction of land transfers may have a social negative impact given the recognized higher productivity of small farms in the Nicaraguan context<sup>24</sup>. Thus, by activating land rental markets, land titles have both an efficiency effect (e.g. raise total net revenues from the agricultural sector) as well as a pro poor effect by increasing the volume of land on the rental market and facilitating the access by small farmers.

The paper by Carter and Yao is an important contribution in the effort of modeling the relationship between tenure security and land rental markets in developing countries. In their paper, Carter and Yao (2002) have investigated how village-level reforms affecting tenure security in China have improved farm efficiency. The authors, posit that tenure insecurity translates into transaction costs, thereby reducing the effective land rents, so that nominal rents are below effective rents for those leasing land in and above for those leasing land out. This gives rise to three rental regimes: rental in, rental out, and autarky. The autarky regime is therefore plagued by two market failures, while the other two regimes are affected only by the labor market failure. The paper tests, and finds positive evidence for, the hypothesis that more tenure security reduces transaction costs, favoring the participation in land rental markets by small and large farms<sup>25</sup>. In addition, it is claimed that traditional tests of separation between production factor ratios

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<sup>24</sup> The latter is measured by per hectare net farm revenues, reflecting private rather than social benefits. See Binswanger et al. (1995) regarding the importance of distinguishing between private and social returns when testing for an inverse farm size productivity relationship.

<sup>25</sup> Of course farm size is intended as conditional on a suitable way of normalizing absolute values.

and factor endowment ratios<sup>26</sup> fail to take into account the discontinuity that exists in the relationship between the product and factor ratios. In other words, when failing to separate different regimes, separation tests may give a wrong answer in that efficient and inefficient (in the allocative sense) producers are mixed together.

Along the same line, an interesting study is that by Olinto (1999), which focuses on Mexican ejidos and applies a friction model to the same set of data we use in this research. Two land rental models are estimated in this paper and we spell the basic equations out in order to better understand the analysis we shall undertake in chapter 5. In his first model, Olinto estimates the relationship between farm size and landholdings controlling for other determinants. The key relationship analyzed empirically is given by:

$$(2.1) A_{it} = A(N_{it}, T_{it}; \theta)$$

where  $A_{it}$  is the hectares of land cultivated by farm  $i$  at time  $t$ ,  $N_{it}$  is the size of the household,  $T_{it}$  is the size of landholdings, and  $\theta$  is a vector of relevant parameters (e.g. dependency ratio, Procampo participation, etc.). According to Feder (1985), if technology exhibits constant returns to scale, family and hired labor are imperfect substitutes, and all other factor markets are perfect, there should be no relationship between farm size and landholdings. Olinto tests this relationship assuming that the Procede affects such relationship. He finds that the Procede has reduced the dependence of farm size from cultivated land, significantly but not by a great amount.

The second model estimated by Olinto follows Skoufias (1995), and attempts measuring the impact of the Procede on the minimum size of land transacted on the market. The model estimated is:

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<sup>26</sup> The independence between production factor ratios and endowment factor ratios occurs when less than two markets are failing (Feder, 1985).



$$(2.2) N_{it} = N_{it}^* = \pi X_{it} + u_{it} \text{ if } N_{it}^* < -\alpha \text{ or } N_{it}^* > \alpha$$

$$N_{it} = 0 \text{ otherwise}$$

where  $N_{it}$  is the effective net land rental (positive is land is rented in, negative if land is rented out),  $N^*$  is the desired amount of net land rentals,  $X_{it}$  is a vector of determinants, including landholdings and the Procede dummy, that influence net land rental decisions, and  $\alpha$  represents a threshold level above which if its sign is negative and below which is its sign is positive no rental takes place. In other words, it represents transaction costs that create an inaction range in the relationship between land rental and transaction costs. Olinto models such threshold as a function of a 1997 year dummy. Having a panel of households, he assumes that between 1994 and 1997 land rental markets have become more fluid. The analysis confirms that transaction costs appear to be lower in 1997, but fails to find evidence of an impact of the Procede on the size of land rental decisions. In addition, a positive association (0.2 hectares of net land rental for a change of one hectare in landholdings) exists between net land rentals and the size of landholdings.

Two aspects need to be underlined with respect to these results. First, both models implicitly assume that the relationship between renting out land and landholdings is symmetric to that between renting land in and holdings. By forcing this symmetry into the data, both models are likely to generate biased results on both accounts. Thus, it would be advisable to estimate renting in and renting out decisions separately as asymmetry is likely to be the typical case. Second, transaction costs are modeled as a function of time only and not as determined by household and village level characteristics, including the Procede. In fact, it is likely that both fixed and variable transaction costs influence both fixed transaction costs (which affect participation

decisions) as well as proportional transaction costs (which affect the size of the transaction, given participation). The empirical work in chapter 5 will attempt to address these issues.

With respect to the impact of land titles on labor markets and household labor allocation decisions, to the knowledge of the author there is only one study that has attempted to investigate the issue explicitly.<sup>27</sup> In an interesting and unfortunately very little known paper, Scott (1996) examines in the Chilean context the importance of property rights failure for the supply of household labor to non-farm activities. Among Chilean small farmers, many have inherited lands that have not been formally split among heirs, leading often to disputes over borders. Lack of agreement and the cost of disputes generate transaction costs that make land less productive. This effect will lower the return to on-farm labor. On the other hand, the ‘Lockean’ argument that property rights are legitimated through the occupation and exploitation of land. In turn, this argument suggests that labor will be allocated to on-farm labor beyond the point in which the value of the marginal return to labor is equal to the wage rate of hired labor, even where family and hired labor are perfect substitutes.

Scott pushes his analysis one step further. He asks how the size of landholdings might affect the impact of insecure land rights on the supply of labor to non-farm activities. On one side, he argues, disputes will be more intense when landholdings are larger as more will be at stake per each dispute. This will lead to less off-farm employment. On the other side, land has an important informal insurance component as an asset that produces food for poor households that face imperfect credit and formal

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<sup>27</sup> The existence of Scott’s article came to my attention as a reference in Cox Edwards (2001). It was only in December 2003 that I could get hold of Dr. Scott and receive a copy of his paper.

insurance markets. The value of this insurance, its premium, will decline as the size of landholdings declines. Thus, fuzzy property rights will affect the risk of losing the insurance represented by land less as the amount of landholdings becomes large.

The empirical analysis concludes that the Lockean argument dominates the transaction costs argument. In addition, the larger the landholdings, the lower the implicit insurance premium, and the smaller the impact of fuzzy land rights on the supply of labor to off-farm activities. These conclusions are much in line with what will be found in the case of Mexico and represent an important finding from the point of view of land administration and rural development policies.

## 2.6. Conclusions and contributions of the present study

This chapter started by defining tenure security and by articulating a series of concepts that could help us in deciphering what the status of tenure security could be in Mexico. The conclusion is that from a legal point of view tenure security in many ejidos is now much stronger as a result of the 1992 reforms. In practice, the Procede has facilitated the ‘delivery’ of the contents of the reform. The program has certified and titled land that embodies a series of rights that is broader than what existed before the reform.

After that we have looked at how the literature on the economics of land titling has analyzed the impact of land titles and tenure security on farm productivity and household income. We concluded that in spite of its importance, the impact of titles on land markets, in particular land rental markets, has received much less attention than it deserves. Land rental markets may be a good point of entrance into what is often termed

the tenancy ladder. In addition, as discussed in section 2.2, land rental markets permit a wider range of production decisions, increasing the shadow value of land-attached capital when future returns from farming are uncertain. Finally, active land rental markets may help building a price discovery dynamics by which the speculative nature of land sales markets may become more evident and easier to limit via competitive pressure<sup>28</sup>.

Substitution between rental and purchase options may in fact help in limiting the increase in land prices that may originate from non-productive considerations (e.g. inflationary pressures, tax evasions, etc).

Whether land rental markets and off-farm labor supply are indeed important channels through which land titles may lead to higher farm productivity and household income is in the end an empirical issue and depends very much on the specific social and cultural traits that vary from one context to the other. The case of Mexico, and of the ejido sector in particular, is important in view of the integration of the country's agriculture with that of the USA and Canada via NAFTA. Adjustments in farm size will likely follow the competitive pressure that the grains sector is facing in Mexico nowadays. Small inefficient producers are likely to face increased pressure to exit agriculture, at least partially, unless appropriate institutions and policies are found to circumvent the disadvantage that these farmers face in accessing credit and commercial input markets. The high share of household income that small farms derive from off-farm employment (see table 1.13) is a sign that the process of exiting farming is already under way, albeit very gradually.

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<sup>28</sup> Ideally, while land prices may reflect both a productivity and a speculative component, land rents are likely to reflect only the productivity one.

The case of the Procede is an interesting example of a decentralized and participatory land regularization program. Its lessons, in terms of activation of land markets and impact on household labor allocation decisions is important also because of the dual system of land tenure that characterizes many ejidos endowed with communal lands. Has the Procede given rise to a process of differentiation that will favor the emergence of more efficient farmers? In view of the paucity of studies that have addressed such question we believe that the present study can offer a contribution of interest.

Two welfare indices have been used in judging the effectiveness of land titling programs: farm productivity and household income. We shall mainly look at the latter, although results on net farm income will allow inferring conclusions about the former. Both indices have their own merit, although the former is more narrowly sector-focused while the latter brings into consideration the trade-off that might exist between farm and off-farm activities.

The study will not look into the impact of land titles on access to credit nor will it examine their impact on investment. First, credit markets in Mexico were undergoing significant changes during the years spanned by our data. Liquidity constraints were severe and only in part relaxed by the Procampo program that took off in 1994. But the key point is that institutional lenders were barred from requiring ejido land as a collateral, even if titled. For these two reasons there is no reason to expect that the Procede has had any impact on access to credit.

Second to properly determine the impact of titles on investment one should rely on data that span at least a decade in order for adjustment in quasi-fixed inputs to have

taken place. Shorter time periods may be considered but only if an exceptional wave of investment has taken place as a result of titling and other reinforcing causes. This is not the case of Mexico agricultural sector. The severe liquidity constraints we just referred to, the “tequila” crisis and the high interest rates it brought, and a general uncertainty existing over the prospects of farming as a result of the progressive implementation of the Nafta agreements, were all factors that had a depressive impact on investment. The Alianza para el Campo program (see section 1.6) is likely to have revived investment, but our data set covers only one crop year since the launch of the program so that its effects do not show in the data yet. Under these conditions, the three-year period spanned by the ejido surveys does not lend itself to an analysis of the investment channel that has attracted so much attention in the literature.

Overall, the aim of this study is to produce better knowledge of what can be expected from the ejido sector in the process of agricultural modernization now occurring in Mexico. Land markets are central to such an effort in view of over seven decades of land reform and of the productivity gap that separates ejidatarios and private farmers. In addition, as poverty is mostly concentrated in the ejido sector, it is important to understand how adjustment in this sector will affect household incomes and farmland values.

## Chapter 3: The analytical framework.

### 3.1. Introduction

The analytical framework developed in this section underlies the empirical analysis of the remaining chapters. We want to examine how, on a theoretical basis, we expect Procede will affect land rentals and resource allocation decisions, in particular family labor. To better frame our focus in the context of the literature on land titling, it is useful to briefly refer to the structural and reduced form models outlined in Place and Hazell (1993). The conceptual framework includes four structural equations. For a household endowed with  $n$  parcels identified by the subscript  $i=1, \dots, n$ , let

$$(3.1) \quad C = f(X^h, X^s, S(P))$$

$$(3.2) \quad L_i = f(X^h, X^p, X^v, S_i(P), C)$$

$$(3.3) \quad I_i = f(X^h, X^p, X^v, S_i(P), C, L_i)$$

$$(3.4) \quad Y_i = f(X^h, X_i^p, X^v, L_i, I_i)$$

where  $C$  is the amount of credit used by the household,  $X^h$  is a vector of household characteristics,  $X^v$  is a vector of location dummies,  $X_i^p$  is a vector of parcel-specific characteristics,  $L_i$  are land improvements,  $I_i$  are inputs used on parcel  $i$ . Finally,  $S$  is an ‘aggregate’ indicator of the parcel-specific land rights  $S_i$ . To adapt this framework to the ejido case, we have made  $S$  and  $S_i$  a function of  $P$ , which denotes adoption of the Procede on the (to be tested) assumption that land titles strengthen land rights. The reduced form of the system of equations 3.1-3.4 is given by<sup>29</sup>:

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<sup>29</sup> As in the ejido sector, the typical ejidatario owns (or possesses) land of the same type of tenure, we have that  $S_i(P) = S(P) \forall i = 1, \dots, n$ .

$$(3.1') \quad C = f(X^h, X^v, S(P))$$

$$(3.2') \quad L_i = g(X^h, X_i^p, X^v, S(P))$$

$$(3.3') \quad I_i = g(X^h, X_i^p, X^v, S(P))$$

$$(3.4') \quad Y_i = g(X^h, X_i^p, X^v, S(P))$$

In chapter 2 we have summarized the empirical literature on the effects of land titling. As we saw, the empirical literature has focused mainly on equations 3.1'-3.4', with some studies examining a sub-set of these equations. The previous two systems of equations embody the implicit view that land titles are meaningful to study as a long-term phenomenon due to the hypothesis that land rights are a key determinant of land-attached investments and ultimately of land productivity. We complement that approach by examining three other relationships, mostly overlooked in the literature. In particular, we shall focus on the following set of reduced form equations:

$$(3.5') \quad N = g(X^h, X^v, X^p, S(P))$$

$$(3.6') \quad Y^j = g(X^h, X^v, X^p, S(P)); \quad j = f, n, o$$

$$(3.7') \quad H^j = g(X^h, X^v, X^p, S(P)); \quad j = n, o$$

where  $N$  stands for land rented (either rented in or out),  $Y^f$  is net farm income,  $Y^n$  is non-farm income, and  $Y^o$  is off-farm income,  $H^n$  is household labor allocated to non-farm income activities, and  $H^o$  is household labor allocated to off-farm activities. We are therefore interested in understanding whether ejido land markets have become more active as a result of the Procede, how the program has affected the allocation of household labor across activities, and how household income components have overall



been affected. The theoretical model outlined in the next section serves the purpose of giving more information on the relationships underlying functions 3.5' to 3.7'.

### 3.2. The effects of land titling on household income and labor allocation decisions.

Households are assumed to maximize net income, which is the sum of farm profits and income earned out of the farm. The latter type of income includes both income earned in local labor markets, mainly agricultural wages, and income earned in non-agricultural activities. The latter is assumed to involve some sort of seasonal migration whose costs are borne by the household and are a function of the amount of labor allocated.

Farm production technology is assumed to display constant returns to scale and is described by a linearly homogeneous and strictly concave function,  $F(B, l_f, l_h)$ , in which the three factors of production are farm land,  $B$ , family labor,  $l_f$ , and hired labor,  $l_h$ . It is assumed that family and hired labor cannot substitute perfectly for each other and are complements in production, i.e.,  $\frac{\partial^2 F}{\partial l_f \partial l_h} > 0$ . Including typical assumptions on marginal

returns to factors, the technology displays the following characteristics:  $\frac{\partial F}{\partial l_f} > 0$ ,

$\frac{\partial F}{\partial l_h} > 0$ ,  $\frac{\partial F}{\partial B} > 0$ ,  $\frac{\partial^2 F}{\partial l_f \partial l_h} > 0$ ,  $\frac{\partial^2 F}{\partial l_f^2} < 0$ ,  $\frac{\partial^2 F}{\partial l_h^2} < 0$ ,  $\frac{\partial^2 F}{\partial B^2} < 0$ . Various reasons have

been put forth to justify the assumption that family and hired labor do not enter in  $F(\dots)$  additively. For example, hired laborers may find it advantageous to supply less efficient labor than family members, the latter being residual claimants of farm profits. In the farm household literature more refined specifications of the production technology

have been proposed in order to capture the supervisory role of family labor and its impact on the efficiency of hired labor. Here we limit ourselves to the requirement that the two types of labor cannot be substituted perfectly for each other, i.e. their elasticity of substitution is less than infinite. The ejidatario's household is endowed with individual landholdings of size  $A_i$  and with household labor  $\bar{L}$ . Individually owned land can be either farmed directly or hired out ( $H^o$ ). Land can be also rented in ( $H^l$ ) so as to increase farm size. The size of the farm is therefore equal to  $B_i = A_i + H_i^i - H_i^o$ . Total farm profits are then equal to:  $Y = F(B; l_f, l_h) - wl_h + rH^o - rH^l$ , where  $w$  is the wage rate and  $r$  is the rental rate of land. Farmers take both  $w$  and  $r$  as given.

Ejidatarios face transaction costs related to tenure insecurity when entering the land market. Assuming that land titles do have an effect on land tenure security, it is postulated that these transaction costs are reduced if the Procede is adopted. It would be appropriate to assume that Procede's impact on tenure security is mediated by local community-specific factors. As argued in chapter 1, property and use rights of ejidatarios at the local level were quite different from those specified by the Law. Local customs and very unique cultures due to the country's ethnical heterogeneity implied that centrally defined rules of the game had to be adapted to the local conditions. When applied to land markets, these rules limit the degree of ownership that individuals exercise over their endowments. In fact, these rules often influence also the allocation of households' labor and livestock endowments. For simplicity, we assume that only land transactions are affected by village-level regulations. It is assumed that these limitations can be interpreted as proportional costs of transaction, so that at any ongoing land rental rates, the effective rent perceived by an ejidatario will be discounted by a factor  $\rho$ .

Transaction costs are typically assumed to reflect different types of frictions in market participation. Two classic examples would be search and bargaining costs resulting from participating into land rental markets, which can be thought of as costs of transaction that would occur in most villages. The size of the village and the strength of local institutions that help reduce the moral hazard attached to transactions<sup>30</sup> are all factors that influence the size of the transaction costs associated with land rentals. Tenure security may compound these factors, further increasing search and bargaining costs. Lack of precision in the measurement of the borders of a plot, or uncertainty over legitimate ownership of a plot may increase the screening process undertaken by farmers that want to rent some land out and are concerned with minimizing the risk of losing the rented plot or entering into a dispute over rights to that plot. If land titles in Mexico matter to tenure security, then one would expect that Procede, by reducing tenure insecurity would diminish the size of the transaction costs. A key point to underline is that while transaction costs are likely to affect the rental in of land as well as the rental out, we expect Procede to have a direct impact on such costs primarily on rental out decisions. Indirect impacts could in principle imply Procede to increase rental in decisions through market equilibrium effects, whereby stronger tenure security increases the supply of rental land on the market leading to a lower equilibrium rental rate. Yet, ejidatarios have the option of renting land in from neighboring private farmers. Depending on the supply elasticity of private land and on the elasticity of demand for

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<sup>30</sup> For example, benefits derived from renting a parcel of land might be perceived a long time after incurring into the rental costs, that is rental payment occurs after harvest. This is a dominant characteristics of land rental transactions in Mexico. Upfront payment may in fact signal that moral hazard is indeed an issue in Mexico's land markets.

land rentals for both ejidatarios and private farmers, an increase in the supply of ejido land might have an insignificant impact on the equilibrium rental rate of land.

Summarizing the above discussion, we assume that the transaction costs functions for leasing land out and in can be represented respectively as:  $TC^o = \rho^o(P, V_j)$  and  $TC^l = \rho^l(V_j)$  where  $P$  is a dummy variable equal to one if Procede has been adopted and completed, and  $V_j$  is a vector of village  $j$  characteristics that mediate the impact of the Procede and serve the function of representing the local rules regulating land transactions involving ejido lands. We therefore assume that due to the discrete change implied by the adoption of the Procede  $\rho^o(1, V_j) < \rho^o(0, V_j)$ . Below we shall nevertheless assume continuous derivatives to simplify the derivation of the results<sup>31</sup>.

To keep the derivation of key propositions simple, we avoid positing the existence of liquidity constraints. While liquidity constraints may be a real issue for many small farmers in Mexico, we abstract from their existence. Moreover, concerns over liquidity constraints might be alleviated by the fact that over 85% of the ejido farmers in our sample receive Procampo payments during the 1996/97 crop year. Nevertheless, the empirical analysis will control for ownership of key assets, besides land, which are likely to be good proxies for farmers' wealth.

Bringing together the various strands of the discussion, we posit that the ejidatario will maximize the net income of the household by choosing the optimal amount of land rented in and out,  $H_i^i, H_i^o$ , the amount of family labor allocated to on-farm labor,  $l_f$ , and

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<sup>31</sup> This is not too much of a restrictive assumption as in fact the impact of Procede will take place through increased tenure security and transaction costs depend more directly on tenure security than on the availability or not of land titles per se. Thus, receiving a title may have a different impact on tenure security depending on village characteristics. As tenure security can be conceived as a continuous variable indexed from 'no-security' to 'full security', resorting to continuous first derivatives of the transaction costs function may be quite appropriate.

implicitly that allocated to off-farm labor,  $l_o = \bar{L} - l_f$ . To account for the presence of costs of accessing off-farm labor markets, we assume that the income received from off-farm labor is a function of the amount of labor allocated to it<sup>32</sup>. Thus, we let off-farm income be determined by  $g(l_o)$ , with  $g' > 0$ ,  $g'' < 0$ .

We then have the following maximization problem:

$$(3.9) \quad \underset{H_i^o, H_i^i, l_f, l_h}{\text{Max}} \quad F(A + H^I - H^o, l_f, l_h) + g(l^o) - wl_h + [r - \rho^o(P, V_j)]H^o - [r + \rho^i(V_j)]H_i^i$$

s.t.

$$(i) \quad \bar{L} = l_f + l_h$$

$$(ii) \quad A \geq H^o$$

Substituting (i) and (ii) into the objective function, and assuming that land rental out will not drive the farmer out of production (i.e. ii holds as a strict inequality), we obtain the following Lagrangian:

$$(3.10) \quad L = F(A + H^I - H^o, l_f, l_h) + g(\bar{L} - l_f) - wl_h + [r - \rho^o(P, V)]H^o - [r + \rho^i(V)]H^I$$

Solving (3) with respect to  $l_f, l_h, H^o, H^I$  the following first order conditions hold at the maximum:

$$(3.11.i) \quad \frac{\partial F(B, l_f, l_h)}{\partial l_f} - \frac{\partial g}{\partial l_f} \leq 0; \quad l_f \geq 0; \quad \text{with c.s.}$$

$$(3.11.ii) \quad \frac{\partial F(B, l_f, l_h)}{\partial l_h} - w \leq 0; \quad l_h \geq 0 \text{ with c.s.}$$

$$(3.11.iii) \quad -\frac{\partial F(B, l_f, l_h)}{\partial H^o} + [r - \rho^o(P, V)] \leq 0; \quad H^o \geq 0; \quad \text{with c.s.}$$

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<sup>32</sup> See Sadoulet, de Janvry, and Benjamine for evidence on transaction costs to access off-farm labor markets in Mexico's rural areas.

$$(3.11.iv) \quad \frac{\partial F(B, l_f, l_h)}{\partial H^i} - [r + \rho^i(V)] \leq 0; \quad H^i \geq 0; \quad \text{with c.s.}$$

where c.s. stands for complementary slackness conditions. To simplify matters, we assume interior solutions for all choice variables so that the first-order conditions 3.11.i-iv hold with equality. We then notice that either land is leased in or is leased out or that no leasing takes place. That is, the above model does not allow for contemporaneous leasing in and out of endowed land. This observation, in turn, leads to the conclusion that ejidatarios, depending on their initial land endowments, and the specific conditions under which common land is appropriated, will fall into three possible rental regimes in the land market. Either they will rent land out, in which case 3.11.iii is the relevant FOC; or they will rent in, so that 3.11.iv is the relevant FOC. Alternatively, they will be autarkic farmers in the land market if the following condition holds at the maximum:

$$(3.12) \quad [r - \rho^o(P, V)] < F_B(A_i, l_h, l_f) < [r + \rho^i(P, V)]$$

This condition is very similar to the one in Carter and Yao (2002) and Deininger and Bresciani (2001), except for the appearance of the *Procede* variable in the transaction cost function.

We now turn to the derivation of the key results of comparative statics, more precisely those related to changes in tenure security ( $P$ ), land endowments ( $A$ ), and labor endowments ( $\bar{L}$ ).

The autarky regime (A):

When condition (3.12) holds, the relevant FOCs are given by 4i and ii:

$$F_{l_f} - g' = 0$$

$$F_{l_h} - w = 0$$

Exploiting Cramer's theorem the system is analyzed in order to derive the changes in the endogenous variables  $l_f$  and  $l_h$  with respect to changes in the parameters  $\bar{L}$  and  $A$ .

Infinitesimal changes in tenure security do not affect farmers initially in the autarky equilibrium. The following set of results is obtained:

$$A1: \frac{\partial l_f}{\partial A} \geq 0, \quad \frac{\partial l_f}{\partial \bar{L}} \geq 0$$

$$A2: \frac{\partial l_h}{\partial A} \geq 0, \quad \frac{\partial l_h}{\partial \bar{L}} \geq 0$$

Rental out regime (RO):

When the household rents out land, the following set of FOCs hold:

$$F_{l_f} - g' = 0$$

$$F_{l_h} - w = 0$$

$$-F_B + [r - \rho^o(P, V)] = 0$$

Total differentiation of the first order conditions yields the following system of equations:

$$\begin{bmatrix} F_{ff} + g'' & F_{fh} & -F_{fB} \\ F_{hf} & F_{hh} & -F_{hB} \\ -F_{Bf} & -F_{Bh} & F_{BB} \end{bmatrix} \begin{bmatrix} dl_f \\ dl_h \\ dH^o \end{bmatrix} = \begin{bmatrix} -F_{Bf} & g'' & 0 \\ -F_{Bh} & 0 & 0 \\ F_{BB} & 0 & \rho'(P) \end{bmatrix} \begin{bmatrix} dA \\ d\bar{L} \\ dP \end{bmatrix}$$

Applying Cramer's theorem one obtains the following set of results:

$$RO1: \frac{dl_f}{dA} = 0 \quad \frac{dl_f}{d\bar{L}} = 0 \quad \frac{dl_f}{dP} \leq 0$$

$$\text{RO2: } \frac{dl_h}{dA} = 0 \quad \frac{dl_h}{dL} = 0 \quad \frac{dl_h}{dP} \leq 0$$

$$\text{RO3: } \frac{dH^o}{dA} = 1 \quad \frac{dH^o}{dL} \leq 0 \quad \frac{dH^o}{dP} \geq 0$$

A few points are worth mentioning. First, in the rental out regime a farmer with a constant return to scale technology facing only one market failure (i.e. that related to labor), will determine its farm size independently from its land and labor endowments (see Feder, 1985). Thus, an increase in land endowments will be balanced by an equal increase in land rented out. In addition, the amount of family and hired labor employed on the farm will be independent of the household's labor and land endowments. Second, strengthening tenure security through the Procede will lead farmers to rent more land out or increase their incentives to participate into the land market if they were previously in autarky. In turn, this will lead to a reduction of family and hired labor employed on the farm and a contextual increase in the amount of family labor allocated to off-farm activities.

The latter is a key result with two implications. First, increased tenure security leads farm households to diversify their income sources by increasing their participation to off-farm income activities. Second, farm income may fall as a result of increased tenure security while income from off-farm sources will acquire a larger weight in total household income.

It is important to underline that the expression for  $\frac{dH^o}{dP}$  is a complicated function of  $A$ , the landholdings. Consequently, land may enter non-linearly in an equation in which the amount of land rented out is regressed on the size of landholdings. This point is



worth bearing in mind when discussing the specification of the rental regressions in chapter 5. More generally, the predictions obtained from this application of the basic model will be tested in chapters 5 and 6.

Rental in regime (RI):

In this regime, the relevant FOCs are given by:

$$F_f - g' = 0$$

$$F_h - w = 0$$

$$F_B - [r + \rho'(V)] = 0$$

The derivation of the comparative static results is similar to that followed in the case of the rental out regime, with the exception that the land tiles variable P does not appear in the transaction costs function. In fact, transaction costs are affected by land titles only when land is rented out. We therefore have that:

$$\text{RI1: } \frac{dl_f}{dA} = 0 \quad \frac{dl_f}{dL} = 0$$

$$\text{RI2: } \frac{dl_h}{dA} = 0 \quad \frac{dl_h}{dL} = 0$$

$$\text{RI3: } \frac{dH^i}{dA} = -1 \quad \frac{dH^i}{dL} = 0$$

### 3.3. Testable propositions and introduction to the empirical work

In examining the results A-RI, we note the following. First, land market participation is affected by the adoption of the Procède as both more land is rented in and

out. Thus, the size of the set of autarkic farmers shrinks. We therefore expect, *ceteris paribus*, more farmers to participate and more land being traded.

Second, as already noted by Carter and Yao (2002) in a different context, separability between production decisions and factor endowments does not hold in the case of autarkic farmers, while it does when farmers are either in the RO or RI regimes. This is not surprising in view of the fact that farmers participating in the land market are affected only by off-farm labor market imperfections. They are influenced by transaction costs in the land rental market, but once the size of the transaction costs per hectare of land rented out is given, farmers cannot influence the shadow price of land. Autarkic farmers, on the other hand, face both labor market imperfections as well as a shadow price of land that is inversely related with their land endowments. The result that separability is restored for land market participants means that improved land markets can lead to important efficiency gains if tenure security is increased and overall transaction costs are reduced<sup>33</sup>.

Turning to the empirical framework represented by equations 3.5-3.7, the above results suggest a number of testable hypotheses for the empirical work that follows:

1. Procede favors participation in the rental out land market and has a greater impact on the supply than on the demand of land rentals. In particular, Procede favors the participation of small ejidatarios in the rental in market.
2. Land titling through Procede will increase the importance of off-farm income sources in total household income;

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<sup>33</sup> The source of the efficiency gain lies in the fact that the optimal farm size is influenced only by parametrically given prices and not by endowments. Thus, land will be reallocated from less to more efficient farmers, thereby raising total agricultural profits.

3. The income-source effect will be larger especially among larger farmers as these are more likely to rent land out once tenure security improves;
4. Farm revenues may decline as land tenure security improves as a result of the Procede.

If confirmed empirically, these propositions provide new insights on the effects of land titling programs. Before going ahead with the econometric testing of these hypotheses, it is important to understand the nature of the process by which the Procede has been delivered to some ejidos and not to others and why some ejidos have decided to join the program while others have refused to do so. This is the focus of chapter 4.

## Chapter 4: Determinants and support of Procede's adoption.

### 4.1. Introduction

As we have discussed in chapter 1, the Procede was administered at the ejido and not at the household level. Yet, all households in a participating ejido would receive an individual title at the end of the process. Either all ejidatarios would be certified and titled or none would be. Moreover, as explained earlier in chapter 1, during its implementation in any given ejido the Procede required several intermediate votes by the ejidatarios in order for it to advance towards completion. A majority of ejidatarios assisting a given assembly was necessary for each stage to be approved and a majority was required for the summoned assembly to be valid. Thus, in principle a well-organized coalition of ejidatarios could in fact push the process through or stop it if it had enough members and discipline.

Thus, the dynamics of the Procede's adoption needs to be analyzed at the ejido level. The key questions we ask in this chapter are: (1) can the program's implementation be explained by some criteria based on ejido characteristics; and (2) was the program perceived differently by different groups of ejidatarios, and if yes which of these characteristics were the most influential ones. The first question is addressed in section 1 and is explored on the basis of the plausible motivations by the personnel of the Agrarian Attorney office (PA) and on the potential demand for tenure security by the ejidatarios and other groups of ejido members.

Understanding the dynamics of acceptance or rejection at the household level (question 2 above) is important in order to better assess the scope and impact of the

program. As the literature on land titling makes clear, voluntary programs, in which individual households may participate or not, will maximize the efficiency impact of land titles. On the other hand, they might increase the inequality in the distribution of farm income, as titled farms will attract more land-related investments and improve access to credit provided the institutional framework is the appropriate one. Compulsory titling, on the other hand, will minimize distributive effects, but will yield lower efficiency outcomes. The Procede is a titling program that combines the features of both voluntary and compulsory programs.

Section 2 will examine and discuss the key determinants of the process by which an ejido was involved in the process and by which ejidatarios accepted being involved. This interaction is phrased in terms of the supply of and demand for the program. Section 3 explains how we model empirically the process, while the following section presents the results of the analysis. Finally, section 5 considers the issue of which characteristics of the ejidatarios better explain their favorable or unfavorable attitude towards the program. While surely not a definite answer to the issue of the distributive impact of the Procede, the analysis of the opinion of the ejidatarios towards the program should help identifying groups of winners and losers within and among ejidos.

#### 4.2. Modeling the administration of the Procede

By the time the 1997 ejido survey had started, almost 50% of the ejidos had been certified by the Procede. Were certified ejidos chosen randomly? To answer this question, we need to look at the objective function of the bureaucracy entrusted with the

delivery of the program as well as the determinants of the program's rejection or acceptance by the ejidatarios.

The 'supply' of Procede: Before entering into the detail of whether the PA did in fact select ejidos according to some characteristics (that might have relevance in assessing the 'dynamic' efficiency of the program), it is worth pointing out few historical details. When the Procede was launched as part of the 1992 agrarian reform, the PA was given the main responsibility of administering the program. The PA was created in 1992 and began its operations in 1993. Personnel were hired early that year and given the importance attached by the government to the institution, hiring policies were aimed at setting up decentralized offices staffed with motivated *visitadores agrários*. These were the link between the PA's central administration and the ejidos and their function was to disseminate and implement in the field the new provisions of the 1992 reform among the ejidatarios. The PA offices were given brand new equipment and remunerations were generally high compared to other branches of the public administration. When the Procede was launched, the PA became the coordinator of the various strands of the public administration that were to be involved in the various aspects of the titling and certification process. Assistance by the INEGI was required in order to measure and produce maps. The *Registro Agrário Nacional* (National Agrarian Cadastre) was responsible for the delivery of the titles and their conservation. The resolution of conflicts was a responsibility of the newly reformed agrarian courts. In all instances, the coordinating role of the PA was essential. The Procede was then officially launched at beginning of 1993 but became operative only at the end of that year. Communal ejidos were excluded from the program until the end of 1996, as they would have required a

different type of organization in view of the different rules and customs governing these communities<sup>34</sup>.

The budget of the PA came to be largely dominated by the activities of the *Procede*. The staff charged with the execution of the program had an incentive to select ejidos. Bureaucrats of the P.A. faced two very basic objectives, namely (i) meet the centrally established annual quota of ejidos successfully certified and (ii) acquire *momentum*, advancing the program to a stage at which the likelihood of being continued even after the end of the Zedillo administration could be maximized<sup>35,36</sup>. The attainment of the latter objective could be measured both by the number of ejidos certified as well as by the share of ejido land certified<sup>37</sup>. Thus, ‘economies of scale’ could be achieved by targeting larger ejidos. In general, to achieve these two goals high speed in measurement and in conflict resolution were essential.

Given the size of the budget, the available personnel and the need to regularize and certify as many ejidos as possible within a given year, the issue of minimizing the cost and time length of certification per ejido was essential. Certification costs can be separated into (i) conflict resolution costs; (ii) measurement costs; and (iii) costs of administering the program, where the latter would include the cost of informing

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<sup>34</sup> Communal ejidos are included in the analysis that follows because the 1997 survey collected information on the participation to the program when some communal ejidos had already started the certification process.

<sup>35</sup> In other words, the P.A. faced a problem of survival and reproduction of its own structure. This is quite typical of bureaucracies.

<sup>36</sup> Evaluation of operations was organized both in terms of number of ejidos certified as well as the amount of land actually measured and titled. Nevertheless, the former criterion was considered to be more important (private communication with directing staff of the PA, 2000)

<sup>37</sup> It could be argued that these two indicators need not enter monotonically in a hypothetical function describing the probability that the program would be further financed. As a program reaches a certain threshold of successes in terms of ejidos certified and share of land certified, further advances may be perceived by policy makers as less necessary or beneficial and a preference may emerge to allocate the financial resources committed to the program to other newly created programs deemed socially more important. Yet, our analysis uses data from 1997, a year in which the program had barely reached 50% of all ejidos and had certified a share of ejido far less than that.

ejidatarios and the rest of the community about the benefits and implications of certification. Conflicts had to be solved for the program to be completed successfully within each ejido. Measurement was necessary for the issuing of tiles. Administration required managing relationships with ejidatarios at the field level and coordinating with other public agencies at the administrative level.

Conflict resolution costs are likely to be a major share of the total costs of a mandatory titling program. While resolution of conflicts over land rights can be left to the individual interested parties in the case of voluntary programs, this is not a possibility in the case of mandatory titling programs. The authority that certifies land entitlements and issues titles has to ensure that members of the community would accept as legitimate the emerging structure of land rights. As the Procede is voluntary at the ejido level, individual parties alone may resolve conflicts. Yet, given the potential interest of the community in being titled, one should expect the involvement of the community as a whole in the resolution of conflicts existing among a subset of its members. In this process, coordination among its members is required and this is precisely the type of assistance offered by the PA field staff. Solution of conflicts may involve long time periods, lengthy mediations, and the need to resort to agrarian courts. The cost per ejido of resolving conflicts will be a function of the number of conflicts as well as of the type of conflicts that characterizes a given community.

In the ejido context there are fundamentally three different types of conflicts. One category is that of conflicts related to rights over individual parcels. Typically these involve disputes over inheritances and the borders and rights of possession of the land endowments. We posit that the number of conflicts of this type in a given ejido will be a



function of the number of ejidatarios, posesionarios, and avecindados (i.e. landless and right-less ejido inhabitants) and of the value of the land. As the number of individuals with an interest in cultivating the land of an ejido increases, the number of conflicts is likely to rise on probabilistic terms, if nothing else because of the exponential increase in the density of relationships and interactions between members of a given 'network'. In addition, we assume that population density also plays a role in increasing the frequency of conflicts as competition for land increases monotonically with it.

The propensity to engage in a conflict over a tract of land will also be influenced by the value of that land, as any conflict is a costly activity (e.g. Alston, Libecap, and Mueller, 2002). We do not have good estimates of the average value of land in the sampled ejidos as land markets have until recently been black markets and with little circulation of land, so that it is difficult to talk about a process of 'price discovery' in such settings. Nevertheless, we assume that the value of land is related to the economic returns it yields. These returns will depend on the productive potential of land as well as on the potential to commercialize the crops produced. We use the value of yields per cultivated hectare and the distance to the nearest urban center as proxies respectively for the productive and farm income potential of land. As the PA will attempt to minimize conflict resolution costs it will contact first ejidos in which certification is likely to proceed smoothly. Thus, we hypothesize that ejidos will be 'offered' less Proceede the larger the number of beneficiaries, the nearest it is to an urban area, and the higher its productive potential. In addition, conflicts that are difficult to solve, such as those involving bordering ejido will deter the PA from approaching an ejido. Conflicts over common lands should also be seen as problematic and possibly deter the PA.

Measurement costs depend mostly on the topography of the location and on the length of borders that need to be identified and measured. The presence of an irregular landscape will complicate the identification of boundaries. Thus, ejidos located in highlands will be targeted later rather than sooner. In addition, ejidos with small average parcels and with larger common lands will be less attractive from the point of view of the PA.

Administrative costs include those costs related to the man-days spent by the PA in order to complete the various stages of the certification process (see chapter 1 for a description of the stages involved). It is assumed that the coordination costs are the most important type and that these will increase with the number of ejidatarios (not posesionarios and avecindados who cannot participate to the various assemblies required by the program), and with the distance of the ejido from the state capital, where the PA headquarters at the regional level are located. The longer the distance, the higher the transportation costs of the PA staff and the less frequent the contact between the *visitadores agrários* and a given ejido. More frequent contacts increase the confidence between the *visitador* and the ejidatarios, helping speeding up the process<sup>38</sup>. As the ejido might be located near to the capital of a State different from the one to which the ejido belongs, we use the travel time to the nearest urban center as a proxy for traveling costs.

The ‘demand’ for Procede: The demand for Procede can also be separated into different components. At the village level we shall distinguish between: (i) tenure security motivations (given land distribution); and (ii) land redistribution motivations (given tenure security).

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<sup>38</sup> For example, many ejidatarios that have a negative opinion of the Procede fear that the program has been devised by the government to tax the ejido land. Ejido land is still untaxed .

With respect to tenure security motivations, these are likely to have been stronger in those ejidos where conflicts were more frequent. Conflicts are assumed to be positively related to the value of land (e.g. Alston *et al.*, 1996; Platteau, 1996). As we have no information on the value of land, we resort to indicators that are presumably related to the value of land. We posit that the value of land will be positively related to its productivity and to its potential demand. Thus, we take yields per hectare and the population density as two proxies. These two variables are also interacted with the distance of the ejido to the nearest urban area, as distance is likely to affect the value of land by reducing its commercial potential. This negative impact of distance can be counterbalanced by a positive impact. If ejidatarios in more remote ejidos have less non-farm income opportunities and are therefore more specialized in farming as a source of income, land titling may be more demanded if it serves the purpose of securing property rights in order to protect investments in land improvements. In addition, more remote ejidos are also those where migratory pressure might be highest, a further reason to secure land rights in order to reduce the number of household members present on the farm and perhaps lease some land out without running the risk of losing a portion of it.

The presence of conflicts over common lands and over ejido borders might reduce the demand for Procede in some cases (in order to avoid a disadvantageous settlement) and increase it in others (for opposite reasons).

Land redistribution motivations would probably be a major issue in land titling of communities borne out of egalitarian culture. The key aspects related to the distribution of land within the ejidos are related to the presence of *avecindados* (i.e. landless ejido members), the existence of common lands susceptible for redistribution (and the quality

of such lands). As shown in the previous chapter, almost two thirds of the ejidos were endowed with common lands. Most of these lands were assigned to grazing and quality of pastures was very variable across ejidos. Some ejidos cultivated crops collectively on common lands. Other ejidos, and communities in particular, allowed individual members of the ejidos, or the new generations, to settle on the commons and earn a life there.

The majority of ejidos had been given common lands when they initially came into existence. Such lands served various functions. First, as pastures they were exploited either to rear cattle or working animals (de Janvry *et al.* 1997). This was an important function in an undercapitalized setting. Second, common lands were a form of insurance on which the poorest ejidatarios could draw at times of necessity. Firewood and plants could be collected, wood logged, and animals grazed at times of droughts. Third, ejidatarios could use the commons as a land *reservoir* on which younger ejido members could establish their farms by opening new lands, albeit of lower quality<sup>39</sup>. Thus, we would expect that a program that offers the possibility of regularizing appropriations of common lands would raise serious concerns among ejidatarios.

Many ejidos, at the time of the regularization faced the choice of certifying an unequal distribution of land access or to engage in a bargaining among ejidatarios in order to redistribute land so as to redress unbalances. Whether an agreement could be reached depended on several factors among which the ability to equalize land access without subtracting from incumbents, and the distribution of power between opposing interests. Modality of access to the commons was essential in understanding the underlying dynamics. As Baland and Platteau (1998) have underlined, it is important to

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<sup>39</sup> Yet technological progress raised the return from farming marginal land.

separate the issue of exploitation from that of appropriation. As common lands were primarily for grazing unequal distribution of herds translated into an unequal returns from use of the commons. This made cooperation over the management of the commons more difficult to achieve but not necessarily counter to efficiency. Owners of large herds could favor, and directly support, a more sustainable use of the commons given the higher returns they achieved from these and their larger share of environmental or congestion costs arising out of free riding behavior (Olson, 1965). Yet, imposition of equal access quotas might have more success in meeting the approval of those with fewer cattle. In some sense, even if equal quotas could ensure an efficient use of the commons, the latter solution would nevertheless leave the possibility of future encroachment and appropriation opened. The arrival of the Procede had a strong impact on land appropriation in that it raised the issue of subdivision much earlier than one would have expected based on historical trend (Muñoz *et al.*, 2003). A sudden appreciation of the expected value of land translated itself into a potent motive for re-discussing the existing distribution of land and access to common lands within the ejidos. It should therefore be expected that while inequality in the distribution of individual parcels would deter adoption of the Procede, it would be less so if enough commons could be used to redistribute land.

To model appropriately these factors, we assume that the latent demand for Procede related to land distribution (or redistribution) motives can be described as a function of: the concentration of individual parcels within the ejido (measured as the standard deviation of the log of per capita land); the population pressure – at the ejido level - on common lands (measured as the hectares of common lands divided by the size

of the ejido population) and its interaction with (a) the concentration of individual parcels, and (b) its distance from the nearest urban area; and the presence of common lands used for cultivation.

Other institutional factors also play a key role in explaining the advances of the Procede. The existence of an internal registry would signal that the community had been able to regulate its internal affairs to some degree, so that *ceteris paribus* it will have a lower demand for titles as means of improving tenure security; the participation of the ejido to an associations of ejidos, which were known to oppose the program under the belief it would represent a first step towards the privatization and dismantlement of the ejido system; the communal tenure of the village, which we would also expect to be negatively related with the Procede in view of the strongest customary rights that typically characterize these communities; and, along the same lines, whether the majority of the ejidatarios belonged to an indigenous group, as we expect linguistic barriers to be an obstacle for PA Spanish-speaking staff.

Basic descriptive statistics regarding motivations for joining or rejecting the program are reported in table 4.1. The information was obtained from the ejido representatives and might therefore not reflect the true distribution of individual motivations within ejidos.

#### 4.3. Econometric framework

We present both a structural and a reduced form approach to the analysis of the determinants of the delivery of the Procede, its adoption by the ejidatarios, and its finalization. As table 4.1 shows, almost 14% of the sampled ejidos were not informed

about or were not convened to discuss the Procede. To adopt the Procede and to proceed to its finalization an ejido has to be first informed or convened and it is the PA that takes the initiative of informing. Thus, the structure of the decision making tree is such that an analysis of the determinants of adoption can only be applied to the sub-sample of ejido that were previously informed. In other words the sample of ejidos that decided over the adoption is truncated and their selection process needs to be incorporated explicitly.

There are two modeling approaches, each corresponding to two alternative assumptions concerning the PA's behavior in designing its certification strategy. One approach assumes that when the PA has to decide on whether to 'target' a given ejido it does not assess the likelihood that the ejido will accept or reject the program. Thus, the PA acts 'myopically'. The second assumption is that the PA does in fact act rationally. Having perfect knowledge of the behavioral model that maps characteristics of a given ejido to the probability of accepting the program conditional on that ejido being contacted, it incorporates that model into its decision of whether to contact that ejido or not. Thus, the determinants of the ejido's response are present also in the selection (or supply) equation.

Following the myopic assumption, let  $P(I_j = 1) = \text{Prob}(X_j\beta + u_j > 0) = \Phi(X_j\beta)$  be the description of the process whereby the PA decides whether to inform an ejido, where  $X_j$  is a set of ejido characteristics observed by the PA (and the analyst). This selection equation sorts ejidos into those that are called upon to decide on the adoption of the program and those that are excluded from such decision. For the latter group, the indicator variable  $A$  that takes the value of one if the Procede is adopted and zero if

rejected is a missing value. For the ejidos in the former group, the probability that the Procede is adopted is a function of a set of ejido-level characteristics as of 1993,  $Z_j$ .

Let  $P(A_j = 1) = \text{Prob}(Z_j\beta + v_j > 0) = \Phi(Z_j\gamma)$  be the process that describes the selection of ejidos into those that adopt the program and those that reject it. The model can then be written in its structural form as:

$$(1) \quad P(A_j = 1) = \text{Prob}(Z_j\beta + v_j > 0) = \Phi(Z_j\gamma)$$

$A_j$  observed only if  $I_j=1$

$$P(I_j = 1) = \text{Prob}(X_j\beta + u_j > 0) = \Phi(X_j\beta)$$

$$u \sim N(0, \sigma_u^2); \quad v \sim N(0, \sigma_v^2); \quad \text{corr}(u, v) = \rho$$

The likelihood of this function can be found in Greene (2003, pp. 713-14) and is estimated using Stata's 'Heckprob' procedure. White's robust variance estimator is used in order to account for the heteroscedasticity in the data.

When the PA predicts the chance of success on the basis of the ejidos' characteristics and incorporates that prediction into its selection process, model (1) is not appropriate. As the PA does the first move, the supply equation will incorporate both the determinants of supply and demand side of model (1). We model then the supply model as a probit using the full sample of 190 ejidos for which information is available.

The demand for the Procede, also modeled as a probit, will use information only from those ejidos that have been targeted, a total of 166 observations. The determinants included in this model are those that appear in the acceptance equation (1), thus a subset of the determinants of the supply equation in the forward-looking behavior model just discussed.



Finally we further restrict the sample to those ejidos that have accepted the program, a total of 128 ejidos, and examine the probability of successfully completing the program. The objective is to determine whether there are any determinants of acceptance that are not relevant in the process of completion of the program.

A sequence of Probits is therefore applied to  $I_i$  (full sample),  $A_j$  (targeted ejidos) and  $P_j$  limited to ejidos with  $I=1$  (ejidos that have accepted entering the program). Comparing the succession of results provides insights as to how the role of the various ejido characteristics changes according to the stage of the Procede process one is. As before, we use White's robust variance estimator to control for the presence of heteroscedasticity.

#### 4.4. Results

The estimates of the parameters of the structural equations are found in table 4.2. Alternative specifications were attempted and although the maximization process converges to a concave point of the likelihood function surface, invariably the estimate of  $\rho$  hits its boundary value of  $-1$ . The lack of robustness of the 'structural' model can be interpreted as a rejection of the myopic assumption. We therefore move directly to examine the results of the probit equations obtained on the basis of the 'forward-looking-behavior' assumption.

We start from the targeting equation, column 1 in table 4.3. Concerning the importance of measurement costs, ejidos that are located in mountainous regions (proxied

by altitude) are less likely to be contacted<sup>40</sup>. The size of the ejido, on the other hand, has a positive sign. This contradicts our initial hypothesis. One way to rationalize it, already discussed in the previous section, is that the ejido's extension could give rise to economies of scale in measurement due to the presence of fixed costs as well as contributing positively to the ability of the PA to lobby for the protracted support of the program by the government. Thus, the PA might be interested in presenting its operational results in terms of the amount of land certified within a given year. Notice that the number of ejidatarios is controlled for.

Although the sign of the coefficient on the number of ejidatarios is consistent with the notion that administrative costs raise with the number of ejidatarios, this motivation (i.e. the administrative cost motivation) cannot be identified from the conflict motivation which also explains the negative relationship between the number of ejidatarios and the probability for a given ejido to be targeted by the PA. The number of ejidatarios and of posesionarios both have a negative impact on the probability of involvement (or program delivery). The sign on the posesionarios coefficient is negative and identifies the (expected) conflict resolution cost motivation as posesionarios are not involved in the assembly that approves the advances of the Procede, but might instead represent a factor of opposition to the program's implementation. As we shall see in the last section of this chapter, posesionarios are likely to be opponents rather than supporters of the Procede. Of the variables that according to our previous discussion should characterize the demand for the Procede, only two are somewhat significant (except for the dummy denoting a

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<sup>40</sup> It might be argued that ejidos located at higher altitudes are more difficult to reach. On the other hand, as travel time to the nearest urban area is controlled for, this result is to imputed to the rougher topography of mountainous ejidos.

communal ejido)<sup>41</sup>. One is the value of yields per hectare. Provided more fertile and economically productive land is subject to more land-related conflicts, these tend to become less of an issue from the point of view of the PA as the ejidos become more remote. The second is the percentage of ejidatarios that rents land in, which appears with a positive sign. An active land rental market is expected to generate a demand for stronger land rights. What is puzzling is that one would expect the percentage of ejidatarios leasing land out also to positively affect such demand. That might be explained by considering that a high percentage of ejidatarios renting land out might signal stronger informal land rights. Thus, the percentage of ejidatarios renting land in might be a better proxy, probably manifesting a demand driven pressure for land.

The presence of conflicts over use of the commons and boundaries of the ejido seem not to be a deterrent for the PA. This is a striking result, as it suggests that perhaps the PA is not considering either of these type of conflict particularly insurmountable.

The acceptance equation delivers mainly two results. First, conflicts over ejido borders are likely to lead to a rejection of the Procede. We have just seen that this type of conflict is not important in explaining the targeting of a given ejido. Thus, the importance of this type of conflict in the acceptance equation lies in the fact that many ejidos refuse to give up on their conflicts (which would be the typical request of the PA in order to speed the certification process) and rather opt for staying out of the program. This is most

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<sup>41</sup> A rough test of the forward looking behavior hypothesis is to test that the coefficients on: population pressure and its interaction with travel time, yields and their interaction with travel time, percentage of ejidatarios renting land in and out, per capita common land and its interaction with travel time, the dummy for common lands used for agricultural production, the concentration of land holdings and its interaction with per capita common lands, and the dummies signaling association with an ejido organization and the presence of a register in the ejido, all are simultaneously equal to zero. The null hypothesis cannot be rejected at the 15% confidence level. That result lends some support to the notion that the PA bureaucracy was advancing on a centralized base and did not use in its planning detailed ejido-level information obtainable from its field staff. Rather, crude indicators were used in order to simplify the selection process of ejidos to be targeted.

likely due to the opposition by the ejidatarios to come to a compromise over these types of conflicts that involve neighbors that might have had a troubled history with an ejido since its foundations. Moreover, these types of conflicts typically involve large tracts of land so that a settlement might entail the risk for some ejidatarios or for the whole community to lose part of that land.

Second, although the amount of common lands per capita has the right sign (i.e. positive), it fails to be significant at the 10% level. The coefficient on the interaction term between per capita commons and travel time to nearest urban center is negative, although very small. These results weakly suggest that as the distance from the nearest urban area increases, the value of land (which is a function of yields and the cost of transporting crops to the market), including the commons, decreases; in turn this leads to less incentives for dividing the commons.

Third, the concentration of per capita landholdings interacted with the amount of per capita common lands is positive and significant at the 10% level. Thus, the more unequal the distribution of land endowments within an ejido, the higher the probability of accepting the program. As within ejidos the variance of land holdings increases, the larger will be the group of ejidatarios with an amount of land above a given threshold. If these holdings were the result of past appropriations through the internal land black market or through violence, these ejidatarios may in fact want to regularize their holdings. Notice that in spite of the fact that the Procede is decentralized and democratic program, in fact the last assembly, which is called upon to finalize the Procede, needs only half of the ejidatarios to be valid. A majority of ejidatarios in favor of the Procede is then sufficient to let the program be approved. As a result, the Procede can be finalized

with 25% of the ejidatarios plus one. Thus, a motivated and well organized minority can have success. Clearly less opposition would be preferred. One would then expect that by compensating the smaller ejidatarios by agreeing to the redistribution of large tracts of the commons, the larger ejidatarios would have better chances of regularizing their past acquisitions of lands. In fact, the data suggest that this is indeed the case as more per capita common lands improve the impact of land inequality on the adoption decision. This result is in stark contrast to the one reported in Deininger and Bresciani (2001) where it was hypothesized that the Procede would be favored by the small ejidatarios and opposed by the larger ones.

Fourth, communal ejidos are characterized by an ‘institutional’ aversion to the Procede, perhaps because of the program’s objective of strengthening individual land rights relative to common land rights. Communal ejidos have the reputation of being characterized by strong customary tenure rights and if these are successful at keeping land conflicts low, a program like Procede might in fact appear redundant if not counterproductive<sup>42</sup>.

Fifth, yields interacted with travel time (i.e. distance or infrastructure development) enters with a positive sign, in contrast to the targeting equation as previously discussed. Why is that the case? One plausible explanation calls into question migration incentives. To the extent that household members in remote ejidos need to migrate permanently to participate in non-farm activities, they might display a demand for secure land rights so as to reduce the risk of dispossession by community members left behind. The likelihood of such event is expected to depend on the value of the land in

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<sup>42</sup> See Platteau (1996) on a forceful discussion of the negative impact of titling programs in sub-Saharan Africa, where customary rights are typically strong.

question, which in turn can be reasonably be proxied with yields. Yet, this explanation is difficult to reconcile with the interaction of travel time with yields. Instead, a plausible explanation is that productive ejidos located in more remote areas of the country may be characterized by a higher demand for land rentals given the little scope available to households for diversifying their income sources. Thus, the more productive the land, the higher the demand for tenure security and stronger land rights. In addition, the higher demand for land rights will increase with the remoteness of the ejido, a factor associated with greater specialization in farming.

Regarding the probability of an ejido finalizing the Procede (column 3 of table 4.3), notice that the number of posesionarios is a significant obstacle. As their numbers increase the expected number of conflicts over individual parcels and common lands is likely to increase. Posesionarios have much fewer rights than ejidatarios and might risk from the process of conflict resolution within the ejido.

Overall, these results suggest that the certification of the ejidos has been driven to a large degree by the strategy adopted by the PA in order to maximize its objective function. Yet, there are also important ejido characteristics that determine whether an ejido will accept the implications and results of the programs, showing that the goal of titling all ejidos will not necessarily be met within the present setup provided by the Procede. In fact, the results suggest the ejidos pending certification will be mainly characterized by a large number of ejidatarios, a higher value of yields ( a factor associated with individual conflicts), the presence of persistent border conflicts, and location into mountainous areas. These characteristics will make it difficult for the PA to advance towards a completion of the certification process as time advances.

Paradoxically, those ejidos where conflict resolution would be most warranted are likely to be left behind and unless sufficient resources are fielded to take care of these situations, it might very well be that the program will be terminated on the grounds that it has been successful in its advances when in fact that success has been achieved by targeting less problematic ejidos first. For example, ejidos characterized by border conflicts (presumably an important type of conflict given the community attitude in rejecting the Procede) and a relatively high 'density' of posesionarios have been excluded from the program's initial phase. This observation signals a major institutional weakness in a program like the Procede. As bureaucrats of the PA need to show progress in order to receive additional funds, they tend to 'cue' ejidos placing in the front those that are characterized by fewer conflicts and leaving at the end those that are most in need of conflict resolution. Thus, the PA bureaucrats might face the wrong system of incentives in organizing the advance of the program.

Where customary land rights are enough strong the program will have less chances of being adopted. Communal ejidos, where customary rights are typically stronger, represent about 10% of all communities. Excluding those communities is not necessarily a negative aspect and in fact, it might make more sense to think of a different program designed to accommodate their specific characteristics and demands.

#### 4.5. Characterizing support and opposition to the Procede

Given the above results, it is of interest to gain a first, even though partial, view of who is likely to gain or lose from the implementation of a program such as Procede. To see this, we rely on information collected with the 1997 survey on the judgment that

ejidatarios manifest over the ‘goodness’ of the Procede. We model their positive attitude towards the program as a binary variable that take the value of one if they have a positive judgment, zero otherwise. A Probit model is used to explain the ejidatario’s attitude as a function of individual characteristics and ‘location’ (i.e. distance from nearest urban center – a proxy for land values and off-farm income opportunities). Individual characteristics are: age, gender, education, size of landholdings, participation to the land market in 1993 (leasing in or out land), the amount of cows owned, whether the ejidatario had access to common lands, and whether she is a posesionario.

The results are presented in table 4.4. They show three important results that will be useful in the analysis that will follow in the next chapters. First, ejidatarios leasing land out in 1993 were favorable to the Procede. Second, their attitude becomes more positive as the amount of landholdings in 1993 increases. Third, posesionarios have a negative perception of the Procede. These results suggest that among the gainers from the Procede’s implementation one would find large ejidatarios that are interested in participating to the land market on the supply side. Within the ejidos there are groups of winners and losers from the process of certification and regularization of individual rights.



Table 4. 1: Motivations for participating and rejecting Procede

<i>Reasons for participating in the Procede</i>	(%)
Obtain tenure security	85.2
Comply with governmental requirement	14.8
Solve border problems	27.0
To rent and sell land	9.0
To access credit	11.1
To access Procampo	4.2
To invest more in land	1.1
Total # ejidos	189
# Certified ejidos	51
# Ejidos in process	138
% of Surveyed ejidos (certified and in process)	64.1

  

<i>Reasons for not participating in the Procede</i>	(%)
Lack of information about program	35.1
Were not convened	2.1
Lacked documents	5.2
To avoid taxes	13.4
To avoid land transactions	2.1
No interest in buying/selling lands	1.0
Problems with parcels' borders	16.5
Avoid conflicts ejidatarios and posesionarios	7.2
Total # ejidos	97
% of Surveyed ejidos	33.9

Source: 1997 Ejido Survey

Table 4. 2: Determinants of Procede adoption, 'structural model.'

	(1) Prob. Accept	(2) Prob. Targeted
Population density	0.033 [0.343]	
Pop. Den. * travel time	0.000 [0.152]	
Value of yields (per hec)	0.001 [0.587]	-0.000 [1.189]
Yields * travel time	0.000** [2.072]	
% leasing land in	-0.011 [1.211]	
% leasing land out	-0.003 [0.334]	
Trav time, nearest urban	-0.000 [0.067]	-0.005* [1.765]
Common lands per capita	0.000 [0.972]	
Commons*travel time	-0.000*** [3.337]	
Conflict on commons, D	-0.110 [0.374]	-0.642* [1.714]
Conflicts on borders, D	-0.771** [2.494]	0.105 [0.278]
Had cultivated commons, D	0.015 [0.056]	
Landhold. concentration	-0.376* [1.744]	
Landh. con.*Commons p.c.	0.000* [1.713]	
Is associated, D	-0.259 [1.116]	
Has internal registry, D	-0.129 [0.537]	
Is communal, D	-1.340 [1.422]	-0.323 [0.791]
# ejidatarios		-0.005*** [5.076]
# posesionarios		-0.015*** [4.330]
# avecindados		0.002 [1.399]
Size of the ejido		0.049** [2.529]

Average parcel size		0.010
		[0.752]
Altitude		-0.000**
		[2.017]
Constant	1.731***	2.088***
	[4.156]	[5.997]
<u># Observations</u>	<u>190</u>	<u>190</u>

Robust z statistics in brackets  
\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%.  
Heckman Probit: Maximum Likelihood

Table 4. 3: Determinants of Procede adoption and finalization

(Marginal probabilities)

	(1) Targeted	(2) Accept	(3) Finalized
# ejidatarios	-0.000** [2.449]		
# posesionarios	-0.001*** [2.590]		
# avecindados	0.000 [1.341]		
Pop. Density	0.006 [0.385]	0.008 [0.432]	0.002 [0.640]
Density*Trav time	0.001 [0.825]	-0.000 [0.095]	-0.001 [1.308]
Yields (value)	0.000 [0.467]	0.000 [0.711]	0.000 [1.274]
Yields*Trav time	-0.000* [1.889]	0.000** [2.037]	0.000 [0.757]
% leasing in	0.002* [1.717]	-0.002 [1.066]	-0.001 [0.200]
% leasing out	-0.000 [0.563]	-0.000 [0.209]	-0.006** [2.063]
Commons per capita	-0.000 [0.394]	0.000 [0.749]	-0.000 [1.492]
Comm p.c*trav time	0.000 [0.373]	-0.000*** [3.021]	-0.000 [1.062]
Conflict commons, D	-0.035 [1.018]	-0.043 [0.679]	0.087 [0.798]
Conflict borders, D	0.000 [0.003]	-0.169*** [2.736]	-0.172* [1.672]
Cultiv commons, D	-0.021 [1.145]	0.010 [0.222]	0.075 [0.911]
Land inequality, D	0.001 [0.043]	-0.070 [1.510]	0.173** [2.366]
Land ineq*pc commons	0.000 [0.709]	0.000 [1.619]	0.000** [2.166]
Associated, D	-0.009 [0.529]	-0.041 [0.933]	-0.287*** [3.489]
Internal registry, D	0.011 [0.696]	-0.029 [0.693]	0.159** [2.057]
Comunal tenure	-0.003 [0.108]	-0.542** [2.558]	
Size of ejido (has)	0.003** [1.968]		
Avg parcel size (has)	0.001		

	[1.357]		
Altitude	-0.000***		
	[2.862]		
Travel time	-0.000	-0.000	0.000
	[1.429]	[0.159]	[0.199]
Observations	190	166	128

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Robust z statistics in brackets

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

Table 4. 4: Determinants of positive attitude towards Procede adoption

	Probit (Marginal Effects)
Head of household education (years)	0.004 [0.824]
Head of household age	-0.001 [0.877]
Head of household male (dummy)	-0.004 [0.067]
Head's primary activity non agriculture, D	-0.058 [0.484]
Leasing in land in 1993 (dummy)	0.029 [0.562]
Leasing out land in 1993 (dummy)	0.120** [2.541]
Land endowment (hectares)	0.002* [1.838]
Cattle herd size	-0.001 [1.643]
Had access to commons in 1993	-0.038 [1.409]
Posesionario in 1993	-0.415*** [6.253]
Travel time to nearest urban center	-0.001 [1.453]
Observations	1190

Robust z statistics in brackets

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

Controls for cluster effects

## Chapter 5: The Impact of Procede on Ejido Land Markets

### 5.1. Introduction

In this chapter we analyze the impact of the Procede and other variables reflecting institutional features of the ejido sector on the land rental decisions. A positive impact would imply that in those ejidos where the Procede was adopted transaction costs associated with weaker property rights had in fact been a factor limiting the entrance into the land market or reducing the amount of land supplied to the market

In chapter 4 the determinants of Procede were analyzed and it was found that the program had in fact been ‘supplied’ by the bureaucrats to the ejidos in a non-random fashion and according to certain observable ejido characteristics. This raises the possibility that when analyzing individual decisions, treating the program as if it were exogenous might bias our results. Thus, in estimating land rental decisions we shall be very careful in assessing the assumption of exogeneity of the Procede dummy, which is our key explanatory variable.

The next section will provide detailed descriptive evidence concerning ejidos land markets. Section 3 will review the empirical strategy followed in this chapter, while section 4 will analyze econometrically the impact of Procede and other variables, identifying institutional features at the ejido and household level that influence rental decisions. Section 5 will then test whether adoption of Procede has affected the choice of the contractual counterparts in ejido land markets. Finally, section 6 discusses the findings of this chapter.

## 5.2. Descriptive evidence of ejido land markets

To better understand the nature of the variables used in the analysis, we provide in this chapter some descriptive evidence of the available information on ejido land markets. More rigorous econometric analysis will then uncover the relationship among variables otherwise not distinguishable by looking at simple means.

The decision to rent out land is affected by several factors, among which the literature signals as the most prominent the cost of screening and monitoring hired labor; missing markets for non-tradable inputs, uncertainty in the labor supply, and the failure of insurance markets (e.g. Sadoulet *et al.*, 1998). Some institutions, or contractual arrangements, play a key role in modulating the impact of these factors on the final decision to lease land. Legal prohibition to rent land are found in many countries, analogously to the case of Mexico's ejidos before the 1992 reform. In some settings cultural norms may inhibit or limit the functioning of land rental markets (e.g. inter-cast land transactions in India). Finally, where the legal 'infrastructure' does not support land ownership or use rights, landowners may refrain from entering the land rental market due to the fear of losing the control of their property. We will not look here into the theory underlying the choice between cash and sharecropping arrangements, which is well developed in the literature<sup>43</sup>. Yet it is worth fleshing out some facts regarding contractual arrangements that characterize Mexico's land rental markets<sup>44</sup>.

Besides cash rent, sharecropping is widespread in Mexico. Sharecropping arrangements and the division of revenues take various forms depending on the

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<sup>43</sup> Recommended readings on the subject are Sadoulet, Murgai and de Janvry (1998) or Otsuka and Hayami (1988).

<sup>44</sup> Procuraduría Agraria (1998) provides a detailed description of the contractual arrangements existing in Mexico's ejidos using census-type of information collected during the implementation of the Procede.



contribution to costs by the two parties in the agreement. As in many other countries, the percentage of revenues going to the sharecropper depends on the amount of inputs contributed by the sharecropper, such as animal or mechanical traction, water, and liquidity to finance commercial inputs. As Finkler (1978) has shown, in Mexico's ejidos sharecroppers are quite entrepreneurial individuals that enter into agreements with co-villagers that otherwise would not have enough liquidity to purchase the optimal amount of inputs. In the villages examined by Finkler, sharecroppers were identified as individuals that had ramified connections with traders, input providers, and local authorities regulating access to irrigation. These attributes can be regarded as non-traded inputs that increase the convenience for both landlords and tenants of entering into leasing arrangements.

Besides the traditional arguments that see sharecropping as an optimal response by both landlords and tenants to risk and imperfect markets, contractual arrangements may also depend on the degree to which tenure is secure. Sadoulet *et al.* (1998) and de Janvry *et al.* (2002) have pointed out that sharecropping can also be preferred to cash rents on the grounds that by requiring some commitment in the production process it reduces the landlord's risk of losing the land to the tenant. In the case of Mexico's ejidos, this hypothesis has as a corollary that *Procede*, by reinforcing tenure security, should favor cash rents *vis a vis* sharecropping. Notice that the choice of sharecropping as means of reducing the risk of losing the land rented out implies that some other opportunity of increasing income is foregone by the landlord. Cash contracts allow for example the landlord to increase the supply of labor off-farm. Thus, tenure insecurity

may exact its toll on income by forcing landlords to prefer an otherwise sub-optimal contractual arrangement.

Another common form among of leasing land in Mexico is that of the loan (*prestamo*). Borrowing or lending land is often matched by transactions in other markets, analogously to inter-linked transactions often cited in the literature on institutional economics applied to agricultural contracts (see Bardhan, 1984). Thus, the fact that the rent declared by interviewed ejidatarios is nominally equal to zero in the case of loaned land obscures the fact that there indeed is some sort of compensation attached to such transaction. We therefore shall not exclude land loans from our analysis below and a dummy variable will signal that this specific type of arrangements characterizes a particular observation.

Table 5.1 provides a more detailed description with respect to our sample of households of rental decisions in 1993 and 1994 compared to that reported in chapter 1. Leasing decisions are divided into rentals, sharecropping contracts, and land loans. It immediately appears that the amount of land rental going on in the ejidos in 1997 is quite limited. While this is indeed so by European and North American, European, and Asian standards, it is quite in line with the rental activity documented for other Latin American countries (see de Janvry *et al.* 2002). Second, as discussed in chapter 1, there has been an increase in the total amount of land rentals between 1994 and 1997, following a trend that had already started back in 1990 and which is probably attributable to the effect of the 1992 reforms. We then notice that between 1994 and 1997 both leases in and leases out increased considerably, and more so the latter compared to the former. While land loans (i.e. loans and borrowings) remained relatively stable, the increase in leasing was mainly

due the increase in share contracts and rentals. Looking at the first two columns, one can see that total leases in have increased by similar percentages in titled and untitled ejidos (plus 2.4 and 3.0 percent). On the other hand, total leases out were higher in titled ejidos (5.9%) than in untitled ejidos (2.8%). Finally, in terms of composition, there seems to be no significant difference between titled and untitled ejidos in terms of contract patterns.

We then look at contract characteristics for the crop year 1996/97, which are reported in table 5.2. Looking at the last column, we notice that land apt for cultivation of grain crops (corn primarily) is the main type of land on the market, both in leasing in and leasing out contracts. The pattern is stable across titled and untitled ejidos. The second part of the table examines the characteristics of the counterpart in the contractual arrangement. Some asymmetries should be mentioned. First, almost 50% of the ejidatarios that lease in do so from a relative, while only 26% of those leasing out do so to a relative. This asymmetry can be explained by looking at the status of the counterparts. While 23% of the rental out contracts involve as a counterpart a private landed farmer (26% if we include landless farmers), in the case of rental in contracts this share drops to 7%. These figures are consistent with the idea that in land-related contractual relationships family and community ties dominate exchanges such as those taking place between members of different ejido communities or with private farmers.

In a regime in which rental out entails fewer transaction costs, one would expect a high percentage of renters to be small farmers and landless households. Landless farmers within the ejido (i.e. *avecindados*) and landless agricultural workers constitute around 24% of the rental out contracts; 29% in uncertified ejidos and 22% in certified ejidos.

In 77% of the leasing in contracts, the counterpart is an ejidatario, implying that when ejidatarios expand their farm size they do so mostly within the community's boundaries. This is quite natural considering that renting in land from farmers outside the community entails transaction costs attached perhaps to greater distances to be dealt with as compared to land located within the community. But ejidatarios might also be discriminated against in the private land market due to their role in the historical process of land expropriation. Overall, this suggests that by liberalizing land rentals, the 1992 reforms have quite surely improved the legal access to landless farmers belonging to the ejido. To the extent that Procede has further improved the functioning of land markets, the program could be an important redistributive impact in favor of landless farmers.

Thirdly, we do not observe major differences between titled and untitled ejidos in terms of counterpart characteristics, except for some more involvement of outsiders of the ejido in the case of rental out contracts in titled ejidos (74% versus 80%). Although the difference is explained by a higher participation of farmers belonging to other ejidos, this difference is consistent with a more open land market in titled ejidos compared to untitled ejidos.

An important aspect of land rentals in the ejido sector concerns the tenure status of the land being transacted. For example, among rent-in contracts common land appears more frequently in uncertified ejidos, reflecting two points. First, uncertified ejidos are more likely to include communal ejidos, which were excluded from the Procede until the end of 1997 and a large portion of land in communal ejidos is typically under common

land tenure<sup>45</sup>. Second, leases of communal land involve more leases-in than leases-out. This would be expected given the weaker rights that can be claimed on communal lands by its occupants, making leasing out communal land perhaps more risky than leasing out ejido land, whether titled or not. The difference between the leasing in and out on communal lands reflects probably the fact that the community tacitly approves most of the leases in while the leases out (of lands which may in fact happen to be illegally occupied) are done individually and possibly require a more explicit consent by the community.

Other characteristics that are worth mentioning concern the land quality and the degree of formality of leasing contracts. First, land rented out is more likely to have access to irrigation than land rented in. This asymmetry is consistent with the greater involvement of private farmers in out-leases than in in-leases and with the fact that private farmers tend to be relatively better endowed than ejidatarios with assets for cultivating land and better access to credit. Second, lease contracts are predominantly informal and short in terms of duration, with one year of leasing on average.

That land leases in Mexico seem to be characterized, if not plagued, by short duration, anticipated payments, and informality is confirmed by Secretaria Reforma Agraria (1998). The traditional informality of land rental contracts might be a signal that ejidos as communities are able to provide some sort of enforcement by which contracts are honored. Yet, the fact that most cash contracts are paid in advance suggests that this might not be the case after all and that advanced payment in fact makes formal contracts

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<sup>45</sup> The reason why not all land in communal ejidos is common land is that there are communal ejidos that in all respect resemble typical ejidos, in that members have exclusive individual rights defined over parcels. This is basically a misclassification issue.

irrelevant<sup>46</sup>. The fact that rental contracts in Mexico's ejidos commonly provide for an upfront payment of the rents has been documented in other studies (Procuraduría Agraria, 1998; 2000).

To better appreciate the working of ejido land markets, we examine household and productive characteristics in table 5.3. Information is broken down by type of market participation in 1994 and 1997. We notice the following. First, the average head of the household is endowed with very little human capital. Those farmers leasing in have on average slightly more human capital than the rest. Second, heads of households are old by Mexican standards (and are becoming increasingly older). There appears to be no substantial difference across type of market participants. Third, land assets of farmers renting out are on average larger, while they are quite similar across households that rent land in or do not participate to the market. Fourth, farmers renting out have more access to irrigation than the rest. In particular, autarkic farmers are endowed with land with the scarcest access to irrigation. While farmers leasing in are endowed with less irrigated land as compared to farmers leasing out, they are advantaged with respect to autarkic farmers, signaling that participating into the land market by leasing in land requires some acquired productive potential.

On average, farmers own small stocks of mules and oxen. Cow stocks are instead more important, especially among those that rent in land. This may be interpreted as another signal of the productive background that justifies entrance into the land market; something remarked by the fact that being a recipient of Procampo payments, and owning

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<sup>46</sup> On the other hand, ejidos might 'supply' some sort of enforcement regarding non-monetary provisions of contracts such as not mistreating the land or some the structures located on it (fences, wells, etc). Unfortunately, we have no data on the type of legal problems and conflicts that landlords and tenants have typically experienced so that the role of the ejido as an effective local authority in backing contractual arrangements cannot be identified.

a truck or a tractor are more frequent among farmers that rent in than among those renting out. Farmers renting in are also characterized by a higher amount of per capita transfers received through the Procampo payment<sup>47</sup>. Looking at differences in assets and transfers is important in explaining a positive association between wealth and leasing. Wealthier farmers face less liquidity constraints and manage better risk, thereby raising the propensity to expand farm size.

The data suggest that access to irrigation surprisingly has a positive impact on renting out. One hypothesis that can be attempted on the basis of the available evidence is that an important part of the land rental market activity is centered on irrigated land and that farmers with a higher ratio of productive assets relative to irrigated land are those that rent in, while those with a lower ratio of productive assets to irrigated land are those that rent out. This would be consistent with the notion that access to productive capital is restricted by endowed liquidity (see also Finkler, 1978, cited above).

Summarizing, we find some evidence that ejido land markets do allow landless farmers to access land; in particular landless community members (e.g. *avecindados*) do participate actively in the land market; participation by outside farmers is somewhat greater in certified ejidos; possession of communal lands limits participation in the land rental market; leasing in is associated with better endowment of productive assets. In the next sections we shall examine whether these initial inferences stand up to more rigorous econometric testing.

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<sup>47</sup> We look at per capita Procampo payments as a means of normalizing total Procampo receipts. Dividing by hectares operated does not provide much variation as Procampo payments by design tend to be the same on a per hectare basis.

### 5.3. Econometric methodology

The model elaborated in chapter 3 provides the basic framework for the empirical analysis of the role of tenure security and property rights in the ejido land markets. The basic empirical model on which we work in the present chapter is made of the two following equations:

$$(1) RO_{ijt}^* = \beta^o X_{ijt} + \delta_0^o P_{jt} + \delta_1^o L_{ijt} + \delta_2^o P_{jt} L_{ijt} + \delta_3^o N_{ijt} + \delta_4^o P_{jt} N_{ijt} + \mu_{ij} + a_j + u_{ijt}$$

$$(2) RI_{ijt}^* = \beta^i X_{ijt} + \delta_0^i P_{jt} + \delta_1^i L_{ijt} + \delta_2^i P_{jt} L_{ijt} + \delta_3^i N_{ijt} + \delta_4^i P_{jt} N_{ijt} + \mu_{ij} + a_j + u_{ijt}$$

where  $RI^*$  and  $RO^*$  are respectively the latent rental out and rental in equations for individual  $i$  in village  $j$  at time  $t$ ;  $X_{ijt}$  is a vector of household characteristics (to be specified later) that influence land rental decisions;  $P_j$  is the Procede dummy, which has the same value across all household living in village  $j$ ;  $L_{ijt}$  is the land endowment of the individual and includes cultivated and fallow land and natural pastures;  $N_{ijt}$  is the number of adult household members, where adults are defined as those household members older than 15 years;  $\mu_{ij}$  is a household-specific dummy that captures the effect that unobservable (to the econometrician) household characteristics may have on rental decisions. Depending on whether these unobservable effects may be assumed to be correlated or not with the observable characteristics the appropriate estimation approach is fixed effects or random effects respectively. While  $u_{ijt}$  is the usual random error term, assumed to be distributed normally with mean zero and variance  $\sigma_{ij}$ , the term  $a_j$  represents unobservable time invariant, village-level effects that affect rental decisions by individual households in village  $j$  in the same direction. These effects may as well include social norms and commitments that bind households to each other and which might be rooted in the village's history and modality of foundation. We assume that  $a_j$  is



distributed normally with mean zero and variance  $\sigma_a^2$ . The question is whether it is uncorrelated with all other variables included in either (1) or (2). We develop this possibility below.

As corner solutions associated with (1) and (2) cannot be ruled out, these two equations generate the following model in terms of observables:

$$(1') \quad RO_{ijt} = RO_{ijt}^* \quad \text{if } RO_{ijt}^* > 0 \quad \text{and} \quad RO_{ijt} = 0 \quad \text{otherwise}$$

$$(2') \quad RI_{ijt} = RI_{ijt}^* \quad \text{if } RI_{ijt}^* > 0 \quad \text{and} \quad RI_{ijt} = 0 \quad \text{otherwise}$$

Given the likelihood that the *Procede* is not allocated randomly across villages, we need to develop an estimation framework that allows incorporating unobserved time-invariant and/or village-member-invariant village level effects. These effects can be assumed to be fixed, thereby allowing for correlation with the explanatory variables. Alternatively, one can assume they are random, in which case the implicit assumption is that they are orthogonal with respect to the set of explanatory variables.

It is well known that in the traditional context of models with corner solutions consistent estimates of the parameters cannot be obtained due to the incidental parameter problem<sup>48</sup>. To overcome this limitation, we follow the approach elaborated by Chamberlain (1984) and suggested by Wooldridge (2001) that assumes that unobserved fixed effects can be modeled as linear projections of averaged explanatory variables plus a random effects

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<sup>48</sup> This problem could in principle be overcome by applying either semi-parametric methods devised by Honoré (1992) or by estimating the model using simulated maximum likelihood methods as in Carter and Yao (2002). We did not attempt to follow the latter method in view of the warning in Carter and Yao (2002) that the computational burden is significant and that the set of explanatory variables needs to be quite restricted. We prefer to maintain the richness of our specification in terms of explanatory variables. Concerning the Censored Least Absolute Deviations (CLAD) approach elaborated by Honoré, we attempted to apply it to our data, but without success. The reason of such failure might be the fact that almost 85% of the households do not participate on at least one side of the rental market.

term. Mundlak (1978) has shown that in the context of linear panel data GLS estimation of such model is identical to estimation of a fixed effects estimator.

Going back to equations (1) and (2), assume that the unobserved term  $a_j$ , common to all households living in the same ejido, is in fact correlated with individual and ejido-level variables, *including* the Procede dummy and is time invariant. If one thinks about the historical process that has brought an ejido into existence, it is plausible to suspect that many individual variables could in fact be correlated with ejido characteristics that are potentially unobservable to the analyst, such as cultural specificity and institutions forged by a long process of interaction. Ejidos were formed as a result of landless peasants occupying a tract of land, which was then allocated on an egalitarian basis by the Ministry of Agrarian Reform (SRA). The presence of common lands and other 'public goods' shared among ejidatarios also implied frequent interaction and influence on household-level decisions. Although there might be a tendency for ejidos to display some degree of heterogeneity among member households, the origin of this institution is grounded in egalitarian principles, at least at the level of a given community and one would expect that the initial homogeneity across households in terms of endowments has survived at least to some degree among ejidatarios. The above implies that a correlation between  $P_{ij}$  and the village-specific component of the error term may in fact exist. To deal with such correlation, the appropriate way to proceed would be to assume that such unobserved effects are in fact fixed rather than random. As the dependent variables are censored, the need to use a Tobit approach raises the difficulty of relying on the assumption of the effects being fixed. Given the impossibility of concentrating the fixed effects out of the likelihood function (Greene 2000), one way to

overcome such constraint is to resort to Chamberlain's approach to modeling unobserved effects (see Wooldridge, 2001, pp. 540-542) as specified in Mundlak (1978). This consists in modeling the unobserved effects as a linear projection of the explanatory variables or a subset of these. In particular, let  $Z_{ijt} = W'_{jt} | W''_{jt}$  be a  $NT \times (K_{W1} + K_{W2})$  matrix, where  $N$  is the number of households in the sample,  $T$  is the number of panels (2 in our case),  $K_{W1}$  is the number of village time variant observable variables and  $K_{W2}$  the number of village time-invariant observable variables. Assuming that

$a_j | Z_{ijt} \sim N(\psi_1 + \bar{Z}_i \xi_1, \sigma_a^2)$ , where  $\bar{Z}_i = \frac{1}{T} \sum_{jt} Z_{ijt}$ , we can re-write equation (1) as:

$$(1'') \quad RO_{ijt} = \max(0, \psi_1 + X_{ijt} \beta + \bar{Z}_{ij} \xi_1 + \eta_a + u_{ijt})$$

where:  $\bar{\psi} = \psi_0 + \psi_1$ ;  $\eta_a | Z_{ijt} \sim N(0, \sigma_a^2)$ ; and where (1') has been taken into account in restating the functional form for the dependent variable. A similar series of steps can be applied to (2) and (2'). Notice that averaged time-invariant village observable variables will be equal to their original observation-specific value by definition. Thus, when interpreting the results, one will not be able to separate the effect of those variables at the individual level from that imputable to the linear representation of the village-specific effects.

Having specified a specific functional form for the village specific effects, we are left with the presence of potential household-level effects. Their inclusion would complicate considerably the estimation process. Moreover, as we have just explained, it is more village-level effects that are likely, if at all, to generate correlation between household assets and the error term in (1). Although heterogeneity in terms of

entrepreneurial ability might well exist, we hope that inclusion of education, gender, and age variables will capture a substantial portion of it.

Notice that testing that jointly the community variables have no explanatory power, i.e. testing  $\xi_j=0$ , is equivalent to testing that the Procede adoption variable is in fact uncorrelated with the error term in (1). .

To summarize, we estimate equations (1) and (2) specified as follows:

$$(1''') \quad RO_{ijt} = \max(0, \bar{\psi} + X_{ijt} \beta^o + \bar{Z}_j \xi_1 + \eta_{aj} + u_{ijt})$$

$$(2''') \quad RI_{ijt} = \max(0, \bar{\psi} + X_{ijt} \beta^i + \bar{Z}_{ij} \xi_1 + \eta_{aj} + u_{ijt})$$

under the assumption that the unobserved individual effects are uncorrelated with the explanatory variables.

We have mentioned the fact that pooling data from the two surveys yields more observations and time variance, yet reduces the set of information available on some institutional aspects one may want to explore in relation to the evolution of land rights in the ejidos. Therefore, we repeat the above steps limiting the estimation to data from the 1997 survey. A comparison of coefficients will allow gauging the extent to which relying on the 1997 survey data only will produce qualitatively different results.

#### 5.4. Results

To specialize to the problem at hand the theoretical model of land rental decisions presented in chapter 3 and outlined in the previous section, we posit that the amount of land rented in and rented out is a function of the following set of variables:

Head of the household characteristics: the age of the household head and its square, the education of the household head, and a dummy equal to one if the household head is male.

Household productive assets: the number of adult household members; the size of land endowments and of the land endowment squared, the number of oxen owned, the number of tractors owned, the number of pick-ups and trucks owned, the size of the cow herd, a dummy equal to one if the household cultivates perennials or horticultural crops. As shown in equation (1) and (2), we also allow for land endowments and number of adult household members to interact with the Procede dummy to test implications of certification for factor market efficiency. Finally, the share of land endowments with access to irrigation is also included.

Institutions: the Procede adoption dummy; the share of owned land that is private; the share of owned land that is communal under individual exploitation; a dummy for whether the village is a comunidad; the size of the village population; a dummy equal to one if the ejido has common lands cultivated or used for grazing livestock; a dummy signaling the existence of a roster of internal rules – or registro; and three dummies signaling the presence of conflicts or disputes with neighboring ejidos or private landowners, among ejidatarios on parcel borders, and on delimitation of common lands.

Ejido infrastructure: total travel time to the nearest urban center; the size of the population – also a proxy for the size of the ‘internal’ ejido land market (pobtota); the number of urban areas within one hour of transportation (menosu).

Table 5.4 reports the results of the Tobit estimates of equations (1) and (2) using the panel of data obtained from the 1994 and 1997 surveys. Both equations were initially estimated by maximum likelihood methods assuming the unobserved effects being the sum of random effects component and a linear projection component based on village averages of the explanatory variables.

For the rental out equation, a Chi2 test of the null that the random effects and pooled model do not differ systematically was rejected at the 5% level of significance. In the case of rental in equation convergence under the assumption of random errors was not achieved as the estimate of the panel component of the overall error term tended to ‘explode’ to infinity. Thus, the latter equation was estimated using a Tobit pooled estimator (see second part of table 5.4), and it also was estimated by maximum likelihood methods. We then tested for both equations the null that the coefficients on the village averages are jointly equal to zero. The Wald test of the null was rejected at the 5% confidence level in the case of the rental in equation. A likelihood ratio test of the same null in the case of the rental out equation yielded a rejection at the 5% confidence level. Thus, it appears that in both equations village characteristics, analogous to peer effects, do have a conditioning power and that excluding them from the rental in regression will result in biased parameter estimates. On the other hand, in the rental in equation unobserved village level effects are more appropriately dealt with through the assumption of clustering effects rather than through the assumption of random-errors. This ‘asymmetry’ might be explained by the fact that almost 20% of the rental in counterparts is owners of land located out of the ejido. Thus, unobserved factors influencing the rental in decision may in fact be related to institutions or local specific factors that are not

directly related to the ejido. Yet, given the structure of the data at hand, we have no way to test such hypothesis.

The results of the rental out equation using the two panels show that certification and titling indeed matter in the ejido land markets. First, while in all ejidos the amount of land rented out increases with the size of the landholdings, such relationship is stronger in the case of certified ejidos. This result is consistent with the notion that land markets tend to be more efficient in certified ejidos, where by efficient we mean that there is a perfect substitution between owned and rented land and farm size is independent of landholdings.

How important is the effect of *Procede* on the efficiency of land rental markets? We recall from chapter 3 that if factor markets were competitive, output and input prices would determine the optimal size of the farm. One hectare of owned land would then trade with one hectare of leased land. Whether that land is leased in or out depends respectively on whether the size of the landholdings is below or exceeds the optimal size of the farm. Table 5.4 reports also the estimated expected marginal effects of the explanatory variables on the amount of land rented out and in. For each type of rental decisions both the marginal effect conditional on the explanatory variables as well as the marginal effect conditional on participating into the market are provided. Marginal effects are computed at the sample average of the explanatory variables. In ejidos without *Procede*, each additional hectare of land endowment will add 0.10 hectares conditional on market participation. *Procede* adds 0.025 hectares to that already small marginal effect. Thus, in spite of the positive impact of the *Procede*, leasing out decisions continue to appear quite unresponsive to the size of landholdings.

Second, the sign of the square of land endowments shows that in both ejidos the monotonic relationship between land holdings and land rented out breaks down when land holding exceeds a given (large) size.

Third, the evidence concerning the importance of wealth for land rental out decisions is mixed. The number of tractors owned, the size of cattle herd, and ownership of trucks (although at the 10% level), all reduce the amount of land rented out. Production of perennials, a proxy for land-related capital investment, is also negatively related with the amount of land rented out. The latter effect may also be imputed to a crop-specific effect, whereby land with apt for grains and horticultural products as well as grazing land present less transaction costs in the land rental market. In other words, trees might face a higher risk of being damaged by the tenant. An alternative interpretation is that the perennial dummy captures the positive impact of the relative price effects of fruits on farm size. Yet, we favor the earlier interpretation in view of the fact that price effects are likely to be captured better by the ejido-level average of this variable (see latter part of table 5.4).

With respect to herd size, note that its ejido-level average is positively related to the amount of land rented out by the household. The same relationship holds for the average number of oxen owned by ejidatarios. This is possibly an indication of a demand effect, whereby larger average herds denote a potentially higher demand for grazing land at the village level once the average size of land holdings is controlled for.

Fourth, various variables that are related to different types of transaction costs appear also to play a role in rental out decisions. The presence of a conflict regarding the ejido's borders decreases land rental out. The impact is statistically weak – at the 10%



level – but this might be interpreted as a result of the possible substitution that might exist between tenants coming out of the ejido and those that belong to the ejido (i.e. other ejidatarios, *avecindados*, and *poseionarios*). A larger population within the ejido increases participation to the land rental market significantly. This is likely to be a consequence of lower search costs within the local land market. Finally, the more disconnected is an ejido from markets, as proxied by the travel time to the nearest urban center, the lower the participation and size of land rented out. As the remoteness of the ejido increases, the less scope there is for commercialization of crops while participation to the urban labor market on a circular base becomes less favorable. An insurance motivation may be at work, whereby poor ejido farmers may in fact attach importance to maintain access to land as a form of insurance against shocks in the labor market or in the price of corn (see Fafchamps, 1992; Burgess, 2003). Thus, the more remote an ejido is the higher the costs will be of cultivating while simultaneously maintaining employment in non-farm activities. As the cost of returning to the ejido on a cyclical basis is independent of the size of the plot, there is an incentive to reduce the amount of land rented out. Interestingly enough, we do not find an effect associated with the communal tenure of land at the ejido level.

Fifth, with respect to ejido effects and their influence on rental out decisions, we note that there is more participation to the market in ejidos where ejidatarios are on average older, and where the average number of female ejidatarios is higher<sup>49</sup>.

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<sup>49</sup> Note that the presence of women as ejidatarios is becoming increasingly important in the ejido sector (PA, 2001). As of 2000, it was estimated that 15% of the ejidatarios were women. Before the 1992 reform, ejidatarios could only be males. After the 1992 reform, an increasing number of women are becoming ejidatarios when their husbands die. They often entrust their son with the cultivation of the land.

Concerning the rental in of land, the sign on the landholdings variable is negative and significant at the 5% level of confidence. Although this is consistent with theory, it is important to notice that the magnitude of the response is quite low. As the second and third column of table 5.4 (rental in equation) show, each additional hectare of landholdings reduces on average the amount of land rented in by 0.03 hectares or by 0.10 hectares if we restrict our attention to decisions taken conditional on participating to the land rental market. If one is satisfied with a 10% level of confidence, an even more striking result emerges. In those ejidos where the Procede was adopted, there is no relationship between landholdings and the amount of land rented. Both results indicate that from the point of view of land rentals, small ejido farmers do face substantial impediments in adjusting their farmland to an optimal size and that the Procede has not helped improving this state of affairs. Thus, contrary to what concluded in Olinto (1999) and World Bank (1999), the Procede did not have a quantitatively significant impact on access to land by the ejidatarios. Those conclusions were induced by the fact that the model estimated implicitly imposed a symmetry between rental in and rental out decisions. In our case, estimating separately the two types of decisions allows discerning the different type of response that ties the demand and supply of land to the size of the original landholdings.

With respect to the issue of how access to capital influences rental decisions, we find that indeed renting land in is influenced by liquidity constraints. Capital is here proxied by the size of landholdings, the number of tractors and trucks owned, the size of the cattle herd owned, the ownership of trees in orchards (or in plantations), and the involvement in horticulture production, usually quite intensive in capital and labor

relative to land. All of these variables, with the exception of the perennial dummy, have a positive impact on the amount of land rented in.

Interestingly enough, in ejidos where common land is used for agricultural purposes, there is more land rental in activity going on as the positive sign on the dummy for common grazing lands shows. We do not have a clear interpretation of this relationship, which incidentally is significant at the 5% level. It should be noticed, nevertheless, that the same dummy averaged at the ejido level and across time, has a significant negative impact on the amount of land rented in. The same holds for the average dummy for cultivated common lands. These findings can be interpreted as a manifestation of the fact that as common lands is reduced (in some ejidos commons have disappeared as a result of the process of appropriation), individual farm sizes tend to increase on average as a result of the ‘erosion’ of the commons. Larger holdings reduce the incentive to rent land in. On the other hand, once the evolution of common lands embodied in the average dummy for common grazing lands is controlled for, access to these reduce the cost of maintaining cattle and oxen, while simultaneously offering a way of sustaining eventual shocks to crop production. These effects might in fact have an impact on the decision to increase the size of the farm.

We now examine the rental equations estimated using the 1997 survey data only. As we mentioned, the use of the 1997 panel allows us to include in the regression potentially important variables. These are the share of owned land that falls under communal and/or private tenure, the share of owned land that is irrigated, and three dummies for conflicts in the ejidos, on ejido borders, on parcel borders, and on assignment of common lands rights respectively. Both equations were initially estimated

using the same random error plus village averages as we did before using the two panels. Nevertheless, in both cases a likelihood ratio test could not reject the null that the panel-level variance component of the error term is equal to zero. We therefore estimated the two equations using the Tobit estimator while controlling for village-level cluster effects. In both cases, a Wald test rejected the null that village averages were jointly equal to zero.

Looking at the rental out decisions, we first notice that from a qualitative point of view the parameter estimates do not differ very much from those appearing in table 5.4, with the exception of the communal dummy, which now has become insignificant.

The marginal effects of landholdings on rental decisions are quite similar to what seen in table 5.4 above. The impact of *Procede* is somewhat stronger in the case of the rental out of land (with a net marginal effect of 0.40 versus 0.25 in table 5.4).

An important result is that the amount of owned land that is irrigated affects positively the decision to rent land out. This seems to contrast with the effect of those variables that are assumed to be related with access to capital. What the result suggests is that ejidatarios endowed with land of better quality are more inclined to rent out and reduce their farming activities rather than increasing their involvement in farming.

Finally, we notice that the ‘more private’ a farmer is (i.e. the more of his land holdings are under private tenure) the less likely he is to rent out land. Does this imply that Mexico’s land markets are characterized by an asymmetry between private farmers and ejidatarios? We cannot test for this given the structure of our data. In fact, the negative coefficient may also be explained by the hypothesis that *mixtos* (i.e. ejidatarios that also own private land) face higher transaction costs in renting their land out within

the ejido. They might be able to rent their land to outsiders, but this would raise search costs. Thus, we have competing explanations for this observation and no real way to discriminate empirically among them, except noticing that in the rental in equation the same variable has no explanatory power. This would tilt the balance in favor of the second hypothesis.

With respect to the rental in equation, we notice that many variables that were significantly different from zero when the two panels were used are now not significantly different from zero. In particular, this is the case for the land endowment both as such and when interacted with the *Procede* dummy, the number of tractors and cows owned the ownership of land with trees, the presence of common grazing land, and the dummy for communal villages. On the other hand, we see that the presence of agricultural common lands reduces the amount of land rented in, as access to such land is a substitute for renting individually owned parcels.

What do we learn from these results? The World Bank (1999) and Olinto *et. al* (2001) studies concluded that the *Procede* had contributed to increase the efficiency of ejido land markets. As argued above and in chapter 2, those studies implicitly imposed a symmetric relationship in the response of the demand and supply of land rental to the size of land holdings. Thus, a marginal unit of land holdings is assumed to have, in absolute terms, the same impact in terms of the final amount of land rented in or out. The model estimated in the previous section, by separating renting in from renting out decisions, relaxes that assumption. A shortcoming of this model is that it still does not allow for simultaneity of rental in and rental out decisions, an aspect that could be amended by adopting a modeling strategy such as the friction model of land rental markets in Skoufias

(1995). The estimation of a friction model that incorporates the assumption of random-effects with village unobserved time invariant effects is not trivial and we leave it for future research<sup>50</sup>. In spite of the shortcoming of the model presented here, we are confident that the approach followed in modeling unobserved village effects has provided parameter estimates with a satisfactory degree of reliability.

What then could explain the weak relationships between land holdings and land rental decisions we have observed? And why does *Procede* have some effect on rental out decisions, but not on the amount of land rented in?

Regarding the first question, the results confirm that tenure insecurity is one possible source of inefficiency of land markets, but that by no means it is the most important one. While land titles may surely reduce substantially tenure insecurity, it may well be that the final impact is quite modest.

An answer to the second question relies on the structure of the data at hand, in particular the sampling strategy adopted by the two ejido surveys. We in fact miss information on the rental decisions of private neighboring farmers and of landless ejido members, mostly *avecindados*. As we have mentioned at several points, private farmers border the ejidos in the typical setting of rural Mexico, and it is to be expected that while the *Procede* might have reduced the cost of transacting among ejidatarios, it might have had a modest impact on the cost of transacting between ejidatarios and private farmers. In general private farmers neighboring an ejido would be wary of renting their lands to those that possibly might have contributed to the expropriation of their land a few years before. It is difficult to argue that the *Procede* may have had an indent in this state of affairs.

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<sup>50</sup> That type of modeling approach was carried out using the 1997 survey data and the results obtained are very much consistent with those obtained in our initial tobit regression with village cluster effects. The results are presented in the appendix

Thus, to rent land in, ejidatarios would need to restrict their market to land located within the ejidos. Yet, this does not explain why land rented in is weakly related to land holdings in certified ejidos. The key point to notice is that Procede might have proved successful at increasing the access to land by landless households residing in the ejido (i.e. the *avocindados*). The ejidatarios included in our sample are almost all landed, and therefore are not the least endowed with land in the ejido. The lack of impact of the Procede can therefore be explained by the fact that those that have benefited most in terms of increased access to the ejido land are not observed and by the concurrent fact that access to private farm land has not been affected by land titles. To indirectly assess the merit of this explanation we examine how tenure-related characteristics of the counterparts in land rental contracts involving ejidatarios have been affected by the Procede.

#### 5.5. Procede and the choice of the contractual counterpart

To test whether the Procede has affected the characteristics of the contractual counterpart we exploit retrospective information on land rentals contained in the 1997 survey that extends back to 1992. By counterpart, we mean the other side of the transaction in the land rental market. Thus, in the case of lease-in contracts the counterpart would be the landlord, while in the case of lease-out contracts it would be the tenant. The available information allows to reconstruct the characteristics of the contractual counterpart in terms of the characteristics of the respondent<sup>51</sup>.

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<sup>51</sup> A legitimate question is why was such retrospective information used in order to reconstruct some of those variables whose use justifies estimating the land rental decisions with the 1997 Survey only. Retrospective information on market participation was compared to what effectively declared by respondents during the 1994 survey. The result was that participation was underestimated when retrospective information was used. Here the use of retrospective information is justified by the fact that we are limiting our sample to those farmers that, retrospectively, have declared having rented out their land.

Counterparts to rental out contracts are divided into five groups: ejidatarios with land and posesionarios; avecindados (which are landless ejido members, but not ejidatarios); ejidatarios from other ejidos; private farmers; and others<sup>52</sup> (non farmers and others). We then posit that the choice of the contractual counterpart is a function of the following ejidatario and village characteristics: the Procede dummy, the age, education, and gender of the ejidatarios, the (log of) endowments of land, the number of adult household members, the population of the ejido, the number of urban areas within one hour of the ejido, a dummy for the existence of a village register, the dummies for conflicts on ejido borders or on common lands, the ejido population density, travel time to nearest urban center and travel time interacted with the Procede dummy, the share of ejido land irrigated, the year to which the observation corresponds (i.e. either 1994 or 1997) and a dummy indicating whether the observation corresponds to that of a land loan contract. Finally, dummies controlling for the regional location of the ejido were also included.

As the choice of the counterpart is not an ordered categorical variable, we estimated the model using a Multinomial Logit (ML), controlling for village-level cluster effects. The choice of renting land to an ejidatario was taken to be the reference type of counterpart. The results reported in table 5.7 are to be interpreted as relative risk ratios and are computed taking the exponential of the corresponding parameter. They measure the marginal effect of a given variable on the probability of selecting one of the alternative counterparts relative to an ejidatario from the same ejido. A coefficient less

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<sup>52</sup> We abstain from interpreting the results for this specific group. It includes several typologies of counterparts such as non-farmers, private firms, etc. whose participation into the land market is not explainable by the rental model in chapter 3.



than one means that the alternative group is less likely to be selected relative to the reference group. The opposite holds when the coefficient is greater than one.

Table 5.7 reports also the marginal effects estimated at the sample averages of a given variable on the probability of a given counterpart being selected. As discussed in Greene (2002; p. 722) these parameters are not easily interpreted. They nevertheless provide further information that helps in explaining how the ejido land market has changed as a result of the Procede.

The results in table 5.7 can be summarized as follows. Certification through the Procede has had a negative impact in absolute terms (i.e. through the intercept effect) only on ejidatarios from other ejidos. Concerning *avecindados* (i.e. members of the ejido without land) we see that in uncertified ejidos these are ‘discriminated’ against by those ejidatarios with more land. On the other hand, in certified ejidos the *avecindados* tend to be the preferred counterpart choice of larger farmers relative to landed ejidatarios. This result has quite strong implications, as it suggests that with the Procede previously excluded groups of the village population have now found their way into the land market. From the results, it can also be inferred that stronger cohesion, perhaps induced by conflict resolution among ejido households, has also improved the stand of *avecindados* within the ejido agricultural economy. *Avecindados* are also favored by the presence of an internal registry, which as we have explained in chapter 1 contains the rules that govern the use of lands within the ejido. Thus, where local institutions for conflict resolution are developed, the weakest segments of the ejido sector find more participative space within the local land market. This increased participation by the *avecindados* takes place in the context of ejidos where land quality seems to be lower as the estimated

relative risk ratio of the share of ejido irrigated land shows. The share of irrigated land at the ejido level should be a reasonable indicator of the ejido's land productivity and propensity to commercialization. In these types of ejidos, so the estimates suggest, *avecindados* tend to be discriminated against in favor of landed *ejidatarios*. Finally, *avecindados* tend to be selected by older *ejidatarios*, probably in the context of inter-generational land rentals taking place within the same household or between an *avecindados* and an older relative. The association of *avecindados* with land loan contracts also reflects the importance of familiar ties.

We mentioned the impact of *Procede* on members from other ejidos. The data also reveal that members of other ejidos tend to be less favored as the size of the ejido, probably reflecting the size of the 'internal' market increases. There is weak evidence (i.e. at the 10% confidence level) that larger *ejidatarios* tend to prefer renting their land to *ejidatarios* from other communities rather than renting it to own ejido members. The fact that this is the case in ejido with *Procede* implies that, consistently with what happens with the *avecindados*, the program has opened the ejido land market also to outside *ejidatarios* but only with respect to those *ejidatarios* with more land. This signals, once more, some heterogeneity within ejidos as to how stronger property rights affect the rental decisions of farmers. Finally, population pressure, which in the rental out equation was not significant, is instead a factor favoring outside *ejidatarios*. An interpretation of this result might be based on the hypothesis that ejidos characterized by higher population density belong to regions where population density is higher. In that case, search costs for outside farmers interested in renting land in, which are fixed, might be

inversely related population pressure. As a result, outside ejidatarios face lower search costs per hectare rented and are therefore more likely to be selected.

With respect to private farmers, the model lacks explanatory power. The only result that makes some sense is the weak evidence that ejidos with border conflicts do not trust renting their land to private farmers and tend to favor, and this is a reasonable thing to expect, ejido landed members. The equation for private farmers should be interpreted for what it does not say. Private farmers seem to have not benefited from the Procede relative to ejidatarios, at least not in absolute terms.

### 5.7. Conclusions

What have we learned from the findings of this chapter? In general terms, we have confirmed that the Procede has had an impact on ejido land rental markets, although only rental out decisions seem to be those that have been most influenced by the program. We also saw that Procede has had a sizeable impact in terms of the responsiveness of land rental out to landholdings relative to the conditions prevailing in uncertified ejidos. Yet, it appears that the impact of Procede is concentrated among the largest ejidatarios, while the smallest ejidatarios do not register significant effects. This raises the question of the distributive impact of the Procede through land market participation. Nevertheless, the final result is still far away from that one would expect in a setting characterized by efficient land markets. As we saw, land rentals are quite unresponsive to the size of land holdings even after titling.

Concerning other institutional aspects, we found that that communal villages, common lands, and ownership of private land do have an impact on individual rental

decisions. We therefore suspect that more needs to be done in Mexico in order to improve the efficiency of land markets if the key policy concern is raising farm productivity.

Access to working capital is strongly connected to farm size. This was to be expected in an environment plagued by missing or imperfect capital and insurance markets. On the other hand, it seems that farm size is unrelated to the labor endowment of the household, perhaps suggesting that labor markets in rural Mexico work enough competitively.

A relevant point that emerged from the previous analysis is that Procede has had a negligible effect on the relationship between the amount of land rented in and the land endowments. To interpret the finding we suggested that the Procede, by lowering rental transaction costs, has favored access to ejido rental markets by farmers endowed with enough liquidity to farm good quality land (mainly private farmers) and to *avecindados* that live within the ejido. This is supported by the importance of irrigated land in the decision to rent out land, as it can be seen from our cross section regression (tables 5.6 and 5.7) and by the fact that *avecindados* are landless and generally poorly endowed with working capital. If this were indeed the case, we would expect small *ejidatarios* in certified ejido losing access to the internal market to the advantage of small private farmers and *avecindados* of the same community with enough capital.

Would this imply that small ejido farmers have in fact lost from Procede? Such a question needs to be broken down into several parts. First, we need to separate farm from non-farm income. By changing the shadow price of land rentals, the Procede might have had an impact on household resource allocation, including labor allocation between farm and non-farm activities. Second, we need to understand whether the Procede has affected

the income patterns of ejidatarios of different sizes. This is the subject of the next chapter.

One more consideration concerns the strong degree of asymmetry between rental in and rental out decisions. From a methodological point of view, a framework that imposes symmetry on the two behavioral equations, as done in the World Bank (1999) runs the (unnecessary) risk of imposing too strong constraints on the parameter estimates, yielding a distorted or partial picture of the functioning of ejido land markets.

Table 5. 1: Land rental characteristics

	Untitled		Titled		Total	
	1994	1997	1994	1997	1994	1997
	%	%	%	%	%	%
<i>Transactions</i>						
Rent in	3.0	4.6	3.5	5.0	3.3	4.8
Shacropped in	0.7	2.1	1.1	3.2	0.9	2.6
Borrowed	2.2	3.1	3.7	3.2	2.9	3.2
Rent out	2.1	3.4	5.0	7.4	3.5	5.3
Shacropped out	0.3	1.8	1.1	3.5	0.7	2.6
Loaned	1.9	1.9	1.4	2.2	1.7	2.1
<i>Summary of transactions</i>						
Total leases in	6.0	9.0	8.0	10.4	7.0	9.7
Total leases out	4.3	7.2	7.5	13.1	5.9	10.1
Total rentals	5.1	8.1	8.5	12.2	6.7	10.1
Total sharecrops	0.9	3.9	2.2	6.7	1.5	5.3
Total loan/borrowed	4.2	5.1	5.1	5.4	4.6	5.3

Source: 1994 and 1997 Ejido Surveys

Table 5. 2: Rental contract characteristics

	Untitled		Titled		Total	
	<i>Lease out</i>	<i>Lease in</i>	<i>Lease out</i>	<i>Lease in</i>	<i>Lease out</i>	<i>Lease in</i>
	%	%	%	%	%	%
<i>Vocation of land</i>						
Grains	83	77	81	73	81	75
Horticulture	3	1	4	4	4	2
Other agricultural	9	5	6	10	7	8
Grazing	3	16	8	12	6	14
<i>Counterpart characteristics</i>						
Relative	23	50	28	48	26	49
Ejidatario	28	80	28	74	28	77
Avecindado	25	0	19	1	21	0
Members of ther						
ejidos	12	4	13	10	13	7
Private with land	25	0	22	0	23	0
Private landless	4	7	3	6	3	7
Non						
farmer/enterprise	4	1	8	2	7	1
Other	0	6	7	6	5	6
<i>Tenure status of land</i>						
Ejido land	92	75	89	88	90	81
Dominio pleno	0	0	1	0	1	0
Communal	8	19	7	5	7	12
Private	0	6	3	6	2	6
<i>Other characteristics</i>						
With irrigation	48	23	50	37	50	30
Written agreement	37	13	34	28	35	20
Registered in ejido	36	17	33	15	34	16
Length of contract						
(months)	12	12	11	14	11	13

Source: 1994 and 1997 Ejido Surveys

Table 5. 3: Characteristics of households by land market participation

	Autarkic		Lease in		Leasing out	
	1994	1997	1994	1997	1994	1997
# adults in household	2.3	3.5	2.7	3.5	2.0	3.5
# children in household	1.9	2.1	2.1	2.1	1.3	1.8
education of the head (years)	3.1	3.1	3.6	3.5	2.9	3.3
age of the head	49.3	52.2	50.5	52.6	51.7	55.1
hectares of owned land	10.9	14.0	10.5	11.1	19.9	20.2
share owned land irrigated	-	16%	-	24%	-	43%
# oxens owned	0.2	0.3	0.1	0.3	0.1	0.1
# horses, mules owned	1.0	1.0	1.3	1.0	0.6	0.6
# of cows owned	5.7	4.8	12.4	8.8	4.0	2.8
ejidatarios owning a tractor	6%	6%	22%	22%	5%	4%
ejidatarios owning a truck	14%	9%	38%	31%	13%	6%
per capita Procampo payments (MX \$)	-	422	-	737	-	581
ejidatarios receiving Procampo	-	83%	-	82%	-	74%
# observations	1126	1037	89	124	75	129

Source: 1994 and 1997 Ejido Surveys



Table 5. 4: Rent-out equation: panel data and random effect with and without village averages

	(1)	Partial Effects of (1)		(2)
	With Village Averages	E(Y   X)	E(Y   X, Y > 0)	Without Village Averages
Procede dummy	3.534 [1.171]	0.06	0.37	3.381 [1.184]
# adult household members	-0.324 [0.690]	-0.01	-0.03	-0.141 [0.316]
Procede*# adult hh. members	-0.278 [0.389]	0.00	-0.03	-0.305 [0.438]
Age of ejidatario	-0.216 [0.789]	0.00	-0.02	-0.116 [0.445]
Age of ejidatario squared	0.002 [0.639]	0.00	0.00	0.001 [0.575]
Schooling years of ejidatario	-0.174 [0.722]	0.00	-0.02	0.030 [0.130]
Gender of ejidatario (1=female)	-3.510 [1.331]	-0.06	-0.37	-6.844*** [2.719]
Landholdings (hectares)	0.971*** [7.027]	0.02	0.10	1.003*** [8.709]
Procede*landholdings	0.226*** [2.805]	0.00	0.02	0.177*** [2.577]
Landholdings squared	-0.007*** [4.871]	0.00	0.00	-0.009*** [7.013]
# oxen owned	-0.073 [0.096]	0.00	-0.01	-0.200 [0.370]
# tractors owned	-6.664** [2.380]	-0.11	-0.71	-5.477** [2.088]
# trucks, pickups owned	-3.407* [1.895]	-0.05	-0.36	-3.169* [1.777]
# cattle owned	-0.269*** [3.194]	0.00	-0.03	-0.192** [2.565]
Producer of perennials (dummy)	-3.556** [2.078]	-0.06	-0.38	-5.490*** [3.462]
Hort producer (dummy)	-0.017 [0.010]	0.00	0.00	-0.145 [0.095]
Ejido commons cultivated (dummy)	0.525 [0.234]	0.01	0.06	-0.410 [0.254]
Ejido commons grazed (dummy)	-0.868 [0.370]	-0.01	-0.09	-1.109 [0.705]
Ejido has internal rules (dummy)	-2.046 [1.111]	-0.03	-0.22	-2.665* [1.869]

Ejido with border conflict (dummy)	-4.067** [2.045]	-0.06	-0.43	-1.689 [1.076]
Ejido comm.. with conflict (dummy)	2.130 [0.851]	0.03	0.23	1.860 [0.910]
Village population	0.001*** [2.639]	0.00	0.00	0.001*** [2.760]
Population pressure	-0.067 [0.513]	0.00	-0.01	-0.063 [0.520]
Travel time to nearest urban area	-0.039* [1.930]	0.00	0.00	-0.058*** [2.650]
# urban centres within 2 hrs.	-0.131 [1.508]	0.00	-0.01	-0.082 [0.915]
Ejido is communal (dummy)	2.359 [0.698]	0.04	0.25	3.066 [0.828]
Share of ejido lands with irrigation	3.115 [0.772]	0.05	0.33	4.808* [1.749]
North Pacific (dummy)	2.994 [1.004]			5.924** [1.989]
Central Mexico (dummy)	-1.100 [0.433]			-0.479 [0.179]
Gulf (dummy)	-1.019 [0.249]			-4.543 [1.057]
South Pacific (dummy)	-1.005 [0.352]			-0.743 [0.246]
Sub-humid tropical (dummy)	-9.915*** [2.813]			-7.962** [2.121]
Humid temperate (dummy)	-9.236 [1.619]			-8.452 [1.325]
Sub-humid temperate (dummy)	-9.200** [2.305]			-5.330 [1.258]
Arid and semi-arid (dummy)	-10.776** [2.560]			-6.838 [1.572]
V_Procede (dummy)	-1.021 [0.105]	-0.02	-0.11	
V_# adult household members	0.044 [0.034]	0.00	0.00	
V_Procede*# adult hh. members	0.411 [0.156]	0.01	0.04	
V_Age of ejidatario	0.512 [0.695]	0.01	0.05	
V_Age of ejidatario squared	-0.002 [0.301]	0.00	0.00	
V_Schooling years of ejidatario	1.033* [1.645]	0.02	0.11	
V_Gender of ejidatario (%)	-19.971** [2.550]	-0.32	-2.12	

V_Landholdings (hectares)	0.109 [0.444]	0.00	0.01	
V_Procede*landholdings	-0.157 [0.717]	0.00	-0.02	
V_Landholdings squared	-0.004 [1.372]	0.00	0.00	
V_# oxen owned	3.035* [1.776]	0.05	0.32	
V_# tractors owned	-0.184 [0.033]	0.00	-0.02	
V_# trucks, pickups owned	4.395 [0.902]	0.07	0.47	
V_# cattle owned	0.259** [2.036]	0.00	0.03	
V_Producer of perennials (%)	-9.495*** [2.677]	-0.15	-1.01	
V_hort producer (%)	-0.265 [0.078]	0.00	-0.03	
V_Ejido commons cultivated (%)	-1.790 [0.567]	-0.03	-0.19	
V_Ejido commons grazed (%)	-1.515 [0.486]	-0.02	-0.16	
V_Ejido has internal rules (%)	0.289 [0.106]	0.00	0.03	
V_Ejido with border conflict (%)	4.496 [1.476]	0.07	0.48	
V_Ejido commons with conflict (%)	0.648 [0.165]	0.01	0.07	
V_Share of ejido lands with irrigat.	2.926 [0.540]	0.05	0.31	
Constant	-10.720 [0.603]			-11.373 [1.303]
Observations	2346			2346
Number of ejidos	249			249

LR Test within-ejido averages=0: 50.389; prob>Chi2: 0.001

Absolute value of z statistics in brackets

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

Table 5.4 (continued). Rent-in equation: pooled data with and without village averages

	(1)	Partial Effects of (1)		(2)
	With Village Averages	E(Y   X)	E(Y   X, Y > 0)	Without Village Averages
Procede dummy		-0.43	-1.28	-11.498
	[1.059]			[1.386]
# adult household members	-0.376	-0.02	-0.05	-0.109
	[0.301]			[0.095]
Procede*# adult hh. members	2.781	0.13	0.37	1.330
	[1.374]			[0.686]
Age of ejidatario	0.730	0.03	0.10	1.094
	[0.795]			[1.333]
Age of ejidatario squared	-0.008	0.00	0.00	-0.010
	[0.926]			[1.293]
Schooling years of ejidatario	0.069	0.00	0.01	0.888
	[0.087]			[1.318]
Gender of ejidatario (1=female)	-3.425	-0.15	-0.46	-1.868
	[0.331]			[0.191]
Landholdings (hectares)	-0.741**	-0.03	-0.10	-0.614**
	[2.348]			[1.990]
Procede*landholdings	0.602*	0.03	0.08	1.026***
	[1.832]			[3.316]
Landholdings squared	-0.001	0.00	0.00	-0.004
	[0.495]			[1.078]
# oxen owned	-0.013	0.00	0.00	-0.446
	[0.011]			[0.399]
# tractors owned	10.448**	0.47	1.40	16.224***
	[1.967]			[3.519]
# trucks, pickups owned	9.840**	0.44	1.32	12.687***
	[2.495]			[3.533]
# cattle owned	0.512***	0.02	0.07	0.630***
	[3.645]			[5.211]
Producer of perennials (dummy)	2.640	0.12	0.35	1.396
	[0.540]			[0.346]
Hort. producer (dummy)	9.653**	0.43	1.30	8.325**
	[2.058]			[2.139]
Ejido commons cultivated (dummy)	-3.232	-0.15	-0.43	-12.621***
	[0.508]			[2.971]
Ejido commons grazed (dummy)	15.618**	0.70	2.10	5.498
	[2.521]			[1.457]
Ejido has internal rules (dummy)	0.108	0.00	0.01	-4.158
	[0.020]			[1.198]
Ejido with border conflict (dummy)	-0.895	-0.04	-0.12	-0.079
	[0.156]			[0.021]

Ejido commons with conflict (dummy)	-10.135			-6.122
	[1.528]	-0.46	-1.36	[1.208]
Village population	0.001	0.00	0.00	0.001
	[0.751]			[0.924]
Population pressure	-0.453	-0.02	-0.06	-0.354
	[1.133]			[0.916]
Travel time to nearest urban area	0.016	0.00	0.00	0.007
	[0.348]			[0.157]
# urban centres within 2 hrs.	-0.319	-0.01	-0.04	-0.294
	[1.525]			[1.426]
Ejido is communal (dummy)	-15.840*	-0.71	-2.13	-17.027**
	[1.815]			[1.982]
Share of ejido lands with irrigation	-6.295	-0.28	-0.85	-7.575
	[0.501]			[1.086]
North Pacific (dummy)	0.148			1.297
	[0.019]			[0.179]
Central Mexico (dummy)	13.994**			9.463*
	[2.557]			[1.812]
Gulf (dummy)	13.295			11.305
	[1.482]			[1.314]
South Pacific (dummy)	-3.854			-5.503
	[0.543]			[0.812]
Sub-humid tropical (dummy)	2.570			-2.297
	[0.312]			[0.300]
Humid temperate (dummy)	16.936			13.391
	[1.446]			[1.181]
Sub-humid temperate (dummy)	8.380			4.541
	[0.898]			[0.515]
Arid and semi-arid (dummy)	4.481			-4.247
	[0.455]			[0.456]
V_Procede (dummy)	17.869	0.80	2.40	
	[0.788]			
V_# adult household members	0.390	0.02	0.05	
	[0.126]			
V_Procede*# adult hh. members	-11.393*	-0.51	-1.53	
	[1.845]			
V_Age of ejidatario	1.037	0.05	0.14	
	[0.539]			
V_Age of ejidatario squared	-0.005	0.00	0.00	
	[0.295]			
V_Schooling years of ejidatario	2.045	0.09	0.27	
	[1.269]			
V_Gender of ejidatario (%)	0.001	0.00	0.00	
	[0.000]			
V_Landholdings (hectares)	-0.257	-0.01	-0.03	

	[0.841]		
V_Procede*landholdings	0.994**	0.04	0.13
	[1.989]		
V_Landholdings squared	-0.000	0.00	0.00
	[0.400]		
V_# oxen owned	-2.548	-0.11	-0.34
	[0.589]		
V_# tractors owned	19.847	0.89	2.67
	[1.608]		
V_# trucks, pickups owned	5.910	0.27	0.79
	[0.518]		
V_# cattle owned	0.206	0.01	0.03
	[0.662]		
V_Producer of perennials (%)	-1.447	-0.07	-0.19
	[0.174]		
V_Producer of greens (%)	-0.894	-0.04	-0.12
	[0.105]		
V_Ejido commons cultivated (%)	-12.935	-0.58	-1.74
	[1.569]		
V_Ejido commons grazed (%)	-18.961**	-0.85	-2.55
	[2.370]		
V_Ejido has internal rules (%)	-4.005	-0.18	-0.54
	[0.570]		
V_Ejido with border conflict (%)	2.439	0.11	0.33
	[0.306]		
V_Ejido commons with conflict (%)	15.582	0.70	2.09
	[1.629]		
V_Share of ejido lands with irrigation	-2.531	-0.11	-0.34
	[0.167]		
Constant	-118.959**		-92.223***
	[2.417]		[3.537]
Observations	2346		2346
Number of ejidos	249		249

Absolute value of z statistics in brackets

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

Table 5. 5: Rent-out equation: 1997 survey and effects with and without village averages

	(1) With village averages	Partial Effects of (1) $E(Y   X)$ $E(Y   X, Y > 0)$		(2) Without village averages
Procede dummy	-0.859 [0.130]	-0.01	-0.09	-1.891 [0.545]
# adult household members	0.305 [0.508]	0.01	0.03	0.287 [0.485]
Procede*# adult hh. members	-0.194 [0.268]	0.00	-0.02	-0.339 [0.456]
Age of ejidatario	-0.273 [0.895]	0.00	-0.03	-0.249 [0.870]
Age of ejidatario squared	0.003 [0.936]	0.00	0.00	0.003 [1.118]
Schooling years of ejidatario	-0.172 [0.727]	0.00	-0.02	0.196 [0.817]
Gender of ejidatario (1=female)	-2.634 [0.995]	-0.04	-0.28	-8.145*** [3.513]
Landholdings (hectares)	0.949*** [5.008]	0.02	0.10	0.870*** [5.280]
Procede*landholdings	0.372** [2.182]	0.01	0.04	0.370*** [3.607]
Landholdings squared	-0.009*** [4.821]	0.00	0.00	-0.009*** [4.321]
# oxen owned	-0.131 [0.582]	0.00	-0.01	-0.112 [0.369]
# tractors owned	-8.053** [2.056]	-0.13	-0.86	-5.623* [1.734]
# trucks, pickups owned	-1.472 [0.509]	-0.02	-0.16	-1.136 [0.423]
# cattle owned	-0.302*** [3.144]	-0.01	-0.03	-0.173* [1.827]
Producer of perennials (dummy)	-2.879 [1.501]	-0.05	-0.31	-7.668*** [3.732]
Hortic. producer (dummy)	0.514 [0.225]	0.01	0.06	-0.874 [0.471]
% landholdings with irrigation	14.431*** [3.479]	0.24	1.55	12.350*** [5.329]
% landholdings communal	-2.253 [0.357]	-0.04	-0.24	-6.294* [1.925]
% landholdings private	-17.998* [1.812]	-0.30	-1.93	-15.391* [1.829]

Access to Procampo (dummy)	-3.541*	-0.06	-0.38	-2.688
	[1.691]			[1.432]
Ejido commons cultivated (dummy)	-0.229	0.00	-0.02	-0.755
	[0.117]			[0.346]
Ejido commons grazed (dummy)	-1.520	-0.03	-0.16	-1.349
	[0.872]			[0.772]
Travel time to nearest urban area	-0.043*	0.00	0.00	-0.056**
	[1.906]			[2.193]
Village population	0.000**	0.00	0.00	0.000***
	[2.099]			[2.678]
# urban centres within 2 hrs.	-0.096	0.00	-0.01	-0.022
	[1.561]			[0.403]
Ejido has paved access road	-0.918	-0.02	-0.10	-2.364
	[0.563]			[1.313]
Ejido has internal rules (dummy)	-0.016	0.00	0.00	-0.440
	[0.010]			[0.263]
Population pressure	-0.035	0.00	0.00	-0.041
	[1.097]			[1.568]
Ejido is communal (dummy)	6.933*	0.12	0.74	7.036*
	[1.771]			[1.773]
Ej.with conflicts on parcels (dummy)	-0.306	-0.01	-0.03	0.194
	[0.199]			[0.126]
Ejido with border conflicts (dummy)	-1.668	-0.03	-0.18	-1.866
	[0.898]			[0.923]
Ejido comm. with conflicts (dummy)	0.855	0.01	0.09	0.857
	[0.364]			[0.338]
North Pacific (dummy)	3.181			3.159
	[1.116]			[1.186]
Central Mexico (dummy)	1.209			1.135
	[0.520]			[0.478]
Gulf (dummy)	7.962*			0.105
	[1.824]			[0.026]
South Pacific (dummy)	-0.188			-1.234
	[0.062]			[0.386]
Sub-humid tropical (dummy)	-4.009			-6.292**
	[1.223]			[1.978]
Humid temperate (dummy)	-6.903			-9.178
	[1.044]			[1.225]
Sub-humid temperate (dummy)	-0.925			-2.460
	[0.245]			[0.639]
Arid and semi-arid (dummy)	-2.452			-4.889
	[0.639]			[1.241]
V_# adult household members	0.563	0.01	0.06	
	[0.393]			
V_Procede*# adult hh. members	-0.794	-0.01	-0.09	
	[0.433]			



V_Age of ejidatario	-0.008 [0.008]	0.00	0.00
V_Age of ejidatario squared	0.002 [0.289]	0.00	0.00
V_Schooling years of ejidatario	1.619*** [2.653]	0.03	0.17
V_Gender of ejidatario (%)	-24.035*** [3.273]	-0.40	-2.57
V_Landholdings (hectares)	-0.156 [0.707]	0.00	-0.02
V_Procede*landholdings	0.060 [0.240]	0.00	0.01
V_Landholdings squared	-0.000 [0.989]	0.00	0.00
V_# oxen owned	0.861 [0.958]	0.01	0.09
V_# tractors owned	2.628 [0.455]	0.04	0.28
V_# trucks, pickups owned	0.278 [0.057]	0.00	0.03
V_# cattle owned	0.318** [2.007]	0.01	0.03
V_Producer of perennials (%)	-13.420*** [3.656]	-0.22	-1.44
V_Producer of greens (%)	-4.651 [1.129]	-0.08	-0.50
V_share of landhold. with irrigation	-5.411 [1.118]	-0.09	-0.58
V_share of landhold. communal	-4.854 [0.702]	-0.08	-0.52
V_share of landhold. private	2.171 [0.213]	0.04	0.23
V_Access to Procampo (%)	2.354 [0.609]	0.04	0.25
Constant	1.052 [0.048]		-5.757 [0.603]
# Observations	1431		1431

Robust z statistics in brackets

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

Cluster effects controlled

Table 5.5 (continued): Rent-in equation: 1997 survey and effects with and without village averages

	(1)	Partial Effects of (1)		(2)
	With village averages	E(Y   X)	E(Y   X, Y>0)	Without village averages
Procede dummy	-39.157 [1.241]	-1.58	-5.11	-32.431 [1.621]
# adult household members	-2.486 [1.010]	-0.10	-0.32	-3.044 [1.140]
Procede*# adult hh. members	5.019 [1.547]	0.20	0.66	4.576 [1.390]
Age of ejidatario	1.421 [1.112]	0.06	0.19	0.764 [0.686]
Age of ejidatario squared	-0.013 [1.076]	0.00	0.00	-0.005 [0.496]
Schooling years of ejidatario	-0.281 [0.258]	-0.01	-0.04	0.854 [0.887]
Gender of ejidatario (1=female)	19.919 [1.108]	0.80	2.60	26.538 [1.380]
Landholdings (hectares)	-1.752 [1.255]	-0.07	-0.23	-1.120 [1.294]
Procede*landholdings	0.893 [0.784]	0.04	0.12	1.175 [1.509]
Landholdings squared	-0.000 [0.043]	0.00	0.00	-0.002 [0.400]
# oxen owned	-0.431 [0.345]	-0.02	-0.06	-0.704 [0.691]
# tractors owned	11.784 [1.391]	0.47	1.54	17.406** [2.104]
# trucks, pickups owned	17.829** [2.105]	0.72	2.33	16.248** [2.412]
# cattle owned	0.808 [1.525]	0.03	0.11	0.945* [1.732]
Producer of perennials (dummy)	15.524* [1.821]	0.63	2.03	12.641** [2.004]
Hortic. producer (dummy)	9.641 [1.434]	0.39	1.26	9.395* [1.697]
% landholdings with irrigation	5.637 [0.428]	0.23	0.74	3.525 [0.473]
% landholdings communal	-17.237 [1.146]	-0.69	-2.25	-12.353 [1.468]
% landholdings private	-0.996 [0.044]	-0.04	-0.13	-20.605 [0.992]

Access to Procampo (dummy)	-3.747 [0.493]	-0.15	-0.49	3.064 [0.454]
Ejido commons cultivated (dummy)	-22.112** [2.201]	-0.89	-2.89	-21.481** [2.197]
Ejido commons grazed (dummy)	10.408 [1.502]	0.42	1.36	10.895 [1.610]
Travel time to nearest urban area	-0.018 [0.320]	0.00	0.00	0.021 [0.371]
Village population	0.001 [1.266]	0.00	0.00	0.002 [1.439]
# urban centres within 2 hrs.	-0.385 [1.505]	-0.02	-0.05	-0.241 [0.798]
Ejido has paved access road	-1.659 [0.329]	-0.07	-0.22	-2.106 [0.397]
Ejido has internal rules (dummy)	-0.494 [0.109]	-0.02	-0.06	-1.407 [0.283]
Population pressure	-1.169** [2.006]	-0.05	-0.15	-1.441** [2.117]
Ejido is communal (dummy)	-22.521 [1.167]	-0.91	-2.94	-25.045 [1.219]
Ej. with conflicts on parcels (dummy)	-1.270 [0.272]	-0.05	-0.17	-4.534 [0.838]
Ejido with border conflicts (dummy)	0.857 [0.162]	0.03	0.11	2.619 [0.489]
Ejido comm.. with conflicts (dummy)	-9.273 [1.046]	-0.37	-1.21	-10.004 [1.053]
North Pacific (dummy)	5.894 [0.595]			6.573 [0.653]
Central Mexico (dummy)	26.178** [2.117]			21.131* [1.942]
Gulf (dummy)	36.058** [2.103]			30.126* [1.954]
South Pacific (dummy)	2.435 [0.249]			-1.584 [0.161]
Sub-humid tropical (dummy)	-0.099 [0.010]			-8.282 [0.924]
Humid temperate (dummy)	26.277 [1.490]			15.454 [0.974]
Sub-humid temperate (dummy)	15.300 [1.229]			8.421 [0.714]
Arid and semi-arid (dummy)	8.153 [0.651]			-4.862 [0.419]
V_# adult household members	-4.272 [0.782]	-0.17	-0.56	
V_Procede*# adult hh. members	1.405 [0.195]	0.06	0.18	

V_Age of ejidatario	-3.547 [1.242]	-0.14	-0.46	
V_Age of ejidatario squared	0.039 [1.438]	0.00	0.01	
V_Schooling years of ejidatario	3.911 [1.247]	0.16	0.51	
V_Gender of ejidatario (%)	2.448 [0.091]	0.10	0.32	
V_Landholdings (hectares)	0.742 [0.950]	0.03	0.10	
V_Procede*landholdings	0.180 [0.271]	0.01	0.02	
V_Landholdings squared	-0.001 [0.656]	0.00	0.00	
V_# oxen owned	-0.692 [0.153]	-0.03	-0.09	
V_# tractors owned	27.248 [1.438]	1.10	3.56	
V_# trucks, pickups owned	-17.837 [0.967]	-0.72	-2.33	
V_# cattle owned	0.309 [0.474]	0.01	0.04	
V_Producer of perennials (%)	-2.387 [0.187]	-0.10	-0.31	
V_Producer of greens (%)	-2.049 [0.186]	-0.08	-0.27	
V_share of landhold. with irrigation	-3.518 [0.228]	-0.14	-0.46	
V_share of landhold. communal	8.408 [0.506]	0.34	1.10	
V_share of landhold. private	-12.221 [0.370]	-0.49	-1.60	
V_Access to Procampo (%)	16.272 [1.278]	0.66	2.13	
Constant	-76.577 [1.029]			-123.638** [2.453]
# Observations	1431			1431

Robust z statistics in brackets

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

Cluster effects controlled

Table 5. 6: Partial effects and predicted average hectares of rented land\*

	Rent-out		Rent-in	
	$E(y   x)$	$E(y   x, y>0)**$	$E(y   x)$	$E(y   x, y>0)**$
Panel	0.5	5.0	1.4	16.5
1997 Survey	0.9	5.3	2.0	19.8

\* Computer at sample average

\*\* Conditional on participation to the land market

Table 5. 7: Determinants of counterpart choice in rental out contracts, RRR\*

	(1) Avecindados	(2) Other Ejidos	(3) Private	(4) Other
Procede (dummy)	0.016 [1.498]	0.002* [1.908]	0.310 [0.394]	0.262 [0.524]
Age of ejidatario	1.097*** [2.894]	1.009 [0.397]	1.011 [0.409]	1.052 [1.299]
Gender (1=male)	0.022 [1.447]	0.944 [0.026]	1.415 [0.197]	0.350 [0.316]
Landholdings (log)	0.165*** [2.738]	1.975 [0.895]	0.805 [0.332]	0.249* [1.890]
Landholding*Procede	8.418** [2.288]	8.879* [1.736]	2.346 [0.895]	6.558** [2.151]
# adult household members	0.863 [0.426]	0.879 [0.368]	1.404 [0.950]	0.880 [0.450]
Village population	1.060 [0.167]	0.469*** [2.871]	0.716 [1.439]	1.115 [0.414]
# urban areas within 1 hour	0.970 [0.726]	0.995 [0.092]	0.863 [0.923]	1.111 [1.110]
Internal rules (dummy)	18.460** [2.329]	0.504 [0.541]	0.368 [1.181]	3.254 [0.895]
Conflict on ejido border (dummy)	1.484 [0.439]	0.192 [1.510]	0.179* [1.761]	1.001 [0.001]
Conflict on ejido comm.. (dummy)	2.186 [0.644]	4.741 [1.112]	0.609 [0.364]	0.659 [0.237]
Population pressure	0.984 [0.024]	3.297** [2.304]	1.872 [1.540]	0.708 [0.612]
Travel time to nearest urban area	1.015 [0.715]	0.957 [1.278]	0.981 [0.338]	1.003 [0.148]
Procede*Travel time	0.979 [0.966]	1.078* [1.839]	0.985 [0.281]	0.963 [1.066]
Share of landholdings with irrig.	0.008** [2.268]	0.018 [1.469]	0.766 [0.150]	0.007* [1.687]
Year of contract	0.746 [0.552]	0.460* [1.693]	0.372*** [2.589]	0.422** [2.108]
Land loan (dummy)	28.913*** [3.111]	0.161 [1.600]	0.472 [0.535]	3.454 [1.194]
North Pacific (dummy)	11.168 [1.640]	273.074 [1.633]	5.014 [1.170]	62.944* [1.936]
Centre (dummy)	1.078 [0.042]	18.738 [1.109]	0.442 [0.655]	3.000 [0.543]
Gulf (dummy)	2.435 [0.483]	0.003** [2.325]	1.996 [0.415]	1.368 [0.136]

South Pacific (dummy)	2.526	235.330	0.000***	44.493*
	[0.611]	[1.500]	[32.352]	[1.917]
Observations	164	164	164	164

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Wald Test - Chi2 value: 12081.067. p-value: 0.000

Robust z statistics in brackets

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

Reference group: Ejidatarios.

\*: RRR=relative risk

Table 5.7 (continued): Marginal effects on counterpart choice

	(1) Avecindados	(2) Other Ejidos	(3) Private	(4) Other
Procede (dummy)	-0.610 [1.355]	-0.273 [1.095]	0.001 [0.144]	0.035 [0.128]
Age of ejidatario	0.015** [2.252]	-0.001 [0.975]	-0.000 [0.789]	0.003 [0.593]
Gender (1=male)	-0.651* [1.714]	0.061 [0.630]	0.002 [1.121]	0.004 [0.012]
Landholdings (log)	-0.285*** [2.645]	0.077 [1.332]	0.001 [0.631]	-0.124 [1.579]
Landholding*Procede	0.284* [1.815]	0.074 [1.052]	-0.000 [0.106]	0.149 [1.593]
# adult household members	-0.020 [0.357]	-0.004 [0.250]	0.001 [1.117]	-0.010 [0.325]
Village population	0.017 [0.293]	-0.044 [1.283]	-0.000 [0.996]	0.020 [0.652]
# urban areas within 1 hour	-0.009 [1.035]	-0.001 [0.285]	-0.000 [1.149]	0.015 [1.221]
Internal rules (dummy)	0.495** [2.384]	-0.091 [1.345]	-0.003* [1.723]	0.054 [0.347]
Conflict on ejido border (dummy)	0.096 [0.643]	-0.098 [1.218]	-0.002 [1.607]	0.001 [0.009]
Conflict on ejido comm.. (dummy)	0.136 [0.674]	0.080 [1.036]	-0.001 [0.489]	-0.100 [0.446]
Population pressure	-0.007 [0.058]	0.070 [1.166]	0.001 [1.090]	-0.057 [0.791]
Travel time to nearest urban area	0.003 [1.065]	-0.003 [1.227]	-0.000 [0.368]	0.000 [0.132]
Procede*Travel time	-0.004 [1.065]	0.005 [1.346]	-0.000 [0.165]	-0.005 [1.181]
Share of landholdings with irrig.	-0.633** [2.041]	-0.110 [0.855]	0.003 [1.155]	-0.438 [1.258]
Year of contract	-0.009 [0.107]	-0.031 [0.909]	-0.001 [1.379]	-0.096* [1.849]
Land loan (dummy)	0.590*** [3.157]	-0.162 [1.245]	-0.002 [1.254]	0.056 [0.452]
North Pacific (dummy)	0.201 [0.760]	0.241* [1.716]	0.000 [0.032]	0.408 [1.532]
Centre (dummy)	-0.069 [0.218]	0.153 [1.579]	-0.002 [0.814]	0.116 [0.436]
Gulf (dummy)	0.232 [0.739]	-0.342 [1.014]	0.001 [0.550]	0.063 [0.225]
South Pacific (dummy)	-0.038	0.261**	-0.064**	0.429*



	[0.163]	[2.056]	[2.294]	[1.793]
Constant	0.964	2.840	0.100	9.080*
	[0.118]	[0.885]	[1.402]	[1.822]
Observations	164	164	164	164

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Absolute value of z statistics in brackets

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

Reference group: Ejidatarios

## Chapter 6: Assessing the impact of the Procede on household income

### 6.1. Introduction

Typically, evaluation of titling programs is carried out by examining how farm productivity is affected by the increased security of tenure that titles are assumed to deliver. The analysis of the previous chapter follows that line of thought. In the present chapter we shift the focus of the analysis in order to better understand the full impact of the Procede on household incomes via reallocation of resources. The principle is that evaluating Procede's impact on household income requires examining separately farm and non-farm income. Following the implications of the model outlined in chapter 3, by changing relative perceived factor prices, one would expect Procede to affect the allocation of household resources across farm and non-farm activities.

With respect to the impact on farm activities, sources of efficiency gains typically explored in the literature on land titling are not relevant or applicable in the case of the Procede. As we have argued in chapter 1, the legal framework restricting the use of ejido land as a collateral for loans was unaffected by the 1992 reforms, so that even though tenure security may have increased as a result of the program it could not improve access to short and long terms loans<sup>53</sup>.

Investments in land improvements are also not important in our specific case, due to the short time interval between the first and second ejido survey. While these may emerge as a significant effect of the Procede in the long run, evaluating this dynamic

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<sup>53</sup> As Lopez (1996) has shown, where the institutional and legal framework are appropriate, land titles can improve the farmer's access to credit market, although only the better off farmers will benefit. The ineffectiveness of the Procede and the 1992 reforms in improving access to credit among ejidatarios has been documented in Deininger and Bresciani (2001).

effect using the short panel of data provided by the 1994 and 1997 ejido surveys is not appropriate. Future work in Mexico should address this concern.

Given the available data, we focus more closely on short-term impacts of the Procede. We approach the problem estimating income functions for the different type of activities pursued by ejidatarios. In particular, as the setting in which ejido households operate is characterized by incomplete or absent markets, a program like Procede is expected to affect the shadow value of land and labor (see chapter 3). Thus, it is important to recognize that households will face income functions whose parameters may differ according to whether they are located in certified or uncertified ejidos. We assess the Procede's impact in the framework of the literature of program evaluation and treatment effects.

Before proceeding, one word of caution is necessary. Ideally, one would want to include landless ejido members (i.e. the *avecindados*) in a full evaluation of Procede's impact on the ejido sector. In evaluating the program's impact through farm size adjustment, we face some difficulties due to the particular sampling strategy followed in designing the ejido surveys. In fact, *avecindados* were excluded from the survey and this means that a sizeable portion of ejido members that might in fact have resulted as relevant beneficiaries from the Procede are in fact 'cut-off' from the evaluation. The evaluation of the Procede's benefits has therefore to be confined to the subset of *ejidatarios*.

Section 2 will discuss the methodology that will be followed in order to estimate the income effect of the Procede. Section 3 will present the empirical results of the analysis, while section 4 will draw the conclusions.

## 6.2. Methodology

To estimate the impact of the Procede on the income of the ejidatarios, we shall follow two steps. First, we examine whether participation to activities other than farming is influenced by the completion of the Procede in the ejido where the household is located. Second, we estimate an income function at the household level. The key assumption is that increased tenure security and stronger property rights affect the shadow price of production factors, *in primis* land and labor. The functional form of the income function needs to account for the possible influence of the Procede on factor returns.

Household income is disaggregated into four components: farm profits, non-farm income, off-farm income, and other income. Farm profits comprise profits from crops and from livestock activities. Land rentals paid and received are included in the computations of farm income. Receipts from Procampo and Alianza are also included in the computation. Receipts from Procampo are an important part of household income, averaging roughly 8% of the total. Although in some cases Procampo has been treated more as a transfer from the government and therefore included in a category of other income along with pensions and other non-productive subsidies (e.g. de Janvry and Sadoulet, 2001), we follow a different line. First, Procampo is paid on the basis of hectares of land owned inscribed in a roster established in 1994. Procampo would be paid only if that land was cultivated with at least one of the eight crops considered admissible at that time (see chapter 1). In additions, to be eligible for the Procampo payment the land inscribed in the roster had to be under cultivation. Thus, receipt of Procampo is

conditional on production and is therefore to be considered as a transfer only in a partial sense. Guaranteed prices were administered also as transfers conditional on a production (and marketing) decision.

Yet there is a second important, and more practical, question related to the inclusion of Procampo as part of income from farming. Although formally tenants of rented land could claim the Procampo, it often happened that it would be the landlord the one to claim the payment. Land rentals were influenced by the decision of who would in the end claim the Procampo. Thus separating Procampo from income from land rentals may generate inconsistencies in the computation of farm income as this is computed by subtracting rental payments and adding rental receipts. By including Procede and Alianza, farm income can then be understood as net returns to land holdings and household labor.

Non-farm income is the sum of wages received from employment out of agriculture plus income from self-employment. The former includes wages from employment in the services, constructions, and industrial sectors among others. The latter would include incomes received from owned business other than farm, sale of artisan crafts, and the like. Non-farm income is intended to comprise all of those income sources that are unrelated, in a direct sense, to the level of activity of the local farm economy<sup>54</sup>.

Off-farm income is instead hereby defined as that part of income derived from activities that are directly related, in an ejido economy, to the level of activity in the farm sector. Agricultural wages and income received from the exploitation of common lands are included in this category. Although exploitation of common lands sometimes

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<sup>54</sup> Indirect linkages can of course occur indirectly through higher farm income as consumption and production linkages lead to higher consumption of non farm products and therefore higher non farm incomes.

involved mining or other activities that are hardly related to agricultural activity at the local level, these were the exception rather than the norm. Common lands would in fact be mostly exploited by grazing livestock owned jointly by the ejidatarios, by cultivating land in collective groups, or by renting the commons to ejido members or private farmers or firms. Finally, other income comprises transfers from government (pensions and non farm subsidies) and from privates (i.e. remittances).

The importance that these income sources have in forming the income of the ejidatarios is shown in table 6.1, which provides also a breakdown by status of certification.

These aggregates of non and off-farm activities are then employed in constructing dummies that denote whether households are participating in the underlying income generating activities<sup>55</sup>. We use these dummies, which describe household behavior, in order to estimate how Procede has affected household income strategies and resource allocation. This is done as follows. Let  $d_{ij}$  be the dummy that is equal to one if household  $i$  is participating in activity  $j$ , where  $j$  is one of the non-farm or off-farm activities. We model the household decision to participate in market  $j$  using a probit model specified as follows:

$$(6.1) \quad \Pr ob(d_{ij} = 1) = \Pr ob(X_{iv}\beta_j + \gamma_j P_v + \xi_v - \varepsilon_i > 0) = \Phi\left(\frac{X_{ij}\beta_j + \gamma_j P_v + \xi_v}{\sigma_\varepsilon}\right)$$

where  $X_{iv}$  is a vector of household variables (including a column of ones) that explain the decision to participate into activity  $j$  by household  $i$  in village  $v$ ;  $\beta_j$  is a vector of unknown parameters relative to activity  $j$  that needs to be estimated;  $P_v$  is the Procede dummy

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<sup>55</sup> Note that participation decisions are modeled as household outcomes rather than as a result of individual choice. This approach was followed in Yunez and Taylor (2001) in an analysis of the role of education on in Mexico's rural incomes.

which is equal to one if the program is completed in village  $v$  and zero otherwise;  $\zeta_v$  is a village unobserved and time invariant effect<sup>56</sup>;  $\varepsilon_i$  is a random error term which is assumed to be i.i.d. across households according to a normal distribution,  $N(0, \sigma_\varepsilon^2)$ ; and  $\Phi(\cdot)$  is the cumulative normal distribution.

One possible approach to the analysis of participation decisions would be to model the household choice of which activities to participate in using a multinomial logit (see de Janvry and Sadoulet, 2001). Yet, as all households included in our sample are engaged in farming, we lack a reasonable alternative choice against which the probability of selecting other activities can be compared. In addition, we are not interested in analyzing the probability of being employed in non-farm versus off-farm activities. We are interested in understanding which households would participate in these activities (as a result of the Procede) given their involvement in farming. Thus, the model does not analyze the decision to exit farming (although the results we obtain can be suggestive of that choice).

As we have argued in the previous chapter, unobserved village effects are likely to be important when analyzing households in the ejido sector and one should expect these time invariant effects to be correlated with household variables such as human and land assets and more specifically with the decision to adopt the Procede. Yet, if we were to model these unobserved village effects as fixed, we would lose along the way the Procede dummy, as this is common to all ejidatarios. That would in principle be a

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<sup>56</sup> As argued in the course of chapter 5, village level affects are appropriate in the ejido setting. Ejidos are tightly knit communities whose internal life is regulated by commonly shared (or at least felt) institutional arrangements. Moreover, ejidos were created on an egalitarian basis and even though inequality in access to assets may have evolved over time individual ejidatario characteristics are likely to be closely correlated to each other. For these reasons, it is not off-the-mark to assume that individual decision making is subject to peer pressure in these communities. A village unobserved effect approximated through village averages of individual characteristics, the approach followed here and explained below, is therefore quite in line with the institutional setting treated here.

solvable problem if we could use in the analysis data from both ejido surveys. However that is not possible for two reasons. First, the methodology of collecting information on household income and activity participation differs between the two surveys. Second, costs sustained in farming are not reported so that it is impossible to construct farm income for the 1992/93 crop year. The latter would be a problem only when we estimate the income functions.

We are therefore left with the option of resorting to the methodology elaborated by Chamberlain (1984) which models unobserved ‘fixed’ effects as a projection of the averages of variables at the household level. In other words, we assume:

$$(6.2) \quad \xi_v = \psi \bar{X}_v + a_v ; \xi_v | X_{iv} \sim N(0, \sigma_a^2) ; E(a_v | X_{iv}) = 0 ; E(a_v | \bar{X}_v) = 0$$

where  $\bar{X}_v = \frac{1}{n_v} \sum_{i=1}^{n_v} X_{iv}$  is a vector of the household characteristics averaged across the  $n_v$  households in village  $v$ . In addition,  $a_v$  is a village unobserved effect that is assumed to be uncorrelated with both individual variables and village averages. Inserting (6.2) into (6.1), one obtains:

$$(6.3) \quad \text{Pr } ob(d_{ivj} = 1) = \Phi \left( \frac{X_{iv} \beta_j + \gamma_j P_v + \bar{X}_v \psi_j + a_v}{\sigma_\varepsilon} \right)$$

We estimate (6.3) using a probit with random effects. We then test (i) whether  $\psi_j=0$ , and (ii) whether the estimates of the parameters obtained by applying model (6.3.) differ from those estimated using a simple ‘pooled’ probit model<sup>57</sup>.

Household income functions are a useful mean of relating household assets and characteristics of their environment such as location and village characteristics. The

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<sup>57</sup> We also include estimates of a fixed effects logit model as a mean of comparing the estimates of the parameters on the household level variables obtained under (6.3) with those obtained under the assumption that unobserved village effects should in fact be modeled as fixed.



parameter estimates can be interpreted as the returns to those assets. The derivation of the household income functions in an imperfect factor markets setting was discussed in chapter 3. There we saw that the household income function, when factor prices are endogenous to household *and* location characteristics, including institutions, could be modeled as:

$$(6.4.) \quad Y_{iv}^j = Y^j(K_i, S_i, P_v, V_v; T_i)$$

where  $K_i$  are household assets,  $S_i$  is a vector of variables that affect household productivity,  $P_v$  is the Procede dummy,  $V_v$  are village characteristics that are assumed to influence the final outcome, such as land quality, location variables, etc. Finally,  $T_i$  denotes the state of the technology under which household  $i$  operates.

Specification (6.4) implicitly assimilates tenure security to the set of assets that influence income. Yet that does not capture an essential aspect of the problem at hand. As shown in chapter 3, when tenure security and property rights are strengthened, the shadow prices of land and of labor are affected by the changes in transaction costs that result from incomplete or rights. This implies that if one were to include in equation (6.4) the Procede dummy as a proxy for the strength of tenure security, one would be implicitly assuming that the return to a given asset, given by  $\frac{\partial Y}{\partial K}$  is independent of whether the ejido of residence has been certified or not. On the other hand, the assumption that the completion of the Procede, by changing the shadow prices of assets, would affect their returns could be modeled by interacting the marginal returns with the Procede dummy, i.e. by extending (6.4) so that:

$$(6.5) \quad Y_{iv}^j = Y^j(K_i, K_i P_v, S_i, P_v, V_v; T_i)$$

In fact, equation (6.5) is a wrong specification of the empirical model that should be adopted to estimate Procede's impact. On the other, as we shall briefly see, (6.4) would be a correct specification only under some restrictive assumptions. The point to notice as a factor that affects tenure security and property rights, the completion of the Procede contributes to a switch in regime. In other words, equation 6.4 holds with different parameters depending on whether the household operates in a certified or uncertified ejido.

Following Wooldridge (2001: pp.603-614) let  $Y^u$  denote the income of a household if it operates in an uncertified ejido and let  $Y^c$  denote the income corresponding to the same household if it were to operate in a certified ejido. Let  $P$  be an indicator of Procede's completion in a given ejido, such that  $P=1$  if the ejido is certified and  $P=0$  otherwise. The observed household income  $Y$  is therefore equal to:

$$(6.6) \quad Y = PY^c + (1 - P)Y^u$$

Assume now that the income functions under the certified and uncertified regimes can be modeled respectively as:

$$(6.7) \quad Y^c = \mu^c + u^c \text{ and } Y^u = \mu^u + u^u$$

Where  $u^c$  and  $u^u$  are two error terms such that  $E(u^c)=E(u^u)=0$ . Let  $X$  be a vector of observed variables (i.e. our  $K_i$ 's in equation (6.4)) Assume now that  $u^c$  and  $u^u$  satisfy the following assumptions:

$$(6.8) \quad E(u^c | X) = \kappa^c + X\beta^c \text{ and } E(u^u | X) = \kappa^u + X\beta^u$$

Taking  $E(Y | X, P)$ , i.e. expectations of household income conditional on the observed covariates and the Procede dummy, and using (6.7) and (6.8) one obtains:

$$(6.9) \quad E(Y | X, P) = \mu^u + (\mu^c - \mu^u)P + \kappa^u + X\beta^u + P[X(\beta^u - \beta^c) + (\kappa^c - \kappa^u)]$$

Now,  $E_X(u^i | X) = E(u^i) = 0$ ,  $i=u,c$ . Thus, from (6.8) we obtain that  $\kappa^i = -\bar{X}\beta^i$ .

Substituting into (6.9) one obtains:

$$E(Y | X, P) = \mu^u + (\mu^c - \mu^u)P + \kappa^u + X\beta^u + P[(X - \bar{X})(\beta^u - \beta^c)]$$

or

$$(6.10) \quad E(Y | X, P) = \tilde{\mu} + \alpha P + X\beta^u + P(X - \bar{X})\delta$$

Expression (6.10) has three important aspects that are worth discussing. First,  $\alpha$  is a key parameter that identifies the average effect (or treatment effect) of the Procede on the income of the sampled households. This can be easily seen by noticing that the impact of the Procede on household income is given by

$E(Y^c - Y^u) = \mu^u - \mu^c + E(u^c - u^u) = \mu^c - \mu^u$ . Second, (6.10) allows assessment of the distributive impact of the Procede across households according to their specific asset endowments. To see why that is the case, notice that using (6.8) we get:

$$(6.11) \quad E(Y^c - Y^u | X) = \mu^c - \mu^u + E(u^c - u^u | X) = \alpha + (X - \bar{X})\delta$$

Having obtained  $\hat{\alpha}$  and  $\hat{\delta}$ , one can then derive how household assets affect Procede's impact:

$$(6.12) \quad \frac{\partial(Y^c - Y^u | X)}{\partial X} = \hat{\delta}$$

Finally, we note that if one is willing to accept the restrictive assumption

$$(6.13) \quad E(u^c | X) = E(u^u | X)$$

then (6.10) 'shrinks' to

$$(6.14) \quad E(Y | X, P) = \tilde{\mu} + \alpha P + X\beta^u$$

which is what one would get by specifying (6.4) as a function linear in variables, including P. Assumption (6.13) is restrictive because it implicitly restricts the switch in

regime to affect only the intercept terms in (6.7). That assumes that the returns to assets are unaffected by the change in regime, which might be questionable in environments characterized by a high degree of market imperfection.

To proceed with the empirical analysis of the impact of *Procede*, we need to specify equations (6.10) and (6.14). The first step is to decide which variables should be included. Household assets are assumed to consist of labor, land, machinery and working animals, and livestock. Labor is defined to be the number of household members older than 16 and is separated into female and male adult members. Land assets are separated into rainfed and irrigated cultivable lands and into natural pastures. The latter are typically used for grazing livestock, although in some instances households cultivate crops on these lands. Units of measurement are hectares.

As machinery, working animals, and livestock are reported in terms of units by type rather than in terms of their value, their inclusion as a vector of variables would have complicated the estimation process while adding little in terms of information. To aggregate the various types of assets we proceeded as follows. Concerning machinery and working animals, the 1997 survey provides information on the number of units of various types of machinery (tractors, trucks, harvesters, threshers, etc.) and working animals (oxen, horses). In addition, *ejidatarios* that have rented machinery and working animals report information on the rental rates paid. These rates are used to construct municipal level rental rates for each category of machinery and working animals. Owned machinery and working animals are then aggregated using the imputed rental rates as weights.

The value of owned livestock, which includes cattle, sheep, and goats, is computed using the information on prices of animals purchased and sold. Prices averaged at the municipal level are then used in a procedure analogous to the one used in the computation of the value of machinery and working animals.

Following other studies on Mexican households' income sources (e.g. Yúnez-Naude and Taylor, 2001, de Janvry and Sadoulet, 2001), we assume that the household income function corresponding to regime  $i$  is given by a linear function in levels:

$$(6.15) \quad Y_{iv}^j = \beta_{1j}S_{iv} + \beta_{2j}M_{iv} + \beta_{3j}F_{iv} + \beta_{4j}I_{iv} + \beta_{5j}R_{iv} + \beta_{6j}A_{iv} + \beta_{8j}L_{iv} + \beta_{9j}N_{iv},$$

$j = c, u^{58}$ , where  $Y_{iv}^j$  is the net income of household  $i$  in village  $v^{59}$ ,  $M$  is the number of males,  $F$  that of females;  $I$ ,  $R$ , and  $A$  are the hectares of irrigated, rainfed, and pasture land respectively;  $L$  is the value of livestock owned, while  $N$  is the value of machinery and working animals owned;  $S$  is taken to be:  $S = Z_{iv}\lambda_j$ , where  $Z$  is a vector of household and location characteristics. The vector of unknown (reduced form) parameters  $\beta$  and  $\lambda$  depends on which type of regime  $j$  the household operates in.

The  $Z$  vector is assumed to include the age and age squared and education of the head of the household (both expressed in years and their squared terms), a dummy equal to one if the ejidatario is a male; a dummy for whether the ejido is endowed with common lands; and the number of urban areas located within one hour of public transportation as a measure of location and non-farm opportunities. Unobserved village effects are modeled as done in the participation analysis.

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<sup>58</sup> Note:  $c$  stands for certified, while  $u$  stands for uncertified.

<sup>59</sup> Net income is defined as the sum of farm profits and revenues from off and non farm income. See above for an explanation of how farm profits were computed.

The Procede dummy is included as an additional element in the vector  $Z$  in the restricted model (6.14). In addition, we expand (6.16) by including the interaction terms as in (6.10). More specifically, we interact the Procede dummy with the variables representing land assets and male and female household members, all transformed in deviation from the sample mean (see (6.10)).

Finally, we estimate (6.15) in its ‘restricted’ and ‘interaction’ forms (see 6.14 and 6.10 respectively) for the four different types of incomes. As all ejidatarios included in the sample are farmers<sup>60</sup>, we estimate the income function for farm income and total household income using the GLS estimator assuming random effects with village averages (which in the case of the equation with interaction terms will include also averages of such interaction terms in the linear projection of the village unobserved effects). The equations for non-farm, off farm, and other income will be estimated using a Tobit, along the lines of the land rental equations in chapter 5.

### 6.3. Results

Tables 6.1 and 6.2 report descriptive statistics of the variables used in the analysis that follows. These tables suggest that farming is more important as a source of income for ejidatarios in uncertified ejidos, while farm size tends to be somewhat larger in the case of certified ejidatarios. Participation in off farm and non-farm activities is greater among certified ejidatarios. Table 6.2 compares certified and uncertified ejidatarios by type of out of farm activity<sup>61</sup>. Years of education of the household head are higher for

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<sup>60</sup> We recall that not all ejidatarios own land. Some ejidatarios may have retained their title, which gives rights of access to common lands, even though they own no land.

<sup>61</sup> A give ejidatario may contribute to the average of more than one columns of the table if its household is involved in more than one out of farm activity.

households that participate into non-farm activities, for both type of ejidatarios. Ejidatarios engaged in non-farm activities appear to own more land, and of better quality, and to being endowed with more machinery and livestock.

We begin by examining the participation equations with a probit model with random effects and village-level variables (see above). Moreover, we provide estimates of a logit model with fixed effects in order to compare the implications in terms of parameter estimates of alternative specifications of unobserved (village-level) effects. The traditional fixed effects approach does not allow separating the effect of the *Procede* on the participation decisions, as the variable is common to all households living in a given ejido. The results of the logit model with fixed effects are therefore presented only as a mean of comparing the parameter estimates obtained from the regressions based on the specification of the unobserved effects *à la* Chamberlain (1984).

A likelihood ratio test of the null that the random effects model does not differ systematically from the pooled model is rejected at the 5% confidence level in the case of both the non-farm and off-farm regressions. On the other hand, the test that the effects of village averages (excluding the dummies for the *Procede* and for the presence of common lands, and the regional and agro-ecological zones dummies) are jointly equal to zero cannot be rejected at the 5% level of confidence. Thus, we examine the results of the regressions presented in columns 2 and 4 of table 6.3.

First, households that are relatively more endowed with labor, controlling for land assets, do participate more to off and non-farm activities. This in itself is not surprising, but the results suggest that there is some specialization by females in participating to non farm activities, while males seem to influence participation to off-farm activities

comparatively more. The coefficient on the female adult members is significant at the 1% level in the non-farm equation and insignificant in the off-farm equation. As off-farm activities are largely local in nature, women seem to be relatively more mobile than men in finding employment out of the farm. Notice that the gender of the head of the household is 'neutral' with respect to out of the farm employment decisions. The results point towards a gender-based specialization in working activities out of the farm.

Second, land assets play a very different role in the participation in off versus non-farm activities. Regarding individual land assets, the negative and significant at the 1% level relationship between irrigated land and off-farm activities is to be expected. Rainfed land fails to be significant. This may reflect different intensities of labor in the production of crops: if crops on irrigated land, such as vegetables and fruits are more labor intensive, farmers that own these type of land will demand more hired labor and supply less of their own on the local market. A second explanation is that irrigated land implies double cropping, while rainfed land typically implies a single crop in a year<sup>62</sup>. Thus, the difference in the patterns of seasonality among farmers with and without irrigated land may explain why the two types of lands have different impact (rainfed land has none in fact) on activities out of the farm. Irrigated land may also be a proxy for better access to capital, which would then reduce the need to supply labor in order to circumvent liquidity constraints. However, this hypothesis seems not to be corroborated. If a liquidity constraint motivation were really at work one would expect to find a significantly negative relationship also in the non-farm activities equation. In addition, other proxies for access to capital such as value of machinery and livestock owned would

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<sup>62</sup> There are exceptions such as farms in States located in the Gulf region, where climatic conditions favor double cropping on rainfed lands.



also appear significantly negatively related. Concerning common lands, their presence in an ejido is a source of income at the local level.

Human capital, as one would expect, is a significant asset in improving participation to non-farm activities, while it has no effect on participation to off-farm activities. This is an interesting result that resembles those obtained in recent work on rural poverty in Latin America (see López and Valdés, 2001). Livestock capital is negatively related to off-farm employment, perhaps reflecting the nature of the activity, which is less subject to the seasonal peaks that characterize crop production.

The key variable is the *Procede* dummy. The interesting result we obtain is that at the 1% level of significance certification through the *Procede* is associated with a higher share of income from (and participation in) off-farm activities, controlling for other factors. In spite of its statistical significance, the impact is not too high. The marginal effect at its maximum is roughly equal to 0.4 (the maximum value of a standard normal density function) times the estimated coefficient, 0.303. Participation to the *Procede* increases the probability for a household to participate to off-farm activities by 13%. As on average 23% of the households participate in off-farm income activities (table 6.2), this impact is not trivial. On the other hand, *Procede* fails to be associated with increased participation to non-farm activities. As employment in off-farm activities is typically inversely related to access to land<sup>63</sup>, one would assume that the former result would be particularly important for those households that are net suppliers of labor on the local market, i.e. small farmers and *avecindados*, i.e. for those households endowed relatively more in terms of labor. As the households included in the sample are ejidatarios only (i.e.

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<sup>63</sup> Provided land and labor are complements in production (i.e. increase in the use of one factor raises the marginal productivity of the other).

*avecindados* are excluded), it is difficult to state with certainty that an activation of the local labor market has been another channel through which the Procede has benefited the landless ejido members. Yet that is a reasonable suspicion on the basis of the evidence produced relative to the ejidatarios.

To bring more convincing evidence on how Procede's impact is mediated by access to assets, we need to look at the income function model with interaction effects presented in equation (6.10). The model was applied to estimate the total income function and the income functions for the separate types of activity. Non-farm, off farm and other income activities<sup>64</sup> are estimated using a Tobit given the large number of zeros appearing in the data (see table 1). All equations assume unobserved village heterogeneity being modeled as described in the previous section. In all equations with the exception of the one for other income, a likelihood ratio test that the random error model is not systematically different from a pooled model is rejected. For all equations a Wald test of the null that the village averages are simultaneously equal to zero is rejected at the 1% level. In the case of the 'other-income' equation, the model is re-estimated assuming cluster effects. The results of the estimations are reported in table 6.4, which is divided into four sections. The first reports results for variables referring to household characteristics and the Procede dummy. The second section contains the results that concern the interaction terms (i.e. the result of the demeaned assets interacted with the Procede dummy), in turn reflecting the distributive effects of the Procede. The following section of the table reports village averages. The last section reports results on variables reflecting location and on dummies that signal whether the household is a borrower or

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<sup>64</sup> Notice that in a strict sense it is improper referring to other income as an activity as this source of income is made of state transfers and remittances, both of which households have little ability to influence over the short term. Nevertheless, we adopt the 'activity' terminology for convenience.

lender of land. The dummy is included in order to control for the monetary effect that land loans have on farm income. One would expect (as in fact it does) that these variables would be irrelevant in the case of out-of farm activities.

We begin our discussion of the results by looking at the impact of Procede, the focus of our analysis. The clear result is that Procede affects the income received from farm, non-farm, and off-farm activities<sup>65</sup>. Interestingly, the program's impact on farm income is significantly different from zero and negative while it is significantly different from zero and positive on the other two types of income. This contrast helps explaining why the coefficient on Procede in the total income equation appears with a negative sign while being not significantly different from zero<sup>66</sup>.

These results imply that the impact of Procede *via* land markets and on-farm household labor allocation decisions is negative. Although counterintuitive, the result is consistent with the results in chapter 5. There we saw that the Procede increased the supply of land, but did not improve the ejidatarios' access to land via rental market<sup>67</sup>. Thus, the evidence suggests that reinforcing property rights of the ejidatarios has in fact led to their disengagement from farming. Given that in our sample *avecindados* and private farmers are not included, the negative impact we have found is only a partial equilibrium result and it cannot be extrapolated to conclude that the Procede has reduced farm income in the ejido sector and even less so in the whole agricultural sector of Mexico.

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<sup>65</sup> Other income sources are largely transfers and remittances and therefore it is not surprising that they are largely unaffected by the Procede.

<sup>66</sup> Sample variability and measurement noise are also likely to play a role in this lack of significance.

<sup>67</sup> As we saw in chapter 5, the ejidos' *avecindados* were those that most likely have increased their access to land as a result of the Procede.

The parameter of the Procede dummy is an average treatment effect, meaning that averaging across all observations, the impact of the program on income that households derive from farming is negative, while that from off-farm and non-farm activities is positive. Yet, the program's impact may differ across households depending on their access to assets. The interaction terms, which describe the pattern of the distributive impact, are reported in the second of table 6.4. Here we limit the discussion to coefficients that are significantly different from zero at the 10% confidence level. Interestingly enough, the interaction terms with respect to (demeaned) land assets plays a role only in the case of farm income. In particular, above average size farms have a negative return from the Procede, while farms below the average size gain. Thus, looking at farm income, the data suggests that Procede has had an equalizing effect along the farm size distribution curve. Given the importance of farm income, this conclusion is reflected also in the case of the total income regression (i.e. column 1). Second, land is the only type of asset that has a significant interaction with the Procede dummy. The lack of significance of the interaction terms involving male and female labor lends support to the conclusion that there is no systematic difference in the returns to these types of labor across the regimes with and without the Procede (see equation 6.10).

We now look at the returns to household assets, controlling for Procede and other location characteristics (see the first part of table 6.4). The estimates are quite reasonable and in line with expectations. The marginal return to a hectare irrigated land is higher than the one to rainfed land. Land, irrespective of access to irrigation, does not affect the returns to off-farm and non-farm income activities. The presence of common lands in the ejido negatively affects total household income, mainly due their negative impact on farm

income and in spite of its positive impact through the off-farm income activities that include distribution of 'dividends' from management of the commons. This result may suggest that in Mexico common lands are not a factor supporting income, although this does not imply they may have a redistributive or insurance function for the poorest ejido members. The underlying causes might be found in the excessive cost of managing these lands relative to the benefits they effectively provide. This does not imply that common lands should be privatized. Common lands are an important source of income for the poorest ejidatarios and they are relied upon under adverse contingencies. Yet, on average the net effect might be negative across all ejidatarios.

Household labor does have a relevant impact on household income. This is to be expected. Yet the impact of female and male adult members is quite different across type of income. First, the endowment of male labor has no impact on farm income, differently from female labor. Second, male labor has a significant impact on off-farm income, while female labor has none. Thirdly, both female and male labor endowments have a significant return from non-farm income. These results are consistent with the hypothesis that hired and family *male* labor is quite substitutable in local agricultural labor markets that are quite competitive. Therefore, the demand for farm labor would depend only on real wages and perhaps other assets, but not on the household endowment of *male* labor. The endowment of male labor instead increases the supply of household labor to off and non-farm activities, and therefore the income the household derives from these sources. On the other hand, the endowment of female labor increases income received from non-farm activities and, to a lesser extent from farm activities. Coupled with the observation that it is male labor the type of labor endowment that drives the supply of labor to off-

farm activities, the results on female labor lend credit to the hypothesis that it is this type of labor that is less substitutable on the ejido farms.

We have already noticed the negative impact of livestock assets on participation to non-farm activities. This was rationalized by hypothesizing that the nature of livestock production limits the periods of slack during which labor might temporarily be allocated to non-farm activities. Here we find that one peso of livestock yields a yearly net return of 0.14 pesos, i.e. 14% rate of return, slightly below the 18% interest rate prevailing in Mexico in 1997.

The characteristics of the household head are also important in explaining the composition of household income. Older heads are less involved in non-farm activities, while they are receptors of remittances<sup>68</sup>. Education improves the return from non-farm activities, while it has no impact on farm income and off-farm income<sup>69</sup>. This is in line with other studies that have also found the importance of education of farm households to lie in their increased opportunities to access jobs located out of the farm sector (see López and Valdes, 2000). Finally, a female head of the household will receive on average higher remittances per capita.

As a way of comparing the results discussed so far with what would have been obtained by assuming away the interaction terms (i.e. limiting the impact of the Procede

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<sup>68</sup> This finding supports the conclusion that remittances are perhaps motivated by self-interest, more precisely bequest motivations, by the head's family members (see Lucas and Stark, 1999, for a model of remittances which includes farm assets and family size and attempts to separate altruistic from self-interested motivations).

<sup>69</sup> The average level of education of the household's labor force was also included as a regressor but did not prove quite satisfactory. The education of the head performs much better. Perhaps, the education of the household head is a good predictor for the average level of education of the household. In addition, the head's level of education has additional value added as a source of coordination ability in the sense of allocating resources to non farm activities more efficiently.

to the intercept terms in the regime income functions), we report in table 6.5 the set of results of the estimations of the income functions under the restrictive assumption.

What is therefore the return to the Procede? The results in table 6.4 can be used to estimate the answer to that question. Computations of income effects can be made in terms of alternative scenarios by focusing on the subsets of certified and uncertified.

We compute the estimates of net gains relying on coefficient estimates that are significant at the 10% level. The first step is to compute expression 6.10 for each type of income using information from table 6.4. For the non-farm, off-farm, and other income equations, we use the derivative of the unconditional expectations  $E(Y|X)$  to compute the income gain from the Procede, that is  $\frac{\partial E(Y|X, P)}{\partial P}$ . Given that we have estimated these income equations with a Tobit, expression 6.10 needs to be weighted by the probability that the income being considered is in fact positive,  $\Phi\left(\frac{xb}{\sigma}\right)$ , where  $\Phi(\cdot)$  is the cumulative standard normal.

The results are displayed in table 6.6. The interesting result is that the Procede has affected negatively the income of the ejidatarios. In particular, those ejidos that have participated in the program (i.e. certified ejidos) report a loss of MX\$ 4,439<sup>70</sup>, roughly US\$ 490. This loss needs to be added to an estimated per farm cost of certifying an ejido household of MX\$ 4,000<sup>71</sup>. On the other hand, and here we find a really remarkable result, the loss in income comes through its farm component. Non-farm and off-farm

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<sup>70</sup> This is the difference of MX\$ 7,360 (off-farm income) and MX\$ 4,588.

<sup>71</sup> Personal communication with Mr. Nicolás, director of the Procede program at the Procuraduría Agraria in Mexico City. The figure corresponds to approximately US\$ 500 in 1997 and does not include the cost of measuring and certifying common lands.

incomes compensate partially the loss of net farm income. The predicted income loss for uncertified ejidos if they were to participate to the program are estimated at MX\$ 3,194, with the same of patterns of losses and gains as in the case of certified ejidos. In addition, in both cases the program has a stronger positive effect through its non-farm than off-farm component. If Procede is indeed able to reduce those transaction costs related to insecurity of tenure and property rights, then the program will likely have a larger impact through non-farm activities rather than through the local agricultural labor market.

Why do we obtain such unexpected results? How could a program like Procede generate such a loss? Which factors can systematically affect the impact of the Procede on the various components of household income and in particular net farm income? We are inclined to believe that the answer to this question does not lie in an exceptional behavior of farm income. Had yields or prices been particularly good during the 1996/97 crop year, then households that had reallocated their labor from on farm to out of farm activities would have been negatively surprised relative to households who had kept their labor on the farm. In fact, this is not the case. Corn yields and prices were below average compared to 1994, the year in which Procede was launched. This outcome can in fact help explaining why local agricultural labor markets were not particularly 'remunerative' for the ejido farmers. In other words, we would expect to find a negative impact of the Procede on farm income if households had been reallocating labor from the farm to out-of-farm activities<sup>72</sup>. Instead, the explanation needs to be found in the particularly negative impact of the Tequila crisis on urban labor markets, with a fall of real wages and rising unemployment in the few years following the end of 1994. Households that had

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<sup>72</sup> Obviously, some degree of market imperfections explains why farm size adjusted to family labor reallocation away from the farm.



reallocated their labor to non-farm activities were therefore able to realize less income than expected as compared to households that had remained more concentrated on agricultural production.

The key point, nevertheless, is that the Procede has impacted household income sources in opposing directions, signaling a definite drift towards less labor intensity in agricultural production in the ejido sector. This pattern of response signals that the introduction of stronger property rights in the ejido sector through the Procede has started a process of gradual reallocation of labor away from agriculture and towards a pattern of diversification of income sources. This is the fundamental result of this analysis. It sheds light on an aspect related to land titling programs that is at variance with the traditional literature more focused on measuring the impact of titles on land productivity and access to credit.

#### 6.4. Conclusions

In this chapter we have provided an analytical framework to measure the impact of a land titling program on household income and on its different components. The model is based on the assumption that the implementation of the program, by affecting property rights and the institutional dynamics within villages characterized by traditional social structures, has led to a new 'regime' in terms of shadow factor prices. This motivated the switching regression approach followed here.

We then have estimated the impact of the Procede on participation by ejido households to non-farm and off-farm activities. The important finding is that Procede has affected household income components in opposing directions. The results are consistent

with the hypothesis elaborated in chapter 3 that households have reallocated their labor endowment from farming to out of farm activities. This has caused a loss of farm income uncompensated by an increase in income from out-of-farm activities. Yet, the evidence is that a process of disengagement of labor resources from farming, previously characterized by a high labor to land intensity relatively to the private sector, has started with the Procede. It is likely that once the urban economy will be back on a growth path, these changes will produce a positive impact on ejido households and on rural poverty in Mexico.

Should the Procede go on? To begin with, the estimated costs of certifying an ejidatario are likely to increase as the Procede advances for at least two reasons. First, uncertified ejidos are increasingly located in remote areas with a difficult topography (see chapter 4). This will increase the measurement and administrative costs. Second, the cost of conflict resolution will also increase as the program advances as ejidos with border problems have been clearly bypassed in an effort to speed the program (again chapter 4). In addition, the benefits of certification are also likely to get smaller as non-farm income opportunities will be scarcer for more remote ejidos located in mountainous regions and more segregated from the urban economy. Having said that, we believe that the net benefits from the continuation of the program will materialize in the near future and that therefore the option of advancing with the program should not be discarded.

On the other hand, there are reasons to believe that the social benefits generated by the program may also be higher than those accruing through the ejidatarios' incomes. First, we have good reasons to suspect that the *avecindados* have been an important social group whose opportunities in the local agricultural economy have been improved

through the Procede. Second, a titling program of the breadth and scope of the Procede generates two long-term benefits that are difficult to quantify using micro-economic data. One is related to the support that the agrarian cadastre will provide for improving the effectiveness of policy making in rural areas. The second benefit, even more intangible, is related to the reduction in conflicts brought about by the Procede through its built-in decentralized and participative conflict resolution process.

Finally, one important conclusion we draw from the present analysis is that land titling programs do not need to be assessed against their impact on farm productivity. The Procede teaches that the farm economy may be the one least affected by a titling program. Small farmers in many poor areas of the world are undergoing rapid changes in their marketing and commercial environments. There is a growing sense that small farmers find it increasingly difficult to compete with commercial farms in settings where factor markets are largely absent or incomplete. Where land tenure insecurity is a strong deterrent to exit the farm, even if temporarily, titles might offer an initial opportunity to start a process of diversification of household income into more remunerative jobs.

Table 6. 1: Descriptive statistics

	All	Un-certified	Certified
<b>Socio-demographic characteristics:</b>			
<i>Household</i>			
Household size	5.6	5.7	5.4
# male adults	1.7	1.8	1.7
# female adults	1.6	1.6	1.6
# children	2.1	2.2	2.0
<i>Head of household characteristics</i>			
% male household head	96	97	96
education (years)	3.2	3.2	3.2
Age	52	51	53
<i>Productive assets</i>			
<i>Land assets</i>			
Rainfed land (ha)	7.7	7.6	7.9
Irrigated land (ha)	1.7	1.2	2.2
Natural pasture (ha)	4.2	3.5	4.9
Forest (ha)	1.5	1.1	1.9
<i>Farm production capital</i>			
Machinery, working animals, struct. (MX\$)	820	830	808
Livestock (thousand pesos)	14,604	13,600	15,738
<b>Household income:</b>			
<i>Participation to non-farm income sources (%)</i>			
Non farm	50	48	53
Off farm	23	20	26
Other income	30	26	33
<i>Income by source</i>			
Total income	24,591	24,083	25,166
Farm income	15,738	16,387	15,004
Non farm income	5,328	4,484	6,282
Off farm income	1,946	1,635	2,297
Other income	1,580	1,577	1,582
<i>Per capita income by source</i>			
Total income	5,661	5,385	5,973
Farm	3,850	3,806	3,899
Non farm	996	866	1,143
Off farm	420	327	525
Other income	395	387	405
Urban centers within 1 hour transportation	3.5	3.9	3.1
# Observations	1,663	882	781

Source: 1997 Ejido Survey

Table 6. 2: Descriptive statistics by income sources other than farm income

	Income activities other than farm								
	Non Farm			Off farm			Other income		
	All	Un-certified	Certified	All	Un-certified	Certified	All	Un-certified	Certified
Household size	6.0	6.0	6.0	6.2	6.4	6.0	5.2	5.3	5.1
# male adults	1.9	1.8	1.9	1.9	1.9	1.9	1.7	1.7	1.6
# female adults	1.7	1.8	1.7	1.7	1.6	1.7	1.6	1.6	1.6
# children	2.2	2.2	2.2	2.4	2.6	2.3	1.7	1.7	1.8
% male household head	96	97	96	97	97	97	93	94	93
education (years)	3.5	3.6	3.5	3.2	3.1	3.2	2.5	2.6	2.4
age	51	51	51	50	50	50	59	59	58
Rainfed land (ha)	7.5	7.5	7.5	5.7	5.1	6.2	8.8	8.9	8.7
Irrigated land (ha)	1.6	1.1	2.0	1.1	0.6	1.6	1.9	1.7	2.1
Natural pasture (ha)	3.8	3.0	4.6	3.1	2.8	3.4	4.7	5.2	4.2
Forest (ha)	2.0	1.1	3.0	1.0	0.7	1.2	1.2	0.6	1.7
Machinery, working animals, structures (pesos)	858	903	813	677	734	627	977	1,112	857
Livestock (thousand pesos)	13,911	13,831	13,992	8,142	8,206	8,087	17,041	18,878	15,416
Urban centers within 1 hour transportation	4.0	4.6	3.4	3.9	5.3	2.7	4.4	5.9	3.1
# Observations	831	419	412	377	175	202	492	231	261

Source: 1997 Ejido Survey

Table 6. 3: Determinants of household participation to non and off farm activities

	Non-Farm Activities			Off-farm activities		
	(1) Probit r.e.	(2) probit r.e.	(3) Logit f.e.	(4) Probit r.e.	(5) probit r.e.	(6) Logit f.e.
Rainfed land (ha)	-0.001 [0.147]	-0.005 [1.402]	-0.002 [0.312]	-0.024*** [2.868]	-0.029*** [4.124]	-0.046*** [2.924]
Irrigated land (ha)	-0.014 [1.136]	-0.010 [0.989]	-0.028 [1.280]	-0.004 [0.214]	-0.019 [1.206]	0.001 [0.023]
Grazing land (ha)	-0.002 [0.568]	-0.002 [0.985]	-0.001 [0.297]	-0.006 [1.264]	-0.006 [1.318]	-0.016 [1.626]
Ejido with commons (dummy)	0.130 [1.081]	0.103 [0.862]		0.459** [2.561]	0.479*** [2.673]	
# adult males	0.124*** [2.929]	0.140*** [3.506]	0.203*** [2.884]	0.174*** [3.535]	0.196*** [4.247]	0.291*** [3.379]
# adult females	0.220*** [5.091]	0.220*** [5.444]	0.373*** [5.034]	0.082* [1.649]	0.059 [1.263]	0.136 [1.571]
Value of farm machinery	0.000 [0.149]	-0.000 [0.235]	0.000 [0.155]	-0.000 [0.538]	-0.000* [1.647]	-0.000 [0.593]
Value of livestock	-0.000 [0.680]	-0.000 [0.122]	-0.000 [0.649]	-0.000* [1.761]	-0.000** [2.135]	-0.000 [1.376]
Age of ejidatario	-0.005 [1.408]	-0.004 [1.321]	-0.008 [1.356]	-0.007 [1.641]	-0.008** [2.159]	-0.017** [2.062]
Age of ejidatario squared	-0.004* [1.808]	-0.004* [1.709]	-0.007* [1.892]	-0.003 [0.926]	-0.004 [1.032]	-0.008 [1.101]
Education of ejidatario	0.093*** [2.902]	0.098*** [3.357]	0.156*** [2.938]	0.019 [0.443]	0.023 [0.587]	0.041 [0.506]
Gender of ejidatarios (1=male)	0.131	0.086	0.292	0.155	0.138	0.285

	[0.620]	[0.438]	[0.771]	[0.610]	[0.575]	[0.636]
# urban areas within 1hour	0.002	0.003		0.002	0.003	
	[0.346]	[0.701]		[0.435]	[0.484]	
Procede (dummy)	0.144	0.140		0.309**	0.303**	
	[1.501]	[1.458]		[2.314]	[2.290]	
<b><i>Villane</i></b>						
<b><i>averages</i></b>						
Rainfed land (ha)	-0.014			-0.013		
	[1.598]			[1.076]		
Irrigated land (ha)	0.009			-0.030		
	[0.430]			[0.949]		
Grazing land (ha)	-0.005			0.004		
	[0.938]			[0.486]		
# adult females	-0.013			-0.210		
	[0.112]			[1.273]		
Value of farm machinery	-0.000			-0.000*		
	[0.850]			[1.836]		
# adult males	0.123			0.215		
	[1.054]			[1.404]		
Value of livestock	0.000			-0.000		
	[1.388]			[0.532]		
Age of ejidatario	0.001			-0.002		
	[0.096]			[0.200]		
Age of ejidatario squared	0.009			-0.006		
	[1.251]			[0.589]		
Education of ejidatario	-0.034			0.087		
	[0.399]			[0.733]		
Gender of ejidatarios (1=male)	-0.393			-0.379		
	[0.706]			[0.517]		

North Pacific (dummy)	-0.515**	-0.352*		-1.137***	-1.016***	
	[2.529]	[1.914]		[4.066]	[3.923]	
Center (dummy)	-0.012	0.073		-1.065***	-0.976***	
	[0.073]	[0.499]		[4.916]	[4.928]	
Gulf (dummy)	0.271	0.254		-0.084	0.023	
	[1.203]	[1.150]		[0.284]	[0.079]	
South Pacific (dummy)	-0.487***	-0.394**		-1.369***	-1.248***	
	[2.842]	[2.447]		[5.627]	[5.494]	
Sub-humid tropical (dummy)	-0.023	-0.013		0.180	0.144	
	[0.119]	[0.066]		[0.710]	[0.559]	
Humid temperate	0.020	0.039		0.152	0.215	
	[0.058]	[0.115]		[0.350]	[0.501]	
Subhumid temperate	-0.007	0.017		0.317	0.309	
	[0.032]	[0.077]		[1.052]	[1.050]	
Arid and semi- arid	0.185	0.231		-0.122	-0.113	
	[0.788]	[0.993]		[0.385]	[0.361]	
Constant	-0.485	-0.750**		-0.231	-0.761	
	[0.658]	[1.992]		[0.218]	[1.564]	
Observations	1645	1645	1373	1645	1645	870
Number of efolio	286	286	233	286	286	149
Wald test: Chi2=	123.688	115.673		133.604	126.620	
LR test: Chi2=			68.973			42.260

Absolute value of z statistics in brackets

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%



Table 6. 4: Household income functions with distribution effects

	(1) Total income	(2) Farm net income
Rainfed land (ha)	1,076.751*** [6.161]	984.117*** [6.595]
Irrigated land (ha)	2,659.944*** [6.194]	2,630.302*** [7.174]
Natural pasture (ha)	-56.674 [0.710]	-113.897* [1.670]
Common lands (dummy)	-6,544.079** [2.294]	-6,823.211*** [2.645]
# Male adults	1,699.638 [1.126]	-382.226 [0.296]
# Female adults	4,657.276*** [3.161]	2,628.443** [2.090]
Farm capital value	1.162 [1.260]	1.408* [1.788]
Livestock value	0.134*** [3.402]	0.144*** [4.307]
Age of head	72.308 [0.777]	-5.636 [0.071]
Age of head squared	-96.352 [1.493]	-69.701 [1.265]
Education of head (years)	2,164.438** [2.566]	1,248.215* [1.733]
Head gender (dummy=1 if male)	-3,163.171 [0.584]	558.496 [0.121]
# urban areas within 1 hour	-158.763 [1.526]	-143.972 [1.534]
Procede (dummy)	-2,402.619 [1.063]	-4,587.811** [2.244]
<i>Demeaned interacted terms</i>		
Rainfed land	-658.647*** [2.754]	-616.283*** [3.018]
Irrigated land	-1,765.768*** [2.798]	-1,774.081*** [3.292]
Natural pasture	29.101 [0.200]	115.625 [0.931]
# Male adults	-86.725 [0.040]	-1,455.082 [0.795]

# Female adults	673.774 [0.312]	-764.796 [0.415]
<b><i>Village averages</i></b>		
Rainfed land	31.833 [0.110]	144.408 [0.566]
Irrigated land	-522.722 [0.779]	-425.752 [0.718]
Natural pasture	768.607*** [3.726]	781.845*** [4.228]
# Adult female	-7,826.203** [2.068]	-8,270.752** [2.440]
Farm capital	1.287 [0.688]	-0.210 [0.126]
# Adult male	1,094.028 [0.275]	2,741.053 [0.769]
Livestock capital	-0.078 [0.902]	-0.139* [1.793]
Age of head	75.579 [0.402]	60.476 [0.361]
Age of head squared	356.556** [2.018]	292.380* [1.841]
Head education	-3,382.919* [1.681]	-2,423.612 [1.343]
Head gender (dummy=1 if male)	3,625.910 [0.267]	-1,090.158 [0.090]
Demeaned Rainfed land	-24.468 [0.062]	168.250 [0.485]
Demeaned Irrigated land	1,922.709** [2.150]	1,535.004* [1.953]
Demeaned Natural pasture	-740.890*** [2.683]	-721.999*** [2.943]
Demeaned # Adult male	3,050.771 [0.550]	1,444.858 [0.291]
Demeaned # Adult female	6,218.761 [1.135]	8,030.338 [1.638]
<b><i>Other variables</i></b>		
Loans land (dummy)	10,382.994* [1.810]	12,277.764** [2.489]
Borrows/lends land (dummy)	-9,865.949 [1.446]	-11,043.070* [1.876]
North Pacific (dummy)	-10,300.778** [2.088]	-1,960.943 [0.441]

Center (dummy)	-11,636.599*** [3.058]	-4,640.873 [1.349]
Gulf (dummy)	-13,606.539** [2.520]	-4,527.937 [0.927]
South Pacific (dummy)	-13,981.348*** [3.446]	-5,026.823 [1.369]
Sub-humid tropical (dummy)	2,130.011 [0.465]	4,452.839 [1.075]
Humid temperate (dummy)	716.469 [0.089]	4,505.551 [0.608]
Sub-humid temperate (dummy)	3,541.215 [0.691]	6,918.093 [1.492]
Arid and semi-arid (dummy)	-5,329.593 [0.954]	-570.867 [0.113]
Constant	14,144.235 [0.768]	9,849.289 [0.591]
R2 Within	0.11	0.12
R2 Between	0.43	0.42
R2 Overall	0.22	0.22
Chi 2 (Wald test of model significance)	386.08	379.21
Observations	1645	1645
Number of ejidos	286	286

Absolute value of z statistics in brackets

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

Table 6.4 (continued) Household income functions with distribution effects

	(3) Non farm income	(4) Off-farm income	(5) Other income
Rainfed land (ha)	174.265 [1.396]	-707.884 [1.594]	125.979 [1.170]
Irrigated land (ha)	-60.518 [0.180]	-2,147.655 [1.644]	-22.740 [0.105]
Natural pasture (ha)	61.258 [1.057]	12.163 [0.153]	19.058 [1.172]
Common lands (dummy)	1,471.789 [0.666]	5,107.719** [1.966]	968.621 [0.772]
# Male adults	3,634.287*** [3.365]	3,346.475** [2.341]	-1,152.720* [1.668]
# Female adults	3,549.525*** [3.385]	1,555.610 [0.948]	138.671 [0.156]
Farm capital value	-0.580 [0.875]	-0.049 [0.046]	0.737 [1.554]
Livestock value	-0.015 [0.542]	-0.098* [1.872]	0.019 [1.029]
Age of head	-83.506 [1.236]	24.985 [0.154]	293.482*** [5.642]
Age of head squared	-40.805 [0.906]	-108.295 [1.258]	8.851 [0.260]
Education of head (years)	1,372.358** [2.275]	1,394.086 [1.129]	-462.859 [1.088]
Head gender (dummy=1 if male)	-1,271.311 [0.323]	-2,228.347 [0.373]	-4,442.774** [2.322]
# urban areas within 1 hour	-6.663 [0.085]	-14.771 [0.191]	47.596* [1.724]
Procede (dummy)	3,173.949* [1.824]	7,359.796*** [2.916]	550.871 [0.574]
<i>Demeaned interacted terms</i>			
Rainfed land	-151.302 [0.903]	344.002 [0.774]	-174.459 [1.315]
Irrigated land	-196.705 [0.426]	2,692.526* [1.861]	-274.106 [0.963]
Natural pasture	-24.019 [0.227]	-305.932* [1.681]	-124.832** [1.976]
# Male adults	697.208 [0.463]	258.827 [0.147]	346.768 [0.344]
# Female adults	2,012.056	23.017	747.758

	[1.322]	[0.012]	[0.637]
<i>Village averages</i>			
Rainfed land	-320.628 [1.461]	-283.526 [0.981]	-113.239 [0.590]
Irrigated land	-564.005 [1.006]	-536.896 [0.503]	287.249 [1.027]
Natural pasture	-55.936 [0.356]	137.954 [0.614]	-52.421 [0.820]
# Adult female	-512.633 [0.177]	1,688.176 [0.557]	1,547.846 [0.816]
Farm capital	0.889 [0.639]	-3.498 [1.564]	1.095 [1.326]
# Adult male	-1,791.298 [0.585]	-1,200.187 [0.379]	-2,253.229 [1.361]
Livestock capital	0.055 [0.846]	0.009 [0.087]	0.040 [0.883]
Age of head	97.879 [0.692]	-180.623 [0.839]	192.786*** [2.613]
Age of head squared	131.135 [0.982]	88.763 [0.487]	-40.448 [0.504]
Head education	-198.650 [0.131]	-1,886.422 [0.997]	85.383 [0.093]
Head gender (dummy=1 if male)	-198.044 [0.019]	-3,676.349 [0.345]	4,959.294 [0.992]
Demeaned Rainfed land	219.969 [0.750]	-232.126 [0.674]	77.234 [0.359]
Demeaned Irrigated land	1,251.948* [1.794]	-228.960 [0.186]	31.600 [0.097]
Demeaned Natural pasture	-143.183 [0.676]	-89.543 [0.321]	194.193 [1.632]
Demeaned # Adult male	4,137.309 [0.988]	6,705.884 [1.523]	-1,481.339 [0.647]
Demeaned # Adult female	-1,604.895 [0.384]	-8,705.317** [2.027]	-421.381 [0.171]
<i>Other variables</i>			
Loans land (dummy)	-205.842 [0.050]	-8,077.814 [1.189]	2,128.487 [1.003]
Borrows/lends land (dummy)	4,740.016 [1.004]	2,866.166 [0.559]	-498.708 [0.198]
North Pacific (dummy)	-9,568.498** [2.494]	-24,140.376*** [3.068]	-2,895.815 [1.293]
Center (dummy)	-3,088.027	-23,976.460***	-1,611.132

	[1.075]	[3.459]	[0.888]
Gulf (dummy)	-752.322	-10,486.213*	1,085.188
	[0.184]	[1.865]	[0.523]
South Pacific (dummy)	-10,742.4***	-26,354.4***	-4,258.2*
	[3.431]	[3.979]	[1.959]
Sub-humid tropical (dummy)	782.349	-1,031.009	-997.574
	[0.225]	[0.199]	[0.593]
Humid temperate (dummy)	741.811	-7,200.068	-2,670.726
	[0.119]	[0.908]	[0.789]
Sub-humid temperate (dummy)	722.438	-2,593.490	-3,410.858
	[0.184]	[0.451]	[1.585]
Arid and semi-arid (dummy)	2,669.335	-10,505.020	-1,937.197
	[0.630]	[1.409]	[0.878]
Constant	-16,972.729	9,247.562	-31,599.762***
	[1.194]	[0.645]	[3.834]
Chi 2 (Wald test of model significance)	174.39	109.52	102.56
Observations	1645	1645	1645
Number of ejidos	286	286	286

Absolute value of z statistics in brackets

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

Table 6. 5: Household income functions without distributive effects

	Total income Random Effects	Farm net income Random Effects
Rainfed land (ha)	740.596*** [5.983]	675.994*** [6.381]
Irrigated land (ha)	1,852.126*** [5.842]	1,818.297*** [6.702]
Natural pasture (ha)	-48.179 [0.712]	-80.114 [1.383]
Common lands (dummy)	-5,621.883* [1.909]	-6,357.056** [2.417]
Male adults	1,817.226* [1.654]	-955.948 [1.017]
Female adults	5,009.978*** [4.617]	2,295.035** [2.472]
Farm capital value	1.401 [1.524]	1.683** [2.139]
Livestock value	0.129*** [3.292]	0.141*** [4.182]
Age of head	94.294 [1.013]	15.879 [0.199]
Age of head squared	-102.615 [1.586]	-74.495 [1.346]
Education of head (years)	2,347.397*** [2.787]	1,373.929* [1.906]
Head gender (dummy=1 if male)	-3,684.704 [0.679]	-311.156 [0.067]
# urban areas within 1 hour	-99.957 [0.933]	-102.228 [1.070]
Procede (dummy)	-2,690.624 [1.143]	-4,815.141** [2.290]
<b><i>Village averages</i></b>		
Rainfed land	82.297 [0.379]	263.653 [1.380]
Irrigated land	429.070 [0.868]	278.168 [0.641]
Natural pasture	250.590* [1.713]	316.154** [2.448]
# Adult female	-3,787.358 [1.293]	-3,669.354 [1.412]
Farm capital	0.566 [0.297]	-0.736 [0.436]
# Adult male	1,898.879	2,809.248

	[0.658]	[1.097]
Livestock capital	-0.048	-0.118
	[0.534]	[1.490]
Age of head	111.209	91.677
	[0.575]	[0.535]
Age of head squared	373.386**	310.973*
	[2.052]	[1.922]
Head education	-3,656.806*	-2,718.009
	[1.760]	[1.473]
Head gender (dummy=1 if male)	12,410.055	5,139.492
	[0.912]	[0.426]
<i>Other variables</i>		
Loans land (dummy)	9,983.239*	11,994.217**
	[1.733]	[2.421]
Borrows/lends land (dummy)	-9,853.124	-11,105.191*
	[1.430]	[1.869]
North Pacific (dummy)	-7,234.529	-248.906
	[1.454]	[0.056]
Center (dummy)	-8,896.002**	-3,064.815
	[2.294]	[0.885]
Gulf (dummy)	-11,399.919**	-3,102.331
	[2.056]	[0.626]
South Pacific (dummy)	-12,843.139***	-4,703.897
	[3.073]	[1.259]
Sub-humid tropical (dummy)	1,734.845	4,094.674
	[0.368]	[0.972]
Humid temperate (dummy)	-1,236.097	3,178.940
	[0.146]	[0.416]
Sub-humid temperate (dummy)	3,945.358	7,103.541
	[0.741]	[1.493]
Ardi and semi-arid (dummy)	-4,588.547	-354.274
	[0.793]	[0.069]
Constant	-4,101.678	-1,883.534
	[0.226]	[0.116]
<hr/>		
Observations	1645	1645
Number of ejidos	286	286
<hr/>		

Absolute value of z statistics in brackets  
significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%  
1/ Tobit controlling for cluster effects



Table 6.5 (continued) Household income functions without distributive effects

	Non farm income Tobit, r.e.	Off-farm income Tobit <sup>1/</sup>	Other income Tobit <sup>1/</sup>
Rainfed land (ha)	89.346 [1.036]	-467.210** [2.011]	36.400 [0.553]
Irrigated land (ha)	-153.144 [0.672]	55.311 [0.165]	-128.959 [0.941]
Natural pasture (ha)	53.382 [1.070]	-115.660 [1.073]	-11.909 [0.431]
Common lands (dummy)	2,271.400 [1.024]	5,887.487* [1.786]	861.331 [0.690]
Male adults	4,048.345*** [5.243]	3,357.068*** [3.362]	-940.366* [1.762]
Female adults	4,526.218*** [5.915]	1,610.763 [1.454]	520.044 [0.869]
Farm capital value	-0.549 [0.838]	-0.459 [0.473]	0.764 [1.591]
Livestock value	-0.015 [0.554]	-0.098* [1.867]	0.018 [0.933]
Age of head	-78.397 [1.162]	19.079 [0.120]	295.570*** [5.658]
Age of head squared	-43.526 [0.965]	-100.497 [1.191]	8.495 [0.251]
Education of head (years)	1,470.061** [2.445]	1,253.151 [1.074]	-415.050 [0.949]
Head gender (dummy=1 if male)	-1,005.869 [0.256]	-1,465.083 [0.275]	-4,340.598** [2.293]
# urban areas within 1 hour	16.920 [0.215]	13.458 [0.140]	41.345 [1.522]
Procede (dummy)	3,284.432* [1.875]	6,036.093** [2.243]	476.310 [0.486]
<b><i>Village averages</i></b>			
Rainfed land	-172.028 [1.079]	-383.604 [1.459]	-63.581 [0.579]
Irrigated land	227.360 [0.629]	-696.914 [1.150]	279.144 [1.508]
Natural pasture	-160.890 [1.457]	74.589 [0.459]	18.418 [0.347]
# Adult female	-1,295.566 [0.594]	-2,254.191 [0.798]	1,266.788 [0.990]
Farm capital	0.384 [0.276]	-2.861 [1.237]	1.195 [1.399]

# Adult male	218.606 [0.103]	2,341.809 [0.834]	-3,007.927** [2.031]
Livestock capital	0.069 [1.051]	0.016 [0.150]	0.040 [0.884]
Age of head	95.690 [0.672]	-183.780 [0.768]	190.656*** [2.587]
Age of head squared	100.284 [0.750]	57.380 [0.261]	-35.564 [0.454]
Head education	-51.361 [0.034]	-1,661.006 [0.730]	15.229 [0.016]
Head gender (dummy=1 if male)	2,414.577 [0.238]	-4,604.718 [0.360]	4,261.996 [0.852]
<b><i>Other variables</i></b>			
Loans land (dummy)	-499.290 [0.120]	-8,748.425 [1.263]	1,638.634 [0.801]
Borrows/lends land (dummy)	4,598.275 [0.971]	1,239.932 [0.210]	-550.166 [0.234]
North Pacific (dummy)	-7,897.909** [2.110]	- [2.588]	-3,082.116 [1.386]
		21,092.387***	
Center (dummy)	-2,007.9 [0.706]	-22,300.9*** [2.976]	-1,550.4 [0.852]
Gulf (dummy)	-638.414 [0.157]	-10,275.482 [1.399]	1,492.330 [0.762]
South Pacific (dummy)	-9,713.0*** [3.110]	-23,995.1*** [3.408]	-4,239.2* [1.954]
Sub-humid tropical (dummy)	263.690 [0.076]	-2,395.161 [0.413]	-895.226 [0.539]
Humid temperate (dummy)	-12.811 [0.002]	-7,181.257 [0.907]	-2,642.840 [0.800]
Sub-humid temperate (dummy)	629.035 [0.158]	-2,893.080 [0.412]	-3,324.501 [1.570]
Ardi and semi-arid (dummy)	2,875.362 [0.673]	-10,961.844 [1.259]	-1,843.772 [0.858]
Constant	-26,766.7** [1.964]	6,244.3 [0.354]	-30,028.2*** [3.809]
Observations	1645	1645	1645
Number of ejidos	286	286	286

Absolute value of z statistics in brackets  
significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%  
1/ Tobit controlling for cluster effects

Table 6. 6: Average Treatment Effects of the Procede

	All ejidos	Certified	Uncertified
Total income*	-3,778	-4,439	-3,194
Farm income	-4,588	-5,679	-3,630
Non-farm income	724	974	503
Off-farm income	128	231	36
Other income	-19	17	-51
# observations	1645	772	873

\*Total income is not equal to the sum of farm, non-farm, off-farm and other income as only significant coefficients in table 6.4 were used in the computations.

## Chapter 7: Conclusions and policy implications

### 7.1. Summarizing the results

This dissertation has examined the rationale, the effects, and the implications of the Procede, a large scale land titling program that was designed as a tool for unlocking the competitiveness of Mexico's ejido sector and raising its income level. The premises of the Procede were that land tenure in Mexico was insecure and that productive incentives were constrained by the local institutions governing access to land. Tenure insecurity and weak property rights over land were at the root of the sector's backwardness. The Procede was conceived as a program that would improve tenure security and increase the incentives to improve land productivity, thereby raising the sector's overall living standards. Looking back at the set of propositions spelled out at the end of chapter 3, what have we found?

A first conclusion is that the Procede has had an impact on land rental out decisions but a minor one on land rental in. Moreover, the magnitude of the former impact is not particularly large. The main conclusion we draw in this respect is that tenure insecurity is only one of several institutional constraints that limit rental market activities in the ejidos.

A second important finding of this research is that the Procede has contributed increased diversification of ejidatarios' income sources. The results suggest that it has affected negatively farm profits, but has favored participation by ejidatarios to non agricultural activities while opening spaces for increased participation in the local land market by *avecindados*, mostly landless farmers. The overall impact was negative, but

this appears to be mostly a reflection of the external shocks affecting the agricultural sector versus the rest of the economy in the years following the ‘Tequila crisis’. The key point is that Procede has structurally affected the composition of household income and the participation by households in non-farm and off-farm activities.

Whether these changes will also translate into more land-related investments is a point we could not analyze in this setting given the structure of the available data. Indeed it is an issue that should be researched once the appropriate data will become available. In what follows we discuss some specific implications of the evidence found so far with respect to land rights in Mexico, land markets, and the process of diversification of income sources undertaken by the ejido households as a result of the new regime of land rights now existing in the country.

## 7.2. Administration of land titling programs

In chapter 4, we examined the important issue of whether the Procede had been implemented following economic incentives or bureaucratic interests. We found indeed that the nature of the process by which the P.A. had selected ejidos in the early stages of the certification process is consistent with the hypotheses that this institution was planning its operations with goals that were not entirely consistent with the idea of maximizing the program’s social impact. In order to acquire enough mass and maintain the program in case of a change in country’s presidency, the PA decided to proceed by maximizing the number and the area of certified ejido at any given point in time. This has led many ejidos that would in fact have benefited from the conflict resolution mechanism embodied in the Procede to remain excluded from the process. In addition, it appears that

more populous ejidos were left out and these, as we saw in chapter 6, were those ejidos who might have benefited most from the Procede by increasing the supply of labor to non and off-farm activities. This raises questions, on a scale that transcends Mexico's context, regarding the implementation of compulsory or quasi-mandatory titling programs when these are subject to political uncertainty. The lesson that one draws is that mandatory titling programs need to be given a realistically long enough horizon to complete their operations. The Procede, from its inception, was assigned the unrealistic task of titling an extension of land equal to the sum of the land areas of Portugal, Spain, and France within a four year time period. This has created the incentives to distort the objectives.

A fundamental problem in mandatory or quasi-mandatory land titling programs is that of their sustainability over time. We have mentioned in chapter 1 that only a small percentage of the land sales that took place (of the few that effectively took place since 1992, contrary to the fears of the reforms' opponents) were in fact registered in the Agrarian Registry. The Procuraduría Agraria also confirmed this finding in a recent study. If such trend dominates future land sales, there is a concrete risk that the investment undertaken with the Procede will become meaningless, as land rights will revert to informality. The risk of never achieving formality of land rights is not an exclusive characteristic of mandatory programs. As Firmin-Sellers and Sellers (1999) have shown, in societies where customary rights are still enough strong, individuals may resort to land titles in order to affirm their rights to land in front of other community members, without in fact completing the bureaucratic procedure required for those rights to be recognized by the State. In other words, the individual investment in demarcating and registering land rights is left incomplete, as it only serves the purpose of informing

the local community of the existence of such rights. In Mexico's ejidos there is the risk that something analogous may in fact happen. Once the Procede has established among members of a community the rights of each member to a given plot of land, there is no interest in investing in further formalizing those rights. The low volume of land transactions may in fact reinforce such lack of interest, at least until the intensity of conflicts will revert to the pre-Procede state. This possibility suggests that alternative ways, cheaper and subject to fewer transaction costs, need to be found in order to record changes in land ownership systematically. Yet, the problem transcends the registration of changes in present land rights. In fact, large tracts of land are still maintained as common property and the privatization process that is now underway may give rise to a substantial share of land with informal rights.

Besides the issue of land certification, it is evident that the Procede has had another major drawback with respect to common lands. As explained in chapter 1, there are no figures that can substantiate fully the following assertion, but good sense suggests that the increase in individual landholdings observed between 1993 and 1996 corresponds to a sizeable privatization of common lands. By offering low-cost means of titling land appropriated informally, the Procede might have favored such a process. It still remains unclear whether the privatization of the commons has advanced too much and it remains a topic for further research once the next agricultural census becomes available<sup>73</sup>. Yet, the privatization of the commons might have created in some cases a group of small ejidatarios enough strong to oppose the program and thereby avoid the legalization of appropriations of common lands carried out by other ejidatarios. As a result, the mere presence of the program might have increased the set of ejidos that would oppose it.

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<sup>73</sup> The last agricultural census was carried out in 1991.

These ejidos would then continue to be plagued by internal conflicts, which in turn might undermine the program's intended objective of bringing social peace among ejidatarios.

The last three points suggest a further principle to apply when designing land registration and titling programs. Effective mechanisms for land dispute resolution and for land transaction registration need to be permanently deployed in the field and become operative once the formal program is finalized. These mechanisms need to be devised so as to keep transaction costs low, while maintaining operational flexibility. Regional programs that can proceed to title without necessarily registering ownership of newly appropriated common lands or recently purchased land would allow fielding programs later on that could proceed to a more formal certification of such transactions. These informal, or quasi-formal, programs could be organized at the community level provided the local village assembly approves the new transactions. As it stands, the Procede only offers full titles and their formal registration in alternative to widespread informality.

### 7.3. Land markets

Land titling programs are thought of as means of reinforcing tenure security and leading to more efficient land markets. This key proposition, relative to land rental market only, was tested with detail in chapter 5. There we found that indeed the Procede increased the supply of land for rental, but that the overall impact was quite modest. The results show that land markets in Mexico's ejido sector are far less efficient than estimated in previous work and other factors are at work increasing the transaction costs participants face. In fact, it was found that land markets are heavily influenced by the productive assets owned by the household, something one would expect in a setting



where access to production credit is severely restricted. In other words, farm size is on average sub-optimal and tenure insecurity appears to be a relatively minor factor in that situation. Customary rights that regulate land transactions, mainly in communal ejidos, do offer tenure security (communal tenure reduces the likelihood of a positive attitude towards the Procede), but reduce participation to the land market. Other institutional factors are also at work. Ejidatarios that are also private owners are less involved in renting land out. This might be easily explained by the fact that ejidatarios with private holdings are ‘acquired’ ejidatarios (i.e. previously they were pure private landowners), or, alternatively, ejidatarios that have ‘exited’ the village boundaries placing themselves out of the close web of interpersonal relationship that characterize a stylized closed ejido village economy. Whatever the case, these mixed landowners participate less in the land market.

Yet, as we have mentioned above, the Procede has favored the inclusion of *avecindados* in the local farm economy. This was clearly seen by analyzing the counterpart choice in chapter 4. The increased participation by *avecindados* was one of the key objectives of the 1992 reform. Whether the inclusion of these younger farmers into the local ejido farm economy will raise farm productivity is an issue that has been raised from time to time in the context of the debate on the intergenerational transfer of land in Latin American agrarian societies (see Tejo, 2003). It remains an area for future research. The key question is whether a tenancy ladder may in fact be at work, favoring the access to landownership by a generation of young farmers with a higher propensity to invest in land improvements. If that is the case, then the 1992 reforms and the Procede

will have indeed favored an important process whose fruits will become more evident in the long term.

#### 7.4. The non-farm economy

In chapter 1 it was shown that a marked characteristic of the ejido sector was the higher labor to land and labor to capital ratios relatively to the private sector. This clearly explains the widespread poverty among ejidatarios. Has the Procede favored the reallocation of labor from farm to non-farm activities? The analysis in chapter 6 has shown that the major impact from the Procede came in fact from the increased participation by ejido households to the local agricultural labor market and to non-farm activities. This was an important result as it showed that land titling programs might have quite different results than that of raising land productivity. One of their main effects may in fact consist in favoring the integration of farm households into the rural economy, promote a diversification of household income sources, thereby leading to more adaptable livelihood strategies, and open new channels through which credit constrained households may accumulate enough liquidity to finance accumulation of capital and smoothen the adverse effects of income shocks.

These findings suggest that it might have become more profitable to invest in public infrastructures to better connect those ejidos that are less integrated into the urban economy, accommodating the increased supply of labor to non-farm activities that accompanies the Procede. The same considerations hold also in the case of additional investments in raising education levels and standards in those areas where labor is being 'released' towards non-farm activities as a result of the Procede.

### 7.5. Final considerations

Dissolution of the ejido land tenure system through a complete privatization presently is not even a theoretical proposition in Mexico. The extremely low rate of adoption of the *dominio pleno* (full private property rights) shows that given the actual structure of transaction costs (including the land tax that only affects private farmers), the ejido sector has reached an 'equilibrium' in the sense that there is no pressure from below towards a complete privatization of land rights. In the meantime, the Procede has been suspended and land tilting now becomes completely voluntary, although it is not yet clear what the costs for titling land would be for an ejido farmer and whether ejidos would still need to act collectively in order to title the land. Yet one would expect that as the share of household income coming from farming will progressively diminish, full privatization will become increasingly more attractive from the point of view of the ejidatarios as the tendency to exit the sector will become more widespread. This process will of course differ from ejido to ejido given socioeconomic characteristics and opportunity for further redistribution of common lands. In this sense, the Procede has marked an important transition in the system of agrarian rights in Mexico, laying the basis for future individualization of rights. It is reasonable to expect that when common lands cease to be an important source of insurance for the poorest ejido households, the process of privatization may in fact accelerate. At that stage, though, a further constitutional reform might become appropriate in order to move the agrarian sector to that new stage of increased individualization of land rights.

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