The Value of Land in Rural Nicaragua

(Running Title: **Marginal Value of Land in Nicaragua**)

by

Ricardo H. Cavazos Cepeda*

University of California at Berkeley

Abstract

The objective of this paper is to explore the impact of increased access to land on household income and consumption. The analysis uses cross-sectional survey data applied to rural peasants in Nicaragua for the year 2000. The model presented allows for imperfections in labor and capital markets. These imperfections can be the cause for past failures in land reform policies. Econometrically, an Income Equation is estimated. The results suggest an extra unit of land has a significant effect on the level of household consumption. Other issues having a significant effect on household

Key Words and Phrases: Poverty, Income Equation, Nicaragua, Land

*All errors are mine.

consumption are the level of women's education and the number of children in the household. Finally, the presence of market imperfections was also detected.

1 Introduction

What is the value of land? To whom and where does land matter the most? Under what conditions can gaining access to more land be beneficial? What kind of policy regarding land would be an effective and efficient strategy to assault rural poverty? In the middle-ages, the amount of land an individual owned completely determined social status. However, with the fast paced technological change and the reorientation of the economies away from agriculture, the importance and the value of land diminished, specially to urban dwellers. This was not the case for the population that remained in rural areas. For them, land continues to be a fundamental asset in determining their income, consumption, and poverty status. This situation precisely describes the day to day living conditions for most of the rural population in Latin America. The objective of this paper is to research and attempt to explain the impact of land on household income, consumption, and poverty status in Nicaragua. Land is valuable to rural people, not only because it is a productive asset, but because jointly with the underutilized labor found in farms peasants are able to attain a higher level of income and consumption.

The analysis is undertaken using a cross-section survey applied to Nicaragua in the

year 2000. The model used to capture the impact of land on the household is called an Income Equation. This model includes variables that take into account the amount of land, the characteristics of the head of the household, the characteristics of the other members of the household, the number of people who have migrated either out of the country or the departamento,[1] infrastructure assets, and location indicators. Previous studies have assumed a linear specification of the model. However, this assumption can sometimes be restrictive and incapable of capturing the relationship between land and household income. Therefore, a linear relationship will not be assumed. The evidence coming from previous attempts at capturing the effects of this relationship is ambivalent showing results in favor and against land market reform policies. This paper will contribute to that debate by employing a data set coming from household surveys. In the first section, a brief overview of the economic and development situation in Latin America is presented. The next section sets forth the theory and model that jointly sustain the empirical econometric estimation and results. The third section describes the data, the estimation process, and results. The last section presents a summary and future research topics.

[1] Nicaragua is divided in 15 departamentos and 2 autonomous regions. The departamentos would be equivalent to states in a federal system.

2 Poverty and Access to Land in Latin America

Poverty and how to measure poverty are topics that have received much attention by researchers, governments, and non-governmental organizations alike (see Ravallion 1996 and Deaton 1997). In particular, Latin American countries have been the object of a number of studies purporting to disentangle the myriad of simultaneous effects preventing individuals from being able to come out of poverty.[2] Latin American countries share several common characteristics like an abundancy of land, coexistence of small farms with large commercial farms, a high proportion of their rural populations are landless workers, and agriculture comprises less than 25% of gross domestic product (Valdes 2000). It is likely that some of these elements, in addition to the necessity to formulate cost effective and efficient poverty alleviation strategies that target, reach, and also create virtuous cycles for the intended groups, may be the driving force behind the inquiries into poverty in this region. Therefore, as a consequence of taking into account such needs and initial situations the ultimate goal would be to seek, design, and implement the best policy that would maximize the probability of rural dwellers permanently leaving the chronic state of poverty.

[2]Studies that deal with poverty and income distribution in Latin America are Aspe and Sigmund (1984), Garcia Rocha (1986), Carter (1990), Carter (1991), Szekely (1998), Carter and Yao (1999), Olinto, Davis, and Deininger (1999), Carter and Zimmerman (2000), and Finan, Sadoulet, and de Janvry (2002), among others.

The need to implement cost effective policies stems from the prolonged period of economic stagnation and low growth rates of gross domestic product during the latter part of the decade of the 80's and the early part of the 90's throughout Latin America. The exception to this phenomenon was Chile that recorded a per capita growth rate of 4.3 per cent per year for the period 1987 to 1994 (Valdes 2000). Unfortunately, for the rest of Latin America growth in gross national product was below 1.5 per cent for the period 1985 to 1995 and for some nations it was negative. Nicaragua was one country where the growth rate of gross national product was negative (-5.4%). Additionally, the growth rate in agricultural gross domestic product during the period from 1980 to 1990 was -5.8 per cent, the gross national product per capita in 1997 U.S. dollars was 410, and in 2001 the proportion of the population living in rural areas was 43%. Finally, Nicaragua is classified among the low income countries in Latin America.

Even though, there are some common elements among the countries that compose Latin America their differences are striking. Therefore, the formulation of a strategy to fight poverty should contemplate and depend on each country's unique fundamental characteristics. With this objective in mind, one way to extract these essentials of the country's rural population is to apply household surveys. The information obtained from these surveys is able to portray household behavior as tightly as possible and serves as the foundation for research, to monitor human well being, and to discover how people respond to modifications in their economic environment (Deaton 1997).

These are the reasons and justifications in using such data in this paper.

Why is land and access to it so important to the rural poor? A simple first answer would be because land is a productive asset. However, economic relationships are not so simple in most cases. When increased access to land is coupled with the underutilized labor resources found in rural farms peasants are able to augment the sources from where they generate their livelihood. In this way a virtuous cycle can be initiated, specially when other sources of income for peasants are at best weak and uncertain. Lopez and Valdes (2000) identify three effects associated with an increase in the endowment of land: 1) a direct production effect; 2) reduction of the effective labor allocation distortion; and 3) improving access to credit allowing farmers greater use of working capital. However, it has already been mentioned in this paper, that a number of effects occur simultaneously and sometimes obscure our understanding of the impact that land markets have on household income and consumption.

Carter and Mesbah (1993) and Carter and Zegarra (2000) identify several problems that blur our understanding about the marginal value of land to a household. Whenever information asymmetries are the cause for labor, capital, and insurance markets to be imperfect, for insecurity in land tenure to exist, and for transaction costs to be prohibitively high then a marginal increment in land or land access will have an impact in the household's resource allocation. The household's resource allocation will vary continually depending on the increase in the endowment of land.

Therefore, in a setting of imperfect markets and resource poor households the value of land would be above the value of its marginal productivy, translating in a higher willingness to pay for extra land (Carter and Zegarra 2000). The imperfections in markets mentioned above and the inability to design an enveloping land market policy that acknowledges and minimizes the distortions created are to be blamed for most of the failures in past land reforms performed in Latin America. The argument in this paragraph is summarized by Carter and Mesbah (1993), "land market reform policies, which leave untouched the structure and rules of access to factor markets face a daunting task."

The above realization has led to conclusions about the general effectiveness surrounding this type of policies, Carter and Zegarra (2000) conclude by proposing that rural poverty might be better addressed by bolstering the access of the poor to employment and the development of human capital and non-land, non-agricultural assets. This conclusion is supported by Lopez and Valdes (2000) where they state that the contribution of land to total household per capita income is small. On the other hand, Finan, Sadoulet, and de Janvry (2002) realize the existence of market imperfections and work with a model flexible enough to allow for such situations.[3] They find that increased access to land has a considerable impact in welfare for the rural poor in Mexico for the year 1997. For small landholders an additional hectare of

[3]The model they use is similar to the one presented in this paper.

land increases welfare on average by 1.3 times the earnings of an agricultural worker. However, they also observe that complementary interventions are needed in order for land to become an important element of a poverty reduction strategy.

The last paragraph highlights a few results that, on one hand, would suggest an increase in the access to land would be highly beneficial for the rural poor, and on the other hand, imply the converse. The clash in outcomes can come from many possible factors. However, all past research coincides in the following: land market policies cannot stand on their own and expect to be successful and effective. They must be part of a bigger well-thought strategy capable and flexible enough to mold itself when unexpected events arise. The next section sketches a model that is general enough to allow for market imperfections in an attempt to capture as closely as possible the impact of land in household consumption.

3 Theoretical Framework

In this section, the theoretical framework is explained. The household production model presented here borrows elements from Carter and Mesbah (1993), Lopez and Valdes (2000), and Finan, Sadoulet, and de Janvry (2002). In first place, lets allow for the possibility of having imperfect markets. In addition, assume the following three things 1) land transactions are ignored and access to land is treated as exogenous; 2) households face the possibility of off-farm unemployment; and 3) access to credit

increases with land size.

3.1 The Model

Consider a household that generates its income by possibly engaging in all of the following activities: supplying labor at an exogenous market wage rate w and cultivating agricultural land. The household is endowed with $\bar{L}$ hours of labor per year which can be allocated to farm activities (L_f) or to the off-farm labor market (L_w); and some agricultural land of size $\bar{T}$, measured in hectares. In order to simplify calculations, assume the household is able to cultivate only one crop using X units of an input purchased at per unit market price P_X. The crops can be sold at market price p. Let $F(L_f, X, T; z)$ be the production function, where z represents the particular household characteristics that may influence the return to the household on productive assets. Let $\Psi(L_s)$ denote the number of days employed as a function of labor supplied, where $\Psi' > 0, \Psi'' \leq 0$. Let $\digamma(T)$ denote the amount of working capital available at interest rate i to a household that has a land endowment of T hectares. Finally, the cost of production has to be financed by the sum of wage income $w\Psi(L_s)$, available capital $\digamma(T)$, and initial wealth Ω.

Therefore, the household determines the allocation of time and purchased inputs in order to maximize its income:

$$Max_{L_s, L_f, X} \qquad pF(L_f, X, T; z) - P_X X + w\Psi(L_s) - i(P_X X - \Omega - w\Psi(L_s))$$

$$s.t.$$

$$L_s + L_f \leq \bar{L}$$

$$P_X X \leq \Omega + w\Psi(L_s) + \digamma(T)$$

$$L_s \geq 0, L_f \geq 0$$

The associated Lagrangian with the problem is the following:

$$\pounds = pF(L_f, X, T; z) - P_X X + w\Psi(L_s) - i(P_X X - \Omega - w\Psi(L_s)) + \lambda(\Omega + w\Psi(L_s) + \digamma(T) - P_X X)$$

The first order necessary conditions for an interior solution are the following:

$$\frac{\partial \pounds}{\partial L_s} = -p\frac{\partial F}{\partial L_f} + w\Psi'(1 + i + \lambda) = 0$$
$$\frac{\partial \pounds}{\partial X} = p\frac{\partial F}{\partial X} + -P_X(1 + i + \lambda) = 0$$
$$\frac{\partial \pounds}{\partial \lambda} = \Omega + w\Psi(L_s) + \digamma(T) - P_X X = 0$$

$$\lambda \cdot (\Omega + w\Psi(L_s) + \digamma(T) - P_X X) = 0; \lambda \geq 0; \Omega + w\Psi(L_s) + \digamma(T) - P_X X \geq 0$$

In this setting, λ is the shadow price that captures the marginal value of an extra unit of capital to finance household production. If λ is equal to zero then the household is not constrained in any way by the capital constraint and therefore an extra unit of capital has no value to the household.

Once we solve the above program.we can denote the solution values with an (*). The income equation congruent with maximizing behavior is the following:

$$Y = pF(L_f^*, X^*, T; z) - X^*(1 + i)P_X + (1 + i)w\Psi(L_s^*) + i\Omega$$

Therefore the household's income is affected by a number of variables that include, product and input prices, the total amount of labor available, the quantity of the inputs purchased, interest rates, market wages, and household's initial wealth, in addition to the particular household characteristics that may influence the return on productive assets. To explore what are the effects of an increase in landholdings we can totally differentiate the above expression.

$$\frac{dY}{dT} = p\frac{\partial F}{\partial T} + \frac{\partial X}{\partial T}(p\frac{\partial F}{\partial X} - P_X(1+i)) + \frac{\partial L_s}{\partial T}(p\frac{\partial F}{\partial L_F} - \frac{\partial \Psi(L_s)}{\partial L_s}w(1+i))$$

$$= p\frac{\partial F}{\partial T} + \frac{\partial X}{\partial T}\lambda P_X + \frac{\partial L_s}{\partial T}\Psi'\lambda w$$

If the capital constraint is not binding ($\lambda = 0$) then the value of land to the household is equal to the value of the marginal product of the asset. On the other hand, if this were not the case, then the value of an increase in landholdings would influence labor and other input allocations. This can be seen because both of the terms in parenthesis above would be positive making the value of an increase in landholdings greater than the value of its marginal product.

3.2 Choice of Welfare Measure

The choice of an adequate welfare variable has been widely argued (Ravaillon 1996). Poverty and welfare are multidimensional issues. Therefore, more often than not, there will be measurement problems and errors associated with the single indicator proposed to capture poverty and welfare. In this paper, the household consumption

variable will be used to identify the household's measure of welfare. Consumption was chosen over income because the latter variable is more sensitive to transitory and volatile shocks (Finan, Sadoulet, and de Janvry 2002). Additionally, in some instances farmers can smooth out bad years by other means, savings or borrowing, mainly. Therefore, expenditures can provide a more stable behavior pattern over time and agree with the theory better. Moreover, there are inherent measurement problems and costs associated with the process of obtaining the data. For example, income data are prone to be underreported simply because people forget or do not want to disclose the full amount of their income.On the other hand, expenditure information can be obtained by fairly accurately by consumption over the past few weeks (Deaton 1997).

Is consumption the adequate measure? No, recall that poverty is multidimensional and cannot be completely captured with a money based estimate. In particular Finan, Sadoulet, and de Janvry (2002) use a welfare index that includes access to potable water, electricity, sewage, and adequate shelter. Similarly, Ravaillon (1996) presents four different types of indicators, each measuring diverse aspects of welfare.[4] This paper uses consumption as a first attempt to capture the complex issue at hand. In future research, the choice of welfare measure will be questioned and investigated

[4]The four indicators Ravaillon presents measure the distribution of real per capita expenditure in the household, access to non-market goods, gender disparities and child nutritional status, and status of personal characteristics.

throughly.

4 Estimation and Results

4.1 Data

The data set employed in this paper comes from a household survey applied to rural farmers in Nicaragua during the year 2000. This survey covered the elements needed to obtain information about household composition and occupations, income and remittances, food consumption, agricultural and animal production, infrastructure, risk, social capital, land assets owned and leased, access to credit, and various dwelling characteristics, among others. Table 1 presents descriptive statistics of the data set decomposed by food consumption quintiles.

The first important issue to notice is that on average for the whole data set monthly food consumption represents 50.4% of the household's income. This relationship repeats in all but the lowest quintile where food consumption is only 21% of income, this last occurance is unusual. One would expect that food consumption as proportion of income would decrease as income rises. With respect to land assets, households have 1.3 plots covering on average 44.99 hectares of land. The total area includes both irrigated and non-irrigated land. The reader will notice, how scarce irrigated land is. Therefore, it would not be unexpected for land to be highly valued.

Turning to farm animals, and in particular to cattle, there is an upward trend in the

number of cattle owned as the quintiles increase. The highest quintile almost doubles the number of cattle owned by the next highest one. The fact that richer households have more cattle is not surprising, however the inequality in the distribution of assets, both land and animals, adds to the difficulties in designing an adequate policy to address poverty.

The composition of the households presents some interesting statistics. The average number of individuals is above 6 per household, with very few men and women over 55 years of age. This would suggest an abundance of labor currently in a productive stage. Additionally, the elevated number of chidren allows for the possibility of labor replacement in the future. If it is not the case that these children are already part of the household labor force.

The table also displays occupations within the household. The majority of individuals in the households tend to be agricultural workers. Finally, these households have relatives that have either migrated out of the country or the departamento. This allows the household the possibility of increasing its income by receiving remittances sent from these relatives. It would not be uncommon for these remittances to account for a big percentage of the household's income. After this brief description of the general descriptive statistics, the explanation of the model follows.

4.2 Econometric Specification

The econometric specification of the model is the following:

$$y = z'\beta + \varepsilon$$

where y is a vector of dimension $n \times 1$, z is a matrix of explanatory variables of dimension $k \times n$, β is a vector of parameters to be estimated of dimension $k \times 1$, and ϵ is a vector of disturbances of dimension $n \times 1$ identically and independently distributed $N(0, \sigma^2 I)$.

The dependent variable is real household food consumption. The model is linear in the parameters. However, acknowledging the possibility of having non-linearities with respect to land, a spline was calculated and included for this variable. Therefore, the marginal effect of land on household food consumption would be the algebraic sum of the estimated coefficient on the level of irrigated land and the coefficient of the spline.[5] The other variables included in the matrix of explanatory variables include characteristics of the head of the household and of other members of the household, the number of people who have migrated either out of the country or the

[5] The marginal effect of land on real household food consumption would be the following: $\frac{\partial cons}{\partial landirr} = \beta_{landirr} + dbreak\beta_{landirr-break}$, where $\beta_{landirr}$ is the estimated coefficient on irrigated land; $\beta_{landirr-break}$ is the estimated coefficient on the spline; and $dbreak$ is an indicator variable that takes the value of 1 when land irrigated is greater than 1 and 0 otherwise.

departamento, infrastructure assets, and location indicators

4.3 Expected effects

What would be the expected effects? Income and consumption are related in a positive manner. When income increases it is usually the case that consumption will also rise in a smaller proportion. It is expected that land will have a positive effect on household for all the reasons explained along in this paper. A marginal unit of land can start a virtuous cycle that comprehends the reallocation of underutilized labor up to increased access to working capital that will ultimately reflect on the income and consumption levels of the household. With respect to the characteristics of the head and of the other members of the household, the effects are not that clear, except for education. It is theorized that education will be positively related to household consumption and that higher levels of education will have a larger impact. Finally, with respect to the other exogenous variables in the model there is no a-priori expectation on their coefficient signs.

4.4 Results

In order to make the presentation of the results easier for the reader, Table 2 presents the descriptions of the variables used in the regression analysis. These descriptions convey an idea about the variable, how is it measured, and whether or not it is a qual-

itative variable. Proceeding with the explanation of the results, Table 3 displays the elasticity values, standard errors, and P-values for those variables that are continuous.

The discussion will be focused to those elasticities whose P-value is in bold type due to space limitations. First, the elasticity values for *landirr* and *noirrland* are both statisically significant. However, the latter is greater than the former. This is a consequence of the relative scarceness of irrigated land with respect to non-irrigated land. A surprise was that the coefficient on the spline was not statistically significant. Therefore, the marginal effect of irrigated land only includes the coefficient of the *landirr* variable and represents 23.8% of household food consumption. These results jointly would suggest that increased access to land, no matter the quality, would raise household food consumption in a considerable manner. These results also hint at the presence of market imperfections. The imperfections can be identified due to the restricted access to the high quality input. It is not uncommon, in any type of transaction to require some form of collateral in order to acquire access to resources that command high market value due to their income generating potential. However, in most cases peasants either lack assets that can function as collateral or the assets they own have a limited market value, therefore, their ability to obtain high quality inputs is hindered.

The education variables where statistically significant mostly for the female members of the household. The impact of women with six or more years of education on

household food consumption is considerable. This could be the result of behavioral patterns in the household. It is common for the male members of the household to have occupations that require them to work in other places, leaving women and children to work at home becoming the labor force in the household. The general notion of the result suggests that women that are more educated are better able to deal with problems, combined with a greater number of children would increase the household consumption level. These results probably reflect some form of education externality and insurance market imperfections that are reflected by the insecurity faced when men in the household are no longer in a productive stage.

The only infrastructure variable that was statistically significant deals with paved roads. The relationship is simple: the farther away the household is from a paved road their consumption level diminishes. When households are isolated they face higher transaction and transportation costs and thus are constrained to only utilize the resources close in hand. This lowers their ability to survive and access product and factor markets. To finalize the discussion of this table, income, as expected, was statistically significant in explaining household consumption.

The relationship between the dummy variables and household consumption is displayed in Table 4 as the estimated indicator value as percentage of the consumption mean for the whole sample and for each quintile. In particular, note that having a male head of the household would decrease the mean consumption level by 65.5% for

the lowest quintile. This result combined with a low level of education by the head completely destroys any possibility of escalating out of poverty for the household. With respect to the location indicators, the reference is Managua, except for Jinotega and Rio San Juan all other values are negative.

In order to find out what is the interaction between education and location with land, interaction terms where created and included in the regression model. In this case, land was not divided by quality. The elasticity values for the interaction between education and land are presented in Table 5. The elasticities would tend to confirm results already discussed here. When given one extra unit of land women are able to increase the household consumption level. On the other hand, when men are given an extra unit of land, the effect is negative. Finally, looking at the interaction between location and land, Table 6 presents the estimated coefficient values as percentage of the consumption mean for the whole sample and for each quintile. The reference for the location indicators is Managua. Overall, the effects of this interaction are rather small.

5 Summary and Conclusions

This paper tried to determine what is the value of a marginal unit of land for individuals in Nicaragua. In doing so, an overview of the conditions that dominate the rural areas of Latin America was provided in order to locate the social situation from which

estimation and explanation would initiate. An important fact consisted in realizing that usually there are many market imperfections operating at the same time and a well defined strategy against poverty should consider all these factors. Additionally, a well defined estimation model and methodology should also take into account this factors. The Income Equation model provided the flexibility to account for market imperfections in case these arose during the process. While the objective was ambitious and complex due to a number of simultaneous effects and market imperfections occuring, it was possible, however, to provide a first glimpse of the value of the input. In particular, both the elasticity values for both land variables were statistically significant. Additionally, women's level of education and the number of children came out as important factors determining the household's consumption levels. The facts just mentioned, in addition to the market imperfections should be taken into account when evaluating a poverty alleviating strategy.

However, there was no measurement as to how well the model performed. An indication was the statistical insignificance of the spline coefficient. It is possible that there might be non-linearities so complex that any parametric form would be unable to capture, and thus, nonparametric or semiparametric estimation would be comparatively better. This will be a topic for further research. Additionally, the choice of the welfare variable has to be researched and questioned. It was mentioned several times, that poverty is a multidimensional issue and one cannot even pretend

to capture it completely with a money based measure. Therefore, different measures of welfare have to be interacted and tested in order to find an appropriate measure.

What is the big picture presented here? When designing a policy intended to fight poverty the individual in charge should acknowledege the fact that there are considerable measurement errors in the variables. The errors start in the process of identifying an appropriate welfare measure and continue up to determining how to disentangle effects stemming from missing or imperfect markets. Therefore, researchers and policy makers should seek the best data available, employ the most general and flexible model, and understand that the results are approximations at best. It is possible that the interactions and dynamics are so complex that it is impossible to pin them down completely. However, ending on a more positive note even an approximation is better than no information.

References

[1] Aspe, Pedro and Paul E. Sigmund (eds). The Political Economy of Income Distribution in Mexico. Holmes and Meier Publishers, Inc. NY. 1984.

[2] Carter, Michael R. Agrarian Class Formation and Structural Evolution in Imperfect Market Environments: Theory and Analysis of Agricultural Decollectivization in Latin America. May, 1990. mimeo.

[3] Carter, Michael R. Experiments in Agrarian Class Formation and Structural Evolution: Agricultural Decollectivization in Peru and Chile, August, 1991. mimeo.

[4] Carter, Michael R., and Frederic Zimmerman. Can Time and Markets Eliminate Costly Land Ownership Inequality? Paper prepared for the Annual Bank Conference on Development Economics, April 2000, mimeo.

[5] Carter, Michael R., and Dinah Mesbah. Can Land Market Reform Mitigate the Exclusionary Aspects of Rapid Agro-Export Growth?, World Development. Vol. 21. No. 7. 1993., pp. 1085-1100.

[6] Carter, Michael R., and Yang Yao. Specialization without Regret: Transfer Rights, Agricultural Productivity, and Investment in an Industrializing Economy., World Bank Policy Research Paper 2202, October, 1999.

[7] Deaton, Angus. The Analysis of Household Surveys: A Microeconometric Approach to Development Policy. The World Bank. The Johns Hopkins University Press, 1997.

[8] Finan, Frederico, Elisabeth Sadoulet, and Alain de Janvry., Measuring the Poverty Reduction Potential of Land in Rural Mexico., Working paper, University of California at Berkeley, October 2002.

[9] Garcia Rocha, Adalberto. La Desigualdad Economica. El Colegio de Mexico. Mexico, 1986.

[10] Lopez, Ramon and Alberto Valdes., Introduction.,in Lopez, Ramon and Alberto Valdes (eds)., Rural Poverty in Latin America., St. Martin's Press, 2000., pp.1-31.

[11] Olinto, Pedro, Benjamin Davis, and Klaus Deininger. Did the Poor Benefit from Land Market Liberalization in Mexico? Panel-Data Evidence of the Impact of the Ejido Reforms. May, 1999. mimeo.

[12] Ravallion, Martin, Issues in Measuring and Modelling Poverty, The Economic Journal, Volume 106, Issue 438, September 1996, pp. 1328-1343.

[13] Szekely, Miguel. The Economics of Poverty, Inequality, and Wealth Accumulation in Mexico. St. Martin's Press, Inc. NY, 1998.

Table 1. Descriptive Statistics. Mean Values

	Consumption Quintiles 2000					
	1	2	3	4	5	Total
Number of Households	475	475	475	475	475	2375
Land Assets						
Plots of Land	1.25	1.18	1.15	1.27	1.67	1.30
Total Area in Hectares	31.73	26.35	34.78	44.68	87.42	44.99
Irrigated Land in Hectares	0.00	0.01	0.09	0.11	0.08	0.06
Farm Animals						
Cattle	8.69	9.55	12.11	19.09	40.05	17.90
Other	13.80	15.33	13.62	16.60	15.98	15.06
Household Characteristics						
Total number of individuals	5.59	6.15	6.05	6.47	6.98	6.25
Number of women older than 55	0.31	0.27	0.28	0.30	0.31	0.29
Number of men older than 55	0.42	0.37	0.33	0.36	0.40	0.38
Number of children	2.55	2.95	2.88	2.96	3.14	2.90
Occupation type within household						
Agricultural worker	0.67	0.76	0.72	0.85	0.85	0.77
Nonagricultural worker	0.24	0.33	0.36	0.45	0.73	0.42
Professional	0.55	0.45	0.45	0.38	0.32	0.43
Head of Household Characteristics						
Education	2.29	2.42	2.44	2.51	2.83	2.50
Age	52.23	50.35	49.50	51.04	51.46	50.92
Family members outside household						
Outside Department	0.01	0.01	0.01	0.02	0.01	0.01
Outside Country	0.07	0.08	0.11	0.10	0.10	0.09
Monthly Income	527.54	489.11	495.18	914.55	1932.26	871.73
Monthly Consumption	113.61	230.35	335.96	484.86	1036.31	440.22

Income and consumption are measured in 1994 Cordobas.

One hundred observations were dropped due to missing data.

Table 2 Description of variables

landirr	irrigated land in hectares	boaco	region dummy
noirrland	non irrigated land in hectares	masaya	region dummy
strchdbeak36	structural break at 1 hectare of irrigated land	chontales	region dummy
moninc	monthly income	granada	region dummy
edadjefe	age head of hh	carazo	region dummy
educjefe	education head of hh	rivas	region dummy
malejefe	dummy =1 if head is male	rsanjuan	region dummy
mad0ed	male adult 0 education	educjefearea	interaction education land
mad16ed	male adult 1 to 6 years education	mad0edarea	interaction education land
mad6ed	male adult 6 years education	mad16edarea	interaction education land
mad69ed	male adult 6 to 9 years education	mad6edarea	interaction education land
mad9ed	male adult 9 years education	mad69edarea	interaction education land
mad91ed	male adult 9 onwards education	mad9edarea	interaction education land
fad0ed	female adult 0 education	mad91edarea	interaction education land
fad16ed	female adult 1 to 6 years education	fad0edarea	interaction education land
fad6ed	female adult 6 years education	fad16edarea	interaction education land
fad69ed	female adult 6 to 9 years education	fad6edarea	interaction education land
fad9ed	female adult 9 years education	fad69edarea	interaction education land
fad91ed	female adult 9 onwards education	fad9edarea	interaction education land
child	number of children in hh	fad91edarea	interaction education land
oldm	number of men above 55 years of age in hh	nsegoviaarea	interaction location land
oldfem	number of women above 55 years of age in hh	jinotegaarea	interaction location land
igles	Any member of the household is a member of a church	raanarea	interaction location land
agcop	Any member of the household is a member of an agricultural cooperative	madrizarea	interaction location land
paisfuera	Number of relatives out of the country	esteliarea	interaction location land
deptofuera	Number of relatives out of the departamento	chinandegarea	interaction location land
centroaco	Distance in km to the "help center"	leonarea	interaction location land
carrepav	Distance in km to the nearest paved road	matagalpaaarea	interaction location land
distr	Distance in km to the distribution center	raasarea	interaction location land
gaso	Distance in km to the gas station	boacoarea	interaction location land
merc	Distance in km to nearest market	masayaarea	interaction location land
nsegovia	region dummy	chontalesa~a	interaction location land
jinotega	region dummy	granadaarea	interaction location land
raan	region dummy	carazoarea	interaction location land
madriz	region dummy	rivasarea	interaction location land
esteli	region dummy	rsanjuanarea	interaction location land
chinandega	region dummy	_cons	constant
leon	region dummy	moncons	monthly consumption
matagalpa	region dummy		
raas	region dummy		

Table 3. Elasticity Values

Variable	Elasticity	Std. Err.	Pvalue		Variable	Elasticity	Std. Err.	Pvalue
landirr	0.01	0.01	**0.08**		fad69ed	0.02	0.01	**0.04**
noirrland	0.14	0.01	**0.00**		fad9ed	0.03	0.01	**0.00**
moninc	0.02	0.01	**0.02**		fad91ed	0.02	0.01	**0.00**
edadjefe	0.06	0.13	0.63		child	0.12	0.04	**0.00**
educjefe	0.03	0.03	0.25		oldm	-0.02	0.03	0.43
mad0ed	0.02	0.02	0.38		oldfem	0.01	0.02	0.72
mad16ed	0.02	0.02	0.38		agcop	0.01	0.01	0.31
mad6ed	0.01	0.01	0.23		paisfuera	0.00	0.01	0.49
mad69ed	0.01	0.01	0.24		deptofuera	0.00	0.00	0.70
mad9ed	0.00	0.01	0.47		centroaco	0.02	0.02	0.39
mad91ed	0.01	0.01	**0.06**		carrepav	-0.13	0.03	**0.00**
fad0ed	-0.02	0.02	0.36		distr	0.01	0.03	0.88
fad16ed	0.04	0.02	0.11		gaso	-0.01	0.03	0.69
fad6ed	0.02	0.01	**0.05**		merc	-0.05	0.03	0.10

P-values in bold type are smaller than .10

Table 4. Indicators as percentage of mean consumption

	Consumption Quintiles 2000					
	1	**2**	**3**	**4**	**5**	**Total**
malejefe	-65.5%	-32.3%	-22.2%	-15.4%	-7.2%	-16.9%
igles	-10.4%	-5.1%	-3.5%	-2.4%	-1.1%	-2.7%
nsegovia	-192.2%	-94.8%	-65.0%	-45.0%	-21.1%	-49.6%
jinotega	65.7%	32.4%	22.2%	15.4%	7.2%	16.9%
raan	-98.6%	-48.6%	-33.3%	-23.1%	-10.8%	-25.4%
madriz	-201.6%	-99.4%	-68.2%	-47.2%	-22.1%	-52.0%
esteli	-167.2%	-82.5%	-56.5%	-39.2%	-18.3%	-43.2%
chinandega	-72.8%	-35.9%	-24.6%	-17.1%	-8.0%	-18.8%
leon	-99.8%	-49.2%	-33.8%	-23.4%	-10.9%	-25.8%
matagalpa	-62.3%	-30.7%	-21.1%	-14.6%	-6.8%	-16.1%
raas	-151.7%	-74.8%	-51.3%	-35.5%	-16.6%	-39.1%
boaco	-230.9%	-113.9%	-78.1%	-54.1%	-25.3%	-59.6%
masaya	-61.5%	-30.3%	-20.8%	-14.4%	-6.7%	-15.9%
chontales	-137.0%	-67.6%	-46.3%	-32.1%	-15.0%	-35.4%
granada	-174.0%	-85.8%	-58.8%	-40.8%	-19.1%	-44.9%
carazo	-69.0%	-34.0%	-23.3%	-16.2%	-7.6%	-17.8%
rivas	-124.8%	-61.5%	-42.2%	-29.2%	-13.7%	-32.2%
rsanjuan	75.5%	37.2%	25.5%	17.7%	8.3%	19.5%

Table 5. Elasticity Values for Interaction Terms

Variable	Elasticity	Std. Err.	Pvalue
educjefearea	-0.15	0.02	**0.00**
mad0edarea	-0.03	0.01	**0.00**
mad16earea	-0.07	0.01	**0.00**
mad6edarea	-0.02	0.01	**0.01**
mad69earea	0.00	0.00	0.30
mad9edarea	-0.01	0.00	**0.00**
mad91edarea	-0.01	0.01	0.11
fad0edarea	-0.02	0.01	0.10
fad16edarea	0.05	0.01	**0.00**
fad6edarea	0.00	0.01	0.60
fad69edarea	0.05	0.00	**0.00**
fad9edarea	0.05	0.00	**0.00**
fad91edarea	0.01	0.00	**0.04**

P-value in bold are less than .10

Table 6. Interaction terms as percentage of mean consumption

	Consumption Quintiles 2000					
	1	2	3	4	5	Total
nsegoviaarea	-0.20%	-0.10%	-0.07%	-0.05%	-0.02%	-0.05%
jinotegaarea	0.62%	0.31%	0.21%	0.15%	0.07%	0.16%
raanarea	1.64%	0.81%	0.56%	0.38%	0.18%	0.42%
madrizarea	1.31%	0.65%	0.44%	0.31%	0.14%	0.34%
esteliarea	4.82%	2.38%	1.63%	1.13%	0.53%	1.24%
chinandega~a	1.59%	0.78%	0.54%	0.37%	0.17%	0.41%
leonarea	-1.19%	-0.59%	-0.40%	-0.28%	-0.13%	-0.31%
matagalpaa~a	2.87%	1.41%	0.97%	0.67%	0.31%	0.74%
raasarea	0.40%	0.20%	0.14%	0.09%	0.04%	0.10%
boacoarea	-0.91%	-0.45%	-0.31%	-0.21%	-0.10%	-0.23%
masayaarea	-1.17%	-0.58%	-0.40%	-0.27%	-0.13%	-0.30%
chontalesa~a	0.75%	0.37%	0.25%	0.18%	0.08%	0.19%
granadaarea	1.15%	0.56%	0.39%	0.27%	0.13%	0.30%
carazoarea	0.25%	0.12%	0.08%	0.06%	0.03%	0.06%
rivasarea	0.15%	0.07%	0.05%	0.03%	0.02%	0.04%
rsanjuanarea	2.15%	1.06%	0.73%	0.50%	0.24%	0.55%

6 Appendix

Table A.1 Regression Output

Variable	Coef.	Pvalue	Variable	Coef.	Pvalue
landirr	104.76	**0.08**	paisfuera	-20.59	0.49
noirrland	1.35	**0.00**	deptofuera	36.51	0.70
strchdbeak36	-129.33	0.13	centroaco	0.44	0.39
moninc	0.01	**0.02**	carrepav	-1.93	**0.00**
edadjefe	0.54	0.63	distr	0.12	0.88
educjefe	5.66	0.25	gaso	-0.24	0.69
malejefe	-74.46	**0.04**	merc	-0.85	0.10
mad0ed	16.52	0.38	nsegovia	-218.32	**0.00**
mad16ed	11.88	0.38	jinotega	74.61	0.26
mad6ed	30.66	0.23	raan	-111.98	0.47
mad69ed	34.06	0.24	madriz	-229.02	**0.00**
mad9ed	30.09	0.47	esteli	-189.98	**0.01**
mad91ed	67.72	**0.06**	chinandega	-82.69	0.17
fad0ed	-19.05	0.36	leon	-113.40	**0.07**
fad16ed	27.19	0.10	matagalpa	-70.77	0.25
fad6ed	56.33	**0.05**	raas	-172.34	**0.02**
fad69ed	58.91	**0.04**	boaco	-262.36	**0.00**
fad9ed	180.26	**0.00**	masaya	-69.88	0.34
fad91ed	149.77	**0.00**	chontales	-155.70	**0.02**
child	18.05	**0.00**	granada	-197.70	**0.01**
oldm	-24.86	0.43	carazo	-78.36	0.29
oldfem	10.10	0.72	rivas	-141.74	**0.04**
igles	-11.85	0.73	rsanjuan	85.80	0.28
agcop	38.46	0.31	constant	446.91	**0.00**

Number of obs	2344	R-squared	0.1849
F(47, 2296)	11.08	Adj R-squared	0.1682
Prob > F	0		

Table A.2 Regression Output

Variable	Coef.	Pvalue	Variable	Coef.	Pvalue
landirr	107.12	**0.05**	raas	-131.28	**0.08**
noirrland	1.39	0.18	boaco	-202.53	**0.01**
strchdbeak36	-128.28	**0.09**	masaya	-95.88	0.16
moninc	0.02	**0.00**	chontales	-148.53	**0.03**
edadjefe	0.40	0.70	granada	-217.85	**0.00**
educjefe	14.80	**0.01**	carazo	-102.51	0.15
malejefe	-68.31	**0.04**	rivas	-155.57	**0.02**
mad0ed	44.29	**0.02**	rsanjuan	-3.40	0.97
mad16ed	57.55	**0.00**	educjefearea	-0.51	**0.00**
mad6ed	76.82	**0.00**	mad0edarea	-0.55	**0.00**
mad69ed	67.36	**0.02**	mad16edarea	-0.87	**0.00**
mad9ed	115.83	**0.01**	mad6edarea	-0.82	**0.01**
mad91ed	118.68	**0.00**	mad69edarea	-0.21	0.30
fad0ed	-6.42	0.76	mad9edarea	-1.28	**0.00**
fad16ed	-7.53	0.64	mad91edarea	-0.36	0.11
fad6ed	57.44	**0.05**	malealfarea	2.69	**0.00**
fad69ed	-66.81	**0.02**	fad0edarea	-0.44	0.10
fad9ed	-59.20	0.15	fad16edarea	0.80	**0.00**
fad91ed	153.10	**0.00**	fad6edarea	0.16	0.60
child	16.42	**0.00**	fad69edarea	2.89	**0.00**
oldm	-21.93	0.44	fad9edarea	3.31	**0.00**
oldfem	13.24	0.61	fad91edarea	0.47	**0.04**
igles	-12.07	0.70	nsegoviaarea	-0.22	0.84
agcop	42.26	0.22	jinotegaarea	0.71	0.50
paisfuera	-22.75	0.40	raanarea	1.87	0.37
deptofuera	6.10	0.94	madrizarea	1.49	0.25
centroaco	0.66	0.16	esteliarea	5.47	**0.00**
carrepav	-1.95	**0.00**	chinandega~a	1.80	**0.09**
distr	-0.31	0.67	leonarea	-1.35	0.22
gaso	-0.48	0.39	matagalpaa~a	3.26	**0.00**
merc	-0.52	0.27	raasarea	0.46	0.67
nsegovia	-219.81	**0.00**	boacoarea	-1.03	0.33
jinotega	24.84	0.70	masayaarea	-1.33	0.58
raan	-193.04	0.24	chontalesa~a	0.86	0.40
madriz	-289.67	**0.00**	granadaarea	1.30	0.55
esteli	-389.73	**0.00**	carazoarea	0.28	0.84
chinandega	-155.57	**0.01**	rivasarea	0.17	0.91
leon	-76.39	0.20	rsanjuanarea	2.44	**0.05**
matagalpa	-261.96	**0.00**	_cons	446.60	**0.00**

Number of obs	2344	R-squared	0.348
F(77, 2266)	15.71	Adj R-squared	0.3258
Prob > F	0		