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Abstract

This paper deals with consumption dynamics and its effects on poverty. An econometric model is proposed in which changes in consumption across time are seen as fluctuations around the level of consumption that each family can sustain in the long term. The advantages of this approach are twofold. First, it allows identification of the main determinants of changes in poverty. Second, it allows distinguishing between chronic and transient poverty, by defining as chronically poor those households whose level of consumption sustainable in the long term lies below the poverty line. This definition of chronic poverty represents a change with respect to previous works on the subject, in which chronic poverty is defined with reference to the average level of consumption (or income) observed at the family level along the temporal interval of the panel. The innovation of our proposal lies in the fact that all the information from the panel data set, relative to all households, is exploited in order to identify which level of consumption each family is tending toward through time. Furthermore, our definition of chronic poverty allows one to identify four different groups of families that differ by level of observed consumption and by potential to generate income for consumption. The four groups are characterized by different incidences of chronic and transient poverty, and hence require different kinds of anti-poverty policies and public support.

Data from two Living Standards Measurement Surveys (LSMS) carried out by the World Bank in Nicaragua in 1998 and 2001 are used, while accounting for potential problems of attrition.

***Key Words**:* chronic poverty, consumption dynamics, Nicaragua
JEL: I32, O54

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1. INTRODUCTION

This paper is concerned with the analysis of the dynamics of consumption and its implications for poverty. Observed movements in and out of poverty over time are driven by changes in household consumption. It is difficult to discern, however, whether these movements are permanent or temporary, and thus whether the resultant poverty is chronic or transient. This is particularly true when information over time is limited or not available. In this paper we tackle the case of a two period panel data set.

We propose an econometric specification in which changes in consumption across time are seen as fluctuations around the level of consumption that each family can sustain in the long term. The advantages of this approach are twofold. First, it allows identification of the main determinants of changes in poverty status. Second, it allows distinguishing between chronic and transient poverty, by defining as chronically poor those households whose level of consumption sustainable in the long term lies below the poverty line. This definition of chronic poverty represents an innovation with respect to previous works on the subject, in which chronic poverty is defined with reference to the average level of consumption (or income) observed at the family level along the temporal interval of the panel. In fact, our specification exploits all the panel information on the dynamics of consumption (for all households) in order to identify which level of consumption is sustainable in the long term, and not only consumption (or income) observed for each single household.

We use data from two Living Standards Measurement Surveys (LSMS) carried out by the World Bank in Nicaragua in 1998 and 2001. The objective was to visit the same 4,000 households in both years. However, as in most panel surveys, a rather high rate of attrition was observed, so that about 25 percent of the initial households were lost in the second round of the survey. Attrition may pose problems of bias, as the remaining panel households may not be representative of the original population. In such cases, appropriate corrections of the estimation process must be made. We address the problem in order to guarantee the validity of the econometric analysis and of the related results.

The paper is organized as follows. In section 2, a description of poverty changes in Nicaragua and some descriptive evidence on household movements in and out of poverty are provided. Sections 3 and 4 describe the econometric model and its theoretical implications. Section 5 deals with attrition. Results are presented in section 6 and 7. Section 8 concludes and provides some considerations on the recommendations for policy.

2. POVERTY DYNAMIC

While Nicaragua over the past decade has ranked among the poorest countries in Latin America in terms of per capita GDP, data from the last three LSMS surveys (1993[1], 1998, and 2001) have shown a consistent, though modest, decline in the incidence of moderate and extreme poverty. Looking at the LSMS panel data, where the same trends are evident, extreme poverty in rural areas fell from 22 percent in 1998 to 19 percent in 2001, and moderate poverty from 38 to 35 percent. Overall, the share of rural households in poverty fell from 60 to 54 percent. Overall urban poverty fell from 23 to 21 percent. Most urban poverty is moderate; only 5 percent of panel urban households lived in extreme poverty in 1998, and 4 percent in 2001.

[1] In 1993, LSMS was carried out on a different set of households, thus it does not form part of the panel.

At the household level, however, it is much more difficult to find and explain an overall march towards increased living standards. In fact, the decline in overall poverty incidence masks active movement in and out of poverty, particularly in the rural sector (Table 1). Overall, the six percent drop in the incidence of poverty in rural areas is the net of 17 percent of households leaving poverty, and 11 percent entering. Another nine percent moved from extreme to moderate poverty, countered by seven percent who moved in the opposite direction. Among urban households much less change is evident, with approximately 80 percent remaining in the original category[2].

In all this movement, we try to discern the relative importance of chronic and transient poverty. Such differentiation is important for policy considerations, as different kinds of poverty call for different policy interventions. If markets were perfect and families could redistribute income across time, the transient poor may not need any help. However, if markets are imperfect and lending and borrowing are difficult, the transient poor may need short term income support. The problem is different for the chronic poor, who do not dispose of sufficient resources for intertemporal redistribution and who have less ability to exit poverty through time. In the short term, these families surely need income support; moreover, in a longer term perspective, they need structural policies aimed at increasing economic potential, such as educational programs which enable family members to access better job opportunities and generate higher and more steady income flows.

Table 1. Entering and exiting poverty, 1998 and 2001 panel households

in percent of households	**total**	**rural**	**urban**
Number of observations	2800	1273	1527
1998			
Extreme poverty	13	22	5
Moderate poverty	27	38	18
All poverty	40	60	23
2001			
Extreme poverty	11	19	4
Moderate poverty	25	35	17
All poverty	36	54	21
Overall			
Not poor in both 1998 and 2001	52	30	70
Exiting any kind of poverty to not poor	13	17	10
Entering any kind of poverty from not poor	9	11	7
Moderate poor in both 1998 and 2001	12	17	8
Exiting extreme poverty to moderate poverty	5	9	2
Entering extreme poverty from moderate poverty	4	7	2
Extreme poor in both 1998 and 2001	6	10	2

[2] Further details on these movements, as well as the characteristics of households in different poverty categories, can be found in Davis and Stampini (2002).

3. ECONOMETRIC MODEL

Our principal indicator for household well being in this study is per capita household consumption. While our main message involves gauging the determinants of exiting poverty, we will not analyze exiting poverty per se, but rather increases in consumption. This consumption, predicted or observed, is then compared to established poverty lines. Studying the dynamic of consumption allows one to take advantage of full information on all households along the whole continuum of well being.[3] We thus avoid performing Probit analyses of poverty status, which uses only part of available information. In this case, all the poor are considered homogeneously (with a 1), as with the non-poor (with a 0). Even when measures of intensity of poverty are considered, such as the distance from the poverty line (poverty gap) or the square of this distance (squared poverty gap), information on the non-poor is lost.

We dispose of two observations in time for each family, in 1998 and 2001, hence we observe C_{98}, X_{98}, C_{01}, X_{01}, where C represents consumption and X is a vector of household assets and demographic characteristics. As we are interested in analyzing the change in consumption, which determines the transition towards or out of the state of poverty, the same information can be organized as dC, dX, C_{98}, X_{98}, where d indicates the change in the variable between the two periods ($dC=C_{01}-C_{98}$). The most general model for the change in consumption can then be formulated as follows:

$$(1) \qquad dC_i = b_0 + b_1 * dX_i + b_2 * X_{98,i} + b_3 * C_{98,i} + u_i$$

where i is the family index and u is the error term.

The change in consumption depends on a dynamic process and is a function of the initial level of household characteristics, of the change in these characteristics and of the initial level of consumption. Reformulating this model can help us to understand the meaning of equation (1). This can be written as follows:

$$(2) \qquad dC_i = b_0 + b_1 * dX_i + b_3 * (C_{98,i} - b * X_{98,i}) + u_i$$

which says that the change in consumption is a function of the change in household characteristics and assets (dX), but also of the distance from that level of consumption which is justified in the long run by the characteristics and assets owned by the family.

Characteristics X justify a level of consumption equal to bX. Current consumption, however, diverges from this long term equilibrium because of market imperfection but also because some of these characteristics cannot develop their full potential immediately. Families adjust consumption towards this level through time. In this context, changes in consumption are driven both by changes in household characteristics and assets, but also by the way in which previous characteristics keep developing their potential, driving consumption towards its long term equilibrium.

The term $(C_i - b*X_i)$ represents a mechanism of correction of the deviation from the long term equilibrium. In equation (2), the coefficients can be interpreted as follows:

- b_1 is the short term effect of a change in X;

[3] For a discussion of related topics, see Ravallion (1996).

- b is the long term effect of X, and hence it represents the real potential of household characteristics and assets once they have fully developed their effect (once equation (1) has been estimated, b can be recovered as function of b_2 and b_3, as $b=(-b_2/b_3)$);
- b_3 is the speed of adjustment towards the long term relationship.

The coefficient b_3 represents the speed of convergence toward the long term equilibrium in case of current disequilibria. Sensible values from the theoretical point of view vary between -2 and zero. Values between –2 and –1 imply adjustment with overshooting, with waves around the equilibrium, while values between –1 and 0 imply smooth adjustment with no overshooting.

4. POVERTY DECOMPOSITION: CHRONIC AND TRANSIENT POVERTY

Specification (2), which is typical of time series analysis and dynamic panel data models[4], is particularly interesting in our case as it allows one to make important considerations regarding chronic and transient poverty. Each household has some characteristics, X, which justify a certain (long run) level of consumption, b*X. If this level is under the poverty line (PL), the family suffers chronic poverty in the long term. Some factors make consumption differ from this long run level in the present. It may happen that the family is currently above the poverty line, but we can expect that in the future they will be poor, as the current level of consumption is not sustainable on the basis of household assets and demographic characteristics. Symmetrically, it may happen that a family with a good level of assets is currently under the poverty line. If b*X>PL, we can expect this poverty to be transient. Consumption will adjust towards its long term equilibrium and the family will exit poverty, by exploiting the full potential of its characteristics.

The estimation of equation (1) enables us to recover the coefficients which express the long term effect of household characteristics and asset holding and hence to calculate the level of consumption sustainable by the family in the long term. The comparison of this consumption against the poverty line determines if a family suffers chronic poverty or not, as well as the comparison of observed consumption against the same poverty line determines if a family is currently classified as poor. To summarize, the purpose of the estimation of equation (1) is twofold: first, it allows identification of the determinants of variations in consumption, which are also the causes of changes in poverty status, as they drive entrance and exit from the condition of poverty; second, it permits estimation of the level of consumption sustainable in the long term, which is necessary in order to decompose poverty into its chronic and transient components.

We proceed by illustrating previous definitions of chronic and transient poverty and by showing how our proposal differs. What follows can be applied to any index of poverty (for example the headcount index, poverty gap, squared poverty gap, etc.). We use the squared poverty gap (SPG) of Foster et al. (1984), which satisfies the usual conditions of additivity and convexity. At the family level, poverty is measured according to the following expression:

$$(3) \quad SPG_{i,t} = (1 - C_{i,t}/PL_t)^2 \quad \text{if } C_{i,t}<PL_t$$
$$= 0 \quad \text{if } C_{i,t}>PL_t$$

[4] See for example Bontempi (2002).

where PL represents the poverty line, i is the family index and t refers to time.

Previous literature on chronic poverty measurement

An interesting treatment of chronic poverty definition and measurement can be found in Rodgers and Rodgers (1993), who review previous literature and propose new analytical methods[5]. According to the authors, economists had addressed the topic in four different ways[6], all requiring information from longitudinal surveys.

The first approach employs a fixed effect regression model. People are poor if their income is lower than the poverty line, i.e. if their income-to-need ratio is smaller than one. Ratios vary through time. By regressing income-to-need ratios on individual constants only, an individual fixed effect is estimated, which captures permanent income-to-need. The residual captures the transitory component. Persistent poverty can be measured as the ratio of individuals with permanent income-to-need ratio smaller than one (Duncan and Rodgers, 1991).

The second approach (Duncan and Rodgers, 1991) measures persistent poverty as the share of individuals whose average income along the panel temporal interval lies below average level of needs (measured by a time changing poverty line).

The third approach may be named the tabulation method. The number of periods in which each individual is poor is studied by presenting a table of the share of individuals whose income is below the poverty line in X of the T periods of the panel, with X varying from 1 to T (X = 1,2,…T).

Finally, the fourth approach focuses on the duration of poverty spells. The distribution of the length of poverty spells is studied, with chronic poverty measured by the share of long lasting spells and transitory poverty measured by the share of short lasting spells. In this case, poverty spells are considered rather than individuals (each individual can enter and leave poverty more than once along the panel, producing more than one poverty spell).

Rodgers and Rodgers point out that none of the above procedures pays attention to what happens in the periods in which the individual is not poor. They stress that the possibility of redistributing income across time through lending and borrowing should be acknowledged, and hence propose defining chronic poverty in terms of distance between the level of income sustainable in the long run (permanent income) and an average indicator of need. Permanent income (Y^*) is defined as the annuity corresponding to the flow of incomes observed along the panel. If poverty lines change with time, the same definition could be adopted for the level of need (PL^*), so that:

$$\sum_{t=1}^{T} \frac{Y_{i,t}}{(1+r_t)^t} = \sum_{t=1}^{T} \frac{Y_i^*}{(1+r_t)^t}$$

and

$$\sum_{t=1}^{T} \frac{PL_t}{(1+r_t)^t} = \sum_{t=1}^{T} \frac{PL^*}{(1+r_t)^t}.$$

[5] Another more recent survey is provided by Jenkins (2000). However, most of the techniques described in this paper require the panel data set to be made of more than two observations, and hence they cannot be applied to our case.

[6] Rodgers and Rodgers (1993), p. 27-29.

At the individual level, intertemporal total poverty can be defined as the average of observed poverty across time, and can be written as follows[7]:

$$(4) \qquad \mathrm{RR\_I}_i = \frac{1}{T}\sum_{t=1}^{T}\left\{ \left(1-\frac{Y_{i,t}}{PL_t}\right)^2 \Big|_{\text{if } \mathrm{Y_{i,t}} < \mathrm{PL_t}\,;\,0 \text{ otherwise}} \right\}$$

where RR_I stands for Rodgers and Rodgers' Intertemporal squared poverty gap.

Chronic poverty is the residual poverty once the household has smoothed the flow of income across time, by converting it to a constant flow equal in each period to permanent income. Transient poverty captures all the variability and is the complement to total poverty. Hence, chronic and transient poverty are calculated as follows[8]:

$$(5) \qquad \begin{aligned} \mathrm{RR\_ICR_i} &= \left(1-\frac{Y_i^*}{PL^*}\right)^2 && \text{if } Y^* < PL^* \\ &= 0 && \text{if } Y^* > PL^* \end{aligned}$$

$$(6) \qquad \mathrm{RR\_ITR_i} = \mathrm{RR\_I_i} - \mathrm{RR\_IC_i}$$

where CR stands for Chronic and TR for Transient (added to Rodgers and Rodgers' Intertemporal squared poverty gap).

Jalan and Ravallion (1998, 2000) follow a very similar methodology, but consider consumption instead of income. The idea on which Rodgers and Rodgers' indices is based is that individuals smooth consumption variability across time when they can lend and borrow part of their income, so that observed income should not be used as a measure of current welfare. When consumption is considered, however, the choice of considering an average value can be justified on the base of market imperfections that make adjustment towards the sustainable level slow. As we intend to show the difference between this procedure and our alternative proposal, we describe Jalan and Ravallion's indices in detail.

Jalan and Ravallion (1998, 2000) measure total poverty through the intertemporal squared poverty gap, i.e. through the mean across time of the squared poverty gap measured at each period; this index is identical to Rodgers and Rodgers's index defined in (4) apart from the fact that consumption is used instead of income Hence, the index can be written as follows:

$$(7) \qquad \mathrm{JR\_I}_i = \frac{1}{T}\sum_{t=1}^{T}\left\{ \left(1-\frac{C_{i,t}}{PL_t}\right)^2 \Big|_{\text{if } \mathrm{C_{i,t}} < \mathrm{PL_t}\,;\,0 \text{ otherwise}} \right\}$$

where JR_I stands for Jalan and Ravallion's Intertemporal squared poverty gap. The index assumes a positive value for all the families which experience some poverty in any of the periods of the panel.

[7] This is analogous to equation (4) of Rodgers and Rodgers (1991, p. 32), which referred to the population average in a single period (instead of time average for a single family).

[8] Ravallion (1988) had considered average income in the context of a measure of poverty. Average income is equivalent to permanent income if interest rates on money lent and borrowed are always equal to zero.

The intertemporal measure of poverty is then split into chronic and transient components. Chronic poverty is a function of the average of welfare across time. Only families whose average consumption lies below the poverty line experience some chronic poverty. As the poverty line changes across time, it is reasonable to consider an average value. Transient poverty is the difference between total and chronic poverty. Hence, chronic and transient poverty are calculated as follows:

$$\text{(8)} \qquad \text{JR\_ICR}_i = \left(1 - \frac{\frac{1}{T}\sum_{t=1}^{T} C_{i,t}}{\frac{1}{T}\sum_{t=1}^{T} PL_t}\right)^2 \quad \text{if} \quad \frac{1}{T}\sum_{t=1}^{T} C_{i,t} < \frac{1}{T}\sum_{t=1}^{T} PL_t$$

$$= 0 \qquad \text{if} \quad \frac{1}{T}\sum_{t=1}^{T} C_{i,t} > \frac{1}{T}\sum_{t=1}^{T} PL_t$$

$$\text{(9)} \qquad \text{JR\_ITR}_i = \text{JR\_I}_i - \text{JR\_IC}_i$$

where CR stands for Chronic and TR for Transient (added to Jalan and Ravallion's Intertemporal squared poverty gap).

All indices are equal to zero for households that are never poor. Households which experience poverty at any time have positive total poverty. When the average level of consumption lies below the (average value of the) poverty line, chronic poverty is also observed. In these cases both chronic and transient squared poverty gaps are positive, unless all observed poverty is chronic.

A procedure based on long term sustainable consumption

Equation (8) defines chronic poverty with reference to the average level of consumption observed at the family level along the temporal interval of the panel ($[(C_{98}+C_{01})/2]$ in our case); this choice is adopted by many recent papers on the topic (Jalan and Ravallion (1998, 2000), McCulloch and Baulch (2000)). If markets are perfectly competitive, life-cycle theory predicts that consumption should be steady across time. If families are changing their consumption, it is possible that they are not in equilibrium. Maybe they are converging towards a new level of consumption and market imperfections prevent them from immediate adjustment. In this case, it is unlikely that this new level of consumption in equilibrium is equal to the panel time average. Let us consider a simple example. Assume that a level of consumption equal to 100 is observed in 1998, and 80 in 2001. This household is experiencing a negative trend. Some factors are driving consumption down through time. Would we expect consumption to be 90 in 2004? Or is it more likely for consumption to be 60? This essentially depends on the reasons that have made consumption decrease. This is exactly what our model tries to capture by conceptualizing long term sustainable consumption as a function of household characteristics. Adjustments towards this level explain changes in consumption through time. It is still possible that long term sustainable consumption lies between the observed values, even if the dynamic process follows an error correction model.

This is the case of adjustment with overshooting[9]. Otherwise, the sustainable level of consumption lies outside the interval defined by C_{98} and C_{01}[10].

Furthermore, defining chronic poverty with respect to average consumption implies that only the information relative to each single household is exploited in order to determine a reference point.

We propose, instead, to use full information from the panel data in order to determine the level of consumption that the household can sustain in the long term ($b*X_i$). As we will show, the two approaches may have different implications and lead to different results.

In order to make our proposal comparable with previous literature, we maintain an intertemporal perspective and define total, chronic and transient squared poverty gap indices as follows:

$$(10) \qquad I_i = \frac{1}{T}\sum_{t=1}^{T}\left\{ \left(1-\frac{C_{i,t}}{PL_t}\right)^2 \Big|_{\text{if } C_{i,t} < PL_t \,;\, 0 \text{ otherwise}} \right\}$$

$$(11) \qquad ICR_i = \left(1-\frac{bX_{i,T}}{PL_T}\right)^2 \quad \text{if} \quad bX_{i,T} < PL_T$$
$$= 0 \qquad\qquad \text{if} \quad bX_{i,T} > PL_T$$

$$(12) \qquad ITR_i = I_i - IC_i$$

where T is the last period of the panel, 2001 in our case. Chronic poverty is a function of the level of consumption sustainable in the long run, given household characteristics and assets[11]. The definition of total intertemporal poverty (I) does not change with respect to Jalan and Ravallion. This means that the two procedures result in the same measure of total observed poverty, but in different shares of chronic and transient poverty.

Some households experience chronic poverty even though their consumption is above the poverty line at all points in the panel, if their asset holding and characteristics justify a level of consumption which is below the poverty line in the long run. In these cases, chronic poverty is latent and positive and transient poverty is consequently negative (as the sum of the two must equal total observed poverty, which is equal to zero). Transient poverty can also be negative for families which experience positive total poverty, when long term consumption lies below the level of consumption observed along all the panel time interval.

We propose to go beyond this attempt at harmonization with previous literature and give the word transient its full meaning by referring transient poverty to what happens in each single period. Poverty exists if observed consumption is under the poverty line at a point in time. This observed poverty can still be divided into chronic and transient. We drop the

[9] This is only possible if the parameter which represents the speed of convergence (b_3) is smaller than –1. We will see that in our case this parameter is actually significant and greater than –1, which implies no overshooting; this means that consumption sustainable in the long run lies outside the interval defined by our two observations.

[10] Long term sustainable consumption could be included between observed level of consumption even in case of adjustment without overshooting, if household characteristics had changed between the first and the last observed period. We overlook this case in this version of the paper, leaving it to future research.

[11] A period of reference must be chosen for household characteristics and assets. We use the most recent observation.

intertemporal component of the definition of the poverty indices. Information from different points in time is still used in order to estimate coefficients b, which are necessary to define the level of consumption sustainable in the long run, but poverty indices are calculated on the basis of consumption and characteristics observed at the point in time to which economic analysis refer. For us, this corresponds to the last period of the panel, i.e. 2001.

In general, our indices of poverty are defined as follows:

$$(13)\quad SPG_i = \left(1 - \frac{C_{i,t}}{PL_t}\right)^2 \quad \text{if} \quad C_{i,t} < PL_t$$
$$= 0 \quad \text{if} \quad C_{i,t} > PL_t$$

$$(14)\quad CR_i = \left(1 - \frac{bX_{i,T}}{PL_T}\right)^2 \quad \text{if} \quad bX_{i,T} < PL_T$$
$$= 0 \quad \text{if} \quad bX_{i,T} > PL_T$$

$$(15)\quad TR_{i,t} = I_{i,t} - C_i$$

where SPG is the squared poverty gap and CR and TR are its chronic and transient components, respectively. Such indices are not intertemporal, as the average across time is no longer considered (the letter I is then dropped from the name).

In order to analyze the decomposition of poverty into chronic and transient, it is useful to consider four groups of households, classified on the basis of observed and sustainable consumption.

First, we have families for which both observed and sustainable consumption are higher than the poverty line. In this case poverty is not a current problem and is not expected to show up in the future, as the family has characteristics and assets associated with a relatively high level of long term consumption. For these households, both chronic and transient poverty assume null value.

(16) $C_{i,01} > PL_{01}$; $b*X_{i,01} > PL_{01}$; $C_{i,01}$ <?> $b*X_{i,01}$
$CR_{i,01} = 0$
$TR_{i,01} = 0$

Second, we observe households whose current consumption is under the poverty line, but with a high level of long term consumption. These households are currently poor, but their demographic characteristics and asset holdings are such that we expect them to exit poverty in the future. For this group, there is no chronic poverty; all the observed poverty is transient, so that:

(17) $C_{i,01} < PL_{01}$; $b*X_{i,01} > PL_{01}$; $C_{i,01} < b*X_{i,01}$
$CR_{i,01} = 0$
$TR_{i,01} = (1 - C_{01,i}/PL_{01})^2$

Third, some households are currently above the poverty line, but their level of consumption is not sustainable in the long term. In these cases, no poverty is observed. There is latent chronic poverty, so the chronic standard poverty gap is positive. As a consequence, the transient squared poverty gap is negative, as the sum of the two must equal zero, which is the squared

poverty gap corresponding to observed poverty. In the words of Rodgers and Rodgers, a negative transient poverty index captures "the amount of chronic poverty which is temporarily absent"[12]. Hence we have:

(18) $C_{i,01} > PL_{01}$; $b*X_{i,01} < PL_{01}$; $C_{i,01} > b*X_{i,01}$

$CR_{i,01} = (1 - b*X_{01,i}/PL_{01})^2$

$TR_{i,01} = -(1 - b*X_{01,i}/PL_{01})^2$

Finally, we have families with both observed and sustainable consumption below the poverty line. These people are poor in the present and are expected to remain as such in the future, as they do not have the means to escape poverty. If current consumption is below the sustainable level in the long term, both chronic (relative distance between sustainable consumption and the poverty line) and transient (relative distance between observed and sustainable consumption) are observed. On the contrary, if current consumption is above the sustainable consumption, then a negative level of transient poverty is observed[13]. For this group, the following definitions apply:

(19) $C_{i,01} < PL_{01}$; $b*X_{i,01} < PL_{01}$; $C_{i,01} <?> b*X_{i,01}$

$CR_{i,01} = (1 - b*X_{01,i}/PL_{01})^2$

$TR_{i,01} = (1 - C_{01,i}/PL_{01})^2 - (1 - b*X_{01,i}/PL_{01})^2$

Formulas for indices of chronic and transient poverty for the four groups of households are summarized in Table 2.

Table 2 – Chronic and transient squared poverty gap indices

SQUARED POVERTY GAP		**PREDICTED**	
		NON POOR	**POOR**
REAL (OBSERVED)	**NON POOR**	$CR_{i,01} = 0$ $TR_{i,01} = 0$	$CR_{i,01} = (1 - b*X_{01,i}/PL_{01})^2$ $TR_{i,01} = -(1 - b*X_{01,i}/PL_{01})^2$
	POOR	$CR_{i,,01} = 0$ $TR_{i,01} = (1 - C_{01,i}/PL_{01})^2$	$CR_{i,01} = (1 - b*X_{01,i}/PL_{01})^2$ $TR_{i,01} = (1 - C_{01,i}/PL_{01})^2 - (1 - b*X_{01,i}/PL_{01})^2$

Coefficients b come from the estimation of equation (1). However, particular attention must be paid to the choice of dX, in order to avoid problems of endogeneity which would bias our results. In particular, we include only characteristics which do not seem to change with consumption within a joint process of decision, and public policies which are not subject to potential program selection bias[14]. Because of this, dX does not include all the variables contained in X. Furthermore, we restrict the size of X, for two reasons:

- some of the characteristics whose effect we would be interested in analyzing occur in a very small number of families, so that considering them we would risk picking up the individual effect of that group of families rather than the potential effect of the variable for the whole sample;
- some groups of variables are very correlated among themselves and their inclusion in the model would create problems of multicollinearity, reducing the precision of the

[12] In the same way as a positive transient poverty index captures "the amount of poverty which is not chronic" (Rodgers and Rodgers, 1993, p. 32).

[13] This surplus is expected to disappear in the future (as all other deviation from the sustainable level of consumption).

[14] We also tried estimating model (1) including all possible dX. The quality of the fit increases a little, but results and conclusions do not change notably. We then chose to maintain the more cautious specification and avoid potential endogeneity problems, so that estimated coefficients keep having the desired causality meaning, which is useful for policy discussion. We also estimated a simplified model including no dX. Results are presented in Table A2.

estimates of the coefficients. This is true, for example, for variables like "cattle" and "pasture land"; in this case only one of the variables is retained.

We estimate two different models for rural and urban families. Included variables are listed in Table A1.

5. ATTRITION

Attrition may be caused by a number of factors. Households may migrate temporarily or permanently for labor or personal reasons, civil unrest, banditry, or natural disaster. Informants may be out on errands when the surveyor is in town, and in some case informants may simply refuse to participate again. Laxness on the part of supervisors and surveyors can also lead to "disappearing" households, particularly in difficult to access areas of a census segment. For approximately 60 percent (635) of missing households in 2001, surveyors found the original dwelling, but with a new household, who was then surveyed. Of the remaining 413 households, for a variety of reasons the original informant was unavailable, and no new household was found in the dwelling. Most dwellings were in fact abandoned, in some cases the house no longer existed or could not be found, and finally approximately 20 percent of the old households simply refused to participate.

With about one quarter of 1998 panel households lost, attrition may constitute a major problem. In the words of Hausman and Wise, "attrition which is related only to the exogenous variables in a structural model does not lead to biased estimates, since these variables are controlled for in the statistical analysis. However, if attrition is related to endogenous variables, biased estimates result" (1979, p. 462). We evaluate the relevance of the problem through a set of methods[15].

First, we compare the distribution of household characteristics in 1998 in the two subsets of attriters and nonattriters.

Second, we perform a multivariate Probit analysis, in order to see which variables influence the probability of attrition when controlling for other characteristics.

Third, we perform the BGLW test (Becketti et al, 1998). This is done by regressing the dependent variable in the initial period (consumption in 1998, in our case) on its determinants, separately for attriters and nonattriters, then evaluating the significance of the difference of the coefficients in the two subsamples. This test assesses how household characteristics determine consumption in a different way for households which leave the sample.

Fourth, we perform a Heckman regression and test if the correlation between the consumption equation and the selection equation is significant. This test is the only one in which we can use model (1). In fact, the BGLW test requires observing the dependent variable for all households, both attriting and nonattriting. Hence, consumption in the first period must be used. On the contrary, Heckman can use a dependent variable relative to the second period, under the assumption that this is not observed for attriters. However, model (1) must be modified by excluding the changes in household characteristics between the two periods, as neither the dependent nor the independent variables are surveyed for attriting households in 2001.

[15] A good treatment of tests of attrition and relative application to cases similar to ours can be found in Alderman et al. (2000).

Fifth, we follow Fitzgerald et al, (1998) and perform a test based on the comparison of the coefficients of ordinary (OLS) and weighted least square (WLS) regression (hereafter FGM test). In fact, WLS estimation is able to correct attrition bias when attrition depends on observable characteristics, hence the problem of attrition can be excluded if OLS and WLS coefficients are similar.

Results from the first two kinds of analysis do not indicate a clear pattern or typology of households which are more likely to abandon the sample. On one side, it seems that smaller households, with a younger head, more members working in poorly paid activities and who do not own the dwelling they live in, are more likely to drop out of the sample. On the other side, however, agricultural assets have conflicting impacts and business assets are positively correlated with attrition. Overall, most of the variability is explained by:

- demographic characteristics, including gender of the head of the household and the size of the household;
- ownership of the house, with families which hold property rights on the dwelling having a probability of attrition lower by over 20 percent;
- regional factors, with attrition least likely in the Pacific region. With respect to this area, the probability of attrition increases by about 7-9 percent in the Central region and in Managua, and by over 20 percent in the Atlantic region.

However, household assets, demographic characteristics, geographic location and initial level of consumption are able to explain only a very small part of the variability in the probability of attrition (with pseudo R-squared in the multivariate Probit analysis at most around 0.10).

Also the other tests indicate that attrition is not a major problem in our sample. BGLW, Heckman and FGM tests reject the hypothesis that attrition introduces a bias in our analysis (Table 3). The only exception is represented by the BGLW test for urban households. We feel confident in proceeding by estimating model (1) for panel households using standard regression techniques. The full results of this attrition analysis can be found in Davis and Stampini (2002).

Table 3 – P values of the test of the null hypothesis of lack of attrition bias.

TEST OF ATTRITION	Rural	Urban
BGLW – test F of joint difference of betas for attriters	.71	.00
Heckman - LR test of indep. eqns. (rho = 0) Prob > chi2	.72	.77
FGM – Hausman test of WLS vs OLS -	1.00	1.00

6. DETERMINANTS OF WELFARE

Full results of the estimation of equation (1) for rural and urban households are presented in Table A2, which also shows the long term coefficients resulting from the transformation of b_2 and b_3 in (1).

Rural households

In terms of rural households, we find justification of the adoption of an error correction model type of approach. The coefficient of initial consumption is strongly significant and equal to –

0.47. This means that consumption changes between 1998 and 2001 are in the direction of reducing the distance from the level of consumption sustainable in the long term through a smooth adjustment (with no overshooting).

As far as concerns the determinants of welfare, the results provide a clear message. First, agricultural activities, both off and on farm, did not serve as a poverty exit strategy during the panel period. Higher levels of consumption are obtained through allocation of household labor to non agricultural activities, both wage and self employment. This does not mean that all on farm agricultural activities are associated with poverty; in fact, ownership of a greater number of heads of cattle is associated with higher levels of consumption, suggesting that certain types of asset accumulation in agriculture increases welfare. Second, education is strongly associated with increased levels of consumption. This is the expected result and justifies current programs which emphasize increased access to education among the rural poor. Third, household size is strongly associated with decreased levels of consumption. In addition, it can be noted that female headed households are characterized by a lower level of consumption, while the age of the head of the household is associated with higher welfare.

Table A2 highlights some differences between short term and long term effects of household assets and characteristics. While an increase in family size seems to produce immediately its negative effect on per-capita consumption, with education the short term effect is much smaller than the long term effect. If all the adult members of the family increase their education by one year, this improvement produces an increase in per-capita consumption by 182 Cordobas/year, but when the long term potential of this asset is fully developed the increase in consumption will amount to 448 Cordobas/year. This result is consistent with theoretical expectation and with common sense, as education needs time in order to fully produce benefits on welfare through better work opportunities.

Urban households

Also for urban households the adoption of model (1) is supported by estimation results. Once again, the coefficient associated with initial consumption is significant, in this case equal to –0.40. Adjustment towards the level of consumption sustainable in the long term seems slightly slower than in rural areas, even though the difference may not be statistically significant. Once again, it is realized without overshooting.

As far as concerns the determinants of welfare, the results provide a somewhat mixed message. First, little effect is found on the allocation of household labor. The lack of significance in part could derive from the overly heterogeneous non agricultural wage labor category, which lumps together skilled and unskilled labor. We suggest that this variable is too blunt and requires further disaggregation into types of non agricultural wage labor. Ownership of agricultural assets (summarized in the adjusted size of land) is associated with greater welfare. Second, average household education level is strongly associated with greater levels of well being. Third, as with the rural families, household size is associated with lower welfare. Differently from rural areas, the quality of the dwelling, an indicator of asset accumulation, is significantly correlated with higher consumption. Access to paved roads from the dwelling is also associated with higher consumption. As with rural households, important differences between the short term and the long term effect of improvements in education can be observed.

It is worth stressing that the estimated b_3 does not imply convergence of consumption towards a common level, which would mean poverty decreasing through time (more equality, less

relative poverty). Each household's consumption tends to converge towards its long run equilibrium level, which can be higher or lower than current (observed) consumption. Econometrically, this depends on the fact that the effect of initial consumption is estimated given all other household characteristics.

7. EVIDENCE ON THE DECOMPOSITION OF TRANSIENT AND CHRONIC POVERTY

Tables 4 to 7 present the decomposition of observed poverty into chronic and transient according to different classifications, in order to allow for comparison of our proposal with previous works of Jalan and Ravallion.
In particular, we show:
- intertemporal total, chronic and transient squared poverty gap indices, using:
    - Jalan and Ravallion's formulas based on average consumption (equations 7 to 9);
    - our definition of sustainable consumption (b*X) (equations 10 to 12);
- non intertemporal total, chronic and transient squared poverty gap indices, based on consumption observed in 2001; here panel data is still used in order to estimate the chronic component, using again:
    - Jalan and Ravallion's formulas based on average consumption;
    - our definition of sustainable consumption (b*X) (equations 13 to 15).

Rural households

The first finding of our analysis concerns the incidence of transient and chronic poverty among rural households (Table 4). If the intertemporal index is used, the squared poverty gap is 0.129. Decomposing chronic and transient poverty according to average observed consumption or to sustainable long term consumption produces quite different results. The first choice suggests that about 12 percent of poverty is transient (0.016 out of 0.129), while the remaining 88 percent is chronic. If the concept of sustainable consumption is adopted, however, the share of transient poverty grows to 24 percent (0.031 out of 0.129).

The same trend can be observed when non-intertemporal indices are used. When chronic poverty is measured according to the average level of observed consumption, as in Jalan and Ravallion, it accounts for 98 percent of total observed poverty. When the concept of sustainable consumption is used instead, only 87 percent of poverty is chronic and the remaining 13 percent is transient.

Using a non-intertemporal index of poverty also allows classification of households according to observed and predicted poverty. This is shown in Table 5. We can observe that 429 households out of a total of 1212 are poor and are expected to remain as such (35 percent). Their asset holding and demographic characteristics do not justify a level of consumption above the poverty line, hence these families have little possibility of leaving poverty without a change in household assets, even in the long run. They need public intervention both in order to fill the consumption deficit in the short term and in order to help generate the skills and assets necessary to permanently abandon poverty. The latter is particularly needed, as Table 5 shows that almost all poverty is chronic in this group. At the other extreme, we find 433 families which are not poor and are not expected to become poor (36 percent). They are safe from poverty and do not need public intervention. Then, we have two more groups for which observed and expected poverty status do not coincide. 265 families are not expected to be

poor in the long run, but are poor in 2001 (22 percent). Their poverty is transient, so only temporary support is needed. The situation is different for the 85 families which are currently above the poverty line, but whose consumption is expected to drop, driving them towards poverty (7 percent). Here a structural intervention would be more useful, focused on improving asset holding and education.

The size of the four groups is different if Jalan and Ravallion's definition of chronic poverty is used (see Table 5, right hand side). Poverty would be seen as totally transient for 65 households only (as compared to 265 – 5 percent instead of 22 percent). This divergence in results is relevant as a different mix of short term and long term policies would be called for.

Table 4 – Total, chronic and transient squared poverty gap in rural areas.

	Intertemporal		Non-intertemporal (in 2001)	
	based on bX	based on mean C	based on bX	based on mean C
Chronic	.098	.113	.098	.111
Transient	.031	.016	.015	.002
Total	.129	.129	.113	.113

Table 5 – Observed and predicted poverty: total, chronic and transient squared poverty gap in rural areas.

Non-intertemporal		Predicted (2001)							
		based on bX				based on average C			
		Non Poor		Poor		Non Poor		Poor	
Observed	Non Poor	N.	433	N.	85	N.	415	N.	103
		Chronic:	.00	Chronic:	.124	Chronic:	.00	Chronic:	.019
		Transient:	.00	Transient:	-.124	Transient:	.00	Transient:	-.019
		Total:	.00	Total:	.00	Total:	.00	Total:	.00
	Poor	N.	265	N.	429	N.	65	N.	629
		Chronic:	.00	Chronic:	.227	Chronic:	.00	Chronic:	.204
		Transient:	.104	Transient:	.011	Transient:	.022	Transient:	.004
		Total:	.104	Total:	.238	Total:	.022	Total:	.208

Urban households

Also for urban households, important differences between the results of the two procedures can be observed, but the situation is quite different.

By adopting the concept of sustainable consumption the measure of chronic poverty grows dramatically, and a high value of negative transient poverty is observed (Table 6). This means that poverty is expected to increase in the long term, when households approach their equilibrium. It also means that an important share of chronic poverty is currently not observed, masked by a high level of negative transient poverty, and that long term policies affecting asset holding and education are particularly needed. In this case, no important differences arise when intertemporal measures of poverty are adopted.

As for the size of the four groups defined by the condition of observed and expected poverty, we must start by noting that most households, 1062 out of 1452 (73 percent), are not poor and given their assets and characteristics are not in danger of falling into poverty in the long run. This means that anti-poverty policies are relevant for only 390 families (27 percent). Of these, 162 are currently poor and are expected to remain as such (11 percent). 45 currently non poor

families need long term policies in order to avoid entering poverty in the future, while 183 families need short term support in order to help overcome transient poverty, as they dispose of assets and characteristics sufficient to drive themselves out of poverty in the future (12 percent).

If Jalan and Ravallion's definition of chronic poverty is adopted, two main differences arise. First, the group of only transiently poor is much smaller, including 72 households instead of 183 (5 percent instead of 12 percent). Furthermore, the strong negative transient poverty is not observed for those households which are classified as poor on the base of average consumption. This is due to the fact that the classification does not capture the trend towards a reduced level of welfare. When average consumption is considered, no trend can be observed. This may imply that analysts are not sufficiently alerted on the seriousness of the depth of poverty for urban poor households. Even if these people live in an environment characterized by a lower amount of total poverty, they may be the "forgotten" of this environment, which with time would end up being characterized by the highest degree of inequality. Structural policies regarding asset holding and education may be needed in order to avoid this scenario in the future.

Table 6 – Total, chronic and transient squared poverty gap in urban areas.

SPG	Intertemporal		Non intertemporal (in 2001)	
	based on bX	based on mean C	based on bX	based on mean C
Chronic	.076	.025	.076	.025
Transient	-.042	.008	-.048	.004
Total	.033	.033	.028	.029

Table 7 - Observed and predicted poverty: total, chronic and transient squared poverty gap in urban areas.

Non-intertemporal SPG		Predicted (2001)							
		based on bX				based on average C			
		Non Poor		Poor		Non Poor		Poor	
Observed	Non Poor	N.	1062	N.	45	N.	1055	N.	52
		Chronic:	.00	Chronic:	.214	Chronic:	.00	Chronic:	.018
		Transient:	.00	Transient:	-.214	Transient:	.00	Transient:	-.018
		Total:	.00	Total:	.00	Total:	.00	Total:	.00
	Poor	N.	183	N.	162	N.	72	N.	273
		Chronic:	.00	Chronic:	.483	Chronic:	.00	Chronic:	.118
		Transient:	.069	Transient:	-.331	Transient:	.028	Transient:	.016
		Total:	.069	Total:	.152	Total:	.028	Total:	.134

8. CONCLUSIONS

The overall drop in poverty from 1998 to 2001 in Nicaragua is rather modest. However, these apparently small changes mask large movements in and out of poverty categories. In order to interpret these movements and inform sensible anti-poverty policies, it is useful to decompose overall poverty into its transient and chronic components.

In the present paper, the dynamic of consumption is studied in order to define the level of consumption that each family can sustain in the long term. This concept is then used to define

the chronic poor, i.e. those households whose long term consumption lies below the poverty line. Previous literature had defined chronic poverty with reference to average observed consumption or income. The innovation of our proposal lies in the fact that all the information from the 2 period panel data set, relative to all households, is exploited in order to identify which level of consumption each family is tending to through time. The fact that the consumption dynamic can contain a temporal trend is accounted for. Furthermore, our definition of chronic poverty allows one to identify four different groups of families which differ by level of observed consumption and by potential to generate income for consumption. The four groups are characterized by different incidence of chronic and transient poverty and hence need different kinds of anti-poverty policies and public support.

With respect to the procedure based on average consumption, in the case analyzed our indicators result in giving transient poverty a more important role. This is true both in rural areas, where transient poverty is positive and accounts for about 15 percent of total poverty, and in urban areas, where transient poverty is negative, meaning that part of the chronic poverty intrinsic in the system is not observed in the present but will show up in the future. This also implies that procedures based on average consumption underestimate the importance of chronic poverty in urban areas and do not correctly identify the need for structural policies.

As for the determinants of welfare and paths out of poverty, the role of education is fundamental in both rural and urban areas. Results suggest that the expansion of targeted interventions such as the Red de Protección Social (RPS, or Social Protection Network, see IFPRI (2002))—which provides cash to extremely poor households in return for sending their children to school and having health checkups—to a greater number of eligible households nationwide should be considered. This kind of program would help reducing the negative effects of both transient and chronic poverty, by supporting income in the short term and increasing income potential in the long run.

The caveat of our proposal is that the definition of consumption sustainable in the long term, and hence the definition of chronic poverty, relies on the econometric specification of model (1). If the model is wrong or does not perform sufficiently well, then the reliability of the decomposition of poverty into chronic and transient is lower. However, if more observations in time were available also the quality of the estimation could be improved dramatically, so that more informed policy decisions could be taken.

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Appendix

Table A1 – Independent variables included in the econometric analysis

Levels in 1998 (X)	*Rural*	*Urban*
Agricultural wage labor, share	x	x
Non agricultural wage labor, share	x	x
Non agricultural self employment, share	x	x
Agricultural self employment, share	x	x
Cattle	x	
Annual agricultural land	x	
Permanent agricultural land	x	
Stock of assets for non-agricultural business	x	x
Participation in agricultural producer organization	x	
Presence of migrants between 1997 and 1998	x	x
Dirt floor	x	x
Average adult education	x	x
Credit constraint	x	x
Paved road	x	x
Household size	x	x
Dependency ratio	x	x
Female head of the household	x	x
Head age	x	x
Head speaks indigenous language	x	
Adjusted land size		x
Managua	x	x
Central region	x	x
Pacific region	x	x
Changes between 1998 and 2001 (dX)		
Average adult education	x	x
Road quality	x	x
Household size	x	x

Table A2 – Determinants of change in consumption, rural and urban households

Dependent Variable: Variation in Consumption	*Rural1 Complete*	*Long Term b*	*Rural2 Simple*	*Urban1 Complete*	*Long Term b*	*Urban2 Simple*
Managua	-278.334		-125.057	27.404		116.397
	(0.65)		(0.27)	(0.06)		(0.25)
Central Region	-208.832		-130.283	195.621		423.685
	(1.06)		(0.65)	(0.49)		(0.99)
Pacific Region	16.742		234.869	-315.756		9.513
	(0.08)		(1.10)	(0.90)		(0.03)
Share of adults, agricultural wage	84.700	179.622	-18.374	-458.646	-1147.198	-1,132.03**
	(0.39)		(0.08)	(0.93)		(2.23)
Share of adults, non agricultural wage	542.169**	1149.770	619.119**	-333.414	-833.959	-408.243
	(1.97)		(2.18)	(0.98)		(1.16)
Share of adults, non agricultural self employed	1,190.345**	2524.348	1,190.404**	-115.690	-289.372	-483.545
	(2.03)		(2.00)	(0.18)		(0.72)
Share of adults, agricultural self employed	-269.844	-572.254	-364.057	548.013	1370.729	-69.754
	(0.75)		(0.98)	(0.67)		(0.08)
Hh average years of education	211.324***	448.152	189.548***	287.399***	718.863	218.974***
	(6.26)		(5.86)	(5.75)		(4.36)
Credit constraint	-82.047	-173.996	-119.131	257.834	644.913	113.042
	(0.67)		(0.93)	(0.83)		(0.36)
Paved access to home	200.911	426.069	349.604	759.422**	1899.520	859.364***
	(0.78)		(1.21)	(2.54)		(2.75)
Cattle [n. of cows]	21.804**	46.239	23.542**			
	(2.42)		(2.48)			
Land in annuals	-1.055	-2.237	0.361			
	(0.71)		(0.18)			
Land in perennials	4.511	9.566	4.969			
	(1.44)		(1.54)			
Value of assets for non agricultural business	0.023	.049	0.028	0.006	.015	0.014***
	(1.10)		(1.43)	(0.84)		(2.90)
Member of agricultural organization	-427.859	-907.354	-463.958			
	(1.32)		(1.41)			
Migration assets	-364.458**	-772.901	-282.491	200.249	500.877	25.805
	(2.04)		(1.49)	(0.23)		(0.03)
Dirt floor	38.251	81.118	42.325	-776.033***	-1941.069	-975.379***
	(0.23)		(0.25)	(3.74)		(4.52)
Family size	-193.546***	-410.450	-79.400***	-378.955***	-947.869	-111.231**
	(7.39)		(3.30)	(7.59)		(2.47)
Dependency ratio	-329.372	-698.494	-373.469	-654.158	-1636.227	-929.299
	(1.00)		(1.09)	(1.05)		(1.47)
Female headed household	-474.308***	-1005.858	-371.503**	119.043	297.759	272.856
	(3.18)		(2.28)	(0.42)		(0.93)
Head of household age	9.700*	20.571	14.903***	12.491	31.243	11.212
	(1.95)		(2.87)	(1.48)		(1.24)
Head speaks indigenous language	467.486	991.391	266.776			
	(1.42)		(0.80)			
Change - Hh average years of education	182.602**			273.704***		
	(2.15)			(2.99)		
Improvement in road conditions	338.531*			248.614		
	(1.78)			(0.81)		
Change - Family size	-396.858***			-771.988***		
	(10.18)			(11.25)		
Per-capita consumption in 1998	-0.472***		-0.445***	-0.400***		-0.375***
	(8.77)		(8.02)	(7.76)		(7.13)
Total land size - adjusted				20.709***	51.799	22.238***
				(5.61)		(5.79)
Constant	2,296.26***		1,414.98**	3,187.25***		2,442.49***
	(3.81)		(2.33)	(4.00)		(3.07)
Observations	1190		1190	1416		1417
R-squared	0.28		0.19	0.24		0.17

Robust t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

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