UNITED NATIONS

ECLAC

SUBREGIONAL HEADQUARTERS IN MEXICO

Distr.
LIMITED

LC/MEX/L.949
15 December 2009

ORIGINAL: ENGLISH

INCOME POVERTY AND UNSATISFIED BASIC NEEDS

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ABSTRACT

This study consists of two substantive components that provide an overview of the different methodologies currently being applied to the measurement of multidimensional poverty for Mexico and Central America. In the first component a typology of different practical methodological concepts is organized according to how different methods deal with the two fundamental decisions in the measurement of poverty, identifying the poor and aggregating the groups into a single index value that is informative. The typology is able to encompass most different methods of multidimensional poverty measurement and is applied to research in multidimensional poverty carried out in the region.

In the second component three different methodologies were applied to the measurement of multidimensional poverty in Mexico and the five countries of Central America using information from household surveys that provided eight different dimensions to determine poverty, one of which was household income per capita and the remaining dimensions that encompassed a broad group of unsatisfied basic needs.

The findings from this analysis suggest that there is an abundant amount of additional information to be found in the analysis and measurement of multidimensional poverty and that the application and extension of such measures is feasible and would help policy makers with the design of appropriate poverty alleviation strategies. In addition an aggregate multidimensional poverty measure can provide better transparency with regard to the normative decisions that define the standards for which a society considers an individual poor or not poor.

INTRODUCTION

One of the key challenges for both developed and developing nations and peoples is that of poverty reduction and elimination. The first Millennium Development Goal agreed to by the United Nations at the Millennium Summit in 2000 was to halve, by 2015, the proportion of the population who live in extreme poverty (United Nations 2000). In addition, 2008-2017 has been declared to be the Second United Nations Decade for the Eradication of Poverty (United Nations, 2008). The recognition that action is necessary is accepted by almost every nation. However the ability of nations to monitor their performance towards poverty eradication and to target specific policies to those in situations of poverty varies greatly. Adding to the challenge is that such policies must be placed within the broader national and regional policy framework that encompasses strategies for economic growth and questions about redistribution.

The ability to effectively monitor poverty eradication and target anti-poverty policies is often based on resolving two practical difficulties; how nations identify the parts of their populations in situations of poverty and how they can agree on indicators of performance in poverty eradication. One of the most common conceptual definitions of poverty is that of income or consumption poverty. This group of poverty measures has been perhaps the most prominent to date in terms of recognition and use in empirical analysis both in the international arena (Foster, Greer et al. 1984; Datt and Ravallion 1992; Jäntti, Danziger et al. 2000; Chen and Ravallion 2004), and within Latin America (Bourguignon, Ferreira et al., 2005; Cetre, 2006; Gasparini, Gutiérrez et al., 2007).

Although the detailed definitions may vary, they are considered authoritative measures of national and international poverty by national governments, regional institutions such as ECLAC, and international Institutions such as the World Bank. However such measures suffer from severe limitations in terms of defining and encompassing the full experience and situation of poverty and there is a widening body of research that now concentrates on the measurement and analysis of poverty according to definitions that are broader than that of just income or consumption and attempts to integrate multidimensional poverty concepts into the research and policy debate. Indeed the Millennium Declaration itself may be considered one international mainstream attempt to define, at a global level, a set of multidimensional indicators of (relative) poverty. Another example is the Human Development Index (United Nations Development Programme, 2007). In the case of the Millennium Development Goals (MDGs), eight development dimensions are specified, from consumption poverty and hunger, education, gender inequality and health to disease, environmental sustainability and development cooperation. Each goal contains a set of agreed indicators. For the extreme poverty goal (MDG 1), the primary measure defining those in extreme poverty is a consumption poverty line for an individual of less than $1.25 per day in dollars adjusted for purchasing power parity (PPP) (United Nations Statistics Division, 2009)[1].

Whilst there is a great quantity of literature on different aspects of multidimensional poverty, no particular author has perhaps been more influential in framing the debate and definition of such a concept as Amartya Sen. The Capability and Functionings approach that Sen formally conceptualized (Sen 1999), has its antecedents in various previous studies but is now increasingly coming to be known as Sen's capability approach to multidimensional poverty in much of the recent research (Alkire, 2005; Deneulin, 2005; Bourguignon, Ferreira et al., 2007; Núñez and Tartakowsky, 2007; Krishnakumar and Ballon, 2008).

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[1] The $1.00 per day consumption line for extreme poverty is based on a 1993 evaluation which has recently been revised to $1.25 per day by the World Bank (Ravallion, M., S. Chen, et al. (2008). Dollar a day revisited.

Sen's approach, the consideration of dimensions not just beyond income and consumption but beyond the basic physical and economic needs to the capabilities to function and participate fully in society, provides a framework with which the assessment of poverty can combine the economic, social and cultural aspects of a person's life to provide a basis for assessing their overall wellbeing and relative deprivation of potential wellbeing. The opportunities in the application of such an approach are many including the additional information generated, the identification of hidden poverty and the recognition and integration of social and cultural norms. However the empirical application is as equally demanding as it is beneficial. The data requirements are great, whilst economic and physical characteristics are relatively easy to measure, the wider aspects of capabilities and functionings are not. They involve subjective and normative assessments and are difficult to clearly define. In addition these challenges are multiplied when attempting to compare and identify multidimensional poverty incidence across areas, countries and regions with widely different social norms and cultures.

Today the challenges involved in implementing the Sen Capability Approach remain a barrier to its widespread empirical application particularly for cross-national comparisons. At the same time, interest in this area of poverty research is increasing rapidly as it reflects a need to consider poverty from an increasingly social perspective and rights-based approach that can complement the traditional economic focus. In particular, outside the OECD nations and those in the European Union it is the Latin American region that has been prominent in its interest in progressing towards applications of poverty analysis beyond the income poverty dimension. Mexico has been a regional leader in furthering such an approach, through the application of specific legislation in the General Law of Social Development (*Ley General de Desarrollo Social*) (Mexico 2004), the work of specific research institutions such as CONEVAL (Consejo nacional de Evaluación de la Política de Desarrollo Social (CONEVAL, 2007) and CONAPO (Consejo Nacional de Población (CONAPO, 2009) and large amounts of research on multidimensional poverty by prominent researchers (Lustig, 1992; Boltvinik, 2001; Damian and Boltvinik, 2003; Foster, López-Calva et al., 2005; López Calva and Rodríguez Chamussy, 2005; Cadenas Rodríguez and Luna López, 2006).

Central America has also been moving in the same direction and although the World Bank Poverty Assessments for Central American countries continue their strong focus on consumption poverty (World Bank, 2005; 2007; 2008; 2009), there is increased acknowledgement of the multidimensional nature of poverty (World Bank, 2006), p. 1). At the same time research in Central America whether on Costa Rica (Gutiérrez Coto and Sandoval Carvajal, 2003), El Salvador (Molina, 2003), Guatemala (Berumen, 2005), Honduras (Macias Ruano, Ogando Caníbal et al., 2009), or Nicaragua (Gallardo Altamirano, 2009) shows the interest in moving away from a simple income/consumption based perspective of poverty.

This study attempts a small, if conservative, step towards the application of multidimensional poverty measures. Using comparable information from nationally representative household surveys around 2006 for six countries in Mexico and Central America, this study analyzes the additional information and poverty implications of combining income poverty measures with common measures of Unsatisfied Basic Needs (UBN). The choice of a small number of dimensions is data driven and based on available information contained in the surveys. This is further limited by the needs for such information to be comparable across the countries. Three aggregation procedures are compared; an a priori rule based Integrated Poverty Measure, the Alkire and Foster aggregation methodology and a pure statistical method of Principal Components and Cluster Analysis.

The rest of the paper is set out as follows: Section 2 provides a common framework with which to compare the different methodological approaches and discusses some of the basic concepts and

development of the current state of the art of multidimensional poverty measurement including the research applied to Latin America, in particular to Mexico and Central America, placing the work within a common methodological typology. Section 3 presents the initial results of poverty identification across each of the different income and UBN dimensions and for six countries in Mexico and Central America. Section 4 presents the results of the alternative multidimensional measures chosen and applied to the sample of countries and discusses the implications for the identification of the poor and compares this to the case of 1-dimensional income based poverty measures. Section 5 concludes.

I. MULTIDIMENSIONAL POVERTY METHODOLOGIES

1. Introduction

There is perhaps no more pressing development issue in the world than the need to alleviate, if not eliminate, poverty. At the same time, poverty is a concept that is quite difficult to define and there is a great body of work that is concerned with the measurement of poverty from various perspectives. This chapter does not aim to revisit this well-trodden ground but instead provides a small survey of the rapidly expanding literature concerning particular methodologies and practical empirical applications of measures of multidimensional poverty both internationally and in Mexico and Central America in particular. A typology is developed that is simple and practical in allowing the categorization of the literature in terms of how the different methods deal with a common set of decision making problems regarding poverty measurement.

2. Poverty as a multidimensional concept

The concept of poverty is one that often encompasses a wide perspective of approaches across a variety of social science disciplines as it is explicitly tied to the social structures upon which individuals depend for their wellbeing. There is a large literature on the discussion of the poverty as a broader concept but common themes arise in which poverty is conceptualized in terms of individual and societal development, from Townsend (1993(2006)) who defines poverty in terms of a lack of resources for meeting social demands and customs and Sen (1999; 1999) who defines poverty as a lack of capacities for the full participation in society to Alkire (2002) who discusses poverty in terms of human development[2].

Amongst the plethora of different definitions of poverty one such definition from the United Nations encompasses the majority of the concepts covered in the theoretical literature.

> *"If human development is about enlarging choice, poverty means that opportunities and choices most basic to human development are denied to lead a long, healthy, creative life and to enjoy a decent standard of living, freedom, dignity self-respect and the respect of others." (United Nations Development Programme 1997)*

The definition above, like the majority of definitions, considers poverty to be a phenomenon that occurs across multiple dimensions. As Kakwani and Silber (2008) explain in their introduction to a Special Issue of World Development on the topic of multidimensional poverty, there is an emerging focus of work beyond that of the dimension of the capability space "income", where poverty is defined narrowly and refers to the ability to meet minimum physical needs, to the more relative approach of considering income or other dimensions and minimum levels above which individuals can function properly in their environment.

However traditional measures have focused strongly on one dimensional economic concepts of poverty both at a global level, for example by comparing countries to GDP per capita, and at a household or individual level by considering the popular dollar-a-day consumption poverty line of the World Bank.

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[2] For a recent survey of the poverty concept in the northern subregion of Latin America, see Reyes, M. (2009). "Conceptos y mediciones de pobreza: Una revisión de literatura con énfasis en la pobreza multidimensional", CEPAL, Mexico City, Mexico: 93, unpublished.

Whilst these measures have dominated due to historical and technological antecedents and they provide easy reference points for decision makers and are proxies of poverty that are more likely to have data available for empirical applications, the fact that they omit other dimensions of poverty can cause blind spots in a researcher's or policy maker's ability to accurately characterize poverty and the populations who live in situations of poverty.

A concentration on income poverty as the sole measure of progress in the fight for poverty eradication fails to consider the other dimensions of poverty that remain hidden from the income perspective. These other social and individual factors are highly relevant for successful policies to decrease poverty and ignoring the multidimensional nature of poverty in policy making risks creating poverty traps that a traditional and simple income measure would fail to take account of. The ability to consider the multidimensional nature of poverty and such measurement in terms of non-economic dimensions can also assist in drawing strong links between short-term social development policy and longer term macroeconomic and fiscal policies targeted towards pro-poor growth, the reduction of vulnerability to business cycles and economic and social shocks and the adequate social protection of the entire population.

Strong theoretical foundations for the aggregation of poverty dimensions have been developed in the work of Ravallion (1996), and most recently in the work of Tsui (2002), Bourguignon and Chakravarty (2003) and Alkire and Foster (2007). Whilst a review of the axioms and their theoretical underpinnings is beyond the scope of this article, it should be noted that such approaches take as their basis a series of axioms formalized by Foster, Greer and Thorbecke (1984) that describe a series of desirable properties for unidimensional poverty measures and extend them to the multidimensional case.

3. A typology of poverty measurement methodologies

In this section a typology of the poverty measurement process is developed and presented. This is hardly the first attempt to provide a categorization of poverty and thorough conceptual reviews of such exercises exist such as the work of Ibrahim and Alkire in reviewing concepts of agency and empowerment (2007) or that of Ranis et al. (2006) reviewing concepts and categorizations of human development and human flourishing.

Within Latin America there also exists previous work on the classification of poverty dimensions (Arriagada, 2005; Saraví, 2005; Berenger, Calderón Villarreal et al., 2009) and the various works of Boltvinik (1997; 2001; 2003; 2003) in his development of a typology of poverty measurement methodologies. However whilst much of the previous typological exercises have been based in attempting to categorize poverty measurement and the poverty concept, typology developed in this study seeks to concentrate on the multidimensional perspective of poverty measurement methodologies solely in terms of categorization of the decisions necessary for the construction of any particular poverty measure. For example, whilst the Boltvinik typology presents a categorization based upon the author's determination and differentiation between determinants of wellbeing and those dimensions that are results of different levels of wellbeing (2003, p. 455), dimensions are categorized here purely for the sake of differentiating methods of poverty measurement on the basis of practical decisions the researcher must make and no assumptions about the appropriate exogeneity or endogeneity of any dimensions are made.

The poverty measurement process

Sen (1976) postulated that for the construction of any poverty measure, the researcher must make two decisions, the first regarding the identification of the poor and the second being aggregating the poor into an index of poverty. In the case of poverty being identified in one dimension, the aggregation decision is applied to the choice of one dimensional poverty measure, for example the headcount index versus the poverty gap measure. For a multidimensional poverty measure the aggregation step takes on new meaning as it defines how the different dimensions should be combined to arrive at a common index of poverty. This concept of identification and aggregation as the basic building blocks of poverty measurement has been followed in recent literature on the theoretical basis for multidimensional poverty (Tsui 2002; Bourguignon and Chakravarty 2003) and it is a concept that also governs the categorization of different empirical methodologies of multidimensional poverty.

4. Identification

As one of the first steps in the empirical exercise of poverty measurement, it is necessary to select the one or more particular dimensions of well-being to measure. Additionally after selecting the particular dimensions, for each dimension a decision rule or criterion must be applied that separates the poor from the non-poor[3].

a) Choice of dimension(s)

The selection of dimensions for poverty measurement has been discussed in detail in previous literature, in particular Alkire (2007) provides a comprehensive review of the conceptual framework for selecting dimensions under Sen's Capability Approach. This section highlights some important decisions in dimension selection and attempts a categorization of the options for dimension selection and decision rules.

In practice the choice of poverty dimensions is the choice of variables that can be defended as representing well-being of an individual[4]. The chosen variable must also have a clear relationship with well-being, whether positive or negative. In defending the choice of variables, Gordon et al. (2000) argues that a selected dimension must have "face validity", the idea that such variables or dimensions "on the face of it" either are directly related to well-being or identify characteristics directly associated with well-being. For example, income is commonly used as a measure of well-being and as such would be accepted by most individuals as an appropriate indicator. But a variable such as shoe size may not, on the face of it, be a clear and obvious indicator of well-being.

This criterion is also important as some counterfactual characteristics can arise in the choice of dimensions across countries and especially across time as there are changes in technology. One particular example would be a variable that measures the presence of a radio in a household and uses this dimension

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[3] Identification is usually a first step in the poverty measurement process but it may also be intermixed with the Aggregation process should the particular methodology for poverty measurement consider dimension choice, aggregation and then decision rules on the aggregated dimensions instead of the individual dimensions.

[4] The Stiglitz group (Sarkozy established) consider alternatives to GDP in terms of the well-being at a national level – that would encompass not just individual well-being but group level and country level factors (also ECLAC Social Cohesion).

as an indicator of well-being (with those having a radio having higher well-being than those without a radio). These types of dimensions, which are used to measure individual or household assets, would seem to be appropriate dimensions of well-being. Such measures are commonly used in studies creating measures of Socio-Economic Status (SES) and are popular with data from Demographic Health Surveys (Wang 2002).

However the relationship between well-being and the variable for the presence of a radio can change depending on the relative inequality and the level of technology in a society. For example, whilst the presence of a radio may indicate higher well-being in less developed countries and poorer communities where assets are few and technology is not so advanced, in the most technologically advanced countries and households with the highest levels of well-being, there has been a rapid change in media technology since the beginning of the new millennium and the ability to listen to listen to broadcasts, news, public information and other aural media has changed from transmission over radio frequency to digital media transmission. As such there may in fact be a negative relationship between well-being and the presence of a radio in a household for those with high levels of well-being if such individuals have moved to other technologies such as internet media and stored media devices such as MP3 players. Another example that illustrates difficulties with choosing time independent dimensions of well-being is that of the black and white television. A survey in developed countries taken 40 years ago may show that the presence of black and white televisions is a good indicator of well-being whereas the presence of such a television in a household now is more likely to be an indicator of lower levels of well-being given the ubiquity of colour televisions and transmissions and the obsolescence of the black and white television technology.

The dimensions of well-being commonly used for identifying poverty can be categorized here into four broad and loosely defined dimension types, economic dimensions of well-being, physiological dimensions of well-being, socioeconomic resources dimensions and sociocultural dimensions of well-being (see Table 1)[5].

TABLE 1
TYPES OF POVERTY DIMENSIONS

Types of poverty dimensions
Economic dimensions of Wellbeing
Physiological dimensions of Wellbeing
Socioeconomic resource dimensions
Sociocultural dimensions of Wellbeing

Source: Prepared by the author.

The first category of economic dimensions of well-being includes standard dimensions of economic well-being such as income and consumption. This category is one of the most commonly used for selecting dimensions to assess and measure poverty. The second category of physiological dimensions

[5] This categorization has been established by the author after considering common variables used in poverty analysis and has a loose association with Maslow's hierarchy of needs Maslow, A. (1943). "A Theory of Human Motivation", *Psychological Review* 50(4): 26.

would include a subset of those dimensions commonly known in development literature as unsatisfied basic needs (UBNs) and the variables would measure well-being in basic physiological conditions such as adequate food and shelter for survival. The third category of socioeconomic needs includes those needs related to dimensions important for the socioeconomic well-being of the individual but not included in other categories, such as education and access to health care. The fourth category, sociocultural dimensions encompasses those variables that attempt to identify well-being in terms of an individual's sense of belonging, their inclusion in society and social networks and their ability to participate in the society and the social dynamic.

b) Decision rules

For each selected dimension, a decision rule must be chosen in order to identify the individuals who are defined as being in situations of poverty. The rules contain two different characteristic categories depending on how they are applied, the first being absolute or relative poverty rules and the second being well-defined or approximate rules. For the first category a rule is absolute if it is not related to the dimension in question. This characteristic is most easily illustrated in the application of the measurement of poverty in the income dimension where two different rules may be used, an absolute poverty line and a relative poverty line. An absolute poverty line is unrelated to the distribution of the income in the sample and represents an absolute limit of income below which a person is defined as poor. The application of a relative poverty line means that the poverty line varies according to the distribution of income in the sample. For example a common relative poverty line is defined as 50% of the median income of all individuals. Therefore the poverty line is relative to the incomes across the sample, whereas an absolute value, for example, $1.25 PPP per day, represents an absolute poverty decision rule that is invariable to the sample in question[6]. Relativity in decision rules for socioeconomic dimensions would follow a similar reasoning where a decision rule may characterize those as poor who represent the 25% of individuals with the lowest education levels and the criterion is relative to the population. The second characteristic division is between well-defined and approximate decision rules. Well-defined decision rules have strict and definite criteria. For example if income is less than $1.25 per day, if education is less than primary level, if a household has three or more people to a room. Approximate decision rules include ranges of poverty and the use of fuzzy logic type procedures to defined an approximate area in which a person is defined as likely or unlikely (but not definitely) being in a situation of poverty or not. This can also encompass subjective decision rules such as those commonly used in Subjective Wellbeing Measures where situations of poverty are self-assessed and based upon no fixed defined switching rule, for example as applied by Rojas (2008).

5. Aggregation

The second step in the construction of a poverty measure is that of aggregation and in the multidimensional poverty context this is especially important given the need to aggregate poverty across distinct dimensions of well-being. The core difficulty is the decision about whether an individual is in a situation of poverty depending upon how the dimensions of poverty are aggregated into one measure and the potential of this measure to distort the true extent of poverty in the population under observation.

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[6] It is recognized that absolute income poverty lines are updated over time to better reflect consumption patterns and thus are relative to the consumption in the sample. However the absoluteness arises because the line is determined exogenously with respect to the dimension in question as compared to the relative poverty line which is endogenous.

This is perhaps the most important issue to resolve in terms of the ability to apply empirical measurements of multidimensional poverty to existing data. There are four broad categories defined here that can describe and typify the most common empirical methodologies for aggregating different dimensions of well-being where situations of poverty have been identified (poverty dimensions). These are simple rules, compound rules, statistical rules and subjective rules. In essence all four types of aggregation categories include various methods that attempt to detail with the relevant weighting of the different poverty dimensions and their specific transformations into a single poverty index measure.

TABLE 2
TYPES OF AGGREGATION RULES

Types of aggregation rules
Simple rules
Compound rules
Statistical rules
Subjective rules

Source: Prepared by the author.

a) Simple rules

Simple rules are single level logical rules and do not have any secondary conditions. The two extreme approaches that best exemplify aggregation by simple rule are also the most basic precepts of multidimensional poverty. These are known as the union and intersection approaches (Duclos, Sahn et al. 2006). A union rule identifies an individual as poor if they are in situations of poverty in any one of the chosen poverty dimensions. The intersection rule aggregates the poor and includes them only if individuals are poor in all poverty dimensions. For example, suppose there exists a poverty measure that attempts to aggregate across three poverty dimensions of income, education and health with poor individuals having been identified within each dimension according to the respective decision rules. The population of individuals can then be divided into different groups, those who are in situations of poverty according to any of the three dimensions, those in situations of poverty in more than one of the dimensions and those in situations of poverty in all three of the dimensions. Under the union rule, the individuals included as multidimensionally poor would be all those who are poor in any of the three dimensions, that is, individuals in this example who are poor in one, two or all three dimensions would all be counted as multidimensionally poor. An individual must be in a situation of poverty in all three dimensions to be counted as poor. Therefore a union method provides higher poverty figures than the intersection method, which is far more exclusive.

In practice applications of simple rule aggregation are not common with most researchers preferring measures that deal with intermediate solutions, as in the work dealing with the remaining three categorizations described below. However Bourguignon (1992) argues that the Union approach is a valid measure of poverty that deals correctly with a minimum standard of well-being that is considered acceptable across each and every dimension.

b) Compound rules

Compound rules as a category of multidimensional poverty aggregation do have secondary conditions and are mainly used to seek an intermediate solution between the union and intersection approaches. They are rules that provide an implicit or explicit basis or reasoning for an appropriate weighting of the dimensions in the aggregation exercise. One example of a compound rule is that of the Integrated Poverty Measure (IPM) developed by Katzman (1989) and applied in the work of ECLAC (2003) in the measurement of poverty with respect to unsatisfied basic needs. The Integrated Poverty Measure combines a consideration of income poverty with poverty dimensions defined as unsatisfied basic needs such as access to water and sanitation and having adequate shelter. There are three measures; i) Short-Term poverty is the headcount of individuals that are in situations of poverty in the income dimension but face no unsatisfied basic need, ii) Structural poverty is a situation in which an individual is in a situation of having one or more unsatisfied basic needs but is not income poor and iii) Chronic poverty is a situation in which individuals are both income poor and have one or more unsatisfied basic needs. The different measures of the IPM can be considered a compound rule for aggregation of poverty dimensions because it combines the union and intersection approaches in two levels. Firstly the union approach is applied to the list of dimensions considered unsatisfied basic needs. The inclusion of an individual in any of the three IPMs depends upon the presence or absence of poverty in any one of the UBN dimensions. This is then combined with a union and intersection approach at the level of a comparison between income and the UBNs in the consideration of Chronic poverty where inclusion in chronic poverty depends upon being in the set of income poor and being in the set of having any UBN.

Another example of the use of compound rules for the aggregation of poverty dimensions is the methodology of Alkire and Foster (2007) which uses a compound rule where the first condition is the minimum number of dimensions to count an individual as being in a situation of multidimensional poverty. After this condition the second rule aggregates the poor individuals according to a specified weighting scheme. This method can be illustrated using the previous example of the problem of aggregation across the three poverty dimensions of income, education and health. According to the Alkire-Foster methodology the decision maker must first select the minimum number of dimensions necessary to be considered poor. The minimum number, one, corresponds to the union rule under the simple rule approach whilst the maximum number, all dimensions which in this case is three dimensions, corresponds to the intersection approach. However Alkire and Foster's first condition allows the selection of intermediate solutions such as two dimensions. Therefore in the hypothetical example given here, the application of the first level rule is to count only those individuals who have two or more dimensions as being in situations of multidimensional poverty. The second condition then applies within the subset of this identified group of poor individuals where the weighting scheme is then selected that determines the relative importance of each poverty dimension. This contrasts with the case of the IPM measure as the IPM measure considers an equal weighting across individuals once the criteria for inclusion in the poverty group has been met. The Alkire and Foster methodology applies weights to individuals that have met the first condition of inclusion in the poverty group according to the number of dimensions in which the individual is deprived. Therefore individuals are given more importance the greater the number of dimensions in which they are identified as poor. That is, an individual in a situation of poverty across three dimensions for example is weighted more highly than an individual in poverty in only two dimensions and is thus more important in determining the aggregate poverty rate.

This weighting by number of dimensions allows further fiexibility by giving selected poverty dimensions more or less weight depending upon a priori decisions of the researcher. Continuing with the example, the first condition is applied and all those in situations of poverty defined by two or three dimensions are included in the group of poor. The second condition states that under an equal weighting scheme for the dimensions, the individual deprived in three dimensions will be weighted more highly than the individuals

identified as poor in only two dimensions. However a different weighting scheme may have different results in terms of the relative importance of each member of the group identified as poor.

TABLE 3
HYPOTHETICAL EXAMPLE OF MULTIDIMENSIONAL AGGREGATION

Dimension	Individual A	Individual B	Individual C	Weighting
Income	Poor	Non-poor	Poor	0.7
Education	Non-poor	Poor	Poor	0.1
Health	Poor	Poor	Poor	0.2

Source: Prepared by the author.

Consider the example in Table 3 above of a weighting scheme where the income dimension is weighted at 0.7, the education dimension at 0.1 and the health dimension at 0.2. In this case the relative importance of the individual within the poor grouping changes depending upon for which dimensions they have been identified as poor. Add to this scheme three individuals, A, B and C where individual A is identified as poor in the income and health dimensions, individual B is identified as poor in the education and health dimensions and individual C is poor across all three dimensions. Individual C receives a higher relative importance in the formulation of the Alkire and Foster poverty measure because they are deprived in a greater number of dimensions whose sum of relative weights (1.0) is greater than that of individuals A and B whose weights sum to 0.9 and 0.3, respectively. In addition although individuals A and B are identified as poor in the same number of poverty dimensions, individual A is given more importance in the aggregation of the poverty measure as they are deprived in dimensions that are considered more important than the dimension pattern of individual B.

c) Statistical and data driven rules

Most of the statistical and data driven rules for aggregation of multiple poverty dimensions fall into one of two further groupings, simple measures of central tendency and model based approaches. Simple measures of central tendency consider values such as the mean or median in order to arrive at an aggregated poverty measure. One example of a simple statistical rule is the aggregation procedure within the calculation of the Human Development Indices which include the Human Development Index (HDI), the Human Poverty Index (HPI) and the Gender Related Development Index (GDI), and are calculated and applied by the United Nations Development Programme (UNDP) (United Nations Development Programme 2007). Taking the HDI as an example, it creates a relative ranking index of countries based upon three dimensions, GDP per capita, Education in terms of illiteracy and enrolment, and Health in terms of life expectancy at birth. The aggregation procedure for the generation of the HDI, as well as the GDI, is simply the average of the values of the individual component indices (Anand and Sen 1994)[7].

By contrast the aggregation procedure for the calculation of the Human Poverty Index (United Nations Development Programme (UNDP) 2009), which consists of two separate indices HPI-1 and HPI-

[7] In addition the creation of the dimension indices to be aggregated, although not aggregation rules in their own right, in many cases use a similar simple measure not based upon central tendency but consist of distance functions from the "goalpost" of the country with the highest value in the particular dimension. In this case the measure is relative to the maximum score.

2, is better described as a model based approach since a non-linear aggregation formula is used to provide greater weighting on observations with greater deprivation. A similar model based aggregation procedure provide for aggregation of the dimensions through use of a parameter that allows for the degree of substitutability between the dimensions in order to adjust the weights of the observations according to the extent of the correlation between the deprivations. Such measures have a constant elasticity of substitution (CES) and have been applied in the work of Bourguignon and Chakravarty (2003) and Calvo (2008).

Another series of applications of statistical and data driven rules for the aggregation of poverty dimensions is through the use of latent variable models. Latent variable models assume that the dimensions of well-being that are observed and used in the determination of poverty are determined by an underlying data generating process that is unobserved. Factor analysis and principal components analysis are basic latent variable models that use the poverty dimensions to estimate the underlying latent variable as a factor or principal component. Multiple Indicators Multiple Causes (MIMIC) models and Structural Equation Models (SEMs) are additional model based aggregation procedures that attempt to determine the underlying latent variable and its properties through the use of the identifying dimensions of well-being in addition to exogenous variables that do not represent the underlying well-being but that may have an external influence on latent factor. Klasen (2000) and Ferro Luzzi et al. (2008) provide examples or multidimensional poverty analysis using factor analysis and principal components analysis whilst applications of MIMIC models can be found in Abdul Naga and Bolzani (2008) and Fay and Leipziger (2005) and uses of SEMs for poverty analysis include the work of Krishnakumar and Ballon (2008). Krishnakumar and Ballon in particular show that latent variable models lend themselves quite well to Sen's capability approach given the distinction between functionings and capabilities where the observed variables represent functionings that are indicators of the underlying capabilities which are the latent variables estimated by the models.

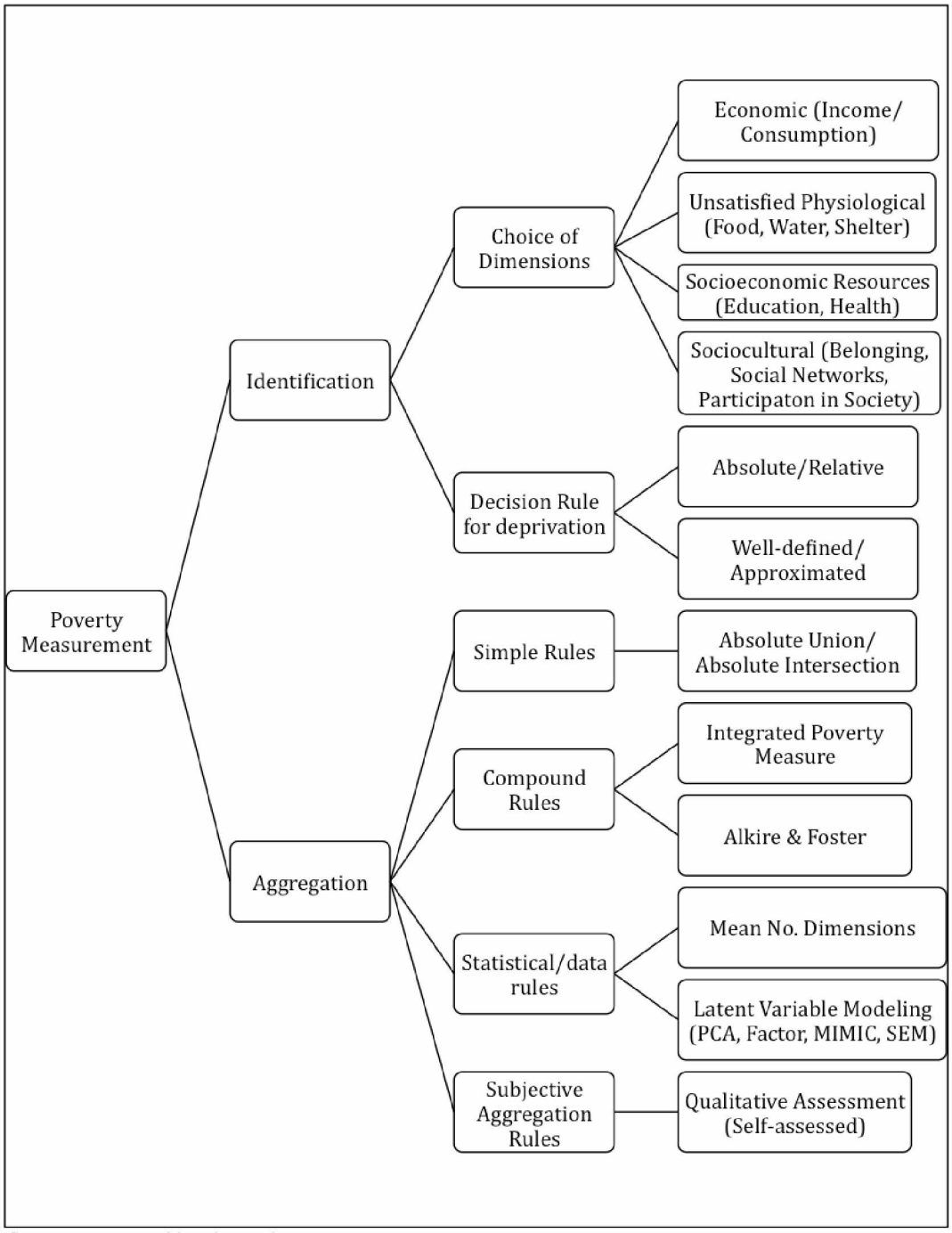
d) Subjective aggregation rules

Subjective aggregation rules seek to aggregate distinct poverty dimensions through the use of explicitly imposing normative values on the aggregation of poverty dimensions and as such recognize the subjectivity of the poverty concept. An example of a subjective aggregation rule is the use of instruments that measure subjective welfare (such as surveys and/or focus interviews) where the individuals themselves are asked to apply relative weightings in terms of the importance of individual dimensions of poverty. An overview of the use of subjective aggregation rules is provided in van Praag and Ferrer-i-Carbonell (2008) and a discussion of the implications for combining this information with quantitative wealth data is given in Hargreaves et al. (2007).

6. Typology of poverty measurement methods

The many options available to enable the empirical application of multidimensional poverty can be consolidated into a common framework as has been done here. A graphical overview of the categorizations applied is shown in diagram 1.

DIAGRAM 1
TYPOLOGY OF POVERTY MEASUREMENT



Source: Prepared by the author.

7. Multidimensional poverty measurement methodologies in Latin America

The use of standard income and consumption dimensions of poverty measurement has dominated the previous work on poverty in Latin America and in particular the six countries that are the focus of this study. The World Bank still uses as its primary instrument of poverty measurement the consumption poverty line in its regular poverty assessments of the countries (World Bank 2005; World Bank 2006; World Bank 2006; World Bank 2007; World Bank 2008; World Bank 2009) and as such these measures represent a choice of the economic dimension combined with an absolute decision rule about the poverty line but for which no aggregation procedure is followed due to the fact that the poverty measure is unidimensional. In addition examples of applications of poverty measures with a focus on dimensions in the economic category include Ravallion and Chen et al. (2008) and the ECLAC official income poverty measures as presented in the annual editions of the ECLAC Social Panorama (2009).

In terms of multidimensional work within the typology previously described, a popular step is the consideration of a combination of income or consumption measures with some concept of unsatisfied basic needs such as the work of Gutiérrez Coto and Sandoval Carvajal (2003) for Costa Rica and Panama, ECLAC (2003) for Central America and López Calva and Ortiz Juárez (2009) for Mexico. The additional dimensions of unsatisfied basic needs provide a consideration of the economic, physiological and socioeconomic resource dimensions but such methods are still unable to capture sociocultural dimensions. The decision rules in the first two cases are some different combination of compound rules that move towards an integrated poverty measure. Gutiérrez Coto and Sandoval Carvajal and ECLAC specifically define slightly different definitions of the integrated poverty measure, but López Calva and Ortiz Juárez present results for the union and intersection methods as well as intermediate solutions closer to the statistical or data aggregation rule of the mean number of dimensions. Battiston et al. (2009) apply the Alkire and Foster aggregation method which is a compound rule for six Latin American countries including El Salvador and Mexico. Their dimensions are also a set of income and unsatisfied basic needs with absolute and well-defined decision rules.

An application of a statistical rule used for aggregation is that of the poverty measures of the Mexican Technical Committee for the Measurement of Poverty (Comité Técnico de la Medición de la pobreza 2002), who established the measures of capability poverty and patrimony poverty that Mexico uses as official poverty measures in addition to a basic food poverty measure[8]. The innovation in this case is the application of monetary measures of the costs for an individual or household of the provision of the physiological and socioeconomic resource dimensions of well-being such as the costs of adequate education, health services or access to water and sanitation. These measures are incorporated into different poverty lines. This can be considered a statistical rule as the non-economic dimensions are each assigned an economic value so that the aggregation can occur and in a unit of measure familiar to the public and policy makers alike. The implicit weights, given by the relative costs of the adequate provision of the dimensions of well-being are subject to expenditure weights of lower income or consumption quantiles. This provides for great relevance in terms of the establishment of poverty lines but is disadvantageous in that the relative weights of the dimensions are distorted by considering only expenditure patterns of a subset of the population. The fact that several dimensions are likely to be more highly weighted for those parts of the population considered multidimensionally wealthy (for example the

[8] There are three official poverty measures currently used by Mexico. Food poverty identifies those who do not have the resources necessary to purchase a basic basket of foods that would provide a minimum caloric intake. Capability poverty is identified by having an income insufficient to obtain the basic food basket as well as necessary expenditure on minimum levels of health and education. Partimony poverty is income insufficient to obtain a basic food basket, and costs in health and education as well as clothing, housing and transport.

fact that education costs are far higher both absolutely and proportionally for those in higher socioeconomic classes) can provide a bias in terms of the ability of the aggregation technique applied in the Mexico case in terms of its multidimensional poverty measurement.

The application of a variety of statistical rules for aggregation is an area in which there is some emerging research in Latin America and in particular Mexico and Central America. Specific latent variable models to aggregate dimensions have been used by D'Ambrosio and Rodríguez (2008) for Brazil and Krishnakumar and Ballon (2008) for Bolivia. The use of the subset of latent variable models that apply factor analysis or principal components analysis has been the aggregation rule of choice for work on multidimensional poverty in Argentina (Conconi and Ham, 2008), Guatemala (Berumen, 2005) and Honduras (Macias Ruano, Ogando Caníbal et al. 2009). In addition, in México the Commission of the Evaluation of Social Development Policy (Consejo nacional de Evaluación de la Política de Desarrollo Social (CONEVAL, 2007) and the Commission of Population Analysis (Consejo Nacional de Población (CONAPO, 2009) use indices of social risk and marginalization respectively that are applied aggregation rules using principal components analysis and such indices assist in the targeting of social development policies such as conditional cash transfer programmes. An alternative route to multidimensional poverty measure is that of Berenger et al. (Berenger, Calderón Villarreal et al. 2009) who uses an application of a statistical aggregation rule but with relative and approximated dimension decision rules based on fuzzy measurement methodologies in an analysis of poverty in Mexico.

One other area of burgeoning interest in terms of multidimensional poverty measurement is the use of subjective measures of well-being through the combination of quantitative and qualitative analysis and through instruments that ask for poverty to be self-evaluated. Molina (2003) conducts a poverty assessment for El Salvador from a sociological approach where participants are asked to self-rate their poverty levels. del Carpio and Castro (2007) also conducted assessments of subjective well-being in their work for the Voices of the Poor study in Nicaragua that provided additional insights to the World Bank's Poverty Assessment. Rojas (2008) conducts a subjective well-being assessment for Mexico based on survey information that included a self-evaluation component for different dimensions of well-being as well as for an overall life satisfaction level.

Table 4 below provides a summary of the selected literature in terms of how these works fit into the typology described in diagram 1.

8. The decision to aggregate dimensions

Recognition of the multidimensional nature of poverty does not necessarily imply that measurement of such a concept needs to be aggregated into one dimension. At the international level recent directions towards improving the multidimensional measurement of well-being do not aggregate dimensions. The millennium development goals (United Nations Statistics Division 2009) are an example of eight goals in different thematic areas of economic and social development that, should they be met would represent great strides in development and progress towards poverty eradication. However they are not aggregated into one dimension and are considered as a group but analyzed in isolation when measuring their progress. Another example, is that of the recent Report by the European based Commission on the Measurement of Economic Performance and Social Progress who suggest a range of additional indicators to account for multidimensionality in the measurement of economic and social progress and the identification of those countries relatively poor or relatively rich and whose status is not best identified purely on the basis of GDP per capita (Stiglitz, Sen et al. 2009). In this case once again, the indicators are

TABLE 4
TYPOLOGY OF SELECTED MULTIDIMENSIONAL POVERTY LITERATURE

Author/Year	Country/Year	Multidimensional poverty measure	Identification dimensions	Decision rules	Aggregation method
(Gutiérrez Coto and Sandoval Carvajal 2003)	Costa Rica and Panama/2000	UBN Integrated poverty Measure	Economic Physiological Socioeconomic Resources	Absolute Well-defined	Compound rules-integrated poverty measure
ECLAC 2003 (Sauma)	Central America, 1990-2002	Income and UBN	Economic Physiological Socioeconomic Resources	Absolute Well-defined	Compound rule integrated poverty measure
Battiston et al.	Argentina, Brazil, Chile, El Salvador, Mexico, Uruguay/1996-2006	Income and UBN	Economic Physiological Socioeconomic Resources	Absolute Well-defined	Simple rules-Results for Union and Intersection Compound rule - Alkire and Foster - Bourguignon and Chakravarty
(López Calva and Ortiz Juárez 2009)	Mexico, 2002	Income & UBN	Economic Physiological Socioeconomic Resources Sociocultural	Absolute Well-defined	Simple rules-Results for Union and Intersection Statistical rules-Mean number of dimensions
(Comité Técnico de la Medición de la pobreza 2002)	Mexico, 2000-2006	Food poverty Capacity poverty Patrimony poverty	Economic Physiological Socioeconomic Resources	Absolute Well-defined	Statistical rule Mean number of dimensions
(Krishnakumar and Ballon 2008)	Bolivia/2002	Simultaneous Latent Variable Model	Economic Physiological Socioeconomic Resources	Relative Well-defined	Statistical/data rules Latent Variable Model

/Continued

Table 4 (Continuation)

Author/Year	Country/Year	Multidimensional poverty measure	Identification dimensions	Decision rules	Aggregation method
(D'Ambrosio and Rodríguez 2008)	Sao Paolo Brazil, 2000	Municipal level deprivation indices-absolute Gini, Esteban and Ray Polarization Index, Bossert et al. deprivation measure	Economic Physiological Socioeconomic Resources	Absolute and relative Well-defined	Statistical/data rules Latent Variable Indices (Deprivation as index dimension)
(Calvo 2008)	Peru/2002	Vulnerability to multidimensional poverty (VMP) measure (Consumption and leisure time)	Economic Socioeconomic Resources	Relative Well-defined	Statistical/data rules Regression model
(Berumen 2005)	Guatemala/ 2002	Physical quality of life index	Physiological Socioeconomic Resources	Relative Well-defined	Statistical/data rules Mean No. dimensions and Principal Components Analysis
(Macías Ruano, Ogando Caníbal et al. 2009)	Honduras/ 1995-2005	Synthetic index from principal components	Economic Physiological Socioeconomic Resources	Relative Well-defined	Statistical/Data rules Principal Components Analysis
(Consejo nacional de Evaluación de la Política de Desarrollo Social, CONEVAL, 2007)	Mexico, 2007	Index of social risk	Economic Physiological Socioeconomic Resources	Absolute Well-defined	Statistical rules Principal Components Analysis
(Consejo Nacional de Población, CONAPO, 2009)	Mexico	Index of marginalization	Economic Physiological Socioeconomic Resources	Absolute Well-defined	Statistical rules Principal Components Analysis
(Conconi and Ham 2008)	Argentina, 1998-2002	Multidimensional poverty index	Economic Physiological Socioeconomic Resources	Absolute Well-defined	Statistical data rules Factor Analysis

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Table 4 (Conclusion)

Author/Year	Country/Year	Multidimensional poverty measure	Identification dimensions	Decision rules	Aggregation method
(Berenger, Calderón Villarreal et al. 2009)	Mexico	Multidimensional poverty index	Economic Physiological Socioeconomic Resources	Relative Approximate	Statistical data rules Fuzzy logic
(Molina 2003)	El Salvador/ 2003	Income poverty compared to Anthropometric Measure (Subjective well-being)	Economic Physiological Socioeconomic Resources Sociocultural	Absolute Well-defined (Income) Relative and approximated (Perceptions)	Subjective aggregation Qualitative assessment
(Del Carpio and Castro 2007)	Nicaragua, 2007	Subjective well-being	Economic Physiological Socioeconomic Resources Sociocultural	Relative Approximate	Subjective aggregation, Qualitative assessment
(Rojas 2008)	Mexico, 2001	Subjective well-being (Domains of life)	Economic Physiological Socioeconomic Resources Sociocultural	Relative Approximated	Subjective aggregation Rules (Self-Rated)

Source: Prepared by the author.

grouped into thematic areas, but are not aggregated. Even recent work by ECLAC in the development of a comprehensive set of indicators for Social Cohesion does not present any suggestion of the need to aggregate such dimensions (Comisión Económica para América Latina y el Caribe, CEPAL, 2007). However these types of measures are focused mainly on assessing international and global well-being and are not necessarily focused upon identifying the poor members of the global community. Avoiding aggregation issues can illustrate the complexity of the conceptual problem of measuring well-being and poverty and whilst this would normally signal a preference to avoid simplistic aggregate categorizations, the lack of aggregation does face disadvantages in terms of policy development because it provides an incentive to deal with different dimensions in isolation and little incentive for policy makers and organizations to consider a more holistic approach to social policy. For example the ability to concentrate on specific health issues and the existence of separate measures highlighting developing needs in this particular dimension provides an incentive for policy makers to put resources into determining pathways to health development, but provides no incentive to consider how such health development affects economic development and how policies for eradicating poverty in health may cause virtuous or vicious feedback effects on policies for eradicating economic poverty. An aggregate measure provides a simple conceptual indicator of the multidimensional nature of well-being and poverty. In terms of incentives, it provides a central point around which to focus economic and social development efforts and eliminates a disincentive to consider a modular or sectoral approach to development and provides an incentive towards a more holistic and mainstreamed approach to development policy. One such example is the rise of popularity and interest in the Human Development Index (United Nations Development Programme 1997). The index has provided a "call to arms" for policy makers to begin to consider development policy beyond that of economic growth and it is also a concept that is more easily understood by the public and the layperson and thus can generate more popular support – also because it allows for the relative ranking of different countries.

Similarly, the ability to provide a multidimensional and aggregated measure of poverty assists in the development of a snapshot or profile of poverty that can help generate popular support for eradication policies whilst at the same time are based on objective, consistent and defensible measurement methodologies.

At the same time aggregate measures are by their nature more complex in interpretation and present more challenges for policy makers. It is necessary to consider the changes in the performance of aggregate indicators alongside the performance of their particular component dimensions so that the policy maker can better monitor the virtuous effects relating from a policy's benefit along one dimension contributing to poverty eradication in other dimensions. However equally necessary is an analysis of any perverse effects that would see positive performance in poverty eradication in one dimension offset by poverty deepening in another dimension. The ability of aggregate indicators and the analysis of their subcomponents to illustrate these interrelated effects is one characteristic that offers greater complexity but also far greater utility to policy makers in improving the design of poverty eradication policies.

II. INTEGRATING INCOME POVERTY AND UNSATISFIED BASIC NEEDS (UBNS)

1. Introduction

In this chapter an empirical analysis of income poverty and **U**nsatisfied Basic Needs is applied to Mexico and five countries of Central America including Costa Rica, El Salvador, Guatemala, Honduras and Nicaragua[9]. The data used in the analysis comes from nationally representative household surveys and details of the surveys are included in Appendix 1. The surveys were carried out in each country between 2004 and 2007. **O**n average these countries carry out nationally representative household surveys once every two to three years and this selection was chosen based on the group of surveys that would cover each of the countries and would be the most recent information available.

The sections are set out as follows. The next section 2 discusses the more traditional income poverty within each country and presents results for the rates of income poverty by country and across the selected region as a whole. Section 3 then discusses the application and measurement of populations in each country with **U**nsatisfied Basic Needs and presents a regional total. Section 4 considers the aggregation problem and the limitations involved in the use of the three aggregation measures chosen. Section 4 concludes.

2. Income poverty

Measuring income poverty in each of the countries requires the identification of two factors – income and an income poverty line. The income measure used is household per capita income, measured, corrected and adjusted according to the ECLAC methodology as described in repeated issues of the ECLAC Social Panorama (ECLAC (Economic Commission for Latin America and the Caribbean) 2004; 2006; 2007; 2008) and a detailed explanation of the definitions and adjustments that ECLAC make to the survey data for income is given by Beccaria (2007).

In synthesis there are a few key characteristics of the ECLAC income measure. The first characteristic is that ECLAC actually considers income and not consumption. Whilst consumption would provide additional insights, not all countries collect consumption consistently and at frequent intervals in their surveys. To ensure comparability, ECLAC, and this study apply a common definition of household income per capita. Household income per capita, as the name suggests, also signifies total household income but to arrive at the per capita amount, a simple division amongst household members is made. This operation applies no equivalence scale and each member is assumed to have access to an equal share of the total household income[10]. Therefore the standard measure of household income per capita provides no insights into the intra-household distribution of

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[9] Although nationally representative household surveys exist for Panama, there is no data collected about the majority of the dimensions that are used to define Unsatisfied Basic Needs in this study. In the case of the Dominican Republic, difficulties with comparability of the UBNs prohibited its inclusion in the sample under analysis.

[10] Equivalence scales have been used to apply different intra-household weighting schemes to the division of income amongst household members due to the assumption that children consume fewer resources than adults and therefore should have lower weighting. However determining values for the parameters of the equivalence of the equivalence scale is still an area of debate. For a complete discussion of equivalence scales see Coulter, F. A. E., F. A. Cowell, et al. (1992). "Equivalence Scale Relativities and the Extent of Inequality and Poverty." Economic Journal 102(414): 1067-82, Mancero, X. (2001). Escalas de equivalencia: reseña de conceptos y métodos. Serie Estudios Estadísticos y Prospectivos. Santiago, Chile**:** 51.

income, or the implications of such distribution in terms of gender equality in the use of the income between male and female members of the household.

The final two major adjustments made to the income data from national surveys is a correction for households that report zero incomes or do not report incomes and an adjustment to align the total with the National accounts. The correction is made by applying totals to households reporting zero incomes based upon estimations made for households with similar characteristics. The adjustment of these corrected household income totals is made to ensure that the total income, after stratification weighting for the population sample, meets the total household income entry in the National Accounts of that country (Expert Group on Poverty Statistics 2006). Given these corrections and adjustments, the ECLAC income measures derived from the national household surveys are executed in an attempt to improve the comparability of the survey totals across countries and these variables will differ from the unadjusted totals in use by the countries themselves.

In terms of the choice of poverty line, the ECLAC Methodology also differs from that of the national statistical agencies and other institutions such as the World Bank. ECLAC define an extreme poverty line, also known as an indigence line, based on a consumption measure of the income necessary to meet the minimum daily caloric requirements of an individual. This line is based on the local cost of a basic basket of goods and is distinct for urban and rural areas. A poverty line is derived by assuming that a remaining portion of the income must be spent on essential non-food items and the total food and non-food components represent a multiple of the extreme poverty line. In the ECLAC case the poverty line is around 1.75 times the extreme poverty line in rural areas and around 2.0 times the extreme poverty line in urban areas. This differs from measures such as the familiar dollar-a-day poverty line of the World Bank (Ravallion, Chen et al. 2008). The dollar-a-day measure, or $1.25 per day after its updating in 2005, is a consumption based poverty line based upon the average of the poverty lines of the 15 poorest countries in a world wide sample then converting to a common numeraire currency adjusted according to purchasing power parity[11].

Using the ECLAC income poverty methodology, the proportions of the populations in situations of poverty in each country around the year 2007 are given in Table 5 below. The values of the income poverty lines for Mexico and the five countries of Central America are presented in Appendix 2.

Across the six countries, a simple weighted average of the seven countries shows that 37 per cent of the regional population lives in situations of income poverty with 53 per cent of the Central American population living in poverty. This means that over 52 million people were in situations of income poverty circa 2007 and 14 per cent or more than 19 million people were living in situations of extreme income poverty or indigence over the same period. The national totals show that this distribution of the incidence of income poverty was hardly uniform. Costa Rica had the lowest rates of extreme income poverty and income poverty with only 5 per cent and 19 percent of Costa Ricans living in situations of extreme income poverty and income poverty respectively. Honduras had the highest incidence of both income measures with almost half its population in situations of extreme income poverty and nearly 70 per cent of Hondurans living in income poverty. Nicaragua and Guatemala also had high rates of extreme income

[11] Purchasing power parity adjustments take into account both exchange rate and inflation or cost of living differentials between countries. Given the large data requirements of assessing and establishing comparable consumption baskets in each country across the globe, such exercises are done infrequently, the one before 2005 being in 1993. These are managed by the International Comparisons Project International Comparison Program (2008). Global purchasing power parities and real expenditures. 2005 International Comparison Program. Washington, D. C., USA, World Bank: 230.

poverty and poverty. El Salvador had lower incidences of extreme income poverty and poverty compared to all Central American countries except Costa Rica. Mexico, by far the most populous country also registered relatively low rates of extreme income poverty and poverty at 9 percent and 32 per cent of its population respectively. However in absolute numbers, the 32 per cent of Mexicans living in income poverty, a quantity of more than 33 million people, still represents nearly 90 per cent of the entire population of the five countries of Central America.

TABLE 5
POPULATIONS IN SITUATIONS OF EXTREME INCOME POVERTY AND INCOME POVERTY, CENTRAL AMERICA AND MEXICO, AROUND 2007

Country	Proportion of population in situation of extreme income poverty			Proportion of population in situation of income poverty		
	Urban	Rural	National	Urban	Rural	National
Costa Rica	4	7	5	18	20	19
El Salvador	14	27	19	41	57	48
Guatemala	15	42	29	42	67	55
Honduras	26	62	46	57	79	69
México	4	16	9	27	40	32
Nicaragua	21	46	32	54	72	62
Central America Average	17	40	28	44	62	53
Regional average (Central America and Mexico)	7	24	14	30	48	37

Source: Author's calculations based on ECLAC (2008) and national household surveys.

Another unfortunate but unsurprising trend is the relative higher incidence of extreme income poverty and poverty in rural areas compared to urban areas. Across the region, persons living in rural areas were over three times more likely to be in situations of extreme income poverty than those living in urban areas.

3. Unsatisfied Basic Needs (UBNS)

As discussed in Section 2, the dimensions and criteria for identifying a household as having an Unsatisfied (or Unmet) Basic Need can vary greatly depending upon the type of research, the perspective of the researcher and the available data. In the case of the sample of countries of the northern subregion of Latin America, the need to ensure comparability between countries restricts greatly the dimensional choice. As such the needs chosen here fit into a very conservative view of UBNs with the majority

relating to basic physical necessities in terms of shelter and infrastructure. The unit of analysis for the majority but not all of the UBNs is measured at the household level and so in many cases the same value will be applied across different household members. The lack of available data prohibits an analysis of a wider set of needs such as those envisioned as falling within the broader human development category of multidimensional poverty measurement, for example social inclusion, subjective wellbeing, happiness and others, that were covered in the previous chapter. These broader factors can be a significant influence on poverty at different levels of analysis, from the national and sectoral levels to the community and household levels. UBNs do not seek to provide any insight into these social dynamics.

The Latin American region in particular has a long history of work in the application of UBN type approaches (Expert Group on Poverty Statistics 2006; Fresneda 2007; Larrañaga 2007). In this section, UBN dimensions are chosen based upon the work of Feres and Mancero (2001) and ECLAC (2003).

There are eight UBNs covered for the selected region, although the individual country figures vary according to the availability of data in their specific household surveys and so only seven UBNs have survey data considered sufficiently comparable and are applied here to an assessment of non-income poverty for Mexico and the five countries of Central America. UBN 1 measures the quality of housing and this is considered an UBN if the materials used in the construction of the housing are inadequate. UBN 2 relates to households that have too high a population density, more than 3 persons for each room in the house. UBN 3 and UBN 4 exist if the households do not have access to potable water or to adequate sanitation, respectively. UBN 5 exists if there is a member of the household that is between 7 and 12 years of age that is not attending school and if other members of the household over 12 years do not have an education of at least primary school level. A household has UBN 6 if one or more members do not have access to medical or social insurance. UBN 7 relates to the availability of electricity for household energy and UBN 8 is a synthetic measure of household consumption capacity with members of the household having a UBN in this dimension if the dependency rate (the ratio of employed members to economically inactive members) is high and if the head of the household has a lower education level[12].

Whilst UBNs 1-4 are based on household factors they apply to each member of the household population. UBN 5 within the methodology suggested by ECLAC (2003), only applies the education requirement on households with children from 7 to 12 years of age. The ability to make statements about poverty amongst the entire population and depends upon each UBN and the lack of application of the ECLAC UBN definition for education is a weakness in this respect (Expert Group on Poverty Statistics 2006). In this study, to enable the education dimension to apply to the entire sample of household populations and not just those with primary school age children, the supplemental criteria of a minimum primary education was included for all members over the age of 12 and up to age 60. Household members younger than school age were given the education UBN of the head of the household as a proxy for their future attained education need. Household members older than age 60 were assumed to have no UBN with respect to education.

The sixth UBN associated with social protection insurance, whether in the form of health insurance, pensions, unemployment insurance or other entitlements was omitted from the analysis because of a lack of comparable data across the seven countries in the sample. Whilst some surveys included data on all types of social protection insurance, others only had data on one particular type of insurance, such as health insurance, whilst some countries restricted the sample of respondents to workers as the regional model for social protection insurance in these cases is more likely to be an employer provided insurance. Given the wide variation of insurance concepts, the data was not comparable and was

[12] Complete definitions and country specific criteria used for comparability are given in Appendix 3.

not included in the UBN analysis[13]. The Table 6 presents the results of the proportions of populations in each country that have unsatisfied basic needs in each of the seven dimensions. There is significant heterogeneity in the incidence of UBNs across the countries of the region where, on average, as little as five per cent of the population of the region had unsatisfied basic needs in education and electricity whilst as much as 35 per cent of the population of the region lived with unsatisfied basic needs in terms of household density. For the Central American subset the there was a similar pattern, albeit with a higher incidence where 11 per cent of Central Americans had a UBN in education and 37 per cent of the sub-regional population had a UBN in household density.

The dimensions in which populations were most likely to be in situations of Unsatisfied Basic Needs were household density and household consumption capacity. Across countries, Costa Rica was the best performing country on average with generally as little as 1-3 per cent of its population having unsatisfied basic needs, with the exception of 11 per cent of Costa Ricans living in inadequate standards of housing. Mexico also had generally low incidences of populations with unsatisfied basic needs across the seven dimensions chosen. In Mexico's case the population with a particular UBN was between 1-5 per cent depending on the dimension whilst a significant outlier in this case was the 35 per cent of Mexicans having UBNs in terms of household density, where in this dimension a UBN exists if there are 3 or more people on average per room in the household. Mexico's strong performance and low incidence had a strong influence on the regional averages given its high proportional share of the regional population in this sample.

Apart from Costa Rica and Mexico, the remaining countries had much more varied performances in the different UBN dimensions with no clear better or worse performer on average. In terms of housing, Guatemala and Nicaragua had the highest incidences of populations living in inadequate housing, at 16 and 17 per cent respectively. Guatemala also has the highest proportion of its population with a UBN in terms of household density. Over half of its population lives in households with a density of more than three persons per room. In terms of access to adequate water supplies, El Salvador has the greatest population with an UBN in this dimension with one quarter of its population having inadequate access to water. A similar proportion of the population in this country also had inadequate access to sanitation but for other countries, the relationship between UBNs in water and sanitation were not so close. Nicaragua has the highest rate of UBN for sanitation at 39 per cent of its population. Education performance was generally better for the countries of the region with a lower dispersion of UBN rates for this dimension than most other dimensions except housing quality. Guatemala is the lowest performing country in this respect, with 15 percent of Guatemalans having a UBN in education – that is either not attending or enrolled if at school age, or having lower than primary level education beyond school age. Honduras and Nicaragua had the highest incidences of UBN 7, access to electricity, amongst the region, with 28 per cent of each population not having access to electricity. In terms of consumption capacity, the UBN established as a combination of the education of the head of the household and the household ratio of economic dependence, El Salvador and Honduras were the worst performers for UBN 8 with 35 per cent and 34 per cent of their respective populations having an unsatisfied basic need in this dimension.

4. Comparing income poverty and UBN incidence

As an initial step towards a comparison of the added information that the UBN results provide, it is useful to consider comparing the additional information that an analysis of the basic UBNs presented in Section

[13] ECLAC (2003) contains details of the variety of different survey questions dealing with social protection insurance across Central America for the periods around 1990 and around 2000.

3 to the traditional income poverty measures that are still the basis for the majority of evaluations and social policy making in the region.

TABLE 6
POPULATIONS WITH UNSATISFIED BASIC NEEDS, CENTRAL AMERICA AND MEXICO, AROUND 2007

Country	Proportion of population with unsatisfied basic needs						
	UBN 1 Housing [a]	UBN 2 Household density [b]	UBN 3 Water [c]	UBN 4 Sanitation [d]	UBN 5 Education [e]	UBN 7 Electricity [f]	UBN 8 Household consumption capacity [g]
Costa Rica	11	3	1	1	2	1	19
El Salvador	9	41	25	27	9	13	35
Guatemala	16	52	13	23	15	18	31
Honduras	9	22	9	27	10	28	34
México	5	35	3	5	3	1	16
Nicaragua	17	43	18	39	11	28	26
Central America Average	13	37	13	24	11	18	30
Regional Average (Central America and Mexico)	7	35	6	10	5	5	20

Source: Author's calculations from national household surveys, modified from definitions from (Comisión Economica para América Latina y El Caribe (CEPAL) 2003).

[a] The UBN was defined in the dimension of the quality of housing if the housing was constructed from improvised materials. This includes walls and roofs constructed from refuse and floors of earth or sand.

[b] A UBN for household population density exists if there are three or more household members per number of rooms in the house, excluding bathrooms, kitchens, passages and garages.

[c] In terms of access to potable water, there is a UBN if the household does not have access to potable water via piping or well directly to the household or directly into the building in which the household lives.

[d] A UBN for sanitation exists if households do not have a toilet, or are not connected to sewerage pipes and systems, or are not connected to septic tanks.

[e] A UBN for education exists if an individual between seven and twelve years of age is not enrolled, or does not attend school, and for any individual twelve to sixty years of age who does not have at least a primary level of education.

[f] If a household does not have access to electricity, at least for lighting, then there is considered a UBN in terms of electricity for this household.

[g] A UBN exists in terms of household consumption capacity if the household dependency ratio, the ratio of inactive members to working members is over 3 and if the head of the household had less than secondary education. This was to make the measure consistent over time, where some surveys did not contain detail about the specific grades of education achieved.

The ordinal ranking of countries in terms of their respective performance between income poverty and each dimension of unsatisfied basic need is outlined in Table 7 below. Whilst this ranking is totally relative to the dimension choice, decision rule, country sample and year, there are some trends worth highlighting. Firstly, Costa Rica is consistently the best performer in terms of poverty alleviation by income or unsatisfied basic need, with the exception of the quality of housing. After Costa Rica, Mexico has made most progress in poverty alleviation with the exception of the dimension of the UBN for household density. On the other end of the scale, Honduras, whilst suffering with the highest incidence of

income poverty amongst the countries of the region, performs better than half the countries in the sample with respect to alleviating UBNs in housing quality, housing density and access to adequate water supplies.

TABLE 7
ORDINAL RANKING OF COUNTRIES BY INCIDENCE OF INCOME POVERTY AND UBN (LOWEST INCIDENCE TO HIGHEST INCIDENCE), CENTRAL AMERICA AND MEXICO, AROUND 2007

Ranking	Income poverty or extreme poverty	UBN 1 (Housing)	UBN 2 (HH Density)	UBN 3 (Water)	UBN 4 (Sanitation)	UBN 5 (Education)	UBN 7 (Electricity)	UBN 8 (HH Consumption capacity)
1	Costa Rica	Mexico	Costa Rica	Costa Rica	Costa Rica	Costa Rica	Costa Rica	Mexico
2	Mexico	El Salvador	Honduras	Mexico	Mexico	Mexico	Mexico	Costa Rica
3	El Salvador	Honduras	Mexico	Honduras	Guatemala	El Salvador	El Salvador	Nicaragua
4	Guatemala	Costa Rica	El Salvador	Guatemala	El Salvador	Honduras	Guatemala	Guatemala
5	Nicaragua	Guatemala	Nicaragua	Nicaragua	Honduras	Nicaragua	Honduras	Honduras
6	Honduras	Nicaragua	Guatemala	El Salvador	Nicaragua	Guatemala	Nicaragua	El Salvador

Source: Prepared by the author.

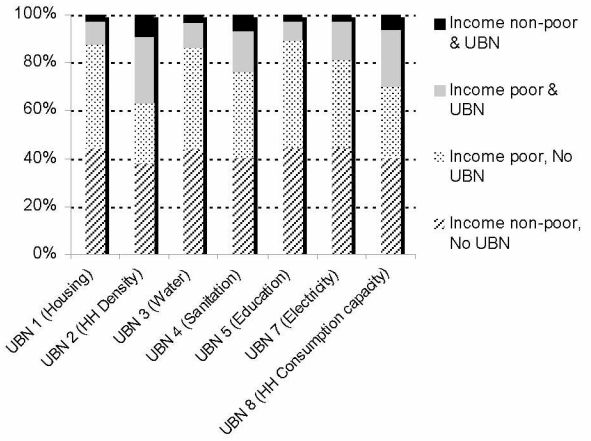
Recognizing the limitations of the UBN analysis and the need to ensure comparability across the countries in the sample, figure 1 shows that complementing income poverty analysis with UBN methodologies can capture additional deprivation that would be hidden by either approach taken in isolation[14].

As shown in figure 1, whilst in Mexico the majority of the population of the region were neither income poor nor had a particular UBN in Central America, only around 40 per cent of the population is non-poor in both income and UBN dimensions. In addition across the dimensions of UBNs considered here, with the exception perhaps of UBN 8 for Central America and UBN 2 for both Central America and Mexico, the pattern of incidence for a particular dimension of poverty tended to be that the proportion of the population that were income poor with no UBN was greater than the proportion that had both a UBN and were income poor. The least likely category was that of populations that were non-income poor having a particular UBN. This shows that the UBN methodology here does not capture a large proportion of the population considered poor that is not already captured by the application of income poverty measures. It does however capture some elements and the fact that not-insignificant proportions of the population, especially in the poorer countries of Central America, have both a particular UBN and are income poor helps to add a dimensional poverty gap in terms of the depth of poverty for these groups of persons.

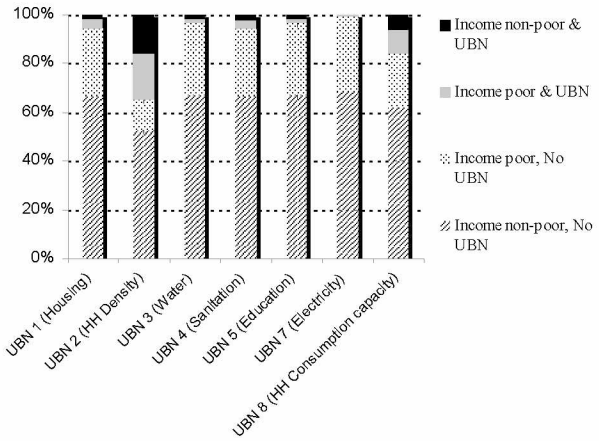
[14] A complete table of results with a disaggregation by country is included in Appendix 5.

FIGURE 1
POPULATIONS WITH UNSATISFIED BASIC NEEDS, BY INCOME POVERTY STATUS, CENTRAL AMERICA AND MEXICO REGIONAL AVERAGE, AROUND 2007 [a]

CENTRAL AMERICA AVERAGE



MEXICO



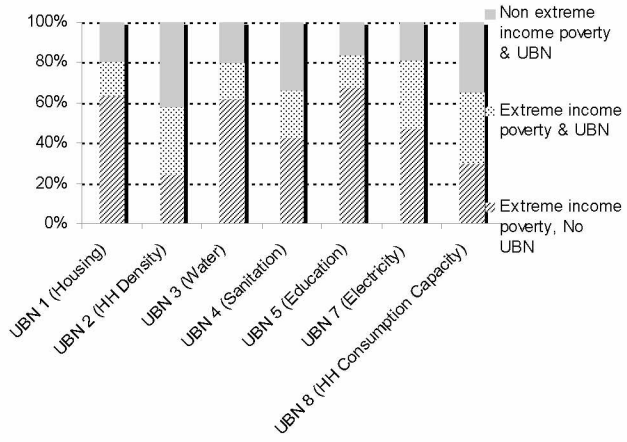
Source: Author's calculations from national household Surveys.
[a] Central America, population weighted average.

There are two other possible reasons for the low incidence of UBNs and income poor. The first is that the UBN decision rules (poverty lines) between having and not having an unsatisfied basic need, were generally set at a rather low standard. This makes the incidence rates lower, but is useful to offset the possible overestimation effects of aggregation in terms of multidimensional poverty indices, as discussed in the next chapter. As such it is perhaps more appropriate to analyse the relationship between the UBNs and extreme income poverty as shown in figure 2. In this case the population having neither extreme income poverty nor a UBN are excluded and it is clear that in both the cases of Central America and Mexico, each dimension of unsatisfied basic need captures a significant proportion of the population that would not normally be identified as extremely poor by the income measure. In addition a comparison of the relative proportions of the extreme

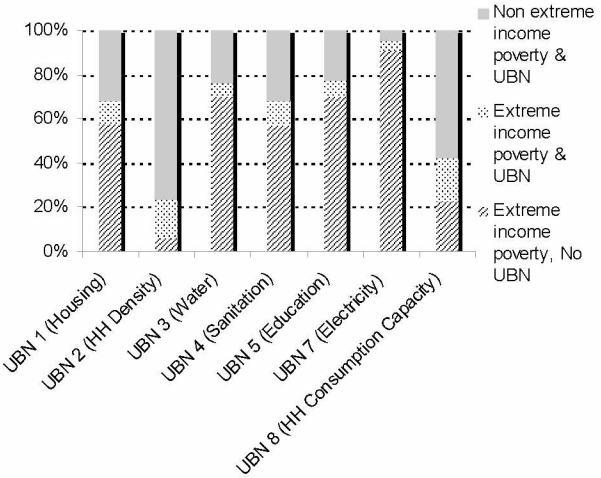
income poor with no UBN and the extreme income poor with a UBN, in figures 1 and 2, would indicate that the populations with both a UBN and income poverty are concentrated at levels of extreme income poverty for populations in Central America, but that such a relationship between extreme income poverty and UBNs is far weaker in the case of Mexico. That is, the population shares that are income poor but not extremely income poor are less likely to have a particular UBN than the part of the population that is living in a situation of extreme income poverty. In Mexico for the case of UBN 2 and UBN 8 the situation is reversed where population shares that are not extremely income poor are more likely to have a UBN.

FIGURE 2
POPULATIONS WITH UNSATISFIED BASIC NEEDS OR IN EXTREME INCOME POVERTY, CENTRAL AMERICA AND MEXICO REGIONAL AVERAGE, AROUND 2007 [a]

CENTRAL AMERICA AVERAGE



MEXICO



Source: Author's calculations from national household surveys.
[a] Central America, population weighted average.

TABLE 8
TETRACHORIC CORRELATIONS BETWEEN DIMENSIONS OF EXTREME INCOME POVERTY AND UNSATISFIED BASIC NEEDS, CENTRAL AMERICA AND MEXICO REGIONAL AVERAGE, AROUND 2007

CENTRAL AMERICA AVERAGE

	Extreme income poverty	UBN 1 (Housing)	UBN 2 (HH Density)	UBN 3 (Water)	UBN 4 (Sanitation)	UBN 5 (Education)	UBN 7 (Electricity)	UBN 8 (HH (Consumption capacity)
Extreme income poverty	1.00							
UBN 1 (Housing)	0.37	1.00						
UBN 2 (HH Density)	0.54	0.46	1.00					
UBN 3 (Water)	0.32	0.24	0.37	1.00				
UBN 4 (Sanitation)	0.39	0.46	0.31	0.34	1.00			
UBN 5 (Education)	0.35	0.22	0.33	0.25	0.20	1.00		
UBN 7 (Electricity)	0.56	0.28	0.42	0.54	0.26	0.41	1.00	
UBN 8 (HH Consumption capacity)	0.54	0.12	0.30	0.21	0.14	0.14	0.31	1.00

MEXICO

	Extreme income poverty	UBN 1 (Housing)	UBN 2 (HH Density)	UBN 3 (Water)	UBN 4 (Sanitation)	UBN 5 (Education)	UBN 7 (Electricity)	UBN 8 (HH (Consumption capacity)
Extreme income poverty	1.00							
UBN 1 (Housing)	0.44	1.00						
UBN 2 (HH Density)	0.54	0.39	1.00					
UBN 3 (Water)	0.27	0.31	0.24	1.00				
UBN 4 (Sanitation)	0.39	0.39	0.38	0.40	1.00			
UBN 5 (Education)	0.29	0.23	0.20	0.22	0.27	1.00		
UBN 7 (Electricity)	0.35	0.51	0.24	0.25	0.52	0.30	1.00	
UBN 8 (HH Consumption capacity)	0.49	0.18	0.32	0.14	0.25	0.16	0.21	1.00

Source: Author's calculations from national household surveys.
[a] Central America, population weighted average.

The second possible reason that the results of the UBN dimensions and incidences fail to capture a significant proportion of the population not already identified by the income poverty dimension, is that the results show the analysis of income poverty with each UBN in isolation. In fact, whilst income poverty identification is analysed in each UBN, the figures 1 and 2 only show that only in the case of UBN 2 and UBN 8 for Mexico has a UBN dimension managed to identify a poor population greater than that already captured by the use of the income dimension. However if incidence of particular UBN dimensions are not highly correlated with each other, then aggregate measures that capture all UBN dimensions and compare this to income poverty will show quite a different trend in terms of the ability of UBN dimensions to identify poor not already identified by the income dimension[15]. The results of TABLE 8 confirm that the likelihood of a person having extreme income poverty is not highly correlated with having any particular UBN. The correlations presented are calculated through a tetrachoric correlation routine (Pearson, 1901; Muthen, 1978) given to take account of the binomial nature of the UBNs and the extreme income poverty identification variable.

In general although there are positive correlations between all UBN dimensions and extreme income poverty, none of the correlations are above 0.5 with the exception of correlations between extreme income poverty and electricity and extreme income poverty and household consumption capacity for the case of Central America, and income poverty and household density for both the Central American region and Mexico samples. These numbers are reasonably low and altogether reflect the fact that UBN dimensions considered here are more complement than substitute for the income poverty dimension as an identifier of poverty. This is highlighted in the next chapter with the calculation of an Integrated Poverty Measure (IPM).

[15] In this sense the identification of UBNs that are complementarity would imply that a union approach to poverty measurement would better identify poor individuals since having any one UBN dimension poor would capture the poor population better since the complementarity signifies that a poor person in one dimension is less likely to be poor in another dimension at the same time. An intersection method requiring UBN across all dimensions would be more effective if the dimensions were highly substitutable.

III. MULTIDIMENSIONAL POVERTY MEASURES

1. Introduction

The aim of this chapter is to illustrate the feasibility of incorporating non-income based poverty measures into poverty analysis and to present a Multidimensional Poverty Measure using three distinct methods of aggregation, a rule based Integrated Poverty Measure, a dimension weighted aggregation method of Alkire and Foster (Alkire 2007), and a statistical latent variable application using principal components analysis and cluster analysis. Whilst each of these applications has been employed previously, their use in this analysis presents one of the first instances of cross-country aggregated poverty measures in Latin America and the northern subregion of Latin America.

The sections continue as follows. Section 2 describes the IPM approach as applied previously in ECLAC work. Section 3 describes the Alkire and Foster methodology in more detail and presents the results of its application to the region. Section 4 discusses the application of Principal Components Analysis and Cluster Analysis to the sample and presents the results of the application of this methodology. Section 5 compares the three methods in terms of their efficacy and concludes.

2. Integrated Poverty Measure (IPM)

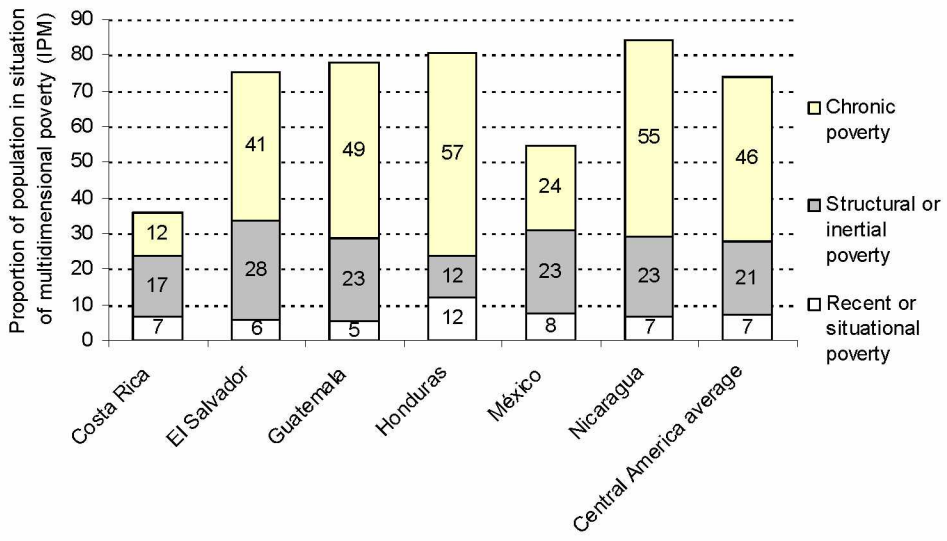
The integrated poverty measure (IPM) is a multidimensional poverty measure that considers two criteria; income and the presence of unsatisfied basic needs. The IPM, was first defined for the Latin American case by Katzman (1989) and was most recently applied to the countries of the Central American Isthmus by ECLAC (2003). It extends the analysis shown in Section 3 by considering the incidence of income poverty jointly with all UBN dimensions together.

The IPM applies three aggregation rules to the calculation of three different categories of multidimensional poverty. The first is that of Recent or Short-Term Poverty, in which an individual is in a situation of recent or short-term poverty if they are income poor, but have no unsatisfied basic needs in any dimension. Structural Poverty is defined as those who are not income poor but have some combination of unsatisfied basic needs. The third category is Chronic Poverty where individuals are in situations of chronic poverty if they are in a situation of income poverty at the same time as being in a situation of having one or more unsatisfied basic needs.

The results of the three IPM measures for Central America and Mexico are given in figure 3[16]. They show that the countries are again divided into two main groups, the first is Costa Rica and Mexico with lower IPM rates and the other is El Salvador, Guatemala, Honduras and Nicaragua with much higher incidences of integrated poverty where a vast majority of each country's population in this second group, between 75-84 per cent in each country, lives in either income poverty, or with one or more unsatisfied basic needs, or both. Another major characteristic of the pattern of integrated poverty rates across countries is that with the exception of Costa Rica, chronic poverty is by far the most common form of poverty across the countries with populations in situations of income poverty and having no UBN being the least common form of poverty representing between 5-12 per cent of the country populations.

[16] The table of results is also given in Appendix 6.

FIGURE 3
INTEGRATED MEASURES OF POVERTY, CENTRAL AMERICA AND MEXICO, AROUND 2007

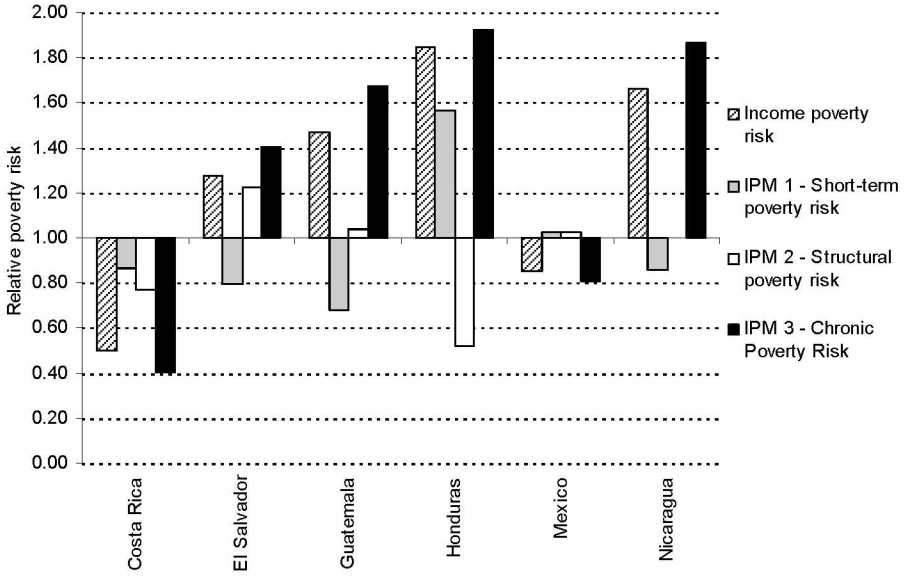


Source: Author's calculations from national household surveys.

Structural poverty, where individuals face one or more unsatisfied basic needs but are not income poor, has a far higher incidence than was indicated in the results in Section II. Whereas in the previous chapter it was shown that the incidence of any one UBN in the non-income poor was quite low, figure 3 confirms what the correlation results indicated; that there is little correlation between UBNs and so the likelihood of households having more than one UBN is lower and the incidence of one or more UBNs is dispersed widely across the populations of the countries. In this case, depending upon the country, structural poverty rates were between 17 and 23 per cent of the population, with the exception of 12 per cent being for Honduras although in the case of this country, chronic poverty is nearly four times as high as the structural poverty rate, whilst in the remaining countries this ratio is less than two times. Therefore the Central American average of structural poverty of 21 per cent and similar to the Mexico figure of 23 per cent signifies that more than 1 person in every five across the region can be identified as poor according to the UBN methodology but would not have been identified as poor under the one dimensional income poverty method.

The complementarity of the integrated measures of multidimensional poverty can be further illustrated when comparing the poverty risk of the populations in each country of the region. Figure 4 shows the poverty risk of country populations relative to the regional total across different definitions of poverty including income poverty and the three categories of IPM. The poverty risk measure is equal to one when the incidence of poverty in a country as a relative share of the total population in poverty throughout the region is equal to the relative population share of that country. For instance, if a country had a poverty risk of 1.0 and represented 20 per cent of the population of a given region, then the countries population in poverty represents 20 per cent of the total population in poverty across the region. A poverty risk value higher than 1.0 means that a particular country is over-represented in terms of poverty compared to its population share, while a value less than 1.0 signifies that a country has less poor as a share of total poor in the region compared to its relative population share.

FIGURE 4
POVERTY RISK ACROSS INCOME AND IPM CATEGORIES, CENTRAL AMERICA AND MEXICO, AROUND 2007 [a]



Source: Author's calculations from national household surveys.
[a] The poverty risk measure is equal to one when the incidence of poverty in a country as a relative share of the total population in poverty throughout the region is equal to the relative population share of that country. A poverty risk value higher than 1.0 means that a particular country is over-represented in terms of poverty compared to its population share, while a value less than 1.0 signifies that a country has less poor as a share of total poor in the region compared to its relative population share.

The results in figure 4 show that only Costa Rica has a consistent pattern of poverty risk across all four definitions of poverty with the poverty risk lowest for situations of income poverty and chronic poverty. Honduras and Nicaragua had relative shares of chronic poverty nearly twice the rate of their respective population shares, however structural poverty risk was disproportionately low for Honduras and exactly 1 for Nicaragua. Mexico is over-represented only slightly in terms of short-term and structural poverty but under-represented with respect to income and chronic poverty. El Salvador and Guatemala were over-represented in terms of income, structural and chronic poverty, but under-represented in terms of short-term poverty. One consistent trend across all countries is that the poverty risk for chronic poverty is greater than the poverty risk for income poverty and is due to the fact that the vast majority of those living in situations of income poverty are also living in situations of chronic poverty.

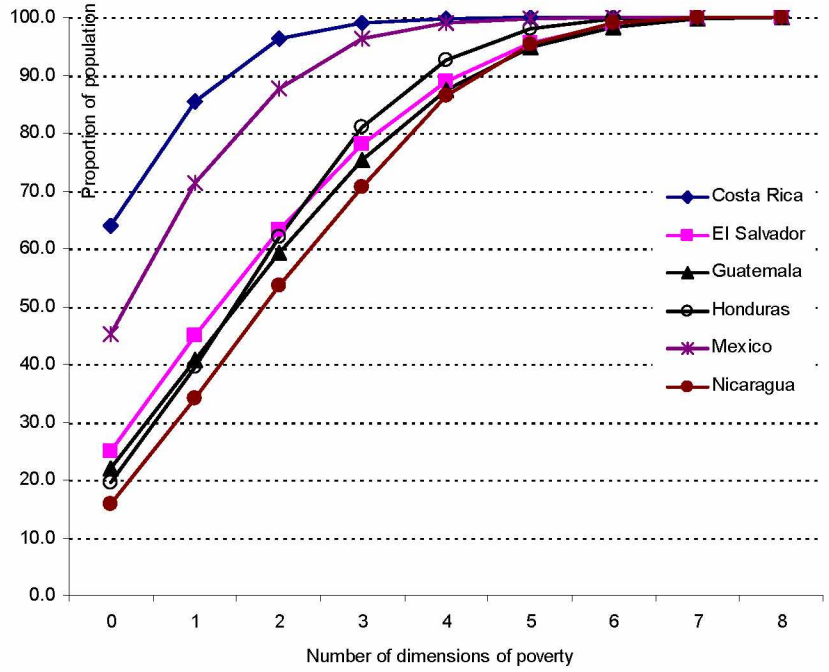
3. Alkire and foster measure

The Alkire and Foster measure of multidimensional poverty has already been discussed in Section 2 but is applied here to the countries of Central America and Mexico. The measure being a multidimensional version of the FGT family of poverty measures, applies an aggregation across dimensions of well-being by applying a weighting scheme to each individual that weights them more highly if they are in situations

of poverty across a greater number of dimensions simultaneously. This is combined with a decision rule about the minimum number of dimensions in which a person must be in a situation of poverty in that dimension (dimensionally deprived). If a person has a number of deprivations equal to or greater than this minimum (noted by the variable *k* in Alkire and Foster) then they are included as a person who is in a situation of multidimensional poverty and all such individuals are then aggregated with greater weight given for those with a greater proportion of dimensional deprivations.

Before considering the results of the specific Alkire and Foster Multidimensional poverty measures, it is useful to illustrate for the sample of countries here the distribution of population by the number of dimensions of income or UBN in which individuals are deprived. Figure 5 shows a cumulative distribution of the number of deprived dimensions for each country with full results given in Appendix 7.

FIGURE 5
PROPORTION OF POPULATION IN SITUATIONS OF POVERTY BY NUMBER OF DIMENSIONS DEPRIVED, CENTRAL AMERICA AND MEXICO, AROUND 2007



Source: Author's calculations from national household surveys.

In Costa Rica, over 60 per cent of the population was not poor in any dimension and over 96 per cent were in situations of poverty in less than three dimensions. Mexico followed a similar trajectory in terms of total dimensions of poverty with 88 per cent of the population either not poor in any dimension or in situations of poverty in less than 3 dimensions. The remaining countries were more closely intertwined in the incidence of population and total dimensions of deprivation with only 15-24 per cent of populations in each country in no situation of poverty and a vast majority of the population in situations of poverty across one to four dimensions. The fact that all of the cumulative proportions in figure 5 lie above the diagonal signifies that the populations are concentrated in situations of poverty with a total

number of dimensions generally less than half the possible number of dimensions (eight in this case). This means that implementing the Alkire and Foster measure with a high cut-off criterion for the dimensional decision rule will produce low rates of multidimensional poverty. It also indicates that the Alkire and Foster poverty rates will be far lower than the headcount rates as each individual receives a generally low weight given that on average an individual is deprived in less than half the possible dimensions. Table 9 presents the results of the Alkire and Foster multidimensional poverty measures for different dimensional cut-off points.

TABLE 9
ALKIRE AND FOSTER POVERTY MEASURE HEADCOUNT FOR DIFFERENT DIMENSIONAL CUT-OFFS, CENTRAL AMERICA AND MEXICO, AROUND 2007 [a]

Number of dimensions for MD poverty	Poverty measures	Costa Rica	El Salvador	Guatemala	Honduras	Mexico	Nicaragua
K=1	H	35.9	75.1	78.0	80.4	54.8	84.3
	M_0	6.9	25.8	27.8	25.9	12.6	30.7
K=2	H	14.6	55.2	59.3	60.5	28.6	66.0
	M_0	4.3	23.3	25.5	23.4	9.3	28.4
K=3	H	3.7	36.9	40.7	38.1	12.4	46.4
	M_0	1.6	18.7	20.8	17.8	5.3	23.5
K=4	H	1.0	22.0	24.6	19.0	3.7	29.4
	M_0	0.5	13.1	14.8	10.7	2.0	17.1
K=5	H	0.3	11.2	12.7	7.3	1.0	13.7
	M_0	0.2	7.7	8.8	4.9	0.6	9.3
K=6	H	0.1	4.4	5.1	1.9	0.2	4.7
	M_0	0.0	3.5	4.1	1.4	0.2	3.6
K=7	H	0.0	1.2	1.7	0.3	0.0	1.0
	M_0	0.0	1.1	1.5	0.2	0.0	0.9
K=8	H	0.0	0.2	0.3	0.0	0.0	0.1
	M_0	0.0	0.2	0.3	0.0	0.0	0.1

Source: Author's calculations from national household surveys.
[a] *H* is the headcount measure of poverty which is the proportion of the population deprived in more than the minimum number of dimensions defined by variable *K*. M_o is the dimension weighted poverty measure that weights each poor individual according to the number of dimensions in which they are poor and compares this with the population of dimensions in which individuals are not poor.

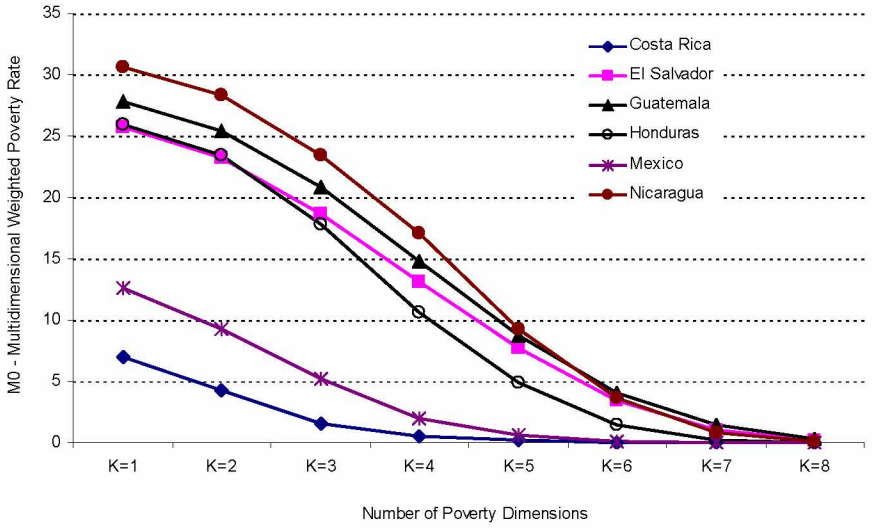
The two extreme measures, $k = 1$ and $k = 8$ are equivalent to the union and intersection aggregation rules respectively. The $k = 1$ rule is the union approach whereby a deprivation in any one dimension is considered a situation of multidimensional poverty. When $k = 8$, to be counted poor an individual must be deprived in a situation of income poverty as well as every one of the seven other dimensions that cover the range of unsatisfied basic needs. This is the intersection approach, a very strict criterion that most individuals do not pass.

The results for $k = 1$ also show that the headcount rate of poverty for each country is equivalent to the sum of the IPM measures from the previous section in figure 3. In general the country ranking of

headcount poverty rates is similar across the number of dimensions with Costa Rica and Mexico having consistently lower headcount rates, despite the additional dimensional cut-off decision rule and less than one per cent of each country is in a situation of multidimensional poverty if judged with a *k* greater than four dimensions. For the same cut-off range, the remaining countries still have poverty rates from 7-13 per cent.

The fact that the poor nations are poorer in more dimensions according to the unweighted headcount measure of Alkire and Foster is illustrated by the calculation of the weighted Alkire and Foster multidimensional poverty rate designated as M_0 in Table 9 and whose rates are also shown in figure 6 below. For Costa Rica and Mexico the poverty rates are low and drop off reasonably quickly from 6.9 and 12.6 per cent poverty respectively for the first dimension whilst this falls to just 1.6 and 5.3 per cent respectively at $k = 3$. In the case of the remaining countries of El Salvador, Guatemala, Honduras and Nicaragua have slower decreasing rates as the dimensions increase and the relative performance between these countries is more mixed given that there is more heterogeneity in the association of dimensions of deprivation amongst the population. Whilst Honduras and El Salvador have similar poverty rates when the number of dimensions is small, Honduras' poverty rate is lower when the number of dimensions is high, illustrating the lower average number of deprivations in which Hondurans are poor compared to El Salvadorians. The same trend applies to a lesser extent between Guatemala and Nicaragua. Guatemala has a lower poverty rate when the number of dimensions is small but when the cut-off criterion is to be in a situation of poverty across at least six dimensions, Nicaragua has the lower poverty rate of the two countries.

FIGURE 6
ALKIRE AND FOSTER WEIGHTED MULTIDIMENSIONAL POVERTY MEASURES BY NUMBER OF DIMENSION CUT-OFF CRITERION, CENTRAL AMERICA AND MEXICO, AROUND 2007



Source: Author's calculations from national household surveys.

In terms of ranking, the clearest change for relative poverty rates when considering the Alkire and Foster weighted multidimensional poverty measure is that of Honduras, which under the income poverty measure was easily the poorest country in the region. However under the weighted Alkire and Foster measure, it has the advantage of a population with fewer average dimensions in which they are deprived compared to the countries of Guatemala and Nicaragua whose populations have more dimensions of poverty.

4. A principal component and cluster analysis measure

In this section the principal components analysis (PCA) methodology is applied to the income and UBN dimensions to provide a latent variable index that represents the multidimensional well-being and from which normative decisions can be made about the extent of multidimensional poverty across the countries of Central America and in Mexico. Latent variable methodologies for estimating multidimensional poverty were discussed in Section 2 and will not be reviewed in depth here. The specific PCA methodology employed here is a derivation of the standard Filmer and Pritchett (2001) exercise for the estimation of a socioeconomic status or asset index. Applying PCA analysis for this sample is based upon the application of discrete binary data for each dimension of income and UBN that represents an individual's status as living in poverty or not according to the dimension. Filmer and Pritchett and numerous similar authors such as Ferro Luzzi et al. (2008) and Vyas and Kumaranayake (2006) have applied PCA to the estimation of the categorical variations on which the UBNs here are based.

One of the most common uses for PCA has been for the construction of an asset index based upon a series of variables that represent assets and the indication of increased well being. These variables are often categorical variables, for example in the case of water provision where two of the options may be for the respondent to report that they have tap water to house compared to a town well or compared to river. The PCA is applied across the *options within each dimension* to arrive at the asset index. In contrast, the analysis here applies PCA to the final one dimensional poverty indicators which already consolidate information about each dimension and apply a decision rule to identify the poor in each case. Using the water provision example, the poverty indicator for water is the variable used in PCA and not the options for water provision themselves. That is, a decision rule is applied that town wells and rivers represent situations of poverty in the provision of water. This implies that all individuals obtaining water from these sources and not tap water to the house directly are coded as 1 whilst individuals with tap water connections are coded as zero. Therefore in this study one fundamental difference in the application of PCA is that it is applied as an aggregation measure of deprivation in this case, as opposed to a well-being index.

The second fundamental difference in the application of PCA for the aggregation of the eight defined poverty dimensions is that in this case the PCA is applied on the basis of a tetrachoric correlation matrix that explicitly takes account of the discrete nature of the data. Kolenikov and Angeles (2009) have shown that Filmer and Pritchett's method of simply applying PCA to discrete data fails to take account of the assumptions of multivariate normality in the procedure and the fact that the discrete data follows an entirely different binomial distribution leading to biases in the covariance structure and underestimated proportions of explained variance (Kolenikov and Angeles 2009). In short it is akin to estimating OLS on a binary dependent variable, a problem long ago overcome by the use of logit and probit models.

a) Principal components analysis in Mexico and Central America

The tetrachoric correlations calculated for the pooled regional sample are given in TABLE 8 of the previous chapter and similar correlations were calculated for each individual country. The PCA routine was then applied to the correlation matrices to derive the eigenvalues of the principal components and the results of for the Central American sample and the Mexico sample are presented in Table 6 whilst the results for the remaining individual country level analyses are given in Appendix 7.

TABLE 10
PRINCIPAL COMPONENTS OF MULTIDIMENSIONAL POVERTY, CENTRAL AMERICA AND MEXICO POOLED REGIONAL POPULATION, AROUND 2007

CENTRAL AMERICA AVERAGE

Principal component	Eigenvalue	Proportion of variation explained	Cumulative proportion of variation explained
1	3.4081	0.4260	0.4260
2	1.0762	0.1345	0.5605
3	0.9225	0.1153	0.6758
4	0.7867	0.0983	0.7742
5	0.6244	0.0780	0.8522
6	0.4738	0.0592	0.9114
7	0.4344	0.0543	0.9658
8	0.2740	0.0342	1.0000

MEXICO

Principal component	Eigenvalue	Proportion of variation explained	Cumulative proportion of variation explained
1	3.2756	0.4094	0.4094
2	1.0788	0.1348	0.5443
3	0.8321	0.1040	0.6483
4	0.7853	0.0982	0.7465
5	0.6944	0.0868	0.8333
6	0.5789	0.0724	0.9056
7	0.3834	0.0479	0.9536
8	0.3715	0.0464	1.0000

Source: Author's calculations from national household surveys.

The results for the principal components show that the first principal component explains around 43 per cent in Central America and 41 per cent in Mexico of the total variation of the indicator of poverty among the income poverty dimension and the seven dimensions that characterize common definitions of unsatisfied basic needs. The first three principal components account for 65-68 per cent of the total variation in the region. Table 11 presents the coefficients of each poverty dimension for the first principal component as well as the Kaiser-Meyer-Olkin (KMO) statistical measure of sampling adequacy (ref). The KMO estimate lies between 0 and 1 and an overall value of 0.77 for Central America and 0.80 for Mexico

is high and represents a good indication that there is sufficient sampling adequacy to warrant the PCA. The KMO values for the individual countries of the region range from 0.61 to 0.80.

TABLE 11
PRINCIPAL COMPONENTS OF MULTIDIMENSIONAL POVERTY, CENTRAL AMERICA AND MEXICO, AROUND 2007

CENTRAL AMERICA AVERAGE

Dimension	Coefficient	KMO
Income Poverty	0.4349	0.7447
UBN 1	0.3253	0.7757
UBN 2	0.3986	0.8432
UBN 3	0.3423	0.7400
UBN 4	0.3178	0.7528
UBN 5	0.2938	0.8775
UBN 7	0.4043	0.7669
UBN 8	0.2795	0.7119
Total	..	0.7725

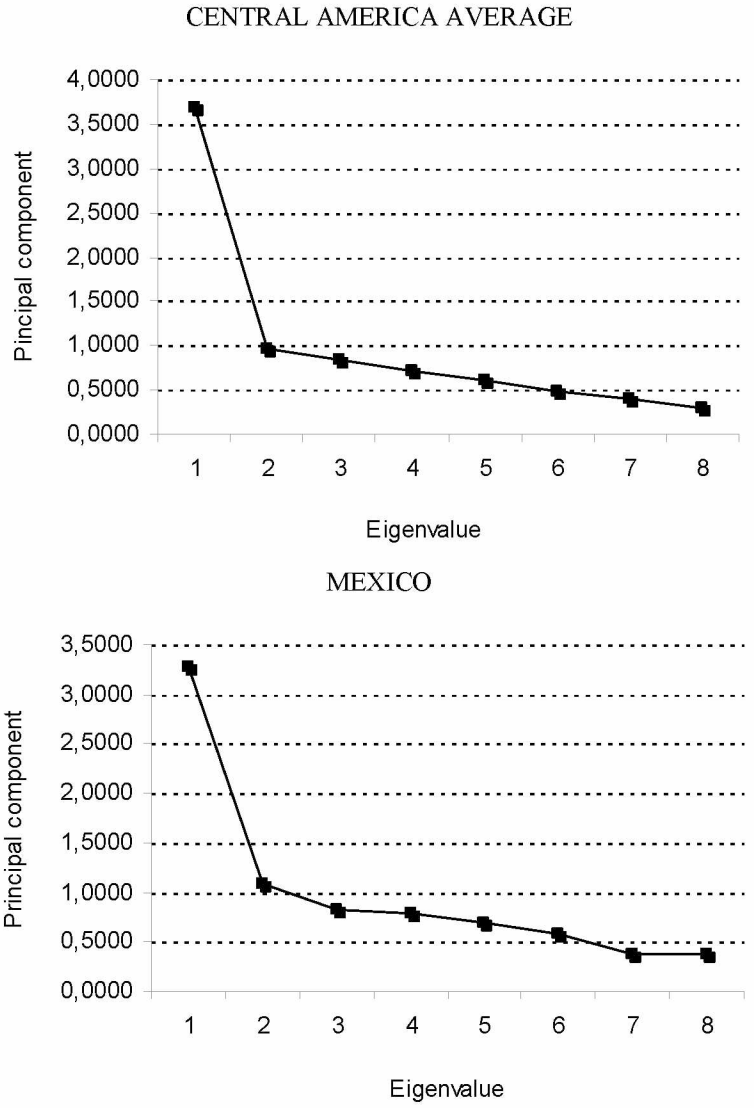
MEXICO

Dimension	Coefficient	KMO
Income Poverty	0.4184	0.7787
UBN 1	0.3852	0.8042
UBN 2	0.3670	0.8148
UBN 3	0.2967	0.8368
UBN 4	0.3993	0.8072
UBN 5	0.2689	0.8855
UBN 7	0.3742	0.7555
UBN 8	0.2865	0.7677
Total	..	0.7981

Source: Author's calculations from national household surveys.

The choice of the number of principal components to use for the construction of a common index is usually guided by the size of the values of the principal components in combination with an analysis of the scree plots of the eigenvalues that track the rate of decline of the explanatory power of successive additional principal components (Vyas and Kumaranayake 2006). A common rule of thumb for the selection of the number of principal components to use is to select all those that have eigenvalues greater than one, although this must be considered in conjunction with the scree plots where the number of principal components is selected as the total number before the "elbow" of the plot that shows a significant turning point in the explanatory power of the principal components (Ferro Luzzi, Flückiger et al. 2008). Figure 7 presents the scree plots for Central America and the case of Mexico and it is clear from the graph that the first principal component is optimal as the basis for the construction of a common multidimensional poverty index.

FIGURE 7
SCREE PLOT OF PRINCIPAL COMPONENTS FOR MULTIDIMENSIONAL POVERTY, CENTRAL AMERICA AND MEXICO POOLED REGIONAL SAMPLE, AROUND 2007



Source: Author's calculations from national household surveys.

The scree plots for the individual countries show similar results for every country with the exception of Nicaragua for which the second principal component was also used.

b) Cluster analysis

Although PCA can be used to generate an index value that accumulates the results of the identification of poverty in the eight individual dimensions, it provides an index variable and does not

aggregate poverty across the dimensions into a value that can represent the relative extent of poverty amongst the population of the region. The procedure therefore provides no insight into the ability to construct headcount rate of poverty to be compare to those results generated by other methods. PCA thus requires an additional decision rule applied on the aggregate multidimensional poverty index to determine the poverty rate.

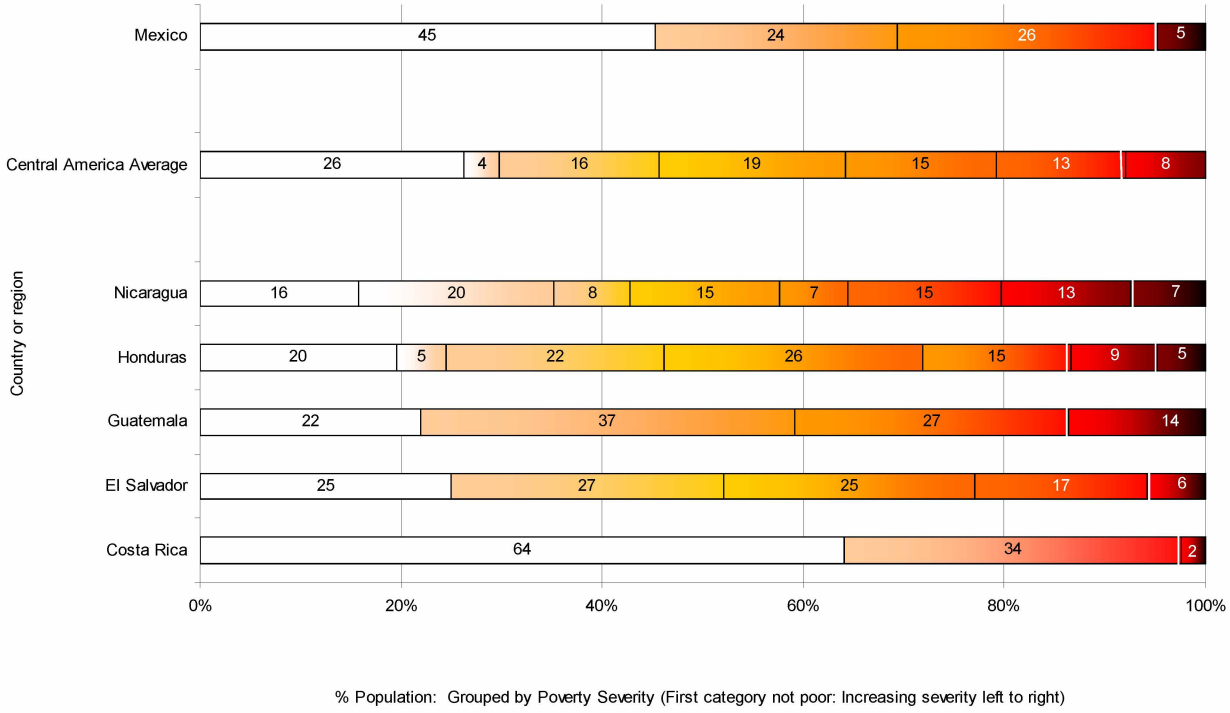
In this instance the application of cluster analysis can provide a useful statistical basis for generating a poverty rate without having to make subjective decisions about relative poverty rates as has been done to highlight characteristics of poverty in other studies. Cluster analysis is a statistical procedure that in this case compares each of the observations to one another in order to generate clusters or groupings that contain similar observations and the procedure has been used before for the classification of poverty as a postestimation procedure of PCA in the work of Ferro Luzzi et al. (2008). This is done on the basis of generating a number of groups for whom the distance between the values for each group member is minimized whilst at the same time the distance between the average values of the groups is maximized. That is, cluster analysis is a min-max procedure that minimizes the difference between group members subject to the maximization of the difference between groups as a whole.

Cluster analysis was applied to the multidimensional index generated by the PCA in order to identify common groups that represent high index values that would indicate the increased presence and extent of multidimensional poverty in the group compared to the rest of the population. It is possible to generate analyses with various numbers of cluster groupings and so it is necessary to select an optimal number of cluster groups. Without a priori information about the optimal number of clusters, statistical tests may be applied to determine the optimum case such as those of Duda and Hart (1973) and Calinski and Harabasz (1974). However in the case of the data for this group of countries and the eight dimensions identifying poverty, the discrete nature of the dimensions presents the possibility of generating an a priori condition rule. The data represents a series of eight vectors of values of zero or one, with one representing a situation of poverty for the individual in the particular dimension and zero the satisfaction of minimum income or minimum basic needs. Therefore the group of non-poor can be identified by the fact that for each of them the total number of dimensions in which they are in situations of poverty is zero. This information can be used to provide an indicator of the optimal number of clusters in the hierarchical analysis where the rule is created that the number of clusters increases until the cluster of non-poor is identified as a separate group figure 7 and Table 8 present the results of the cluster analysis using the conditional rule for the number as clusters as the identification of the non-poor as a separate cluster.

The second column in Table 12 shows the results from an analysis of the proportion of the country populations that are in situations of poverty across none, some or all of the eight dimensions of poverty considered here. The proportion of the population registering no unsatisfied basic need and not in a situation of income poverty corresponds to the entry rate for zero. The third column in the tables represents the number of separate clusters identified by the cluster analysis. In this case, the number of clusters is the lowest distinct number of groupings that produces a separate group that exactly identifies the non-poor. For example in the case of the Central American average, seven clusters was the minimum number of clusters for which the non-poor were distinguished as a separate group compared to the remainder of the population. As can be noted in the fourth column of each table, the corresponding population with the lowest index values according to the principal components analysis is 26.23 per cent, the same group of individuals that are identified as non-poor across all eight dimensions. The cluster proportions increase according to increasing values of the multidimensional poverty index and thus correspond to increasing situations and severity of poverty. The additional characteristic of the cluster analysis is that it breaks down the distribution of those in any situation of poverty and is not a discrete linear function of the number of dimensions deprived. For example, the grouping of the clusters for the

Costa Rican sample is not necessarily a summation of any combination of populations with particular numbers of dimensions in which they are deprived. That is, to take the example of the 33.5 per cent of individuals in cluster two, this is not a simple combination of the proportions of the populations in situations of poverty in 1 or more dimensions. In the case of the combination of the proportions of the population poor in 1 or 2 dimensions for Costa Rica, the sum of these rates is 32.21 per cent. Therefore though it is natural to assume that higher values on the poverty index are associated with progressively greater numbers of dimensions in which an individual is poor, the cluster identification also depends on the index values that are derived using the PCA and is associated with the correlations between the dimensions. In sum, the cluster pattern depends on the number of dimensions in which a person is deprived and also the pattern of dimensions and in which dimensions an individual faces a situation of poverty.

FIGURE 8
POVERTY CLUSTERS FROM A MULTIDIMENSIONAL POVERTY INDEX, CENTRAL AMERICA AND MEXICO, AROUND 2007



Source: Prepared by the author.

TABLE 12
POVERTY CLUSTERS FROM A MULTIDIMENSIONAL POVERTY INDEX, CENTRAL AMERICA AND MEXICO, AROUND 2007

Number of dimensions of poverty	Proportion of population	Clusters (Increasing in poverty)	Proportion of population by cluster
Costa Rica			
0	64,07	1	64,07
1	21,34	2	33,5
2	10,87	3	2,43
3	2,74		
4	0,72		
5	0,2		
6	0,05		
7	0,01		
8	0		
Guatemala			
0	21,99	1	21,99
1	18,68	2	37,15
2	18,6	3	27,2
3	16,16	4	13,66
4	11,92		
5	7,54		
6	3,45		
7	1,32		
8	0,34		
Mexico			
0	45,21	1	45,21
1	26,15	2	24,14
2	16,25	3	25,92
3	8,66	4	4,73
4	2,77		
5	0,75		
6	0,18		
7	0,02		
8	0		
El Salvador			
0	24,92	1	24,92
1	19,91	2	27,1
2	18,29	3	24,99
3	14,93	4	17,14
4	10,74	5	5,85
5	6,83		
6	3,19		
7	1,01		
8	0,18		

/Continued

Table 12 (Conclusion)

Number of dimensions of poverty	Proportion of population	Clusters (Increasing in poverty)	Proportion of population by cluster
Honduras			
0	19,58	1	19,58
1	19,91	2	4,94
2	22,43	3	21,61
3	19,13	4	25,73
4	11,62	5	14,79
5	5,46	6	8,51
6	1,62	7	4,84
7	0,25		
8	0,01		
Nicaragua			
0	15,72	1	15,72
1	18,32	2	19,51
2	19,59	3	7,55
3	17,02	4	14,83
4	15,66	5	6,79
5	9,01	6	15,35
6	3,71	7	12,82
7	0,87	8	7,42
8	0,09		
Central America Average			
0	26,23	1	26,23
1	19,43	2	3,52
2	18,54	3	15,91
3	15,05	4	18,54
4	10,82	5	15,03
5	6,3	6	12,89
6	2,65	7	7,89
7	0,82		
8	0,17		

Source: Author's calculations from national household surveys.

Across the individual countries the number of clusters varied between three clusters for Costa Rica to eight distinct groupings for Nicaragua. In the case of Costa Rica, the poor were separated into two groups where 33.5 per cent of Costa Ricans faced situations of moderate poverty that were not as severe compared to 2.43 per cent of the population who face severe poverty of income and unsatisfied basic needs. Guatemala and Mexico both had three clusters in which the poor were distributed with the grouping of relative populations in the deepest level of poverty consisting of 13.66 per cent of the population for Guatemala whereas a relatively lower proportion of 4.73 per cent of Mexicans were the most deprived in that country. In El Salvador, Honduras and Nicaragua the number of clusters was higher (5, 7 and 8 clusters respectively). The large number of clusters indicates that there are many clusters of

poverty for which the members of the particular group share a similar extent of deprivation. But the distribution of the proportions of the population in successive poverty severity varied across the countries. For example in the case of El Salvador, the first two groupings of poor at lower severities of deprivation were similar in proportion at around 25 per cent of the population in each case. After that a group of over 17 per cent of the population had a greater severity of poverty and 5 per cent of the population represented the group of the most severely poor. For Honduras and Nicaragua, larger proportional clusters of poor individuals were in situations of moderate severity of poverty whilst 4.84 per cent and 7.42 per cent of the population respectively were in situations of the most severe poverty.

c) Comments

The cluster analysis methodology provides a useful guide about how to separate the distinct groups of populations that are poor in multiple dimensions and this can be useful for policy makers and stakeholders to consider the population groups in terms of prioritizing the benefits of social expenditure and services and policies in order to alleviate the severity of poverty if not the situation of poverty altogether in these populations. In addition, the clusters can be used in further analyses to evaluate possible determinants that are distinct to each cluster and use this information in terms of developing policy instruments focused on these factors.

However there are also limitations in the clustering exercise in terms of limitations in the comparability across countries and the ordinal nature of the cluster arrangements. In terms of the first limitation, the number of clusters and groupings is relative to the population in each country. Therefore members of the most severely poor cluster in two different countries cannot be compared in terms of which group is respectively poorer. However an analysis of the regional pooled sample and disaggregation of the clusters by country would give an approximate indication of which countries have more of their populations in situations of poverty that is greater in severity. The second limitation is the fact that there is no distance relationship between successive clusters. That is, although the ordinal relationship between clusters can be interpreted in terms of a direct positive relationship between the increase in the cluster number and the increase in the severity of poverty, there is no insight into the amount of the increase in severity. The difference between cluster 2 and cluster 3 in any particular country can identify the population in cluster 3 as being in situations of more severe poverty than cluster 2, but it cannot say if there is a large increase in severity or a small increase in severity.

IV. CONCLUSION

This study evaluated and categorized the different methodologies currently being applied to the measurement of multidimensional poverty, an area of increasing interest to researchers and policy makers alike. Alternative methodological concepts were organized according to how they proposed to deal with the two fundamental decisions in the measurement of poverty, identifying the poor and aggregating the groups into a single index value that is informative.

Three methodologies were applied to the measurement of multidimensional poverty in Mexico and the five countries of Central America using information from household surveys that provided eight different dimensions to determine poverty, one of which was household income per capita and the remaining dimensions that encompassed a broad group of unsatisfied basic needs. An initial bivariate comparison between income and the unsatisfied basic needs showed little additional information captured by the UBNs that was not already captured by the income measure, however a multivariate comparison showed that there is a significant proportion of the populations of each country that can be considered as living in situations of poverty, but who are not identified as poor according to the income measure of poverty.

So then who is poor and to what extent are the populations of the countries in situations of poverty? The research here attempted to apply three different multidimensional poverty measurement methodologies to answer these questions and each methodology presented different results that in fact complement one another. The Integrated Poverty Measure clearly identified that just less than 60 per cent of the population of the region is living in some situation of poverty according to either a lack of income or some unsatisfied basic need. In addition a significant proportion of this group is not identified by the more traditional income measure. The Alkire and Foster multidimensional poverty measure identified a range of possible poverty rates depending upon the number of dimensions for which the researcher would consider a person in a situation of poverty with individuals given more relative importance if they are considered poor in a greater number of dimensions. For the cut-off value of K=2, 35 per cent of the regional population is in situations of poverty, or 12 per cent of the dimension weighted population is considered poor. In contrast, the principal component and cluster analysis multidimensional poverty measure identified the same proportion of poor as the IPM figure, at almost 60 per cent of the regional population. However the cluster analysis presents greater insight into the distinct levels of poverty with around 40 per cent of the population in situations of poverty less profound than an intermediate 16 per cent group and a final 4 per cent of the population in situations of severe poverty.

The results of the poverty measurement methodologies therefore depend upon the purpose for which they are intended to be used. The IPM is transparent but gives high importance to income poverty. The Alkire and Foster Methodology is flexible and can be adapted quite readily to the a priori decisions of the researcher or policy maker. The Principal Component and cluster analysis can use statistical methods that let the properties of the underlying latent poverty data to separate groups of poor into ordinal rankings that represent different severities of poverty situations. Each methodology has its own advantages and at the same time each method is able to be easily applied to existing data and will accommodate additional dimensions of poverty as such data becomes available. The findings from this study suggest that there is an abundant amount of additional information to be found in the analysis and measurement of multidimensional poverty and that the application of such measures is feasible and would help policy makers with the design of appropriate poverty alleviation strategies.

There are several implications for policy with respect to the analysis conducted here. Firstly there is a large methodology on the construction multidimensional poverty measures and such indicators can be constructed with existing data. However the wider implication is that any particular measure will incorporate a particular set of normative decisions, for example which dimensions identify the poor, which are made by the researcher or policy maker. An aggregate multidimensional poverty measure can provide better transparency with regard to the normative decisions that define the standards for which a society considers an individual poor or not poor. In addition whilst the work in this study considers income and a set of unsatisfied basic needs, the same decisions and exercises can be done on as broad a set of dimensions as a researcher, policy maker or country would wish to define. The difficulties for establishing the measure at the same for any dimension and are normative decisions; the definition of the dimension, the definition of the decision rule identifying the poor and the way in which it is aggregated with other dimensions of poverty. For example, policy makers wishing to incorporate a dimension of social inclusion into an aggregated poverty measure must first make a normative judgement about how best to define and measure such inclusion and secondly how to establish a decision rule that identifies those individuals considered socially excluded. After these standards are established, the dimension could be incorporated into the aggregation procedure and a new multidimensional poverty index would be defined. Another possibility would be the analysis of intra-household dynamics and gender-power relationships that in many cases are still a "black-box" in terms of their implications for social development and poverty alleviation due to the lack of a set of concrete normative decisions about how to identify deprivations in these units of analysis and also the lack of relevant techniques and instruments to collect data to measure the performance of the country according to the standards it sets.

Therefore it is important to consider the empirical needs and data instruments necessary for incorporating other dimensions of poverty into a multidimensional poverty measure. Current survey data and other instruments in the region contain information to measure concepts of income relatively easily and concepts of unsatisfied basic needs with a little more complexity but their ability to provide information about further broader concepts of social and human development are limited. The establishment of the norm that reflects a social standard measuring a broader poverty dimension must go hand-in-hand with the resources and instruments necessary to adequately collect data on such a dimension. Better data collection methods also provide a positive feedback loop into the more rigorous analysis of the appropriate normative decision-rules for identifying poor that best reflect the standards of the particular country or region and the purposes for which a particular poverty measure is put to use.

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APPENDIXES

APPENDIX 1
LIST OF HOUSEHOLD SURVEYS

Country	Year	Name of survey	Period	Geographical coverage	Households		Individuals	
					Sample	Weighted population	Sample	Weighted population
Costa Rica		Encuesta de Hogares de Propósitos Múltiples	July 2007	National	12 361	1 198 120	46 278	4 443 100
El Salvador	2004	Encuesta de Hogares de Propósitos Múltiples	2004	National	16 490	1 626 036	70 558	6 756 786
Guatemala	2006	Encuesta Nacional de Condiciones de Vida – ENCOVI	March - September 2006	National	13 686	2 653 000	68 739	12 987 829
Honduras	2007	Encuesta Permanente de Hogares de Propósitos Múltiples	September 2007	National	21 630	1 623 889	100 028	7 585 155
México	2006	Encuesta Nacional de Ingresos y Gastos de los Hogares	Third quarter 2006	National	20 875	26 541 255	83 624	105 044 205
Nicaragua	2005	Encuesta Nacional de Hogares sobre la Medición de Niveles de Vida	July - October 2005	National	6 882	988 622	36 612	5 142 098

Source: Prepared by the author.

APPENDIX 2
ECLAC POVERTY LINES IN CENTRAL AMERICA, MEXICO AND THE DOMINICAN REPUBLIC, AROUND 2007

Country	Year	Geographical area	Monthly household income per capita poverty line (National currency)		Monthly household income per capita extreme poverty and poverty lines ($US nominal)	
			Extreme poverty line	Poverty line	Extreme poverty line	Poverty line
Costa Rica	2007	Urban	25 865	51 286	50	99
		Rural	20 164	35 032	39	68
El Salvador	2004	Urban	333	666	38	76
		Rural	215	430	25	49
Guatemala	2006	Urban	467	935	62	123
		Rural	362	633	48	83
Honduras	2007	Urban	945	1 872	50	99
		Rural	665	1 155	35	61
México	2006	Urban	879	1 758	80	161
		Rural	628	1 099	58	101
Nicaragua	2005	Urban	491	981	29	58
		Rural	378	661	22	39

Source: ECLAC Social Panorama (2008) (table 4) on the basis of calculations from National Household Surveys.

APPENDIX 3
DETAILS OF VARIABLE CONSTRUCTION OF UNSATISFIED BASIC NEEDS

UBN 1 - Quality of housing

The UBN was defined in the dimension of the quality of housing if the housing was constructed from improvised materials. This includes walls and roofs constructed from refuse and floors of earth or sand.

Costa Rica

No data existed for quality of housing in the 1990 survey. In the 2000 and 2004 surveys the standard of housing that was considered as failing to meet a basic need included if PAREDES or TECHO were made from Material de desecho. In urban areas it also included housing that had PISO of tierra. In addition the two Costa Rican surveys for these periods contained information about the condition of the housing. Therefore there was also an unsatisfied need if at least two of the three questions, ESTADO PAREDES, ESTADO TECHO, and ESTADO PISO were rated in the surveys as being in a male state.

El Salvador

In all three surveys there was an unsatisfied basic need in respect to housing if TIPOVIV was categorized as improvised or if the PAREDES or TECHO were made from materiales de desechos. In addition households in urban areas were classified with the unsatisfied need in this dimension if the PISO was tierra or the PAREDES were made from Bahareque, Paja or Palma. In rural areas if there was housing that simultaneously had PISO of tierra AND PAREDES of Bahareque, Paja or Palma then this was also considered unsatisfied.

Guatemala

The 1989 Guatemala survey contained no relevant questions about housing. In the 2000 survey, an unsatisfied basic need for housing existed if the TIPOVIV was categorized as improvisada. This question did not exist in the 2004 survey. However in both the 2000 and 2004 surveys households in urban areas had housing needs unsatisfied if the PAREDES were made from lamina metálica, bahareque, lepa, palo or cana OR if the PISO was tierra or arena. In the rural areas for both years the same need existed if BOTH the PAREDES were unsatisfactory in terms of being made from bahareque, lepa, palo or cana AND the PISO was tierra or arena.

Honduras

In all three surveys, housing needs were unsatisfied if the TIPOVIV was categorized as improvisada or if the PAREDES were made from material de desechos. In addition in urban areas the needs were unsatisfied if the PISO was tierra OR if the PAREDES were made from bahareque, vara or caña. In rural areas housing was also considered unsatisfactory if simultaneously the PISO was tierra AND the PAREDES were made from bahareque, vara or caña.

Nicaragua

In the surveys, there were unsatisfied housing needs if the TIPOVIV was categorized as vivienda improvisada or ripio or if the PAREDES or TECHO were made from material de desechos or ripio. In addition in urban areas the needs were unsatisfied if the PISO was tierra OR if the PAREDES were made from bambú, palma or caña. In rural areas housing was also considered unsatisfactory if simultaneously the PISO was tierra AND the PAREDES were made from bambú, palma or caña.

Mexico

The Mexican surveys contained no uniform information about the type of housing. Across the three years the necessity for housing was considered unsatisfied if the MUROS OR the TECHO was made from lamina de carton, carton, hule, tela, llantas, botes or similar. In the case of urban areas a necessity was unsatisfied if the PISO was tierra OR the MUROS were made from Carrizo, bambú, palma, embarro or bahareque. In rural areas the criteria was that simultaneously the PISO was tierra AND the MUROS were made from Carrizo, bambú, palma, embarro or bahareque.

UBN 2 – Household population density

For this dimension of unsatisfied basic need the same definition was applied uniformly across all of the countries. An individual had an unsatisfied basic need in household population density if they lived within a household where the number of people per room in the housing space was greater than or equal to 3. The number of rooms in the house or equivalent did not include bathrooms, toilets, kitchens, passages, hallways or garages.

UBN 3 – Access to Potable Water

The basic need in this dimension regards the adequate supply of potable water and each country's criteria for the satisfaction of this need is described below.

Costa Rica

Whilst the 1990 survey contained insufficient information in order to calculate the proportion of the population that suffer from this unsatisfied basic need, the later surveys had such questions and the water supply was considered unsatisfied if the household obtained its water from a tubería fuera del lote o edificio or the household no tiene agua por tubería.

El Salvador

In 1995 the household members had an unsatisfied basic need in terms of water if they responded to the water service question SERVAGUA with tiene pero no funciona or no tiene. In the 2000 and 2004 surveys the household need was unsatisfied in rural areas if the water availability SERAGUA was categorized as by camion, carreta, pipa, ojo de agua, río or quebrada. For urban areas the categories were the same as those for

the rural areas but also included additional categories such as water from cañería del vecino, pila, chorro público, and chorro común.

Guatemala

From the surveys for Guatemala the household members had an unsatisfied basic need in terms of water if their water demand was met in the following ways; by camion, río, lago, manantial, agua de lluvia or se la regala el vecino. An additional category specifically for urban areas was water from a chorro público.

Honduras

In Honduras household members had an unsatisfied basic need in terms of water if their water demand was met in the following ways; by río, riachuelo, ojo de agua, carro cisterna, manantial or pick-up con drones or barriles. An additional category specifically for urban areas was if water was obtained fuera de la propiedad.

Nicaragua

In Nicaragua household members had an unsatisfied basic need in terms of water if their water demand was met by río, quebrada, camión, carreta, pipa, ojo de agua, or manantial. Also in urban areas there was an additional category if water was obtained from a puesto público or from otro vecino, vivienda or empresa.

Mexico

In the 1989 survey households had an unsatisfied basic need for water if their water demand was met by agua de pozo dentro del terreno, agua por acarreo or entrega de agua a domicilio. In the case of the 2000 survey the need was unsatisfied or if the delivery of the water was by agua por acarreo, or if in urban areas the housing did not have agua entubada. In 2004 there was an unsatisfied need if the water was accessed from una pipa or un río, arroyo or lago. Additionally in urban areas the need was unsatisfied if water was obtained from una llave pública or hidrante, or otra vivienda.

UBN 4 – Access to adequate Sanitation

For this dimension of unsatisfied basic need the same definition was applied uniformly across all of the countries. An individual had an unsatisfied basic need for adequate sanitation if they lived within a household where the access to sanitation was not available at all or if the ***inodoro*** was not connected to ***alcantarillado, choaca, red drenaje, or tubería de aguas negras, or a tanque séptico***. In the rural areas latrines and ***pozos negros*** were considered satisfactory.

UBN 5 – Education

Across all countries an unsatisfied basic need for education existed for individuals between 7 and 12 years of age if they do not attend or are not enrolled in a school. For individuals greater than 12, a UBN existed if

they were not attending education or did not have at least a primary level education. For individuals under 7 years of age, education basic needs were proxied by the value of the head of the household.

UBN 6– Insurance

The ability to obtain accurate indicators of the unsatisfied basic need for social or medical insurance varied greatly with the quality of the questions in each country and year and as such the indicator was considered inadequate in terms of its comparability across countries in the sample and therefore not included in the analysis.

UBN 7– Electricity

Across all countries the criteria for determining if the members of a household had an unsatisfied basic need in terms of electricity was if there was a survey question for which the household has answered that they did not have access to electrical energy at least for household lighting.

UBN 8– Household Consumption Capacity

In each country the members of a household were considered to have an unsatisfied basic need in terms of the consumption capacity of the household if the designated head of the household had less than a secondary education AND the household economic dependency rate (that is the number of members of the household divided by the working members) was greater than 3.

APPENDIX 4
PROPORTION OF POPULATION WITH UNSATISFIED BASIC NEEDS, BY UBN DIMENSION AND INCOME POVERTY STATUS

Country	Income poverty status	Proportion of Population with Unsatisfied Basic Needs													
		UBN 1 (Housing)		UBN 2 (HH Density)		UBN 3 (Water)		UBN 4 (Sanitation)		UBN 5 (Education)		UBN 7 (Electricity)		UBN 8 (HH Consumption capacity)	
		UBN Exists	No UBN	UBN Exists	No UBN	UBN Exists	No UBN	UBN Exists	No UBN	UBN Exists	No UBN	UBN Exists	No UBN	UBN Exists	UBN Exists
Costa Rica	Income poor	4.1	14.5	1.0	17.6	0.5	18.1	0.4	18.2	0.5	18.1	0.3	18.3	9.7	8.9
	Non-poor	7.1	74.3	1.7	79.7	0.5	80.9	0.4	81.0	1.1	80.3	0.4	81.0	9.2	72.2
El Salvador	Income poor	6.3	41.1	27.9	19.6	15.7	31.8	18.0	29.5	6.0	41.5	10.0	37.5	25.4	22.1
	Non-poor	2.3	50.2	12.7	39.8	9.6	42.9	8.9	43.6	2.9	49.6	3.3	49.2	9.4	43.1
Guatemala	Income poor	12.7	41.9	39.5	15.2	9.4	45.3	16.2	38.5	11.6	43.1	15.0	39.6	24.4	30.2
	Non-poor	2.9	42.4	13.0	32.3	3.1	42.2	6.5	38.8	3.9	41.5	3.2	42.1	6.3	39.0
Honduras*	Income poor	8.1	60.6	19.0	49.7	7.6	61.1	22.7	46.0	8.7	60.0	25.8	42.9	30.3	38.5
	Non-poor	0.7	30.6	2.8	28.5	1.0	30.3	4.7	26.6	1.3	30.0	1.9	29.4	4.2	27.1
México	Income poor	3.7	28.0	18.8	12.8	1.9	29.8	3.4	28.2	1.9	29.7	0.6	31.1	9.7	21.9
	Non-poor	1.7	66.6	15.9	52.5	1.6	66.8	2.0	66.3	1.5	66.9	0.3	68.1	6.1	62.3
Nicaragua	Income poor	13.5	48.3	34.5	27.3	14.1	47.6	27.9	33.9	9.2	52.6	22.7	39.1	22.2	39.6
	Non-poor	3.7	34.5	8.9	29.4	3.5	34.7	11.6	26.6	2.6	35.7	5.0	33.2	4.2	34.0
Central America Average	Income poor	9.7	43.2	27.8	25.1	9.8	43.1	17.6	35.3	8.3	44.6	15.6	37.3	23.7	29.2
	Non-poor	3.0	44.2	8.9	38.2	3.6	43.5	6.6	40.6	2.6	44.5	2.9	44.2	6.5	40.6
Regional Average (Central America and Mexico)	Income poor	5.2	31.9	21.2	16.0	3.9	33.2	7.1	30.1	3.6	33.6	4.5	32.7	13.4	23.8
	Non-poor	2.1	60.8	14.1	48.8	2.1	60.7	3.2	59.6	1.8	61.1	0.9	61.9	6.2	56.6

Source: Author's calculations from national household surveys.

APPENDIX 5
INTEGRATED POVERTY MEASURES, CENTRAL AMERICA AND MEXICO, AROUND 2007

Country	Proportion of population by different type of poverty			Total poverty rate
	Recent or situational poverty	Structural or inertial poverty	Chronic poverty	
Costa Rica	7	17	12	36
El Salvador	6	28	41	75
Guatemala	5	23	49	78
Honduras	12	12	57	80
México	8	23	24	55
Nicaragua	7	23	55	84
Central America Average	7	21	46	74
Regional average (Central America and Mexico)	8	23	30	60

Source: Author's calculations from national household surveys.

APPENDIX 6
PROPORTION OF POPULATION IN A SITUATION OF POVERTY ACCORDING TO THE NUMBER OF DIMENSIONS DEPRIVED

Country	0	1	2	3	4	5	6	7	8
Costa Rica	64.1	21.3	10.9	2.7	0.7	0.2	0.1	0.0	0.00
El Salvador	24.9	19.9	18.3	14.9	10.7	6.8	3.2	1.0	0.18
Guatemala	22.0	18.7	18.6	16.2	11.9	7.5	3.5	1.3	0.34
Honduras	19.6	19.9	22.4	19.1	11.6	5.5	1.6	0.3	0.01
Mexico	45.2	26.2	16.3	8.7	2.8	0.8	0.2	0.0	0.00
Nicaragua	15.7	18.3	19.6	17.0	15.7	9.0	3.7	0.9	0.09
Regional average	40.3	24.4	16.9	10.3	4.9	2.2	0.8	0.2	0.04

Source: Author´s calculations from National Household surveys.

APPENDIX 7
PRINCIPAL COMPONENTS OF INCOME AND UNSATISFIED BASIC NEEDS, CENTRAL AMERICA AND MEXICO

Costa Rica				El Salvador			
Principal component	Eigenvalue	Proportion of variation explained	Cumulative proportion of variation explained	Principal component	Eigenvalue	Proportion of variation explained	Cumulative proportion of variation explained
1	3.4723	0.4340	0.4340	1	3.4886	0.4361	0.4361
2	1.2466	0.1558	0.5899	2	1.2736	0.1592	0.5953
3	0.9028	0.1128	0.7027	3	0.9561	0.1195	0.7148
4	0.8261	0.1033	0.8060	4	0.6419	0.0802	0.7950
5	0.6141	0.0768	0.8827	5	0.6189	0.0774	0.8724
6	0.4347	0.0543	0.9371	6	0.4152	0.0519	0.9243
7	0.3317	0.0415	0.9785	7	0.3557	0.0445	0.9687
8	0.1717	0.0215	1.0000	8	0.2501	0.0313	1.0000

Guatemala				Honduras			
Principal component	Eigenvalue	Proportion of variation explained	Cumulative proportion of variation explained	Principal component	Eigenvalue	Proportion of variation explained	Cumulative proportion of variation explained
1	3.5597	0.4450	0.4450	1	3.1055	0.3882	0.3882
2	1.0870	0.1359	0.5808	2	1.1899	0.1487	0.5369
3	0.9052	0.1132	0.6940	3	0.8902	0.1113	0.6482
4	0.8155	0.1019	0.7959	4	0.8689	0.1086	0.7568
5	0.5828	0.0729	0.8688	5	0.7877	0.0985	0.8553
6	0.3870	0.0484	0.9171	6	0.5092	0.0637	0.9189
7	0.3543	0.0443	0.9614	7	0.3863	0.0483	0.9672
8	0.3086	0.0386	1.0000	8	0.2623	0.0328	1.0000

Nicaragua				Mexico			
Principal component	Eigenvalue	Proportion of variation explained	Cumulative proportion of variation explained	Principal component	Eigenvalue	Proportion of variation explained	Cumulative proportion of variation explained
1	2.8966	0.3621	0.3621	1	3.2756	0.4094	0.4094
2	1.8423	0.2303	0.5924	2	1.0788	0.1348	0.5443
3	0.9898	0.1237	0.7161	3	0.8321	0.1040	0.6483
4	0.7475	0.0934	0.8095	4	0.7853	0.0982	0.7465
5	0.6777	0.0847	0.8942	5	0.6944	0.0868	0.8333
6	0.3936	0.0492	0.9434	6	0.5789	0.0724	0.9056
7	0.2869	0.0359	0.9793	7	0.3834	0.0479	0.9536
8	0.1655	0.0207	1.0000	8	0.3715	0.0464	1.0000

Source: Prepared by the author.