Nicaragua: trend of multidimensional poverty, 2001-2009

José Espinoza-Delgado and Julio López-Laborda

Abstract

This paper estimates multidimensional poverty in Nicaragua between 2001 and 2009, using data from the three most recent standard of living surveys that are available (2001, 2005 and 2009), and mainly following the methodology proposed by Alkire and Foster (2007 and 2011). For that purpose, 10 dimensions and three weighting systems are used: equal-weightings and two other systems based on the data themselves, one based on the first principal component scores, and the other based on the relative frequencies of dimensional deprivations (both of these systems are new to Nicaragua). Overall, the results show that the incidence, intensity and severity of multidimensional poverty in Nicaragua declined in 2001-2009, and particularly so between 2001 and 2005.

Keywords

Poverty, standard of living, measurement, household surveys, statistical methodology, Nicaragua

JEL classification

D31, I32, O15.

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I. Introduction

The conceptual understanding of poverty has been improved and deepened notably in the last three decades, thanks to the seminal work of Amartya Sen and his theoretical framework of capabilities and functionings (Thorbecke, 2008, p. 3).[1] There is currently a broad consensus that poverty is a multidimensional phenomenon and that its analysis cannot be confined to the study of a monetary dimension (Sen, 1985 and 2000; Atkinson, 2003; Kakwani and Silber, 2008; Stiglitz, Sen and Fitoussi, 2009a and 2009b) —whether per capita income or per capita consumption expenditure, as suggested by the traditional or monetary approach to measuring poverty. In this context, a broader poverty measure, which considers other attributes apart from income (Atkinson, 2003, p. 51), is a key and necessary input for the design, monitoring and evaluation of poverty-reduction policies.

Taking Sen's ideas as a conceptual base, and returning to previous work by Espinoza-Delgado and López-Laborda (2015), this study measures poverty in Nicaragua from a multidimensional standpoint, using the data from the last three available editions of the National Household Survey on Living Standards Measurement (EMNV, 2001, 2005 and 2009) and applying the measurement methodology proposed by Alkire and Foster (2007 and 2011). Specifically, the measures H, M_0, M_1 and M_2 proposed by Alkire and Foster are estimated; and the trend of the first two is compared with the headcount ratio obtained by applying the official methodology used to measure poverty in Nicaragua, which basically follows a monetary approach. Before calculating these measures, a global measure is estimated that follows some of the ideas of the fuzzy poverty measurement proposed by Cerioli and Zani (1990), which is also compared against the official poverty estimates. This global measure could also be used as an anchor to approximate the second cut-off (or multidimensional poverty threshold) required by the Alkire and Foster methodology to identify individuals who are multi-dimensionally poor (Alkire and Foster, 2011, p. 478), and to obtain a specific estimation based on this methodology, which is not done in this paper. The analysis considers 10 dimensions which are then aggregated by using three alternative weighting systems. Apart from equal weights, two weighting systems are obtained from the data themselves: one based on the first principal component scores, and the other based on the relative frequencies of deprivations in the different dimensions.

In general, the literature contains few studies on poverty in Nicaragua, and even fewer have analysed poverty from a multidimensional perspective, beyond the unsatisfied basic needs (UBN) approach, of long tradition in the region (ECLAC, 2009; Boltvinik, 2013). This situation is not peculiar to Nicaragua; studies on multidimensional poverty are very few and far between in all of Latin America (Roche and Santos, 2012, p. 4; Battiston and others, 2013, p. 292), and the monetary approach has dominated the studies undertaken, particularly in Central America (ECLAC, 2009, p. 17).[2]

One of the earliest attempts —if not the first— to measure multidimensional poverty in Nicaragua (and also in other Central American countries) can be found in the ECLAC study on poverty and social vulnerability of December 2003. This applies the "integrated poverty measure" proposed by Kaztman (1989), which jointly considers the incidence of income and unsatisfied basic needs (ECLAC, 2003, p. 19). Although this paper was innovative at the time, its suggested approach has several methodological weaknesses: it accords a major protagonist role to income (ECLAC, 2009, p. 49) and does not take account of the dimensional deficits, an issue raised by Bourguignon and Chakravarty (2003, p. 27). Another ECLAC study (ECLAC, 2009) uses a variety of methodologies, apart from the Kaztman measure —the Alkire and Foster methodology, principal components and cluster analysis—

[1] See, for example, Sen (1985, 1992, 2000 and 2008).

[2] ECLAC (2009) summarizes the different studies that have used different methodologies to measure multidimensional poverty in Latin America, and particularly in Central America (ECLAC, 2009, pp. 19 ff). For the specific case of Nicaragua, there are only two references: Del Carpio and Castro (2007), which uses a subjective approximation of well-being, and ECLAC (2003), which uses the integrated poverty measurement.

to estimate multidimensional poverty in Mexico and Central America (including Nicaragua). Like the Katzman paper, this ECLAC study makes a joint analysis of per capita income and seven dimensions of UBN (housing, overcrowding, water, sanitation, education, electricity, and household consumption capacity). It also applies the Alkire and Foster methodology to the case of Nicaragua for the first time and estimates H and M_0 using data from the 2005 EMNV. The results show that 84.3% of the Nicaraguan population was suffering from deprivation in at least one dimension in 2005, and that 0.1% suffered deprivation in all of the dimensions; estimations for M_0 range from 30.7% to 0.1% (ECLAC, 2009, p. 38).

This was followed by the Alkire and Santos (2010) study, which includes estimations of multidimensional poverty in Nicaragua, in relation to the proposed multidimensional poverty index (MPI). This adheres to the mathematical structure of one of the measures of the Alkire and Foster methodology (M_0) and considers 10 indicators representing the three dimensions that are used to calculate the Human Development Index (HDI) published by the United Nations Development Programme (UNDP). According to this study, data from the 2001 Nicaraguan Demography and Health Survey show that 40.7% of the Nicaraguan population was living in conditions of multidimensional poverty (H); and the country was ranked 64th out of a total of 104 developing countries, with an M_0 of 0.211 (Alkire and Santos, 2010, p. 75). It is worth noting that the index proposed by Alkire and Santos (2010) has been adopted by UNDP; and since 2010 it has formed part of the Human Development Report (UNDP, 2010). Nonetheless, as it is an acute poverty index, it gives relatively lower estimations for Nicaragua, and even for all of Latin America; so its results are not very relevant to the reality of the country and region as a whole (Roche and Santos, 2012). Then, the National Human Development Report for 2011, prepared by the UNDP Office in Nicaragua (UNDP, 2011), puts forward the Youth Multidimensional Poverty Index (IPMJ), which incorporates four dimensions (education, employment, health, and household conditions). This index also uses the M_0 measurement of the Alkire and Foster methodology, and focuses on the Nicaraguan population aged between 13 and 29 years. This report, using data from the 2001 and 2005 EMNV and the 2009 Household Survey for poverty measurement of the International Foundation for the Global Economic Challenge (FIDEG), concludes, among other things, that the proportion of young people and adolescents who were multidimensionally poor declined by 8.3 percentage points between 2001 and 2009 (UNDP, 2011, p. 82).[3] Lastly, Roche and Santos (2012) analyses the results of the IPM for 18 Latin American and Caribbean countries, including Nicaragua, and proposes a number of amendments to the index to better reflect multidimensional poverty in the region, and to make the estimations more relevant.

Thus, as far as the authors are aware, this study, together with the earlier work by Espinoza-Delgado and López-Laborda (2015), represents the first attempt to measure and determine the trend of multidimensional poverty in Nicaragua, at the national level and for the population as a whole, using data from the last three available EMNVs, which the Government of Nicaragua uses to measure poverty (INEC, 2002a, 2002b and 2003; INIDE, 2007 and 2011a). The surveys also have the advantage of including information on the income and expenditure of Nicaraguan households, which makes it possible, among other things, to compare the trend of monetary and multidimensional poverty. This study is also the first attempt to measure the intensity and severity of multidimensional poverty in Nicaragua —two aspects of poverty that are not estimated in the literature that deals with the measurement of multidimensional poverty in Nicaragua and elsewhere, perhaps owing to the nature of the data. Naturally, the intention is not to propose the multidimensional poverty measurement, but to provide empirical evidence for adopting a broader approach to measuring poverty in the country, which complements the official estimations and helps to reduce the deficit in the specialized literature on Nicaragua and the region.

[3] See [online] www.fideg.org.

Section II describes the data and methodological issues (multidimensional poverty measures, the choice and justification of the dimensions and indicators, dimensional poverty lines and weightings). Section III presents the main results obtained. Section IV addresses issues relating to the bilateral correlations and overlaps in identifying the poor; and section V sets out a number of conclusions.

II. Data and methodological issues

The data analysed are obtained from the last three EMNVs (2001, 2005, 2009) conducted by the National Information and Development Institute (INIDE) of Nicaragua, with support from the World Bank.[4] The sample encompassed 4,191 households (22,810 people) in 2001; 6,882 households (36,612 people) in 2005; and 6,515 households (30,432 people) in 2009. Given the aim of this study, the household is the unit of analysis chosen to identify the poor.[5] Nonetheless, information pertaining to individuals is also incorporated, and related to the household in question; and the results are presented in population terms using the survey expansion factors.

1. Multidimensional poverty measures

According to Sen, two problems need to be addressed when measuring poverty: the identification of the poor in the wider population, and the construction of a poverty index that uses the available information on the poor (Sen, 1976, p. 219). To resolve these two issues, in a multidimensional context for Nicaragua, this paper follows the Alkire and Foster (2007 and 2011) methodology, which consists of an identification method (rho-k), which expands the traditional approaches of union and intersection, and a family of measures, M_α, which resolves the second issue.[6] The identification method uses two cut-offs: one within each dimension (dimensional cut-off) to determine whether the unit of analysis is deprived in that specific dimension; and a second cut-off between the dimensions (k), which identifies the poor by counting the dimensions in which the unit of analysis is deprived. Alkire and Foster (2011, p. 478) suggest setting the value of k at some intermediate point between the two extremes that represent the traditional approaches, which is controversial and arbitrary. This study follows the principles of the dominance approach for analysing poverty, and uses a wide range of k-values (Duclos, Sahn and Younger, 2008, p. 246). The M_α measures, meanwhile, are based on the Foster-Greer-Thorbecke (FGT) family of measures, suitably adjusted to take account of multi-dimensionality. This study, apart from the multidimensional headcount ratio (H), calculates the adjusted headcount ratio (M_0), the adjusted poverty gap (M_1) and the adjusted FGT measure (M_2).[7] Accordingly, it addresses the three important aspects of poverty —incidence, intensity and inequality— which have been called the "three Is" of poverty (Jenkins and Lambert, 1997, p. 319).

[4] Previously, INIDE was the National Institute of Statistics and Censuses (INEC).

[5] This is a normative decision making it possible to appropriately compare the estimations made in this study with the official figures and with estimations of the multidimensional poverty index for Nicaragua. In addition, the household represents the unit observation of the surveys used (INEC, 2006, p. 4; INIDE, 2011b, p. 4).

[6] The union approach classifies a household as poor if it suffers deprivation in at least one dimension. At the other extreme, the intersection approach requires the household to suffer deprivation in all of the dimensions to be considered poor (see Atkinson, 2003).

[7] H measures the fraction of the population that is multidimensionally poor; M_0 (which is sensitive to the frequency and amplitude of multidimensional poverty) is obtained by multiplying H by the average proportion of deprivations suffered by the multidimensionally poor (A); M_1 is the product of M_0 and the average poverty gap (G); M_2 is the product of M_0 and the average severity index (S), and it is sensitive to the inequality with which deprivations are distributed among the poor (Alkire and Foster, 2011, p. 479).

Before calculating the measures referred to above, the study estimates a measure that follows the structure of the fuzzy poverty index proposed by Cerioli and Zani (1990), which is also used to approximate the second cut-off required by the Alkire and Foster (2011) identification method. This measure (Cerioli and Zani, 1990, p. 282) is defined as:

$$P = \frac{1}{n}\sum_{i=1}^{n} \mu_A(i) \qquad (1)^8$$

where $\mu_A(i)$ denotes, for each household, a degree of belonging to the subset of multidimensionally deprived persons, and it is constructed according to the following expression:

$$\mu_A(i) = \frac{\sum_{j=1}^{d} w_j Pr_{ij}}{\sum_{j=1}^{d} w_j} \quad (i = 1, 2, \ldots, n) \qquad (2)$$

where w_j represents the weighting of dimension j and Pr_{ij} reflects the deprivation of household i in dimension j. Thus, Pr_{ij} will take the value 1 if the ith household is deprived in dimension j, and 0 otherwise. So, $\mu_A(i) = 0$ if the ith household does not suffer deprivation in any dimension, which would mean that it was clearly not poor; $\mu_A(i) = 1$ if the ith household suffers deprivation in all dimensions, which would make it clearly a multidimensionally poor household; and $0 < \mu_A(i) < 1$ if the ith household is deprived in some but not all of the dimensions.

2. Choice and justification of the dimensions and indicators

Following Alkire and Santos (2010, p. 11), the choice of the relevant dimensions is a value judgement rather than a technical exercise; and it is a crucial step in defining a multidimensional poverty measure (Battiston and others, 2013, p. 294). Bearing this in mind, and based on the UBN approach and guided also by the Millennium Development Goals, this study considers a set of dimensions and indicators that certainly reflect important aspects of the well-being of Nicaraguan households and are directly related to specific basic capabilities (Klasen, 2000, p. 38). Table 1 shows the dimensions, indicators and scores associated with each achievement.

Considering the attainments, as described by the selected indicators, as a matter of degree rather than an "all or nothing" condition (Chiappero Martinetti, 2006, p. 100), and taking advantage of the information available on them, the study has scored each indicator on a scale of 1 to 5. A score of 5 represents the best possible standard or condition; a score of 3 represents a basic level of well-being; and a score of 1 represents the worst condition, or severe deprivation. With this scoring structure, the differences in the levels of achievement are interpreted on a cardinal basis: an achievement that obtains a score of 4 is interpreted as being twice as good as one that scores 2. Although this is arguable, in most cases the scoring is quite intuitive and it is unlikely to cause much debate. Moreover, the cardinal interpretation is a good approximation of the differences in the achievements (Klasen, 2000, p. 39).

[8] *P* represents the proportion of individuals that belong, in a fuzzy-set sense, to the subset of poor; and it provides an effective measure of the full extent of poverty in the population (Cerioli and Zani, 1990, p. 282).

Table 1
Dimensions and indicators

Weightings (1 represents the worst condition or severe deprivation, and 5 indicates the best condition)						
Dimension	Description of the indicator used	1	2	3	4	5
Income	Quintiles of per capita consumption expenditure	Poorest quintile	Quintile 2	Quintile 3	Quintile 4	Wealthiest quintile
Years of schooling	Average years of schooling of adult members of the household (16+ years of age)	0 <= 3	> 3 <= 6	> 6 <=10	> 10 <=14	> 14
Children in school	Percentage of children of 6 to 16 years of age attending school	0%-19%	20%-39%	40%-59%	60%-79%	80%-100%
Housing	Compound index that simultaneously considers construction materials used in the floor, walls and roof of the housing	3 <= 6	> 6 <= 9	> 9 <= 12	> 12 <= 14	> 14
Room availability	Proportion of total rooms available per household member	0-0.19	0.20-0.39	0.40-0.59	0.60-0.79	0.80-over 1.00
Water	Water access source	River, ravine, stream, other	Water source or spring, lake, pond, truck, cart or barrel, other house, neighbour or firm	Public standpipe, public or private pit	Pipe connected to the public grid outside the home, but on the land	Pipe connected to the public grid inside the home
Sanitation	Type of sanitary service	None	Toilet or latrine without treatment, or toilet that discharges into the river or ravine	Toilet or latrine without treatment	Connected toilet or sump or septic pit	Toilet connected to the wastewater pipe
Electricity	Type of lighting in the home	None	Gas or kerosene (candle)	Electricity generator	Other	Electric energy grid
Assets	Number of durable goods that belong to the household (including radio, television, refrigerator, bicycle, vehicle and others)	0-1	2-4	5-7	8-10	Over 11
Energy	Mainly cooking fuel used	Firewood	Coal	Gas, kerosene, or other fuel	Butane or propane gas	Electricity, or do not cook

Source: Prepared by the authors.

The first dimension is income, measured as per capita consumption expenditure, with its quintiles used as scores.[9] According to Sen, income is normally a tool for generating capabilities; and lack of income can be a major cause of the deprivation of a person's capability (Sen, 2000, p. 87). Having a decent income is also related to the first Millennium Development Goal: eradicate extreme poverty and hunger (Santos and Ura, 2008, p. 6). This paper adopts a relative approach in this dimension, based on the idea that being relatively poor can deprive an individual of some of the elementary functionings, such as participating in community life or appearing in public without shame (Sen, 2000, p. 71).

The next two dimensions reflect a capability which is clearly one of the most important aspects of well-being: education (Klasen, 2000, p. 39). A household's education level, measured as the average

[9] A practical reason for using consumption instead of income, is that households might be more willing to reveal, or better able to remember, what they have spent, than what they have received in income (World Bank Institute, 2005, p. 29). In the case of Nicaragua, according to INIDE (2010, p. 5), information on consumption, seen as an indicator of well-being, tends to be more reliable, precise, and of better quality than that of income, because the informer does not relate it to the payment of taxes.

number of years of schooling of its adult members (aged 16 years or older), approximates to the level of knowledge and understanding of household members, and can be seen as a relatively good proxy variable for the functioning is that education requires: reading, writing, numeracy, understanding of information, and others. Although it does not reflect the quality of education or the level of knowledge or skills attained, it is a robust and widely used indicator (Alkire and Santos, 2010, p. 14). The dimension of children in school records the attendance of children at educational institutions. The indicator used in this paper is the percentage of children aged 6-16 years (both inclusive) who are attending school, in line with the second Millennium Development Goal of achieving universal primary education (Santos and Ura, 2008, p. 8), based on the UBN approach.[10] Although, again, school attendance does not reflect the quality of the educational institution or the skills acquired, it is the best possible indicator to indicate whether or not school-age children are being exposed to a learning environment; and it is considered a good enough proxy for educational functionings (Alkire and Santos, 2010, p. 14).

Housing and room availability are the fourth and fifth dimensions, respectively. Housing is a simple compound index, formed by three variables that reflect the type of material that is mainly used in the floor, walls and roof, which proxies for the quality of the home in which the household lives.[11] For various intrinsic and instrumental reasons, the quality of the home is a key indicator of well-being. An instrumental reason is that housing quality involves factors that are important for health and safety; so, intrinsically, it has a direct influence on the well-being of its occupants (Klasen, 2000, p. 41).[12] The room availability dimension, measured by the proportion of the total number of rooms available per household member (excluding kitchen, bathroom, passageways, and garage) is related to the quality of the home, and is also an important dimension of well-being. Crowding directly affects well-being, since it is a key factor in the transmission of diseases and does not contribute to a healthy environment (Elender, Bentham and Langford, 1998; Cage and Foster, 2002).

Water and sanitation are the next two dimensions. Both are included in target 7.C of the Millennium Development Goals (halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation), and they have considerable instrumental and intrinsic importance (Klasen, 2000, p. 41). Drinking water is necessary for health and well-being (Jain, 2012, p. 1), and is also considered a human right (Noga and Wolbring, 2013, p. 1878). Moreover, access to water generates time savings that can be used in other activities (Boone, Glick and Sahn, 2011, p. 1826). Sanitation is also an important component of well-being, since it is essential for good health and prevents various diseases (Mara and others, 2010, p. 1); and it is normally considered in the UBN approach (Battiston and others, 2013, p. 295).

Electricity is the eighth dimension, for which the indicator used in this study is the type of lighting in the home. This dimension is directly related to the seventh Millennium Development Goal: ensure environmental sustainability. Increasing access to electricity is one of the key objectives pursued by this target, because it will not only improve living conditions, particularly among the rural population, but will also reduce the proportion of inhabitants who use solid fuels, thereby improving air quality (Santos and Ura, 2008, p. 8). Electricity is generally also a safer form of lighting (Alkire and Santos, 2010, p. 16).

The measure developed in this study also includes the assets dimension, which considers the equipment available to the household, in the form of utensils, bicycles, vehicles and other durable goods, given their instrumental importance in facilitating work in the household, improving health, and

[10] Households with no children between 6 and 16 years of age have been assigned a proportion of 100% and, therefore, a score of 5, because they would not be suffering deprivation in this dimension.

[11] Previously, each of these three variables was recodified to the scoring scale of 1 to 5 and were added together, with equal weightings, to obtain a joint indicator of the three. Lastly, this joint indicator was recodified to the scale of 1 to 5 to obtain the dimension.

[12] Living in a house with non-precarious wall materials is generally included in the UBN approach (Santos and others, 2010, p. 9).

helping the household to maintain contact with the world outside (Klasen, 2000, p. 42). The indicator used is the number of consumer goods that belong to the household, prepared from a list of 29 items (radio, television, cooker, refrigerator, washing machine, bicycle, vehicle and others) included in the section on household equipment of the databases used.

The last dimension is energy, which reflects the type of fuel used by the household for cooking. This dimension is also included because of its intrinsic and instrumental importance, in addition to being related to the Millennium Development Goals, having clear implications for health and living standards, and particularly affecting women. A clean fuel for cooking prevents respiratory diseases, contributes to a healthy environment in the home (Alkire and Santos, 2010, p. 16) and reduces accidents in the home (Klasen, 2000, p. 41). Its importance is therefore clear.

3. Dimensional poverty lines and weightings

All of the dimensional poverty thresholds were set at 3, except for "children in school," which is set at 5. A household that scores under three in a given dimension (or less than five) is considered deprived in that dimension; as are all of its members. The rationales for these poverty lines are the same as used in forming the dimensions, as discussed above: a weighting of 3 implies a minimum acceptable level of well-being. In the children-in-school dimension, a relatively stricter approach is taken given its nature, requiring at least 80% of children to be attending school. All of the poverty lines coincide with what is generally reported in the empirical literature, although the indicators used have been formed dichotomously.[13]

Weighting the dimensions involves value judgements with clear normative implications (Decancq and Lugo, 2013, p. 9). This study uses three weighting systems. The first, widely used in the literature (see, for example, Alkire and Santos, 2010 and 2014; Batana, 2013; Battiston and others, 2013; Whelan, Nolan and Maître, 2014), assumes that all the dimensions are equally important; so it assigns an equal weight to each of them (1/10). This makes it possible to study the trend of multidimensional poverty in Nicaragua between 2001 and 2009; and it also makes the index easy to interpret (Atkinson and others, 2002, p. 25). In addition, two alternative weighting systems are proposed, derived from the data themselves, which makes it possible to illustrate the sensitivity of the measures to variations in the parameters, in this case the weightings, and to some extent test the robustness of the estimations. For the first of these systems, principal components analysis is used, a data reduction technique that is widely employed in exercises of this type (see, for example, Noorbakhsh, 1998; Klasen, 2000; Cahill and Sánchez, 2001; Ray and Sinha, 2015). The coefficients matrix is used to calculate the scores in the first principal component. Then, the coefficients are normalized to a range of [0, 1], by dividing them, firstly, between the standard deviation of the original indicator and then, between the sum of the previous coefficients. The advantage of this method is that it empirically reveals the commonalities between the individual dimensions and bases their weightings on the strength of the empirical relation between the poverty measure and the individual dimensions. The drawback is that it implicitly assumes that only the components that have a strong correlation are relevant, which could be debatable (Klasen, 2000, p. 39). Nonetheless, this method is less arbitrary than the first one. The second alternative system uses the relative frequencies of the deprivations in each dimension. In the context of multidimensional poverty analysis, some researchers assume that there should be an inverse relation between the frequency of deprivation in a given dimension and the weight assigned to that dimension: more frequent deprivations obtain a lower weighting (see, for example, Cerioli and Zani, 1990; Cheli and Lemmi, 1995; Deutsch and Silber, 2005). This reflects the idea that people attach greater importance to shortcomings in dimensions in which most people are not deprived; a

[13] See, for example, Santos and Ura (2008), Santos and others (2010), Alkire and Santos (2010).

person might feel more deprived if his or her deprivation is shared by a minority group than if most people were similarly deprived (Decancq and Lugo, 2013, p. 19). Following Cerioli and Zani (1990, p. 277), if f_j is the relative frequency of individuals that suffer deprivation in a given dimension, the weights can be derived from the following expression:

$$w_j = log\left(\frac{1}{f_j}\right) \Big/ \sum_{j=1}^{d} log\left(\frac{1}{f_j}\right) \quad f_j > 0, j = 1...d. \tag{3}$$

To the best of the authors' knowledge, these latter two procedures for deriving weighting systems in multidimensional poverty measurement, are innovative for the case of Nicaragua. Accordingly, these exercises constitute the first attempt to propose alternative weighting systems rather than weighting all dimensions equally. Table 2 shows the weightings in question.

Table 2
Weightings
(Percentages)

Dimension/Year	Equal	Principal components analysis			Log(1/fj)		
	All	2001	2005	2009	2001	2005	2009
Income	10.00	10.19	9.73	10.14	10.19	9.25	8.94
Years of schooling	10.00	12.21	11.63	11.93	10.41	10.67	11.61
Children in school	10.00	5.30	5.72	6.08	14.09	14.75	14.46
Housing	10.00	11.18	10.99	10.99	6.92	7.23	7.51
Room availability	10.00	8.27	7.60	8.70	5.44	7.74	7.55
Water	10.00	11.00	11.11	10.86	20.14	17.80	16.54
Sanitation	10.00	10.63	9.94	10.59	7.83	7.96	6.62
Electricity	10.00	9.19	8.18	8.87	14.28	12.97	14.73
Assets	10.00	12.28	11.78	12.08	6.38	7.11	7.35
Energy	10.00	9.75	13.32	9.75	4.31	4.53	4.68
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: Prepared by the authors, on the basis of data from the National Household Survey on Living Standards Measurement (EMNV) of 2001, 2005 and 2009.

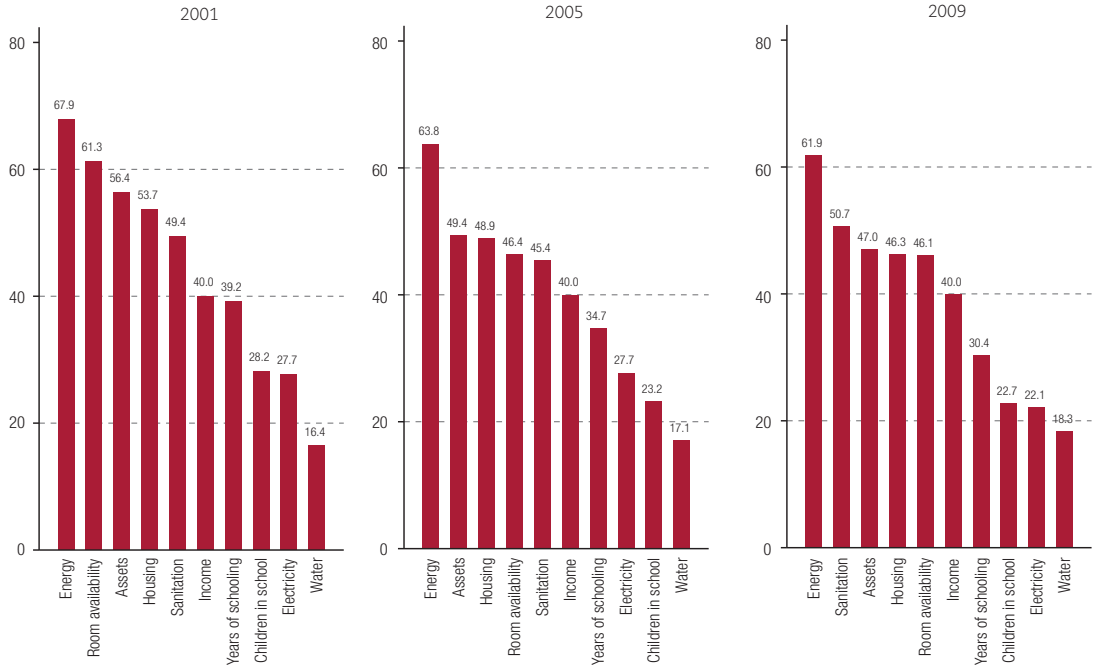
III. Empirical results

1. Aggregate deprivations by dimension

Figure 1 shows the estimated headcount ratio in each dimension (H) ranked from highest to lowest in each year.[14] In all years, energy displays the highest deprivation rate: over 60% of the Nicaraguan population suffer from the effects of using an inappropriate fuel to cook their food. This dimension is followed by room availability, assets, housing and sanitation (not necessarily in this order), all of which have a deprivation rate of above 40%. The dimension with the least deprivation is water, since less than 19% of the population do not have access to a safe water source. Between 2001 and 2009, the variable H declined by at least 5.5 percentage points in all dimensions, except in the case of water and sanitation, where it increased by 2 and 1.2 percentage points, respectively.

[14] The headcount ratio measures the incidence of deprivation in each dimension and represents the proportion of the population that is deprived in a given dimension.

Figure 1
Headcount ratio in each dimension (H), 2001, 2005 and 2009
(Percentages)



Source: Prepared by the authors, on the basis of data from the National Household Survey on Living Standards Measurement (EMNV) of 2001, 2005 and 2009.

These results show that the proportion of the population suffering deprivation in each dimension decreases by more, between 2001 and 2005 than in 2005-2009 and in both absolute and relative terms, except in the years-of-schooling and electricity dimensions. In contrast, official reports suggest the incidence of poverty in Nicaragua increased between 2001 and 2005 (by 2.5 percentage points) and declined in 2005-2009 (by 5.7 points) (INIDE, 2007 and 2011a). Consequently, these initial results cast doubt on the appropriateness of the official approach used to measure and monitor poverty in Nicaragua, and they confirm that poverty is more than monetary deprivation.

2. Measurement and trend of multidimensional poverty

(a) Proportion of multidimensionally poor (P)

Table 3 reports the proportion of multidimensionally poor people (P), estimated by equation (1) of section II.1, for each of the three years of the study, under each weighting system. The results show that the proportion of multidimensionally poor in Nicaragua declined between 2001 and 2009, irrespective of the weighting system used, owing, above all, to the reduction achieved in 2001-2005. In terms of the number of poor people, between 2001 and 2009, using equal weights, just over 76,000 people ceased to be multidimensionally poor. Nonetheless, in 2005-2009, the number of people living in poverty actually increased by over 180,000, which sounds an alarm bell for policymakers.

Table 3
Proportion of multidimensionally poor, and absolute and relative variation, by weighting system
(Percentages)

	Equal			Principal components analysis			Log (1/fj)		
	I	P	S	I	P	S	I	P	S
2001	43.7	44	44.4	44.2	44.6	44.9	36.5	36.8	37.1
2005	39.4	39.7	40	40.9	40	41.5	34.3	34.6	34.9
2009	38.2	38.6	38.9	38.8	39.2	39.6	33	33.3	33.7
	Variations								
	Equal			Principal components analysis			Log (1/fj)		
	2005-01	2009-05	2009-2001	2005-01	2009-05	2009-2001	2005-01	2009-05	2009-2001
Absolute	-4.3	-1.1	-5.46	-4.6	-0.8	-5.37	-2.2	-1.3	-3.5
Relative	-9.9	-2.8	-12.4	-10.3	-2	-12.1	-6	-3.7	-9.5

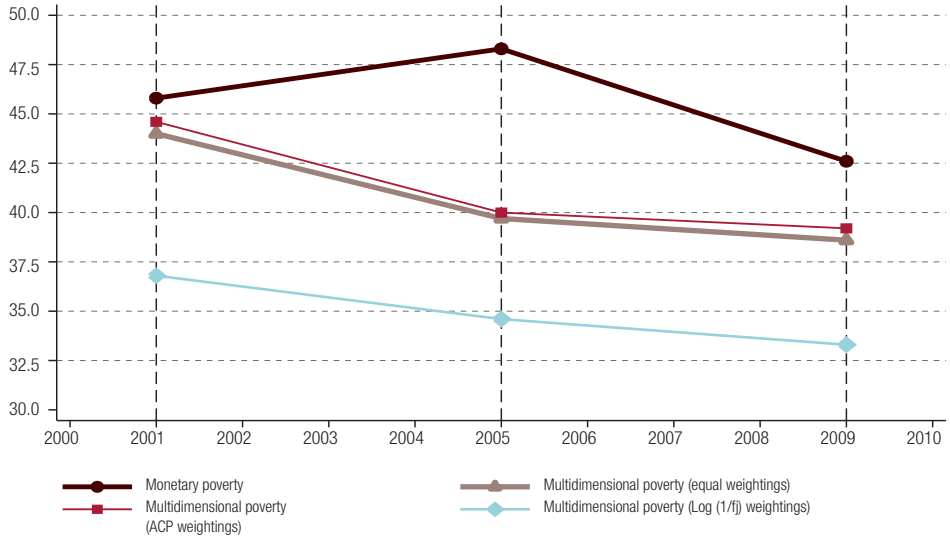
Source: Prepared by the authors, on the basis of data from the National Household Survey on Living Standards Measurement (EMNV) of 2001, 2005 and 2009.
Note: I: Lower confidence interval; S: Upper confidence interval; P: Proportion of multidimensionally poor. The confidence intervals were calculated using a percentile bootstrapping technique (Efron, 1981, p. 151), with 1,000 replications, stratified bootstrapping.

Figure 2 compares the trend of the proportion of monetarily poor, estimated using the official poverty lines (2001: 45.8%; 2005: 48.3%; and 2009: 42.6%),[15] and the trend of the proportion of multidimensionally poor, under each weighting system. In general, the two approaches agree that poverty in Nicaragua declined between 2001 and 2009. Nonetheless, an analysis of each of the periods separately reveals great disparity between one approach and the other. Between 2001 and 2005, the official figures show poverty increasing by 2.5 percentage points, whereas the estimations made in this study show a reduction of between 5.4 and 3.5 points, depending on the weightings used. Moreover, although the two approaches agree that poverty in Nicaragua declined between 2005 and 2009, the monetary approach shows a much faster reduction in this period than the multidimensional approach, in both absolute and relative terms. As regards the number of poor, the results of this study are diametrically opposed to those obtained from the official approach, since the latter estimate that the number of poor people in Nicaragua grew by over 63,000 between 2001 and 2009, despite the reduction, also suggested, of just over 30,000 in 2005-2009.

Aside from the theoretical distinctions between the two ways of measuring poverty, it is important to analyse whether the results that these generate differ, because, if not, the methodological shortcomings of the monetary approach would be less important (Klasen, 2000, p. 36). In this study, the foregoing results raise an initial empirical doubt as to the suitability of the traditional method of measuring poverty in Nicaragua, and underpin the theoretical argument that, to measure poverty appropriately, it is necessary to look beyond income.

[15] See INIDE (2007 and 2011a).

Figure 2
Trend of the proportions of monetarily poor (H) and multidimensionally poor (P)
(Percentages)



Source: Prepared by the authors, on the basis of data from the National Household Survey on Living Standards Measurement (EMNV) of 2001, 2005 and 2009.

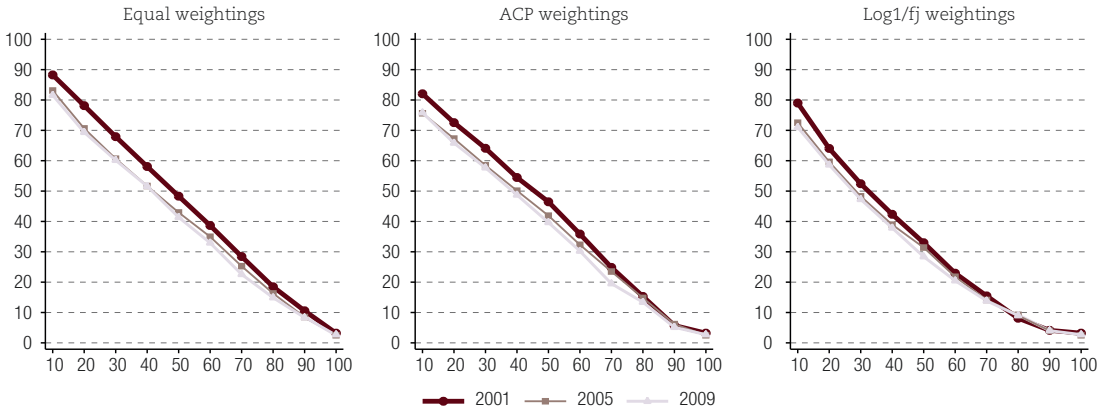
(b) Multidimensional headcount ratio (H)

Figure 3 shows the estimations of H for different k-values under each weighting system.[16] By definition, irrespective of the weightings, H declines as k grows. With equal weightings and principal components analysis weightings, figure 3 clearly shows that, irrespective of the value given to k, H will always be lower in 2009 than in 2001. Accordingly, it can be concluded that the incidence of multidimensional poverty in Nicaragua declined between 2001 and 2009; and this is robust to the selection of a multidimensional poverty line. With Log (1/fj) weightings, the lines intersect when k takes a value of 80%. Consequently, in this case, it is impossible to unambiguously state that the incidence of multidimensional poverty is lower in one year than in the other. Nonetheless, for most k-values, the previous conclusion is maintained. This also holds when the two subperiods are analysed separately. For the first subperiod (2001-2005), only in the case of equal weightings can it be categorically stated that the incidence of poverty declined. In the second subperiod (2005-2009), as the curves intersect, it is impossible to reach an unequivocal conclusion in either case. Nonetheless, in general, as the intersections occur towards the extremes of the curves, it can be concluded that the incidence of poverty decreased in both subperiods, for plausible values of k.[17]

[16] The meaning of the different k-values varies according to the weighting system. With equal weightings, a k of 10%, for example, requires the household to be deprived in any one or more of the 10 dimensions to be considered multidimensionally poor. With the other two systems, a k of 10% requires the household to be deprived in at least one dimension or in a combination of them, provided the weight (or the sum of the weights) is at least 10%, to be identified as poor. For example, a household that is deprived only in the room availability dimension would not be considered poor under these two weighting systems (see table 2).

[17] If the union approach were used, poverty incidence would be exaggerated. At the other extreme, if the intersection approach were used, it would be understated.

Figure 3
Multidimensional headcount ratio for different values of k and different weightings
(Percentages)

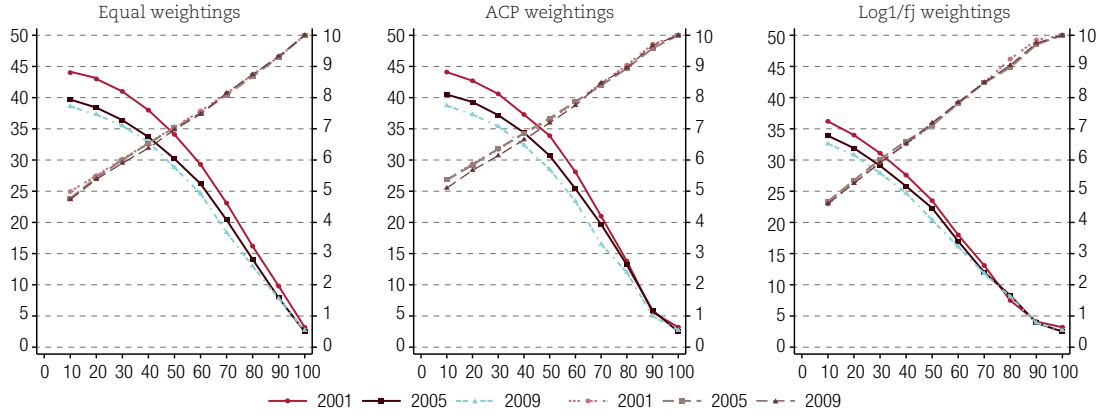


Source: Prepared by the authors, on the basis of data from the National Household Survey on Living Standards Measurement (EMNV) of 2001, 2005 and 2009.

(c) Adjusted multidimensional headcount ratio (M_0) and average of the proportion of deprivations (A)

Figure 4 displays the estimations of M_0 and A for the three years of the study, with different values of k and with the three types of weighting. All of the conclusions derived for H are maintained for M_0, which should not be surprising because the calculation of the latter measure takes account of the estimations of H. Accordingly, observing the criterion of dominance applied above, and assuming plausible k-values, it can be concluded that multidimensional poverty in Nicaragua, measured by M_0, declined between 2001 and 2009, and more rapidly in 2001-2005. As regards the average of deprivations (A), which, by definition, increases with k, regardless of the weightings used, in all cases it is high. Even when a union approach is adopted, the multidimensionally poor suffer deprivation, on average, in more than four dimensions; and there is no evidence that this has declined significantly during the analysis period. Consequently, the decrease in M_0 is due fundamentally to the reduction in the incidence of poverty and not to the number of deprivations suffered by the poor.

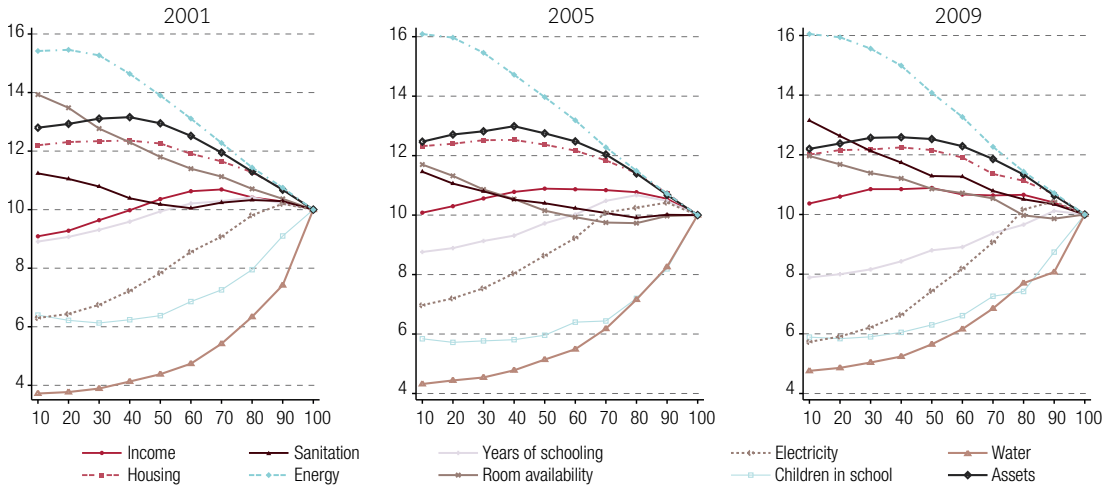
Figure 4
Adjusted multidimensional headcount ratio (M_0) and average of deprivations (A)
(Percentages)



Source: Prepared by the authors, on the basis of data from the National Household Survey on Living Standards Measurement (EMNV) of 2001, 2005 and 2009.

After estimating M_0, the question that naturally arises is how the dimensional deprivations contribute to the estimated multidimensional poverty index. This can be resolved by appropriately decomposing M_0 by dimension, which is one of the attractive properties of this measure (Alkire and Foster, 2011, p. 480). Figure 5 shows the breakdown of M_0 by dimension, for different values of k, with equal weightings and for the three years of analysis. Energy is the dimension that contributes most to M_0, for any k and in all years. On average, across all of the k values and years considered, deprivation in this dimension explains roughly 13.3% of global poverty. This dimension is followed by the assets dimension (around 12%) and housing (around 11.7%). Room availability (11.8%) in 2001 and sanitation 10.5% in 2009, are among the dimensions contributing most to M_0. It is worth noting that deprivation in income is not one of the three dimensions contributing most to multidimensional poverty in either case. Nonetheless, its contribution is greater over the period of analysis. In contrast, water, children in school, and electricity other three dimensions contribute least to multidimensional poverty in Nicaragua. Figure 5 also shows that, with equal weightings, the relative contributions converge, and become equal when k takes the value of 100%.[18]

Figure 5
Relative contribution of each dimension to M_0, for different k-values and equal weightings, 2001, 2005 and 2009
(Percentages)



Source: Prepared by the authors, on the basis of data from the National Household Survey on Living Standards Measurement (EMNV) of 2001, 2005 and 2009.

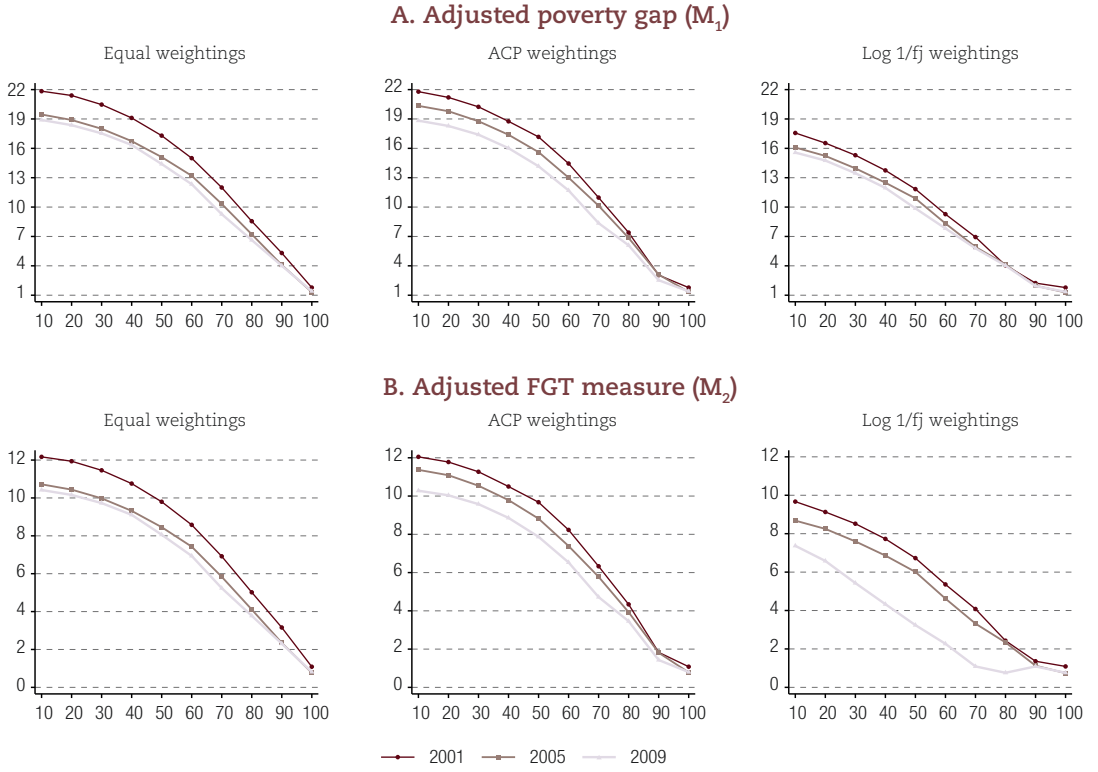
(d) Adjusted poverty gap (M_1) and adjusted FGT measure (M_2)

To complement the foregoing estimations, two measures were estimated that reflect other important aspects of poverty: the depth of deprivations (M_1) and the inequality with which the deprivations are distributed amongst the poor (M_2). These both clearly act as aggravating factors in multidimensional

[18] For space reasons, the figures showing the dimensional contributions to M_0 under the two other types of weighting have not been included in this paper. With principal component analysis weightings, the assets, housing, and energy dimensions contribute most to M_0, whereas children in school, water and electricity remain those the contribute least at any k-value. In general, with these weightings, the contributions tend to converge as k rises, but they never become equal. As would be expected, the story changes diametrically with Log (1/fj) weightings, given their structure, and the contributions diverge as k rises. In this case, electricity, water, children in school, and years of education are the dimensions contributing most to M_0.

poverty. As far as the authors are aware, this study is the first attempt to measure these two features of poverty in Nicaragua in a multidimensional framework. Figure 6 shows the estimations of these two measures for different k-values, with the three weighting systems and for the three years of interest.

Figure 6
Adjusted poverty gap (M_1) and adjusted FGT measure (M_2), for different k-values and different weightings
(Percentages)



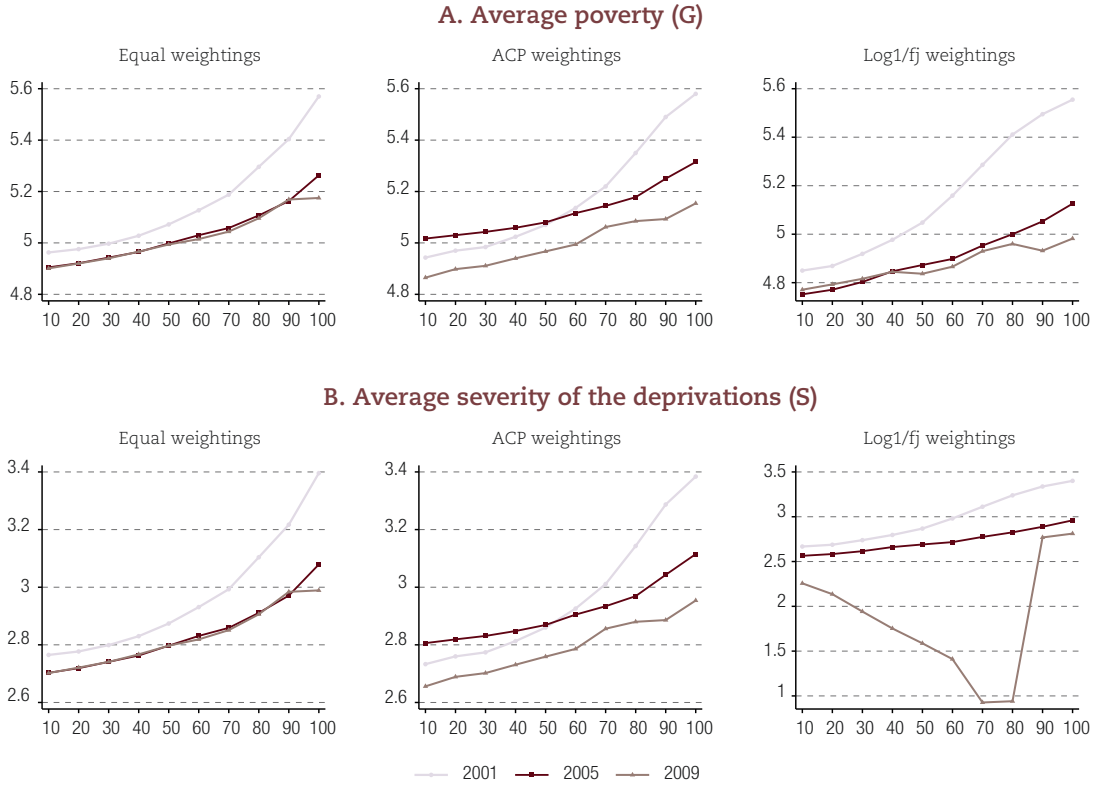
Source: Prepared by the authors, on the basis of data from the National Survey of Household Living Standards (EMNV) of 2001, 2005 and 2009.

As figure 6 shows, irrespective of the weightings used and where the poverty line is set, M_1 and M_2 both declined between 2001 and 2009. An analysis of each of the period separately also shows a reduction in both measures between 2001 and 2005 and in 2005-2009, except when k takes the value of 100%, with principal component analysis weightings, in this second period.

Lastly, figure 7 shows the estimations of the average poverty gap (G) and the average severity of deprivations (S) for the different k-values and with the three weighting systems. It can be clearly seen that G and S declined between 2001 and 2009, irrespective of the weightings adopted and the value defined for k.

The results of this study thus show that the incidence, intensity and severity of multidimensional poverty in Nicaragua declined between 2001 and 2009, and fell faster in the first half of that period (2001-2005). This conclusion is robust to the choice of a multidimensional poverty line; and, in the vast majority of cases, it also holds with alternative weighting systems.

Figure 7
Average poverty (G) and average severity of the deprivations (S), for different k-values and different weightings
(Percentages)



Source: Prepared by the authors, on the basis of data from the National Household Survey on Living Standards Measurement (EMNV) of 2001, 2005 and 2009.

IV. Bilateral correlations and overlaps in the identification of the monetarily and multidimensionally poor

For the three years of the analysis, table 4 reports the bilateral correlations between per capita consumption expenditure, the official indicator used to estimate extreme and general poverty in Nicaragua, and the aggregate vector of deprivations, obtained from the aggregation of dimensional deprivations, under weighting system, and for the dimensions used. All correlation coefficients are statistically significant at the 1% level. Focusing on the bilateral correlation coefficients between per capita consumption expenditure and each of the three aggregate vectors of deprivations, it can be seen that the two vectors are negatively correlated, which should not be surprising; and they display moderate correlation (lower than 0.58) in all cases. With respect to the correlation between per capita consumption expenditure and each of the dimensions, this is lower than 0.50, except for room availability and assets in 2005 and 2009. This again suggests a moderate correlation. Accordingly, the argument that income is highly correlated with achievements in other dimensions, so a focus on the monetarily poor will also encompass the deprived in other dimensions (Santos and Ura, 2008, p. 15), seems not to be supported in the case of Nicaragua. The multidimensional approach would thus be justified.

Table 4
Bilateral correlations

		Aggregate vector of deprivations			Dimensions								
	Year	w (equal)	w (principal components analysis)	w (Log(1/fi))	Years of schooling	Children in school	Housing	Room availability	Water	Sanitation	Electricity	Assets	Energy
GCpc	2001	-0.498(**)	-0.494(**)	-0.457(**)	0.454(**)	0.173(**)	0.380(**)	0.468(**)	0.345(**)	0.411(**)	0.271(**)	0.487(**)	0.440(**)
	2005	-0.561(**)	-0.560(**)	-0.528(**)	0.495(**)	0.200(**)	0.432(**)	0.525(**)	0.393(**)	0.444(**)	0.313(**)	0.545(**)	0.489(**)
	2009	-0.577(**)	-0.574(**)	-0.540(**)	0.492(**)	0.227(**)	0.438(**)	0.545(**)	0.354(**)	0.462(**)	0.295(**)	0.533(**)	0.501(**)

Source: Prepared by the authors.
Note: The aggregate deprivations vector is obtained by adding the dimensional deprivations, under the three weighting systems. GCpc: Per capita consumption expenditure; w: Weightings.
(**) The correlation is significant at 1% (bilateral).

In addition to calculating the correlations, it is also interesting to compare the set of monetarily poor, identified by the official methodology, with the set of multidimensionally poor identified using the methodology applied in this study, to see whether there is any overlap. Table 5 shows the percentage of individuals identified as monetarily poor but multidimensionally non-poor, and the percentage of individuals who are multidimensionally poor but not monetarily poor. It also shows the monetarily poor and multidimensionally poor. The figure also reports the rates of under-coverage and over-coverage of the monetary measure.[19]

The estimations reported in table 5 clearly show that if the official approach to measuring poverty in Nicaragua continues to be used to identify the multidimensionally deprived, a non-negligible error would be systematically committed in identifying the poor. If a set of monetarily poor individuals is included but not the multidimensionally poor, this would be a type-I error; or if a percentage of the multidimensionally poor were excluded because they are not monetarily poor, this would be a type-II error (Santos and Ura, 2008, p. 17). Obviously, minimizing the type-I error, maximizes the type-II error, and vice versa. As table 6 shows, both possibilities occur at the extremes of the k-values. Consequently, any intermediate situation involves a combination of both types of error.

Table 5 also reports the calculation of over-coverage and under-coverage rate of the monetary measure. What do the results show? Assume, for example, a programme of transfers to reduce multidimensional deprivations, with a k-value of 50%. In 2009, the most recent year of this study, 21.7% of the population would not be benefiting from this programme despite being multidimensionally poor; and 23.9% would be benefiting without being multidimensionally poor.[20] Accordingly, to make poverty reduction more effective, the multidimensional approach would be more justified than the monetary approach, although both estimate a similar poverty rate. The same exercise and interpretation could be done for the other years and for different k-values.

[19] The under-coverage rate is the proportion of individuals identified as multidimensionally poor but not as monetarily poor, with respect to the total number of multidimensionally poor individuals. The over-coverage rate is the proportion of individuals identified as monetarily poor, but not as multidimensionally poor, with respect to the total number of individuals identified as monetarily poor (Alkire and Seth, 2008, p. 18 ff.).

[20] In 2009, with a k-value of 50%, the percentages of monetarily poor and multidimensionally poor are very similar.

Table 5
Lack of overlap between monetary and multidimensional poverty for different k-values
(Percentages)

	2001									
	10	20	30	40	50	60	70	80	90	100
Monetarily poor	45.81	45.81	45.81	45.81	45.81	45.81	45.81	45.81	45.81	45.81
Multidimensionally poor	88.27	78.15	67.93	58.10	48.33	38.67	28.44	18.48	10.57	3.20
Both	45.72	45.54	44.22	41.54	38.19	32.99	25.83	17.36	10.36	3.20
Monetarily poor but multidimensionally non-poor	0.09	0.27	1.59	4.27	7.62	12.82	19.98	28.45	35.45	42.62
Monetarily non-poor but multidimensionally poor	42.54	32.61	23.71	16.56	10.14	5.67	2.61	1.12	0.20	0.00
Under-coverage rate	48.20	41.73	34.90	28.50	20.97	14.67	9.17	6.07	1.93	0.00
Over-coverage rate	0.19	0.60	3.47	9.31	16.63	27.98	43.61	62.10	77.38	93.02
	2005									
	10	20	30	40	50	60	70	80	90	100
Monetarily poor	48.35	48.35	48.35	48.35	48.35	48.35	48.35	48.35	48.35	48.35
Multidimensionally poor	83.14	70.66	60.68	51.68	42.96	34.96	25.27	16.29	8.52	2.50
Both	47.89	46.28	44.04	40.72	35.79	30.45	23.16	15.63	8.42	2.50
Monetarily poor but multidimensionally non-poor	0.46	2.07	4.31	7.63	12.56	17.90	25.19	32.72	39.92	45.85
Monetarily non-poor but multidimensionally poor	35.25	24.38	16.64	10.96	7.17	4.52	2.11	0.66	0.10	0.00
Under-coverage rate	42.40	34.51	27.42	21.22	16.70	12.92	8.37	4.06	1.13	0.00
Over-coverage rate	0.95	4.28	8.91	15.78	25.98	37.03	52.10	67.68	82.58	94.83
	2009									
	10	20	30	40	50	60	70	80	90	100
Monetarily poor	42.59	42.59	42.59	42.59	42.59	42.59	42.59	42.59	42.59	42.59
Multidimensionally poor	81.58	69.37	60.17	51.61	41.37	32.93	22.57	14.89	8.32	2.72
Both	42.51	41.73	40.33	37.09	32.39	27.09	20.10	14.13	8.16	2.72
Monetarily poor but multidimensionally non-poor	0.09	0.87	2.27	5.51	10.20	15.50	22.49	28.46	34.43	39.88
Monetarily non-poor but multidimensionally poor	39.07	27.64	19.84	14.53	8.98	5.84	2.47	0.75	0.16	0.00
Under-coverage rate	47.89	39.85	32.97	28.15	21.70	17.74	10.96	5.06	1.87	0.00
Over-coverage rate	0.21	2.03	5.32	12.93	23.95	36.40	52.81	66.82	80.84	93.62

Source: Prepared by the authors, on the basis of data from the National Household Survey on Living Standards Measurement (EMNV) of 2001, 2005 and 2009.

V. Conclusions

This study has attempted to estimate multidimensional poverty in Nicaragua between 2001 and 2009 using data from the three most recently available living standards surveys, and mainly following the methodology proposed by Alkire and Foster (2007 and 2011). The key objective has been to present empirical evidence that contributes to the discussion of these issues in the region and supports the adoption of a broader measurement methodology for the case of Nicaragua. In general, the results of this study overwhelmingly support the adoption of a multidimensional approach to poverty measurement in Nicaragua; they also demonstrate the value added of this approach, and they are more consistent with the Nicaraguan reality than the results of the multidimensional poverty index (MPI), for example. Naturally, all of the assumptions adopted in this paper are debatable and can be improved upon.

Both the monetary and the multidimensional approach agree that the proportion of poor people in Nicaragua declined between 2001 and 2009. Nonetheless, an analysis of each of the subperiods separately reveals great disparity between one approach and the other. Between 2001 and 2005, the official figures suggest a 2.5 percentage point increase in poverty, whereas the estimations made in this study suggest a reduction of between 5.4 and 3.5 points, depending on the weightings used. Moreover, although both approaches agree that poverty declined in Nicaragua between 2005 and 2009, the monetary approach shows faster progress in this period than the multidimensional approach, in both absolute and relative terms. As regards the number of poor, the results of this study are diametrically opposed to those obtained under the official approach, because the latter estimated that the number of poor people in Nicaragua grew by over 63,000 between 2001 and 2009, despite a reduction of just over 30,000 in 2005-2009. In contrast, with equal weightings, our estimations suggest that between 2001 and 2009, just over 76,000 people ceased to be multidimensionally poor. Nonetheless between 2005 and 2009 the number of poor people grew by over 180,000, which should serve as a warning for policy-makers.

In the context of the Alkire and Foster methodology, the results of this study suggest, robustly, that the incidence, intensity and severity of multidimensional poverty in Nicaragua declined between 2001 and 2009, and more intensively in the first half of this period. The fact that this again is diametrically contrary to what is suggested by the official figures raises doubts about the official measure (and methodology).

Moreover, a breakdown of M_0 shows that income deprivation is in no way among the largest contributors to global multidimensional poverty, which reaffirms the belief that income is not everything. In addition, the results of the study reveal that if the traditional measurement approach is used to identify the multidimensionally deprived, a non-negligible error would be committed, either of type-I or of type-II.

Consequently, the recommendation is that the design, evaluation and monitoring of poverty reduction policies should not be exclusively based on a monetary approach, but should be supported with a broader measure that incorporates other important dimensions of the well-being of the Nicaraguan population. The results of the study also show that, to be more effective, policies and programmes should not only be targeted on increasing income, but they should also aim to promote clean domestic energy and a structural and competitive improvement in housing.

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