Poverty traps and low income dynamics in rural Mexico*

Vera CHIODI †

April 6, 2009

(Preliminary version. Please do not quote.)

Abstract

In recent years, a growing literature points to the role of asset dynamics of poor rural households as key determinant of poverty traps. The extent to which the *Oportunidades* program will be able to achieve medium-term welfare improvements for the first generation of beneficiary households depends on their potential for asset accumulation. To explore these ideas, this paper employs a variety of empirical methods drawing on new evidence from the Mexican program. Econometric analysis of asset dynamics over the 1997 - 2006 period identifies a dynamic asset poverty threshold that signals that a large numbers of Mexicans are indeed trapped without a pathway out of poverty. In addition, further analysis of this period examines more closely the patterns of income mobility, and confirms the continuation of this pattern of limited upward mobility.

Key words: Oportunidades; Poverty traps; Income dynamics.
JEL codes: O1; Q1.

*I am indebted to participants of various conferences and seminars for helpful feedback on earlier versions of this paper, including EUDN PHD Students Workshop in Development Economics at Oxford, City University of London - Economics Department Seminar Series, LACEA 13TH Annual Meeting (Rio de Janeiro, Brazil) and PSE Work In Progress. All errors remain of my own.

†PSE - Paris School of Economics; 48 boulevard Jourdan, 75014 Paris. chiodi@pse.ens.fr

Contents

1 Introduction

Poverty has a tendency to persist over time despite the many shocks and jolts every economy receives in the normal course of its existence. This raises the suspicion that underdevelopment is a state of equilibrium and that there are forces at work that tend to restore the equilibrium every time there are small improvements in living conditions. Moreover, this gives the idea of a vicious circle of poverty as a "constellation of forces tending to act and react upon one another in such a way as to keep a poor country in a state of poverty"[1].

A poverty trap arises when poor individuals are faced with two distinct equilibria, one below the poverty line and one above it. Individuals or families with a sufficiently low income or asset endowments are trapped in the poor-equilibrium, and small improvements are not enough to escape the forces bringing them back to this level.

This idea was first applied in the early development economics literature. For instance, Rosenstein-Rodan's (1943) *big-push* theory, where countries need a big enough inflow of capital to break the vicious cycle of poverty, implicitly assumes a dual-equilibrium process. Moreover, the theory of different "convergence clubs" (Baumol, 1986; DeLong, 1988; Quah 1993,1996,1997) turns fundamentally on the existence of an exclusionary mechanism that keeps members of one group or club facing a lower level equilibrium from moving to another group or club with a higher level equilibrium.

The notion of a poverty trap consists on the idea that individuals can be sorted out according to some level of income or assets, such that there is a threshold level

[1] Nurkse 1953, p.4.

above which they will be able to escape the vicious circle of poverty. Here, poor individuals lack a certain minimum level of income or assets to invest in productive human/financial capital. This idea rests on the existence of increasing returns to asset accumulation (higher levels of assets increases the unit productivity) and/or market failures (lack of property rights, absence of saving/lending institutions) which unduly punish the poor.

Several studies suggest that a society like Mexico will suffer from blocked pathways of upward mobility that leaves large numbers of people trapped in poverty. In this paper we study poverty and income dynamics in order to test the existence of a poverty trap and understand socio-economic mobility in rural Mexico in the past ten years. There are several reasons of why this issue is relevant. First, poverty and income dynamics have intrinsic social relevance and policy significance. Their study will help to unravel different and interrelated aspects of household and labour economics and economic demography. The extent of mobility and poverty persistence are important social indicators to be placed alongside information about the income distribution at a point in time. Moreover, it is important to draw attention on the differences between the poverty experience of the population over a period of time and the poverty at a one particular time in order to evaluate whether poverty is a short-duration event with most people or some groups experience at one time or a long-duration event concentrated amongst particular identifiable groups.[2]

Here, we use new data available from Oportunidades (*Progresa*). Launched in Mexico in 1997, it's a program whose main aim is to improve the process of human capital accumulation in the poorest communities by providing conditional cash transfers (CCT) on specific types of behavior in three key areas targeted by the program: nutrition, health and education. It has been now in place for almost ten

[2]Jenkins, 2000.

years. The importance of the dynamics of their income and asset position over time is crucial in order to see where a representative portion of the mexican rural population is at the present time and to increase the attention to rural welfare. The extent to which Oportunidades program will be able to achieve medium or long-term welfare improvements for the first generation in beneficiary households depends on the potential for asset accumulation. It is expected that the continued receipt of cash transfers will allow households to invest in productive assets and therefore lift out of poverty. However, if a poverty trap is present, the program may not facilitate the escape from poverty through asset accumulation.

This paper is organized as follows. Section 2 describes the theoretical background of poverty traps. Section 3 depicts the data used for the analysis and provides some descriptive trends. Section 4 presents a decomposition of the poverty transitions according to the *third-generation* of poverty analysis. Section 5 analyzes households' welfare according to their long-term persistent poverty status through a dynamic analysis of their assets and presents evidence of the existence of a poverty trap, through several empirical strategies. Section 6 carries an alternative approach to test for poverty traps based on a study of the income dynamics. Section 7 concludes.

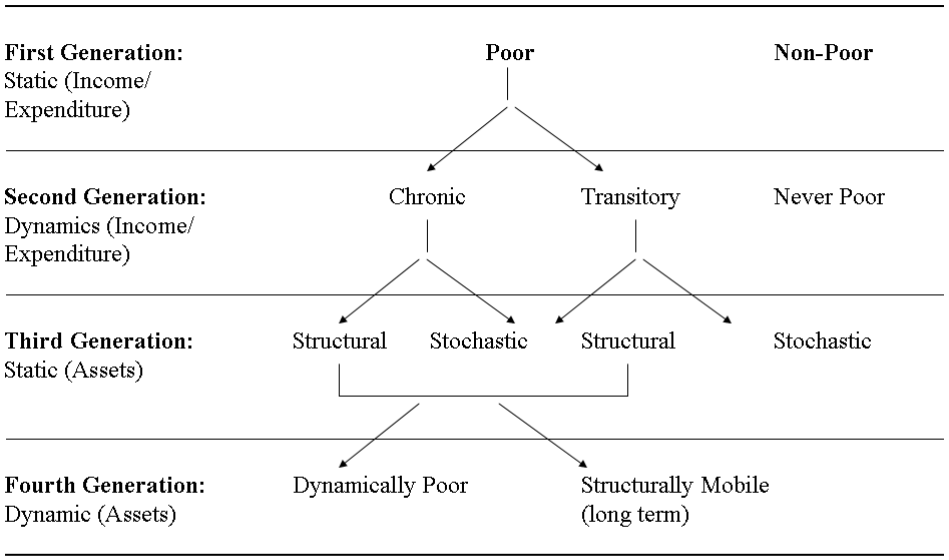
2 Theoretical Background of Poverty Traps

2.1 Four Generations of Poverty Analysis

Many of the studies carried on poverty analysis (see World Bank, Programmatic Poverty Studies) have focused on a cross-sectional poverty measurement as indicated in the first row of Figure 1. But this *first generation* of poverty analysis is unable to distinguish between households for which poverty is a structural phenomenon (expected income below the poverty line) and those for which poverty is

more or less a transitory phenomenon of a given average duration. A first step in distinguishing between these two types of poverty is the analysis of panel data, which allows one to observe a household's poverty status in more than one period as depicted in the second row of Figure 1.

Figure 1: Evolving views of poverty analysis: four successive generations.



Source: The Economics of Poverty Traps and Persistent Poverty:
An Asset Based Approach. Carter and Barret (2004)

In order to distinguish stochastic from structural poverty transition, Carter and Barrett (2005) suggest an approach that redefines poverty measurements in terms of assets. As the *third generation* signals, transitions into (out) of poverty could be the result of a temporary spell of bad luck (a temporary spell good luck or the recovery from a bad luck episode), but could also result from a structural change, such as the loss of assets or a deterioration in the returns to assets possessed (the accumulation of new assets or enhanced returns to assets already possessed).[3] Fur-

[3]Welfare studies have identified that even in Africa, transitory poverty (as measured by income or expenditures) comprises a rather large share of overall poverty (Hoddinot, 2003).

ther development of this idea will be given in section 4.

Poverty can also be analyzed -as the *fourth generation* approach suggests- in the context of the potential for asset accumulation. This paper is grounded within this approach.This dynamic analysis, similarly to macroeconomic growth analysis, seeks to identify the dynamic path of asset accumulation among households. One of the theoretical implications is that there could exist an asset threshold below which individuals are unable to continue to accumulate assets and would tend to converge to a low asset/low income equilibrium and individuals above the threshold would tend to overcome poverty with time through systemic accumulation of assets. Those below the threshold could be defined as caught in deep-rooted persistent structural poverty (a poverty trap) and are unlikely to escape from their situation without large positive shocks or an improvement in the returns to their asset holdings. However, periodic short-term fluctuations due to random shocks are possible.

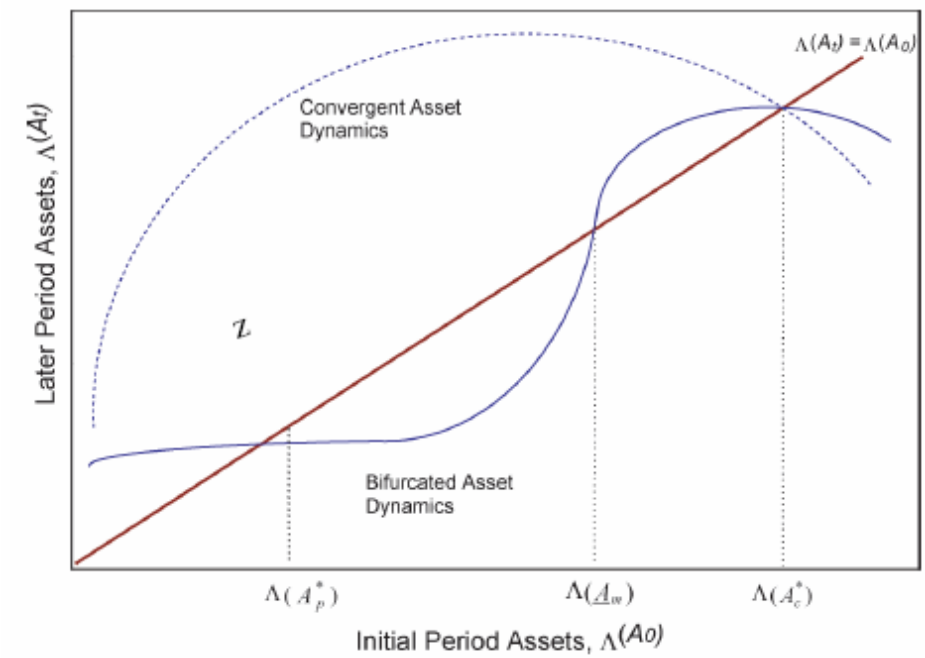
The fundamental question of this paper is to empirically distinguish between two different models that are consistent with the existence of a dual equilibrium framework, but that have very different policy implications.

2.2 The *Threshold* Model

The extent to which Oportunidades program will be able to achieve medium or long-term welfare improvements for the first generation in beneficiary households depends on the potential for asset accumulation within them. If the growth of assets is a slow process, yet not restricted through market failures or other institutional factors, it is expected that the continued receipt of substantial transfer payments will allow households to invest in productive assets and therefore experience continued

improvements in welfare. However, if a poverty trap is present, the program may not facilitate the escape from poverty through asset accumulation. An asset growth path that includes a poverty trap is depicted in Figure 2.[4] The function depicted in solid blue shows a bifurcated dynamic growth path of the asset stock. There are two equilibrium asset stocks: Λ_p^*, and Λ_c^*.[5] In pure statistical terms, this corresponds to the *threshold* model.

Figure 2: Bifurcated vs. Single Equilibrium Asset Growth Paths



The existence of a poverty trap requires that two rather general conditions are met; (1) that there exist increasing returns over a range of levels of asset stocks and (2) a significant market failure is present (for example, in the credit or insurance market). When returns to assets have diminishing marginal returns over all levels, the dynamic path can be represented by a globally concave curve, such as the

[4]Source: Adato et al. (2006). The horizontal axis measures the initial stock of assets and the vertical axis measures the asset stock in the subsequent period.

[5]Whether or not Λ_p^* is a poverty trap depends on where the poverty line is in relation to this level of assets.

dashed blue line in Figure 2. If this growth regime holds, only one equilibrium exists.

2.3 The *Intrinsic Characteristics* Model

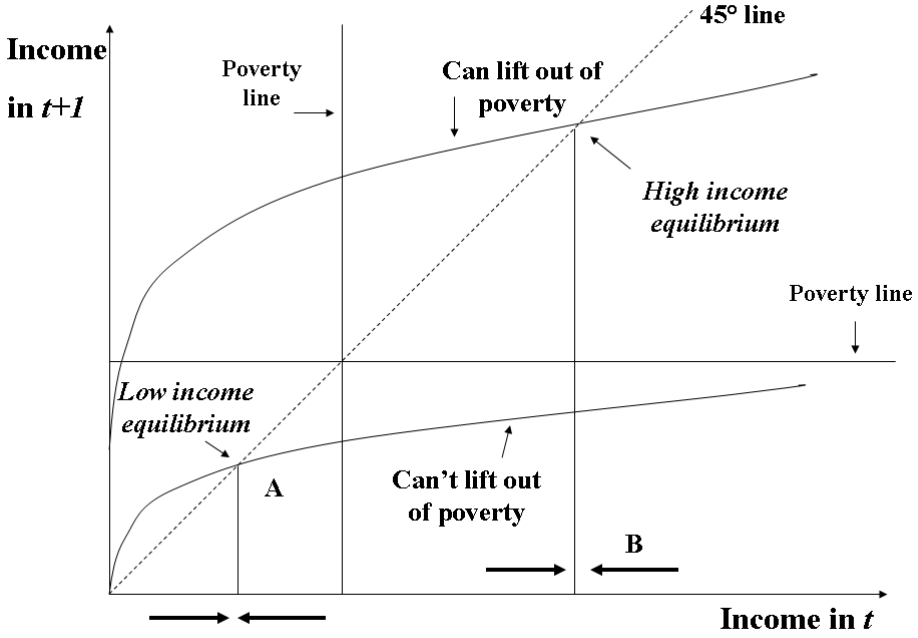
The idea of *intrinsic characteristics* model suppose that it is possible to sort individuals into two groups: the first condemned to the low-income equilibrium, the second with possibilities to lift themselves out of poverty. These characteristics can be either observable or unobservable for the econometrician.

At the micro-economic level, several reasons behind this can be identified: location (e.g. there is evidence that individuals living in slums or shanty towns are discriminated against in the labour market), ability (e.g. only some individuals have access or know how to effectively use government programs for the poor), connections (e.g. belonging to a certain organisation or political or religious group) or social class.

At the macro-economic and growth theory level, this was named the theory of conditional convergence, as displayed in Figure 3, where different countries converge to different levels depending on their fundamentals (e.g. savings rates, technology, population growth, inequality). In pure statistical terms, this corresponds to an *intrinsic characteristics model*.[6]

[6]Because of the nature of our data we will dedicate the section 5.2.2 to the role played by *ability*.

Figure 3: Conditional Convergence



3 The data

The empirical detection of poverty traps is in general complicated by the lack of panels and attrition. This paper uses an unique database that can overcome these difficulties.

3.1 Sampling Strategy

Selection of beneficiaries into Oportunidades involved two main steps. First, communities are selected based on a marginality index as determined from census data. Second, household questions are applied to the entire rural community and in which socio-economic and demographic data are collected. A model derived from discriminant analysis is then applied to the household data to obtain a score (the *puntaje*):

a household was eligible to the program if its score was above 0,69.[7] In december 2006, the *Instituto Nacional de Salud Pública* conducted a survey[8] of recipient households in the rural localities where the program started in 1997. A random sample, stratified by state, was drawn. Thus, we constructed a panel of households based on retrospective information of those same households thanks to previous surveys. The ENCASEH survey represents the baseline carried in 1997 and 1998. The ENCRECEH was the following survey, three years later -around 2001-. This allows to build a panel database composed of three time observations (1997, 2001 and 2006) for almost 4,400 households from 130 rural localities. Rural areas in Mexico have a very high incident of deprivation in terms of access to services and perceived well-being.

Our data has few attrition. Worried by the possibility of attrition bias in our estimation, we compared the distributions between the balanced panel of 4,365 and the unbalanced panel. The result of this comparison is shown in the Appendix where the results of kernel density estimates are reproduced. The distributions appear to be very close to each other.

This database includes detailed information on each beneficiary household, in-

[7]The score relates to the probability that a household falls below a given poverty line (as used to divide the population in the discriminant analysis) and households with a score predicting consumption/income at or below the extreme poverty line are incorporated into the program. The estimated equation for puntaje is gen *puntaje* = −0.926 + 0.139*stacking-ratio +0.176*deprivation-ratio +0.02*head-male +0.475*social-security +0.255*child-0/11years +0.38*head-dummy-no-education +0.201*head-dummy-some-primary-education +0.005*head-age +0.415*no-toilet +0.22*toilet-nowater +0.475*earth-floor +0.761*gas-stove +0.507*refrigerator +0.127*wash-machine +0.159*automobile. Dummy variables by region are also included. Source: Secretaría de Desarrollo Social, SEDESOL: (a) Nota Técnica (2001), Programa de Educación, Salud y Alimentación, PROGRESA. (b), Acuerdo por el que se emiten y publican las Reglas de Operación del Programa de Desarrollo Humano Oportunidades, para el Ejercicio Fiscal 2003, Diario Oficial de la Federación, 2003.)

[8]Encuesta de "Re-evaluación de localidades incorporadas en las primeras fases del Programa (1997-1998)." INSP, 2006.

cluding household demographics, income level and sources, education, assets, and so forth. It also includes community-level data mainly regarding infrastructure. Income aggregates were created and broken down into five categories: agricultural wage employment, non-farm wage employment, self employment, transfers and other (including income from rent and interests). An asset index[9] was created using factor analysis methodology.

3.2 Some Descriptive Trends

Table 1 presents basic household characteristics observed for the three periods, as well as the asset position of the household and income variables.

Table 1. Summary Statistics by period

Variable	1st	2nd	3rd
Indigenous head (speaks indigenous language)	0.25	0.23	0.24
Male head	0.81	0.84	0.81
Age of head	43.24	45.83	48.92
Head has no education	0.27	0.29	0.26
Head some primary education	0.42	0.40	0.39
Head primary education	0.22	0.19	0.21
Head secondary education	0.07	0.07	0.08
Years of education of the household head	3.41	3.32	3.44
Puntaje of the household	2.27	2.10	1.74
Quantity of male working adults per household	1.26	1.29	1.76
Land (total hectares used)	4.06	1.43	3.74
Quantity of working animals	0.79	0.40	0.54
Cow-equivalents for livestock animals in rural survey	1.68	0.97	1.36
Dwelling has electricity	0.79	0.85	0.90
Dwelling is owned	0.88	0.89	0.90
Household owns gas stove	0.40	0.42	0.44
Household owns refrigerator	0.22	0.29	0.53
Household owns a washing machine	0.13	0.15	0.14
Household owns an auto	0.02	0.03	0.04

Continued on next page...

[9]This index includes the following asset variables: years of education of the household's head, radio, television, refrigerator, gas stove, washing machine, owned vehicles, irrigation to land, electricity, earth floor, roof weak, animals, owned house, use of agricultural land.

... table 3 continued

Variable	1st	2nd	3rd
Household owns a truck	0.06	0.08	0.16
Per capita income (2000 pesos)	4,120.54	3,909.26	5,111.81
Per capita income (US$)	396.34	376.01	491.68
Per capita income (rural food poverty line)*	8.89	8.44	11.03

*Per capita inc./per cap.rural food poverty line

Source: ENCASEH, ENCRECEH & INSP surveys

In average, households of the sample are poor. As we could expect, the asset position of the household is low, with respect to durable goods and education levels. With a longitudinal perspective of the data, table 2 provides a standard cross-sectional perspective on changes in the distribution of income. Over this period, average income rose by about 45% and reflecting this, the fraction of the population with incomes below half 1st year average income fell. Meanwhile, income inequality and the proportion of persons with incomes below half contemporary mean income experienced small changes.

Table 2. Cross section perspective on the income distribution 1997-2006[10]

	1997	2001	2006
Mean income (2000 mexican pesos)	17,997.45	19,174.95	26,563.11
Mean per capita income (US$)	326.62	347.98	482,07
Gini coefficient	0.465	0.433	0.475
Percentage below half contemporary mean	29.14%	30.17%	33.68%
Percentage below half 1st year mean	29.14%	26.99%	23.60%

[10] According to the World Bank, in 2004, 17.6% of Mexico's population lived in extreme poverty. The Gini coefficient for general Mexico was 0,54 in 2000, 50,9 in 2005 and 0,44 in 2007. In 1996, the concentration of income in the richest 20% of the population was 52,63% and in the poorest 20% 4,79%.

Table 3[11] provides longitudinal summary statistics based on the share of each of the five different income components of the household. Column 1 shows that agricultural wage income is by far the largest income component in household income packages. The other columns reveal the variation in income packaging across household types. Results are the ones expected. The main source of income of rural households remains the agriculture. For indigenous household head, self-employment activity is one of its main source of income, while for female headed households non-agricultural activities and tranfers (private and public) consist in their principal income. It is likely that for this group the non-agricultural activities have low productivity outcomes. Older households head receive a high percentage of their income in transfers. Finally, for households with a high activity diversification, income is mainly agricultural and non-agricultural.

Table 3. Three-wave-average annual household incomes and their compositions, by person's wave 1 household type.

	All	**Head indigenous**	**Female head**	**Work adults per hh** > 2	**Head age** 65+	**Hh diversif.** > 2
Total income (mex.pesos)	21,245.17	17,564.39	15,244.07	27,894.59	15,653.60	28,638.77
Per capita inc. (mex.pesos)	3,963.65	3,193.52	3,682.14	3,774.64	3,983.10	4261.72
Per capita inc. (US$)	381.25	307.17	354.17	363.06	383.12	409.92
Source as % of hh inc.:						
Agricultural	34.4	34.8	25.2	36.0	30.1	30.5
Non-agricultural	28.4	25.1	30.1	29.1	20.7	35.6
Self-employment	13.2	17.5	15.0	12.2	15.1	13.7
Transfers	15.7	12.0	22.1	15.4	25.8	9.3
Other	8.3	10.6	7.7	7.3	8.3	10.8

[11]The statistics are based on longitudinal averaged incomes for each person. The first column shows the average across all persons of these three-waves averages; the remainder of the columns show averages amongst subgroups of households classified according to their wave 1 household type.

4 Decomposing Poverty Transitions.

4.1 Empirical Strategy

Households in the sample were on average poor with few assets owned. Table 4 presents poverty indicators. When measured against a standard income poverty line[12], 79% of our sample households were poor in 2001 with an average poverty gap[13] that was 57% of the poverty line. The number of poor had fallen to almost 66% in 2006, while the average poverty gap fell to 53%. While these figures are striking, they do not reveal the extent of mobility (for example, how many of the initially poor households were also poor in 2006), nor do they identify the causes of mobility.

Table 4 allows a first look at these mobility issues by including a standard mobility decomposition.[14] As can be seen, 55,5% of the households were poor in both periods, or were chronically poor in terms of standard dynamic poverty analysis. Another 35% of households were poor in one period only and hence can be classified as transitorily poor.

Table 4. Decomposing poverty transitions

[12]The mexican rural food poverty line.

[13]The *poverty gap* is defined as the difference between the income at the poverty line and the median household income for those in poverty expressed as a proportion of the income at the poverty line.

[14]The rows of the table give the 2001 well-being class, while the columns give the 2006 classification. Looking at the top bold row in each cell of the table first, the results of this two-way classification scheme are provided.

		2006	
		Poor 66%	**Non Poor 34%**
2001	**Poor 79%**	55.5% Chronically poor, of which: *Structurally poor 77%*	23.5% Got ahead, of which: *Structurally mobile 35%* *Stochastically mobile 65%*
	Non Poor 21%	10.8% Fell behind, of which: *Stochastically mobile 30%* *Structurally poor 70%*	10.2% Never poor

While these standard mobility indicators are informative, they do not address a key challenge facing the empirical analysis of poverty, that of distinguishing between households that can expect to escape poverty over time from those who cannot. We thus define the asset poverty line as the level of assets needed to generate an expected living standard equal to the poverty line. We estimate the asset poverty line by regressing income of year 2006, y_i^{2006}, on asset holdings at 2001, x_i^{2001}. Using those estimates, it is possible to calculate the expected level of well-being for each household given its assets. A household was deemed above the asset poverty line if it was possible to reject the hypothesis that their expected level of well-being was below the asset poverty line. We predict $\hat{y}_i^{2006}$ from the estimation of the following equation and compare it to the income poverty line:

$$y_i^{2006} = \beta_0 + \beta_1 \mathbf{x}_i^{2001} + e_{i,t} \tag{1}$$

We will say that if $\hat{y}_i^{2006} < \overline{y}$, it is a structural phenomenon (expected income below the income poverty line, $\overline{y}$) , and if $\hat{y}_i^{2006} > \overline{y}$, a transitory phenomenon. Thus using the asset poverty line, we are able to further decompose the mobility patterns shown in Table 4 according to the *third generation* of poverty analysis presented in

section 2. Households with assets below the asset poverty line would be expected to be poor (at least in the short to medium term), while those with assets above that line would be expected to be non-poor. Stochastic shocks can of course move people away from these expected positions.

4.2 Structural vs Stochastic Poverty Distinction

The 10,8% of the sample that fell behind between 2001 and 2006 can be split into those whose movement was structural, based on the accumulation of assets (or increased returns to assets), and those whose movement was stochastic, based on bad luck and the failure to earn expected returns to assets. As can be seen in Table 4, perhaps 30% of the households that fell behind did so for stochastic reasons, meaning that their asset base in 2001 was firmly above the 2006 asset poverty line. The fact that they were observed to be poor in 2006 despite being above the asset poverty line thus indicates bad luck in the form of failure of to achieve expected returns to their assets. In the short- to medium-term (with no further changes in assets or in the structure of the economy), these households would be expected to return to a non-poor status.

The other 70% of the households that moved downwards between 2001 and 2006 are likely structurally poor, with assets below the asset poverty line. Either they were non-poor in 2001 for reasons of good fortune (returns to their assets in excess of the expected returns), or they suffered asset losses between 2001 and 2006 which moved them beneath the asset poverty line. Indeed, 84% and 24% of the households that moved downward between 2001 and 2006 report losses of productive assets as land and animals respectively. In contrast to the households whose downward mobility was stochastic, these households have a structural basis to their poverty and would be expected to remain poor over the short to medium-term.

We similarly decompose the 23,5% of the households that moved ahead between 2001 and 2006 into those whose upward mobility was structural versus those whose mobility reflected the operation of random factors. Stochastic upward mobility - which we estimate was the case for 65% of the upwardly mobile households- could occur when a household that was above the 2001 asset poverty line was observed to be poor in 2001, presumably because of bad luck that depressed returns to assets (for example, a lost job, poor business performance). The move by such a household to a nonpoor standard of living would reflect a return to the standard of living that would be expected given the household's asset base. Upward structural mobility, on the other hand, would occur when a household that was below the 2001 asset poverty successfully engineered an escape from poverty by accumulating additional assets, moving above the 2006 asset poverty line, and gaining the returns expected for those assets. We estimate that no more than 35% of upward mobility roughly 8% of the overall sample reflected this structural process of poverty relief.

However, it is unclear the extent to which household welfare should be expected to improve over time. To investigate this we examine the changes in asset holdings over time to determine if the asset dynamics display any evidence of the existence of a poverty trap.[15]

[15]This methodology is proposed by Carter and Barret (2005) and utilized, among others, by Adato et al (2004) with data from South Africa and Barret et al (2004) with data from rural Kenya and Madagascar.

5 Empirical Investigation of Welfare Dynamics in Rural Communities

5.1 Our Methodology

The first step in this analysis is to reduce the household assets into a uni-dimensional measure, what requires either complete knowledge of the market value of each asset owned, or the construction of an asset index. Given that the prices of many assets owned by households are often unknown or difficult to determine, we construct an asset index following two strategies:

1. We construct an asset index by period using factor analysis methodology,[16] for three categories:

   - Household durables (ownership of radios, TV, refrigerator, gas stove, washing machine and vehicules)
   - Housing quality (irrigation to land, electricity, earthfloor, roof weak, animals, owned house, use of agricultural land)
   - Stock of human capital (years of education of the household head)

2. We employ the methodology used by Adato et al (2004): the household income in each period, normalized by the rural food poverty line, is regressed separately on a polynomial expansion of the household's stock of productive assets owned in each period, its square and cube, along with interactions between each type of asset as well as dummies for state.[17] The household asset

[16] The Kaiser-Meyer-Olkin measure of sampling adequacy is between 0.82 and 0.81 for the three periods, meaning how much overall the variables have in common to warrant this type of analysis. Also, between 0.88 and 0.96 per cent of the joint variability of the data is explained by the index.

[17] To avoid biasing the relationship between productive assets and income, income from Oportunidades is excluded from the measure of total income. The stock of livestock is measured as the total number of cow-equivalent animals owned by the household where the cow value of each animal is determined from the selling prices reported in the survey.

index is the household income (in food poverty-line units) predicted from the estimated coefficients. The results are shown in the Appendix, table A.1. The equation we estimate is of the form:

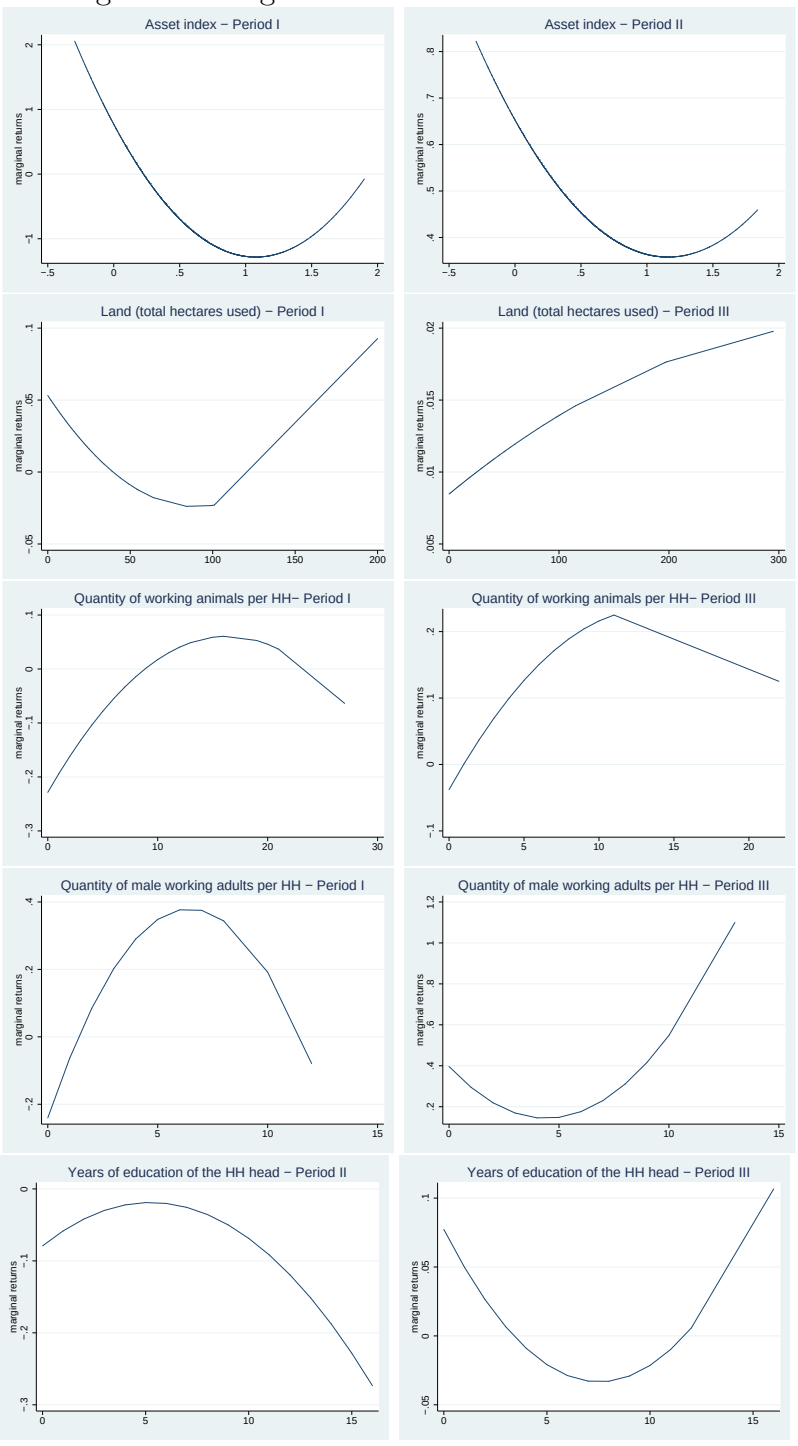
$$y_{i,t} = \beta_0 + \beta_1 \mathbf{x}_{i,t} + e_{i,t} \tag{2}$$

where $y_{i,t}$ is the per-capita income by household and $\mathbf{x}_{i,t}$ is a vector of household characteristics.

For both methodologies, the index is scaled and measured in poverty line units, indicating what fraction of the poverty line a household's bundle of assets would be expected to generate. For each result we will specify the methodology presented.

Table 1 showed some of the assets owned for the three periods. In order to determine if there are local increasing returns we can calculate the marginal returns by taking the mean of the marginal return for each household at each level of the given asset. Figure 4 graphs the returns to the asset index (constructed with factor analysis,) land, male labor, livestock and years of education of the household head across a range of values observed in the data. In all periods, those assets display local increasing returns for some levels. Thus, given that each asset does not display diminishing returns for all levels, the path of asset accumulation among these households could bifurcate toward multiple equilibria.

Figure 4: Marginal Returns to Household Assets

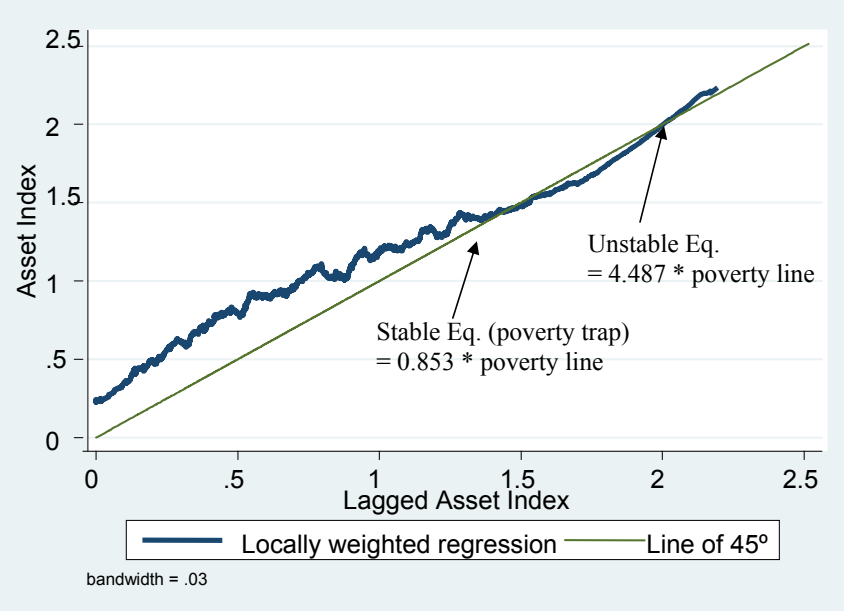


5.2 Results

5.2.1 The *Threshold* Model: Evidence of Poverty Traps

The dynamic path of asset accumulation is estimated through a local weighted regression (locally weighted scatterplot smoother, LOWESS[18]) of assets dynamics. Figure 5 shows the asset dynamics using factor analysis methodology[19]: the solid curve graphs the resulting estimate of Later Asset Index Period given Initial Asset Index.

Figure 5: Asset dynamics 1997 - 2006.



As can be seen, the curve first cuts the 45-degree line at about 85,3% of the

[18]The lowess estimator was chosen here because it leads to a much smoother regression function estimate and more precise estimation at the boundaries, hence it allows to accomodate more easily potential non linearities in the functional form. Lowess computes the estimate for each data point by assessing and weighting a point for a window of a certain percentage of the data. Moreover, the different estimates for a given percentage neighborhood suggest that the more local features of the asset index are taken into account the more the asset index differs from the Normal distribution.

[19]The same analysis was carried out using the regression of income on the full set of assets and their interactions (as presented in Table A.1.) as well as on the set of assets alone and the estimated curves were no different in character to the one presented in Figure 5.

poverty line, [20] and cuts it a second time at an asset index value of 4,487 poverty line units (PLUs). The range of the graph has been truncated a bit after that point.[21] The dynamics implied by this figure are somehow those of the hypothetical case of bifurcated dynamics, or the *threshold model*. Households with assets below the level indicated by the second crossing point that predicts a living standard of about 4.4 PLUs would be expected to experience deterioration in their position, heading back toward the poverty trap level of assets that predicts a level of well-being of about 85% of the poverty line. Households with asset indices above that threshold would be expected to move toward an upper equilibrium asset level. Households that begin in poverty with asset indices less than 85% of the poverty line would be expected to improve their situation, moving toward the poverty trap equilibrium. Using Figure 5, households can be assigned to one of three long-term mobility classes:

1. Caught in the poverty trap equilibrium (if asset index $<$ 1.39 or 0,8 PLUs = a monthly per capita income of 38 US$)

2. Downwardly mobile toward the poverty trap (if 1.39 $<$ asset index $<$ 2.1)

3. Converging to the non-poor equilibrium (if asset index $>$ 2.1 or 4,4 PLUs = a monthly per capita income of 199 US$)

Using these class assignments as predictors of the long-term position of households assumes that the underlying mobility process captured by the initial period data persists over time. The estimates that underlie Figure 5 can be used to calculate the implied velocity of asset changes for households with different initial asset levels. A household that began just above the asset index of 4,4 PLUs (a monthly per capita income of 199 US$) would have a predicted annual growth in assets of

[20] As the income is normalized by the rural poverty line, the point can be expressed in poverty line units.

[21] The analysis may be thus limited by the fact that the sample of households includes only those with low levels of income and assets.

about 4,4%, or over five years would experience a 26,4% increase in expected well-being -meaning that its level of well-being would be expected to rise from 4,4 to almost 5,5 PLUs. A household that began below an asset level of 4,4 PLUs would be expected to have assets that predict a living standard of less than 4,4 times the poverty line after five years.

Finally we show the assets corresponding to the cut-off levels of the asset index:

Variable	**Index = 1,39**	**Index = 2,1**
years of education of the hh head	6	16
irrigation to land	1	1
electricity	1	1
earthfloor	0	0
roof weak	0	1
animals	0	0
owned house	1	1
use of agricultural land	0	0
Ownership of:		
refrigerator	0	1
gas stove	1	1
radio	1	1
TV	1	1
washing machine	0	1
vehicules	1	1

5.2.2 The *Intrinsic Characteristics* Model: Unobserved Heterogeneity

In this section, we develop the idea of intrinsic characteristics of individuals that sort them into two groups: the first condemned to the low-income equilibrium, the second with possibilities to lift themselves out of poverty. In order to do so, a fixed effect in the regression of income on assets is predicted as a mesure of unobserved heterogeneity. The fixed effect by household is considered to capture the effectively immutable physical stature, cognitive development and educational attainment, namely *ability*. We can re-write equation (2) as:

$$y_{i,t} = \beta_0 + \beta_1 \mathbf{x}_{i,t} + \eta_i + e_{i,t} \quad (3)$$

where η_i is the time-invariant household level unobserved heterogeneity.

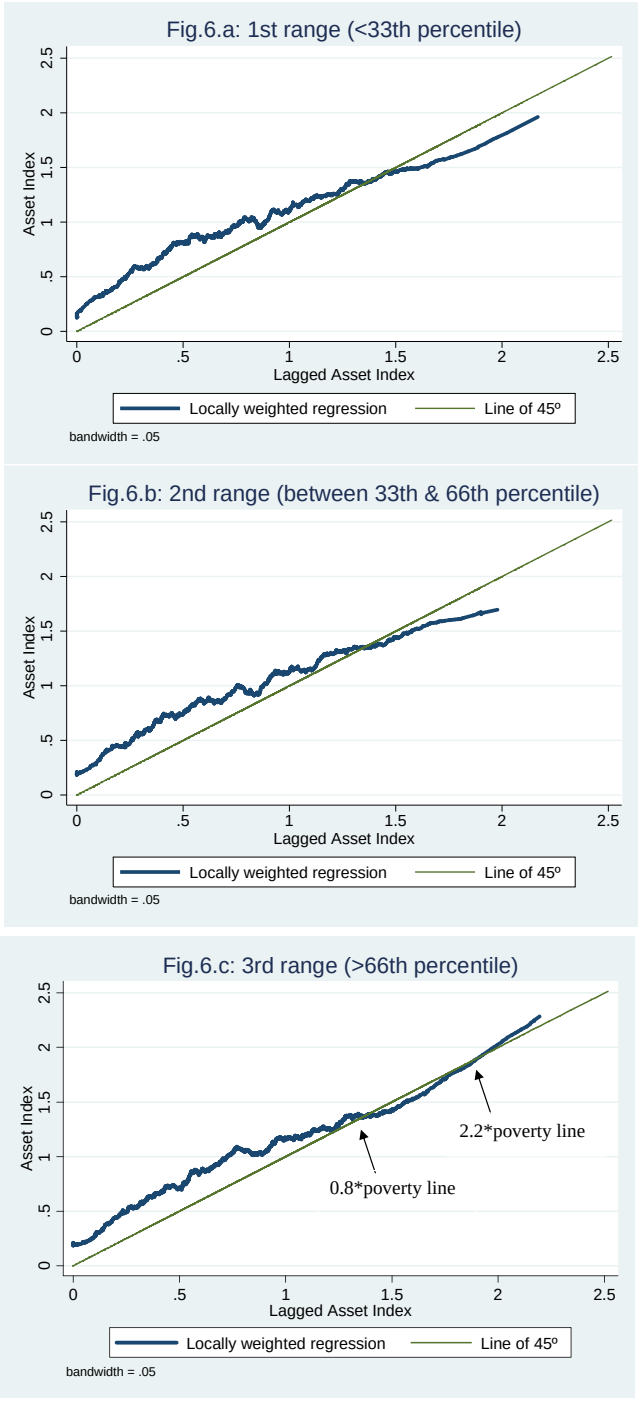
We identify two cut-offs of the distribution function of the predicted $\hat{\eta}_i$: at the 33th and at the 66th percentiles. According to this, we divide our sample in three intervals: each of the intervals correspond either to a low, middle or high level of the unobserved heterogeneity. Hence, we re-run the lowess estimator of the asset dynamics[22]. Figure 6 shows that for a given level of assets, the second interval provides similar results as the first one. The fact that we find multiple equilibria for only those with a higher *ability* means that only for this group a path out of poverty potentially exists if their asset base is no less than 2 (as shown by our asset index). That cut-off is also identified by 2,2 PLUs that corresponds to a monthly per capita income of 98 US$. The role played by *ability* is quite important here. [23]

If households of Figure 6.c. are able to accumulate enough assets (or produce a given level of income), and eventually overpass the threshold or discontinuity line, they may be able to start a better accumulation process and "jump" to a sustainable asset level above the poverty line. In Figure 6, there are two groups (on one hand 6.a and 6.b and on the other hand 6.c.), with distinct unobservable characteristics, and two different dynamic paths emerge.

[22]With a higher bandwith of 5%. Each of the graphs of Figure 6 display results for one third of the sample.

[23]In the appendix we show the kernel densities by the three levels of unobserved heterogeneity for the following variables: asset index, years of education and income. Only for this last one we see differences accross levels. Asset index level and education among households for the three intervals do not significantly differ from each other.

Figure 6: The *intrinsic characteristics model*: asset dynamics by intervals of the distribution function of the predicted fixed effect



5.2.3 Additional Strategy: Quantile Regressions

To further decompose our findings on the existence of poverty traps, we follow an additional strategy: we run simultaneous-quantiles regressions[24] to describe the household heterogeneity in terms of unobservable variables, as maybe only some quantiles of the distribution are experiencing a poverty trap. We re-run the lowess estimator to show the asset dynamics for three quantiles (0,25; 0,5 and 0,75). Figure 7 displays similar results finding multiple equilibria only for the higher quantile.

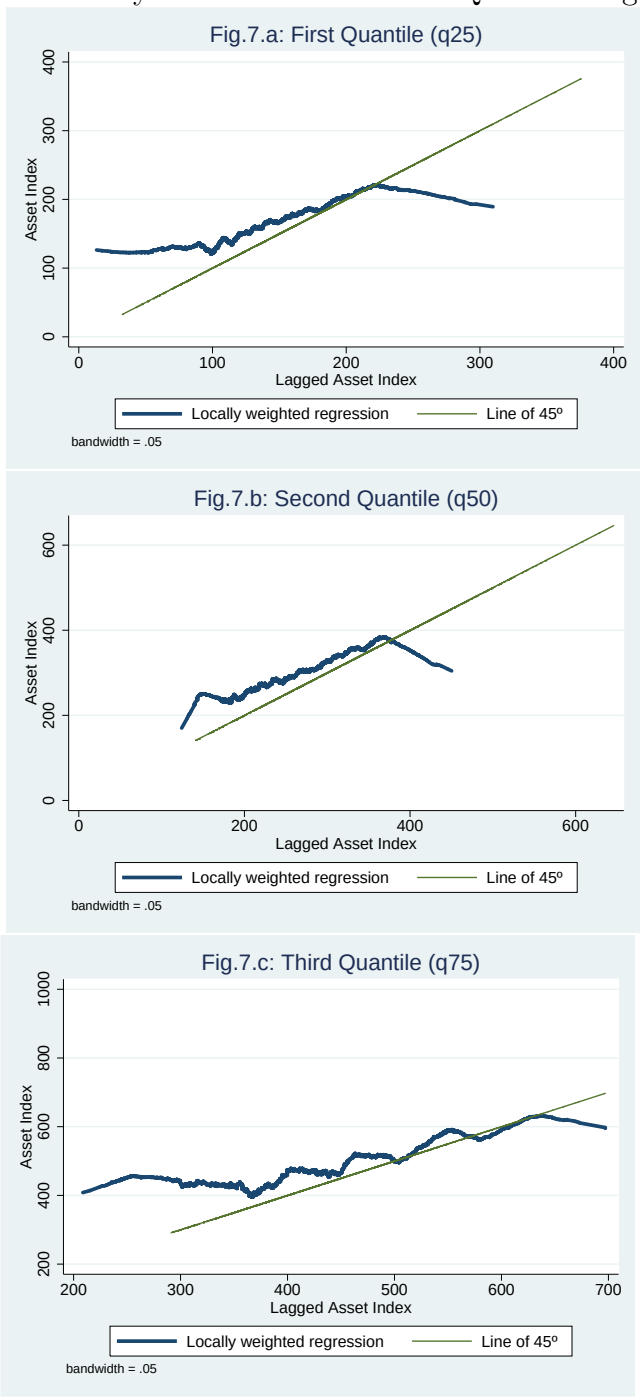
In sum, the data show nonlinearities in the accumulation of assets among households in the sample of communities. Hence, these households face circumstances which limit their ability to improve their welfare. Overall, these results should alert policy makers about whether incentive programs would be enough to lift individuals out of poverty, or other types of intervention are necessary. For instance, microfinance projects rest on the assumptions that individuals are locally constrained, and if they access a bigger pool of resources (credit, grants) they could lift out of poverty by themselves. However, this is only valid if the *threshold model* is valid. If, on the contrary, the *intrinsic characteristics model* holds, a substantial policy intervention is needed to change the fundamentals associated with poverty. In this paper we show, among other specific results, evidence for both models.

5.3 Other Evidence of the Existence of a Poverty Trap

Markets imperfections are often present in poor rural areas strengthening the possibillity of existence of a poverty trap as households may employ risk coping strategies (Jalan and Ravallion, 1999; Siegel and Alwang, 1999). Fafchamps and Pender (1997)

[24]Simultaneous-quantile regressions use all observations of the sample and obtain an estimate of the variance-covariance matrix via bootstrapping.

Figure 7: Asset dynamics: Simultaneous Quantile Regressions.



show that the availability of credit spur investment in irrigation in India. Ruben and Masset (2003) show that income shocks can lead to obligations to sell land and

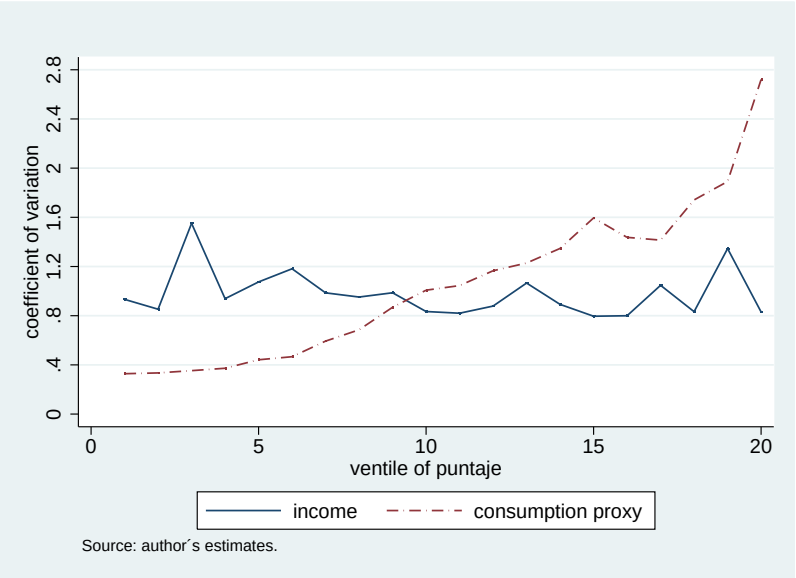
this can drive people into poverty. They show that small farms in Nicaragua are most affected by idiosyncratic shocks and usually adopt a defensive strategy based on reduced consumption to maintain their land. Even in the presence of credit constraints, households can smooth consumption through precautionary savings often in the form of liquid assets, such as livestock (Udry (1994), Townsend (1994), and Paxson (1992)). Morduch (1994) explains that this strategy can be quite costly when income shocks are covariate instead of idiosyncratic as it may reduce the ability of the household to smooth consumption (Zimmerman and Carter, 2003). Moreover, it is more costly when other investment opportunities are also available (Dercon, 1998; Rosenzweig and Binswanger, 1993; Paxson, 1990). Rosenzweig and Wolpin (1993) also find evidence that low income and borrowing constraints result in suboptimal investments in highly productive bullocks in India.

As smoothing consumption can require depleting productive assets, another alternative risk-coping strategy households can use is to try to reduce the variability in their income by employing income smoothing strategies (Morduch, 1994). Thus, another *test* for the existence of a poverty trap involves examining the variability of both income and consumption among households. Thus, if the variation of income is lower than the variation of consumption, this may suggest, among other topics, that households are reacting to conditions of a poverty trap. We use an index of asset as a proxy of consumption and then compute the coefficient of variation of this index -derived from factor analysis-.[25]

Figure 8 presents the mean coefficient of variation of income and assets by ventile

[25]In poor regions particularly where there is limited capacity to collect consumption, expenditure and price data, there is an asset-based alternative to the standard use of expenditures in defining well-being and poverty. Sahn and Stifel (2002) find that the asset index is a valid predictor of a crucial manifestation of poverty and that is measured as a proxy for a long-term wealth with less error than expenditures.

Figure 8: Variation of Income and Consumption (1997-2006)



of household *puntaje* (scores) for the periods. The variability of income shows that less poor households[26] have higher variability of income than the poorest households. On the other hand, for the poorest households - i.e. from ventile 10 onwards- the variation of income is lower than the variation of consumption.

6 An alternative approach to test for poverty traps.

6.1 Nonlinear Income Dynamics

The picture of relative stability of table 2 disappears if one examines period by period income mobility instead. Table 5 shows average annual transition rates between three income groups where group membership depends on the size of the household' income relative to the fixed real income thresholds. The pattern revealed is one of

[26]Left ventiles correspond to the lowest puntaje and thus, the less poor.

much mobility.

Table 5. Longitudinal perspective on the income distribution 1997-2006[27]

	Income group, wave t		
Income group			
wave $t-1$	< 0.5	$0.5 - 1.25$	$>= 1.25$
< 0.5	37.8%	40.6%	21.4%
$0.5 - 1.25$	29%	41.3%	29.5%
$>= 1.25$	20.1%	35.1%	44.6%

In sum, the data show that income mobility is a significant empirical phenomenon. The challenge here is to unravel some of its determinants. And by doing so, the aim of this section is to extend the analysis of the existence of poverty traps. The parametric strategy is based on the estimation of a polynomial where the dependent variable is a measure of stock of assets, income or consumption, and the independent variable is the dependent variable lagged one period. The estimation of this polynomial allows us to check for non linearities in the income dynamics and the possibility of multiple equilibriums such that can give place to poverty traps. Our strategy follows the one proposed in Jalan and Ravallion (2004) that allows overcoming econometric challenges as lack of long duration panels and attrition. In this model we suppose that the process of adjustment is common for all the households, thus the point of equilibrium could be different because of the presence of the fixed effect that is not observable per household, α_i. This effect may do that only some households face a poverty trap.

[27]Outflow rates (%) from wave $t-1$ income group origins to wave t income group destination. Income is income per capita. Households classified into income groups according to the size of their income relative to fixed real income cut-offs equal to 0.5 and 1.25 times mean wave 1 income.

6.2 Empirical Strategy

We suppose that the functional form of the household income can be specified as a polynomial of degree three of the income lagged one period. According to this, the generating process of the real income of household i during t is $y^*_{i,t}$:

$$y^*_{i,t} = \beta_0 + \beta_1 y^*_{i,t-1} + \beta_2 (y^*_{i,t-1})^2 + \beta_3 (y^*_{i,t-1})^3 + \alpha_i + \mu_{i,t} \tag{4}$$

If the real values of the income are observed and the errors are not correlated, the equation (4) can be consistently estimated with the Generalized Method of Moments (GMM). As mentioned by Antman and McKenzie (2005b), without measurement error in income, we can obtain a consistent estimation of β_1, β_2 and β_3 to determine the existence of non linearities in the income map. Nevertheless, the estimation of these parameters is not sufficient to determine whether the households face a poverty trap. If the map of income is always over the line of 45°, the existence of non convexities does not imply that a poverty trap exists. For the existence of a poverty trap, it is necessary to be in presence of a stable equilibrium in a low level of income -i.e. the map of income cuts the line of 45° from below. Given an income map, a necessary and sufficient condition for the existence of a poverty trap based on an income threshold and multiple equilibria is that the derivative:

$$g_i(y^*_{i,t-1})|_{y^*_{i,t}=y^*_{i,t-1}} > 1 \tag{5}$$

This condition must be evaluated in the roots of the equation (4). Equation (4) is estimated considering three specifications: linear, quadratic and cubic. In Table 6.a, it is possible to observe evidence of the existence of non linearities in the income dynamics (here, the dependent variable is the per capita income, in units of the rural poverty line) as the coefficient of the quadratic term (in the quadratic

and cubic specifications) and the coefficient that accompanies the cubic term (in the cubic specification) turn out to be statistically significative. Condition (5) is satisfied only for the cubic specification since the slope of the function of income when it cuts the curve of 45° is more than one. Table 6.b shows the solutions and the relative derivatives of the function of income. For the cubic specification the derivative is higher than 1 and hence there is evidence of a poverty trap, according to the non linearities in the income dynamics shown in Table 6.a.

Table 6a. GMM Estimation of equation. Without fixed effects[28]

ß1	-0.147	-0.242	-0.331
	(2.98)***	(4.53)***	(5.26)***
ß2		0.011	0.064
		(4.03)***	(5.93)***
ß3			-0.002
			(5.89)***
Observations	8730	8730	8730

Absolute value of z statistics in parentheses

*** significant at 1%

Table 6b. Solutions and derivatives of the equation (without fixed effects)[29]

Lineal specification		Cuadractic specification		Cubic specification	
Solution (1)	Derivative (2)	Solution (1)	Derivative (2)	Solution (1)	Derivative (2)
0.80	-0.147	0.77	-0.22	0.74	-1.24

(1) Solution of the equation

(2) Derivative of the polynomial evaluated in the solution

The results find evidence for the existence of poverty traps due to nonlinearities in income dynamics.

[28]The relative coefficients when controlling for time dummies don't result significant.

[29]When controlling for time dummies results are similar.

7 Conclusion

Several studies suggest that a society like Mexico will suffer from blocked pathways of upward mobility that leaves large numbers of people trapped in poverty. To explore these ideas, this paper employs a variety of empirical methods drawing on new evidence from the Mexican program. Econometric analysis of asset dynamics over the 1997 - 2006 period identifies a dynamic asset poverty threshold that signals that large numbers of Mexicans are indeed trapped without a pathway out of poverty. Analysis may be limited by the fact that the sample of households includes only those with low levels of income and assets.

The results show that the dynamics are somehow those of the hypothetical case of bifurcated dynamics, meaning multiple equilibriums. Households can be assigned to one of three long-term mobility classes: (1) Caught in the poverty trap equilibrium (if asset index $<$ 0,8 poverty line units -PLUs-); (2) downwardly mobile toward the poverty trap (if 0.8 $<$ asset index $<$ 4.4); (3) converging to the non-poor equilibrium (if asset index $>$ 4,4 PLUs).

In general, our results should alert policy makers about whether incentive programs (such as highly ranked cash-transfer programs as *Oportunidades*) would be enough to lift individuals out of poverty, or other types of intervention are necessary. If the *threshold model* is valid, a substantial minimum level of asset holdings is necessary to facilitate the escape from poverty. However, if the *intrinsic characteristics model* holds, a particular policy intervention is needed to change the fundamentals associated with poverty.

This study opens several avenues for future research on the topic. Beyond the aboved mentioned use of a more detailed database containing qualitative data, an-

other potentially fruitful and complementary approach aims at testing if the underlying mobility process captured by the initial poverty status persists over time. In particular, long term studies would be useful in part to test the accuracy of this assumption.

A Appendix

Table A.1. OLS estimates of per capita income (in food poverty-line units)

Household Assets	**1st period**	**2nd period**	**3rd period**
Male household head	0.626	-0.127	-0.011
	(1.96)*	(0.49)	(0.04)
Age of household head	-0.166	-0.191	-0.029
	(3.89)***	(4.69)***	(0.57)
Age of household head squared	0.004	0.004	0.001
	(4.57)***	(4.58)***	(0.54)
Age of household head cubed	-0.000	-0.000	-0.000
	(4.63)***	(4.20)***	(0.27)
Asset index by HH	0.836	0.724	0.726
	(1.64)	(2.01)**	(1.68)*
Asset index by HH squared	-1.848	-0.234	-0.293
	(2.97)***	(0.49)	(0.73)
Asset index by HH cubed	0.599	0.058	-0.076
	(1.76)*	(0.24)	(0.45)
Land (total hectares used)	0.046	0.085	0.015
	(1.39)	(2.37)**	(1.82)*
Land (total hectares used) squared	-0.001	0.001	0.000
	(1.75)*	(2.24)**	(0.63)
Land (total hectares used) cubed	0.000	-0.000	-0.000
	(1.43)	(3.10)***	(0.54)
Quantity of working animals	-0.201	-0.089	-0.023
	(2.39)**	(0.66)	(0.19)
Quantity of working animals squared	0.018	-0.000	0.021
	(2.00)**	(0.01)	(1.66)*
Quantity of working animals cubed	-0.000	-0.000	-0.001
	(1.22)	(0.12)	(1.16)
Quantity of male working adults per household	-0.108	-0.103	0.404
	(0.57)	(0.56)	(2.34)**
Quantity of male working adults per hh squared	0.104	0.002	-0.057
	(2.69)***	(0.07)	(2.21)**
Quantity of male working adults per hh cubed	-0.005	-0.000	0.004
	(1.84)*	(0.04)	(2.42)**
Years of education of the hh head	0.103	-0.068	0.107
	(1.08)	(1.08)	(1.54)
Years of education of the hh head squared	-0.014	0.012	-0.015
	(1.17)	(1.30)	(1.92)*
Years of education of the hh head cubed	0.000	-0.001	0.001
	(0.22)	(1.37)	(1.95)*
Quantity of working adults per hh	2.533	1.732	1.174
	(6.91)***	(5.26)***	(4.07)***
Quantity of working adults per hh squared	-1.026	-0.385	-0.216
	(8.52)***	(4.49)***	(3.34)***
Quantity of working adults per hh cubed	0.103	0.032	0.014
	(7.42)***	(3.44)***	(2.55)**
Dummies for State & Interactions included	yes	yes	yes
Observations	4,365	4,365	4,365
R-squared	0.31	0.12	0.11

Robust t statistics in parentheses.

Significant at: * 10%; ** 5%; *** 1%

Figure 9: Comparing kernel density estimates: Balanced and Unbalanced panel

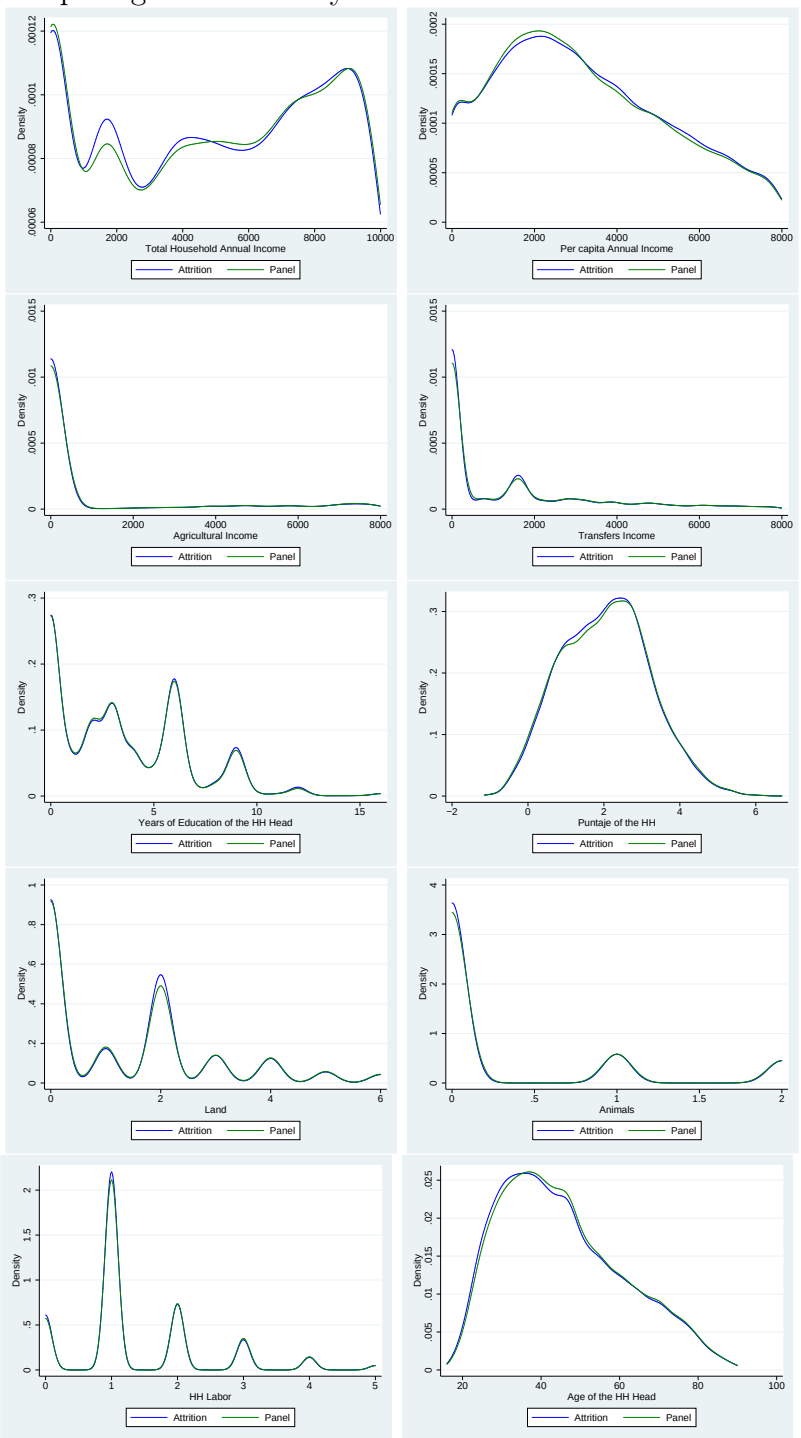


Figure 10: Asset index by different levels of unobserved heterogeneity

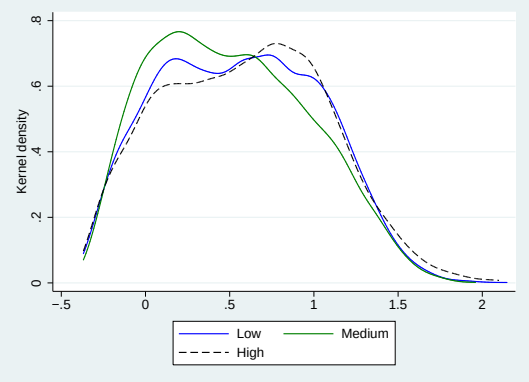


Figure 11: Years of education by different levels of unobserved heterogeneity

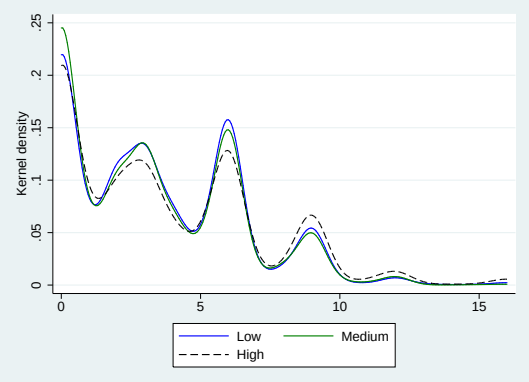
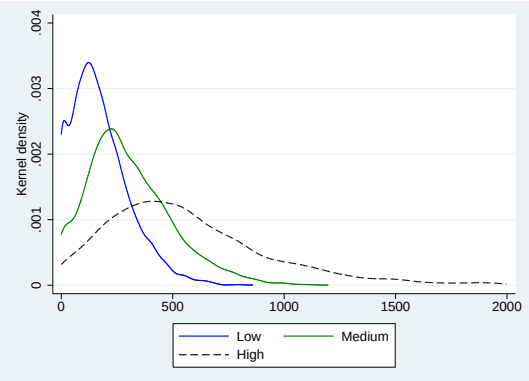
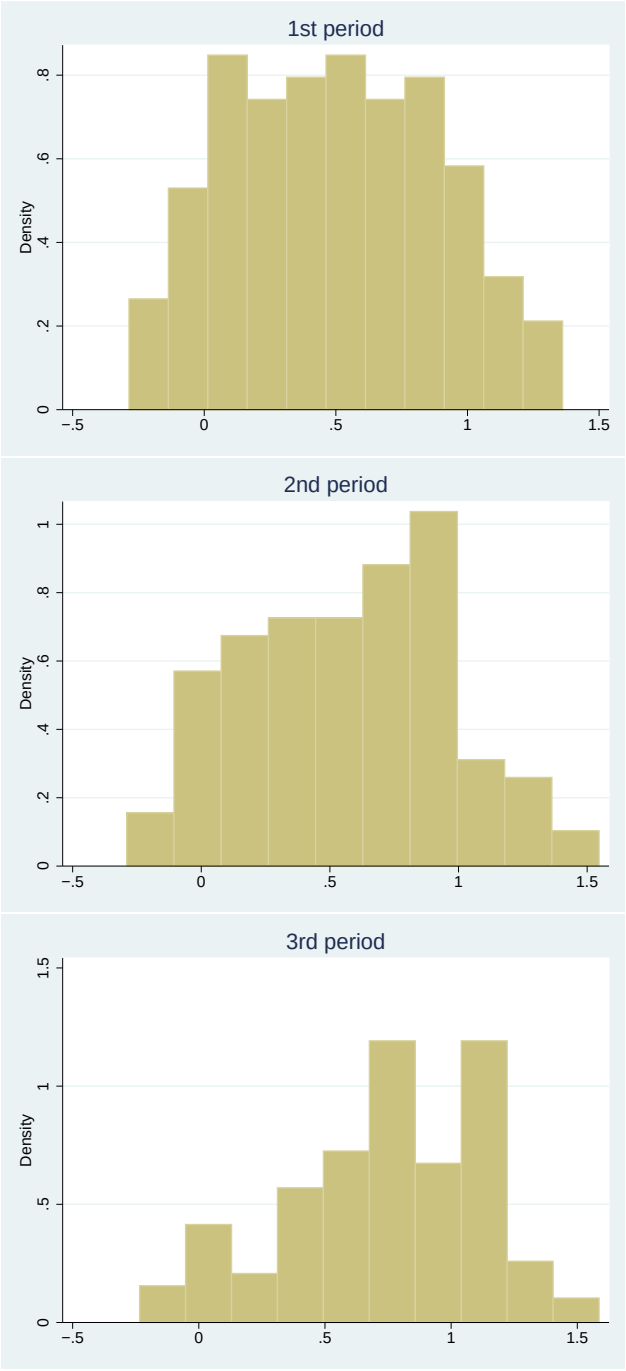


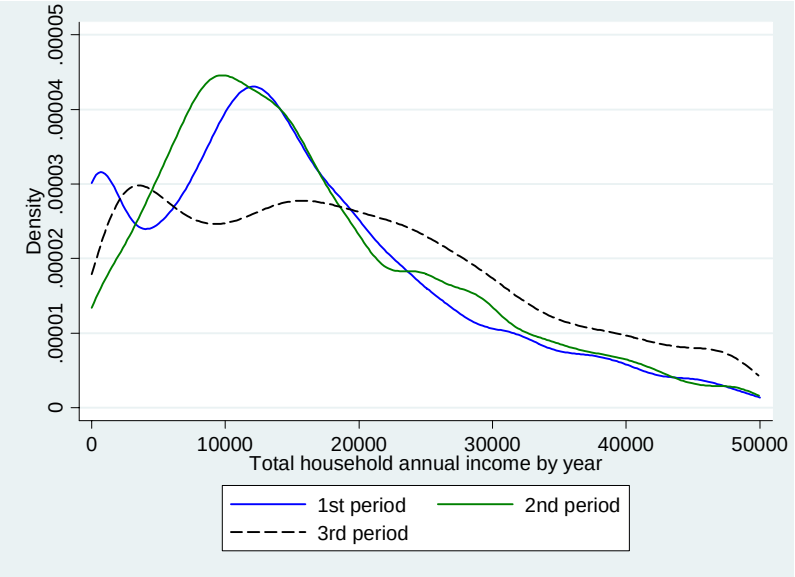
Figure 12: Per capita income by different levels of unobserved heterogeneity

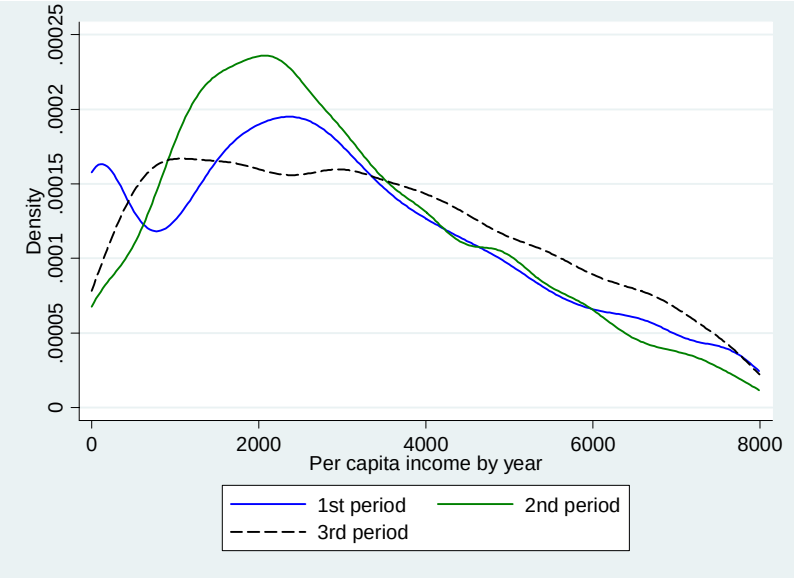


Asset index average by locality

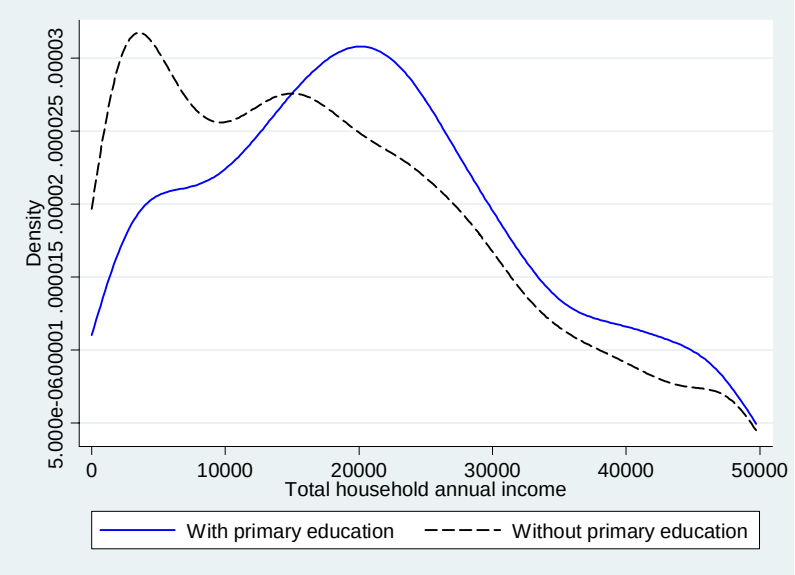


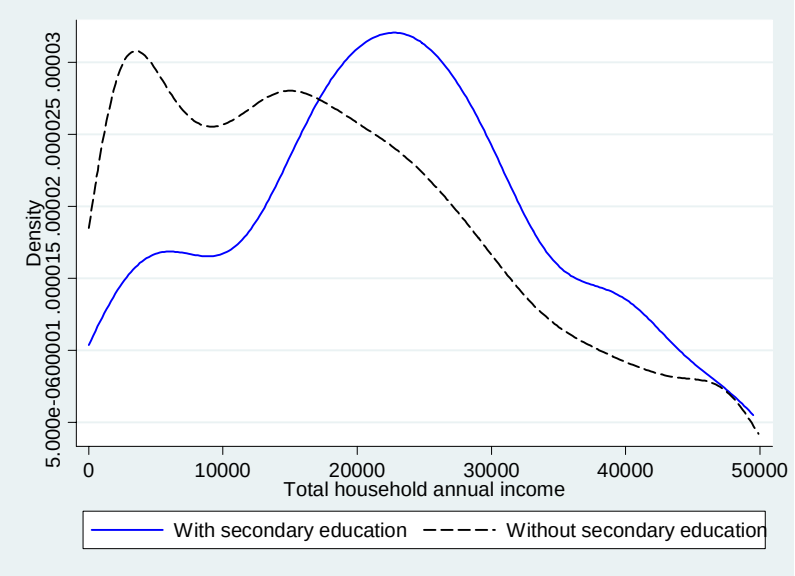
Total household annual income and per capita income -in units of the rural poverty line-, by year (Kernel density).



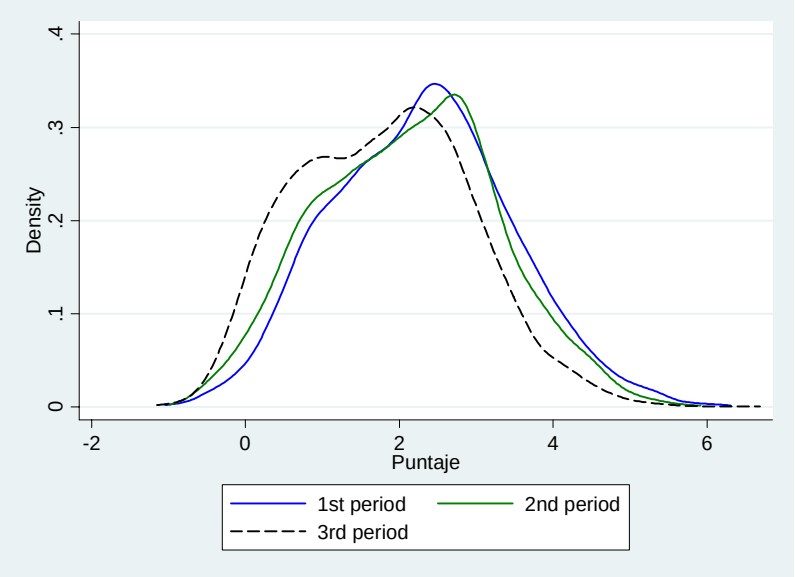


Total household annual income by having or not primary and secondary education (Kernel density; household head education).

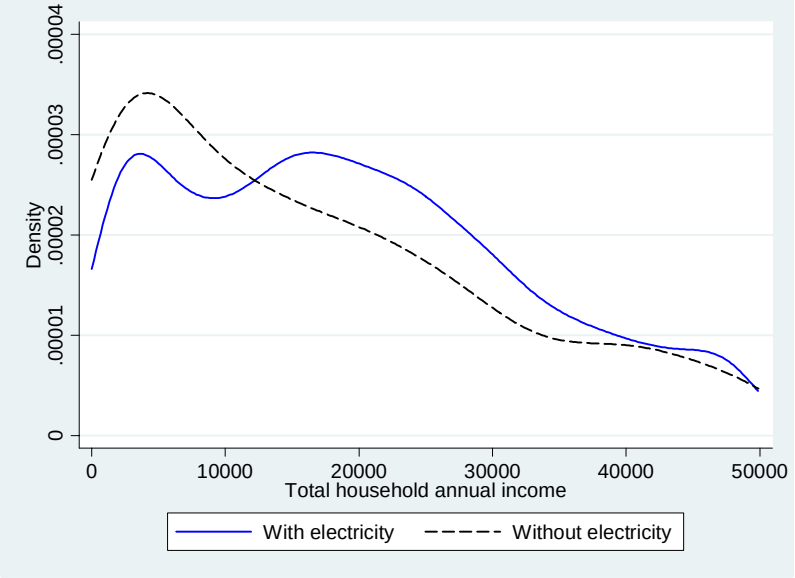




Puntaje, by year (Kernel density).



Total household annual income by having or not electricity in the community (Kernel density).



References

[1] Adato, Michelle, Carter, Michael R. and May, Julian (2006) "Exploring poverty traps and social exclusion in South Africa using qualitative and quantitative data", Journal of Development Studies, 42:2, 226 - 247.

[2] Alderman, Harold, 1996, "Saving and economic shocks in rural Pakistan", Journal of DevelopmentEconomics, 51, 343-366.

[3] Antman F. and McKenzie D., "Earnings Mobility and Measurement Error: A Pseudo-Panel Approach", World Bank Policy Research Working Paper No.3745, (2005a).

[4] Antman F. and McKenzie D., "Poverty Traps and Nonlinear Income Dynamics with Measurement Error and Individual Heterogeneity", World Bank Policy Research Working Paper No. 3764, (2005b)

[5] Azariadis, C. and Stachurski, J., "Poverty Traps", Prepared for the Handbook of Economic Growth (Philippe Aghion and Steven Durlauf, eds.).

[6] Barrett Christopher B., Carter M.R. and Ikegami M., "Poverty traps and Social Protection", World Bank

[7] Behrman, Jere R.; Parker, Susan W. and Todd, Petra E.. "Medium-Term Effects of the Oportunidades Program Package, including Nutrition, on Education of Rural Children Age 0-8 in 1997", Technical Document Number 9 on the Evaluation of Oportunidades 2004.

[8] Bond, S.R., 2002. "Dynamic panel data models: a guide to micro data methods and practice." Portuguese Economic Journal 1, 141-162.

[9] Capellari, Lorenzo and Stephen P.Jenkins, 2004, "Modelling low income transitions", Journal of Applied Econometrics, 19: 593-610.

[10] Carter, Michael R. and Christopher B. Barrett, 2005. "The Economics of Poverty Traps and Persistent Poverty: An Asset-Based Approach," forthcoming in Journal of Development Studies.

[11] De Vreyer, Ph., Herrera, J., Mesplé-Somps S. (2009). "Consumption growth and spatial poverty traps : an analysis of the effect of social services and community infrastructures on living standards in rural Peru", in Klasen S. and F. Nowak-Lehmann (eds.), Poverty, Inequality and Policy in Latin America, CESifo Series, Harvard: MIT Press, pp.129-156.

[12] Deaton A., "Panel Data from Time Series of Cross-Sections" , Journal of Econometrics n.30, (1985), pp. 109-126.

[13] Dercon, Stefan, 1998, "Wealth, risk and activity choice: Cattle in western Tanzania", Journal of Development Economics, 55: 1-42.

[14] Fafchamps, Marcel and Pender, John, 1997. "Precautionary Saving, Credit Constraints, and Irreversible Investment: Theory and Evidence from Semiarid India," Journal of Business and Economic Statistics, American Statistical Association, vol. 15(2), pages 180-94, April.

[15] Hoddinott, J. 2003. "Pathways from poverty in sub-Saharan Africa," International Food Policy Research Institute working paper.

[16] Jalan, Jyotsna and Martin Ravallion, 1999, "Are the Poor Less Well Insured? Evidence on Vulnerability to Income Risk in Rural China", Journal of Development Economics, 58(1): 61-82.

[17] Jenkins, Stephen P., 2000, "Modelling household income dynamics", Journal of Population Economics, 13: 529-567.

[18] Morduch, Jonathan, 1994. "Poverty and Vulnerability" American Economic Review Papers and Proceedings, vol. 84(2): pp. 221 – 225.

[19] Morduch, Jonathan, 1995. "Income Smoothing and Consumption Smoothing," Journal of Economic Perspectives, vol. 9: pp.103-114.

[20] Mundlak, Y., 1978. On the pooling of time series and cross section data. Econometrica 46(1), 69-85.

[21] Nurkse, R (1953), "Problems of Capital-Formation in Underdeveloped Countries", 1962 edition, New York: Oxford Univeristy Press.

[22] Paxson, Christina, 1990, "Borrowing Constraints and portfolio choice," Quarterly Journal of Economics, vol. 10591): 535-543.

[23] Paxson, Christina, 1992, "Using weather variability to estimate the response of savings to transitory income in Thailand", American Economic Review 82(1): 15-33.

[24] Rosenstein-Rodan, P. (1943), "The problem of industrialization of eastern and south-eastern Europe," Economic Journal, 53, 202-211.

[25] Rosenzweig, Mark R., and Hans Binswanger, 1993, "Wealth, weather risk and the composition and profitability of agricultural investments", Economic Journal, 103: 56-78.

[26] Rosenzweig, Mark R., and Kenneth I. Wolpin, 1993, "Credit market constraints, consumption smoothing, and the accumulation of durable production assets in low- income countries: Investments in bullocks in India", Journal of Political Economy, 101: 223-245.

[27] Ruben, R. and E. Masset (2003) "Land Markets, Risk and Distress Sales in Nicaragua: the Impact of Income Shocks on Rural Differentiation", Journal of Agrarian Change, Vol. 3, No. 4, pp. 481-499.

[28] Sahn David E. and Stifel David C., 2002, "Exploring Alternative Measures of Welfare in the Absence of Expenditure Data", Under revision for the Review of Income & Wealth.

[29] Long Scott J. and Freese J., "Regression models for categorical dependent variables using stata", Stata Press Publication, College Station, Texas.

[30] Quah, D. T. (1993), "Empirical cross-section dynamics in economic growth," European Economic Review, 37, 426-434.

[31] Quah, D. (1996), "Convergence empirics across economies with (some) capital mobility", Journal of Economic Growth, 1, 95-124.

[32] Siegel, Paul B. and Jeffrey Alwang, 1999. "An Asset-Based Approach to Social Risk Management: A Conceptual Framework," Social Protection Discussion Paper No. 9926, Social Protection Unit, Human Development Network, The World Bank, Washington, D.C.

[33] Townsend, Robert M., 1994. "Risk and Insurance in Village India," Econometrica, Vol. 62(3): pp. 539-591.

[34] Udry, Christopher, 1994. "Risk and Insurance in a Rural Credit Market: An Empirical Investigation in Northern Nigeria," Review of Economic Studies Vol. 61(3): pp. 495-526.

[35] Wooldridge, J.M., 2005. Simple solutions to the initial conditions problem in dynamic, nonlinear panel data models with unobserved heterogeneity. Journal of applied econometrics, 20(1), 39-54.

[36] Zimmerman, R. and M.R. Carter (2003). "Asset Smoothing, Consumption Smoothing and the Reproduction of Inequality under Risk and Subsistence Constraints," Journal of Development Economics, Vol. 72(2): pp.233-261.