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Re-Crafting Rights over Common
Property Resources in Mexico

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Re-Crafting Rights over Common Property Resources in Mexico

by

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Re-Crafting Rights over Common Property Resources in Mexico

I. Endogenous evolution of land rights

The propositions of Ester Boserup (1965) and the Property Rights School (Demsetz, 1967; Alchian and Demsetz, 1973; North and Thomas, 1973) have dominated thinking about the endogenous evolution of land rights from open access to individual property. According to these views, there are two fundamental changes that push toward the privatization of a resource. One is its rising scarcity associated with population growth. The other is the rising value of the resource associated with greater market integration and the commercialization of agriculture. As long as there was land abundance and the resource had little commercial value, the marginal cost to current users of entry by an additional user was sufficiently small not to be worth opposing, and the magnitude of the externalities imposed in extraction by each user on all others was insignificant, making it not worth controlling.

As the scarcity and value of the resource increases, changing property rights to regulate entry and to internalize the externality imposed by other users becomes profitable. Regulating entry requires transformation of the resource from open access to common property (CPR) or to private property, limiting in each case access to the resource to a well defined group of users (Ostrom, 2001). Internalizing externalities requires choosing between two options. One is to cooperate in the management of the CPR by introducing and enforcing rules that deter opportunism in the provision of services to the CPR and in the appropriation of resources from the CPR (McCarthy et al., 2001; Otsuka and Place, 2001). The other is to divide the CPR among members of the community, either in sub-coalitions where cooperation may prevail more easily, or in individual allotments (Baland and Platteau, 1996). The default option prevails when there is failure to enclose, failure to cooperate in the management of the CPR, and failure to enforce individual property rights after division. In this case, incentives to manage the resource for sustained use are missing, and there is both under-provision of services for maintenance and over-extraction from the resource, leading to degradation and depletion, the well known “tragedy of the commons” (Hardin, 1974).

Recent contributors to the New Institutional Economics of property rights have attempted to identify conditions under which the CPR option was eventually chosen over the division option (Wade 1987; Ostrom, 1992b; Baland and Platteau, 1996). There are basically four situations that can lead to this

outcome. The first is when there are high expected benefits from keeping the land in CPR as opposed to dividing it into individual plots. These advantages derive from economies of scale in production, geographical risk spreading over large areas, and benefits of maintaining the land in common as the basis for community life which provides, in turn, other advantages such as information sharing, mutual insurance, and political clout (Nugent and Sanchez, 1999). The second is when the community is able to maintain a low cost governance structure and effective cooperative relations among members. From the logic of collective action (Olson, 1965; Hirschman, 1984), we know that this is related to structural characteristics of the resource, the community, and the context where cooperation occurs, and there has been some empirical work to quantify the relative importance of these determinants of cooperation (Bardhan, 2000; de Janvry et al., 2001). The third is when the high costs of privatizing overwhelm the expected gains. This is the case when the costs of negotiating division and of enforcing individual property rights are too high. Finally, there are situations where concerns with unequal gains from privatization, and lack of commitment devices to make credible that compensations will be paid to compensate for unequal gains, prevent mobilizing support in favor of division (Baland and Platteau, 1998).¹ Division may thus be opposed by those currently making greater use of the CPR (for instance large livestock owners) or by those who fear low allocations when division will occur. Hence, there are many reasons why the CPR option may be chosen over division in spite of population pressure and market development. These CPRs are sometimes well managed, but more often over exploited and poorly maintained, continuing to exist as a dysfunctional institution blocked from further evolution along the lines predicted by Boserup.

Much of the empirical evidence in support of these evolutionary paths is qualitative because we rarely have a sufficiently large number of observations on the institution being transformed to engage in statistical analysis. North (1990), Wade (1987), and Ostrom (1992a), for instance, provide us with fascinating case studies of how particular communities have responded to the pressures of increasing resource scarcity and increasing value of the resource, inducing transformation of property rights. Only recently have Otsuka and Place (2001) conducted systematic empirical studies in seven countries to identify quantitatively the role of different factors explaining the privatization of communal tenures. They

¹ This is an argument similar to that used by Alesina and Drazen (1991) and Fernández and Rodrik (1991) in analyzing opposition to stabilization and trade reforms.

find that population pressure (rising land scarcity) has been the main determinant of privatization of land rights.

In this paper, we turn to Mexico's recent experience with re-crafting property rights over its extensive common property resources as a unique opportunity to analyze in great detail, both qualitatively and quantitatively, the determinants of the endogenous evolution of land rights. In that country, the peasant-led revolution of 1910 resulted in an extensive process of land reform that distributed half of the national territory to 29,162 peasant communities called ejidos. Members of these communities (called ejidatarios) received access to an individual land parcel, principally cultivated in crops, and to land held in common property, mostly kept in pastures and forests. In ejidos where agriculture is practiced as shifting cultivation, all land is often held communally.

The legislation that created the ejidos severely constrained the ejidatarios' property rights over land. This is not surprising since the overriding objective of the land reform was to avoid recurrence of peasant-led uprisings (Gordillo et al., 1998). Land transactions involving individual parcels were prohibited: no rental and sales were allowed. It was illegal to divide common property areas into individual plots. Membership in the ejido was also tightly controlled. Any request for the incorporation of new members had to be submitted to the Agrarian Reform Agency, which had the policy of curbing membership expansion to avoid reducing the land area per member and the potential return of revolutionary demands for land. The same goal was behind the restriction imposed on ejidatarios to bequeath their individual land parcel and their right to the commons to a single descendant. As a consequence of this restriction, the village in an ejido typically contains many non-members, mainly the non-heir sons and daughters of members with no rights of access to ejido land (Otero, 1989).

The 1992 constitutional reform of property rights gave ejidos the freedom of reallocating land between common property and individual parcels, as well as of incorporating new members, provided specific procedures were followed. The land certification program Procede (National Certification Program of Ejido Rights and Urban Lots) initiated in 1994 provided the means to implement these changes. A new agency, the Agrarian Attorney's Office, led the certification effort through organizing introductory meetings, providing guidance during the required assemblies, and helping in the process of defining and registering individual plots. While not free from struggles and confrontations as can be expected from

changes in rules governing the commons (Klooster, 1990), the process was remarkably transparent and democratic due to rules imposed by Procede. Such rules required a majority vote to initiate the program, active role of a commission of the assembly in the identification of individual parcels, public posting of land assignments to accommodate disagreements, signed recognition of boundaries by owners of lands surrounding the ejido, and majority approval (with a 75% quorum) of the revised property rights needed for the Agrarian Land Registry to issue certificates. This sudden reform of property rights in Mexico gives us an exceptional observatory of the endogenous process of preservation or division of CPRs, and of incorporation or not of new members in the community.

It is this endogenous process of division and incorporation that we analyze in this paper. Specifically, we want to: (1) identify the factors explaining community decisions over changes in property rights (division and incorporation), discriminating in particular among different hypotheses advanced in the literature; and (2) follow the implications of endogenous changes in property rights over individual access to land, and how they affect poverty and inequality. We use for this purpose a nation-wide panel of ejidos and ejidatarios conducted by the Agrarian Reform Agency, the University of California at Berkeley, and the World Bank. The first survey was done in 1994 before implementation of Procede. By the time of the second survey in 1997, nearly two-thirds of the ejidos had at least initiated the land certification program. The surveys give us information about changes in property rights (division) and in membership (incorporation) at the ejido level, and also about changes in household-level land endowments within the ejidos surveyed. In-depth case studies of ejidos were also conducted in 1999 to understand the motivations for a community in deciding to divide and incorporate or not, and to whom to allocate additional land.

In Part II of the paper, we use the literature on enclosure of the commons to derive a number of hypotheses for the specification of the empirical analysis of division and incorporation. In Part III, we use case studies conducted in 12 ejidos to understand causalities in the changes observed. In Part IV, we present the results from the ejido-level empirical analysis of the decisions to divide and incorporate. In Part V, we analyze the determinants of changes in land endowments at the household level to derive implications for poverty and inequality. We extract conclusions in Part VI.

II. Hypotheses on the determinants of division and incorporation

The literature review in Part I of the paper gives us a number of hypotheses to structure the analysis of the decision to divide the commons. This literature does not consider the problem of incorporation since membership rights in communities are usually acquired by birth and consequently are not an endogenous choice. Membership determined by democratic vote is specific to property rights in the ejido and to rules under the Procede program. For that decision, hypotheses consequently need to derive from the historical specificity of the ejido and from the case studies.

1. Decision to divide

The literature on the decision to divide gives us three analytical categories: Boserup and the rising costs of externalities, the opportunity cost of dividing, and the risks and cost associated with division.

1.1. Boserup: scarcity and value

Following this approach, there are two categories of variables that would induce division of CPR in individual tenures. They are:

- i) Land scarcity: This is reflected by the amount of communal land available per member.
- ii) Value of the resource: This is reflected by the yield potential of the land that can be converted in individual tenures and by the degree of market integration.

1.2. Opportunity cost of division: quality of cooperation

Different communities have vastly different abilities to cooperate and collectively manage their CPRs. When the quality of governance is high, CPRs are better managed and CPR land is more profitable, increasing the opportunity cost of dividing the land. Hence, ejidos with greater ability to cooperate are more inclined to refrain from dividing the commons in individual tenures (McCarthy et al., 1998).

1.3. Risks and costs of division

If the current distribution of economic benefits from use of the commons is highly unequal, dividing the commons may be seen as a way of redistributing opportunities toward greater equality. This would be the case when livestock ownership is highly unequally distributed across community members and when median voters in assemblies consequently feel cheated in the use made of CPRs. By contrast, as pointed out by Baland and Platteau (1998), high inequality in economic power may signal risks in agreeing on distribution resulting in unequal benefits, blocking the possibility of moving forward with distribution of the commons. High inequality in current use (livestock ownership) would consequently create incentives

for division while high inequality in economic power (individual land ownership) would deter division. Larger communities (Olson, 1965) may also have higher costs of decision-making in changing property rights, reducing division.

2. Decision to incorporate

This decision is specific to the nature of property rights in the Mexican ejido and to the restrictive rules of incorporation that prevailed before the reforms.

2.1. Population pressure on those with rights

The principal determinant in deciding to incorporate new members is the population pressure on those currently with rights of access. This pressure originates from the sons and daughters of ejidatarios and from migrants to the community who could not be incorporated under the restrictive rules of admission that prevailed before the 1992 reforms. Clearly, the special affective relations between members and non-members is a strong determinant of incorporation in spite of the negative externalities they may impose on current members.² This pressure is represented by the number of households in the community that do not have ejidatario rights relative to the number of ejidatarios.

2.2. Abundance of common land

New members must receive an individual parcel of land and access to their share of the remaining land in CPR. The area of common land per member before incorporation is thus an indicator of the ease of incorporating new members. In particular, greater abundance of common land results in a lower negative externality on current users created by one additional member (Poteete, 2001).

2.3. Abundance of private land

New members can also be incorporated by gaining access to part of the land held by a current member, either through sale or gift, and then asking the assembly to be accepted as full members. The larger the land parcels held by current members, the more likely this form of incorporation. When the sale is ratified by the assembly, the new members acquire ejidatario status and also gain access to their shares of CPR land. If the assembly chooses not to accept them as ejidatarios, they can keep the land as posesionarios, but they cannot vote in assembly meetings and have no rights over the commons.

3. Legal opportunity to divide and incorporate

The opportunities to divide and to incorporate were given by the Procede program. By 1997, 62% of the communities were in progress or had completed certification of land rights to ejidatarios and 87% had held a first meeting with Procede officials. In all cases, however, given that Procede began in 1994, ejidos were informed of the incoming reforms and could take autonomous initiatives in dividing the commons, to be later ratified by Procede. In some cases, conflicts over the ejido's external boundaries implied delays in dividing the commons as allocated lands could subsequently be challenged by outsiders.

4. Implications for poverty and inequality

Initial allocation of individual parcels was egalitarian among members of the ejido. After this, however, decades of internal exercise of influence in encroaching on the commons and informal land transactions have resulted in inequalities. Certification of land parcels and opportunities to divide and incorporate under Procede could be used to amplify, ratify, or compensate for inequalities. Under the traditional vision that market forces are unequalizing while government (in this case the ejido assembly) interventions can be equalizing, certification under the transparent and democratic approach imposed by Procede rules and procedures could be both poverty reducing (access to land for the poor) and equalizing (access to more land for those with smaller endowments).

We use these categories to organize the analysis of the decisions to divide and incorporate in both the case studies and the ejido-level survey data. Because the two decisions are related, a reduced form analysis of these two decisions will, in the end, rely on the hypotheses advanced for both decisions.

III. Case studies of responses to Procede³

There is richness in information from case studies that cannot be equaled by the information contained in survey data. This richness of details does not of course aggregate into global patterns. Survey data are needed for this purpose. We consequently proceed sequentially in using these two levels of

² Poteete (2001), in reviewing the determinants of exclusion from a group for the purpose of regulating extraction in forestry communities, thus found that most important is the nature of the political relation among users.

³ Field work for these case studies was done jointly with Céline Dutilly (2001).

information, case studies to extract insights about processes and survey data to confirm the significance of these processes.

Twelve case studies were conducted between 1997 and 1999 in ejidos located in the states of Yucatan, Tabasco, Campeche, San Luis Potosi, and Zacatecas. From the wealth of information provided by the case studies, we only report here information that helps us (1) set up hypotheses for the empirical analyses of the decisions to divide, incorporate, and equalize and (2) provide us with interpretations of motivations and causalities involved. The ejidos selected all went through the Procede program. Table 1 gives a summary of the results.

1. Boserup: scarcity and value

1.1. Land scarcity in communal ejidos

Case studies show that the logic of dividing and incorporating takes on special aspects in communal ejidos. In these ejidos, 100% of the land was in common property. In the three communal ejidos analyzed, common property land was used by community members for subsistence shifting cultivation. The cooperation mechanisms embedded in local traditions have regulated land use and maintained high soil fertility for as long as land was abundant enough to keep long rotation cycles. This is still the situation in Yaxcabá and San Pedro Yaxcabá where land is abundant. In these communal ejidos, the tradition is that all children of ejidatario households are incorporated as members as soon as they become adults. That is, as long as there is unused land. According to the ejidatarios in El Eden, competition for the best land plots had shortened the fallow periods, increasing the expectation of gains from switching to an individual property rights system. Rising land scarcity thus led members of that ejido to vote for division of the commons.

1.2. Value of the resource

The quality of common property land, and its consequent potential for agricultural use, is important in inducing partial or total division. In Corregidora, the land most suitable for growing corn or for establishing cocoa and palm plantations was titled individually. In Plan de Ayala and La Manga, division was prompted by the profitability of introducing high yielding forage varieties on good quality lands and enclosing the fields. The argument made by ejidatarios was that they wanted to have more control over these investments, and thus preferred to make them individually. The partial privatization of

El Huizache, El Chilar, and Socorro de Dios also support this idea, because it was only the best lands that were divided, while the rest was maintained as common property. In San Pedro Yaxcabá, even when division was voted down, the main interest in the assembly debates was on division of the few high quality areas.

2. Pressure and possibility to incorporate new members

2.1. Population pressure on those with rights

In Table 1, population pressure refers to the number of non-ejidatario households living in the ejido village relative to the number of ejidatarios. In the case of Corregidora, members could respond to population pressure by endowing with land the whole younger generation of households because the commons were very extensive. This was done as a one-time deal under the agreement that any future endowments would have to come from the parents themselves. La Manga, on the other hand, despite high population pressure, decided not to add new ejidatarios and divided the commons only among the older generation. In Socorro de Dios there is no population pressure because the young are long term migrants. Nevertheless, the commons were divided and allocated in their names. The parents expected that this would either give their children reasons to resettle permanently in the ejido or that they would become stewards of their children's lands, building up the cattle herds funded with their remittances. Thus, while population pressure induces incorporation and division, we also see refusal to incorporate in spite of pressure and incorporation without pressure.

2.2. Land abundance and incorporation

The amount of individual property land held by ejidatarios favors the incorporation of new members for two reasons: 1) Facing restrictions on how many of their children they can bequeath land to, ejidatarios can use the legal loophole of requesting their incorporation as new ejidatarios with the sale to them of part of their individual landholdings at a zero price. 2) For outsiders wanting to purchase ejido land, it is easier to be incorporated as new ejidatarios and to use the less restrictive intra-ejido trading regulations, than to undergo the long, costly, and uncertain process of taking the land out of the ejido system before purchasing it. In the case of Corregidora, there were examples of the first procedure in incorporating members, while Plan de Ayala had cases of the second. Individual to individual trades have thus been occurring through incorporation, which the assemblies preferred because it would "strengthen the

ejido” instead of weakening its internal links and collective functions. These trades are favored by abundance of land in individual parcels.

3. Risks and costs of division: the role of inequality

Cases where regulation of use of common grazing lands was attempted always addressed the two problems of overgrazing and unequal use of the commons. The purpose of the proposed regulations was to solve simultaneously these two interconnected issues. By fixing the total number of animals that could be introduced in the commons, overgrazing would be reduced and each member would receive an equal quota. Those with less animals could then trade their quotas with those with an excess of animals. With no limits, everyone had the right to put as many animals as desired, and there was no reason for those who grazed more animals to compensate those who had less.

In none of the cases studied was regulation entirely successful. In Efigenia, regulation was voted down while, in the cases of Socorro de Dios and Pozo Hondo, it was approved only to be abandoned at the implementation stage. With cooperation failure, we observe that division appears as the main alternative for those making little use of the commons. High inequality in livestock ownership thus induces the median voter to prefer division.

One of the reasons ejidatarios gave for the failure of regulating cattle grazing was weak enforcement due to traditional reliance on “voluntary” compliance. Either the regulations did not include sanctions or the ejidatarios did not expect them to ever be enforced. With inability to regulate, some ejidos responded by changing the size and composition of the decision group, effectively dividing the commons among subcoalitions of members. This strategy was used both before the reforms and when legal division was effectively blocked by a majority vote in the post-Procede environment. In these cases, the objective of the assembly was to create a situation more conducive to cooperation. This is why in Plan de Ayala and Mala Noche, the common property land was divided into sections managed by subgroups. In Plan de Ayala, the process of forming subcoalitions following cooperation failure continued until land was completely divided, first into extended family units and finally into individual household units. In Mala Noche, subcoalitions persisted despite the possibility of individual division. People interviewed mentioned that the large distance between the ejidatario dwellings and the commons made enforcement of individual rights too costly. A different reason for subcoalition formation in a post-reform environment occurred in

Pozo Hondo and Efigenia. There, the parties in favor of division proposed divisions among subcoalitions as the second best solution when their assemblies rejected full individual privatization of the commons.

4. Equalizing division

Because of informal transactions and unequal encroachment, there are differences in land assets among members of a same ejido even if initial endowments were egalitarian. In the case of La Manga, division of the commons was used as a way of compensating for the existing differences in individual endowments and endowing every member with the same amount of land. The same happened in Socorro de Dios, where a minority had control over the best quality land in the commons, claiming it as their own, and had been desperately trying to obtain individual titles to it, blocking for months attempts by the majority to proceed with a formal and egalitarian division of the commons. In Corregidora and El Eden, the allocation combined assigning the plots that had been occupied informally, plus a complement to make them add up to equal shares.

The division process entails risks with regards to quality of the land particular ejidatarios will receive. When opting for individual titling, the ejido must solve the problem of land allocation among its members, which is especially difficult when land quality is heterogeneous and difficult to predict. The solution observed in La Manga, Socorro de Dios, and El Eden was to use a lottery system. Most of their commons had not been encroached previously and were relatively homogeneous, so a lottery system was perceived as a fair way of allocating land of unknown quality. Where land has heterogeneous quality that was hard to predict, allocation problems discouraged division as it happened in San Pedro Yaxcabá.

IV. Econometric analysis of the decisions to divide and incorporate

1. The survey data

The panel data for the econometric analysis cover 288 ejidos and 1,068 ejidatarios. These communities and households were interviewed first in 1994, before the titling program began, and then again in 1997. The ejidos and the households within these ejidos were randomly chosen nation-wide in 1994. Only the state of Chiapas was excluded from the analysis because of warfare at the time of the 1994 survey. The number of households surveyed per ejido is not sufficient to make inferences from them on the rest of the members, so the ejido-level analysis only uses information from the corresponding survey.

2. Importance of common property resources in the ejido

Not all ejidos are endowed with commons. In the survey, 181 (63%) of the 288 ejidos have CPR. Historically, some ejidos received all their land as commons, while others had a mix of individual and common tenure, and others no CPR. This depended on the inclination of the group that had asked for land, on the ideology of the government under which the distribution took place, on the physical characteristics of the land, and on the number of people that would form the ejido. The stated objective of the redistribution was to give enough land to peasants so the household could be self-sufficient in food production. In 1994, after more than seven decades of creation of ejidos, the percentage of land held in common varies across ejidos of different sizes, as can be observed in Figure 1. Among ejidos with CPR, 12.2% have less than 10% of their land in common while 29.8% have more than 90% of their land in common, with a mean value of 62%. As Figure 2 shows, the share of the land in CPR increases when there is more land abundance: this share rises from 47.1% in ejidos with less than 25 ha of land per member to 90.3% in ejidos with more than 150 ha per member.

Of the 181 ejidos with commons in the survey, 70 did not divide or incorporate new members in the 1994-97 period, while 35 divided without incorporating, 47 incorporated without dividing, and 29 both divided and incorporated.

3. Ejido-level analysis

The two decisions to divide and to incorporate are clearly interrelated, as division of the commons often was for the purpose of incorporating new members. In other cases, division may be induced by factors such as land scarcity or rising value of the land, and will be pursued to increase efficiency without incorporation. We thus tested a bivariate probit model, but could not reject orthogonality of the error terms.⁴ This shows that the two decisions are related by the exogenous variables used, not by unobservables. We consequently report in Table 2 results for two separate probits. Table 2 gives the marginal effects of each exogenous variable on each decision. We also calculate in the last three columns the marginal effects of each variable on the decisions to divide with or without incorporating, and on the decision to incorporate without dividing. These are calculated as follows:

⁴ The Wald test of zero correlation between the two error terms in the bivariate probit has a p-value of 0.63. Hence, the hypothesis of zero correlation cannot be rejected.

Let the probability of division (D) be $\Pr(D=1) = \Phi(\beta'X)$ and the probability of incorporation (I) be $\Pr(I=1) = \Phi(\gamma X)$, where Φ is the cumulative normal and X the vector of explanatory variables with coefficients β in division and γ in incorporation. Since the two probits are independent, we can calculate joint probabilities as follows:

Probability of division without incorporation: $\Pr(D=1, I=0) = \Phi(\beta'X)(1 - \Phi(\gamma X))$.

Probability of division with incorporation: $\Pr(D=1, I=1) = \Phi(\beta'X)\Phi(\gamma X)$.

Probability of incorporation without division: $\Pr(D=0, I=1) = (1 - \Phi(\beta'X))\Phi(\gamma X)$.

Note that the marginal effect of any variable X on the probability to divide can be additively decomposed into its effect on the probability to divide without incorporation and the probability to divide with incorporation:

$$\frac{d \Pr(D=1)}{dX} = \frac{d \Pr(D=1, I=0)}{dX} + \frac{d \Pr(D=1, I=1)}{dX}.$$

A similar decomposition can be written for the probability to incorporate.

Even though they are measured in 1994, the variables that characterize cooperation can be suspected of endogeneity with the decisions to divide and incorporate. We perform a test of statistical exogeneity following the method proposed by Smith and Blundell (1986). The instruments are whether the CPR provides sources of revenues for the ejido and the age of the ejido. These are valid instruments as they are significant in the equations that explain cooperation but not in the equations that explain division and incorporation. Similarly, we do a test of statistical exogeneity of the decision of initiating Procede during the 1994-97 period.⁵ Instruments are the geographical regions, which again prove to be valid instruments. In all three cases, statistical exogeneity cannot be rejected.

Results are presented using the same categories of variables used in the formulation of hypotheses and the case studies.

3.1. Boserup: scarcity and value

3.1.1. Land scarcity in communal ejidos

⁵ The other Procede variable, whether a first meeting was held with program officials, is exogenous as it is decided by Procede.

Communal ejidos where shifting agriculture is practiced on CPR land characterize the type of situation analyzed by Boserup. We find that these ejidos have a 50% higher chance of dividing the commons and a 39% higher chance of incorporating new members than non-communal ejidos. As shown by the decomposition in the last three columns, these marginal effects result from a decision to jointly divide and incorporate, the probability of which increases by 52%. When land scarcity is higher, the probability of division increases by 6.9% for the loss of each hectare, and the main motivation behind division is not incorporation as 60% of the effect comes from the decision to divide without incorporation. Hence, as predicted by Boserup, division would be pursued for efficiency purposes, namely to reduce the negative externalities associated with CPR. When land endowments per member are low, as was the case of El Eden, division is perceived as a necessity in spite of the deep cultural changes that this implies for the community.

3.1.2. Value of the resource

The value of the resource is also a Boserupian determinant of the decision to divide. We use the lowest yield on parcels individually cultivated in corn as an indicator of the marginal value of common land. Historically, mixed tenure ejidos were formed with individual parcels located in the best lands for agriculture, leaving the rest in commons. It is, therefore, expected that any expansion of agriculture over the commons would generate the low end of the observed yields in parcels. The estimated coefficient for the effect of land quality on division is positive, supporting the hypothesis that individual property rights emerge where land is more valuable, and this effect comes equally from cases of division with and without incorporation.

Boserup also calls upon the argument of market integration in explaining why the value of the resource changes, leading to eventual individualization. We used for this reason distance to the nearest urban center as an indicator of market integration. However, it is not significant.

3.2. Pressure and possibility to incorporate

3.2.1. Population pressure on those with rights

Pressure on ejidatarios to incorporate new members is proportional to the number of non-ejidatarios in the community relative to the number of ejidatarios. On average, this pressure is high, with 1.2 non-ejidatario households for every ejidatario household. A 10% increase in non-ejidatario pressure

increases the probability of incorporating by 26.6% and of dividing by 2.2%. The decomposition of marginal effects shows that the main motivation is incorporation, and that it comes both with and without division of the commons (10% and 16.6%, respectively). This pressure to divide for incorporation is, however, compensated by a strong reduction in the temptation to divide among those that decide not to incorporate (-7.9%). This finding supports the hypothesis suggested by the case studies, where the ejidos' assemblies accept non-ejidatario households belonging to the community as members, endowing them with land from the commons. Note that this population pressure is not a Boserupian land scarcity argument. It is an institutional problem embedded in the constitution of the ejido that was designed to minimize incorporation of new members to avoid division of the land over larger and larger numbers of members. Elimination of these restrictions, and the legal possibilities of dividing and incorporating, were thus the cause of the changes observed where population pressure was high.

3.2.2. Land abundance in non-communal ejidos

Results show that the larger the CPR endowment per member, the higher the probability that some of it will be divided into individual plots. Similarly, higher CPR endowments per member allow greater incidence of incorporation of new members. We see, however, that there is no division without incorporation, and that division is in response to the desire to accommodate new members. This effect is thus different from the situation considered by Boserup: it is not greater land scarcity that induces division, but greater abundance that offers opportunities to incorporate new members (principally the sons and daughters of ejidatarios), and some of the CPR land is divided to provide individual land endowments to these new members.

Individual land endowment per ejidatario is not important for the decision to divide, but it is important for the decision to incorporate new members which may happen either with or without division of the commons. As we have seen in the case studies, incorporation of new members is in part done by dividing individually held parcels. The larger these are, the more it is possible to follow this strategy to incorporate the sons and daughters of ejidatarios.

3.3. *Opportunity cost of division and incorporation: quality of cooperation*

The opportunity cost of dividing the land depends on the quality of management of the CPR as determined by the level of cooperation in the community. The indicators of cooperation available in the

survey are two: 1) The presence of regulations that reduce the negative externalities present in common property, which in the case of forested ejidos means a forestry organization and in that of rangeland ejidos regulation on the number of animals. 2) The frequency of assembly meetings held in the past 12 months, which acts as an indicator of the quality of cooperation, where a higher frequency of meetings points to greater possibilities of enforcing and adjusting the existing coordination mechanisms. Table 2 shows that estimated coefficients for the two cooperation indicators are negative. This result supports the hypothesis that better cooperation under a common property regime reduces incentives to divide the commons (McCarthy et al., 1998, had found a similar disincentive for individuals to encroach on the commons when cooperation is higher).

Cooperation (ejido with formal rules) also deters incorporation of new members. Since cooperation allows better management of CPR, it is land-saving and should thus have favored incorporation in the same way as more common land per member favors incorporation. However, cooperation is harder to maintain the larger the size of the group (Olson, 1965; Hirschman, 1984). As a consequence, when cooperation is strong, the group may be wary of incorporating new members that would make sustaining this level of cooperation more difficult.

3.4. Risks and costs of division: inequality and size of the group

The literature review suggested that risks in the process of division affect the decision to privatize. We use inequality in land parcels owned (ratio of largest to smallest parcel) to measure the relative economic power of ejidatarios, and hence their unequal abilities to influence the decision to divide. Econometric results confirm the suggestion made by Baland and Platteau (1998) that inequality deters division (up to a maximum inequality of 27.5 when average observed inequality is 6.5). Conditional probabilities show that the division which is deterred by higher inequality is not being pursued for the purpose of incorporation.

Inequality in the size of herds of livestock grazing in the commons (ratio of largest to smallest herd) has the opposite effect: higher inequality induces division, with no impact on incorporation, confirming what we saw in case studies. The costs in deciding to divide or incorporate can be expected to rise with the number of members in an ejido. However, this variable is not significant, neither on division nor on incorporation.

3.5. Legal opportunity to divide and incorporate

The unique feature of the period over which we have panel data is the sudden opportunity given to ejidos by the Procede program in privatizing common property resources and incorporating new members in the ejido. Econometric results show, however, that neither the holding of an initial meeting nor initialization of the certification process make any difference on division and incorporation. This does not mean that Procede was inconsequential since 61% of the ejidos with CPR divided and/or incorporated new members during the 1994-97 period. What it means is that all the communities that wanted to implement these changes had already started the process on their own based on information that these changes were now legal and were to be ratified by Procede once it would reach the ejido. The certification program was thus massively effective during the period, but it cannot be distinguished from other changes that occurred in the intervening years. However, neither division nor incorporation could have happened at that scale during this period without the discounted effects of the program.

Conflicts regarding the external limits of the commons reduce the likelihood of division. Historical disputes and limited political commitment from the federal government to solve these conflicts had nearly 8% of the ejidos with commons under a status of uncertainty about their external limits in 1994. If division were carried out, individuals receiving disputed land would risk losing it. By keeping the commons as such, the ownership claim would still have the interest and backing of all ejidatarios. In addition, Procede had the policy of not giving out individual titles in areas that were under legal challenge, so any informal division would have even less value.

4. Relative importance of theoretical determinants of division and incorporation

We have used five categories of determinants in explaining the decisions to divide and incorporate: Boserup scarcity and value, pressure and possibility to incorporate, opportunity cost of division and incorporation, risks and costs of division, and legal opportunity to divide and incorporate. To measure the relative importance of these five categories of variables, we re-estimate the equations in Table 2 as linear probabilities. Each category i of variables is a $(\beta'X)_i$. We can then decompose the total

explained variance, $\text{Var}\left(\sum_{i=1}^5 (\beta'X)_i\right)$, as:

$$\text{Var}\left(\sum_{i=1}^5 \left(\beta'X\right)_i\right) = \sum_{i=1}^5 \text{Var}\left(\beta'X\right)_i + \sum_{i=1}^5 \sum_{\substack{j=1 \\ j \neq i}}^5 \text{Cov}\left(\left(\beta'X\right)_i, \left(\beta'X\right)_j\right).$$

We measure the share of the total variance that each category explains as a direct effect equal to $\text{Var}\left(\beta'X\right)_i$ and an indirect effect equal to $\sum_{j \neq i} \text{Cov}\left(\left(\beta'X\right)_i, \left(\beta'X\right)_j\right)$. This is more acceptable given that indirect effects are here small relative to direct effects. Results in Table 3 show that the Boserup effect accounts for 40% of explanatory factors in the decision to divide and provides the most powerful explanatory category. Land scarcity in communal ejidos and value of the resource play equal roles. The role of cooperation in managing the commons is the next most important explanatory factor accounting for 27% of the explained variance. This is followed by the pressure and possibility to divide in order to incorporate (17%), and finally the risks and costs of division (8%). The Boserup theory was of course not developed to explain incorporation. For this, the most important factor is the pressure and possibility to incorporate, accounting for 39% of explained variance. Of nearly equal importance are the Boserup effects (22%, mainly land scarcity), the opportunity cost of division (18%), and the risks and costs of division (16%).

Confirming the results obtained by Otsuka and Place (2001) in other countries, this decomposition shows the importance of Boserupian scarcity and value effects for the Mexican ejido. It, however, also stresses the importance of looking beyond the effects of scarcity and value in explaining the division of CPRs. Of great importance from a policy standpoint is the role of cooperation in giving communities an alternative to division if there are better options. Indeed, if there are economic and environmental gains from keeping the CPR as a unit of management, this result has meaningful policy implications in showing the importance of assisting communities improve their abilities to govern when control over resources is devolved to them (see, on this point, the suggestions made by Abraham and Platteau, 2001).

5. Incorporation in ejidos without commons

Ejidos with no commons have also responded to Procede by incorporating new members. The presumption, however, is that the decision model for these ejidos is quite different from that of ejidos with CPRs, in particular as many variables pertaining to the common resources cannot enter the model. From an independent estimation on the 37 ejidos without commons for which we have complete data, the significant

factors in inducing incorporation are Procede (which increases the probability of incorporation by 45 percentage points), inequality in private land (marginal effect of 4.2 percentage points), population pressure from non-ejidatarios (6 percentage points), and the total number of ejidatarios (0.13 percentage points).

To test for this hypothesis, we estimated the decision to incorporate for all ejidos, and found that there is no difference in parameters between those with and without CPR, except for two: the intercept and average individual land per ejidatario. Ejidos without commons have a 30% higher probability to incorporate, and the marginal effect of individual land per ejidatario is to increase the probability of incorporation by 1.8% per additional hectare, compared to 0.86 for ejidos with commons. This last result is quite intuitive as incorporation of new members when the ejido does not have any commons relies on the possibility of sharing individual plots. Ejidos without CPR thus also responded to Procede by incorporating new members, and this all the more that current members had more individual land to share.

V. Household-level analysis

The household panel shows a large number of ejidatarios (53%) reporting a gain in individual control over land between 1994 and 1997, with an average of 2.6 additional hectares (Table 4). Before the reforms, appropriation of the commons only took place informally. Encroachment through exercise of influence has been a prevalent practice in ejidos with commons suitable for agriculture. Access to land can still increase in this fashion in ejidos with commons and no formal division. With the reforms, land assets can be increased through division of the commons if the assembly approves it. In addition, an ejidatario can now purchase individual ejido parcels from fellow members, in addition to buying private land outside the ejido which always was an option. Hence, access to land can also increase even where there are no commons.

The surveys show noticeable differences in land asset changes between ejidatarios living in ejidos with commons and those without, and whether ejidos with commons engaged in division and incorporation during the period or not. The data in Table 4 show that net increases in land assets at the household level were more frequent in ejidos with commons (55%) than in ejidos without (43%), and that the gains in land were larger in the first case (2.9ha) than in the second (1ha). Among ejidos with commons, the frequency of gains was highest when there was division without incorporation (63%).

To complement descriptive statistics, we present in Figures 3 non-parametric fits of the relation between probability of additional access to land and initial land assets held in 1994 (measured in rainfed equivalent hectares) separately for households in ejidos that did not divide, divided and incorporated, and divided without incorporation. They show the progressive nature of gains in land in ejidos where there was division, especially division without incorporation, with those with less land more likely to gain more. In Figure 4, the percentage gain in land assets is fitted against initial land endowments. They also show the progressive nature of gains in access to land, particularly when there was division. Gains in land were largest when there was division without incorporation.

The impact of Procede on land inequality differed across ejidos depending on their decisions to divide and incorporate. We characterize this using the Gini coefficient for the size of individual plots in the panel of households in 1994 and in 1997. In ejidos where there was no incorporation and no division, the Gini remained constant, equal to 0.54 in 1994 and to 0.53 in 1997. In ejidos where there was incorporation without division, plots of land were divided by some to accommodate new entrants, increasing inequality from 0.52 in 1994 to 0.56 in 1997. By contrast, when there was division without incorporation, division was used to equalize access to land. In these ejidos, the Gini coefficient fell from 0.55 in 1994 to 0.51 in 1997.

In analyzing changes in individual access to land, we want to contrast the role of market forces and unregulated exercise of influence (encroachment) to the role of governance codified by Procede in reallocating assets (division). The presumption is that market forces and exercise of influence can increase inequality and be discriminatory (ejidos that did not divide), while democratic governance can play an anti-poverty and redistributive role (ejidos that divided). To do this, we analyze separately the ejidos where there was no division of the commons, and hence where changes in access to land were the product of market and influence forces, and the ejidos where there was division of the commons, and hence where changes in access to land were the outcome of democratic interventions, in addition to market forces.

Changes in a household's land assets are thus expected to depend on household characteristics (the natural, human, and physical capital assets it had in 1994 and its demographic and ethnic status), ejido characteristics (abundance of common and individual land, quality of cooperation in the management of

CPR, degree of market integration), and the decisions taken by the ejido about the commons (division) and the membership (incorporation).⁶

Table 5 presents the econometric analysis of the changes in land assets held by individual households. For the qualitative analysis of changes in land assets, we use both a probit analysis (increase in assets or not) and an ordered probit (decrease/no change/increase in assets). Because individual observations are bunched in different ejidos, we use a correction for heteroscedasticity due to the clustering of errors. For the probit, results with a clustering of errors are similar to a random effects probit (not reported). For the quantitative analysis of hectares gained or lost, we use regressions with random or fixed ejido effects, reporting the results from fixed effects regression when random effects are rejected. Adding treatment for clustering of errors does not change results when random or fixed effects are used (not reported). We also use a median regression to mitigate the effect of large outliers that may be due to measurement errors.

Following the method proposed by Smith and Blundell (1986), we conduct tests of statistical exogeneity on the ejido-level decisions to divide and incorporate. We verify that land inequality, marginal yield, cattle inequality, and the number of ejidatarios are valid instruments. The test of residuals shows that we cannot reject statistical exogeneity of these two decisions in the household land assets equations. We consequently proceed with a sample split based on the observed division of the commons, and with the observed incorporation of members as an exogenous variable.

When there was no division of the commons (upper part of Table 5), results show that the more land an ejidatario had in 1994, the less likely his land is to expand in the following period: one additional initial hectare reduces the probability of gaining land by 0.6% and the quantity of land acquired by 0.86ha. Market forces and exercise of influence are thus mildly progressive. By contrast, being an indigenous household, which is very strongly associated with poverty in Mexico, has a strong negative role, reducing the gain in individual area by 6.4ha. Finally, the size of common property land increases gains in individual land, and this has to occur through encroachment since there was no official division.

⁶ In the sample, 11.2% of the ejidos are 100% indigenous, 13.1% partially indigenous, and 75.7% have no indigenous members.

When there is division of common property land (lower part of Table 5), the redistributive effect is much stronger. The probability of gaining access to land when a household has one less hectare of land increases from 0.6 without division to 1.8 with division and, although average gain is not different, median gain in hectares is five times larger. Division under democratic governance is thus a strongly equalizing process. We saw in the case studies that land certification indeed often had an equalizing objective. At the same time, having more capital, such as owning a pick-up truck, allows ejidatarios to acquire more land. Those that gained the most land were consequently the households with smaller land endowments and higher capital assets.

Despite the fact that the number of adults has an insignificant coefficient, an interaction term between the number of adults and distance to the nearest urban labor market is positive. This suggests that, when selling labor off-farm is less profitable because of higher transportation costs, households seek instead to expand their land assets.

When there is division, indigenous households have an 18% higher probability of accessing more land. Thus, while market forces and exercise of influence play against indigenous households, democratic governance in recrafting property rights plays in their favor. We can thus conclude that endogenous changes in property rights under democratic governance were able to reduce both poverty and inequality.

Among ejido characteristics, the area in private parcels (average individual land per ejidatario) is important because it is the pool of land that can be used for individual transactions. Results show that the average size of private parcels is in all regressions a strong determinant of gains in access to land.

Finally, the ejido's response to the reforms in deciding to incorporate new members when there was division strongly reduces gains in access to land for the original members. Thus, while division increases gains in access to land, division with incorporation reduces this gain. Incorporation thus competes with individual gains. This supports the observation made in case studies and in the ejido-level analysis that some division of the commons was used to endow new members with land assets of their own.

VI. Conclusions

Following the peasant-led revolution of 1910, the Mexican government distributed half of the nation's territory to peasant communities (ejidos). Members of these communities have control over an

individual land parcel and in most cases access to common property resources. Because dividing parcels was forbidden, and incorporating new members was severely restricted by the state, ejido villages have accumulated an increasing number of non-members relative to the number of members, generally descendants of members who could not be given land directly by their parents and could not be made members of the community. The 1992 reform of the constitution introduced a land certification program (Procede) which allows the ejido assembly to decide on dividing or not the CPR, on incorporating or not new members, and on the allocation across community members, both old and new, of land taken from the commons. Division of the commons could thus be pursued to enlarge individual parcels and/or to incorporate new members, and land taken from the commons could be allocated to compensate or not for inequalities in individual land endowments.

Changes in property rights from common property to individual parcels has been the object of attention by a number of scholars such as Boserup (1965) and the Property Rights School, and Baland and Platteau (1998), providing us with a rich set of hypotheses in explaining these changes. Econometric analyses have, however, been few due to lack of data on a sufficiently large number of communities to identify the determinants of change in property rights. The Mexican constitutional reform of property rights in the ejido sector provides a laboratory to analyze these changes. To do this, we use two surveys, one conducted before Procede and the other after three years of implementation. We also use twelve in depth case studies to gain understanding of the causalities underlying the determinants of change that can be identified econometrically with the survey data.

Analysis of the impact of the reform at the ejido level shows the following. (1) The arguments advanced by Boserup are indeed important: land scarcity in communal ejidos pushes toward individualization, and a higher value of the land also induces division across all communities. These divisions are pursued principally for the sake of efficiency gains, not to incorporate new members. (2) When CPR are abundant in non-communal ejidos, and pressure on current members is high to incorporate new members, then both division and incorporation occur. In this case, division is done principally to accommodate incorporation. (3) Greater quality of cooperation in the management of the CPR reduces division. Hence, helping communities improve their capacity to govern would reduce incentives to divide CPRs when there are advantages in preserving them as a unit of management. (4) Finally, inequality

matters on the decision to divide or not. As suggested by Baland and Platteau, inequality in economic power (distribution of land parcels) deters division, in part because it creates uncertainties as to how the distributional struggles will be resolved across members. There is, however, another dimension of inequality that creates incentives to divide: this is inequality in current use of the commons (distribution of herd sizes). In this case, inequality pushes the median voter in ejido assemblies to favor division in order to equalize the gains derived from these lands.

Analysis of the impact of the reform at the household level shows that division of CPR served to equalize individual access to land, compensating for inequalities that had developed over time through market forces and exercise of influence. Households that gained most were those with least land, but also with most working capital. The greatest individual gains in control over land were registered in ejidos that decided to divide common land and did not incorporate new members. In these ejidos, inequality in access to land among ejidatarios declined. Through division, larger gains were secured by indigenous households, the poorest segment of rural society. By contrast, smaller gains were registered in ejidos where there was no official division of CPR as gains in control over land could only occur through encroachment on the commons and through the land market. In this case, indigenous households lost land relative to non-indigenous households instead of gaining greater access under state-managed division.

The exercise of local democratic governance in recrafting rights over common property following procedures imposed by the national state has thus been effective in reducing inequality through providing greater access to land for those with smaller endowments and for households belonging to indigenous groups. It has also been effective in incorporating new members in ejidos, usually landless descendants of ejidatarios. Liberal reforms introduced to provide a more clear definition of property rights, regulated by strict national rules imposed on the communities to secure transparency, democratic participation, and fair conflict resolution, thus resulted in progressive social outcomes.

References

Abraham, Anita, and Jean-Philippe Platteau. 2001. "Participatory Development in the Presence of Endogenous Community Imperfections." Department of Economics, University of Namur.

Alchian, A. A., and Harold Demsetz. 1973. "The Property Rights Paradigm." *Journal of Economic History* 16(1): 16-27.

Alesina, A., and A. Drazen. 1991. "Why Are Stabilizations Delayed?" *American Economic Review* 81(5): 1170-1188.

Baland, Jean-Marie, and Jean-Philippe Platteau. 1996. *Halting Degradation of Natural Resources: Is There a Role for Rural Communities?* Cambridge: Cambridge University Press.

Baland, Jean-Marie, and Jean-Philippe Platteau. 1998. "Division of the Commons: A Partial Assessment of the New Institutional Economics of Land Rights." *American Journal of Agricultural Economics* 80(3): 644-50.

Bardhan, Pranab. 2000. "Irrigation and Cooperation: An Empirical Analysis of 48 Irrigation Communities in South India." *Economic Development and Cultural Change*, 48(4): 847-865.

Boserup, Esther. 1965. *The Conditions of Agricultural Growth: The Economics of Agrarian Change under Population Pressure*. London: Allen and Unwin.

de Janvry, Alain, Céline Dutilly, Carlos Muñoz-Piña, and Elisabeth Sadoulet. 2001. "Liberal Reforms and Community Responses in Mexico." In Masahiko Aoki, Douglas North, and Yujiro Hayami, eds. *Community and Market in Economic Development*. Oxford University Press.

Demsetz, Harold. 1967. "Toward a Theory of Property Rights." *American Economic Review* 57(May): 347-59.

Dutilly Diané, Céline. 2001. *Action collective et cooperation partielle dans la gestion des ressources communes: La cas des ejidos mexicains*. Doctoral dissertation. Université d'Auvergne-Centre d'Etudes et de Recherche sur le Développement International, Clermont-Ferrand, France.

Fernández, R., and Dany Rodrik. 1991. "Resistance to reforms – Status Quo Bias in the Presence of Individual-Specific Uncertainty." *American Economic Review* 81(5): 1146-1155.

Gordillo, Gustavo, Alain de Janvry, and Elisabeth Sadoulet. 1998. "Entre el control político y la eficiencia: evolución de los derechos de propiedad agraria en México." *CEPAL Review*, 66: 149-166.

Hardin, Garrett. 1974. "Living on a Lifeboat." *Bioscience* 24: 561-68.

Hirschman, Albert. 1984. *Getting Ahead Collectively: Grassroot Experiences in Latin America*, New York: Pergamon Press.

Klooster, Daniel. 2000. "Institutional Choice, Community, and Struggle: A Case Study of Forest Co-Management in Mexico." *World Development* 28(1): 1-20.

McCarthy, Nancy, Alain de Janvry, and Elisabeth Sadoulet. 1998. "Land Allocation Under Dual Individual-Collective Use in Mexico." *Journal of Development Economics*, 56(2): 239-264.

McCarthy, Nancy, Elisabeth Sadoulet, and Alain de Janvry. 2001. "Common Pool Resource Appropriation under Costly Cooperation." *Journal of Environmental and Economic Management*. 42(3): 297-309.

North, Douglas. 1990. *Institutions, Institutional Change, and Economic Performance*. Cambridge: Cambridge University Press.

North, Douglas, and R. Thomas. 1973. *The Rise of the Western World: A New Economic History*. Cambridge: Cambridge University Press.

Nugent, Jeffrey, and Nicolas Sanchez. 1999. "The Local Variability of Rainfall and Tribal Institutions: The Case of Sudan." *Journal of Economic Behavior and Organization*, 39(3): 263-91.

Olson, Mancur. 1965. *The Logic of Collective Action: Public Goods and the Theory of Groups*. Cambridge, MA: Harvard University Press.

Ostrom, Elinor. 1992a. *Crafting Institutions for Self-Governing Irrigation Systems*. San Francisco: Institute for Contemporary Studies Press.

Ostrom, Elinor. 1992b. *Governing the Commons: The Evolution of Institutions for Collective Action*. New York: Cambridge University Press.

Ostrom, Elinor. 2001. "The Puzzle of Counterproductive Property Rights Reforms: A Conceptual Analysis." In A. de Janvry, G. Gordillo, J-P. Platteau, and E. Sadoulet, eds., *Access to Land, Rural Poverty, and Public Action*. Oxford: Oxford University Press.

Otero, Gerardo. 1989. "Agrarian Reform in Mexico: Capitalism and the State." In W. Thiesenhusen, *Searching for Agrarian Reform in Latin America*. Boston: Unwin Hyman.

Otsuka, Keijiro, and Frank Place. 2001. "Toward New Paradigms of Land and Tree Resource Management." in K. Otsuka and F. Place, *Land Tenure and Natural Resource Management: A Comparative Study of Agrarian Communities in Asia and Africa*. Baltimore: Johns Hopkins University Press.

Poteete, Amy. 2001. "Strategies for Regulating Use of Forest Resources: How Exclusive?" Mimeo. International Forestry Resources and Institutions Research Program, Indiana University.

Smith, Richard, and Richard Blundell. 1986. "An Exogeneity Test for a Simultaneous Equation Tobit Model with an Application to Labor Supply." *Econometrica*, 54(3): 679–685.

Wade, Robert. 1987. *Village Republics: Economic Conditions for Collective Action in South India*. Cambridge: Cambridge University Press.

Table 1. Summary of Ejido Case Studies

Ejido and State	Decisions	Explanatory variables pre-Procede					
		CPR land scarcity	Private land scarcity	Value of the resource	Population pressure on members	Opportunity cost of division	Risks and costs of division
	Division of the commons	Incorporation of new members	Common property endowments (ha/member)	Individual land endowments (ha/member)	Land quality in the commons	Non-ejidatarios per ejidatario	Cooperation in the commons
El Edén, Yucatán	Divided	Incorporated	9.1 Communal	0 High	High High	Tradition based, growing conflicts	Low n.a.
San Pedro Y., Yucatán	No divided	No change	25.1 Communal	0 Low on average	Low Low	Tradition based, few conflicts	Low n.a.
Yaxcabá, Yucatán	No divided	Incorporated	31 Communal	0 Low on average	Low Low	Tradition based, no conflicts	Low Low
Plan de Ayala, Campeche	Divided	Incorporated	37.7 Communal	32 High	Low Low	Failure	Low Low
Socorro de Dios, San Luis Potosí	High quality land divided	Incorporated	47.6 Divided	20 High	Low High	Failure (palm) & success (timber)	High Low
Corregidora, Tabasco	Partially divided	Incorporated	93.7 Divided	13 High	High High	Failure	High Low
La Manga, Tabasco	Partially divided	No change	9.5 High quality land divided	10 High	High Low	Failure	High High
El Chilar, Campeche	No change	47.6 Irrigated land divided	17 Under discussion	High/low quality	Low Good, but located far from village	Failure Failure	Low n.a.
Huizache, San Luis Potosí	Irrigated land divided	Under discussion	29.1 Division into subcoalitions	20 Good, but located far from village	Low Low	Mixed results Failure	Low Low
Mala Noche, Zacatecas	No change	21.9 Division into subcoalitions	15** Incorporated	Low Low	Low Low	Failure Failure	Low High
Efigenia, Zacatecas	No change	30.4 Division into subcoalitions	25 Incorporated	Low Low	Low Low	Failure Failure	Low High
Pozo Hondo, Zacatecas	No change	27.0 Division into subcoalitions	15 Incorporated	Low Low	Low Low	Failure Failure	Low High
Expected sign for division of the commons		- Communal + Others	?	+	+	-	-
Expected sign for incorporation of new members		+ Others	+	?	+	+	?

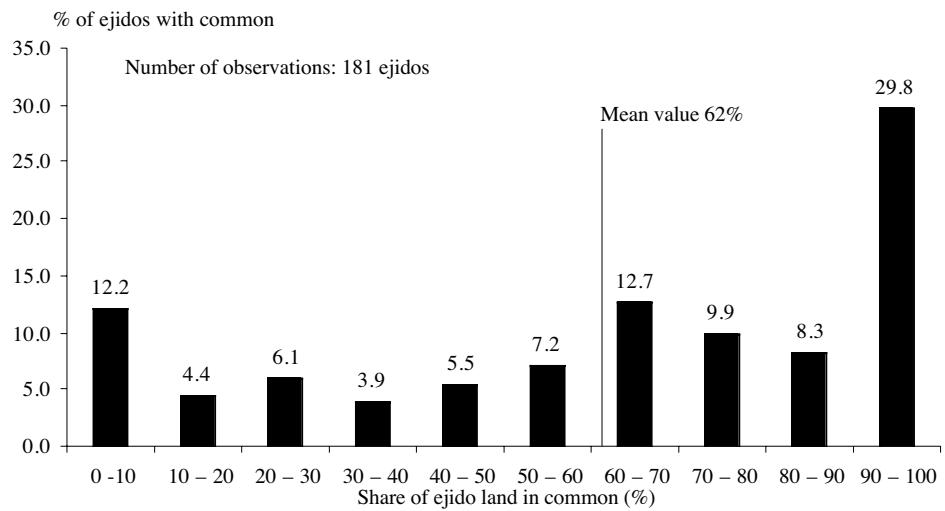


Figure 1. Distribution of common property land

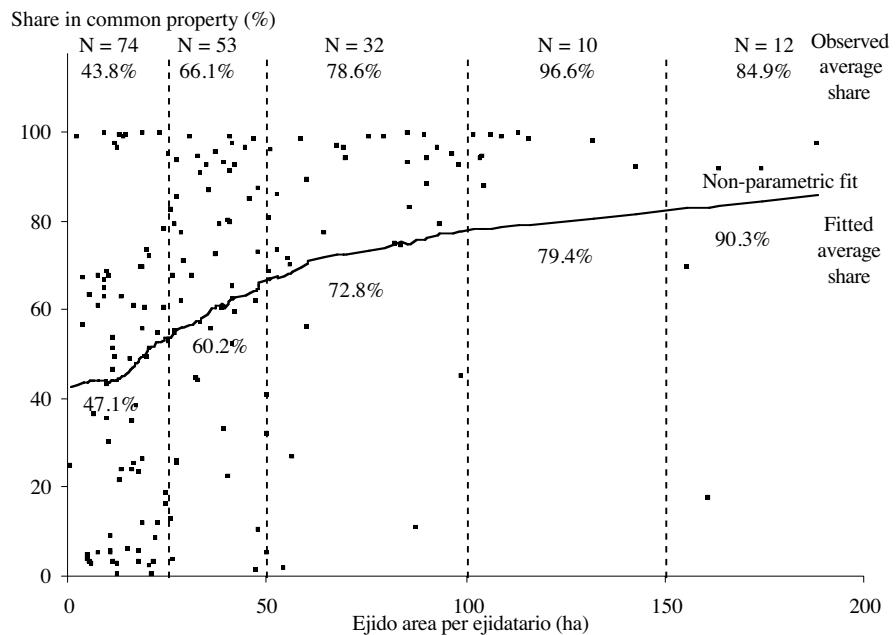


Figure 2. Share in common by ejido per capita size

Table 2. Division of common property land and incorporation of new ejidatarios, 1994-1997

Exogenous variables (1994)	Division of commons			Incorporation of new members			Division w/o incorporation			Division with incorporation		
	Mean	dF/dx ¹ (%)	P-value ²	dF/dx ¹ (%)	P-value ²	dF/dx ¹ (%)	P-value ²	dF/dx ¹ (%)	P-value ²	dF/dx ¹ (%)	P-value ²	
I. Roseup: scarcity and value												
Land abundance in communal ejido only												
Ejido is communal (0,1)	0.17	50.2	0.10	39.4	0.00	-0.9	51.2					
Common land per member when ejido is communal (ha)	17.1	-6.9	0.06	-0.01	0.92	-4.1	-2.8					
Value of the resource												
Marginal agricultural yield (tons of corn per ha)	0.6	15.0	0.01	3.5	0.41	7.7	7.3					
Distance to nearest urban center (kms)	26.9	-0.01	0.94	0.08	0.29	-0.03	0.02					
II. Pressure and possibility to incorporate												
Population pressure on those with rights												
Non-ejidatario households per ejidatario	1.2	0.22	0.04	2.66	0.06	-0.79	1.01					
Land abundance in non-communal ejido												
Common land per member (ha)	29.1	0.11	0.07	0.16	0.00	0.01	0.10					
Average individual land per ejidatario (ha)	10.2	0.19	0.40	0.86	0.01	-0.18	0.38					
III. Opportunity cost of division and incorporation: quality of cooperation												
Ejidos had formal rules for CPR use (0,1) ³	0.19	-17.6	0.06	-17.7	0.01	-6.7	-10.9					
Number of meetings held per year ³	7.8	-1.5	0.01	-1.0	0.22	-0.5	-1.0					
IV. Risks and costs of division: inequality and size of the group												
Individual land inequality ratio (largest/smallest parcel)	6.5	-1.9	0.05	1.7	0.07	-1.7	-0.2					
Individual land inequality ratio, squared	170.3	0.03	0.03	-0.02	0.10	0.03	0.01					
Inequality in grazing in commons (largest/smallest herd)	3.0	0.44	0.00	0.19	0.79	0.20	0.24					
Number of ejidatarios	91	0.04	0.41	0.06	0.34	0.00	0.04					
V. Legal opportunity to divide and incorporate												
First meeting of Proceede held	0.89	4.9	0.76	-7.0	0.36	5.1	-0.1					
Proceede started certification in 1994-97 ³	0.68	-6.8	0.41	16.9	0.31	-10.4	3.6					
Conflicts over the commons' external boundaries	0.08	-27.0	0.01	12.7	0.24	-17.1	-9.9					
Mean value of endogenous variable		0.35		0.42		0.20	0.15					
Number of observations	168	168		168								
Pseudo-R2		0.22		0.14								
Correctly predicted outcomes		71%		70%								
Overall F-test of equation		0.01		0.02								
Marginal effect on probability is average of the marginal effects over the population.												
¹ P-value is for the underlying coefficient in probit.												
² Smith-Bundell test cannot reject statistical exogeneity.												

Table 3. Decomposition of explanatory factors of the decisions to divide and incorporate

Explanatory factors	Decision to divide (% of total variance explained)			Decision to incorporate (% of total variance explained)		
	Direct effect	Indirect effect	Total effect	Direct effect	Indirect effect	Total effect
Boserup: scarcity and value						
Land abundance in communal ejido (population pressure on land)	21	3	50	-32	1	-32
Value of the resource	21	-6	2	1	-31	22
Total effect	42	-3	40	53	-31	22
Pressure and possibility to incorporate						
Population pressure on those with rights	1	-1	11	-3	-21	18
Land abundance in non-communal ejido	18	-1	52	-24	39	18
Total effect	18	-2	17	63	-24	39
Opportunity cost of division and incorporation: quality of cooperation						
Risks and costs of division: inequality and size of group	27	0	27	22	-3	18
Legal opportunity to divide and incorporate	22	-14	8	23	-7	16
Total effect	17	-8	8	14	-10	4
	127	-27	100	174	-74	100