Linking poverty, natural resources, and financial markets: a model of land use by rural households in El Salvador

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Short summary

This paper posits that deforestation and poverty levels are related through an inverted-U shape --the environmental Kuznets-- curve and that access to credit shifts this curve downwards, thus positively impacting natural resource uses. This hypothesis is tested using a household panel data set from El Salvador.

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Abstract

The purpose of this paper is to examine the conditions under which, in developing countries, rural household strategies for income generation and consumption smoothing may lead to deforestation and to other forms of natural resource degradation, such as soil erosion and watershed threats. Further, the paper examines how access to cost-effective financial services (namely, loans) can play a role in the choice of livelihood strategies and through these choices have indirect impacts on natural resource uses. In particular, the paper addresses linkages between low living standards in the countryside, limited access to markets, and agriculture's expansion in fragile environments. The impact of access to financial services on the shape of an Environmental Kuznets Curve (EKC) for land use change is tested empirically using a household panel data set from El Salvador.

Keywords: *Natural resource use, poverty, environmental Kuznets curve (EKC), El Salvador, South America.*

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The relationship between poverty and environmental degradation in the developing world has been a topic of increasing debate and concern. Some posit the existence of a downward spiral, through which low living standards contribute to increased pressure on natural resources while, in turn, this pressure exacerbates poverty (Grepperud). Others claim that environmental damage increases as income does. Still another perspective considers the possibility that, when incomes become sufficiently high, pressures on natural resources may diminish, as wealthy societies demand more and can better afford conservation efforts. An intermediate perspective is the idea that this relationship may be outlined as an inverted U, a shape now known as the Environmental Kuznets Curve. This notion recognizes that income growth may be initially detrimental to natural resource conservation but that, after some threshold, income growth becomes environmentally beneficial.

The relationship between income and natural resource uses is influenced by different factors, such as levels of education and household access to financial markets, particularly credit. In particular, the relationship between access to credit and natural resource use has not been explored in depth. This has reflected, in part, the lack of household level data that would allow consideration of microeconomic variables. In addition, some studies that analyze this relationship have generated ambiguous results. On the one hand, in theory, it is expected that credit would reduce deforestation if it were

used for more intensive agriculture or for investment in forest management. On the other hand, access to credit might increase deforestation if used for clearing activities, such as increasing the amount of land for pasture. Empirically, both results have been observed, with some predominance of studies that support a positive relationship between credit availability and deforestation. It becomes clear that additional research must be undertaken on this topic, to provide better insights to policymakers.

This paper seeks answers about the impact of access to credit on natural resource use decisions and about how poverty levels shape this relationship. Answering these questions can contribute to a better understanding of household decisions on the use of credit as a tool for overcoming poverty and of its implications for environmental degradation in developing countries.

The main hypothesis is that the relationship between agricultural land use and the income of rural households can be represented by an environmental Kuznets curve (EKC) and that this curve shifts as a result of access to credit. The expected effects of access to credit on the EKC are a reduction in the level of environmental degradation at every level of income and a decrease in the threshold at which economic growth begins to be environmentally beneficial. The rationale behind this hypothesis is that, with access to credit, rural households can gain additional purchasing power over market inputs for their agricultural activity –that is, they can engage in a type of agricultural intensification– thereby releasing pressure on those natural resources (non-market inputs) available at the fringe and used as part of an income-smoothing strategy to deal with adverse shocks.

Another expected response from access to credit is an increased ability to engage in non-agricultural activities and thus also releasing the pressure on land.

We use data from El Salvador for the empirical test of these hypotheses. A major data gathering effort has been implemented by the *Fundación Salvadoreña para el Desarrollo Económico y Social (FUSADES)* and the Rural Finance Program at The Ohio State University (OSU). Since 1996, a nationally representative sample of rural households has been questioned biennially about their economic activities during the preceding calendar year. A panel of household-level data for 1995, 1997, 1999 and 2001 thus became available for empirical investigation.

Poverty and Natural Resource Use

To reconcile various perspectives about poverty and environmental degradation, a number of economists have posited an EKC, in reflection of the idea that economic growth may be initially detrimental for natural resources in developing countries but that, after some threshold, economic growth eventually becomes environmentally beneficial. In recent years, several authors have investigated specific dimensions of EKCs that correspond to various kinds of resource degradation, including agricultural land clearing, in different parts of the world (Barbier). Whether resource degradation is high or low at the peak of the curve has much bearing on the environmental consequences of economic development. Similarly important is the income threshold beyond which economic growth and environmental quality are not just compatible but are mutually reinforcing.

Cropper and Griffiths, for example, find that the threshold at which the relationship between income and deforestation becomes negative is well above GDP per capita in the vast majority of African and Latin American countries with extensive tracts of tree-covered land. This finding implies that, ceteris paribus, development in those two continents is likely to coincide with widespread loss of natural habitats. Similar findings for El Salvador are reported by Rodriguez-Meza, Southgate and Gonzalez-Vega.

Barbier points out that most attempts to estimate a general EKC for agricultural land clearing have met with little success. In a comprehensive review of 150 empirical studies on tropical deforestation, Kaimowitz and Angelsen conclude that exceptions are frequent to general claims about the forces driving the loss of tree-covered habitats in the tropics. They report, however, that increases in non-agricultural employment usually ease pressure on forests. Nevertheless, the introduction of improved agricultural technology and other aspects of rural development, which are generally reckoned to diminish the clearing of natural habitats, do not always have this effect.

One reason why insights are still lacking about linkages between low standards of living and deforestation is that much of the empirical literature consists of cross-country studies. Comparison of average incomes, rates of land-use change, and other national aggregates does not allow for a very nuanced examination of the causes of rural poverty, why rural households (poor and otherwise) convert forests into agricultural land, and related topics. Better insights are gained by analyzing household-level data.

Surveys of rural households have been carried out to empirically examine the microeconomics of tropical deforestation. Individual choices among farming systems in

northeastern Ecuador were found to be influenced by a diverse set of factors, including soil quality, tenure security, market access, and educational attainment of adult members of the household (Pichón and Pichón et al.). Rabindran found that land clearing in the Bolivian Amazon is negatively related to educational attainment and off-farm wage labor.

Zwane used panel data to analyze impacts of income change on deforestation in the Peruvian Amazon. She found that permanent income is not differentially correlated with land clearing at the household level, although a household's size and its access to labor markets are. Zwane concludes that creating opportunities for off-farm employment may be the best way to raise living standards while simultaneously conserving forests. Southgate also contends that improved opportunities for non-agricultural employment reduce pressure on natural habitats, as such options raise the opportunity cost of labor needed for land clearing. Bluffstone, Holden, Ozório de Almeida and Campari, and Pichón offer empirical evidence of this linkage.

Zwane illustrates the insights to be gained from using panel data. Indeed, permanent income can be estimated only if panel data are available. Likewise, longitudinal surveying allows for examination of the impacts of positive or negative trends or shocks in income. Panel data analysis of land-use change at the household level was undertaken in southwestern Palawan, the Philippines, where part of the sample interviewed in 1995, 1997, 1999, and 2001 comprised farm households in a lowland area. The rest of the sample was in an upland area experiencing active deforestation (Shively and Martinez). Increases in the derived demand for labor resulting from a major irrigation project in the lowland area were sufficient to drive up the opportunity cost of

labor at higher elevations, which encouraged a switch to farming systems that save labor, are more capital-intensive, and reduce agricultural land clearing (Shively).

Rodriguez-Meza, Southgate, and Gonzalez-Vega estimate a recursive permanent-income model in order to test the hypothesis of the existence of an EKC for farmed area at the household level in El Salvador, using panel data set for 427 households, with four biennial observations between 1995 and 2001. The peak of the EKC plotted with the estimated coefficients is at a level of permanent income well above what is earned by the vast majority of the households in the sample. In effect, predicted per capita incomes for more than 85 percent of the sample are below the threshold at which improved living standards begin to coincide with diminished agricultural land use. This paper builds on these findings in exploring the impact of access to credit on the shape of the EKC.

Rural income growth in El Salvador

Although rural poverty declined during the 1990s in El Salvador, by the end of the century still 59 percent of the rural population were below the relative poverty line and 31 percent were below the extreme poverty line (Lardé de Palomo). Studies using panel household data also revealed wide fluctuations in income and a high degree of mobility across the deciles of the income distribution (Beneke de Sanfeliú).

Indeed, rural households in El Salvador have experienced significant shocks in recent years. First, the country has been buffeted by environmental disturbances of great magnitude. Drought struck in 1997, when the last *El Niño* was at its peak. In early 1999, Tropical Storm Mitch unleashed torrential rains, which flooded low-lying areas and

destroyed roads and bridges. Dry conditions returned in 2001, a year that began with a pair of earthquakes, and the drought-cum-floods continued in 2002. Second, even more devastating has been the steep decline in coffee prices. After peaking at $2.00 per pound in late 1997, the international price fell to $1.00 in 1999, and then it halved again during the following two years (Rodriguez-Meza, Southgate and Gonzalez-Vega).

Based on data from the panel of rural households, average per capita income for 2001 was US $788 (Rodriguez-Meza and Gonzalez-Vega).[1] Thus, the average rural household in El Salvador was slightly above the threshold of two dollars per day. In 1999, however, per capita income among these rural households had been US$ 698, which is below the poverty line. Lopez, based on the first observation of the panel, found that for 1995 per capita income was US$ 460.[2] Thus, per capita incomes increased but the data also reflect a high level of income volatility, which implies vulnerability, and the absence of tools to smooth income and consumption, with the corresponding negative impacts on welfare.

Land use in El Salvador

Even though deforestation in El Salvador reached an advanced cumulative stage long ago, since the early 1990s agricultural land use has increased at the expense of tree-covered habitats. According to FAO, forests in El Salvador cover around five percent of the total land area. One fourth of the farmland shows a high degree of erosion and loss of productivity, and about 70 percent of the population depends on firewood (Panayotou, Faris, and Restrepo).

An aspect of land clearing for agricultural purposes in places like El Salvador is puzzling at first glance. With commodity prices falling and crop yields being diminished by drought, storms, and earthquakes, one might reasonably expect farmed area to decline over time, especially if non-agricultural employment and opportunities for migration abroad have been increasing. However, precisely the opposite has been happening in El Salvador (Gonzalez-Vega et al.). The key to explaining this seeming anomaly is to appreciate that, along with purely commercial demands for agricultural land, there exists a demand that is best characterized as precautionary. The household's precautionary demand for farmland is especially pronounced in relatively bad times, when survival is particularly tenuous and more labor is devoted to subsistence farming. The cultivated portion of the household's landholding then increases. In contrast, this demand is negligible for affluent households, as they usually possess assets and access to markets –a credit line, a savings account, assets that can be sold or pawned, family remittances– that can be used to maintain consumption in the face of income shortfalls.

The relationship between income and agricultural land use is the net result of two influences. One relates to a household's demand for land, which is largely precautionary and is a decreasing function of income. The other has to do with a household's wealth, purchasing power, and access to natural resources and is an increasing function of income. For low levels of income, the first influence dominates, and many households are left with an unsatisfied willingness to cultivate more land. As their income increases, their command over resources increases, and additional land is cultivated. For high levels of income, in contrast, the second influence dominates and the declining demand

for cropland is binding. This behavior results in the EKC identified by Rodriguez-Meza, Southgate, and Gonzalez-Vega. If additions to cultivation imply the use of marginal lands, normally plots with low fertility and considerable slope and thus susceptible to erosion, soil degradation will follow.

Access to credit in El Salvador

Rural households demand loans from different sources: (1) private commercial banks and other regulated financial intermediaries; (2) development agencies, including state-owned organizations whose role is to assist rural households or farmers, as well as non-profit (NGO) microfinance organizations and credit and savings cooperatives; (3) trade-related sources, including input providers or crop buyers; and (4) individuals, who either lend for profit (moneylenders) or because of a personal relationship with the household (relatives, friends, bosses, landlords and the like). The first two types are considered *formal* sources, while commercial and individual sources are considered *informal*.

Formal financial markets in El Salvador are thin and poorly developed, especially in the rural areas. Rodriguez-Meza found that almost two-thirds of the rural households in the sample did not have loans of any type. He also found significant segmentation between formal and informal credit markets in El Salvador.

Private banks and regulated financial intermediaries are less than available for rural households. Just around one percent among households in the two lowest quintiles of the income distribution has used private banks as a source of credit. Trade-related

sources are also relatively less frequent among low-income households, but their share grows steadily as income increases. Development agencies reach 20 percent of the lowest income households, and this share increases to 35 percent for the two quintiles with the highest incomes. By far, however, informal lenders continue to be the source of loans for an important fraction of the rural population. These sources are the most frequently used for households in three out of five income quintiles.

Because households adopt both *ex ante* and *ex post* mechanisms to cope with risk, observed credit outcomes must be evaluated by simultaneously considering other risk-management options of the household (Deaton, Morduch). Among alternative mechanisms for coping with adverse shocks, the cultivation of marginal lands appears to be particularly costly, in terms of yields and sustainability. Adoption of this strategy may suggest that barriers to access to credit markets exist. Poor, credit-constrained households may thus engage in environmentally adverse risk-management strategies.

The impact of access to credit on deforestation and other uses of natural resources remains indeterminate. In an extensive review of papers related with deforestation, Kaimowitz and Angelsen conclude that analytical studies find ambiguous effects of access to credit on changes in land use. Empirical studies, in turn, have reported increases in deforestation as result of access to credit. These reviewers claim, however, that the results are not reliable due to the type of data used.

The problem may in part be attributed to the way in which access to credit is included in the models. In analyzing the potential impact of access to credit on land use decisions, special consideration should be given to credit rationing. In rural credit

markets, households are not always granted the amount of credit they demand, even if they are willing to pay the going interest rate. Rationing may in general reflect policy and other constraints on the setting of interest rates or the unwillingness of lenders to clear credit markets by raising interest rates, in the presence of adverse selection and moral hazard. Moreover, major difficulties for credit transactions to occur emerge from the limited and asymmetric information possessed by potential lenders from outside the rural areas and incentive and contract enforcement problems when an efficient legal and judicial framework does not exist as well as simply from the high transaction costs that result from undeveloped physical and institutional infrastructure.

Analysis of the impact of access to credit on household decisions should recognize the disequilibrium that is created in credit markets by these difficulties (Freeman et al.). Survey figures about the incidence of loans seem to suggest that rural households in El Salvador are prone to be credit rationed or not to have access to loans at costs comparable to those found in other segments of the economy. Credit is rationed mostly by formal sources (commercial banks and development credit agencies). For the analysis of credit rationing here, only formal sources are considered.

To identify the presence of credit rationing, it is not enough to observe the presence or absence of loans. Households not using credit may not be rationed, and households using it may be rationed. To determine whether households are credit constrained, information about their perceptions and actual use of credit sources must be combined.

In terms of the actual access to loans, households were surveyed as to whether they had asked for credit or not. Among those that had applied, some obtained a loan and others did not. Rejected applicants are considered to have been credit rationed, although no information is available about their true creditworthiness. Those that did obtain a loan but received less than the amount they had asked for are also considered as credit rationed. Those that asked for a loan, obtained it, and received what they asked for (or more) are considered non-credit rationed.

In turn, households that did not apply for loans are not necessarily rationed. Those that did not apply were questioned about the reasons for this decision. The answers can be grouped into four categories:

a. *No need*. Some households claimed not to need a loan. They either faced few budget restrictions or such low productivity opportunities that they did not required additional funds. These households are categorized here as non-credit rationed.

b. *Risk averse.* Some households asserted that credit is very risky, that they do not like being indebted, or that they feel uncomfortable having debt.

c. *High cost.* In this category fall all the households that considered that loans are available, but that the contract terms are not favorable, given their own budget and preferences. Contract terms include too high interest rates, short terms to maturity terms, too many requirements, and so on. While these households do not truly face non-price rationing, as they simply do not want to pay prices that seem too high for them, the unresolved shortcomings of

financial markets in rural areas explain the excessive cost of loan funds and excludes them from using credit in order to take advantage of opportunities with marginal rates of return equivalent to others being funded elsewhere.

d. *Self selected out.* In this category are included all the households that think that even if they applied, they would not obtain a loan, or that lenders are not available, as well as other reasons to consider themselves out of the credit market *a priori*.

All households in the last three categories are considered to be credit rationed.

Once this classification is applied to the sample, 15 percent of the total number of households during 1999 and 19 percent during 2001 are categorized as not rationed. These figures show some improvement in the outreach of formal sources of credit.

Econometric analysis

The main hypotheses to test with the econometric analysis are that access to financial markets shifts the environmental Kuznets curve, not only by lowering the threshold at which increases in income reduce the degradation of natural resources, but also by shrinking the whole curve, so at every level of wealth environmental degradation is less.

To include the distinction between credit rationed and non-rationed households in the analysis, several alternatives have been proposed (see Jabbar, Ehui and VonKaufmann, Freeman et al., Lyons, among others). A popular approach is to acknowledge the differentiation between credit-constrained and non-constrained

borrowers and use a switching regression model to correct for possible sample selection bias, due to unobservable characteristics of the households (Freeman et al., Fuglie and Bosch, Feder et al.).

The switching regression approach uses a probit model in the first stage, to determine the probability of a household being credit constrained and establish the relationship of this status with socioeconomic and loan terms variables. In the second stage, separate regression equations are used to model land use decisions by categories of households, conditional on a specified criterion function.

Following Freeman et al., the credit-constrained condition of a particular household is described by an unobservable excess demand for credit, which is postulated to be a function of household socioeconomic, income generation, and credit conditions variables.

$$I^* = \delta' Z_i + u_i \qquad (1)$$

The excess demand for credit is not observed but, using the available data, it is possible to determine those households whose productive activities are or not constrained by credit. Households are credit-constrained if the demand for credit exceeds the supply. These functions are used to define a dichotomous variable, which takes the value of one if excess demand for credit is positive, and zero otherwise.

$$I = 1 \quad \text{if} \quad I^* = \delta' Z_i + u_i > 0$$

$$I = 0 \quad \text{otherwise} \qquad (2)$$

Following Feder et al., the land use decision of the two groups of farmers is modeled by using separate regressions for each group.

$$Y_{1i} = \beta_1' X_{1i} + u_{1i} \qquad if \qquad I=1$$

$$Y_{2i} = \beta_2' X_{2i} + u_{2i} \qquad if \qquad I=0 \qquad (3)$$

Estimating these models using OLS yields inconsistent estimates of the coefficients, because the expected value of the error term conditional on the sample selection criterion is non-zero (Maddala). Therefore, following Lee, a two-stage method is used to estimate this system of equations. From the first stage, an inverse Mills ratio can be obtained for each household constrained or non-constrained.

$$\lambda_{1i} = \phi(\delta' Z_i)/\Phi(\delta' Z_i)$$

$$\lambda_{2i} = \phi(\delta' Z_i)/[1-\Phi(\delta' Z_i)] \qquad (4)$$

These terms are included in the specification of the second-stage equations, making their new residuals to exhibit zero conditional means.

$$Y_{1i} = \beta_1' X_{1i} + \sigma_{1u}\, \lambda_{1i} + \varepsilon_{1i} \qquad if \qquad I=1$$

$$Y_{2i} = \beta_2' X_{2i} + \sigma_{2u}\, \lambda_{2i} + \varepsilon_{2i} \qquad if \qquad I=0 \qquad (5)$$

In order to account for possible heterogeneity within and between households through the longitudinal sample, a random-effects approach is included in the two-stage estimations.

The first stage implies a probit regression of the rationing condition on household socioeconomic variables, income generating activities, and credit conditions. The former include demographic characteristics, such as gender and age of the household head as well as the education of all household members, and variables capturing household endowments, such as total available land, numbers in the labor force, and assets owned. Overcrowding in the house and distance to paved roads are included to reflect other

dimensions of poverty and isolation from markets. Income generating opportunities are captured by the share of the household labor force working off-farm and in microenterprises. Credit conditions include a dummy for households receiving formal credit and another one for informal credit.

In stage two, separate regression equations are used to model agricultural land use decisions by the households, conditional on a specified criterion function. Here, the dependent variable is the area of land devoted to crops. Explanatory variables, along with income net of remittances and subsidies, include income diversification options, agricultural related decisions, and control variables. Income generation possibilities are captured by the shares of the household's labor force devoted to off-farm employment and microenterprise activities and by the receipt of remittances. Agriculture-related variables include a dummy for access to technical assistance (to capture the level of the technology), total expenditures in agricultural inputs per hectare (fertilizer, chemicals, seed, irrigation), in order to capture degrees of intensification, number of crops grown, and an index reflecting the slope of the parcels, to capture plot-related characteristics. Total available land is used as a control. Finally, loan amounts for the corresponding year are also included for both formal and informal sources.

Empirical results

Results from the first stage can be observed in Table 1. The table shows that credit rationing, as broadly defined here, is a response to both demand-side and supply-side circumstances, which result in households having full access to credit or not. Only 17

percent of the households in the sample can be considered to be non-credit constrained, as already indicated. Education of the head of the household is a strong determinant of rationing. This reflects both a greater ability to take advantage of productive opportunities and a potential screening criterion easily observable by lenders. As found in Gonzalez-Vega et al., microenterprises generate a pulling force that takes households out of poverty and integrates them into markets. This integration includes access to credit markets as well.

Another important feature affecting the rationed condition is the receipt of remittances. Households with remittances from abroad are less frequently rationed. Remittances seem to complement a demand for formal credit for income smoothing. Moreover, households with access to remittances may be more able to fulfill lender requirements. The value for ρ and its significance show that a random-effects approach is most suitable for this analysis.

Coefficient estimates from the second-stage switching regression models for cropland are shown in Table 2. The average columns show differences between the two categories. In general, non-credit constrained households exhibit higher incomes, more educated heads of household, more land, more remittances, have access to less steep plots, spent more in agricultural inputs, and use more credit (from both formal and informal sources).

Credit constrained households do exhibit the expected EKC, with significant parameters, while this is not the case for credit constrained households. In both cases, better-educated household heads tend to reduce the area of land devoted to agriculture. If

these heads of household are not credit-constrained, cultivated area is more elastic to increases in education. Having access to more total land increases the opportunities of expanding the agricultural frontier at the farm level for both groups. Credit-constrained households, however, are more elastic to increases in available land. The ability to participate in off-farm markets and microenterprise activities reduces significantly the chances of using land for agricultural purposes. This is a fact found in several studies, and it confirms the positive impact of off-farm employment opportunities in reducing environmental degradation, especially for the case of credit-constrained households.

Non-constrained households are more responsive to less steep plots than those constrained. This finding, along with results about access to technical assistance, show that non-constrained households engage in more intensive agriculture. Having less budget restrictions, nevertheless, when exposed to plots of good quality or with access to technical assistance, the result is more use of land for the cultivation of crops. This might suggest that households with access to modern technology and no credit constrains might be driving the pressure for land in El Salvador. Less constrained households are thus responsible for most of the pressure on land. This view coincides with the fact that most of these households are at the top of the EKC, close to the maximum level where the curve turns downwards. They may be generating, however, strong impacts on the environment.

Finally, in both cases it was observed that access to funds from formal and informal sources reduce the pressure on land. This might be either because households engage on more intensive production processes or because households ask for credit to

move out of agricultural activities into microenterprises and other non-agricultural opportunities.

Two technical comments about the regressions: The switching model seems to be appropriate, as shown by the significance of the inverse mills ratio coefficient in both equations. At the same time, the random-effects approach also seems to be adequate for this dataset, per the p-values and R^2 observed.

Conclusions

Levels, depth, and dispersion of poverty declined in El Salvador in the last decade of the century. Inequality, however, persists, and rural households have not fully enjoyed all the benefits from economic growth. Growth is enjoyed first by households with better endowments, in terms of both human capital and physical wealth. Barriers to the exploitation of new opportunities can be overcome through improvements in access to markets and human capital formation.

Given the current structure of income generation in rural El Salvador, it is expected that economic growth will exert additional pressure on natural resources, especially land. Those households overcoming poverty, creating new income-generating opportunities, and gaining access to credit markets are at the same time those creating the maximum pressure on land. In a setting where land is extremely scarce and land markets are far from perfect, this will be reflected in further environmental degradation.

Access to credit exerts a positive impact on land conservation, given that households that use loans either for intensification of the agricultural process or –more

importantly- for the consolidation of non-agricultural productive opportunities, release pressure on marginal lands.

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Table 1. Rationing condition random effects probit.

Variable	Coefficient	Semielasticity	Average
Head gender	-0.32	-0.27	0.8
Head education	-0.04**	-0.12**	2.7
Share of labor force in microent.	-0.55**	-0.07**	0.1
Formal loans amount	-0.05***	-0.07***	1.4
Informal loans amount	-0.09***	-0.03***	0.4
Remittances	-0.01*	-0.05*	5.3
Number of crops	-0.03	-0.04	1.4
Technical assistance	-0.32	-0.02	0.1
Year 2001	-0.20*	-0.10*	0.5
Constant	2.07***		
Rho	0.38***		
Observations	909		
Groups	469		
Wald chi2(9)	54		
Log likelihood	-362		

*** significant at 1% ** significant at 5% * significant at 10%

Table 2. Random effects model for cropland decisions conditional upon credit constrain

Variable	Credit constrained			Credit non-constrained		
	Coefficient	Semi elast	Average	Coefficient	Semi elast	Average
Income	0.03**	0.25**	6.1	-0.01	-0.06	8.4
Income squared	-0.00*	-0.05*	83.2	0.00	0.05	150.9
Head education	-0.04***	-0.17***	2.5	-0.04*	-0.20*	3.5
Total land	0.11***	0.30***	1.8	0.06***	0.19***	2.3
Share labor force off farm	-0.29***	-0.17***	0.4	0.05	0.03	0.4
Share labor force micro	-0.90***	-0.16***	0.1	-0.09	-0.02	0.2
Remittances	-0.01***	-0.10***	5.0	-0.01	-0.05	6.6
Technical assistance	-0.28**	-0.02**	0.1	0.31*	0.04*	0.1
Terrain slope	0.19***	0.53***	1.8	0.26***	0.71***	2.0
Inputs cost	-0.03**	-0.06**	1.2	-0.03	-0.06	1.6
Formal loans size	-0.06***	-0.04***	0.5	-0.01	-0.12	6.1
Informal loans size	-0.19***	-0.07***	0.2	-0.04	-0.05	1.0
Year 2001	-0.26***	-0.19***	0.5	-0.13	-0.09	0.5
Inverse Mills ratio	15.72***	7.85***	0.3	-2.03*	-3.74*	1.4
Constant	-4.49***			3.23*		
Rho	0.62			0.84		
Observations	756			153		
R-sq: within	0.167			0.580		
Between	0.510			0.459		
Overall	0.464			0.487		

*** significant at 1% ** significant at 5% * significant at 10%

Footnotes

[1] The exchange rate was 8.75 colones per US dollar. All figures are deflated to constant colones of 1999. Average values are usually inflated by outliers. In fact, median per capita incomes were US$ 465 and US$ 547, for 1999 and 2001, respectively.

[2] Lopez indicates that some correction may be needed for the income reported in the surveys. He found that, according to the GDP estimates for El Salvador and using information about the rural sector, there was under-reporting of about one hundred dollars, which requires a correction of about 22 percent. Revised methods for estimating income have reduced the degree of underestimation (Rodriguez-Meza and Gonzalez-Vega).