

*The Demand for Private Property Rights:  
Land Titling, Credit, and Agricultural Productivity in Mexico*

By Nancy L. Johnson

Selected Paper  
American Agricultural Economics Association  
Salt Lake City, Utah,  
August 1998

## **Introduction**

The relationship between land tenure and agricultural productivity is one of the most thoroughly analyzed in the field of economic development. Early research identified a positive link between tenure security and investment (Feder et al). Later researchers argued that the relationship is more complex and suggested a variety of possible mechanisms that could relate tenure security, land titles, credit demand and supply, investment, farm size, and productivity (Roth et al). Recent attempts to sort out the competing theories empirically confirm a positive relationship between tenure security and productivity, but are unable to identify which of the possible mechanisms is responsible (Besley; Carter and Olinto). The main problem is that existing data are not sufficiently precise to permit distinction between multiple hypotheses

In spite of the lack of conclusive empirical evidence on causality, land privatization and titling continue to be popular policies to stimulate agricultural development. Many governments around the world are enacting or contemplating land privatization programs in order to boost output and productivity. Privatization and titling programs, and the economic theory that underlies them, are particular common amongst governments committed to increasing the role of the market in allocating resources.

While there is undoubtedly an important relationship between land rights and productivity, understanding the exact nature of this relationship within the context of a particular economy may be critical to the success of privatization and titling policies. For example, if traditional land rights are secure, then issuing a title may not have an impact on a farmer's willingness to make long-term investment. Similarly, if no formal credit is available, or none demanded, a mortgageable title will be of little value in the short run. Further, a title that is not enforceable and/or supported by an adequate legal system cannot be considered an improvement in land rights. Making land titling policies effective requires a clear understanding how the current tenure system is constraining production.

This information can, if necessary, be used to design complementary policies that will help the tenure reforms achieve their intended goals.

This paper examines the case of land tenure reform in Mexico. In 1992, the Mexican government initiated a program to privatize and title *ejido* land. *Ejidors* are communities that own land communally and work it under a system of permanent but non-transferable use rights. The new legislation offers *ejidos* the option to participate in a voluntary titling program and receive individual, private titles. The goal of the reform is to give farmers both the ability and incentive to invest in new technologies and improved production practices (Tellez K.; *The Economist*). This is mainly expected to come about through the increased access to credit that a collateralizable title will provide. As mentioned earlier, transferable titles could also increase tenure security and/or stimulate the development of a land market. However it can be convincingly argued in the case of Mexico that *ejidal* titles have always offered security, and that land markets have always been active in spite of the transfer prohibitions. Therefore, in practice the main impact that the reform is likely to have is to increase farmers' access to collateralizable credit. Success of the program will therefore depend upon the extent to which farmers were previously rationed in their access to credit.

This paper will test the hypothesis that farmers faced a binding credit constraint by comparing the behavioral implications of asset-based credit rationing with *ejidos*' actual decisions regarding participation in the titling program. Evidence of a relationship between the asset-value of land and participation in the program would suggest that the reform is in fact releasing a binding credit constraint for farmers. This can be tested because there are different types of *ejido* land and not all are suitable for use as collateral. Lack of a relationship, on the other hand, would suggest that complementary policies may be required in order for the reform to achieve its intended impact. The results of the analysis will also make a useful contribution to the empirical literature on tenure and titling. The voluntary nature of the land titling program in the Mexican context provides a rare

opportunity to analyze the impact of titles on credit use in an environment in which tenure is endogenous.

The paper is organized as follows. Section 2 reviews the recent changes in Mexican agriculture and agrarian policy. Section 3 presents a conceptual model showing how asset ownership affects credit demand, supply, and use in the context of agricultural production. The implications of this model are compared with an analysis of the determinants of participation in the Mexican titling program in Section 4. Section 5 summarizes and concludes.

## **2. Mexico's Second Agrarian Reform**

In 1992, the Mexican constitution was amended to permit the voluntary privatization of *ejido* land, land granted to groups of peasants through the 1917 post-revolutionary land reform. Prior to 1992, all *ejido* land was owned by the community, and *ejido* members had use rights which could be inherited but not rented, mortgaged, nor sold. By 1990, half of Mexico's agricultural land--and half its irrigated land--was in the *ejido* sector (DeWalt and Rees). While the tenure restrictions were often not binding in practice,<sup>1</sup> there has been growing support since the mid 1980s for a reform of the system based on economic efficiency arguments. (Téllez K.; DeWalt and Rees).

The 1992 legislation immediately lifted some restrictions on *ejido* land use, most importantly the ban on land rental. It also established a process through which *ejido* members could obtain individual, transferable titles to their land. To receive a title, the entire *ejido* must complete a certification and titling program known by its Spanish acronym *Procede*.<sup>2</sup> Participation in *Procede* is voluntary and free. The decision to join is made by majority vote of the *ejido* general assembly. Once incorporated into the program, *ejido* members work with program officials to resolve inter- and intra- *ejido* boundary disputes, clarify membership status, and measure, map, and title all agricultural and residential land within the *ejido*.

While Procede is often referred to as a privatization program, the titles it issues are not fully private titles. Rental rights are unrestricted, however sale of the land is technically only permitted within the *ejido*. Procede titles can be exchanged for fully private titles (*dominio pleno*) by individual *ejidatarios* through a petition to the National Agrarian Register (Bailón).

One important new economic benefit of the 1992 reforms that is only available for those *ejidos* that have completed Procede is that titled land can be used as collateral to guarantee loans from formal lending institutions such as banks. The mortgaging of *ejido* land does not appear to have occurred prior to the reforms (Myhre).

The Procede program was to have completed its work by the end of 1994, however that goal proved overly optimistic. The program is now expected to continue in operation until the end of the Zedillo sexenio in 2000 (*La Jornada*). By the end of 1996, 72 percent of *ejidos* were incorporated in the program, and 48 percent had received their titles (*La Jornada*).

### **3. A Model of Credit Use Under Asset-Based Rationing**

This paper assumes that the main effect of the Mexican land titling program will be to increase the supply of credit available to farmers. Because farmers already had secure title to their land, the demand for credit, especially short term production credit which is the major type of collateralized credit used by *ejido* farmers, is unlikely to be substantially affected by the titling program.<sup>3</sup> The hypothesis to be tested is that farmers were currently credit constrained, which means that they would like to have more credit but are unable to get it. If this is true, then they would have incentive to participate in the titling program in order to increase access to credit. Evidence in favor of this hypothesis would support the idea that the reform will release a binding credit constraint and therefore have a positive impact on farmer behavior and on agricultural production.

The model, based on Feder and Feeny, shows how credit supply constraints—in the form of collateral requirements—affect farmer’s input and output decisions. The model is used to generate hypotheses about the circumstances under which an increase in a farmer’s available collateral would lead to an increase in expected utility. In the model, farmers allocate resources between risky agricultural production ( $f$ ), and riskless saving ( $A$ ) to maximize the expected utility of income ( $Y$ ). Production is a function of capital ( $K^f$ ) whose rental price is set equal to one. Credit ( $B$ ) is available at interest rate  $r$ , however collateral is required. Farmers are endowed with cash reserves ( $A_0$ ) and physical capital ( $K_0$ ). The physical capital endowment is divided between collateralizable capital ( $K'$ ) and non-collateralizable capital ( $K_0 - K'$ ).

Risk to agricultural income is represented by  $\theta$ , which is assumed to have a mean value of one and a finite variance. Farmers face both a cash constraint which says that capital inputs must be purchased before income from agricultural production is realized, and the collateral constraint which says that borrowing cannot exceed the value of collateralizable assets. In addition there is a transaction cost ( $\phi$ ) which has the effect of driving a wedge between the market interest rate and the effective rate paid by agents at the local level.

The model can be written as:  $\text{Max}_{(K^f, A, B)} EU(Y)$  subject to:  $Y = \theta P^f f(K^f) - K^f + K_0 + A - (1+r\phi)B$ . In addition there is a cash constraint:  $K^f + A \leq K_0 + B + A_0$ , and a collateral constraint:  $B \leq P^k K'$ .  $P^f, P^k$  are relative prices for agricultural output and capital. Again,  $r$  is the interest rate at which farmers can borrow money from banks, and the rental rate of capital is the numeraire. The parameter  $\phi$  is assumed to be greater than one, and it is also assumed that both the utility function and the production function are concave, i.e.  $U'$  and  $f' > 0$ , and  $U''$  and  $f'' < 0$ .

This model explicitly shows how borrowing affects agricultural production decisions and expected utility, and how collateralizable assets affect borrowing. If the collateral constraint is binding, i.e. at the optimum,  $B = P^k K'$ , then an increase in the percent of total assets that are

collateralizable ( $K'$ ) leads to an increase in borrowing ( $B$ ), i.e.,  $\partial B/\partial K' > 0$ . The borrowed money is then invested in agricultural production, leading to higher expected output, income, and utility.

The model can also be used to derive relationships between borrowing and other parameters. In particular, it can be shown that if the collateral constraint binds, then  $\partial B/\partial A_0 = \partial B/\partial \phi = 0$ . Marginal changes in the value of initial wealth ( $A_0$ ) or the transactions costs of obtaining credit ( $\phi$ ) would not affect borrowing ( $B$ ). This is to be expected since when the collateral constraint binds, the shadow price of credit is higher than the effective interest rate paid by the farmer ( $r\phi$ ). Changes in wealth or transactions costs might affect the shadow price, but would not affect the observed quantity borrowed.

If the collateral constraint is not binding, then clearly  $\partial B/\partial K' = 0$ . Changes in the percent of assets that are collateralizable would have no effect on borrowing because the demand for credit is not a function of collateralizable assets. In this case, it can also be shown that  $\partial B/\partial A_0 < 0$  and  $\partial B/\partial \phi < 0$ . An increase in initial wealth decreases borrowing because farmers prefer to finance production out of savings to reduce both cost and risk exposure. An increase in the transactions cost parameter ( $\phi$ ) decreases borrowing because it has the same effect as an increase in the interest rate.

If Mexican farmers are currently rationed in their use of credit, then possession of a land title, which essentially increases  $K'$ , would increase their borrowing and their expected utility. Therefore they would be expected to complete *Procede*. If, on the other hand, they are not currently constrained in their credit use by lack of collateral, then a land title may not increase their expected utility, and they would not have an economic incentive to complete the program. In the next section, data from the first four years of the land titling program are analyzed to see whether there is evidence of a relationship between the asset value of land and program completion.

#### **4. Analysis of Participation In the Land Titling Program**

#### 4.1 Empirical model and data

Existence of a binding credit constraint would imply a positive relationship between collateralizable land holding and program completion. If farmers face asset-based credit rationing and the value of a title is that it makes land collateralizable, then we would expect farmers to want titles. In principle, the voluntary nature of the program and the diversity of land holdings within *ejidos* makes this hypothesis empirically testable. In some *ejidos*, farmers have individual, arable parcels, while in others they have access to a communal pasture, to forest land, or to a share in one of the few remaining collective *ejidos*. If the incentive to participate comes from the desire to increase access to credit, then we would expect farmers with individual plots, which are the most collateralizable, to have higher participation rates than other farmers, others things equal. Since the time and administrative costs of completing the program are essentially fixed, we would expect the relation to be stronger for larger farms.<sup>4</sup> From the perspective of an individual farmer, the transactions costs of dealing with lenders are also essentially fixed, which would also implies an positive relationship between farm size and the value of a title.

We can test for such a relationship using data on Procede completion rates and *ejido* characteristics. Due to the nature of the Procede program and the available data on *ejido* characteristics, aggregation to the county level is required to carry out the analysis. Since participation in Procede is a group decision, we only observe the outcome of the *ejido*'s vote, not how each member voted. Further, data on *ejido* characteristics are available only at the *municipio* (county) level. As always, information and precision are sacrificed when data are aggregated. In particular, aggregation also masks the internal dynamics of the *ejido*'s group decision making and voting process. Understanding these internal dynamics would be interesting, and in some cases they are undoubtedly critical in explaining the ultimate decisions made. However as long as the internal organizational characteristics of the *ejido* are random and not correlated with any of the variables in



the statistical model, failure to account for them will not bias the results of the analysis. Specific attempts to control for possible aggregation bias were made, and are discussed with the results of the estimation.

In the following analysis, the dependent variable ( $P_i$ ) is the percent of *ejidos* in a *municipio* that completed Procede by November, 1995. The data come from the Office of Procede's monthly progress report (Procuraduría Agraria). The explanatory variables (the vector  $\mathbf{x}_i$ ) are characteristics of *ejidos* in the *municipio* (INEGI). The subscript  $i$  indicates the *municipio*. The empirical model is logistic regression, which is used to analyze aggregate data when the underlying choice is binary (Maddala; Greene). The results are coefficients which can be used to measure the relationship between the level of an explanatory variable and the probability of a positive outcome.

Table 1 compares the average values of the independent and dependent variables for the states of Sonora and Chiapas. These states were chosen for analysis because they are important agricultural states for which data were available. Sonora, which borders Arizona, is an arid state where cattle ranching and irrigated crop production predominate.<sup>5</sup> By contrast, in the southern state of Chiapas most of the land is rain fed. Eighty percent of crop land is devoted to basic grains, in particular, to corn (Erenstein and López B.).

## 5.2 Results

The results of the regression of *ejido* characteristics on Procede completion rates, presented in Table 2, are not consistent with the existence of widespread credit rationing based on ownership of collateral. The average amount of irrigated land per member (AVPRIEM) is not significantly associated with finishing Procede.<sup>6</sup> If demand for a title were primarily motivated by demand for

additional credit, then we would expect those *ejidos* with higher levels of collateralizable land to have higher participation rates. The variable “irrigated land per member” was selected because it was considered to be the most appropriate measure of the amount of individually-collateralizable assets that an *ejidatario* would receive if his or her *ejido* completed the program.<sup>7</sup> Banks are most likely to loan money for irrigated production. In addition, irrigated agriculture is more capital intensive than rain-fed agriculture, increasing the probability that a farmer with irrigated land would be capital constrained.

The variable PCTSER, percent of *ejidos* with basic services such as electricity, potable water, and access to paved or graded dirt roads, was included as a measure of transactions costs associated with engaging in economic activity outside the community. PCTSER, the inverse of  $\phi$  in the economic model, should not affect the demand for credit or for a land title if farmers are rationed. In this analysis, PCTSER is positively and significantly associated with finishing the program. This suggests that higher accessibility (lower transactions costs) does affect the demand for credit, which is what would be expected in the absence of rationing. Lower transactions costs might also increase the amount a lender is willing to lend to a farmer, which would have the same effect on the participation decision.

The percent of *ejidos* with livestock (PCTCRIA) is taken as a measure of liquid assets, denoted as  $A_0$  in the theoretical model. The selection of this variable is based on the fact that households without access to savings institutions often hold livestock because it is a relatively liquid asset whose price is unlikely to be strongly correlated with local crop or land prices.<sup>8</sup> The coefficient on PCTCRIA is negative and significant, which is what theory would predict in the absence of rationing.

In addition to the variables suggested by the model, other variables were included in recognition of the fact that the real choice faced by *ejidos* is more complex than that posited in the

theoretical model. The average number of members per *ejido* (AVSIZM) was included as a measure of internal administrative and transactions costs associated with completing the program, the assumption being that fewer members would result in lower costs.<sup>9</sup> Smaller average size was not significantly associated with higher completion rates, nor were other measures of internal transactions costs, such as the average number of membership associations within an *ejido*. While it is certainly true that in specific cases the internal organizational costs prevent program completion in spite of demand for credit, as long as the internal costs are not systematically related to the participation decision, they do not bias the results of the analysis.

The percentages of forested land (PCTBOSQ) and pasture land (PCTPAST) were included to account for the fact that the benefits of individual, private property rights are primarily associated with parcelized crop land. Percent of land that is forested is negatively associated with the probability of finishing the program, as would be expected. The percent of pasture land is insignificant.

The percent of *ejidos* reporting non-agricultural activity was included to control for the increasing demand for land for non-agricultural purposes. The risks and returns associated with non-agricultural investments are likely to be very different from those associated with agricultural investments, which are the primary focus of the reform, and therefore of this analysis. It is not surprising that this variable is positively associated with completion of the program. Finally, a dummy variable (STATE= 1 for Chiapas) was included to capture any systematic differences between the two states that were not accounted for by the other regressors. STATE is not significant at conventional levels.

## **5. Summary and Conclusions**

Overall, this analysis does not support the hypothesis that *ejido* farmers in Mexico face asset-based rationing in formal credit markets. If the primary motivation for participation in *Procede* were to gain access to collateralizable credit, then we would expect to see a positive relationship between collateralizable assets and participation. Controlling for other factors, such a relationship does not appear to exist. This would imply that, by itself, the *Procede* program is unlikely to achieve its goals of increasing the capital intensity and productivity of *ejido* agriculture. To the extent that *Procede* resolves once and for all any boundary disputes or tenure insecurities within or between *ejidos*, it could have a positive impact on production. However, *Procede* does not appear to release a binding constraint on capital access, and therefore may not have a significant direct impact on farmers' decisions regarding credit and capital use.

The main implication of this analysis for policy, both in Mexico and elsewhere, is that lack of collateral and credit may not be the cause of the low capital use and low productivity often observed among farmers in developing countries. Increasing investment and output may require improving the productivity of agriculture through support of basic crop and production system research. The results also suggest that input and investment demand could also be increased by reducing the impact of risk and transactions costs on expected income from agriculture. Public investment in rural infrastructure may be one way to reduce transactions costs associated with participation in the formal credit market. Improved infrastructure would also benefit rural residents in other ways, and is generally considered to be a sound use of scarce public resources. Reduction of risk is more problematic, as the poor performance of many public insurance schemes has demonstrated (Binswanger and Rosenzweig; Wilcox).

Before advocating government intervention in formal insurance and financial markets, it is also worth examining other ways through which small farmers get access to capital. Recent research in the area of rural factor markets has demonstrated not only that publicly-administered programs are

likely to suffer from severe incentive problems, but also that rural residents can and do develop their own arrangements for overcoming the market imperfections they face (Hoff et al.). Informal lenders may offer higher interest rates, but the flexibility and low transactions costs of their terms are often appealing to asset-poor, risk-averse farmers.

Indeed, preliminary evidence from Mexico suggests that farmers of all sizes are responding to the recent economic liberalization policies, increasing their production and incomes as a result (López et al.). This would suggest that farmers are sensitive to the incentives offered by market liberalization, and that the formal credit market is not the only source of capital available.

Therefore policies that build on or facilitate the functioning of alternative or informal markets—for example group lending schemes that use social pressure rather than individual collateral to ensure compliance—may contribute to the increased capital intensity and productivity among small farmers that are the goals of the current titling program.

**Table 1 - Characteristics of *Ejid*os in Sonora and Chiapas**

<u>Variable</u>		<u>Sonora</u>	<u>Chiapas</u>
Number of <i>ejidos</i>		890	2,072
Percent of all state land that is in <i>ejidos</i>	31		42
Average number of <i>ejidos</i> per county	13		19
Average number of members per <i>ejido</i>		99	271
Average hectares per <i>ejido</i>		10,700	2,446
Average hectares per member		119	14
Average parcelized hectares per member <sup>10</sup>	11		9
Average irrigated hectares per member <sup>11</sup>	11		0.21
Percent of land that is forested		3	13
Percent of land that is irrigated	6		2
Percent of land in pasture	87		27
Percent of <i>ejidos</i> that report raising animals		88	99
Percent of <i>ejidos</i> with basic services <sup>12</sup>		97	90
Percent of <i>ejidos</i> reporting non-agricultural activity		12	31
Percent of <i>ejidos</i> finished with PROCEDE (P <sub>i</sub> )		31	11
Percent of <i>ejidos</i> in PROCEDE <sup>13</sup>	59	31	

Data sources: Procuraduría Agraria and INEGI

**Table 2 - Results of Logistic Regression Analysis of PROCEDE Completion Rates**

Average irrigated hectares per member (AVPRIEM)	-0.007	(.005)
Percent of <i>ejidos</i> with services (PCTSER)	3.810**	(.616)
Percent of <i>ejidos</i> that report raising livestock (PCTCRIA)	-2.373**	(.411)
Average number of members per <i>ejido</i> (AVSIZM)	-.002	(.001)
Percent reporting non-agricultural activity (PCTNONAG)	.955*	(.431)
Percent of land that is forested (PCTBOSQ)	-3.137**	(.984)
Percent of land in pasture (PCTPAST)	.370	(.332)
Dummy variable (STATE)	-.281	(.245)
(Constant)	-2.046**	(.574)
R <sup>2</sup>	.63	
N	151	<sup>14</sup>

\*\* and \* indicate significance at a level of .01 and .05, respectively. Standard errors are in parentheses.

## References

- Adams, Dale W., and Delbert A. Fritchett, 1992, *Informal Finance in Low-Income Countries*, Westview Press, Boulder, CO.
- Adams, Dale W., Douglas H. Graham and J.D. Von Pischke, 1984, *Undermining Rural Development with Cheap Credit*, Westview Press, Boulder, CO.
- Appendini, Kirsten, 1995, "Changing agrarian institutions: interpreting the contradictions," paper presented at the research workshop of the Ejido reform Project, Center for US Mexican Studies, La Jolla, CA, August 25-26.
- Bailón, Moises, 1995, "Reformas a la legislación agraria, sistemas de dominio regional y pueblos indios en el sur de México; el caso de Oaxaca," paper presented at the research workshop of the Ejido reform Project, Center for US Mexican Studies, La Jolla, CA, August 25-26.
- Bassols, Mario (ed.), 1994, *Campo y Ciudad en Una Era de Transición: Problemas, Tendencias y Desafíos*, Universidad Autónoma Metropolitana, Unidad Iztapalapa, Mexico
- Besley, Timothy, 1996, "Property Rights and Investment: theory and evidence from Ghana," *Journal of Political Economy*, 103(5):903-937.
- Binswanger, Hans P. and Mark Rosenzweig, 1986, "Behavioral and material determinants of production relations in agriculture," *Journal of Development Studies*, 22(3):503-539.
- Carter, Michael, 1988, "Equilibrium credit rationing in small farm agriculture," *Journal of Development Economics*, 28:83-103.
- Carter, Michael and Pedro Olinto, 1996, "Getting institutions right for whom? The wealth-differentiated impact of property rights reform on investment and income in rural Paraguay," mimeo, University of Wisconsin-Madison, WI.
- DeWalt, Billie R. and Martha W. Rees, 1994, "The End of Agrarian reform in Mexico: Past Lessons, Future Prospects," Center for U.S-Mexican Studies, University of California-San Diego.
- The Economist*, 1993, "Rural revolution," 326(7798): 12-16, February 13-19.
- Erenstein, Olaf and Walter López B. (eds.) 1995, Taller sobre proyectos productivos para productores de maíz en el estado de Chiapas, SAG, UNACH, INIFAP, CIMMYT, May 4, 1995, Tuxtla Gutiérrez, Chiapas, Mexico.
- Feder, Gershon and David Feeny, 1993, "The theory of land tenure and property rights," in Hoff, Karla, Avishay Braverman and Joseph Stiglitz (eds.), *The Economics of Rural Organization: Theory, Practice and Policy*, Oxford University Press, New York, pp. 240-258.



- Feder, Gershon, et al., 1990, "The relationship between credit and productivity in Chinese agriculture: a microeconomic model of disequilibrium, *American Journal of Agricultural Economics*, December.
- Feder, Gershon and Tongroj Onchan, 1987, Ownership security and farm investment in Thailand, *American Journal of Agricultural Economics*, 69(2):311-320.
- Fritscher, Magda and Cristina Steffan, 1994, "Políticas neoliberales y cambio productivo en el agro mexicano: su impacto regional," in Bassols, Mario (ed) *Campo y Ciudad en Una Era de Transición*, Universidad Autónoma Metropolitana, Unidad Iztapalapa.
- Greene, William H., 1993, *Econometric Analysis*, Macmillan Publishing Company, New York.
- Heath, John Richard, 1990, Enhancing the contribution of land reform to Mexican agricultural development, World Bank Working paper WPS-285, Washington, DC.
- Hewitt de Alcantara, Cynthia, 1992, "Economic Restructuring and Rural Subsistence in Mexico: Maize and the Crisis of the 1980s," UNRISD Discussion Paper DP 31, January, 1992.
- Hoff, Karla, 1993, "Designing land policies: an overview," in Hoff, Karla, Avishay Braverman and Joseph Stiglitz (eds.), *The Economics of Rural Organization: Theory, Practice and Policy*, A World Bank Book, Oxford University Press, pp. 231-239.
- INEGI (Instituto Nacional de Estadística, Geografía e Información), 1994, Resultados Definitivos, VII Censo Agropecuario, Aguascalientes, Ags., Mexico.
- Iqbal, Farrukh, 1986, "The demand and supply of funds among agricultural households in India," in Inderjit Singh, Lynn Squire and Johns Strauss (eds), *Agricultural Household Models: Extensions, Applications and Policy*, A World Bank Publication, Johns Hopkins University Press, Baltimore, MD.
- Kochar, Anjini, 1997, "An empirical investigation of rationing constraints in rural credit markets in India," *Journal of Development Economics* (forthcoming).
- Labastida Ochoa, Francisco, 1997, "Technological change and the transformation of Mexico's agricultural sector," COMUNIICA, Year 2, No. 6, pp. 11-18.
- La Jornada*, 1997, "Avances en la regulación de la tenencia de la tierra," January 8, 1997, p. 18.
- Lopez, Ramon, John Nash and Julie Stanton, 1995, "Adjustment and poverty in Mexican agriculture: how farmers' wealth affects supply response," World Bank, 1995, Policy research working paper 1494, Washington, DC:
- Maddala, G.S., 1983, *Limited Dependent Variables and Qualitative Variables in Econometrics*, Econometrics Society Monograph No. 3, Cambridge University Press, New York, NY.

- Morret Sanchez, Jesús C., 1992, *Alternativas de Modernización del Ejido*, Instituto de Propositiones Estratégicas, A.C., Editorial Diana, Mexico City.
- Myhre, David, 1996, "Appropriate agricultural credit: a missing piece of agrarian reform in Mexico," in Randall, Laura (ed.), *Reforming Mexico's Agrarian Reform*, M.E. Sharpe, Armonk, NY.
- NACLA, 1993, "The fate of the *ejido*," *Report on the Americas*, Vol XXVI, No. 5, May, p. 3
- Otsuka, Keijiro, Hirouki Chuma and Yujiro Hayami, 1992, "Land and labor contracts in agrarian economies: theories and facts," *Journal of Economic Literature*, Vol. XXX, pp. 1965-2018.
- Paguaga, Roger et al, 1991, Mexico's Agriculture, prepared for Agriculture Canada by George Morris Centre, University of Guelph, Canada.
- Place, Frank and Peter Hazell, 1993, "Productivity effects of indigenous land tenure systems in sub-saharan Africa," *American Journal of Agricultural Economics*, January, 75: 10-19.
- Procuraduría Agraria, 1995, *Avance del Procede a Noviembre de 1995*, Office of Procede, Mexico, D.F.
- Roth, Michael et al., 1989, "Land ownership security and farm investment: a comment," *American Journal of Agricultural Economics*, 71(1), 211-214.
- Stiglitz, Joseph E. and Andrew Weiss, 1981, "Credit rationing in markets with imperfect information," *American Economic Review*, 71(3), pp. 393-410.
- Téllez Kuenzler, Luis, 1992, "La reforma al artículo 27 y la modernización del campo," *Examen*, April.
- Thiesenhusen, William C., 1995, Mexican Land Reform, 1934-1991: Success or failure?, paper presented at the Conference on the Reform of Mexican Agrarian Reform, Columbia University, New York City, April, 1995
- Thompson, Gary D. and Paul N. Wilson, 1994, "Ejido reforms in Mexico: Conceptual issues and potential outcomes," *Land Economics*, 70(4): 448-65.
- Udry, Christopher, 1993, "Credit Markets in Northern Nigeria: Credit as insurance in a rural Economy," in Hoff, Karla, Avishay Braverman and Joseph Stiglitz (eds.), *The Economics of Rural Organization: Theory, Practice and Policy*, Oxford University Press, New York, pp. 87-108.
- Wilcox, Duane Edward, 1972, "Credit, Cooperatives and Politics: A Case Study of Mexico's *Ejido* Bank," M.S. Thesis, Cornell University.
- Yates, P. Lamartine, 1981, *Mexico's Agricultural Dilemma*, University of Arizona Press, Tucson, AZ.

---

<sup>1</sup> Yates cites studies that estimate the amount of *ejido* land rented to be between 50 and 90 percent in the irrigated northwest and about 35 to 50 percent in the rain-fed areas. DeWalt and Rees provide a comprehensive review of the evidence of such violations.

<sup>2</sup> *Programa de Certificación de Derechos Ejidales y Titulación de Solares Urbanos*, or Program for Certification of *Ejidal* Rights and Titling of Urban Areas.

<sup>3</sup> There is some debate over how secure *ejido* titles really were. In some *ejidos*, powerful individuals were able to appropriate additional lands at the expense of other *ejidatarios*, through this often occurred during a land transfer when legitimate heirs did not exist or had difficulty supporting their claims. In general the titles can be considered secure, at least as secure as an private title would be under similar social and political circumstances.

<sup>4</sup> The costs of completing *Procede* are essentially time costs, time spent going to meetings, documenting *ejido* membership, working with *Procede* officials to determine the internal and external boundaries of the *ejido*. The community must approve of the boundaries before titles can be issued.

<sup>5</sup> Other researchers have speculated that the large, irrigated *ejidos* in northern states such as Sonora would be the most likely focus of any privatization program because they are the most likely to respond to the incentives offered by a title (Thompson and Wilson). If this is true, it would strengthen the results of this analysis since if rationing is not found in these areas, it is unlikely to be found in others where the demand for credit is lower.

<sup>6</sup> Use of average value is unlikely to mask great variation within the *ejidos*. In most *ejidos*, but especially in the northern irrigated *ejidos* distribution of irrigated land is near uniform.

<sup>7</sup> Other variables including “total hectares per member,” “average parcelized land per member,” and “percent of land that is parcelized” were also tried, and none was significant.

---

<sup>8</sup> Using livestock as a measure of liquid assets could be a problem in the empirical analysis if livestock are also used as collateral. It would not affect the conclusion that land titles are unlikely to affect borrowers demand for credit, however it would undermine the interpretation of that result to mean that farmers do not have a demand for collateralized credit. However, livestock are not commonly collateral. Their value depends on their physical condition, which can vary greatly and is especially sensitive to treatment (Binswanger and Rosenzweig). In interviews with Mexican farmers, none reported using livestock as collateral.

<sup>9</sup> It was suggested to me that, by this same logic, Procede officials initially focused their efforts on smaller *ejidos* in order to get them through the program as quickly as possible. Inclusion of the variable “average number of members per *ejido*” would control for this bias as well.

<sup>10</sup> There are three types of *ejido* land: parcelized, unparcelized and collective. Parcelized land has been divided up for use by individuals. Unparcelized land, such as pasture, is used communally. Collective land, by far the smallest of the three categories, is worked jointly by all members. Most *ejidos* contain both parcelized and unparcelized land.

<sup>11</sup> The variable is the average hectares of irrigated land per member with access to a parcel. Since not all *ejidos* have parcelized land, not all *ejidatarios* have access to parcelized land. The majority of irrigated land is parcelized, but not all of it, the difference being the collective *ejidos*.

<sup>12</sup> Basic services include electricity, potable water, and access to a dirt or paved road.

<sup>13</sup> Percent in Procede includes *ejidos* in the process as well as *ejidos* that had finished. Not included are *ejidos* that had not yet been contacted, had not yet voted, or those that voted to reject Procede.

<sup>14</sup> Not all counties in the two states were included in the analysis. Cases in which the discrepancy between the number of *ejidos* per county reported in the PROCEDE data and the number reported in

---

the census data exceeded 50 percent were dropped. The difference could occur for a variety of reasons, however one of the main concerns for this analysis was that it could be related to the political problems in some areas of Chiapas that coincided with the implementation of the land reform program. However it is curious to note that while many *municipios* in Chiapas were eliminated, some of those most associated with the Zapatista rebellion remained in the analysis.