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Income and Beyond: Multidimensional Poverty in six Latin American countries

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Abstract

This paper presents empirical results of a wide range of multidimensional poverty measures for: Argentina, Brazil, Chile, El Salvador, Mexico and Uruguay, for the period 1992–2006. Six dimensions are analysed: income, child attendance at school, education of the household head, sanitation, water and shelter. Over the study period, El Salvador, Brazil, Mexico and Chile experienced significant reductions of multidimensional poverty. In contrast, in urban Uruguay there was a small reduction in multidimensional poverty, while in urban Argentina the estimates did not change significantly. El Salvador, Brazil and Mexico together with rural areas of Chile display significantly higher and more simultaneous deprivations than urban areas of Argentina, Chile and Uruguay. In all countries, access to proper sanitation and education of the household head are the highest contributors to overall multidimensional poverty.

Keywords: Multidimensional poverty measurement, counting approach, Latin America, Unsatisfied Basic Needs, rural and urban areas.

JEL Classification: D31, I32.

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Acronyms

AF	Alkire and Foster
BC	Bourguignon and Chakravarty
CES	Constant Elasticity of Substitution
ECLAC	Economic Commission for Latin America and the Caribbean
FGT	Foster Greer and Thorbecke
UBN	Unsatisfied Basic Needs

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1. Introduction

There is a longstanding literature on poverty analysis in the region, based both on the Unsatisfied Basic Needs (UBN) approach and on income poverty. The former approach was promoted in the region by the Economic United Nation's Economic Commission for Latin America and the Caribbean (ECLAC) and used extensively since at least the beginning of the 1980s (Feres and Mancero, 2001). The latter was spurred by the relatively early development of calorie consumption-based national poverty lines derived from consumption and expenditure surveys (Altimir, 1982).

Most commonly, the UBN approach combines population census information on the condition of households (construction material and number of people per room), access to sanitary services, education and economic capacity of household members (generally the household head). The UBN indicators are often reported by administrative areas in terms of the proportion of households unable to satisfy one, two, three, or more basic needs, and are often presented using poverty maps. Thus, in practice, the approach does not offer a unique index but rather the headcounts associated with the number of basic needs unmet. Among other things, the approach has been criticized for its crude aggregation index.

In a context where household surveys were not as widespread as nowadays and income and consumption were difficult variables to measure, the census-based UBN measures became the poverty analysis tool *par excellence* in the region, while income poverty studies were restricted to specific surveys and individual studies (Gasparini, 2004).[1] However, as household surveys started to be regularly administered and progressively available to the public, distributional studies using income gained increasing attention and – in a way – displaced the UBN approach.

With the increased popularity of the income approach, income poverty measures based on national and international poverty lines started to be routinely reported by statistic institutes and research centers from the region, and scores of studies employ this information. However, most databases and studies tend overwhelmingly to focus on the poverty headcount, that is, the same crude aggregation methodology used by the UBN approach.[2]

Recovering interest in the multidimensionality of poverty, highlighted early in the region by the UBN approach, this study aims to provide estimates of poverty beyond the income dimension for countries in Latin America. However, this is done using a more sophisticated approach to the combination of these multiple dimensions, based on sound principles of distributive analysis. By promoting a multidimensional approach to poverty measurement, the paper is also attuned to the current needs of tools for targeting social programmes. [3]

The results below attempt to fill the gap in the literature by presenting a multi-country analysis of multidimensional poverty based on the latest development in poverty measurement. The existing studies

[1] Household surveys did not become regular until the 1970s or even later in Latin American countries and even when they were performed, micro-datasets were not publicly available for researchers.

[2] A series of income-based poverty measures and unsatisfied basic needs indicators for most countries in the region are computed regularly and available online through the Socio-Economic Database for Latin America and the Caribbean (CEDLAS and World Bank, 2009). This is one of the few exceptions, reporting not only income poverty headcounts but also the poverty gap and the squared poverty gap for each survey (Foster, Greer and Thorbecke, 1984).

[3] Indeed the identification of the beneficiaries of the Progresa/Oportunidades (Conditional Cash Transfer Program) uses multidimensional indicators. Also, the Mexican population Council (CONAPO) developed the Marginality Index which allows relative deprivations in nine dimensions suffered by different geographic units to be identified, constituting a tool for policy design. Finally, motivated by the 2004 General Law for Social development (LGDS), the National Council for the Evaluation for Social Policy (CONCEVAL) in Mexico has developed the Social Backwardness Index, another multidimensional indicator.

in this specific area are limited in the region. Amarante et al. (2008) and Arim and Vigorito (2007) present a similar analysis for Uruguay, while others used data from countries in the region to illustrate different methodological developments – Paes de Barros et al. (2006) for Brazil, Conconi and Ham (2007) for Argentina, Ballon and Krishnakumar (2008) for Bolivia. Lopez-Calva and Rodriguez-Chamussy (2005), and Lopez-Calva and Ortiz-Juarez (2009) have also adopted a multidimensional approach to studying poverty in Mexico, estimating the magnitude of the exclusion error when a monetary measure (vs. a multidimensional one) is adopted.

In summary, the contribution of this study is twofold. On the one hand, it presents a discussion of the application of multidimensional poverty measures in the context of Latin America. On the other hand, it presents results from six countries (Argentina, Brazil, Chile, El Salvador, Mexico and Uruguay) based on comparable data sources and indicators.

The rest of the paper is organised as follows. Section 2 briefly discusses the existing approaches to multidimensional poverty. Section 3 describes the poverty measures selected for this study. Section 4 presents the dataset, the selected dimensions, the indicators, thresholds and the weights employed in the analysis. Section 5 presents the empirical results, and Section 6 provides some concluding remarks.

2. Approaches to multidimensional poverty

In recent years, a consensus has emerged among those studying and making policies related to individuals' well-being: poverty is best understood as a multidimensional phenomenon. However, views differ among analysts regarding the relevant dimensions and their relative importance. Welfarists stress the existence of market imperfections or incompleteness and the lack of perfect correlation between relevant dimensions of well-being (Atkinson 2003, Bourguignon and Chakravarty 2003, Duclos and Araar 2006), which makes the focus on a sole indicator such as income somewhat unsatisfactory. Non-welfarists point to the need to move away from the space of utilities to a different and usually wider space, where multiple dimensions are both instrumentally and intrinsically important. Among the non-welfarists, there are two main strands: the basic needs approach and the capability approach (Duclos and Araar 2006). The first approach, based on Rawls' Theory of Justice, focuses on a set of primary goods that are constituent elements of well-being and considered necessary to live a good life (Streeten et al. 1981). The second approach, championed by Sen (1992), argues that the relevant space of well-being should be the set of functionings (or outcomes) that the individual is able to achieve. This set is referred to as the capability set "reflecting the person's freedom to lead one type of life or another" (Sen 1992, p. 40).[4]

Rooted in different theoretical understandings of what constitutes a good life, all three approaches face the same problem: if well-being and deprivation are multidimensional, how should we make comparisons between two distributions and assess, for instance, whether one distribution exhibits higher poverty levels than the other? To answer this question one needs to make decisions about the domains relevant to well-being, their respective indicators and threshold levels, and the aggregation function (if completeness is desired). While these choices might differ substantially across approaches, in the present paper a single choice of dimensions, indicators and thresholds is considered and the focus is placed instead on the different aggregation forms.[5] In particular, we compare the results obtained using the multidimensional poverty measure proposed by Alkire and Foster (2007), built in the spirit of the capability approach, with the indices proposed by representatives of the two other perspectives: the Bourguignon and Chakravarty (2003) measure and the Unsatisfied Basic Needs index.

[4] See Duclos and Araar (2006) for a thorough analysis of the differences between the three approaches.
[5] On the debates and criteria for selection of dimensions and indicators of well-being, see Alkire (2002, 2007).

The UBN approach has been criticized on several grounds, specifically regarding the (arbitrary) selection of the indicators, the (arbitrary) implicit weights, the identification methodology and the aggregation index, which uses headcounts. Overcoming some of these deficiencies, Alkire and Foster (2007) (AF from here onwards) propose a family of measures which combine information on both the number of deprivations and their level, and – when data are cardinal – information on poverty depth and distribution can be incorporated also. The family is an extension of the FGT class of measures (Foster, Greer and Thorbecke, 1984) and satisfies a set of desirable properties. In addition, the AF measures also allow for different dimension weighting schemes. The approach uses a dual cut-off – one for each dimension, and one for the number of dimensions *k* required to be considered poor. Therefore, a household is described as poor if it is deprived in *k* or more dimensions. A key feature of one of the measures in the family is that it allows qualitative and quantitative information to be combined. Thus census information (such as dwelling characteristics and access to services) and income or consumption data can be aggregated in a meaningful way.

At the same time, when using quantitative information (i.e. continuous variables), one might be interested in incorporating the idea that dimensions of deprivation are to some extent substitutes (or complements). In other words, high deprivations in one dimension can be compensated by lower deprivations in another one. Bourguignon and Chakravarty (2003) (referred to as BC hereafter) suggest a family of multidimensional poverty measures which is also a generalization of the FGT family of measures, but that aggregates relative deprivations using a Constant Elasticity of Substitution (CES) function, implying a degree of substitution between dimensions.

The following pages describe these three groups of measures – the UBN, the AF and the BC measures. The empirical results below present estimates of these measures, as well as deprivation rates by dimension, for Argentina, Brazil, Chile, El Salvador, Mexico and Uruguay at five different points in time between 1992 and 2006, using two alternative weighting systems.

3. Multidimensional poverty indices

The construction of a poverty measure involves two steps (Sen, 1976): first, the identification of the poor; second, the aggregation of the poor. In the unidimensional income approach, the identification step defines an income poverty line based on the amount of income that is necessary to purchase a basic basket of goods and services. Individuals and households are thus identified as poor if their income (per capita or adjusted by the demographic composition of the household) x_i falls short of the poverty line z. The individual poverty level is generally measured by the normalized gap defined as:

(1)
$$\begin{cases} g_i = [(z - x_i)/z] & for \quad x_i < z \\ g_i = 0 & for \quad x_i \geq z \end{cases}$$

The individual information is most commonly aggregated in the second step using the aggregation function proposed by Foster, Greer and Thorbecke (1984) known as the FGT measures, defined as:

(2)
$$FGT_\alpha = \frac{1}{n}\sum_{i=1}^{n} g_i^\alpha$$

The coefficient α is a measure of poverty aversion. Larger values of α give greater emphasis to the poorest poor. When $\alpha = 0$, the FGT is the headcount measure, where all poor individuals are counted equally. When $\alpha = 1$, the measure is the poverty gap, where individuals' contribution to total poverty depends on how far away they are from the poverty line, and with $\alpha = 2$, the measure is the squared poverty gap, where individuals receive higher weight the larger their poverty gaps are. For $\alpha > 0$ the measure satisfies monotonicity (i.e. it is sensitive to the depth of poverty); while for $\alpha > 1$, it satisfies transfer (i.e. it is sensitive to the distribution among the poor).[6]

In the multidimensional context, distributional data are presented in the form of a matrix of size $n \times d$, $X^{n,d}$, in which the typical element x_{ij} corresponds to the achievement of individual i in dimension j, with $i = 1,....,n$ and $j = 1,....,d$. Following Sen (1976), one is first required to identify the poor. The most common approach is to first define a threshold level for each dimension *j,* below which a person is considered to be deprived. The collection of these thresholds can be expressed in a vector of poverty lines $z = (z_1,....,z_d)$. In this way, whether a person is deprived or not in each dimension is defined. However, unlike unidimensional measurement, a second decision needs to be made in the multidimensional context: among those who fall short in some dimension, who is to be considered multidimensionally poor? A natural starting point is to consider all those deprived in at least one dimension, the so called *union approach*. However, more demanding criteria can be used, even to the extreme of requiring deprivation in all considered dimensions, the so called *intersection approach*. In terms of Alkire and Foster (2007), this constitutes a second cut-off: the number of dimensions in which someone is required to be deprived so as to be identified as multidimensionally poor. The authors name this cut-off k. If c_i is the number of deprivations suffered by individual i*,* then she will be considered multidimensionally poor if $c_i \geq k$.[7]

Once the process of identification of the multidimensionally poor has been solved, the aggregation step comes next. The measures described in what follows are multidimensional extensions of the FGT family of measures. For simplicity in the exposition, it is assumed that each selected dimension has only one indicator. This becomes relevant to the weighting structure discussed in Section 4 below.

3.1 The Multidimensional Headcount and the Unsatisfied Basic Needs Approach

The simplest extension of the FGT family of indices is the multidimensional headcount. Once the k cut-off value has been selected, it is straightforward to calculate the fraction of the population deprived in k or more dimensions. Formally, this can be expressed as:

(3) $$H(X;z) = \frac{1}{n}\sum_{i=1}^{n}\left[\sum_{j=1}^{d} g_{ij}(k)\right]^0 = \frac{q}{n}$$

where $g_{ij}(k)$ is the censored poverty gap of individual i in dimension j, such that $g_{ij}(k) = \lfloor (z_j - x_{ij})/z_j \rfloor$ if $x_{ij} < z_j$ and $c_i \geq k$, and $g_{ij}(k) = 0$ otherwise, it is the number of people deprived in k or more dimensions (q) over the total population (n*)*. This measure is the one used by the Unsatisfied Basic Needs Approach (UBN), with the union approach ($k = 1$) as the most common identification criterion.

[6] Foster (2006) provides a recent survey of axioms in unidimensional poverty measurement.

[7] Another approach would be to first define an aggregate of well-being for individual i and then define the poverty threshold in the space of the well-being metric, which can be a function of the dimension specific poverty thresholds ($z = (z_1,....,z_d)$). By construction, this approach would ignore the second cut-off requirement. On this see Maasoumi and Lugo (2008).

One implication of the approach is that households are described by counting the number of deprivations suffered. This implies that each indicator is weighted equally, irrespective of its nature and the number of indicators used to describe each dimension. If there is more than one indicator corresponding to the same dimension, this means that some dimensions are weighted disproportionately more than others (Feres and Mancero, 2001). Secondly, as pointed out by Alkire and Foster (2007), the multidimensional headcount is not sensitive to the number of deprivations that the multidimensionally poor experience; that is, it violates what the authors call dimensional monotonicity. Given a k value, unless the intersection approach is used ($k = d$) if an individual identified as poor becomes deprived in an additional dimension, the multidimensional headcount does not change. Thirdly, in line with traditional critiques of the headcount in the unidimensional space, it ignores all information over the extent of deprivation. Thus, the UBN approach is not able to account for the extent and severity of poverty.[8] Finally, although it is possible to decompose the headcount in subgroups of population, it is not possible to distinguish the contribution of each dimension to overall poverty. The following families of indices account for these problems.

3.2 Alkire and Foster (2007) family of indices: the M_α measures

Using the dual cut-off approach previously explained for the identification of the multidimensionally poor, Alkire and Foster (2007) propose the dimension adjusted FGT measures, or M_α family of measures, given by the following expression:

(3) $$M_\alpha(X;z) = \frac{1}{nd}\sum_{i=1}^{n}\sum_{j=1}^{d} w_j \left(g_{ij}(k)\right)^\alpha \qquad \text{with} \quad \alpha \geq 0$$

where $g_{ij}(k)$ is the censored poverty gap of individual i in dimension j, as defined in the previous section; w_j is the weight assigned to dimension j, such that $\sum_{j=1}^{d} w_j = d$, and α is the parameter of dimension-specific poverty aversion. It is worth noting that the weighting system affects not only aggregation but also identification. When equal weights are used, ($w_j = 1$ for all $j = 1,...,d$), the identification cut-off ranges from k=1, corresponding to the union approach, to k=d, corresponding to the intersection approach, and someone is multidimensionally poor when her number of deprivations is equal or greater than k: $c_i \geq k$. When ranking weights are used, so that some dimensions receive higher weights than others, c_i becomes the *weighted* number of deprivations in which the individual is deprived.[9] In this case, the minimum possible k value, which corresponds to the union approach, is given by the minimum weight: k=min(w_j), while the maximum possible k cut-off value remains to be d.[10]

Similar to the unidimensional FGT measures, three members of this family are worth mentioning. When $\alpha = 0$, the measure is the adjusted headcount ratio. It can be shown that it is the product of the multidimensional headcount ratio H (defined in expression 2) and the average deprivation share across

[8] Another criticism is that, in practice, UBN measures are considered more "structural", since they are not sensitive to short-run spells of poverty due to the exclusion of variables such as income and consumption. UBN measures also tend to underestimate urban poverty since deprivations related to the dwelling and access to sanitary services tend to be lower in urban areas. We do not stress these points in the paper given that they are the direct consequences of the dimensions and indicators chosen and not the way indicators are aggregated, the focus of this section.

[9] For example if an individual is deprived in income and health, and income has a weight of 2, while health has a weight of 0.5, then $c_i = 2.5$ and not 2, as it would be with equal weights.

[10] The M_α family of measures is presented in Alkire and Foster (2007) as the mean of the censored matrix of normalised alpha poverty gaps. In this paper, the traditional notation is used to facilitate the comparison with the Bourguignon and Chakravarty (2003) family of measures.

the poor A ($M_0 = HA$), where A is given by $A = \sum_{i=1}^{n} c_i /(qd)$. The A measure indicates the fraction of the *d* dimensions in which the average multidimensionally poor individual is deprived. In this way, M_0 has an advantage over the multidimensional H: it is sensitive to the number of deprivations the multidimensionally poor experience, i.e. it satisfies dimensional monotonicity (Alkire and Foster, 2007, p. 16). When $\alpha = 1$, the measure is the adjusted poverty gap, defined as the weighted sum of dimension-specific poverty gaps. This measure is not only sensitive to the number of deprivations the poor experience but also to their depth, that is, it satisfies monotonicity. Finally, when $\alpha = 2$ the measure is the adjusted squared poverty gap, defined as the weighted sum of the dimension-specific squared poverty gaps. This measure satisfies the two types of monotonicity mentioned above, and it is also sensitive to the inequality of deprivations among the poor, satisfying the multidimensional transfer property.[11]

In addition to the aforementioned properties, all members of the M_a family can be decomposed by subgroups of population and by dimensions. Given a population subgroup I, its contribution to overall poverty is given by:

(4) $$C_I = \left[\left(\frac{n_I}{n}\right) M_\alpha^I\right]\frac{1}{M_\alpha}$$

where (n_I / n) and M_α^I are the population share and the poverty measure of subgroup I respectively, and M_α is the poverty measure for the overall population. Moreover, once the identification step has been completed, all members of the M_a family can be decomposed into the contribution of each dimension.[12] Specifically, the contribution of dimension J is given by

(5) $$C_J = \left[\left(\frac{1}{nd}\sum_{i=1}^{n}\left(g_{iJ}(k)\right)^\alpha\right)\right]\frac{1}{M_\alpha}$$

These two decompositions will be used in the results presented below to unveil the composition of the multidimensional poverty observed and their evolution, and to highlight the differences across countries.

3.3 Bourguignon and Chakravarty (2003) family of indices

Bourguignon and Chakravarty (2003) adopt a union approach for the identification of the multidimensionally poor. In terms of the second cut-off parameter specified in the previous subsection, this means that they use a value of *k* = 1, so that a person is considered to be multidimensionally deprived as long as she falls short in any of the considered dimensions. In terms of the identification step, Bourguignon and Chakravarty's (2003) family of measures constitutes a special case of Alkire and Foster's (2007). However, as shown below, in terms of the aggregation step the opposite is true. The

[11] Alkire and Foster (2007) show that that M_1 is the product of the multidimensional headcount H, the average deprivation share across the poor A, and the average poverty gap G among the poor ($M_1 = HAG$), where G is given by $G = \left[\sum_{i=1}^{n}\sum_{j=1}^{d} g_{ij}(k)\right] / \left[\sum_{i=1}^{n}\sum_{j=1}^{d}\left(g_{ij}(k)\right)^0\right]$. Analogously, the authors express M_2 as the product of the multidimensional headcount H, the average deprivation share across the poor A, and the average severity of deprivations among the poor S ($M_2 = HAS$), where S is given by $S = \left[\sum_{i=1}^{n}\sum_{j=1}^{d}\left(g_{ij}(k)\right)^2\right] / \left[\sum_{i=1}^{n}\sum_{j=1}^{d}\left(g_{ij}(k)\right)^0\right]$.

[12] Strictly speaking, because the identification step needs to be completed in the first place, this is not a decomposability property.

interaction between these families of measures is related to the core of the discussion in the contemporary literature on multidimensional poverty and well-being: the interrelation between dimensions and its implication for poverty measurement.

The relationship between dimensions becomes relevant for poverty measurement under a specific type of transfer or rearrangement, called *correlation increasing switch* by Bourguignon and Chakravarty (2003).[13] Given two poor individuals A and B, with A having strictly higher achievements than B in some dimensions, but strictly lower achievements in others, there is a transfer between the two that makes one of them – say A – end up having higher achievements in *all* dimensions and hence the correlation (or the association) between dimensions has increased as a result of it. What should happen to the poverty measure in such a case? If dimensions are thought to be substitutes, poverty should not decrease, whereas if dimensions are thought to be complements, poverty should not increase.[14] These two properties are referred to by Bourguignon and Chakravarty (2003) as 'Non-Decreasing Poverty under Correlation Increasing Switch' (NDCIS), and 'Non-Increasing Poverty under Correlation Increasing Switch' (NICIS), respectively. There is also scope for dimensions to be considered independent, in which case, poverty should not change under the described transformation. It should be mentioned that the substitutability, complementarity or independence relationship between dimensions is defined in this literature in terms of the second cross partial derivative of the poverty measure with respect to any two dimensions being positive, negative or zero, respectively. This corresponds to the Auspitz-Lieben-Edgeworth-Pareto (ALEP) definition, and differs from Hick's definition traditionally used in the demand theory (which relates to the properties of the indifference contours) (Atkinson, 2003, p. 55).[15]

The family of multidimensional poverty indices proposed by Bourguignon and Chakravarty (2003) aggregates shortfalls across dimensions for each individual using a constant elasticity of substitution function that allows for different degrees of substitutions to be incorporated, and then aggregates across individuals' multidimensional deprivations using the standard FGT formula. The family of indices is then given by:

(4) $$P_\theta^\alpha(X;z) = \frac{1}{n}\sum_{i=1}^{n}\left[\sum_{j=1}^{d}\left(\frac{w_j}{d}\right)\left(g_{ij}(1)\right)^\theta\right]^{\alpha/\theta} \text{ with } \alpha \geq 0 \text{ and } \theta \geq 1$$

Following the previous notation, $g_{ij}(1)$ is the censored poverty gap of individual *i* in dimension *j,* using a cut-off value of k=1 and when w_j and *d* are defined as above. The parameter α measures the degree of aversion to multidimensional poverty, with higher values attaching a higher weight to individuals with higher multidimensional deprivation. Note that in AF the parameter α measures the level of aversion to *dimension-specific* poverty while in BC it measures the aversion to *multidimensional* poverty. The θ parameter measures the degree of substitutability between dimension shortfalls in the Hicks' sense; the higher the θ, the lower the substitutability between dimensions. The value of θ is set to be equal or greater than one so that the standard convex – diminishing returns – assumption between dimensions is

13 This type of transformation was first discussed by Atkinson and Bourguignon (1982) and Boland and Proschnan (1988). It was first introduced in the multidimensional inequality measurement by Tsui (1999) and multidimensional poverty measures by Tsui (2002). Alkire and Foster (2007) rename the term as *association increasing rearrangement*, since the term 'association' seems better suited than 'correlation', which refers only to a specific type of association. Seth (2008) provides further discussion on this issue.

14 The intuition is that if dimensions are substitutes, before the transfer, both A and B were able to compensate their meagre achievements in some dimensions with their higher achievements in the others; after the transfer B is no longer able to do so, and therefore poverty should increase (or at least not decrease). On the other hand, if attributes are complements, before the transfer, neither A nor B were able to achieve a certain level of well-being since both were lacking in some dimension; after the transfer, at least A is able to do so.

15 See Kannai (1980) for critiques of the ALEP definition.

satisfied.[16] For θ = 1 dimensions are perfect substitutes. At the extreme, for $\theta \to \infty$, dimensions are perfect complements and individuals are judged according to their worst performance in any single dimension. In terms of the ALEP definition, dimensions are considered substitutes, complements or independent depending on the value of α relative to that of θ. When $\alpha > \theta$, dimensions are considered substitutes, and the indices satisfy the NDCIS property, so that an increase in the association between dimensions does not decrease poverty. On the other hand, when $\alpha < \theta$, dimensions are considered complements, and the indices satisfy the NICIS property, so that an increase in the association between dimensions does not increase poverty. Finally, when $\alpha = \theta$ dimensions are considered to be independent, and increases in the association between them do not affect the poverty measure.

Some members of the BC family of measures are worth noting. With $\alpha = 0$, independently of the value of θ and of the weights used, the BC measure is reduced to the multidimensional headcount with *k*=1 and equal weights (UBN): $P_\theta^0(X;z) = H(X;z)$.[17] Also, when the parameter of inequality aversion equals the degree of substitution between attributes, the BC measure coincides with the indices suggested by AF when *k*=1. Specifically, when $\theta = \alpha = 1$ the BC measure is the M_1 measure: $P_1^1(X;z) = M_1(X;z)$, while, when $\theta = \alpha = 2$ the BC measure is the M_2 measure: $P_2^2(X;z) = M_2(X;z)$. In those cases, in which the two parameters α and θ coincide, dimensions are considered independent, and the poverty measure is insensitive to changes in the level of association between dimensions. Therefore, in terms of the aggregation procedure, the AF measures can be seen as a specific case of the BC measures.[18]

In general, note that for $\alpha > 0$, and given that $\theta \geq 1$, the indices satisfy monotonicity, and for $\alpha > 1$ and $\theta > 1$, they satisfy the transfer requirement.[19] Moreover, all members of the family can be decomposed in subgroups of population, so that the contribution of each subgroup can be calculated in an analogous way to that presented for the Alkire and Foster (2007) measures. However, only in the case in which $\theta = \alpha$, that is, when dimensions are considered independent, can the indices be decomposed into the contributions of each dimension. This points to a trade-off present in multidimensional measurement: the possibility of breaking down the aggregate measure by dimensions vs. allowing for sensitivity to changes in the level of association between attributes. While BC seem to lean towards allowing some type of interaction between dimensions – given the indubitable interrelation between dimensions of well-being such as income, education, and health – AF seem to prefer dimension-decomposability, given the usefulness of being able to identify each dimension's contribution for policy purposes.

4. Datasets, dimensions, poverty lines and weights

The dataset used in the paper corresponds to the *Socioeconomic Database for Latin America and the Caribbean* (SEDLAC), constructed by the Centro de Estudios Distributivos Laborales y Sociales (CEDLAS) and the World Bank. The dataset comprises household surveys of different Latin American countries which have been homogenised to make variables comparable across countries – the details of this process are covered in CEDLAS (2009). This first multi-country study on multidimensional poverty in the region

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16 As presented, the degree of substitution is assumed to be constant and the same for all pairs of attributes. This might be considered unsatisfactory when working when more than two dimensions. One alternative is to consider a nested approach in which two dimensions of several subsets of dimensions are aggregated using the same CES function with each subset having a different θ, and second, these subsets are combined using again the same expression. Another alternative suggested by the authors is to allow the substitutability parameter to be a function of the achievements.

17 This marks a difference with the AF family, since in that case, the M_0 measure satisfies dimension monotonicity and it is sensitive to the weighting system used.

18 However, AF mention that their measure can be extended to a class that considers interrelationships among dimensions by replacing the individual poverty function $M_\alpha(x_i;z)$ by $[M_\alpha(x_i;z)]^\gamma$.

19 Bourguignon and Chakravarty (2003) provide a formal definition of this transfer in the multidimensional context.

concentrates on a subset of the available database to maximize the possibilities for comparison across time and between countries.[20] The study covers the following six countries: Argentina, Brazil, Chile and Uruguay, El Salvador and Mexico. Altogether, they account for about 64 per cent of the total population in Latin America in 2006.

The paper performs estimates at five points in time between 1992 and 2006 for each country. Full details of survey names and sample sizes can be found in Table A.1 in the Appendix. In the case of Argentina and Uruguay, the data are representative only of urban areas and correspond to the years 1992, 1995, 2000, 2003 and 2006 in Argentina, and to the years 1992, 1995, 2000, 2003 and 2005 in Uruguay. In the other four countries data are nationally representative, including information from both urban and rural areas. In Brazil, data corresponds to the years 1992, 1995, 2001, 2003 and 2006; in Chile to 1992, 1996, 2000, 2003 and 2006; in El Salvador to 1991, 1995, 2000, 2003 and 2005 and finally in Mexico, to the years 1992, 1996, 2000, 2004 and 2006. The definition of 'rural areas' by the surveys performed in each of these four countries is fairly similar.[21] In each country, only households with complete information on all variables and consistent answers on income were considered.[22]

The selection of dimensions was based on several factors. As mentioned earlier, Latin America has a strong tradition of using the UBN approach. This approach is often also called the 'direct method' to measure poverty, since it looks directly at whether certain needs are met or not, as opposed to the 'indirect (or poverty line) method', which looks at the income level and compares it to the income level necessary to achieve these needs (Feres and Mancero, 2001). It has been long argued that both methods capture partial aspects of poverty, that both the income dimension as well as the UBN indicators are relevant for assessing well-being, and that there are significant errors in targeting the poor (either of inclusion or exclusion) when only one of them is used.[23] Therefore, in this paper, a 'hybrid method' is adopted, in which both an income indicator as well as indicators typically used in the UBN approach are selected.[24]

Table 1 presents the dimensions selected to perform the poverty estimates. For the income dimension, the World Bank's poverty line of US$2 per capita per day was selected. It is acknowledged that this is a rather conservative poverty line for Latin America, but it guarantees full comparability across countries.[25] Children's education is another dimension considered, requiring all children between 7 and 15 years old

[20] The SEDLAC database (CEDLAS and World Bank, 2009) will report multidimensional poverty indicators systematically starting in 2009.

[21] In Chile it corresponds to localities of less than 1,000 people or with 1,000 to 2,000 people, of which most perform primary activities. In Mexico it refers to localities of less than 2,500 people. In Brazil, rural areas are not defined according to population size but rather they are all those not defined as urban agglomerations by the Brazilian Institute of Geography and Statistics. In El Salvador, rural areas are all those outside the limits of municipalities heads, which are populated centres where the administration of the municipality is located. Again, this definition does not refer to any particular population size.

[22] The Statistics Institute of each country has a criterion to identify invalid income answers (such as reporting zero income when working for a salary), which is incorporated in the SEDLAC dataset, as well as other types of invalid answers (such as reporting labour income when being unemployed).

[23] Cruces and Gasparini (2008) illustrate these inclusion and exclusion effects by studying the targeting of cash transfer programs based on a combination of income and other UBN-related indicators.

[24] This 'hybrid method' can be criticized of potential double-counting, arguing that dimensions that may have been considered in the basic consumption basket used to determine the poverty line are included again as a separate indicator. However, the spearman correlations between income and the other different indicators are relatively low (not exceeding 0.5 in any case) and decreasing over time, suggesting that a multidimensional approach does indeed incorporate new elements to poverty analysis.

[25] This poverty line is prior to the latest amendment by the World Bank (Ravallion, Chen and Sangraula, 2008), which raised this line from approximately from US$2.15 to US$2.50. The impact of this change in the poverty line differs across countries. In Argentina, Brazil, Chile and Uruguay it produced an increase in the income poverty estimates, whereas in El Salvador and Mexico it produced a decrease in the income poverty estimates. Therefore the income deprivation rates reported in this paper should be taken as a lower bound in the first group of countries and as an upper bound in the second. This does not alter the conclusions of this paper.

(inclusive) to be attending school. This indicator belongs to the UBN approach. Households with no children are considered non-deprived in this indicator. A third indicator refers to the educational level of the household head, with the threshold set at five years of education. Again this indicator is part of the UBN approach, although in that approach (a) the required threshold is second grade of primary school and (b) it is usually part of a composite indicator together with the dependency index of the household (considered to be deprived if there are four or more people per employed member). Two years of education seemed a very low threshold, so five years were used instead. Also, given that the income indicator is being included, the high dependency index seemed less relevant in this hybrid approach. The other three indicators used relate to the dwelling's conditions. The first two; having proper sanitation (flush toilet or pit latrine) and living in a shelter with non-precarious wall materials are typically included in the UBN approach.[26] The third indicator is having access to running water in the dwelling. Although this is not usually included in the UBN approach, it is considered important. In the absence of comparable health data, it can be seen as a proxy of this dimension, which is one of the most valued according to the participatory study performed in Mexico "Lo que dicen los pobres" (Székely, 2003)[27].

Table 1: Selected Indicators, Deprivation Cut-Off Values and Weights

Indicator	**Deprivation Cut-off value**	**Weights**	
		Equal Weights	**Voices of the Poor Weights**
Income	Having a per capita family income of US$2	1	2.4
Child in School	Having all children between 7 and 15 attending school	1	1.8
Education of HH	Household head with at least five years of education.	1	0.6
Running Water	Having tap water in the dwelling.	1	0.6
Sanitation	Having flush toilet or pit latrine in the dwelling.	1	0.3
Shelter	House with non-precarious wall materials.	1	0.3

Two alternative weighting systems are used.[28] The first scheme weights each indicator equally. However, if more than one indicator is associated with the same dimension, the equal weights are not really equal across dimensions. In this case, three of the indicators used refer to dwelling's characteristics and two other indicators (children attending school and the education of the household head) refer to the dimension of education of the household. Therefore, the equal weights are implicitly weighting the dwelling conditions three times, and the education dimension twice, compared to the income dimension.

The second weighting structure is derived from a replica performed in Mexico – the participatory study on the voices of the poor – carried out by the country's Secretaría de Desarrollo Social (Székely, 2003). In this study the poor were asked about their valuation of different dimensions. The number and variety of dimensions included in the questionnaire exceeds those considered here, however, its results are useful for producing a ranking of the six indicators. The new weighting scheme (last column in Table 1)

[26] In the UBN approach (and also in the Uruguay survey) the quality of shelter is defined in terms of "adequate shelter".

[27] Clearly, using the same thresholds for both urban and rural areas is an arguable decision. One could imagine that the standards of what is 'acceptable' in a rural context (particularly in terms of sanitation, water and shelter) may differ from the standards in an urban context. However, from an ethical point, we see no strong reason why people in rural areas should conform to lower achievements in certain aspects of their living conditions than people in urban ones. We therefore deliberately require households in both areas to meet the same minimum requirements so as to be considered non-deprived. Additionally, this guarantees comparability across these areas.

[28] On the meaning of dimension weights in multidimensional indices of well-being and deprivation and alternative approaches to setting them, see Decancq and Lugo (2009).

gives the income dimension the highest weight, being 1.3 times the weight received by the children's education, 4 times the weight received by the education of the household head and access to running water, and 8 times the weight received by having access to sanitation and proper shelter. These sets of weights will be referred to in what follows as voices of the poor weights (VP weights).

Three of the indicators are cardinal variables (income, proportion of children in the household not attending school and years of education of the household head) and three are dichotomous (having running water in the household, having proper sanitation and living in a house with non-precarious materials). When poverty measures other than the multidimensional headcount or the M_0 measure are estimated, equal weights assigns higher weight to the dichotomous variables than the continuous ones, because poverty gaps of all those that are poor are equal to 1. Applying measures that require cardinal data to a set of variables that include dichotomous ones is not technically correct. The only reason to do so is to obtain a rough sense of the depth and distribution of the deprivation in these dimensions. Also, when VP weights are used, the two variables that receive the highest weights (income and children in school) are continuous, shifting weight from dichotomous to cardinal variables, which lessens the problem.

5. Empirical results[29]

5.1 Deprivation rates by dimension

Figure 1 presents the deprivation rates for each dimension in each country and year, in rural and urban areas, except for Argentina and Uruguay where the rates correspond only to urban areas. Despite being a crude poverty measure, the headcount ratio for each dimension, country and year provides a preliminary picture of deprivation in the region. Comparing across countries and regions, one can distinguish two groups: the urban and rural areas of El Salvador, Mexico and Brazil together with the rural areas of Chile, and the urban areas of the southern cone countries – Argentina, Chile and Uruguay. The first group of countries and regions exhibit deprivation rates much higher than those in the second group, producing a sharp contrast. In particular, El Salvador is the country with the highest levels of deprivation in all dimensions. The deprivation rates in this country are high, not only in relative terms to those of the other countries, but also from an absolute point of view: in five out of the six indicators, the rural areas of the country presented deprivation rates of 50 per cent or higher in 2006. For most of the dimensions, deprivation headcounts in rural areas of El Salvador are followed by those of the rural areas of Brazil, Mexico and Chile, and then by the urban areas of El Salvador, Brazil and Mexico. Deprivation rates in the urban areas of Argentina, Chile and Uruguay are, for each dimension, well below those in the aforementioned regions. It is worth noting the disparities within countries between urban and rural areas: deprivation rates in rural areas are at least double urban deprivation rates. In Chile the difference is particularly marked, as if each of these areas – rural and urban – belonged to a different country.

Comparing across dimensions, three interesting features emerge. First, deprivations in the level of education of the household head and in sanitation are the dimensions with the highest headcount ratios in all six countries. They are extremely high in the rural areas of El Salvador, Brazil and Mexico where 70, 75 and 50 per cent of the population, respectively, lived in a household where the household head had less than 5 years of education in 2006 and 96, 80 and 68 per cent, respectively, lived in a household without access to proper sanitation facilities. Comparable deprivation rates in respective urban areas and in rural areas of Chile are between 22 and 45 per cent, whereas in the urban areas of Argentina, Chile and Uruguay they do not exceed 17 per cent. Second, in all countries, income deprivation lies in the middle of the rankings of deprivations, though rates vary significantly across countries (between 58 per

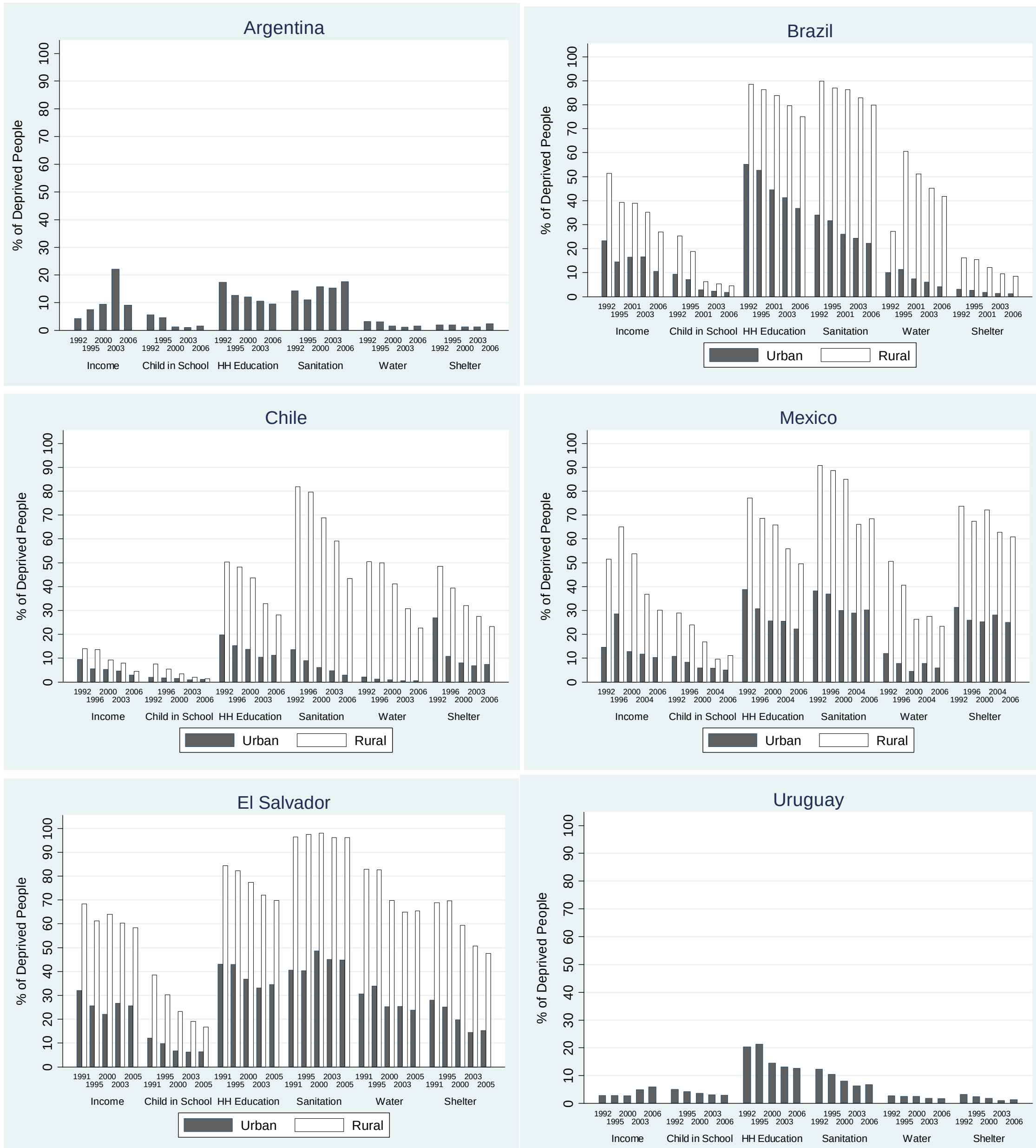
[29] Detailed and complete estimates of all measures, all k cut-offs and weights can be found in a companion document 'WP 17 Tables' (http://www.ophi.org.uk/pubs/ophi%20WP%2017%20Tables.pdf).

cent in rural El Salvador to 3 per cent in urban Chile). Finally, it is worth noting that, although deprivation in the education level of the household head is one of the most prevalent deprivations in all countries, the percentage of families with at least one child that is not attending school is among the lowest deprivation rates. This is somewhat encouraging. If these low rates were to be sustained or – even better – decreased, future heads of households will be more educated than their parents and educational deprivation will cease to be as severe as at present.

Temporal trends are also encouraging. In almost all cases, deprivation rates declined between 1992 and 2006 and in many cases they were halved. The few exceptions are Uruguay, where income poverty steadily increased throughout the period, and Argentina, where poverty headcounts in income, sanitation and shelter are somewhat higher in 2006 than fifteen years before.[30]

[30] The evolution of the income poverty headcount reflects the increase of income poverty that the country registered during the 1990s, and the abrupt increase in 2003 is a consequence of the crisis of 2001-2002. See Gasparini and Cruces (2008) for a detailed account of income distribution over this period in Argentina.

Figure 1: Deprivation Rates by Dimension
Rural and Urban Areas, 1992-2006



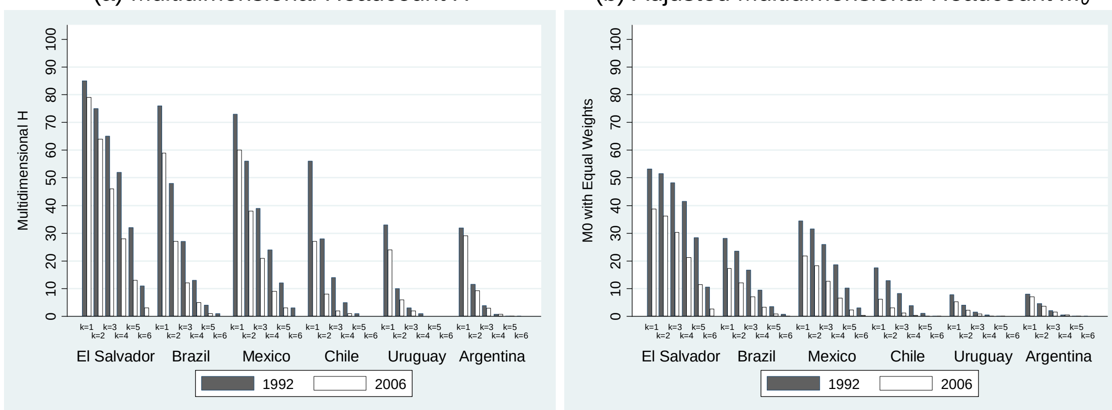
4.2. Multidimensional poverty: the multidimensional H and the M_0 measure

The Multidimensional Headcount *H* and the Adjusted Multidimensional Headcount M_0 measures were estimated for *k*=1,…6, using the two weighting structures detailed above. This section focuses on the most relevant points that can be derived from these results.

Figure 2 presents the multidimensional headcount (a) and adjusted headcount (b) for the different *k* values using equal weights in 1992 and 2006: the black bar corresponds to 1992, and the white one to 2006. The *H* measure is the one used by the UBN approach and indicates the percentage of people deprived in 1 or more dimensions (*k*=1), two or more (*k*=2), and so on. In the figure, countries are sorted according to their deprivation in 1992 when *k*=1. It is worth noting that the estimates in Argentina and Uruguay correspond only to urban areas.

Figure 2: Multidimensional Poverty for Different *k* Values and Equal Weights
1992 and 2006

(a) Multidimensional Headcount *H* (b) Adjusted Multidimensional Headcount M_0



Note: Estimates in Uruguay and Argentina correspond only to urban areas.

Among the countries for which data are available for both urban and rural areas, El Salvador is the poorest country, followed by Brazil, Mexico and then Chile. For *k*=1, Brazil has a higher H than Mexico in 1992, and about the same in 2006, but for higher *k* values, Mexico has much higher H. This suggests that deprivations in Mexico are more coupled than in Brazil: if one person fails to achieve an adequate level in a given indicator, it is more likely that she will also fall short in another indicator in Mexico than in Brazil.

Between 1992 and 2006, all countries reduced their multidimensional headcounts for all *k* values.[31] Most impressively, Chile halved its headcounts for all *k* values whereas El Salvador, Mexico and Brazil achieved this sort of reduction for higher *k* values ($k \geq 4$). In Argentina, the reduction in the multidimensional headcount was very mild and indicates that losses in some dimensions (such as income, shelter and sanitation) are being compensated by the gains in others (such as education and water)[32]

Using the adjusted headcount ratio M_0, a measure sensitive to the breadth of poverty shown in (b) of figure 2, the differences between El Salvador and the rest of the countries for which urban and rural data are available become sharper. Not only does it exhibit the highest multidimensional poverty levels, but it is also well above the estimates for the other countries, doubling or more the next highest estimate for all *k* values. Also, once the multidimensional headcount is adjusted it becomes more evident that Mexico is worse-off than Brazil; the average number of deprivations experienced by the poor in Mexico is higher relative to Brazil. In El Salvador, Mexico, Brazil and Chile, the declines in M_0 are larger in relative terms than those in *H*, most notably for lower values of *k*. The interpretation of this is that not only that there are fewer deprived people at the end of the period but also that those that are deprived, experience fewer deprivations on average. In urban Uruguay, the reduction of M_0 was very small and virtually nil for urban Argentina. All in all, this is a promising picture in terms of poverty for the countries considered and complements the declining trend in inequality documented by Gasparini et al. (2008) for most countries in Latin America over the same period. However, the international financial crisis of 2007–2008 and the

[31] In the case of Argentina and Uruguay this only applies to urban areas as we do not know the evolution in rural ones.
[32] All estimates were bootstrapped using 200 replications. Results of the bootstraps can be found in the companion document 'WP 17 Bootstrapped Estimates and Correlations' (http://www.ophi.org.uk/subindex.php?id=publications0).

ensuing fall in commodity prices of exports by countries in the region might hamper the falling trends in both poverty and inequality in the near future.

Figure 3: M_0 measure for different *k* values in 2006
Urban vs. rural areas

(a) Equal Weights (b) VP Weights

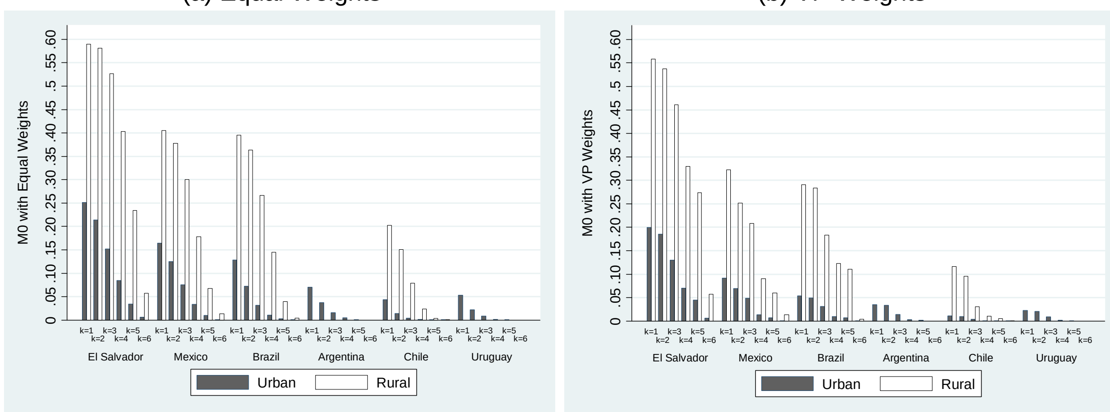


Figure 3 presents the most recent estimate of M_0 using equal weights in (a), and using VP weights in (b). Whenever possible, urban and rural estimates are presented. Not surprisingly, the rural estimates are at least twice the urban values, in all cases. One particularly important point to note from this figure is that in the urban areas of Argentina, Chile and Uruguay, both with equal and VP weights, the M_0 estimate becomes virtually 0 (less than 5 per cent) with $k \geq 2$. This is a consequence of both a small fraction of the population in the urban areas being deprived in two or more dimensions simultaneously and a relatively low average deprivation share among the poor.[33] However, this is not the case for the rural areas of Chile and both the urban and rural areas of Brazil, El Salvador and Mexico. For these countries and regions, the M_0 estimates become closer to zero only with much higher *k* values. Note, for example, that in the rural areas of El Salvador and Mexico, the M_0 estimates using equal weights become below 5 per cent only with the intersection approach at the identification step ($k=6$). This suggests a pattern in terms of coupled *versus* single deprivations in the analysed countries. In Brazil, Mexico, El Salvador and in the rural areas of Chile, if someone is deprived in one indicator, she is likely to be deprived in several other indicators at the same time, while if she lived in the urban areas of Argentina, Chile or Uruguay, she is likely to be deprived only in that single indicator. Moreover, within Brazil, El Salvador and Mexico, coupled deprivations are more likely in rural areas than in urban ones.

Finally, comparing the two weighting schemes, the M_0 estimates using the VP weights are smaller than those using equal weights. This is to be expected, since the requirement to be counted as poor is generally more demanding for a given *k* than with equal weighting – unless the person is deprived in the highest weighted dimensions (income and children in school), which is less likely as these are among the lowest deprivation counts.[34] Assuming the participatory study from which these weights were derived is representative of the poor in Latin America, the estimates suggest that when dimensions are weighted according to the value ranking the poor assign, multidimensional poverty is lower. They care more about having enough income and their children in school, which have relatively lower deprivation rates, than

[33] Indeed, with equal weights for example, the multidimensional headcount with k=2 in 2006 is 10 per cent in Argentina, 8 per cent in Chile and 6 per cent in Uruguay, whereas the average deprivation share is about 0.38 in the three countries (2.3 dimensions). This can be verified in panel (a) of figure 2.

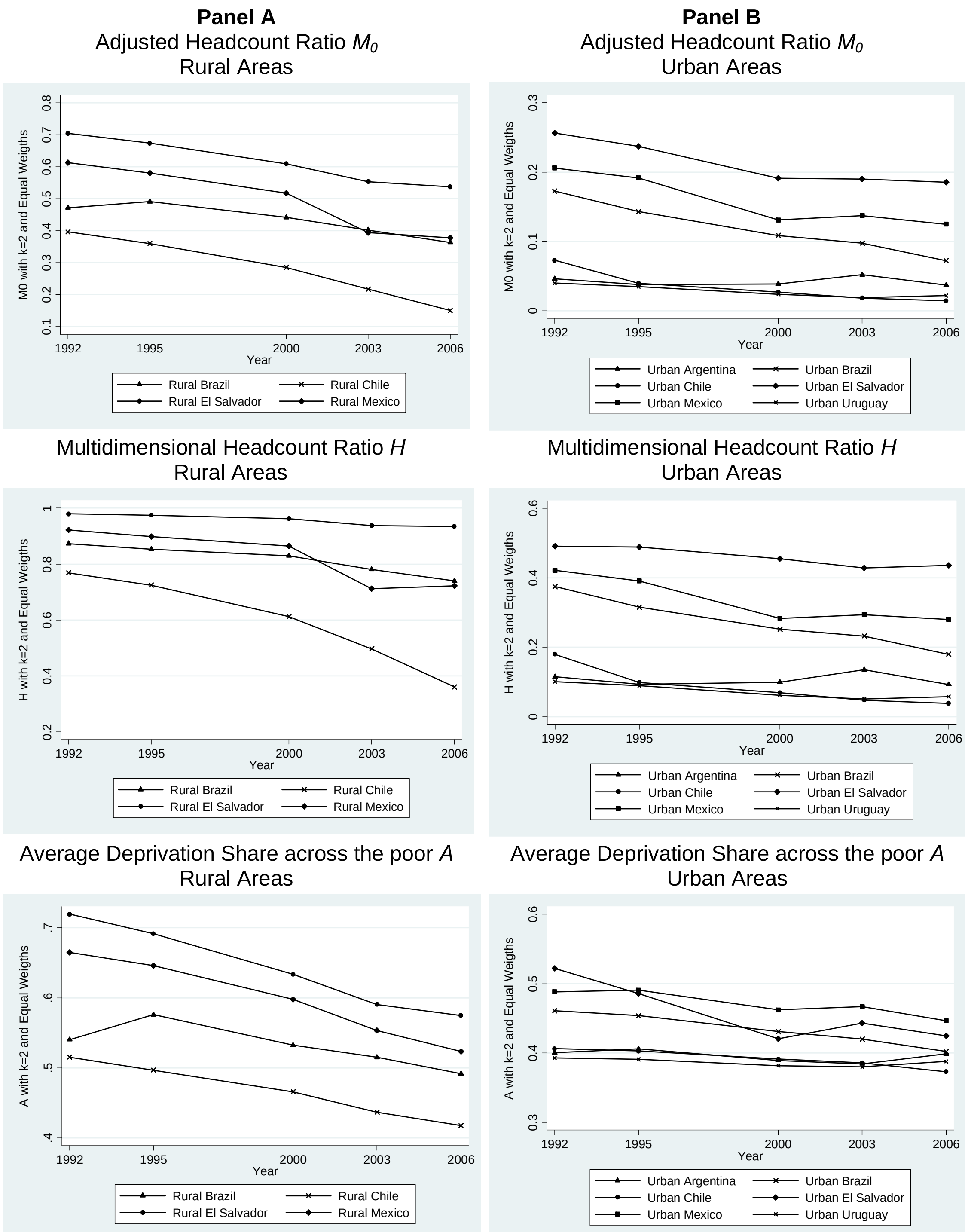
[34] For example, when VP weights are used and the cut-off is $k=1$, someone living in a household deprived either in income or having children that do not go to school would be considered poor. However, someone with a household head with a low level of education and without access to sanitation would not be identified as poor, since the sum of weights is lower than 1.

having access to sanitation and a household head with five or more year of education, which have relatively higher deprivation rates.

As explained in Section 3 above, the M_0 measure is the product of two informative measures: the multidimensional headcount ratio H and the average deprivation share across the poor A. The evolution of M_0 together with its two components H and A over the study period is presented in figure 4 for the case of k=2 and equal weights. Figure 4 panel A refers to rural areas of Brazil, Chile, El Salvador and Mexico, while panel B refers to urban areas of these countries together with Argentina and Uruguay. k=2 is chosen because it is the minimum k that requires an individual to be deprived in more than one dimension so as to be considered poor (i.e. it is 'truly' *multidimensional*) and at the same time it is meaningful for all countries (for higher k values the aggregate M_0 estimate becomes virtually zero in the urban areas of Chile, Argentina and Uruguay).

Figure 4 shows clearly the different patterns of evolution of multidimensional poverty in rural and urban areas of the six countries. Both in the urban and rural areas of Brazil, Chile, El Salvador and Mexico, the reduction in M_0 was the result not only of reductions in the percentage of people deprived in two or more dimensions, but also of the fact that, on average, they became poor in fewer dimensions. However, the proportional reductions in each of the components of M_0 differed. In both the rural and urban areas of Chile and Brazil, as well as in the urban areas of Mexico, the reduction in the percentage of the poor was relatively larger than the reduction in the average deprivation, especially in Chile. On the contrary, in both the rural and urban areas of El Salvador the proportional reduction in A was larger than that of H, while in rural Mexico, both the percentage of the poor and the average deprivation were reduced in similar proportions. In urban Uruguay there was a very small reduction of M_0 led by a reduction in H; whereas in urban Argentina estimates of M_0, H and A did not change significantly over the study period.

Figure 4: Evolution Over Time of M_0 and its Components with k=2 and Equal Weights

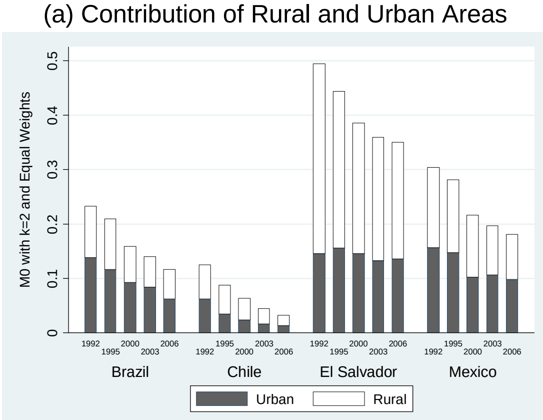


The last figure of this section shows the relative contribution of urban *versus* rural areas to the aggregate M_0 estimates using k=2 and equal weights. Panel (a) of figure 5 presents the contribution of each of them to the aggregate M_0 estimates. The height of each bar corresponds to the aggregate estimate, and the shaded regions to the relative contributions. To complement this graph, panel (b) presents the actual M_0 estimates in each sector and panel (c) the evolution of the share of urban population over time in each of the countries that have data for both urban and rural areas.

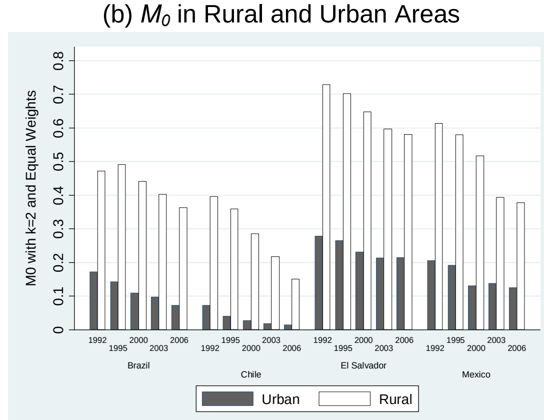
In the urban-rural contributions to aggregate poverty, the population weight of urban areas plays a significant role. In Brazil, Chile and Mexico in 1992, although the M_0 estimate in rural areas was three or more times that in urban areas, urban poverty accounted for 47 per cent or more of overall poverty because the urban population share was 76 per cent or higher in the three countries. Over the study period, the contribution of urban areas to overall poverty decreased by 8 percentage points in Brazil (to 51 per cent) and by 6 percentage points in Chile (to 41 per cent) because, although the urban population share increased, the poverty reduction achieved in urban areas was larger than that achieved in rural ones. In contrast, the urban contribution to overall poverty increased in Mexico by 4 percentage points: a combination of the increase in the share of urban population and a reduction in multidimensional poverty that was more similar in rural than in urban areas. The only case in which the urban contribution to overall poverty was low (only 28 per cent) in 1992 was El Salvador because multidimensional poverty in rural areas was two an a half times that of urban areas and also because the urban population share was only 52 per cent. Over the period, the contribution of urban areas to aggregate M_0 in the country increased to 37 per cent, given that the share of urban population increased to 63 per cent and the reduction in M_0 in rural areas was similar to that in urban areas.

Figure 5: Evolution of Multidimensional Poverty – M_0 with k=2 and Equal Weights
Rural and Urban Areas, 1992–2006

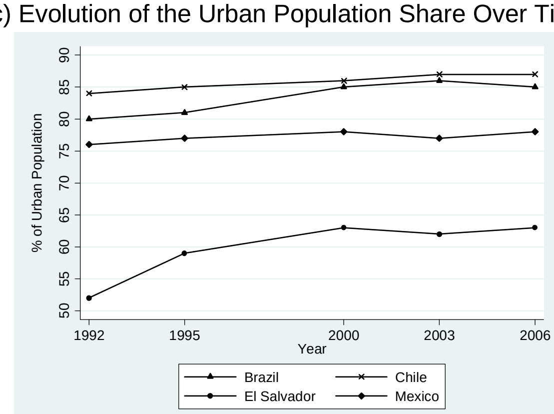
(a) Contribution of Rural and Urban Areas



(b) M_0 in Rural and Urban Areas



(c) Evolution of the Urban Population Share Over Time



5.4 Multidimensional poverty: BC family of measures, M1 and M2

Figures 6 and 7 present the BC estimates for each country and each year, with $\alpha = 1$ and $\alpha = 2$ respectively. They also contain the contribution of urban and rural areas to the overall estimate.[35] The first group of bars in each graph of figure 6 coincides with the M_1 measure of AF with *k*=1, in which dimensions are considered to be independent; the next two groups correspond to the cases of $(\alpha = 1, \theta = 2)$ and $(\alpha = 1, \theta = 3)$, which imply that dimensions are considered as complements. In figure 7, the first group of bars corresponds to the combination of $(\alpha = 2, \theta = 1)$, meaning that dimensions are considered substitutes, the second group of bars corresponds to the case of $(\alpha = 2, \theta = 2)$, which is the M_2 measure of AF with *k*=1, and dimensions are considered independent, and finally the third group of bars corresponds to the case of $(\alpha = 2, \theta = 3)$, with dimensions considered as complements. In all the figures, results correspond to the equal weights case.[36]

For a given value of θ, the estimates of poverty are lower as α increases, which is what happens with the FGT indices as the parameter of the aversion to poverty is increased. At the same time, for a given value of α, the estimates of poverty are higher as θ increases, as the lower elasticity of substitution, the higher the weight given in the aggregation to larger gaps.

For each country over time and across countries, the same pattern is found across the different values of α and θ. For all combinations of parameters among countries with information on both urban and rural areas, El Salvador, Mexico and Brazil are the countries with the highest levels of multidimensional poverty, while Chile is the lowest. In terms of evolution over time, El Salvador, Mexico, Brazil and Chile experienced important decreases in the levels of multidimensional poverty for all combinations of parameters. Urban Uruguay experienced a small reduction in multidimensional poverty, which was already at low levels at the beginning of the period, while urban Argentina's estimates remained stable over the study period. (The same patterns are found with $\alpha = 3$ and when VP weights are used, and are also coincident to those analyzed with the M_0 measure.) This means that both the reduction of multidimensional poverty found in Brazil, Chile, El Salvador, Mexico and urban Uruguay, as well as the stagnation found in urban Argentina are robust to the values of the parameters regarding poverty aversion. Moreover, the results are robust to alternative assumptions regarding the relationship between the dimensions (substitutability/complementarity/independence). Also, given that both AF and BC families of measures satisfy monotonicity for $\alpha > 0$, and transfer for $\alpha > 1$, these results suggest that in El Salvador, Mexico, Brazil, Chile and urban Uruguay, multidimensional poverty decreased not only in incidence but also in depth and severity.

[35] Note that the BC indices with α=0 coincide with the multidimensional headcount for *k*=1 already reported in figure 3.

[36] When VP weights are used, the estimates with each combination of (α, θ) are lower. This is because weight is shifted from the dichotomous variables to the two continuous variables that receive the highest weights (income and children in school), which are not the ones with the highest deprivation rates. These results can be found in a companion document 'WP 17 Tables' (http://www.ophi.org.uk/pubs/ophi%20WP%2017%20Tables.pdf).

Figure 6: Evolution of BC Estimates with α=1 and θ=1,2,3 and Equal Weights
Urban and Rural Contributions

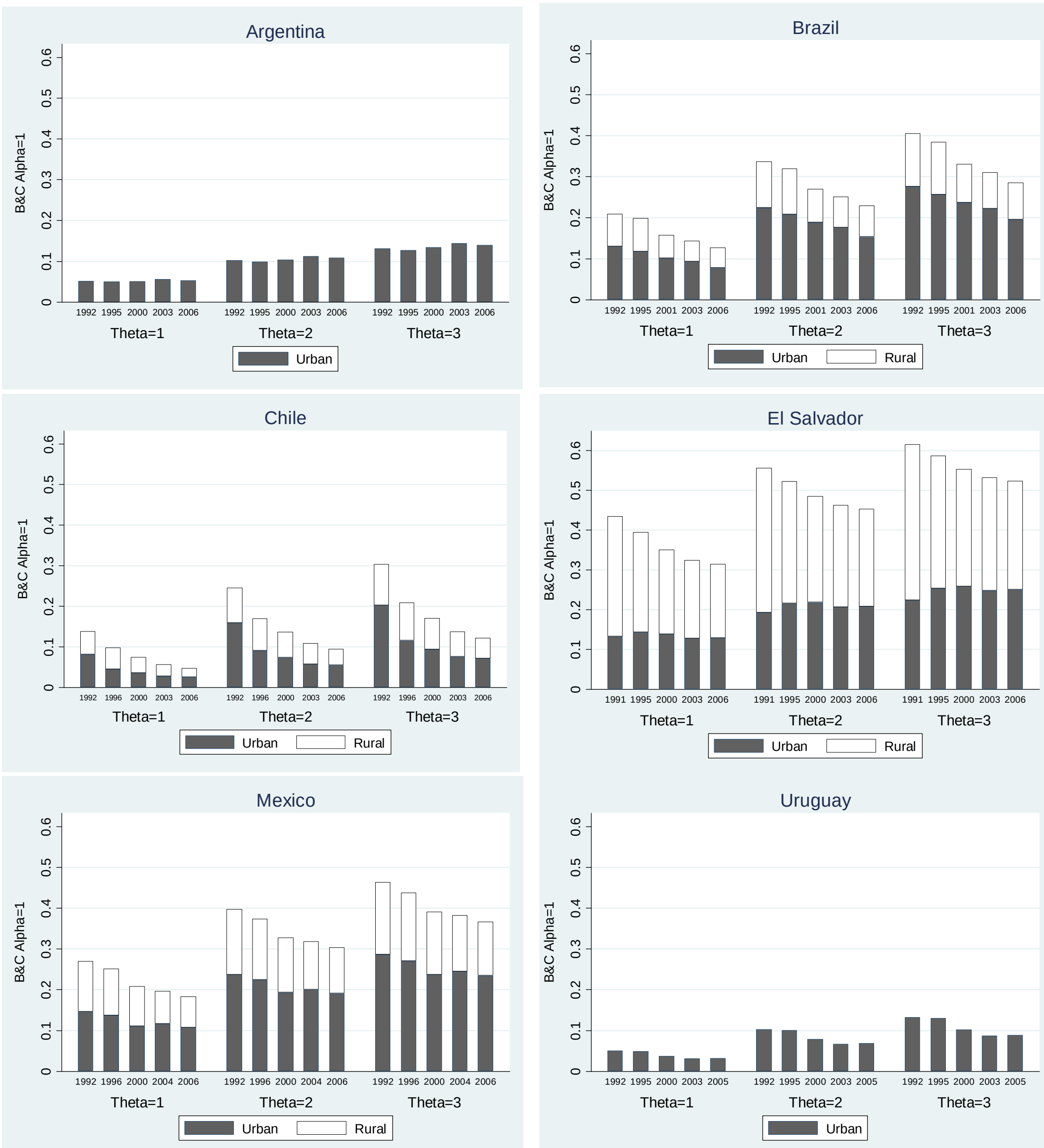
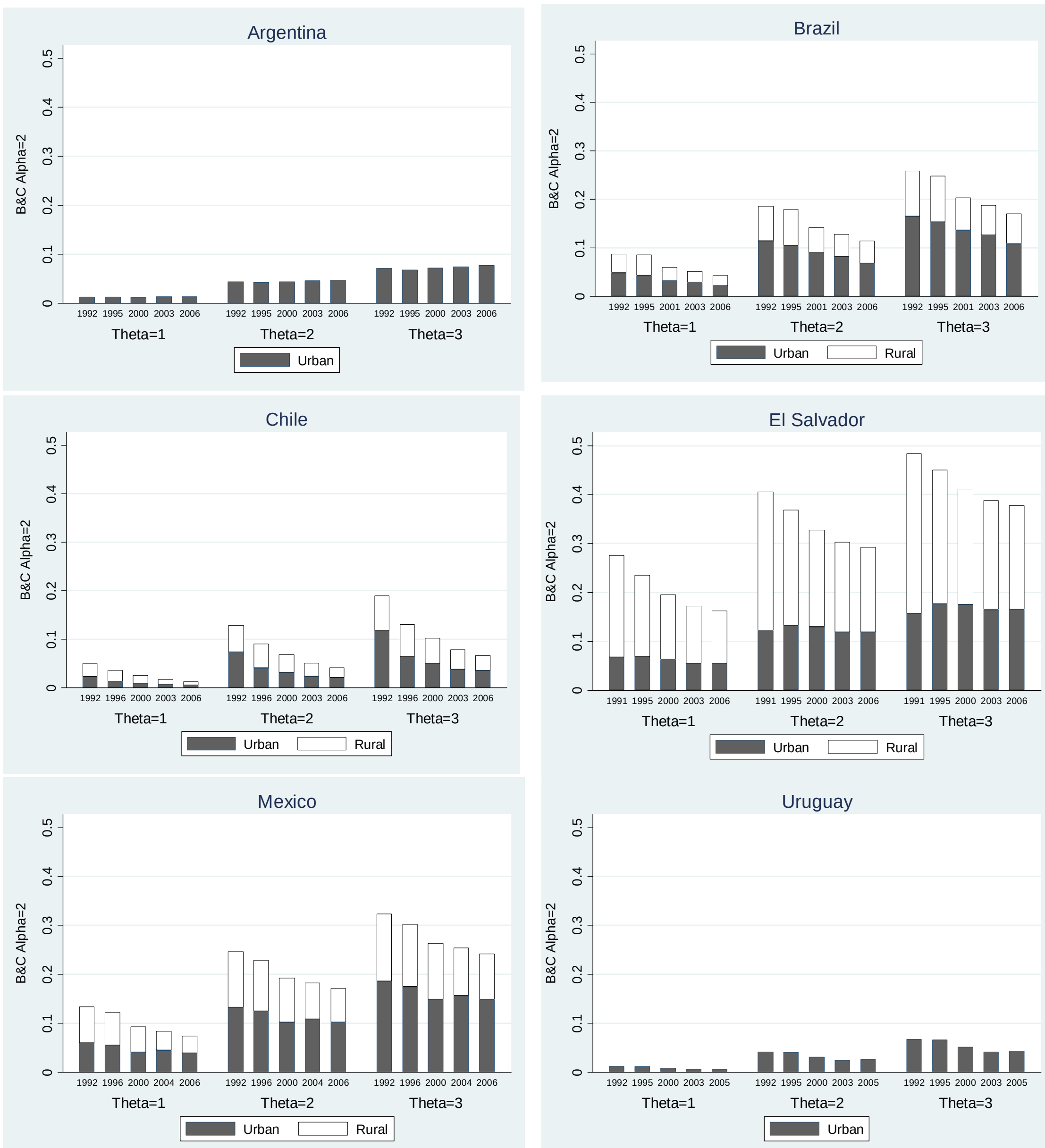


Figure 7: Evolution of BC estimates with α=2, θ=1,2,3 and Equal Weights
Urban and Rural Contributions



Given that results do not differ whether dimensions are assumed to be substitutes, complements or independent, it is not possible to determine whether association across dimensions increased, decreased or did not change. However, to gain a sense about the association between dimensions, one can look at the Spearman rank correlation coefficient between dimensions. Table 2 presents these coefficients for each country, at the beginning and at the ending point of the study period. In the first place, it can be seen that correlation coefficients are sufficiently low so as to motivate multidimensional approaches to the study of poverty. The two pairs of variables that tend to have the highest correlations are sanitation and water (with the highest value being 0.67 in 1992 in El Salvador), and income and education of the household head (with the highest value being 0.50 in 2006 in Mexico). Interestingly, in Brazil, Chile, El

Salvador, Mexico and Uruguay, most correlation coefficients decreased over the study period. Argentina is the only country in which most correlations increased.[37]

Table 2: Spearman Rank Correlation Coefficient between dimensions 1992 and 2006

Country	**Dimension**	**Income**		**Child School**		**Educ. HH**		**Water**		**Sanitation**	
		1992	2006	1992	2006	1992	2006	1992	2006	1992	2006
	Income	1	1								
	Child School	0.19	0.21	1	1						
Argentina	**Educ. HH**	0.37	0.41	0.03	0.05	1	1				
	Water	0.16	0.09	0.05	0.02	0.14	0.06	1	1		
	Sanitation	0.27	0.31	0.06	0.10	0.23	0.24	0.39	0.25	1	1
	Shelter	0.12	0.16	*0.01*	0.02	0.10	0.12	0.11	0.14	0.20	0.23
	Income	1	1								
	Child School	0.22	0.19	1	1						
	Educ. HH	0.43	0.39	0.13	0.05	1	1				
Brazil	**Water**	0.29	0.25	0.10	0.07	0.26	0.27	1	1		
	Sanitation	0.39	0.30	0.13	0.07	0.39	0.32	0.33	0.38	1	1
	Shelter	0.18	0.13	0.07	0.03	0.18	0.12	0.23	0.24	0.21	0.15
	Income	1	1								
	Child School	0.17	0.15	1	1						
	Educ. HH	0.20	0.29	0.02	-0.04	1	1				
Chile	**Water**	0.16	0.07	0.06	*0*	0.30	0.19	1	1		
	Sanitation	0.28	0.20	0.05	0.01	0.37	0.28	0.56	0.47	1	1
	Shelter	0.18	0.12	0.02	-0.01	0.18	0.16	0.25	0.14	0.31	0.28
	Income	1	1								
	Child School	0.23	0.21	1	1						
El Salvador*	**Educ. HH**	0.41	0.40	0.17	0.10	1	1				
	Water	0.40	0.31	0.19	0.09	0.41	0.24	1	1		
	Sanitation	0.46	0.41	0.18	0.11	0.47	0.41	0.67	0.46	1	1
	Shelter	0.35	0.30	0.13	0.09	0.33	0.28	0.38	0.30	0.45	0.35
	Income	1	1								
	Child School	0.21	0.15	1	1						
	Educ. HH	0.46	0.50	0.16	0.08	1	1				
Mexico	**Water**	0.30	0.24	0.09	0.06	0.26	0.22	1	1		
	Sanitation	0.44	0.47	0.14	0.11	0.44	0.43	0.45	0.37	1	1
	Shelter	0.34	0.36	0.11	0.07	0.35	0.37	0.35	0.31	0.48	0.49
	Income	1	1								
	Child School	0.22	0.23	1	1						
	Educ. HH	0.31	0.41	-0.02	0	1	1				
Uruguay*	**Water**	0.13	0.09	0.03	0.01	0.05	0.07	1	1		
	Sanitation	0.35	0.27	0.10	0.08	0.21	0.18	0.27	0.25	1	1
	Shelter	0.10	0.06	*0.01*	*-0.01*	0.06	0.04	*0*	*0*	0.13	0.04

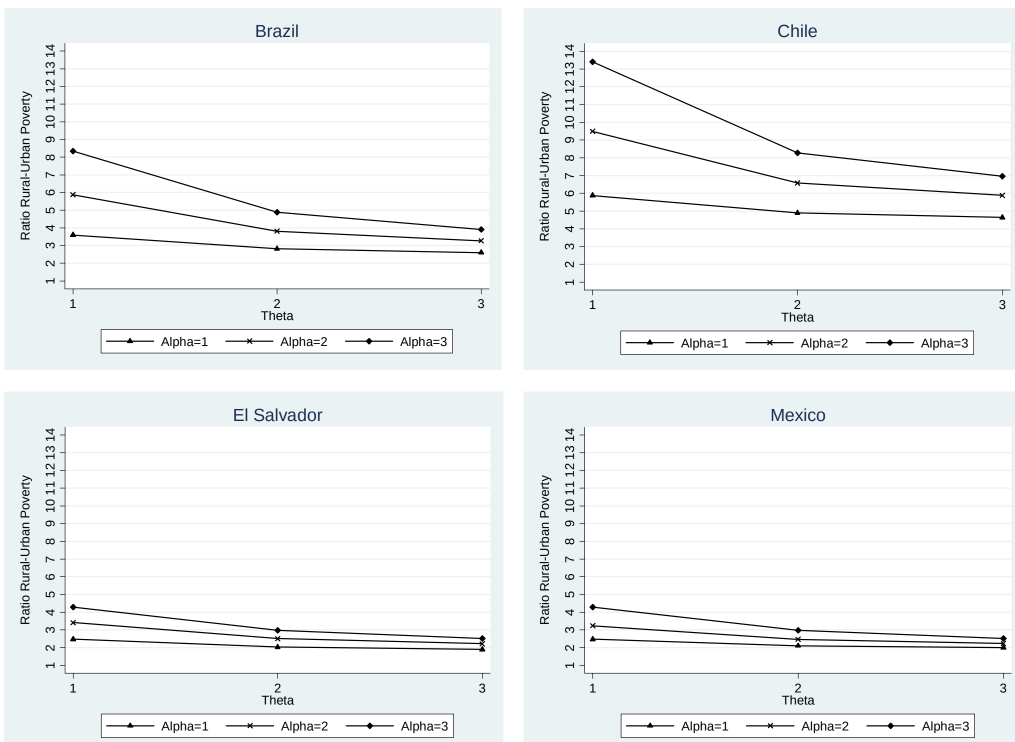
*For these countries, the estimated correlations reported in the column titled '2006' actually correspond to the year 2005. Also, for El Salvador, the estimates reported in the column titled 1992, actually correspond to the year 1991. Correlations refer to all the sampled population in each country and not merely the poor. All correlations are significant at the 5% level (most at the 1% level) except for those marked in italics.

In terms of urban *versus* rural contribution to the aggregate BC estimates, results are similar to those analysed for the case of M_0.: significantly higher estimates of poverty in rural areas than in urban ones, but higher contribution of urban poverty to overall poverty due to a higher population share of urban

[37] To calculate the correlations households with no children were assigned a value of 1 for children attending school (as it was done when calculating the poverty estimates, ie. this households are considered non-deprived in this indicator). Water, sanitation and shelter (non-precarious materials) take a value of 1 if the household has access to the thresholds defined in Table 1 and 0 otherwise. Income takes the household per capita income while education of the household head corresponds to his/her number of the years of education. An alternative set of correlations was calculated eliminating the households with no children from the sample. For full correlation results see the companion document 'WP 17 Bootstrapped Estimates and Correlations' (http://www.ophi.org.uk/subindex.php?id=publications0).

areas, except for El Salvador. A detailed observation of figures 6 and 7 reveals that the urban contribution to overall poverty changes as the parameters change: for a certain year and α value, the contribution is increasing in θ, while for a given θ, it is decreasing in α. The reason behind this is how the rural poverty estimate compares to the urban one as the parameters change. Figure 8 depicts the ratio of rural to urban poverty for the year 2006 in each country as the two parameters α and *θ* change. It can be seen that for a given value of α, the ratio rural-urban poverty is decreasing in *θ*, whereas for a given value of *θ*, it is increasing in α. A higher value of α gives a higher weight to the multidimensionally poorest individuals whereas a higher value of *θ* gives a higher weight to the biggest gaps. These results suggest that more people in rural areas suffer from coupled deprivations, so that as α is increased, they receive a higher weight and the difference with poverty in urban areas increases more and more. While people in urban areas experience fewer simultaneous deprivations than in rural areas, they suffer from poverty gaps at least as big as those in rural areas. Then, when the poorest gaps receive an increasing weight as *θ* increases, the difference between poverty in rural and urban areas is reduced.

Figure 8: Ratio of Rural Poverty to Urban Poverty BC Estimates with α=1,2,3, θ=1,2,3 and Equal Weights, 2006



5.4 Decomposition by dimensions

As detailed in section 3, one of the advantages of the AF family of measures is that, once the multidimensionally poor have been identified, it allows aggregate multidimensional poverty to be broken down into each dimension's contribution. This provides additional information which has the potential to guide policy towards poverty reduction. Figure 10 presents this decomposition of M_0 with k=2 and equal weights. Panel (a) shows this for aggregate poverty estimates of each country in each year; panel (b) for urban areas of the countries, which in the case of Argentina and Uruguay are the same as the aggregate estimates; panel (c) presents the decomposition in rural areas for Brazil, Chile, El Salvador and Mexico. By definition, as k increases and equal weights are used, the contribution of dimensions tends to equalize (so that each dimension contributes with 1/d). In this case the value k=2 is selected to perform this analysis since this was the *k* value used to compare across countries and over time. Also, the analysis is conducted with equal weights since the contribution of each dimension to overall poverty when VP weights are used is influenced by them so, for example, income would naturally have a greater contribution since it has a greater weight.

For Argentina and Uruguay, the aggregate estimates are actually only urban estimates. The relative contribution of dimensions in these two countries, and its change over time is fairly similar. In 1992, deprivation in sanitation and in the education of the household head accounted for about 33 per cent and 36 per cent of overall poverty, respectively. These were followed by deprivation in the other dimensions, with much lower contributions. Income deprivation, in particular, contributed with 10 per cent in both countries. By 2006 however, the contribution of sanitation and education of the household head remained at the top although with lower contributions, while the contribution of income deprivation increased to about 24 per cent in both countries, with reductions in the contributions of the other dimensions.

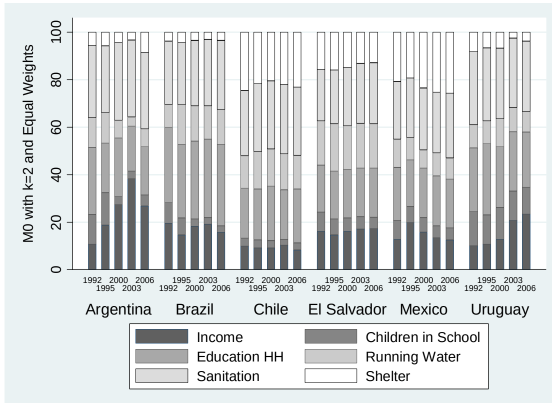
The relative contributions of dimensions in Brazil did not change significantly between 1992 and 2006. Deprivation in education of the household head, sanitation and income are in that order – the three main contributors. Comparing the poverty composition in rural and urban areas (panels b and c in figure 10), one can see that there are some differences, especially in 2006. In particular, in rural areas the contribution of deprivation in water is more than twice that in urban areas, and the contribution of deprivation in shelter is about one and a half times that of urban areas. The higher contribution of these dimensions in rural areas is compensated by the lower contribution of the others.

In the case of Chile, the three main contributors to overall poverty over the period are deprivation in sanitation, shelter and education of the household head. Comparing between regions, one can see that in rural areas, the contribution of deprivation in sanitation and running water is about one and a half, and three and a half times that in urban areas, respectively. On the other hand, in urban areas the contribution of deprivation in shelter is about one and a half times that in rural ones. The contribution of deprivation in income in urban areas is three and a half times that in rural ones and the contribution of deprivation in children attending school in urban areas is four and a half times that in rural ones.

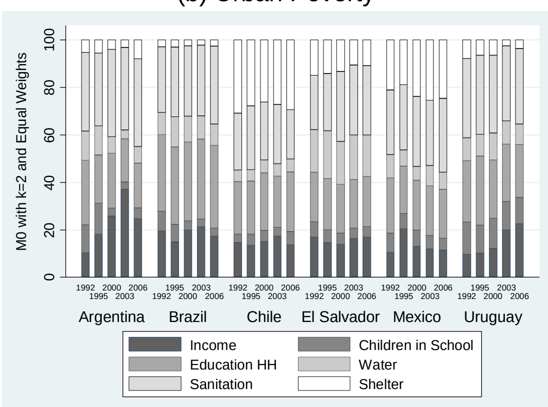
As in Chile, deprivation in sanitation, shelter and education of the household head account for most of overall poverty in Mexico, and this did not change significantly over the study period. Rural and urban areas do not present very different patterns. Finally, in El Salvador, the contribution of deprivation in the different dimensions is more equal than in the other countries, except for the contribution of deprivation in children attending school which was 5 per cent in 2006, all the other dimensions have two digits percentage contributions. This remained quite stable over the study period. In a way, this suggests that all dimensions are equal priorities to achieve poverty reductions. As in Mexico, there are no significant differences between urban and rural areas.

Figure 9: Contribution of Deprivation in Each Dimension to Overall M_0 with k=2 and Equal Weights
Aggregate, Urban and Rural Estimates, 1992–2006

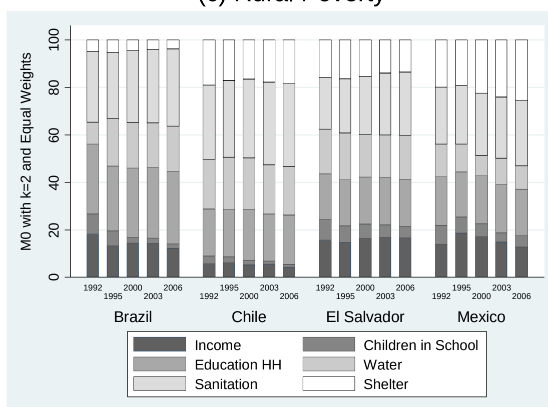
(a) Aggregate



(b) Urban Poverty



(c) Rural Poverty



6. Concluding Remarks

This paper provides an in-depth study of multidimensional poverty in Argentina, Brazil, Chile, El Salvador, Mexico and Uruguay for the period 1992–2006. A hybrid approach is used in terms of the selected dimensions. They include the widely used income dimension (using the US$2 per day), together with four dimensions typically considered in the Unsatisfied Basic Needs Approach: education of the household head (at least five years of education), children attending school, access to improved sanitation and shelter with adequate wall materials. Access to running water is also included, considered to be the best available proxy for health.

A broad set of measures is estimated, ranging from simple headcounts by dimension and the multidimensional headcount with different deprivation cut-offs (as typically used by the UBN approach), to more sophisticated ones which correspond to two multidimensional versions of the FGT class of poverty indices. One of these extensions corresponds to Alkire and Foster (2007) (AF) which, by assuming that dimensions are independent, allows the measure to be broken down into the contributions of each dimension (once identification has been applied). The other extension corresponds to Bourguignon and Chakravarty (2003) (BC), which allows for interrelationships between the dimensions. All estimations were performed for two alternative weighting systems: one in which each indicator receives the same weight, and another derived from a participatory study performed in Mexico, where the income and children in school indicators receive the highest weights (VP weights).

The data available for Brazil, Chile, El Salvador and Mexico allows urban areas to be distinguished from rural areas. Among these four countries, El Salvador is the poorest, followed by Mexico and Brazil, while Chile is the least multidimensionally poor. The possibility to distinguish between areas allows the huge disparities within countries to be identified, to the point that rural areas of Chile can be grouped together with El Salvador, Mexico and Brazil in terms of their poverty estimates and the degree of coupled deprivations, while the urban areas of Chile have poverty levels similar to those of urban Argentina and Uruguay. In El Salvador, Mexico and Brazil, higher poverty and more coupled disadvantages are found in the rural areas as compared to the urban ones.

Over the study period, El Salvador, Brazil, Mexico and Chile experienced significant reductions of multidimensional poverty independently of the measure considered. This is a robust result, and suggests that in these countries, not only was there a decrease in the incidence of multidimensional poverty, but also in its depth and severity. An analysis of the components of M_0 also showed that the average number of deprivations among those multidimensionally deprived decreased in the four countries over the study period. In contrast, in urban Uruguay there was a small reduction in multidimensional poverty, while in urban Argentina the estimates did not change significantly. Also contrasting with the other four countries, both Uruguay and Argentina experienced an important increase in income poverty between 1992 and 2006. However, because of the reduction of deprivation in other dimensions, this worsening did not translate to an increase in multidimensional poverty. When VP weights are used, the estimates for all countries, independently of the index used are lower, because the two dimensions that have the highest weight (income and children in school) are not those that show the highest levels of deprivation. These weights do not change significantly the conclusions regarding cross-country and over-time comparisons.

The decomposition of the multidimensional poverty measure M_0 into the contributions of each dimension, as well as the deprivation rates by dimension, suggest that increasing access to proper sanitation (either flush toilet or pit latrine) as well as improving education of the household head (intrinsically valuable and also instrumentally important as a mean to access a better income) should be priorities in all countries. These two dimensions are the highest contributors to overall multidimensional poverty, accounting for 20 to 30 per cent of overall poverty. Other big contributors to multidimensional deprivation are income in Argentina, Uruguay and Brazil (especially rural areas), and shelter in Chile and Mexico. Finally, deprivation in children attending school is among the lowest contributors in all countries, which results from the high enrolment rates observed in the region. This may imply that future generations will enjoy better educated household heads. Differing from the other countries, in El Salvador the contributions of the different dimensions are more balanced. It therefore seems reasonable to suggest that in this country all dimensions should be targeted in a poverty-reduction policy.

In summary, the overall picture from these six Latin American countries seems encouraging, with a decreasing trend in aggregate multidimensional poverty and in the deprivation in the underlying dimensions over the 1990s and the first half of the 2000s. On the other hand, the international financial crisis of 2007–2008 and the ensuing fall in prices of commodities exported by countries in the region might hamper the declining trends in both poverty and inequality in the near future.

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Appendix

Table A.1: Sample Size for each country and year, rural and urban areas

Country	Household Survey	Year	Sample Size (People)	
			Urban	Rural
Argentina*	Encuesta Permanente de Hogares (EPH)	1992	59,528	NA
		1995	62,372	NA
		2000	43,255	NA
		2003	29,075	NA
	Encuesta Permanente de Hogares Continua (EPH-C)	2006	45,676	NA
Brazil	Pesquisa Nacional por Amostra de Domicilios (PNAD)	1992	244,473	55,544
		1995	266,287	57,859
		2001	316,860	52,753
		2003	322,839	53,932
		2006	337,509	65,372
Chile	Encuesta de Caracterizacion Socioeconomica Nacional (CASEN)	1992	86,179	46,698
		1996	94,925	32,500
		2000	142,029	89,441
		2003	150,156	80,411
		2005	153,234	86,058
El Salvador	Encuesta de Hogares de Propositos Multiples (EHPM)	1991	49,243	39,235
		1995	20,989	18,009
		2000	40,940	29,843
		2003	35,622	35,708
		2005	34,127	35,517
Mexico	Encuesta Nacional de Ingresos y Gastos de los Hogares (ENIGH)	1992	27,913	20,265
		1996	39,974	21,840
		2000	26,402	13,989
		2004	68,016	21,907
		2006	58,760	23,140
Uruguay	Encuesta Continua de Hogares (ECH)	1992	28,658	NA
		1995	64,177	NA
		2000	51,913	NA
		2003	54,750	NA
		2005	53,738	NA

*For the sake of comparability over time, the samples used correspond to the same 15 urban agglomerations.