

Mexico's "second agrarian reform": Implementation and impact

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Abstract: We describe key characteristics and the legal and institutional changes made by the Mexican Government in 1992 to reform the *ejido* sector and systematic implementation of these changes in a land regularization program (*PROCEDE*) and use survey evidence to assess the impact of this intervention. Non-economic benefits associated with the program include a reduction in conflicts, significantly increased land access for formerly marginalized groups, and improved governance and accountability at the local level. Quantitative evidence suggests that *PROCEDE*, but not the legal reforms per se, improved the functioning of rental markets and access to common property resources but had no significant impact on credit access or land sales. These economic benefits were generated mainly through increased incorporation of *ejidatarios* into the non-farm sector and the reform had a clearly positive impact on equity.

1. Introduction

From the 1917 revolution until 1992, Mexico has implemented a large-scale process of land reform, which distributed more than 100 million hectares, or 50% of the arable area, from large farms to the so-called "social sector". This sector comprises of households mainly organized in *ejidos*, rural communities modeled after a mixture of soviet-style collectives and pre-colonial indigenous social structures. While the achievements in terms of physical distribution of land were impressive, the model of production adopted was widely seen as being characterized by several shortcomings which prevented the realization of the expected benefits from the reforms (Tellez 1994; deJanvry et al. 1998). First, a continuing mandate for redistribution of private land undermined the security of property rights and thus agricultural investment outside the *ejido* sector while centralized intervention by the state in day-to-day governance of the social sector decreased local governance and responsibility. Second, property rights within the *ejido* were weak. Legal provisions making usufruct of *ejido* lands conditional on self-cultivation. At the same time, inheritance restrictions undermined the functioning of land markets and opened up the possibilities for political manipulation. This led to a situation where many old *ejidatarios* were unable to make efficient use of their land while young households next to the *ejido* suffered from land shortage or insecure tenure. It also created obstacles to the process of urban expansion that affected an increasing number of *ejidos* and reduced the scope for effective collective action for resource management.

To overcome these limitations, the Mexican Government adopted in 1992 a comprehensive set of reforms that focused on modifications of the legal environment, institutional changes, and the implementation of a systematic program of land regularization (*Programa Nacional de Certificacion de Derechos Ejidales y Solares Urbanos* or *PROCEDE*). The goal was to eliminate restrictions on the functioning of land markets, empower communities to choose the property rights regime most suitable to their needs (i.e.

either communal, individual, or mixed), to increase security of tenure and investment by issuing certificates of land ownership, establish an institutional structure to reduce the cost of verifying and transferring land rights, and deal with the backlog of land conflicts that had been inherited from the past. The reforms were subject to substantial discussion and controversy; while supporters viewed them as essential to overcome what they considered a long-standing and policy-induced stagnation of the rural sector, critics argued that the reforms were, at best, unnecessary and focused on the wrong issues and, at worst, would lead to the disappearance of the *ejido* and irreparable damage to the social structure in rural areas (Thompson and Wilson 1994).

Despite the large scale of the program, the discussion surrounding its adoption, and the potential importance of the reforms for other countries faced with the task of making a transition from customary to more individualized forms of land tenure, no systematic evaluation of the legal reforms or the implementation of *PROCEDE* has, as of yet, been undertaken. Evidence at the *municipio* level, though providing interesting hypotheses, is insufficient to make inferences on the program's impact {Johnson 2001}. An array range of publications by the Mexican Government (Rincon 2000, Secretaria de Reforma Agraria 1998; Procuraduria Agraria 1998 and 2000) provides detailed information on *ejidos* that have undergone *PROCEDE* but, due to the absence of a control group, is unable to draw conclusions on program impact. World Bank (1998) focuses on a describing rural poverty as well as other government programs but offers little evidence as to the impact of either the legal changes or their implementation. The essays and case studies compiled in Cornelius and Mhyre (1998) offer fascinating insights into specific issues but are neither representative of the whole sector nor comparable among each other. Based on a more representative sample, an impressive amount of descriptive evidence is, in view of the recent nature of the reforms, lack a sufficient basis for making causal inferences on the impact of the reforms {deJanvry et al. 1997}.

In this paper, we use a combination of data sources to describe the changes made, the implementation of *PROCEDE*, and to make inferences on the impact of these measures. Section two describes the background, emphasizing in particular the relevance of the *ejido* to deal with the inter-related issues of poverty, sustainable resource use, and productivity and the broader macro-economic and sectoral reforms undertaken in the early 1990s. Section three discusses the motivation for the legal and institutional changes adopted in the context of Mexico's *ejido* reform, the implementation arrangements for the land regularization program, and quantitative accomplishments as well as determinants of program implementation. Section four presents evidence concerning the impact of the program on the operation of factor markets, natural resource management, and the overall benefits. Section five discusses conclusions

and policy implications concerning the completion of the program, the sustainability of the information generated, and the program's contribution to broader development in rural Mexico.

2. *Macro-economic and sectoral background*

As a background for the subsequent analysis, this section describes salient characteristics of the *ejido* sector which, located at the intersection of the problems of productivity and efficient land use, poverty, and sustainable resource management, epitomizes many of the broader issues that need to be tackled for economic and social advancement in rural Mexico. A description of the macro-economic and sectoral reforms undertaken since the early 1990s as well as measures to facilitate the transition illustrates that these need to be complemented by direct attention to the endowments of the poorest and improved functioning of factor markets, something that was attempted with the *ejido* reforms.

2.1 *The ejido sector at the core of Mexico's rural problems*

The social sector, comprising 29,162 communities (26,796 *ejidos* and 2,366 *comunidades*¹) with an estimated population of 3.2 million, emerged from the land reforms after the Mexican Revolution. Art. 27 of the country's 1917 Constitution endowed it with control over substantial land resources. It controls 103 million hectares or 56% of the land usable for agriculture as well as 70% of the nation's forests. Individual *ejido* members could acquire usufruct rights to individual parcels of land, access to communal land, and a house plot. They had to work the land directly; rental or sale, as well as hiring of labor, were prohibited and being absent from the land for more than two years led to loss of usufruct rights. This limited the ability to access credit and led to the evolution of a special system that gave credit in kind to the group, rather than individuals, conditional on cultivation of approved crops. Even though members could vote in the *ejido* assembly, political interference was common; the validity of assembly decisions had to be countersigned by state institutions, which were often aligned with powerful political interests. Independent mechanisms to seek redress, e.g. against appropriation of common lands by powerful and politically well-connected individuals, were unavailable. The combination of weak property rights and political interference in *ejido* matters appear to have reduced investment incentives, undermined the potential for collective action, and eliminated the ability to participate in outside factor markets. Three key areas and challenges to which the traditional *ejido* system was increasingly unable to respond can be identified.

First, Mexico is unique not only in its extraordinary ecological and biological diversity but also in that about 70% of its forest area is located within the social sector, in *ejidos* with a significant share of indigenous population and poverty. In 1996, 85% of the rural population was classified as poor and 60%

as extremely poor, compared to 47% and 19% for urban areas, respectively. Much of this poverty is concentrated in unfavorable agro-ecological endowments, lack of irrigation, ethnicity, and location in the Southern States and in the *ejido* sector, something as highlighted by census data. As illustrated in table 1, 53% of *ejido* households, as compared to 26% of the total population, received less than one minimum wage. Regional differences are pronounced, with the share of households below one minimum wage lowest in the North Pacific (15% and 25% for *ejidos*) and highest in the Gulf (49% in the general population and 79% in *ejidos*). The 1995 financial and economic crisis appears to have further exacerbated these pre-existing differences, leading to a widening of rural inequality as indicated by the increase of the Gini coefficient from 0.448 in 1984 to 0.480 in 1998 (World Bank, 2001). High levels of poverty by themselves pose a significant threat in terms of land degradation and deforestation (Deininger and Minten 1999).

On the other end of the spectrum, more and more *ejidos* have, with continuing urban growth, to confront the issue of incorporating their land into urban settlement. 1,122 communities are now located in urban or peri-urban areas and two thirds of the area required for urban settlement will, for the foreseeable future, have to come from the social sector. Historically, with land sales and rental prohibited, informal rental and sales were the only means for *ejidatarios* to capture part of the appreciation of their lands before it was expropriated by government. Not unsurprisingly, this caused widespread corruption on the part of officials who, by acquiring land at agricultural values and then selling it to urban developers at much higher prices, could turn a handsome profit (Jones and Pisa 2000). It also led to a multiplication of informal settlements, undermining incentives for a less costly process of planned urban expansion. Indeed, more than 20% of *ejidos* are characterized by informal land occupations, something that greatly increased the cost of *ex post* providing infrastructure and services, implying that many of the migrants to urban areas were left without safe water and electricity.

A third group of what one might call “agricultural” *ejidos* is located in regions with greater agricultural potential. Although not all of the differences are policy-related, comparison of information from the 1991 agricultural census illustrates the vast gap between producers in the social sector and private farmers. First, the labor-land ratio in *ejidos* was, with 7.02 individuals per 100 ha, more than double of that in the private sector (2.87).² This phenomenon can partly be explained as the consequence of a policy which for decades “bound” producer households to the land rather than allowing rentals and free movement of

¹ Indigenous communities had the choice of forming either *comunidades* or *ejidos*. As the legal distinction between the two is of little relevance for our analysis, we will hereafter refer to both as *ejidos*.

² Accounting for land quality would further exacerbate the difference as land in the *ejido* sector is generally believed to be of lower quality than that for private farmers.

labor.³ It illustrates the danger of the *ejido* sector developing into a repository of low-productivity “surplus” labor that is prevented from moving out by legal restrictions that were adopted for completely different reasons. Second, one notes that investment, e.g. in livestock, perennials or machinery, was significantly lower in ejidos than in the private farm sector. Furthermore, since, in the absence of property rights to land that could have been used as collateral, credit was dispensed to the ejido sector through a specialized system of intermediation which is often alleged to have developed into a conduit for political favoritism (Varley, 1989), productivity of such investment may have been low. The closure of this source of funds following the restructuring of the agricultural credit system has further reduced the access of *ejidatarios* to credit financing.

More recent evidence from a sample that was explicitly designed to be comparable between private and ejido farmers (see below) suggests that, while there may have been some narrowing, many of these gaps continue to persist (table 2). High labor density and limited productivity in the ejido sector are highlighted by the fact that, even though age and household size are similar, the median size of land owned by private farmers is 2.8 as compared to 1.2 ha for *ejido* farmers, while 32% of the private farmers have access to irrigation as compared to 23% in the social sector. The extent of cattle ownership (43% vs. 21%), the average herd size (29 vs. 5.6), and machinery ownership (29% vs. 19%) are all much larger in the private sector. a higher share of producers (43% vs. 28%) uses improved seeds. Private farmers achieve these higher levels of income through higher agricultural productivity rather than diversification into non-farm employment, a fact that is not too surprising given the geographic proximity of the sample households.

2.2 The broader macro economic and sectoral framework

Before discussing the ejido reforms more specifically, it is useful to briefly describe the country’s rural sector and the reforms aimed to increase its productivity: Even though Mexico is highly urbanized, 25% of its approximately 100 million inhabitants live in rural areas and 20% have their main occupation in the agricultural sector. However, in 1999, agriculture, livestock and forestry together contributed only about 5% of GDP, pointing not only towards a low standard of living in rural areas but also highlighting the importance of exploring non-agricultural sources of income in rural areas. Major types of land use are agriculture (13% of the total area), livestock (55%), and forestry (23%). About 25% of the arable area used for agriculture is irrigated but low value grains such as maize, beans, wheat, and sorghum are grown on 80% of cultivated acreage with maize alone occupying 50% of the total. The rural sector is characterized not only by its high incidence of poverty, but also large differentiation along geographical lines. Technically advanced commercial farmers, mainly in the North, who have access to irrigation and

³ A second possibility is that there are significant non-economic barriers to incorporation into the labor market, e.g. language in the case of the indigenous population.

infrastructure as well as modern technology, and are well-endowed with are producing high value crops mainly for the US market. However, the large majority of rural producers has traditionally produced import-substituting staple crops, with more than half (according to the 1990 Census) producing only for their own subsistence. For these farmers, improved participation in factor and output markets, and improving technology, will be key challenges. Finally, there are producers in the marginal areas for whom limitations of endowment, markets, and infrastructure leave only limited potential for advancement through intensification.

Historically, Mexico's agricultural potential has been further depressed by macro-economic and exchange rate policies biased against exportables, high protection of food crops, and deficiencies in road and market infrastructure. As a consequence, instead of focusing on export crops with high value added, Mexico's agricultural sector was inward-looking, emphasizing the production of low-valued staples for subsistence, and lacking integration with other markets. The balance of agricultural trade over the last decade was consistently negative, the share of agricultural exports to GDP (46% in 1996) is one of the lowest in Latin America. To overcome this legacy and make the transition from a centralized and controlled system to more dynamic setup dominated by private sector initiative, the country has, since the mid 1980s, undertaken major reforms at the macro and sectoral level.

Quantitative restrictions on most agricultural imports and exports were eliminated or partially converted into tariff equivalents that are progressively being reduced to agreed levels by 2008 with NAFTA in 1994. Pan territorial guarantee prices for major grains, which had constituted a major drain on fiscal resources, were eliminated in the early 1990s. Price subsidies on maize and beans, which had been substantial in the late 1980s and early 1990s, were gradually phased out. A transition to floor prices for maize and beans was made in 1995⁴ and the maize market was liberalized in 1999. Major steps to reduce subsidies for consumers were taken. A costly, untargeted tortilla subsidy was phased out and the marketing parastatal, CONAPSUPO, was eliminated in 1995. On the input side, subsidies for seeds, fertilizer, pesticides, machinery and diesel fuel (but not a subsidy on electricity for groundwater extraction), were dismantled. Advances were also made in passing legislation to improve natural resource conservation such as the National Water Law (1992 and 1994 respectively) and a 1992 Forest Law with revisions in 1997.

While these reforms intended to improve the incentive framework within the sector, high inflation and an overvalued exchange rate implied that, up to 1994, the impact on producers was muted (in fact, up to 1997, nominal rates of protection remained negative. High interest rates in the wake of the 1994/95 financial crisis impaired small producers' ability to respond to the changed incentive framework with

⁴ Note, however, that the government continued to provide marketing subsidies, funneled through ASERCA. Until very recently when further reforms were implemented (as discussed below), these marketing subsidies continued to affect the majority of the domestic maize crop.

major investment. Domestic marketing also remained inefficient, implying that even for high value crops, farmers receive no more than 35-45% of the retail price of the product as against the 65-75% in Central American countries. As a result, the dominant position of import substitutes such as maize in agricultural output was not altered substantially and sectoral performance remained mediocre, with annual growth rates of about 3.5%. Partly as a result of increased trade in other areas, agricultural exports as a percentage of the total declined from 5% in 1989 to 3.2% in 1998.

While it was clear from the beginning that liberalization and the associated competition of staple grains from the world market would create considerable pressure, this context implied that in many respects liberalization appears to have reinforced and exacerbated pre-existing inequalities in endowments and access to productive resources. Exporters of fruits and vegetables in the North benefited from a surge of exports to the US, which grew by more than 10% annually during the first six years after NAFTA (World Bank 2001). At the same time, small rainfed producers in poorly endowed and marginal areas often found markets flooded by cheap imports of basic grains from the North, at prices that made it difficult for them to even recoup their costs of production. Lack of access to credit made it difficult to undertake the investments needed for a change in the productive structure. Even though migration to the United States appears to have increased significantly, from 3% of households in 1994 to 8% in 1997, this was insufficient to move out of poverty for most.

It is uncontroversial that, to ensure that the liberalization has its desired impacts, it is necessary to help the poor increase their assets, improve the functioning of credit and output markets, and to provide at least a temporary safety net. Indeed, government was well aware of the need for the latter and spending on social programs aimed at poverty reduction amounted to 8.5% of GDP, or nearly 53% of government's programmable expenditures in 1997. However, the main programs were either poorly targeted or insufficiently geared towards better functioning of factor markets and long-term investment.

The largest program, *PROCAMPO*, was intended to compensate all producers (up to an area of 100 hectares) for the loss of revenue due to the liberalization of agricultural trade and removal of price supports in the grain sector through a de-coupled payment over a 15 year adjustment period that is to end in 2008.⁵ It took a long time to ensure smooth payments and implement a full de-coupling of these payments. This, together with the broader financial crisis, implied that, contrary to the intention of policy makers, it was impossible for producers to use the stream of future *PROCAMPO* payments as a collateral for investments that would help in diversifying the production structure. Thus, even though the program was large -contributing some 8% to the average household income and up to 40% for low-income

⁵ In 1999, expenses for *PROCAMPO* amounted to about US \$1 billion (or 0.25% of GDP), benefiting some 3.2 million producers.

families (World Bank 1997)- and helped to stimulate other sectors of the economy (Sadoulet and deJanvry 2001)-, it had a limited impact on long-term investment.

A more specific productivity-increasing impact was expected from *Alianza para el Campo*, a bundle of programs that were to transfer modern technology, promote investment in infrastructure, decrease the incidence of animal diseases, and support an integrated development of the rural communities. Preliminary evaluations point towards limited outreach and community involvement, and implementation being biased towards better off-communities (World Bank, 1997).

To overcome the severe deficiencies in Mexico's marketing and storage infrastructure, a third program, *ASERCA* (*Apoyos y Servicios a la Comercialización Agropecuaria*), initiated in 1991, aimed at developing and modernizing agricultural grain marketing. While the idea of using subsidies to reduce the transaction costs of marketing and stimulate investment was valid, implementation was inconsistent with broader sectoral goals. Traditional crops received over 90% of the subsidies, thus undermining incentives to shift away from grains and impeding the move towards patterns of production to more accurately reflect Mexico's comparative advantage. With payments proportional to marketed production (and no link to improvements in infrastructure such as storage), the program benefited mainly large producers and had limited impact on reducing the transaction costs of marketing in the future. Clearly, other measures that would improve the functioning of factor markets were needed. Doing so was one of the main objectives of the 1992 ejido reforms and their implementation.

3. The ejido reforms

This section describes the rationale behind the 1992 legal reforms, including the revision of Article 27 of the Mexican constitution, intended to end almost a century of politically motivated interventions in the internal structure of the *ejido* and, by giving more secure property rights and a choice between different property rights regimes to *ejidatarios*, increase investment incentives and improve the functioning of land and labor markets in rural areas. We review the way in which these reforms were implemented, the procedural safeguards adopted to prevent abuse, and the advances, both in terms of numbers as well as impact, made in implementing them.

3.1 Background and main characteristics

The system of state sponsored redistribution of land that was put in place after the 1917 revolution had a number of disadvantages, up to the point that it has been described as being directly responsible for the backwardness of the social sector (Tellez 1994). Three main limitations were the following:

- The limitations on functioning of land markets led to a situation whereby many old people in an over-aged *ejido* sector were unable to make efficient use of their land, while young households next to the

ejido suffered from significant land shortages. It is also widely reported that powerful members in the community had *de facto* appropriated large amounts of common property resources and used them as a source of patronage, thereby undermining both the ideals of the *ejido* and the livelihood of the poor (de Janvry et al. 1998).

- Restrictions on land transfers within *ejidos* also created a formidable obstacle to an effective and efficient process of urban expansion, which is important in view of the fact that about two thirds of the space needed for urban development will, for the foreseeable future, come from the social sector. Local governments could get access to this land only via expropriation with land values at the agricultural rate provided perverse incentives to *ejidatarios* who often encouraged invasion and “sold” their land to squatters (Jones and Ward 1998).
- Partly as a consequence of legal and administrative restrictions, *ejidos* suffered from low levels of investment, often unsustainable resource use, and high levels of poverty. In an income equation for 1991, being located in an *ejido* increased the probability of being in extreme poverty by 50% (Velez 1995). All of this implied an urgent need to “complete” Mexico’s land reform.

The legal and institutional reforms of 1992 aimed to overcome these shortcomings. In the legal area, three main elements of reform were to (i) strengthen self-governance of the *ejido* in a way that allowed it to choose, among others, its property rights regime; (ii) the elimination of land rental restrictions; and (iii) a reduction of the discretionary powers of the executive.

- The law explicitly recognized the legal personality of *ejidos* and the ability of the assembly to regulate matters internal to the *ejido*, in addition to defining *ejido* organs and setting a procedural framework. The assembly of all *ejido* members can decide whether lands owned by its members are to be held under communal or individual ownership, whether *ejido* members have the possibility to acquire fully individual property rights (*dominio pleno*). The assembly, in representation of the *ejido*, can also enter into contracts, including the formation of joint ventures (*sociedades mercantiles y civiles*).
- The wholesale prohibition on the exchange of land in markets was replaced with a more nuanced set of regulations that freed land rental completely and allowed sales within the *ejido* but not with outsiders (unless the assembly had decided on adoption of *dominio pleno*). A systematic program of land rights regularization (PROCEDE), to be described below, served to document existing land rights and to issue legally valid certificates to individual land holders, both to furnish proof of these rights and to possibly transfer them.

- The President's power (or obligation) to grant lands was eliminated and the administration of agrarian justice was separated from the executive and vested with an independent system of agrarian justice. The end of free land distribution (the "*reparto agrario*") as the means for land access and the establishment of a clear set of rules, including compensation, for expropriation, together with an independent judiciary, was critical to increase the security of property rights within and outside the ejido.

Key institutional measures involved the establishment of a decentralized and accessible system of agrarian justice, an independent registry for the social sector, and the creation, in the *Procuraduría Agraria*, of a de-concentrated structure to provide legal support to *ejidatarios* and systematically implement the program of property rights regularization.

- To allow effective and accessible agrarian justice, a system of 42 *Tribunales Unitarios Agrarios* and an appeals court, the *Tribunal Superior Agrario*, were created. Between 1992 and 1999, about 350,000 conflicts were brought before, and dealt with, these Courts, thereby eliminating a huge backlog of cases that had accumulated from the past. In dealing with conflicts, the *tribunales* are explicitly instructed to seek a settlement out of court and special mechanisms were put in place to ensure accessibility by the poor.
- To allow independent verification of property rights, a special registry (*Registro Agrario Nacional*; RAN), with delegations in each of the states, was created. The RAN issues, among others, certificates that document a household's entitlement to his individual parcels, *certificados de derecho al uso comun*, that document a household's right to the proportional use of common lands (in case the assembly has decided in favor of common use), and titles for urban plots as well as titles for *dominio pleno* for those individuals who adopt it.
- Since small farmers who had been under the tutelage of local authorities for a prolonged period of time would still find it difficult to ascertain their rights—especially to correct past irregularities—the *Procuraduría Agraria* was created to provide legal assistance to *ejidatarios* and perform an ombudsman function, specifically by supervision implementation of PROCEDURE and by representing *ejidatarios* as well as private farmers in court dealings through a structure of paralegal assistance.

3.2 The land right regularization program

All of the legal elements and institutional arrangements were to feed into a program of voluntary land regularization (*PROCEDURE*), the purpose of which was to resolve boundary conflicts, regularize land tenure, and issue property rights certificates. Over a 12 - 18 month period, this program, implemented jointly by the *SRA*, the *PA*, *INEGI*, and the *RAN*, allows *ejidatarios* to choose their property rights regime,

delineates *ejido* boundaries, measures individual plots, and issues certificates to individually owned plots (including house plots), as well as communally managed lands to each individual in a well structured process which contains clear procedural safeguards. The sequence of steps is highlighted below:

Boundary assessment, demarcation, and conflict resolution: To identify conflicts or legal ambiguities that need to be resolved before the program can be implemented, the basic legal documentation relating to the *ejido* (i.e. the Decree of foundation, as well as any modifications in area or membership that might have occurred over time) is reviewed by the responsible institutions. This allows to determine whether the *ejido* can be included or whether there is need for prior resolution of conflicts, either within or outside the *ejido* in which case the necessary steps are to be initiated.

Dissemination and approval: If the *ejido* is suitable for inclusion (i.e. external boundary conflicts have been resolved), representatives of the PA launch a dissemination campaign that explains the nature and procedures of the program. This process culminates in an assembly of “Information and Consent” which requires a quorum of at least 50% of the *ejidatarios* and which formally decides on whether or not the *ejido* will participate in the program.

Division of land: In case of a positive decision, an auxiliary committee of *ejidatarios* which is responsible for the next steps in implementation of the program is formed. This committee, together with the teams from PA and INEGI, identifies the boundaries of the *ejido*, the different types of land (i.e. urban plots, parceled lands, and common lands), as well as individual plots. Sketch maps are prepared, owners’ consent is obtained, and an inventory of occupancy by subjects without formal title, to be regularized in the process, is established. Informal processes of conflict resolution are drawn upon as needed. The materials thus generated are presented to a second assembly whose formal approval is required to proceed to the next phase.

Land demarcation: Once this approval has been obtained, formal demarcation of lands (i.e. areas of urban settlement, common lands, and individual plots) is initiated in order to formalize the sketch maps and informal agreements from the previous phase. Once finalized, the results are displayed publicly for at least two weeks and an “assembly of delimitation, assignment, and entitlement to land” is called to ratify the results. This assembly requires a quorum of 75% of community members (including *ejidatarios*, *avecindados*, and *posesionarios*)⁶ as well as the presence of a public notary (*Fedatario Publico*) and a representative of the PA who have to certify that due process was followed in these proceedings.

⁶ *Avecindados* (26% of agrarian subjects) are members of the community that have lived in the *ejido*'s urban area for more than a year and are recognized by the assembly. They are usually descendants of *ejidatarios* but, due to the prohibition of subdivision of land on inheritance, were prevented from getting legal access to land. *Posesionarios* (11% of agrarian subjects, but most common in the *ejidos* of the South, i.e. South Pacific and Gulf where population pressure is higher and outside opportunities are more limited) have been granted plots within the *ejido* but no other rights.

Formalization: Once approved, all the documentation, which includes files for individual plots, maps, and the plan of the *ejido*, is forwarded to the *RAN* which processes the request and produces titles for urban plots to be inscribed in the Public Register of Property as well as titles and certificates for individually owned and communal lands which are handed over to owners in public acts.

The quantitative accomplishments achieved by *PROCEDE* have been impressive. As of Dec. 2000, 57.2 million hectares of land (more than double the size of Spain) have been measured and mapped and 2.9 million agrarian subjects had received titles and certificates. In the process, almost 6.4 million cartographic products, 3.6 agrarian certificates and property titles to parcels, 1.3 million certificates of rights to use the common lands, and 1.6 million of titles to urban plots were generated. The program has also led to a profound change in the transparency in which the internal working of the *ejido*: Over 18,000 *ejidos* have an internal set of rules recognized by the assembly and over 90% have democratically elected representatives. About 50% have an accounting book reporting the community's expenses and revenues and approximately 35% have a recently updated list of *ejidatarios*. In terms of the regularization program, the diagnostic review and information of community representatives through the *PA* is completed for all *ejidos*. The decision to join *PROCEDE* has been made in 86% of the communities while 78% have completed the *croquis* and the registration of the members' consents to the demarcation of their borders.

4. Impact of the 1992 legal changes and *PROCEDE*

In view of the fact that *PROCEDE* constituted a sizeable public investment, this section aims to assess the determinants of *PROCEDE* adoption, the impact of this program on the functioning of land markets, household welfare, and access to common property resources. We find that the program had a significant impact on equity, conflict resolution, governance, transparency, as well as a positive economic return. We use this to argue that it will certainly be worthwhile to complete the program but that, in doing so, the specific characteristics of *ejidos* that have not yet undergone the program need to be taken into account. Specifically, *PROCEDE* is less likely to have been implemented in large *ejidos* with boundary disputes, high inequality of land access, illiteracy, and economic backwardness. This has implications for the completion of the program and for efforts to make its impact more sustainable.

4.1 Data and methodology

To assess the impact of legal changes separately from their implementation, we use a number of different data sources, including previous studies and background material available within the Social Sector. Main sources of quantitative information are a 1994/97 survey of 1297 panel households undertaken by SAR with support from FAO and the University of Berkeley (hereafter referred to as the "1997 and 1994 *ejido* surveys"), and a small survey which, together with qualitative group discussions at the community level,

was administered to a sample of 351 *ejidatarios* and 75 private farmers in 24 *ejidos* located in 10 out of Mexico's 32 states (hereafter referred to as the "2000 *ejido* and private farmer survey"). De Janvry et al. 1997 provide a more detailed description of the former, the sample of which is based on the 1988 *Ejido Census*.

For the latter, data was collected by the *Procuraduria Agraria* (PA), with support from the World Bank, between July and Sept. 2000. A multi-stage stratified process of sampling was adopted. In the first stage, rural municipalities that counted with both certified and non-certified *ejidos* were grouped into 12 clusters based on the extent of rural-urban migration; presence of irrigation; and the average size of landholdings. One municipality was then selected randomly from each of the clusters. In a second stage, two *ejidos*, one that had been certified through PROCEDURE, and one that had not been certified, were selected randomly in these municipalities. For each of these *ejidos*, households were drawn randomly from a list of *ejido* members. To be able to compare with private producers, private farmers in the same *municipio* were selected randomly from a list of participants in the Government's *Procampo* program.⁷

To make an assessment regarding the impact of PROCEDURE independently of the reforms in the legal framework and any independent time trend, it is necessary to make comparisons in three dimensions. First, comparing the situation in the same *ejido* households with and without PROCEDURE, at two points in time, allows to quantify the net effect of the program. Second, by comparing *ejidos* to the private sector, before and after the legal changes, one can identify the impact of the legal changes independently of PROCEDURE. Finally, as the period under concern coincided with far-reaching macro-economic changes that are likely to have affected behavior by all the groups under concern, we need to allow for a separate time effect.

The questionnaires administered to individuals also included retrospective questions on access to credit, i.e. the first and last year in which respondents obtained credit, and a complete history of their involvement in land sales markets. We use this information to construct variables for access to credit and land purchases for the 8 years before and after 1992, as well as the farmer's land endowment in 1984 and 1992. This allows inferences about credit access and involvement in land sales or purchase markets before and after the legal change and/or the adoption of PROCEDURE. As the survey did not contain information on access to common property resources, we use household-level information from a panel of 1290 *ejidatarios* who were surveyed in 1994 and 1997, i.e. before and after the adoption of PROCEDURE, to explore this aspect.

⁷ Participation in Procampo is very high, comprising 80% to 90% of all private producers. In view of this, use of the readily available and up-to date Procampo lists as a sample frame for the private sector was considered to be preferable to the use of the 1990 Agricultural Census which would have required considerable re-listing.

4.2 Determinants of PROCEDE implementation

Even though the program is free for the *ejido*, the process described above implies that either a decision about lack of feasibility by *PA* representatives or resistance by *ejidatarios* can result in a failure to move ahead with *PROCEDE*. Understanding the factors that underlie both can help identify areas that need to receive greater attention in the future, something that is of particular importance if the goal is to complete the program within a reasonable time frame. To do so, we estimate a probit model of the form

$$(1) I_i = \alpha E_i + \beta' C_i + \gamma P_i + \delta F_i + \varepsilon_i$$

where I_i is a dummy indicating whether the *ejido* adopted *PROCEDE* in the period under concern, E_i is dummy for the presence of external boundary conflicts that would make it impossible for *PROCEDE* to proceed, C_i is a vector of initial *ejido* characteristics affecting the cost of implementing the program, P_i characterizes the distribution of political power within the *ejido*, and F_i is a dummy for presence of indigenous people. We expect β to be significant and negative if bureaucrats try to maximize the number of *ejidos* regularized subject to a given budget. Sign and significance of δ highlight systematic differences in regularization of indigenous *ejidos*. The coefficient γ would indicate whether and how the power structure within the *ejido* affects the probability of implementing *PROCEDE*; we would expect it to be positive (i.e. a more unequal power structure increasing the probability of implementation) if the program allows the rich to ratify their de facto appropriation of common property resources and negative if *PROCEDE* strengthens the property rights of the traditionally powerless. This is clearly an empirical question, though the answer will be of importance for the future of land right regularization programs.

Results from the analysis (Table 4) allow to draw a number of conclusions. First, presence of external boundary conflicts is estimated to be highly significant and of significant magnitude, reducing the probability of *PROCEDE* implementation by between 30% and 35%. This is in line with the fact that in many *ejidos* step two, i.e. dissemination and approval of the program, could not be started due to presence of unresolved boundary conflicts. For the future of the program, this implies that the ability to deploy effective mechanisms of (alternative) conflict resolution may be important.

Second, inequality of land access within the *ejido* is found to have a significant negative impact on the probability of *PROCEDE* implementation. This suggests that, contrary to the fears voiced, land regularization can indeed have an equalizing impact, by providing an avenue for households whose share of common lands has been appropriated by others, to re-establish their ownership rights. It supports the prediction that unequal distribution of wealth and/or political power within the *ejido* will cause powerful members, who are likely to lose from the more egalitarian distribution of common lands that comes about through implementation of the program, to resist its implementation. Due to the losses it would imply for

these, *ejidos* where land access is more unequal are less likely to adopt PROCEDURE. Again, with respect to future implementation strategies, it will be important to explicitly include measures to deal with resistance by landowners. One such issue would be to improve the program's capacity for conflict resolution, possibly by increasing the presence of the *Procuraduría Agraria* and improving the effectiveness of the *Tribunales Agrarios* in attending to specific conflicts on a priority basis. Addressing these conflicts is likely to become of increased importance as polarized *ejidos* can no longer be avoided.

Third, factors relating to the cost of program implementation are significant, as expected. *Ejidos* localized in areas with better infrastructure (as proxied by access to a paved road) were more likely to be targeted for certification, and higher income levels and human capital endowments are found to increase the likelihood of PROCEDURE being implemented. At the same time, land market participation does not have any additional explanatory power. Larger *ejidos* (measured in terms of area) were less likely to be certified, something that can be explained by the fact that the authorities' goal was to maximize the number of certified *ejidos* rather than area or number of people. The fact that *ejidos* that are not yet certified are larger, more conflictive, poorer, more difficult to access, and endowed with less human capital than the average, will have implications for the completion of the program.

Finally, it is of interest that, in the data available, an indigenous dummy remains insignificant, implying that there was no bias in implementation of PROCEDURE against indigenous *ejidos* once other variables are accounted for. This suggests that the slow pace of PROCEDURE adoption in indigenous communities is more due to the presence of conflicts, inequality in access to land and resources within the community, and lack of human capital and economic potential, than to specific "indigenous" character of the *ejido*.⁸ This is in line with evidence that there are few if any differences between certified *ejidos* located in communities with high levels of indigenous presence and those in non-indigenous municipalities (Robles, 2000). Even though adaptation to the cultural factors involved is needed, there may be less need to develop a completely different mechanism for land right regularization in indigenous communities.

4.3 Impact of legal reforms and PROCEDURE implementation on factor markets

Before reporting results of the analysis regarding participation in factor markets and use of common property resources, we review evidence regarding *ejidatarios'* perceptions. The 1997 *ejido* survey which asked members about the perceived impact of the program leads us to conclude that, even at this early stage in its implementation, PROCEDURE has reduced conflicts and increased social unity in the *ejido*, with more limited impact on factor markets (Table 3). 28% of respondents felt that PROCEDURE reduced the number of conflicts (and 21% that it had increased social unity in the *ejido*), while only 5% (and 12%) felt

⁸ Note that this result may be affected by the fact that, due to violence, there was no data collection in Chiapas in the 1994 survey, forcing us to drop the state from the analysis.

the opposite. Also, 19%, 23%, and 15%, respectively indicated that PROCEDURE had increased the number of land rental and sales transactions as well as migration, while 12%, 11%, and 8% felt that it reduced these factors. By comparison, the perceived impact on credit access and productive investment remains ambiguous; 5% felt that PROCEDURE had augmented investment, 4% felt the opposite. Questions included in the 2000 survey (not reported) point into a similar direction: *Ejidors* without PROCEDURE have a significantly higher presence of conflicts than those with PROCEDURE or private land owners (15% vs. 6%) and certified *ejidos* are more likely to have a written internal rule (63% vs. 30%). In addition to resolving conflicts, the program has resulted in increased security of land access for a huge number of *avecindados* and *posesionarios* who previously often had very limited rights and precarious security of tenure based on occupation. The program awarded secure land rights to more than 1 million households in this category, signifying a significant increase in assets for those affected.

4.3.1 Land rental markets

Before 1992, *ejidatarios* were prohibited from renting out land under their possession; those violating this rule could have their usufruct right terminated and be evicted. Even though this prohibition appears to have been widely violated (PA 1998), land rental in the “black market” exposed households to risks and social pressures (Heath 1992; Finkler 1978), suggesting that the elimination of the restriction would affect behavior. While, after 1992, land rental was legal for all *ejidatarios*, those who had undergone PROCEDURE had in addition a legally recognized certificate of land ownership which, by increasing the household’s tenure security, may well have had an impact on the supply of land to the market over and above the legal change.⁹ To test for this, the ideal would have been to estimate an equation with household fixed effects, comparing participation in rental markets before and after the legal changes, doing so was impossible because, in view of the illegal nature of rental transactions before 1992, it was impossible to obtain information on this variable. Thus, we estimate an equation of the form

$$(2) \quad N_i = \alpha + \beta E_i + \gamma P_i + \delta_0 L_i + \delta_1 E_i L_i + \delta_2 P_i L_i + \mu X_i + \varepsilon_i$$

where N_i denotes net operated land, E_i and P_i are dummies for *ejido* membership and PROCEDURE implementation, L_i is the land owned by the household, and X_i is a vector of household characteristics such as age and education of the household head, the number of adult household members, the dependency ratio, a dummy for ownership of machinery, and land improvements.

⁹ Such a differential whereby legal provisions remain largely ineffective as long as they are not implemented on the ground has been reported for India (Appu 1996, Banerjee et al. 1999).

The rationale underlying this equation is that, with constant returns to scale and well-functioning factor and credit markets, the amount of land operated should be independent of the amount of land owned, tenure status, and any other household characteristics. Households would just rent in or rent out land to obtain their optimum operated land area (see Olinto et al. 2000; Pender and Fafchamps 2000), and we would expect the coefficient on own landholding to be zero. By interacting L_i with E_i and P_i , we can thus test for systematic differences in the functioning of land markets between *ejidatarios* with and without *PROCEDE*, as well as private owners. The idea is that, if the derivative of the land demand function for a specific group equals zero, i.e. if (i) for private farmers $\delta_0 = 0$; (ii) for non certified *ejidatarios* $\delta_0 + \delta_1 = 0$; and (iii) for certified *ejidatarios* $\delta_0 + \delta_1 + \delta_2 = 0$ we are unable to reject the hypothesis that land markets work efficiently for this group. Comparing between non-certified and certified *ejidos*, thus, provides an implicit way of testing whether adoption of *PROCEDE* has affected the functioning of land markets. Although there is little specific literature on the topic, *a priori* one would expect that markets function best for private farmers, somewhat less well for certified *ejidos*, and worst for non-certified *ejidos*.

While this provides a test for well-functioning factor markets, it does not give information on why factor markets do not work well. To gain insight into this, we complement equation (2) with estimation of a tobit equation for the amount of land rented out or rented in, respectively

$$(3) \quad R_i = \alpha + \beta E_i + \gamma P_i + \delta_0 L_i + \delta_1 E_i L_i + \delta_2 P_i L_i + \mu X_i + \varepsilon_i$$

where R_i is the amount of land rented in or out (one equation for each case). The equation for renting in land includes all producers, allowing to compare the propensity of private farmers to rent in land as compared to that of *ejidatarios* with and without *PROCEDE*. Under the assumption of constant returns to scale and an unequal distribution of land ownership, an efficient land market should distribute land from large owners to smaller producers *ceteris paribus*, i.e. the slope parameter should be less than zero. In terms of the parameters, this would imply that $\delta_0 + \delta_1 + \delta_2 < 0$ for certified *ejidos*; $\delta_0 + \delta_1 < 0$ for non-certified *ejidos*, and $\delta_0 < 0$ for private farmers. *A priori*, we would expect these slope parameters to be either negative or insignificant.

Regression results for the estimation of equations (2) and (3), respectively, are presented in Table 5. The first column contains the results of the analysis of the regression of operated land.¹⁰ To eliminate the impact of outliers, which may affect results in such a relatively small sample, we use a median regression, with standard errors obtained by bootstrapping. There are three key findings. First, the land endowment is

¹⁰ Note that the tobit equation for renting out land includes only *ejidatarios*, thus allowing us to identify only the impact of *PROCEDE* implementation.

highly significant and positive, while the *ejido* dummy itself and interacted with the land endowment remains insignificant. This suggests that, both in the private sector and in non-certified *ejidos*, the amount of land operated is highly dependent on the amount owned, i.e. that markets do not work perfectly. Also, and more surprisingly, once other factors are controlled for, rental markets did not operate more efficiently in the private sector than in the *ejido* sector. This may point to the presence of tenure insecurity in the private sector.

Second, the coefficient on the PROCEDE dummy is positive, and the coefficient on this dummy's interaction with the land endowment is negative and significant. This implies that implementation of PROCEDE has increased the demand for operated land and, by decreasing the dependence of operated on owned land, helped improve the functioning of rental markets. In fact, we can not reject the hypothesis that in certified *ejidos*, but not in non-certified ones, the average household was able to rent in whatever amount of land they wanted, independently of their initial endowment.

Finally, the presence of improvements on owned land, which can be seen as a proxy for the farmer's unobserved managerial ability, is positive and significant. By comparison, neither ownership of machinery nor household characteristics are significant. The positive impact (at 10%) of the receipt of Procampo payments could imply that, during the period under concern, farmers were credit constrained and the cash payment thus received were used to acquire working capital.

Estimates from the tobit regression for land rented in or out in Table 5 provide additional insights into the operation of land rental markets and the impact of PROCEDE on the functioning of these markets, especially the differences between certified and non-certified *ejidos*. The coefficient on the *ejido* dummy is negative and significant, while this dummy's interaction with land is positive in non-certified *ejidos*, while the opposite is true in certified *ejidos* (all coefficients are significant at the 1% level). On the one hand this suggests that, in line with the descriptive evidence, the demand for renting in land is higher in certified than in non-certified *ejidos*, supporting the hypothesis that PROCEDE has improved the functioning of land rental markets. On the other hand, it implies that, even though the structure of land ownership is quite similar in both types of *ejidos*, rental markets work completely differently in each of them— in non-certified *ejidos* it is the large farmers who rent in land and the small farmers who rent out, while the opposite is true in certified *ejidos*.¹¹

Thus, in non-certified *ejidos*, the rental market tends to contribute to land concentration instead of redistribution towards smaller producers. If results from other countries pointing towards an inverse farm size-productivity relationship (Bardhan, 1973; Barrett, 1996; Carter, 1984) can be transferred to the Mexican situation, this would imply that, in this situation, rental markets might actually *decrease*

efficiency. By contrast, in certified *ejidos*, the exact opposite is true –the rental market is more active and distributes land towards those with lower endowments of owned land. This is consistent with the hypothesis that the implementation of PROCEDE, rather than the legal changes by themselves, increased tenure security and, by allowing small land owners to increase their operational holding size through rental, helped to bring about efficiency-enhancing land transfers.

Column 3 of Table 5 presents the results of estimating the corresponding tobit equation for ejido members only (negative signs mean higher supply to the rental market). The negative and significant coefficient on the *PROCEDE* dummy and the negative, though insignificant, point estimate on its interaction with land endowments suggest that certification increases land supply to the rental market, especially by large land owners. In addition, ownership of machinery significantly reduces the amount of land rented out. To summarize, at least insofar as the rental market and operational land holdings are concerned, there is little foundation to claims that the 1992 policy reforms and the implementation of PROCEDE favored land concentration. Instead, certification of land rights appears to have increased overall demand for cultivated land, and allowed small producers to enter the market on the demand side. As noted earlier, it is remarkable that land rental markets seem to have been affected by PROCEDE implementation rather than the changes in the legal framework. In fact, legal changes by themselves appear ineffective, suggesting that systematic implementation was needed to make a difference in the operation of the market.

From a policy perspective, this raises two issues. First, completion of the program would be warranted in order to improve operation of land rental markets. Second, the fact that rental markets function better in certified *ejidos* than in the private sector could suggest lack of titles and tenure security in the private sector may be an impediment to smooth operation of land markets may be worth exploring further. This is in line with evidence from case studies (Robles 2000), and could suggest that avenues to improve the status of public property registers may warrant attention. Third, the almost universal prevalence of short term contracts, even in the *ejido* sector, suggests that activation of the land rental market alone may not be sufficient to allow longer-term structural change that is likely to be required for Mexico's agricultural sector in the future. Short term land rental contracts are unlikely to provide sufficient security to make long term plans and the investments required to improve the productivity of the land, be they land related (e.g. irrigation, perennial, etc.) or of a more general nature (e.g. mechanization, packing plants, and marketing arrangements). Unless land purchase markets allow rural producers to make these adjustments, ways to encourage long-term contracts or to remove obstacles that would at present prevent their spread use, will be an important item on a policy agenda.

¹¹ The presence of improvements on owned land is likely to be correlated with the operator's (unobserved) managerial ability.

4.3.2 Land sales markets

There are two reasons for wanting to explore the functioning of land sales markets separately from the market for rental. On the one hand, land ownership, or at least long-term rental, is often needed as an incentive for making long-term investments as noted above. On the other hand, imperfections in credit markets and other policy distortions will have a greater impact on sales markets than on rental. Even if land rental markets were to function well, this could lead to undesirable equity effects through speculative land acquisition by wealthy producers with good credit access, and to distress sales from small landowners who are unable to access credit even for consumption smoothing. It was for this reason that critics feared that the 1992 reforms would lead to massive sales of *ejido* land, the dissolution of the *ejido* sector and re-concentration of land (CAP, 1995; *Reunión Nacional de Organizaciones y Movimientos*, 1995). Available information suggests that sales have been relatively limited and that, therefore, the feared sales may not have materialized.¹² To conduct a more rigorous test, we analyze producers' land purchase decisions before and after 1992.¹³

Results of a regression of amount of land purchased on the factors of relevance, reported in Table 6, allow a number of conclusions. First, the data reject the notion that either the 1992 reform or *PROCEDE* have increased the propensity to sell land. Being an *ejidatario* does not result in a higher participation in the land market, whether one belongs to a certified or a non certified *ejido*, and independently of the time period considered (i.e. before or after 1992). Thus, there is no basis to conclude that, as feared by critics, the reforms led to a wave of land sales. Second, there is evidence that, since 1992, activity in the land sales market has sharply decreased irrespectively of tenure status. This is consistent with the notion of a stagnation in the agricultural sector, possibly due to the restructuring of the credit system or to an overall depression of the sector's profitability, following the removal of government interventions in commodity and input markets, and as a consequence of the reduction of tariff protection following the liberalization of the sorghum market and NAFTA (Mhyre, 1998). Third, we note that net purchases of land are negatively related to the amount of own landholdings, independently of tenure status. This leads us to reject the hypothesis that sales markets have led to land concentration. Finally, the regression suggests that *PROCEDE* did not have an appreciable impact on land sales market activity, in contrast to its impact on land rental markets.¹⁴ All of this supports the conclusion that it is more difficult to activate land sales markets than to get land rental markets going. Where sales of *ejido* lands are likely to be important in the future, i.e. especially in peri-urban areas, further steps are likely to be required. These could include

¹² The data maintained by the RAN provide additional evidence indicating that there was, at least in the formal market, no sell-off of land after the reforms.

¹³ We focus on land purchases as the survey does not include farmers who have sold their land and exited the agricultural sector altogether. This is not a great problem since sales out of the *ejido* sector were still prohibited. Also, use of land sales leads to substantively similar conclusions.

measures to make all participants aware of their rights in order to achieve outcomes that are satisfactory from an efficiency and an equity perspective.

4.3.3 Credit access

Given the low level of productive assets in the *ejido* sector, as compared to private producers, highlighted in the descriptive statistics, higher levels of investment, and access to credit, would be important for productive development of the sector. Indeed, hopes for land certification to increase *ejidatarios*' access to formal credit were a driving force underlying the 1992 reforms. As adoption of *dominio pleno* is contingent on having completed the process of certification, PROCEDURE would appear to be a necessary condition for improved credit access. However, remaining restrictions on the marketability of land that formally continue under the *ejido* regime –i.e. without making the transition towards *dominio pleno*– imply that PROCEDURE may be a necessary but not sufficient condition for better access to credit markets. The reason is that, though it provides ownership to home lots, it only recognizes usufruct to agricultural parcels, something that may not be an attractive collateral for formal lenders. If this is the case, the impact of both the legal reforms and the implementation of PROCEDURE on credit access may be limited.

Table 7 provides descriptive statistics regarding credit access for the whole sample and for the sub-groups of interest. One notes that there has been a general decrease in credit availability, with 22% of producers having received credit in the 1992-2000 period, compared to 25% during 1984-92. While the descriptive statistics suggest that the decrease in credit use was slightly lower in certified than in non-certified *ejidos*, they also caution against premature conclusions from cross-sectional evidence; as illustrated in Table 13, certified *ejidos* seem to have had slightly higher credit access already before introduction of PROCEDURE. Complementing the statistics on aggregate credit use with evidence on the modalities of such credit for the different groups during the 1999/00 season suggests that the modalities under which certified *ejidatarios* were able to access credit are similar to those in the private sector, and somewhat better than those available to members of non-certified *ejidos*. Even though most of the credit obtained was for the short term, between 13% and 14% of private farmers and certified *ejidatarios* (as compared to 7% in the non-certified sector) had access to long-term credit. Also, while 44% of non-certified *ejidos* accessed credit as a group, the corresponding percentage for private farmers and certified *ejidatarios* was only 27% and 29%, respectively. Certified *ejidatarios*' access to private credit (i.e. buyers and commercial banks) is higher than for non certified *ejidatarios* (9% versus 4%), although below that of private farmers (14%). Despite the legal limits on the ability to use land as a collateral, 27% of certified *ejidatarios* (vs. 50% of private sector producers and 4% in non-certified *ejidos*) used land as a collateral for obtaining credit. The

¹⁴ The fact that Procede is insignificant not only in the panel but also in the OLS regression suggests that this is not a function of the estimation technique.

use of land by *ejidatarios* as a guarantee for obtaining credit is likely to reflect the practice by rural banks to take possession of land titles as a mean to exert pressure on the borrower, rather than of insuring effectively against borrower's default.

Are the suggestions emerging from descriptive analysis borne out by econometric analysis? Results on credit access from a pooled as well as a fixed effects logit (not reported) suggest that, except for a highly significant and quantitatively important decrease in the probability of accessing credit over time there are few other factors of significance. In particular, there is *no* difference between *ejidatarios* and private land owners once other factors, such as ownership of other assets that can function as collateral substitute, are controlled for. This suggests that, during the period under concern, land tenure in the *ejido* sector was not the main constraint to credit access, a conclusion that is supported by the finding that, even among those who had undergone the program, the 1997 survey found few households (less than 20%) who claimed to be interested in getting *dominio pleno* to increase credit access. *PROCEDE* is found to not have a significant impact, suggesting that the ability to use the usufruct to a well-demarcated parcel of land as collateral did not increase *ejidatarios'* ability to access *formal* sources of financing.

We conclude that, during the period under concern, it was not the lack of individual title, but the combination of a financial crisis with insufficient asset endowments which prevented credit access by *ejidatarios* and private farmers alike. While this does not preclude the possibility that, as the financial system recovers, the lack of fully transferable ownership rights may become of importance and measures to reduce the transaction costs of making the transition to *dominio pleno* be called for, this does, at present, not appear to be the most binding constraint.

4.4 Access to and use of natural resources

One of the key characteristics of Mexico's *ejido* sector is the availability of large amounts of relatively marginal common lands (*tierra de uso comun*) which, while being of limited agricultural value, may be of great importance for the preservation of biodiversity. While these lands help low-income households to diversify their income sources and insure against exogenous shocks, their use is also subject to significant collective action problems (Key *et al.*, 1998; McCarthy *et al.* 1998). The key question to be addressed in the empirical analysis is whether *PROCEDE* has allowed politically powerful individuals to formally ratify their de facto appropriation of such resources or whether it enabled poorer households to exercise their rights and insist on a more equitable access to common property resources.

To examine this issue, we use information on three types of land use, namely collection of firewood, pasturing of animals, and cutting of forest by individual *ejidatarios*, each before and after the reform, respectively. This allows to estimate determinants of households' access to common property resources before and after *PROCEDE* as follows:

$$(4) \quad A_{it} = \alpha + \beta t + \gamma P_{it} + \delta_0 Hh_{it} + \delta_1 L_{it} + \delta_2 P_{it} L_{it} + \nu_i + \varepsilon_{it}$$

where A_{it} is a dummy variable equal to one if household i accessed common property resources at time t (before and after PROCEDURE), Hh_{it} represents household size, as well as other characteristics such as the endowments with assets and initial access to common property resources, and L denotes land wealth. As in the earlier equations, we use a fixed effect panel estimator and, for each of the equations, $\gamma = 0$ would imply that PROCEDURE had no impact on the access to the common resource by *ejidatarios*.

Table 8 reports the results of the estimation of equation (4) using a random and fixed effect logit estimator, respectively. Tests of the random error against the fixed effects specification for each equation using a Hausman specification test reject the former in each case and we focus our interpretation on the latter. Note that, in the fixed effects specification, only households whose forest use changed over time contribute to the likelihood function in the fixed effects models, the number of observations in this case is limited to 173, 243, and 167 out of the full sample of 1267 households.

With respect to grazing of animals, we note that the probability of households using common lands for this purpose has increased over time, possibly as a consequence of less intensive cultivation in the wake of worsening crop prices following the removal of the guarantee prices and the liberalization under NAFTA. PROCEDURE is estimated to have had a significant and positive impact on access to pastures, consistent with the notion that in the process of certification, *ejidatarios* are more likely to formulate rules to govern the access to common lands, and to establish an effective institutional framework that can actually enforce such rules (Zepeda, 2000). This is of interest in view of the fact that, due to partial individualization, PROCEDURE was in almost all cases associated with a decrease of the total area under common lands (*Procuraduria Agraria*, 2000). It would be of interest to explore to what extent such enhanced equity in access has been associated with greater efficiency in resource use.

Both random and fixed effect regressions for gathering of forest products suggest that use of such products has increased between 1994 and 1997, pointing towards a general crisis of rural livelihoods. The PROCEDURE dummy remains insignificant, suggesting that this intervention has neither increased nor decreased households' propensity to rely on common property resources. Even though household characteristics change little over time, we find that larger households have increased their reliance on common property resources, supporting the role of such resources as a buffer against shocks (e.g. return of family members who lost their migrant job).

Finally, as a (admittedly imperfect) proxy for environmental conservation, we introduce the number of households who rely on logging in common forests. As Table 9 illustrates, the number of people engaging in this activity has decreased markedly between the two periods. At the same time, there is no significant

difference between certified and non-certified *ejidos*. The regression suggests, however, that more educated households have decreased reliance on logging, illustrating the importance of human capital and possibly alternative rural employment opportunities. Regarding PROCEDE, we conclude that the program has been effective in increasing access to common pastures, but that it did not have a major impact on conservation of forest resources. This is in line with the fact that it is easier to internalize externalities arising from overuse of common pastures than those from forests at the *ejido* level. Even though fears that PROCEDE would eliminate access to common property resources by the poor appear to be unjustified, better mechanisms for enforcement or payments for environmental services rendered may thus be required if a reduction of activity in this area is to be achieved.

4.5 Welfare impact, costs and benefits of the program

To assess the welfare impact of PROCEDE, we regress the changes in income received, both on- and off-farm, on changes in household characteristics as well as a number of initial conditions and a dummy for adoption of the program and its interaction with a number of the variables of interest. Formally, we estimate an equation of the form

$$(5) \Delta Y_i = \gamma' \Delta X_i + \delta' Z_i + \Delta \varepsilon_{it}$$

where ΔY_i is the change in income between 1992 and 1997 for household i (separated into off-farm and farm elements), ΔX_i is a vector of changes in household level variables, including a dummy for whether or not the *ejido* adopted PROCEDE during the period and the interaction of this dummy with some of the variables, and Z_i is a vector of initial conditions at the household level. Doing so allows to test the hypothesis that PROCEDE or the legal reforms provided a basis for engaging in land rental transactions thus allowing households whose comparative advantage is not in farming to pursue more profitable off-farm opportunities. Results from estimating this equation for farm- and non-farm income separately, using median regression, are presented in Table 9.

The most surprising result is the significant and quantitatively large positive impact of Procede on off-farm income which suggests that the program of land rights regularization has indeed helped activate factor markets and allowed those without a comparative advantage in agriculture to rent out their land and join the non-agricultural labor force. The interaction terms suggest that Procede provided disproportional benefits to those with higher levels of education and greater availability of household labor, consistent with the hypothesis that these households were in a better position to participate in land and other markets and take advantage of local non farm jobs. The positive coefficient on the interaction between education and PROCEDE implementation is consistent with the hypothesis that the program enabled those with higher levels of human capital to take up more remunerative off-farm employment. To the extent that this was not possible before Procede, it would imply that implementation of the program has made acquisition

of education and human capital more attractive. Indeed, indications for an impact of Procede on improved functioning of rental markets in regularized *ejidos* have been found in earlier analysis (Olinto et al. 2000), supporting the hypothesis that the recognition of land rights through the program has helped labor-abundant households (with lower management skills) to adjust through rental markets, while at the same time improving the potential for utilization of land by those who remain in agriculture. Overall, adoption of Procede is estimated to have increased annual real off-farm income by 1,014 pesos, mainly as a result of the relocation of labor toward non farm activities with higher returns to human capital that was facilitated by higher levels of tenure security and the ability to rent out land. Both of these were directly intended by the legal changes adopted in 1992 and the systematic implementation of these changes through Procede.

Compared to the very clear impact of Procede on off-farm income, the evidence with respect to farm income is less unambiguous. The point estimate is negative, suggesting that farm income in households who adopted Procede was lower by about P 200 than in those who did not participate in the program. Part of this may be spurious and due to the omission of rental income in the measurement of income. Also, as most of the *ejidos* were regularized only one or two years before the survey was conducted (in 1997), this still leaves open the possibility that a larger investment effect will materialize over time, especially as macro-economic and sectoral conditions improve. Nonetheless, the result suggests that in a period of severe agricultural crisis, land regularization, without accompanying other inputs, did little to improve agricultural production. To do this, a more integrated type of intervention would have been needed.

The finding of a positive benefit from the program allows us to conduct a back of the envelope comparison between costs and benefits of the program. Information from the *PA* puts the cost of certification at about US \$ 50 per beneficiary household. Transforming this at the 1997 exchange rate and comparing to the estimated net benefits from the program implies an internal rate of return of 37%, clearly suggesting that the program has been justified economically. Concerning policy, this implies that, to the extent that costs and benefits could be expected to be of similar order of magnitude in the future, completion of the program would be clearly warranted. There is some concern that in the natural resource rich (but not the peri-urban) *ejidos* that remain to be covered costs may be higher and benefits lower than in those that already underwent the program. Examination of the different cost components reveals that the main item was the cost of measurement and survey (75% of the total), as compared to much lower allocations of 12.5% each for conflict resolution (by the *PA*) and registration (by the *RAN*). The high precision required may be justified in peri-urban areas whereas a less sophisticated approach may be fully sufficient for the natural resource rich areas that are left to be regularized. Increased amounts of resources

for conflict resolution that are likely to be required in these communities, could thus be obtained from savings on measurement, up to the point where the total cost of the process may actually be lower.

5. Implications and policy conclusions

The combination of case study and econometric evidence provided here suggests that *PROCEDE* had a positive impact. Qualitative and descriptive evidence implies that, from an equity perspective, the program has resulted in the award of secure land rights through formal recognition of occupancy rights for more than 1 million households (*avecindados* and *posesionarios*) who previously did not have property rights. More than one quarter of *ejidatarios* surveyed in 1997 indicate that as a result of this program they now have more secure land tenure with slightly less affirming that *PROCEDE* has increased social unity within the *ejido*. Governance in rural areas was improved through the establishment of an accessible system for the administration of agrarian justice. About 350,000 land conflicts, many of which dated from before 1992 and constituted a time bomb that could threaten social stability in the countryside, were dealt by the Agrarian Courts. Moreover, all *ejidos* have now written internal by-laws, as well as books that can be scrutinized by their members and *ejidatarios* in regularized *ejidos* can obtain confirmation of land rights directly from the *RAN* rather than having to go through political channels, leading to greatly increased transparency.

Econometric analysis indicates that, *PROCEDE* has laid the basis for better functioning of rural factor markets, especially those for land rental. At the same time, and contrary to what was feared by opponents of the changes and of *PROCEDE*, there has not been a wave of land sales as a consequence of the program. Moreover, households' ability to access common lands for pasture has increased, presumably as a result of a more equitable award of land certificates and adoption of internal decision-making structures in certified *ejidos*. Neither gathering of forest products nor logging have been affected by the program. Use of the panel data also highlights that *PROCEDE* has increased household welfare, predominantly by allowing participation in off-farm labor markets. Comparing the magnitude of the estimated benefits to the costs of the program suggests that, even though the latter were not inconsequential, the program can be justified even on economic grounds.

We conclude by highlighting policy issues regarding (i) the completion of *PROCEDE*; (ii) measures to ensure the sustainability of the accomplishments; and (iii) issues regarding the broader context of land policy and rural productivity in Mexico.

Completion of PROCEDE: One class of *ejidos* where the program has advanced much slower than expected are agriculturally "marginal" ones that rely largely on natural resources. As the economic, but not the social, benefits from implementing the program in these areas are likely to be lower than in these

already regularized, it will be necessary to explore measures for reducing the cost of implementation. This could include strengthening the capacity of existing institutions, especially the *PA*, for alternative conflict resolution, emphasizing internal arrangements for decentralized management and sustainable exploitation of the natural resources with which such ejidos are more abundantly endowed.

A second group of *ejidos* where key issues to be addressed by the program have not been resolved satisfactorily is in peri-urban areas. This is of great relevance for the speed and price at which housing can be supplied to the urban poor. It would be desirable to build on improved collaboration, in the form of a coordinated program (*PISO*) achieved recently to develop forms of fast-tracking *PROCEDE* and integrating it into the adoption of either the *dominio pleno* or other forms of entrepreneurial development that would allow to make land markets in peri-urban areas more fluid and transparent.

Sustainability of the accomplishments: Case studies and survey evidence indicate that, even for households who had undergone *PROCEDE*, land transactions are often not registered, implying that the vast amount of information generated at high cost could soon become obsolete, thereby also undermining the usefulness of the registry as an authoritative source of information on land ownership. One factor that discourages registration and at the same time increases the load of cases that need to be resolved either by the *tribunales* or the *PA* is the continuing prohibition of subdivision of land upon inheritance - about 60% of the cases to be dealt with by *PA* and *Tribunales* are reported to be directly or indirectly related to inheritance (Zepeda, 2000). In an environment where, contrary to the pre-reform situation, rental markets are allowed to operate freely and, as ascertained in the study, function relatively well, it is difficult to justify the continuation of this prohibition. Abandoning it in favor of the civil law to regulate inheritances, which is already in place for the private sector, is thus recommended. Fear that information will be used for taxation purposes is an important motivation for *ejidatarios* to reject the program, to avoid keeping registry information current, or to fail completing the transition towards full private ownership (*dominio pleno*). To demonstrate that such fears are unsubstantiated, it may be necessary to review land taxation with the aim of removing distortions and ensuring that contributions (in cash and kind) are adequately accounted for.

Finally, unless local or state governments appreciate the usefulness of up to date registry information, for tax collection or land use planning, incentives to maintain it current will remain low. Improving mechanisms to share information with other institutions and local governments, reduce costs, and streamline operations, possibly through decentralization of the *RAN* and a closer link (or even a merger) with *registros publicos* at the state level should therefore be explored.

The broader context for rural development: Our study indicates that land markets in *ejidos* that have undergone *PROCEDE* function reasonably well, possibly even better than in the private sector. At the

same time, there is strong evidence that *ejidatarios* remain severely credit constrained, implying that the award of certificates and titles did not increase credit supply and may thus have limited impact on investment. One potential reason is that, due to a variety of reasons, the scope for establishment of joint ventures has not been realized for a variety of reasons, including lack of familiarity with the applicable laws and collective action problems on the part of *ejidatarios* and private investors. Dissemination of models of organization that have proven to be successful elsewhere could help to increase the scope for utilization of this instrument in peri-urban, agricultural, and natural-resource rich *ejidos*. This might be combined with the establishment of channels to provide technical assistance and capital to help facilitate the process.

Also, while there was no wave of land sales or dispossession of the social sector, land markets in peri-urban areas continue to suffer from lack of transparency, increasing the cost of providing infrastructure and housing to the poor. In addition to improving price information and reducing arbitrariness on the part of local governments, mechanisms for fast-tracking of the *dominio pleno* in these areas could provide considerable benefits and might be explored on a pilot basis. In rural areas, the short term nature of land rental contracts does not provide sufficient predictability to make these contracts an effective instrument for structural and generational change involving longer-term investments and changes in the structure of production. Eliminating regulatory obstacles preventing such contracts and at the same time providing support so that *ejidatarios* be able to identify and implement, possibly with the support of others, the needed investments, may help to add productivity, in addition to the non-economic accomplishments and the impact on non-farm benefits, to the positive impacts from Mexico's "second agrarian reform".

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Table 1: Poverty in the overall population and in ejidos

	Total population	Ejidos
National	26	53
North Pacific	15	25
South Pacific	49	79
Gulf	33	65
North	25	60
Center	24	52

¹ Poverty is defined as having an household income below one minimum salary

Source: 1990 Population Census

Table 2: Comparing characteristics of *ejidatarios* and private farmers

	All farmers	All <i>ejidatarios</i>	Private farmers	<i>Ejidatarios</i> w/o Procede	<i>Ejidatarios</i> with Procede
Household characteristics and income					
Household size	4.11	4.06	4.36	4.32	3.84
Age of household head.	40.63	40.91	39.32	39.88	41.75
Mean education of household head (years)	4.61	4.27	6.23	4.25	4.29
Per capita household income (median)	3,771	3,771	5,280	3,771	3,300
Households earning less than a minimum wage (%)	38.0%	40.0%	25.0%	35.0%	44.0%
Share of household income from agriculture	58.0%	59.0%	57.0%	54.0%	62.0%
Share of households receiving remittances	20.0%	22.0%	15.0%	23.0%	21.0%
Endowments					
Per capita land owned (median)	1.56	1.40	3.00	1.25	1.42
Per capita agricultural land (median)	1.32	1.20	2.78	0.75	1.42
Irrigation available	25.0%	23.0%	32.0%	17.0%	28.0%
Share of agricultural land with irrigation	0.28	0.27	0.33	0.17	0.33
Cattle ownership (%)	24.0%	21.0%	43.0%	18.0%	23.0%
Avg. herd size (for cattle owners)	9.73	5.62	29.00	6.57	4.2
Ownership of ag. Machinery/ equipment	21.0%	19.0%	29.0%	20.0%	18.0%
Agricultural technology					
Used fertilizer	41.0%	40.0%	48.0%	43.0%	37.0%
Used improved seeds	31.0%	28.0%	43.0%	23.0%	32.0%
Used rented/ owned machinery	34.0%	31.0%	45.0%	30.0%	32.0%
Median Corn Yields (kg/ha)	929	897	1050	1000	750
Median Wheat Yields	4274	3875	5000	4000	3375
Number of observations	426	351	75	157	194

Source: 2000 Ejido and private farmer survey.

Table 3: Subjective perceptions regarding the impact of Procede

	Change due to Procede	
	More	Less
Tenure security and factor market participation		
Problems with land tenure security	5.0%	28.0%
Rental of lands	19.0%	12.0%
Land Sales	23.0%	11.0%
Migration	15.0%	8.0%
Access to credit	12.0%	8.0%
Productive investments	5.0%	4.0%
Ejido characteristics		
Social unity in the <i>ejido</i>	21.0%	12.0%
Participation in associations	5.0%	4.0%
Land consolidation	3.0%	2.0%
Land subdivisions	4.0%	2.0%

Source: 1997 *Ejido* survey (based on 1291 *ejidatarios*)

Table 4: Determinants of PROCEDE adoption.

	Technique	
	Probit, marginal eff.	Probit, marginal eff.
Boundary problems, external	-0.369*** (4.25)	-0.327*** (3.07)
<i>Ejido</i> area (log)	-0.146*** (3.26)	-0.141*** (3.12)
Inequality of land ownership	-0.334** (2.36)	-0.322** (2.26)
Rental market partic.	0.113 (0.43)	0.096 (0.36)
<i>Ejido</i> average income	0.000*** (3.27)	0.000*** (3.28)
Literacy (%)	0.003*** (2.59)	0.003** (2.56)
Indigenous majority	-0.174 (1.34)	-0.175 (1.35)
Member of <i>ejido</i> union	-0.159* (1.83)	-0.157* (1.81)
Access to paved road	0.112 (1.14)	0.118 (1.19)
Boundary problems, internal		-0.096 (0.74)
Observations	247	247
Pseudo R-squared	0.344	0.346

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

Absolute value of z-statistics in parentheses.

Table 5: Determinants of operated land and land rental market participation

	Quantile regression Net operated land	Tobit Net renting in	Tobit Net renting out
Endowment of agricultural land	1.501** (2.37)	-0.146 (0.49)	
<i>Ejido</i> dummy	3.624 (0.81)	-203.788*** (2.98)	
<i>Ejido</i> dummy * Land endowment	-0.954 (1.35)	18.087*** (8.72)	
Procede dummy	1.358** (2.00)	287.133*** (4.62)	-6.036** (1.98)
Procede dummy * Land endowment	-0.422** (2.35)	-37.704*** (3.93)	-0.208 (1.45)
Owens machinery	1.078 (1.13)	2.734 (0.06)	7.602** (2.02)
Improvements on owned land	1.128** (2.18)	107.233** (2.47)	-1.288 (0.44)
Received Procampo	1.540* (1.89)	22.877 (0.45)	-5.454 (1.59)
Age of household head (years)	0.007 (0.42)	0.784 (0.62)	0.009 (0.12)
Education of head (years)	0.016 (0.21)	4.583 (0.68)	0.554 (1.30)
Number of adults	0.057 (0.76)	4.177 (0.71)	-0.143 (0.30)
Dependency ratio	0.350 (0.34)	52.584 (0.51)	-7.598 (0.99)
Constant	-5.428 (1.19)	-314.007** (2.41)	23.372*** (2.86)
No. of observations	358	327	283
Pseudo R-squared	0.451	0.155	0.200

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

Absolute value of t-statistics in parentheses.

Table 6: Determinants of net land purchases, 1984-1992 vs. 1992-2000.

	(1) Pooled OLS	(2) Pooled OLS	(3) Fixed effects	(4) Fixed effects
Time dummy	-6.205 (1.32)	-6.190 (1.32)	-10.724* (1.80)	-10.723* (1.80)
<i>Ejido</i> dummy	-4.257 (0.94)	-3.365 (0.78)		
<i>Ejido</i> *time	6.267 (1.13)	5.877 (1.12)	10.454 (1.48)	10.100 (1.50)
Procede	0.751 (0.30)	0.653 (0.26)	0.762 (0.18)	0.744 (0.17)
Land holdings	-0.049*** (4.19)	-0.048*** (4.15)		-0.377 (0.38)
<i>Ejido</i> *Land	0.102 (0.64)		-0.352 (0.35)	
Time* <i>Ejido</i> *Land.	-0.052 (0.27)		-0.041 (0.17)	
Constant	3.592 (0.78)	3.605 (0.78)	3.298 (0.42)	7.448 (0.41)
Observations	393	393	393	393
No of households		226	226	226
R-squared			0.02	0.02
Adjusted R-squared	0.0476	0.0514		

Absolute value of z-statistics in parentheses.

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

Table 7: Evidence on access to credit markets by *ejidatarios* and private farmers.

	All farmers	All <i>ejidatarios</i>	Private farmers	<i>Ejidatarios</i> w/o Proceede	<i>Ejidatarios</i> with Proceede
Credit market access					
Obtained credit during 1984-92	25%	23%	35%	20%	25%
Obtained credit during 1992-2000	22%	20%	29%	17%	23%
Type of credit obtained (last year **)					
Short term	82%	83%	77%	93%	78%
Long-term	12%	11%	14%	7%	13%
Individual	62%	60%	68%	56%	62%
In group	33%	35%	27%	44%	29%
Credit source (last year)					
Banrural	36%	32%	50%	11%	44%
Commercial Bank	4%	1%	14%	0%	2%
Buyer of produce	4%	6%	0%	4%	7%
Collateral used					
Land	26%	18%	50%	4%	27%
Harvest	4%	6%	0%	15%	0%
Animal	1%	0%	5%	0%	0%
Machinery	6%	8%	0%	4%	11%
Other	3%	4%	0%	4%	4%
Rejection of credit					
Solicited credit after 1992 and was rejected	11%	10%	13%	13%	9%
Lack of collateral	16%	14%	20%	16%	13%
Not affordable	13%	3%	50%	0%	6%
Insufficient project quality	11%	11%	10%	21%	0%
Personal/ political	7%	9%	0%	5%	13%
Unpaid credit	4%	6%	0%	0%	13%

Source: 2000 Ejido and private farmer survey.

Table 8: Determinants of common land access, 1994 and 1997

	<i>Use of common land for pasture</i>		<i>Use of forest products</i>		<i>Forest logging</i>	
	Fixed effect	Random effect	Fixed effect	Random effect	Fixed effect	Random effect
Time dummy	0.538** (2.44)	0.666*** (4.62)	1.026*** (3.92)	0.598*** (3.47)	-0.730*** (2.80)	-1.425*** (8.64)
Procede dummy	0.965** (2.06)	-0.200 (1.03)	-0.101 (0.18)	-0.758*** (3.56)	0.533 (0.97)	0.044 (0.18)
Household size (persons)	0.051 (0.81)	0.032 (1.43)	0.135* (1.65)	0.061*** (2.61)	0.146* (1.78)	-0.002 (0.06)
Age (years)	0.034 (0.98)	-0.003 (0.57)	-0.029 (0.67)	-0.013*** (2.62)	-0.050 (1.16)	-0.003 (0.66)
Education (years)	-0.095 (0.94)	-0.006 (0.53)	-0.189 (1.24)	-0.043** (2.16)	-0.305** (2.11)	-0.008 (0.41)
Land owned (ha)	-0.012 (0.83)	-0.010 (1.34)	-0.004 (0.33)	-0.021*** (2.86)	0.008 (0.52)	-0.016** (2.48)
Land*Procede	-0.035 (1.04)	-0.017 (1.16)	0.013 (0.25)	-0.006 (0.35)	-0.048 (0.88)	-0.023 (1.10)
No of cattle	0.020 (1.04)	0.033*** (5.37)				
Cattle * Procede	0.085* (1.76)	0.006 (0.58)				
Common land %	-0.005 (1.32)	0.001 (0.84)				
Common land* Procede	-0.002 (0.83)	0.001 (0.50)				
Percent Forest			0.000 (0.05)	0.008*** (3.15)	0.007 (1.00)	0.011*** (4.56)
Percent * Procede.			0.004 (0.38)	0.023*** (3.16)	0.002 (0.23)	0.012** (2.34)
Constant		-2.078*** (2.59)		-0.744 (0.88)		0.842** (2.14)
No of observations	486	1908	346	1718	334	1718
No of households	243	1288	173	1289	167	1289

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

Absolute value of z-statistics in parentheses.

Table 9: Impact of Procede on household income growth

	<i>Farm income</i>	<i>Off-farm income</i>
Procede adoption	661.837*	1,014.411***
	(1.65)	(2.98)
Land per capita (log)	69.209	-130.800
	(0.29)	(0.64)
Procede * per capita land	-379.135	-168.634
	(1.10)	(0.57)
Per capita land squared	-69.317	98.820
	(0.60)	(1.00)
Procede *per capita land square	-315.434**	-133.047
	(2.05)	(1.02)
Procede *hh labor	30.816	582.533***
	(0.22)	(4.83)
Procede *education	12.637	352.807***
	(0.08)	(2.74)
Procede *common land	348.117	84.873
	(1.54)	(0.45)
Procede *irrigated land	-641.785	-1,107.974***
	(1.30)	(2.66)
Procede *rainfed land	23.220	162.507
	(0.07)	(0.57)
Procede *pasture	4.859	157.679
	(0.02)	(0.86)
Procede *migration MX	-54.202	-39.020
	(0.53)	(0.45)
Procede *migration USA	-691.526***	-15.685
	(3.20)	(0.08)
Household labor	-68.978	83.448
	(0.69)	(1.00)
# migrants in US	102.781	403.833***
	(0.71)	(3.26)
# migrants in Mexico	42.125	22.298
	(0.56)	(0.35)
# harvesters	-395.873	479.209*
	(1.31)	(1.80)
# tractors	1,173.688***	260.974**
	(8.22)	(2.12)
# pick-up/trucks	5,482.717***	-749.029
	(7.68)	(1.25)
Pig stock	88.511***	-33.667
	(3.46)	(1.50)
Cow stock	107.739***	25.716**
	(8.70)	(2.48)
# mules and horses	27.665	129.443***
	(0.50)	(2.70)
Per ejidatario commons	-48.822	225.504**
	(0.38)	(2.08)
Constant	-495.644*	667.098***
	(1.80)	(2.85)
No. of observations	1231	1231

Absolute value of t-statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%