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The Colombian Multidimensional Poverty Index: Measuring Poverty in a Public Policy Context

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Abstract Previous multidimensional indices for the Colombian context, such as the Unmet Basic Needs Index or the Living Conditions Index, have lost their public policy relevance and arguably have become poor instruments for poverty measurement. This paper presents the Colombian Multidimensional Poverty Index (CMPI), a synthetic indicator that overcomes the methodological problems from previous multidimensional indices and has a broad public policy scope of use. The CMPI is based on the methodology of Alkire and Foster (J Public Econ 95:476–478, 2011a) and is composed of five dimensions (education of household members, childhood and youth conditions, health, employment and access to household utilities and living conditions). Additionally, it uses a nested weighting structure, where each dimension is equally weighted, as is each indicator within each dimension. This paper proposes the CMPI for tracking multiple deprivations across the national territory, to monitor public policies by sector and to design poverty reduction goals, among other public policy uses. Analysis of the results demonstrates that multidimensional poverty in Colombia decreased between 1997 and 2010 in both urban and rural areas, but imbalances remain.

Keywords Multidimensional poverty · Colombia · Alkire and Foster measures · Deprivation · Urban and rural differences

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1 Introduction

Several countries in the developing world have started to move away from relying solely on unidimensional measures of poverty based on income or consumption. They are now complementing these indicators with multidimensional indices that also capture households' achievements in a range of areas relating to non-tradable goods.

Since the end of the 1980s, many countries, such as those in Latin America, have used the Unmet Basic Needs Index (UBN), developed by the Economic Commission for Latin American Countries (ECLAC) specifically to measure multidimensional poverty. The UBN is a composite index comprising ordinal indicators on households' living conditions, such as housing materials, access to public services, critical overcrowding, economic dependency and school attendance. It identifies households with unmet basic needs as those deprived in at least one indicator (Muñoz 1995; PNUD et al. 1987). Other multidimensional indices proposed by supranational organizations have also been widely discussed and disseminated among academics and policy-makers across the region. This is the case with the World Bank's recent Human Opportunities Index (HOI), as well as the Human Development Index (HDI) and the global Multidimensional Poverty Index (MPI), both launched by the United Nations Development Programme (UNDP).

In particular, the Colombian government has made substantial advances in this area by implementing and using multidimensional indices proposed by supranational organizations, such the UBN, the HDI or the Colombian HOI (Vélez et al. 2010). In addition, Colombia has developed its own multidimensional indices, such as the Living Conditions Index (LCI) and the index used for targeting social programs, SISBEN. The LCI measures households' living standards in regards to access to services, human capital, demographic conditions and housing materials, and it uses a principal component methodology (Cortés et al. 1999a, b; González and Sarmiento 1998). The SISBEN, on the other hand, is an index used to target potential beneficiaries of social programs. Its name, SISBEN, corresponds to its acronym in Spanish: *Sistema de Identificación de Potenciales Beneficiarios de Programas Sociales*. The SISBEN has had three versions. Its latter version corresponds to a living standards index that uses the fuzzy sets method to estimate a household score that varies between 0 and 100, with the poor having lower scores. The cut-off points, differentiated for each social program, are defined based on the objectives and characteristics of the population they serve (Castano et al. 1999; Cortés et al. 1999b; Florez et al. 2011).

However, these existing Colombian multidimensional indices have proved been not entirely satisfactory. On one side, none of them satisfy a set of properties necessary for consistent profiles of measured poverty, as proposed by the axiomatic approach defined by Sen (1976). For example, a multidimensional poverty measure should capture welfare losses that result when poor households face greater deprivations. Nevertheless, the Unmet Basic Needs measure does not change if a poor household increases its number of deprivations. In addition, a poverty measure should only reflect improvements among the universe of poor people, a property that the Living Conditions Index fails to fulfil, as it is sensitive to changes in the living conditions of the non-poor. On the other side, there are problems with their content as well, so they are arguably becoming poor instruments for poverty measurement in the Colombian context.

These limitations, together with the need of a multidimensional poverty measure able to capture the actual living conditions in Colombia and the effect of public policies on the reduction of poverty, motivated the Colombian National Planning Department to design an

improved multidimensional poverty index.[1] In this context, this paper presents the proposed Colombian Multidimensional Poverty Index, henceforth CMPI.

The CMPI embodies a standard of living notion that considers household deprivations as constitutive elements to describe the lack of a minimum standard of living. It includes, among others, dimensions regarding early childhood and youth conditions, access to health services and labour conditions, quality of life descriptors that had not been included in previous multidimensional indices. The dimensions and indicators that the CMPI includes summarize the social policy priorities of the government that are based on national social agreements. The CMPI uses the multidimensional poverty measurement methodology proposed by Alkire and Foster (2011a) and, hence, identifies as multidimensionally poor, households that experience a greater number of considered deprivations.

In general, when multidimensional approaches are used to measure poverty, questions arise about which evaluative space should be used, the dimensions and indicators to be considered within such space, the procedures to be used for aggregating indicators and individuals, the unit of analysis and the identification of the poor. In the case of the CMPI, most of the answers to those questions rely on value judgements based on social agreements. In particular, Sect. 2 of this paper carefully describes the criteria used to answer those questions in order to design this multidimensional poverty index for the Colombian case. We present the key results obtained from the Index in terms of trends of poverty rates within the whole country, across urban and rural areas and in comparison to income and subjective poverty (Sect. 3). We also outline public policy applications for our proposed CMPI (Sect. 4) and possible further developments for the CMPI (Sect. 5). We finalize this paper by presenting some concluding remarks.

It is worth highlighting that at the time of this paper's development, the CMPI was being used as public policy tool in the Colombian context to track deprivations across the country, to monitor public policies by sector and to estimate the multidimensional poverty reduction goal of the 2010–2014 national development plan.

2 Data and Methodology

In developing a multidimensional poverty index, several decisions need to be made relating to the data to be used, the unit of analysis and the poverty methodology to be applied. The CMPI is proposed to assess poverty as a conjunction of n dimensions of quality-of-life simultaneously observed and experienced by households. For this purpose, we use the Alkire and Foster (2011a) multidimensional approach to poverty, henceforth the AF methodology. Additionally, we select household as the unit of analysis, and we assess overall society multidimensional deprivation with the Colombian Living Conditions Survey. These decisions are discussed in this section.

2.1 Data

When measuring household simultaneously experienced multiple deprivations, the methodology requires that all indicators come from the same data source. However, once

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the source is chosen, its own limitations determine the thematic scope of the indicators to be used. For the Colombian case, the selected data is the Colombian Living Standards Measurement Surveys (LSMS). The Colombian LSMS is a nationally representative survey conducted by the Colombian National Statistical Department (Departamento Administrativo Nacional de Estadísticas—DANE) in order to track living conditions among the Colombian population. The Colombian LSMS, which began 1993, is the most complete survey measuring socio-economic conditions in Colombia. The survey is a repeated cross-sectional dataset with waves in 1993, 1997, 2003, 2008 and 2010. After 2010, the survey was collected on an annual basis. By selecting this survey as the main source for the CMPI, the government will be able to continue to track multidimensional poverty year by year.

The survey implements a clustered, multi-stage, stratified and probabilistic sample of 9121 households for 1997, 22,949 for 2003, 13,600 for 2008 and 14,801 for 2010. The estimates of the current paper include results for 1997, 2003, 2008 and 2010, based on the LSMS. The results were calculated at the national level, for urban and rural areas, and by regions (Atlantic, East, Central, Pacific, Bogotá, San Andrés, Amazonía and Orinoquía and Antioquia). The LSMS does not include information for the territories of Guainia, Guaviare, Vaupes and Vichada. This paper focuses the discussion on the national figures and the rural and urban disaggregation. The regional analysis can be accessed by request.

2.2 Household as the Unit of Analysis

We select the household as the CMPI's unit of analysis. Following the Colombian LSMS 2008 definition of household, a household is defined as a person or group of persons, relatives or non-relatives, who occupy all or part of a particular dwelling, address basic needs under a common budget and often share meals.[2]

The selection of this unit of analysis implies that deprivations are assumed as simultaneously experienced by all household members rather than by isolated individuals. For instance, if child employment is a deprivation (children between the ages of 5 and 17 working), we assume that this deprivation impacts not only the child who is working, but the whole household. This means that all other individuals living in this household are considered deprived with respect to this dimension (child labour). Four good reasons were found as jointly important for using household as the unit of analysis, and we proceed to describe them as follows.

Previous indices of poverty in Colombia have focused on the household or the family, and so have strategies directed towards the reduction of poverty. SISBEN, the main instrument for targeting potential beneficiaries of social programs, is a standards-of-living measure that uses the household as the unit of analysis. Likewise, most of the Colombian anti-poverty policies and programs are designed to intervene at the household or family level. For instance, the objective of the Network for Overcoming Extreme Poverty (UNIDOS) is to ensure that households living in extreme poverty have access to all programs where they are eligible; in order to achieve this goal, UNIDOS offers households an agent to help them in the process. In addition, the government's conditional cash transfer program, Families in Action (*Familias en Acción*), focuses on the household by design. Since the CMPI is aimed to be a policy instrument to track multidimensional

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[2] Although the term household is not equivalent to the term family, in Colombia approximately 82 % of households are made up of members of the same family, 60 % of households correspond to nuclear families and 22 % to extended families.

poverty, defining household as its unit of analysis allow different policy interventions to use the CMPI as a measure to track their effectiveness.

In Colombia, households are considered the units that respond to difficult situations. Empirical evidence indicates that households show solidarity and work together in order to overcome negative shocks or adverse events, particularly homes made up of extended family members. Mision Social (2002) found that within the city limits, the 1990's crisis led to the disintegration of poor bi-parental nuclear households, which then changed into extended mono-parental households. On the other hand, households respond to difficult situations by implementing a combination of actions that involve different members. In poor households, this strategy is generally linked with poverty traps. In that regard, the Mision Social (2002) found that during the 1990s financial crisis, the critical event with the highest impact on households was unemployment of the household's head, while the main recovery strategy was the entry of the spouse and children into the labour market.

In Colombia, the family is recognized as the basic institution of society. In particular, the Colombian Political Constitution recognizes the family as "society's basic institution" and concedes joint responsibility between the family, society and the state in ensuring the population's living conditions and rights—specifically, decent living conditions for children and senior citizens, and essential aspects such as education. Some examples from the Constitution, related to the protection of children, senior citizens and education are as follows: "The family, society and the state are under the obligation of assisting and protecting children in order to guarantee their harmonious and comprehensive development, and their rights" (Art. 44). "The state, society and the family will concur in order to protect and assist senior citizens, and promote their active integration in the community" (Art. 46). "The state, society and the family are responsible for the education, which will be compulsory between the ages five to fifteen" (Art. 67).

Comparability with monetary poverty measures. A household-based multidimensional poverty measure is arguably more consistent with the widely applied Foster et al. (1984) monetary measures, well known as the FGT family of poverty measures. The FGT measures are the most commonly used one-dimensional poverty metrics based on income, expenditure or consumption. Since the FGT poverty measures almost always use household-based measures, it is also easier to compare the CMPI against them.

2.3 Why the AF Methodology?

The AF method has a number of distinct advantages for the formulation and monitoring of public policy.

Clarity. The methodology is simple and easily understood by non-specialists, including policy-makers and the general public.

Allows the inclusion of quality-of-life dimensions and indicators relevant for the society and sensitive to public policy implementation. The AF methodology allows for the inclusion of dimensions which society deem to be particularly important or desirable at a point in time, which are alterable via social policy, or which reflect the main objectives of said social policy. Once the dimensions are chosen, the methodology allows for selecting indicators that reflect direct actions from public policy aimed at reducing poverty.

Monitoring the efficacy of public policy. The sum of the above-mentioned attributes plus their ability to be decomposed by the contribution of each dimension and/or population subgroups allow for the AF methodology to be used as an instrument for monitoring public policy actions aimed at reducing poverty. The clarity of the multidimensional notion of poverty expressed by the index is transmitted to the multi-sector discussion about design

and strategic planning for the reduction of poverty. When the government is tracking the behaviour of all dimensions and indicators included in the CMPI, it is possible to determine which dimensions and indicators register the highest deprivation rates among the poor and also which dimensions show relatively less improvement among poor households over time. Finally, if the dimensions in any way reflect social priorities, and the indicators have been selected in order to monitor public policy actions, these warnings will either signal failures in policy execution or point out the need for them to be strengthened and redesigned. A poverty measure based on income or expenditure makes accountability difficult, given that it is expressed in terms of one single variable. In addition, accountability is difficult in the case of an index that does not allow decomposability.

Multidimensional poverty profiles comparable with unidimensional poverty profiles. The AF methodology is based on the FGT indicators and adapted to the multidimensional space. It uses an explicit axiomatic property structure, as defined for the one-dimensional poverty measures by Sen (1976), to produce a family of multidimensional poverty measures that are directly comparable with the analogous FGT indicators. The ability to compare multidimensional measures of poverty with unidimensional income-based poverty measures has important advantages to evaluate and monitor policies.

2.4 Identification of the Poor Population

Within the literature on multidimensional poverty measurement, there are four recognized types of methods for the identification of multidimensionally poor people: (1) the unidimensional method; (2) the union approach; (3) the intersection approach; and (4) the dual cut-off point approach, which corresponds to the Alkire–Foster proposed identification method.

The *unidimensional* method aggregates the achievements of different dimensions into a single quality-of-life index and uses an aggregated cut-off point to identify the poor population. The LCI, for example, aggregates achievements of the different indicators to be included in one synthetic index. In its first version, the LCI was conceived as a living standards index rather than a deprivation index. As a result, the index did not use any cut-off point to differentiate poor from non-poor population (Cortés et al. 1999a, 2000; González and Sarmiento 1998). A later version of this index, however, developed an aggregated cut-off point to differentiate the poor from the non-poor population. It is important to note that this latter LCI is unidimensional both in the sense that it uses one aggregated index to rank households from worse off to better off living conditions, and in the sense that it uses one aggregated cut-off point to identify the multidimensionally poor people. As was pointed out by Alkire and Foster (2011a), the unidimensional method to identify multidimensionally poor people does not satisfy some of the axiomatic properties presented later in this paper as desirable for the measurement of multidimensional poverty.

On the other hand, the *union* approach considers a household to be multidimensionally poor if it is deprived in at least one dimension. This is the method that the Unmet Basic Needs Index uses for the identification of the poor. One of the limitations of this approach is that it may incorrectly identify some households as poor, given that deprivation in one dimension may be due to reasons unrelated to poverty, such as behavioural exceptions (for example, a household deciding, of his own free will, to live in a house built with austere materials, regardless of a generally good living conditions, or high level of education or formal employment of its household members).

The third method is the *intersection* approach. This method identifies a household as poor if it is deprived in all of the indicator dimensions. This approach is too strict and

therefore identifies only a very small part of the population. As an example, in large cities in Colombia, where household utilities coverage reaches almost 100 %, the intersection approach would underestimate poverty by determining that almost no one is poor.

The AF identification method uses a *dual cut-off* point approach. The first cut-off, defined separately for every indicator, determines whether a household is deprived in each indicator. The number of deprivations that any i household face (C_i) is then calculated using appropriate weights. The second cut-off is the weighted sum of deprivations k above which a household is considered multidimensionally poor. There is no deterministic method for the definition of the parameter k. The dual cut-off approach includes, as particular solutions, the union approach ($C_i > 0$) and the intersection approach ($C_i = 1$). In Sect. 2.10, we further discuss the selected k threshold for the CMPI and the reasons behind that selection.

2.5 Aggregation

We use the aggregation method proposed by the AF methodology. Consequently, the measures that we use are the following:

- *Headcount ratio* (H) The headcount ratio or multidimensional poverty incidence rate is defined as $H = q/n$, where q is the number of people suffering a deprivation share of at least k, and n is the total population.
- *Adjusted headcount ratio* ($M0$) The adjusted headcount ratio combines information on the number of multidimensionally poor people and the breadth of deprivation. $M0 = HA$, where A is the average deprivation share among the poor.
- *Adjusted poverty gap* ($M1$) The adjusted poverty gap adds in information about the depth of poverty (how far multidimensionally poor households are from ceasing to be so). $M1 = HAG$, where G is the average poverty gap between each household's score on a dimension, and the cut-off point for that dimension, across all indicators where poor households are deprived. The poverty gap identifies the distance between each dimension's cut-off point and the achievement of the poor population in the dimensions in which they are deprived. For the case of Colombia, the distance is based on the proportion of household members that face deprivation in each of the indicators. For example, the cut-off point for the health insurance indicator, explained below, is 100 % of household members with health insurance. In a poor household where only 80 % of its members have health insurance, the gap is given by $(100 - 80\%)/100\% = 20\%$. The gap is censored at zero, that is, people who are not multidimensionally poor do not contribute to the calculation of G.
- *Severity* ($M2$) The severity measure assigns a higher weight to deeper deprivations of poor households; in other words, it emphasizes households that are severely deprived. By including the squared normalized gaps of the poor, the measure provides information on the incidence, range and severity of multidimensional poverty. $M2 = HAS$, where S refers to the average of the squared normalized gaps.

2.6 Advantages in Properties

The AF methodology produces a family of multidimensional poverty indices, some of which satisfy the axiomatic properties proposed by Sen (1976, 1979) as desirable for any poverty measure. These properties were the basis for the Foster et al. (1984) proposed measures. The AF methodology builds upon previous multidimensional analysis, such as

the ones proposed by Tsui (2002), Atkinson (2003), and Bourguignon and Chakravarty (2003). It is also based on the axiomatic structure by Pattanaik and Xu (1990), which is defined for individual freedoms.

One of the advantages of using the AF methodology for the CMPI, in comparison with previous multidimensional measures, is that it fulfils of a number of axiomatic properties that other measures do not fulfil. These properties make the CMPI more suitable than previous Colombian multidimensional indices for poverty comparisons across time, geographical areas, dimensions and population subgroups. We describe in this section those axiomatic advantages of our proposed CMPI against previous Colombian multidimensional indices. A full characterization of the properties of the AF methodology and their presence across members of the family of measures can be found in Alkire and Foster (2011a).

The first advantage of the CMPI aggregated indices is that they are not sensitive to changes within a non-deprived dimension: that is, if a household which is not deprived in a particular dimension receives a higher score in that dimension, none of the indicators change. This is in contrast to the LCI and SISBEN, which when used as poverty measures use the one-dimensional identification of the poor approach. Both indices are sensitive to changes across both deprived and non-deprived dimensions, and therefore, neither the LCI nor the SISBEN satisfy the *deprivation focus* desirable poverty measurement property proposed by Alkire and Foster (2011a).

In addition, the CMPI is not sensitive to transfers between non-poor individuals. The construction of the index does not produce lower levels of poverty due to changes among the non-poor population. Thus, the CMPI fulfils the *poverty focus* axiom. By contrast, when LCI and SISBEN averages are applied to a subgroup (as is generally the case), the measurement is sensitive to changes in the living conditions of the non-poor.

Also, three of the four measures we use ($M0$, $M1$ and $M2$) satisfy the *dimensional monotonicity* axiom. If a poor household faces a new deprivation that was not previously suffered, a higher level of poverty will be recorded. Thus, these measures provide not only information about how many people lie below the poverty line, but also how poor they are in terms of the breadth of deprivation. The UBN, LCI and SISBEN do not satisfy the dimensional monotonicity axiom, and they do not reflect the breadth of deprivation.

Moreover, two members of the family ($M1$ and $M2$), are not only sensitive to the number of deprivations suffered by poor people, but also to the size of the need in each of the deprived dimensions. These poverty measures show greater poverty whenever a poor individual suffers an increase in the depth of deprivation in any of the dimensions in which he or she is deprived. This refers to the *weak monotonicity* axiom and the *monotonicity* axiom. In the UBN, by contrast, changes (increments/reductions) in the level of any indicator do not necessarily produce changes (increments/reductions) in the aggregated score.

Finally, all the four measures that we use are decomposable, which allow the government to track poverty across different geographical areas and by thematic sectors, making it possible to determine the contribution of each one to the overall societal measure. This is the case of neither the SISBEN nor the LCI.

2.7 The Evaluative Space

According to the purpose of the measure to build and its empirical restrictions, the use of the AF methodology leads to a notion of multidimensional poverty that can be adapted to different evaluative spaces (Alkire and Foster 2011b). In fact, Alkire and Foster (2011b)

recognize the flexibility of their AF method to contribute to public policy orientation: "Our methodology is perhaps best seen as a general framework for measuring multidimensional poverty since many key decisions are left to the user. (...) We note that this flexibility makes it particularly useful for measurement efforts at the country level where these decisions can fit the purpose of the measure and can embody normative judgements regarding what it means to be poor" (Alkire and Foster 2011b, pp. 290–291).

In particular, the CMPI's evaluative space within which to select dimensions and indicators is defined by the set of thematic decisions and value judgements that constitute the index. Specifically, the CMPI embodies a standard of living notion that considers household deprivations as constitutive elements to describe the lack of a minimum standard of living. These living standard objects can be considered as the most valuated and relevant in the Colombian context.

However, because of information limitations, we cannot avoid describing living conditions through indicators of "input", rather than only through indicators of "outcome". Neither the Colombian LSMS nor other Colombian household surveys allow all quality of life dimensions to be measured in full through outcomes. We, therefore, acknowledge that the CMPI's approach to measure the Colombia's standard of living might still be inaccurate, as it uses in some cases, input indicators instead of living standard outcomes.

The standard of living notion expressed by the CMPI is represented by dimensions and indicators of quality of life, which summarize the social policy priorities of the government and the national social agreements. Besides its standard of living nature, the CMPI's evaluative space involves public policy concerns such as the selection of indicators that can be goals of public policy and that lead to a clear accountability. We follow describing in Sect. 2.8 the selected dimensions and indicators that are proposed to constitute the CMPI and the empirical and normative criteria used to select them.

2.8 Dimensions and Indicators

For the CMPI proposed here, the strategies described below were followed in the process of defining dimensions, indicators and cut-off points (the result of this exercise is shown in Table 1):

- A review of frequently used indicators from other indices applied to Latin America. The Human Development Index, the Human Poverty Index, the Subjective Conditions Index, CEPAL's Social Cohesion Index, the World Bank's Human Opportunity Index, and Oxford University's Dissimilarity Index were reviewed, among others.
- A review of the literature with regard to: (1) key dimensions and indicators often used in multidimensional indices applied to Colombia (UNB, LCI, SISBEN III); (2) priorities established by the Constitution of Colombia; (3) relevant variables raised by the study of Voices of the Poor for Colombia; (4) the thresholds set by the Millennium Development Goals (MDGs Colombia) and by the respective public policy sector. The comparative result of this review can be accessed upon request.
- The government's social policy. The indicators were selected in such a way that all of them are susceptible to modification by public policy.
- Availability of data within a single source, that is within the Living Standards Measurement Surveys of the Colombian National Statistics Department.
- Discussions with experts and sector heads.

Table 1 Dimension and indicators for CMPI

Dimension	Indicator label	Indicator definition	Cutoff point
Household education conditions (0.2)	Educational achievement (0.1)	Average education level for people 15 and older living in a household	9 years
	Literacy (0.1)	Percentage of people living in a household 15 and older who know how to read and write	100 %
Childhood and youth conditions (0.2)	School attendance (0.05)	Percentage of children between the ages of 6 and 16 in the household that attend school	100 %
	No school lag (0.05)	Percentage of children and youths (7–17 years old) within the household that are not suffering from school lag (according to the national norm)	100 %
	Access to childcare services (0.05)	Percentage of children between the ages of 0 and 5 in the household who simultaneously have access to health, nutrition and education	100 %
	Children not working (0.05)	Percentage of children between 12 and 17 years old in the household that are not working	100 %
Employment (0.2)	No one in long-term unemployment (0.1)	Percentage of a household's EAP that is not facing long-term unemployment (more than 12 months)	100 %
	Formal employment (0.1)	Percentage of a household's EAP that is employed and affiliated with a pension fund (formality proxy)	100 %
Health (0.2)	Health insurance (0.1)	Percentage of household members over the age of 5 that are insured by the Social Security Health System	100 %
	Access to health services (0.1)	Percentage of people within the household that has access to a health institution in case of need	100 %
Access to public utilities and housing conditions (0.2)	Access to water source (0.04)	Urban households are considered deprived if lacking connection to public water systems. Rural households are considered deprived when the water used for the preparation of food is obtained from wells, rainwater, spring sources, water tanks, water carriers or other sources	1
	Adequate elimination of sewer waste (0.04)	Urban households are considered deprived if they lack a public sewer system. Rural households are considered deprived if they use a toilet without a sewer connection, a latrine or simply do not have a sewage system	1
	Adequate floors (0.04)	Households with dirt floors are considered deprived	1
	Adequate external walls (0.04)	An urban household is considered deprived when the exterior walls are built of untreated wood, boards, planks, guadua or other vegetation, zinc, cloth, cardboard, waste material or when no exterior walls exist. A rural household is considered deprived when exterior walls are built of guadua or other vegetation, zinc, cloth, cardboard, waste materials or if no exterior walls exist	1
	No critical overcrowding (0.04)	Number of people sleeping per room, excluding the kitchen, bathroom and garage	Three persons per room[a]

Source: National Planning Department (NPD), Social Development Unit (SDU), Social Promotion and Quality of Life Division (SPQLD). 2011. *Notes*: The weight assigned to each dimension and indicator is shown in parenthesis

[a] Urban: Three or more people per room; rural: more than three people per room

- Sample precision of the selected indicators. Once the indicators were defined, an analysis was made to determine the sample precision for each of the study's domains, and only those with a coefficient of variation (cv)[3] below 15 % were selected.

As a result of this process, five dimensions were selected (household education conditions, childhood and youth conditions, health, employment and access to household utilities, and living conditions). These five dimensions are measured using 15 indicators. We proceed to describe them below.

2.8.1 Dimension of Household Education Conditions

Educational achievement The indicator is measured by the average level of education for individuals 15 years of age and older within the household. However, it is worth noting that if a household member selects preschool as the highest level of education approved, zero years of schooling is assigned to such a member.

In terms of the cut-off point used by this indicator, a household is considered deprived when the average years of schooling of its members aged 15 and over are below nine.[4] However, when there are no household members 15 years of age or older within the household, the household is automatically considered as deprived in terms of educational achievement.

Literacy This indicator is defined as the percentage of people aged 15 or above in the household that know how to read and write. A household is considered deprived if at least one of the household members aged 15 or older does not know how to read or write (i.e. <100 % of its members 15 years old and over are able to read and write). When there are no household members 15 years old or over, the household is considered deprived.

2.8.2 Dimension of Childhood and Youth Conditions

School attendance The indicator is calculated as the proportion of school-age children (6–16 years old) in a household who attend an educational institution. According to this indicator, a household is considered deprived if at least one of the children between 6 and 16 years old do not attend school (i.e. <100 % of children 6–16 years old are attending school). Households with no children between 6 and 16 years old are not considered deprived in this indicator.

No school lag School lag is calculated for the households with children between the ages of 7 and 17. The school lag of each child is defined as the difference between the number of legally expected years of schooling by specific age and the number of school years completed in fact. The legally expected years of schooling by age are defined by the Sector Plan for Education 2006–2010, presented by the National Ministry of Education; children that are 7 years old are expected to have completed 1 year of education; 8 year

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[3] The coefficient of variation (cv) is defined as the ratio of the standard deviation obtained from sample to the mean $cv = \sigma/\mu$. This measure is also known as the relative standard deviation and shows the extent of variation of a measure in relation to the population mean. According to 2008 DANE guidelines, the cv "measures the ...variability of the estimator's sampling distribution, that is, it indicates the accuracy with which universe characteristics are being estimated." For the LSMS case, DANE considers that an estimate is accurate if the $cv < 7\%$, has acceptable accuracy if $7\% < cv < 15\%$, has regular accuracy if $15\% \leq ve \leq 20\%$, and finally, the estimate is inaccurate if $cv > 20\%$.

[4] The cut-off point was determined according to the Sector Plan for Education 2006–2007, presented by the National Ministry of Education, and the basic competencies acquired by an individual in primary school (1st–5th grades) and secondary school (6th–9th grades) that are required to have a decent job.

old children are expected to have completed 2 years of education; 9 year old children are expected to have completed 3 years of education, and this pattern continues until 17 year old children are expected to have completed at least 11 years of education.

A household is considered as deprived in this indicator if any of the children between 7 and 17 years are lagging in school. In other words, the desired result is 100 % of children in a household without school lag. Households with no children between 7 and 17 years old are not deprived in this indicator.

Access to childcare services This indicator provides the percentage of children 0–5 years old in each household who have access to childcare services (health, proper nutrition, and adult supervision or education) simultaneously. A household is considered to be deprived in access to childcare services if there is at least one child between 0 and 5 years old with no simultaneous access to all childcare services. Thus, a household is not deprived if its children under the age of 5: (1) spend most of the week at a community home, nursery or preschool, or they are under the care of a responsible adult;[5] (2) are covered by health insurance; and (3) receive lunch in the care facility where they spend most of time (as, for instance, community home, nursery or preschool).[6]

Children not working According to the International Labour Organization (ILO)[7] and the Colombian National statistical Department (DANE), child labour refers to children under 18 years old that carry out household chores for more than 15 h per week, children under 14 years old classified as employed, and children under 18 years old involved in hazardous work.[8] In the case of the CMPI and given the data constraints of the LSMS, the CMPI only includes the percentage of children in the household between 12 and 17 who are employed. The indicator of children not working is defined as the percentage of children who are out of the labour market. A household is deprived in this indicator if at least one child between 12 and 17 years old is employed. A household with no children between 12 and 17 years old is considered not deprived.

2.8.3 Dimension of Employment

Absence of long-term unemployment This indicator measures the percentage of the economically active population (EAP)[9] in the household that has been unemployed for more

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[5] A child is considered under the care of a responsible adult if (1) he/she remains at home under the care of father or mother, (2) is under the care of a relative, (3) is under the care of a nanny or maid, or (4) is under the care of neighbours or friends. The last two categories of care were defined as responsible adult because there is no evidence that indicates inadequate care in those cases. Being under the care of a nanny is considered adequate, and since it is not possible to separate the responsibilities of the maid from those of a nanny, the whole option is considered adequate. On the other hand, the ages of friends and neighbours are unknown is not sufficient to determine deprivation. A child that (1) is taken to work by a parent, (2) remains home alone, or (3) remains under the care of other minors younger than him is considered to be under inadequate care.

[6] Due to a lack of information, it is assumed that children under the care of a responsible adult receive adequate nutrition.

[7] See ILO convention No. 138 on the minimum age for admission to employments and work and ILO convention No. 182 on the worst forms of child labour, 1999.

[8] The definition of hazardous work varies from country to country, as well as among sectors within countries. According to the World Health Organization, for example, what makes child labour hazardous is the presence of hazards and risks at the workplace (such as the presence of chemicals, noise, ergonomic risks like lifting heavy loads, etc.) and working conditions (long hours, night work, harassment).

[9] The economically active population in this case is made by household members 12 years old and over who are either employed or actively seeking employment (unemployed).

than 12 months. The indicator is calculated as: $1 - (long\,term\,unemployed/EAP)$. A household where there is at least one person in long-term unemployment is considered to be in deprivation. Households with no economically active population are considered deprived in this indicator, with the exception of households made up of people living on a pension.

Formal employment This indicator takes the proportion of the economically active population within the household that is employed and actively affiliated to a pension fund (*employees affiliated to a pension fund*/EAP), where affiliation to a pension fund is taken as a proxy of formality. A household is considered deprived when less than 100 % of the EAP has formal employment. This indicator also captures unemployment. For this reason, the long-term unemployed population is removed from the denominator in order to avoid counting them in deprivation twice. Children under the age of 18 who hold jobs are also eliminated in order to be congruent with the non-child employment policy.[10] Households with no EAP are considered deprived.

2.8.4 Dimension of Health

Health insurance coverage Health insurance coverage is defined as the proportion of household members covered by the Social Security Health System.[11] A household is deprived if any of its members is not affiliated with a health insurance regime. Given that the access-to-childcare-services indicator takes into account the health insurance status of children between 0 and 5 years old, this indicator is measured only for the population older than five.

Access to health services in case of need This indicator measures the proportion of people in a household who have access to health services in case of need. A household is not deprived in access to healthcare services if all of its members who in the last 30 days have suffered an illness, an accident, dental problems or any other health issues that have not required hospitalization, have been attended by a doctor, specialist, dentist, therapist or health institution. Households where no one has had a need for healthcare services are not considered to be deprived in this indicator.

2.8.5 Dimension of Access to Public Utilities and Living Conditions

It is worth noting here that the indicators that belong to this particular dimension are naturally measured at the household level, meaning that each indicator is equally defined across all the household members. This particular issue arises since household members share the available amenities at the dwelling. This feature is fully concordant, then, with the above-mentioned indicators that were defined at the household level as well.

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[10] It is a contradiction to determine that a child is deprived when employed and at the same time that he/she is deprived if unemployed or actively seeking employment. The objective of the policy for elimination of child labour is for children to be excluded from the job market and, therefore, not classified as employed or unemployed.

[11] It includes any type of health insurance regime, namely contributory regime, subsidized regime or special regimes. Contributory Regime: for those with sufficient income and/or are formally employed, whose affiliation is subject to a monthly contribution of 12.5 % of their income. Subsidized Regime: for the poor population without payment capacity, identified with SISBEN instrument. Special Regimes: for people who have or had a labour relation with ECOPETROL (national petroleum company), the armed forces, the national police, the National Teaching Fund and public universities.

Access to improved drinking water This indicator was defined using WHO-UNICEF guidelines provided by the Joint Monitoring Programme (JMP) for water and sanitation (WHO and UNICEF 2010). The JMP stablishes a set of world-wide drinking-water and sanitation categories to determine improved drinking water sources and improved sewer systems. The categories, however, used in each country correspond to the national circumstances. In particular, for the Colombian case, urban households are considered deprived when they have no access to public water services. In rural areas, households are considered deprived when they have no access to public water services, and the water used to prepare food is obtained from a well, rainwater, a river, spring water source, public tap or standpipe, water truck, water carrier or any other source other than piped water.

Adequate elimination of sewer waste In this case, urban households without access to a public sewer system are considered deprived. Rural households are considered deprived if they have a toilet without a sewer connection, a latrine or if they simply do not have a toilet.

Adequate floors Households with dirt floors are considered deprived.

Adequate exterior walls An urban household is considered deprived when the exterior walls are built with untreated wood, boards, planks, guadua (a type of bamboo) or other vegetation, zinc, cloth, cardboard, waste material or when no exterior walls exist. A rural household is considered deprived when exterior walls are built of guadua or other vegetation, zinc, cloth, cardboard, waste materials or if no exterior walls exist.

No critical overcrowding An urban household is considered critically overcrowded, and therefore deprived, when the number of people sleeping per room (excluding kitchen, bathroom and garage) is greater than or equal to three; a rural household is considered deprived when the number is more than three people per room.

2.9 Weighting Structure

There is no definitive procedure of assigning weights over dimensions in a multidimensional measure of poverty. Several methods exist to assign weights to the dimensions that make up a multidimensional index. For instance, Decancq and Lugo (2013) identify three different types of methods to assign weights: (1) data driven (obtained from the same data used descriptively or statistically), (2) normative, and (3) hybrid. However, there is no consensus on the weighting scheme that should be used; therefore, weight selection is completely in the hands of the researcher.

For the CMPI, one normative approach and two data driven sets of weights were tested. The first data-driven approach that was tested assigned an equal weight to each dimension, and the weight received by the indicators within them was set according to the households' deprivation rates in each indicator, which gave a higher weight to indicators with high deprivation rates. On the contrary, the second data-driven set of weights assigned weights to each dimension, as well as for each indicator within the dimensions, according to the deprivation rates. These two approaches, and data-driven methods in general, face a constraint: the moment in time when the weights are calculated. As an example, for the case of Colombia, if weights were set according to households' deprivations in 1997, a high weight would have been assigned to the health insurance indicator; whereas today, this indicator has relatively moderate deprivation rates, and in the coming years it will drop even more. Therefore, one of the disadvantages of data-driven methods is that weights change over time, while with a normative method's weights remain constant. When weights change for each measure, it is impossible to compare indexes over time.

Consequently, the CMPI uses a normative approach with a nested weighting structure, where each dimension has the same weight (0.2) and each indicator has the same weight within each dimension. Note that the weights are chosen to sum to one and to express the relative importance of each indicator in the overall index. Under this approach, all dimensions carry the same weight, indicating that they are equally important in terms of quality of life of the population. However, since each dimension is measured by a different number of indicators, and within each dimension the indicators are equally weighted, the 15 indicators thought the overall index do not have the same relative importance. This can be seen in Table 1, which presents in parenthesis the weight assigned to each dimension and indicator. In the dimensions with more indicators, each indicator has less weight than the indicators that belong to dimensions captured by fewer indicators. Therefore, one of the limitations of this approach is that the weight assigned to indicators within dimensions that have many indicators is lower in comparison to that of the indicators within dimensions that have few indicators. This limitation, however, is lessened if the indicators chosen are a good expression of the dimensions they represent, considering that the dimensions do weigh the same. On the contrary, in hypothetical cases where all indicators carry the same weight, a higher percentage would be assigned to dimensions with a greater number of indicators.

As a result, this nested weighting structure that the CMPI uses was established based on the following points: (1) the equal weight assigned to each dimension reflects their equal importance as constituents of quality of life; (2) in the debate among experts, this was the option on which there was greater agreement; (3) although the weighting structure should ideally take into account correlations between indicators, there is still no well-established way to implement this without compromising some of the indicator's other properties, "... nor has it even been established that the potential interrelationships must be reflected in an overarching methodology for evaluating multidimensional poverty. Instead, the interconnections might be the subject of separate empirical investigations that supplement, but are not necessarily part of, poverty measurement" (Alkire and Foster 2011a).

2.10 Selecting the Value of *k*

As with any other poverty measure, poverty levels vary according to the threshold selected; lower poverty thresholds produce lower poverty rates, and higher thresholds produce higher poverty rates. In general, for the AF methodology and specifically for the CMPI, the *k*-threshold to identify the poor and non-poor populations represents the minimum weighted sum of indicators in which a household is deprived, in order to be identified as poor. Note that household deprivation indicators take values of one and zero, where one refers to presence of deprivation and zero refers to the absence of it. The aforementioned, in Sect. 2.4, weighted sum of deprivations (C_i) is obtained from aggregating those $\{0, 1\}$ deprivation indicators, while using the correspondent weighting structure. As a result, C_i varies from zero to one, where zero implies there is no indicator in deprivation for the *i*-household, and one implies that all are indicators in deprivation. Since the cut-off point *k* is the minimum weighted deprivation share that a household must have to be considered as poor, *k* may potentially take any value from 0 % (every household is automatically poor) to 100 % (no household is ever poor).

As previously mentioned, there is no deterministic method for choosing this second cut-off point, and in much of the analysis in this paper, we compare poverty estimates obtained using the full range of *k*-thresholds. However, it is often necessary to generate a single

estimate based on a selected value of k; this section outlines the process of making this selection.

The first step towards defining an initial range of values for k was to discard those k-thresholds that would produce ranges of poverty estimates which could not be captured by the survey; at this stage, we excluded any possible k threshold that would produce poverty indices with a cv greater than 15 % (H, $M0$, $M1$ and $M2$). This was done at the national level and for each analysis domain.

In the case of H and $M0$, estimates with poor precision were observed for k values greater than or equal to 40 %. By contrast, for $M1$ and $M2$, estimates with a cv greater than 15 % were observed for k starting at 45 %. Also taking into account minimum thresholds, the set of k-values generating accurate estimates is the interval [7, 40 %], hereafter called the robust band of k values, for the H and $M0$, and the interval [9, 45 %] for $M1$ and $M2$.

We supplement these statistical criteria with empirical evidence on the share of deprivations faced by different groups. The average deprivation share across the whole population in 2008 was 27 %. This varies according to a household's experience of poverty, measured both subjectively and via income-based measures, and across time. Table 2 shows the average share of deprivations between 2003 and 2010 across these sub-population groups. Households that do not identify themselves as poor and households that are not income-poor face an average deprivation share of 21 %. In 2010, households that defined themselves as poor, or poor by income, faced average deprivation shares of 31 and 33 %, respectively.

This indicates that a k threshold of 21 weighted sum of deprivations might be too low, while 41 % would be too high. Within this range, we computed 95 % confidence intervals for H and $M0$ for different values of k. For both H and $M0$, the confidence intervals overlap for $k = 27\%$ and $k = 33\%$, hence we infer the selection between these two values of k could be indifferent. Given that overlapping of confidence intervals is not a definite condition for concluding the existence of equal means, one may conclude that there may be no significant statistical difference between the estimates of $k = 27\%$ and $k = 33\%$.

This combination of statistical methods and empirical data suggests a value of $k = 33\%$ for the overall threshold for all H and $M0$. We also review the values of k used in other papers. We find that most use a value of k of around 30 %. For example, López Calva and Ortiz Juárez (2009) uses a k of 2/6 and Alkire and Santos (2010) takes a k of 1/3

Table 2 Average share of deprivations, 2003–2010

Population subgroup	Average share of deprivations		
	2003 (%)	2008 (%)	2010 (%)
Population where the household head perceives the household as poor	37	33	31
Population below the (income) poverty line	40	35	33
Population where the household head perceives the household as poor and beneath the poverty line	41	37	35
Population where the household head does not perceive the household as poor	22	21	20
Population above the poverty line	25	21	21

Source: 2008 LSMS. *Note*: The subjective poverty measure is not available in the 1997 LSMS

(3.33/10). Hence, our chosen k-threshold is very similar to the k threshold selected by other authors in comparable contexts.

3 Empirical Results

This section presents estimates of multidimensional poverty for the selected k-threshold ($k = 33$ %) across 1997, 2003, 2008 and 2010. We also use a simple k-dominance analysis technique, which involves plotting estimated poverty rates for the years in question for all possible choices of k, the poverty threshold. In this way, we are able to assess whether estimated changes in poverty rates are observed only for certain values of k, or whether they are robust to different assumptions about the k poverty threshold. In addition to national-level estimates, we present urban/rural profiles.

3.1 A National Pattern of Multidimensional Poverty Reduction

Table 3 presents the multidimensional poverty results at $k = 33$ %. Results indicate a reduction in the percentage of multidimensionally poor people (H) between 1997 and 2010, from 60.4 to 30.4 %, representing an absolute change of 30 % points or half of the 1997 level. Between 1997 and 2010, at our preferred threshold of $k = 33$ %, $M0$ decreased from 0.29 to 0.13, indicating a reduction of around 55 % of the original level. This is similar in magnitude to the reduction in the headcount ratio (H), but it is slightly larger. This difference arises because *both* the number of multidimensionally poor people and the proportions of deprivations experienced by the poor (A) decreased over this period. On average, the estimated percentage of deprivations among the poor population decreases by around 5 % points during the period of analysis (from 48.3 % in 1997 to 43.2 % in 2010).

The estimates of the multidimensional poverty headcount (H) and the adjusted headcount ($M0$) at the national level at any possible value of k are presented in Figs. 1 and 2. One line is shown for each of the years 1997, 2003, 2008 and 2010. As expected, all lines slope downwards, indicating that higher poverty thresholds yield lower levels of poverty. This stands in contrast to the analogous result for income-based poverty measures, where a higher poverty threshold would produce higher poverty rates; this occurs because k indicates the percentage of possible deprivations above which people are defined as poor, and a negative relationship is observed. Note that the scale on the vertical axis for $M0$ is different to the scale for H because $M0$ is the A-adjusted version of H and therefore always lies below H.

Table 3 Multidimensional poverty results for $k = 33$ %. Total national, 1997–2010

	1997	2003	2008	2010	2010–1997 (p.p.) reduction	2010–1997 % reduction
Headcount ratio (H)	60.4 %	49.2 %	34.7 %	30.4 %	30.0	49.6
Average deprivation share among the poor (A)	48.3 %	46.5 %	44.8 %	43.2 %	5.2	10.7
Adjusted headcount ratio ($M0$)	0.29	0.23	0.16	0.13	0.16	55.02

Source: LSMS

Note: The percentage change represents the relative change between the old value and the new one
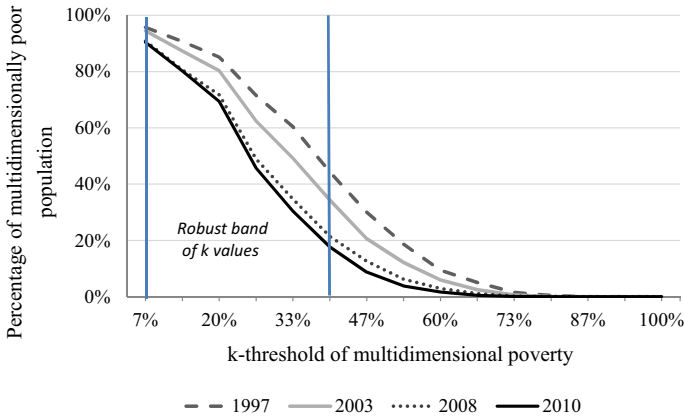
Fig. 1 Multidimensional poverty headcount ratio (H). 1997–2010, for different values of k. *Source*: LSMS
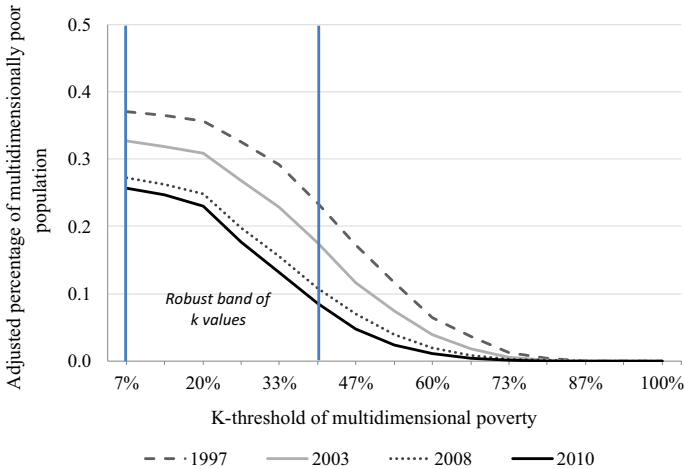

Fig. 2 Adjusted headcount ratio ($M0$). 1997–2010, for different values of k. *Source*: LSMS

The fact that in H the line for each year lies everywhere below the line for the earlier year in the series indicates that headcount poverty in Colombia decreased continuously between 1997 and 2010; this is robust to changes in the value of k. Likewise to the headcount ratio, $M0$ decreased over the observed period, independent of the value of k. Similar k-dominance analysis for the share of deprivations (A) indicates that the changes on A are also robust to the choice of k for all values in the robust band ($7 < k < 40\%$).

3.2 Health Dimension Leading the Changes

Table 4 shows the evolution of contribution of each dimension in the evaluated $M0$ at the selected k ($k = 33\%$). Across the four years, the dimension that contributes the most into $M0$ corresponds to household education conditions. On average, across the 4 years, this

Table 4 Dimensional contributions in $M0$ for $k = 33\%$. Total national, 1997–2010

	1997 (%)	2003 (%)	2008 (%)	2010 (%)	2010–1997 reduction (p.p.)
Household education conditions	28	30	32	34	5.3
Childhood and youth conditions	17	16	16	16	−0.6
Employment	24	24	25	26	1.2
Health	23	22	17	15	−7.4
Access to dwelling services	8	8	10	10	1.5

Source: LSMS

dimension explains 31 % of the adjusted multidimensional headcount. In contrast, access to dwelling services is the dimension that least contributes to multidimensional poverty, having an average across the four years of 9 %. The dimension that has contributed the most in the reduction trend observed during 1997 to 2010 is health. Between 1997 and 2010, this dimension decreased its contribution by 7.4 % points. About two thirds of this reduction occurred between 2003 and 2008, a period in which major improvements in health insurance coverage were introduced. Figure 8 within the "Appendix" presents the evolution of the rate of deprivation by indicators across 1997, 2003, 2008 and 2010.

3.3 The Urban/Rural Gap

In this section, we assess whether national reductions in multidimensional poverty were experienced equally in urban and rural areas. Figure 9 on the "Appendix", present estimated values of H for all values of k, with urban and rural areas plotted respectively. In line with what other analysis has shown for the Colombian case, levels of poverty are higher in rural areas than in urban areas. However, in *both* urban and rural areas, there are clear reductions in multidimensional poverty rates over all values in the robust band of k.

Table 5 presents estimates of poverty rates in urban and rural areas at our selected threshold $k = 33\%$. The incidence of multidimensional poverty declined over time in both urban and rural areas. In terms of percentage points, the drop was considerably larger in rural areas than in urban areas (33pp vs 27pp); however, when reductions are expressed in terms of a percentage of the original level, the reduction was substantially higher in urban areas than in rural areas (54 vs. 38 %). This represents a significant reduction, as most of Colombia's population resides in urban areas (in 2010, close to 77 % of the population lived in urban areas).

What does this mean in terms of rural/urban differences? The third row of Table 5 shows differences in poverty rates between rural and urban areas for each year and the differences in the overall percentage point and percentage reductions. The fourth row shows rural poverty rates as a multiple of urban poverty rates.

The magnitude of the gap between rural and urban poverty rates remains fairly stable over the period, reducing from 35 % in 1997 to 30 % in 2010. This may suggest that rural areas have benefited more than urban areas from improvements in living standards. However, when we examine the ratio between rural and urban poverty rates, we see that they have diverged: rural poverty rates were 1.7 times higher than urban poverty rates in 1997, but they were 2.3 times higher in 2010. This implies a steady widening of the rural/ urban gap within this period, and it suggests that rural populations have not benefited as much as urban populations from improvements in coverage of public services.

In fact, this effect is not driven solely by coverage in public services, as the same widening of the rural/urban gap is observed in official estimates of income poverty. Here, the same trend in poverty reduction from 2003 to 2010 may be observed in urban and rural areas. Both, income poverty and multidimensional poverty, show faster reductions in urban areas than in rural areas. According to DANE's income poverty estimates, rural poverty declined from 57 % in 2003 to 49 % in 2010 and from 45 to 33 % in urban areas, a drop in 12 % points in both rural and urban areas, but a much larger drop as a percentage of the original levels in urban areas.

We now proceed to look at the range of deprivations experienced by the poor and how this varies between urban and rural areas.

Rows (5) and (6) from Table 5 show the average deprivation share among the poor in urban and rural areas, respectively. A higher average of deprivation is observed among the poor living in rural areas than among those living in urban areas for every year of analysis and for every value in the robust band of k (see Fig. 10 within the "Appendix"). The intensity of poverty decreases in both urban and rural areas over the period studied. Although the intensity of poverty is higher throughout among the rural poor, the decrease between 1997 and 2010 was larger in rural areas than in urban areas, both in terms of percentage points (8pp vs 4pp) and in terms of percentages of the original levels (14 vs 8 %).

We have seen that urban populations have benefited more than rural populations in terms of reductions in poverty rates, while the urban poor have benefited more than the rural poor in reductions in the intensity of deprivation. What does this mean for the adjusted headcount ratio $M0$? Rows (7) and (8) from Table 5 present the estimates of $M0$ at $k = 33\%$ for Urban and Rural areas. Also, Fig. 11 within the "Appendix" presents the dominance analysis performed for $M0$ across every value of k for rural and urban areas.

Estimates of $M0$ show that reductions in poverty rates in urban areas dominate reductions in poverty rates in rural areas. Although the percentage point decrease in $M0$ is much larger in rural areas than in urban areas (0.21 vs 0.13), the reduction expressed as a percentage of 1997 levels is lower in rural areas (47 % against 57 % in urban areas).

Table 5 Multidimensional poverty headcount ratio (H), average percentage of deprivations among the poor population (A) and adjusted headcount ratio $M0$. 1997–2010, for $k = 33\%$ across urban and rural areas

		1997	2003	2008	2010	2010–1997 reduction (p.p.)	2010–1997 % reduction
Multidimensional poverty headcount ratio (H)							
(1)	Urban	51 %	40 %	27 %	23 %	27.3	54
(2)	Rural	86 %	77 %	60 %	53 %	32.9	38
(3)	Rural/urban gap	35 %	33 %	33 %	30 %	5.6	16
(4)	Rural/urban ratio	1.7	1.9	2.2	2.3		
Average percentage of deprivations among the poor population (A)							
(5)	Urban	46 %	44 %	44 %	42 %	4	8
(6)	Rural	52 %	50 %	46 %	45 %	8	14
Adjusted headcount ratio (M0)							
(7)	Urban	0.23	0.18	0.12	0.1	0.13	57
(8)	Rural	0.45	0.39	0.28	0.24	0.21	47
(9)	Rural/urban gap	0.22	0.21	0.16	0.14	0.08	10
(10)	Rural/urban ratio	2.0	2.2	2.3	2.4		

Source: LSMS 2008

This may also be observed in the last row of Table 5, where rural poverty rates expressed as a percentage of urban poverty rates increase from 2.0 to 2.4 between 1997 and 2010. This again implies that rural populations have benefited less from social interventions than urban populations, although the change is less stark than in H, showing the ameliorating effect of changes to poverty intensity in rural areas.

3.4 Inequalities Among the Poor

In Sect. 2.5, we explained two measures that adjust for the depth of poverty:

$M1 = HAG$, in which the headcount measure is adjusted by the average share of possible deprivations experienced by poor households (A) and the average gap, over all the indicators on which a household is deprived, between its achieved level and the poverty threshold for that indicator (G).

$M2 = HAS$, in which the headcount measure is adjusted here not only by A, but also by the average squared poverty gap over all indicators and all poor people.

These two measures reflect the magnitude of the poverty gap among the poor, with $M2$ placing greater weight on the poorest people; they are particularly useful in that they offer additional information on the magnitude of poverty, facilitating the targeting of social policy.

In contrast to H and $M0$, $M1$ and $M2$ require cardinal information—that is, not just a measure of whether an individual or a household meets a particular threshold, but by how far it falls short of that threshold. The CMPI consists of household-level aggregates of (a) individual-level categorical indicators for the first four dimensions and (b) household-level indicators for the housing conditions dimension. All the indicators on the housing conditions dimension take the value 0 or 1 and thus do not provide cardinality; these indicators are therefore excluded from this analysis. However, the indicators over the other dimensions are aggregated across all household members and thus may take a range of values between 0 and 1. These values indicate the fraction of household members who do not meet each target. Thus, they do not exactly represent the normalized gap between the achievements of a household (or its individual members) and the deprivation threshold, as strictly required for the calculation of $M1$. However, they do allow for the calculation of statistics analogous to $M1$ and $M2$, which capture the degree of deprivation and the need at the household level.

The poverty gap on each indicator for any i household (g_{ij}) is calculated as the distance between the proportion of eligible household members who face deprivation and the threshold for each indicator (see Table 8 within the "Appendix" for the definition of the gap for each indicator). Taking, for example, the formal employment indicator, which has a cut-off point of 100 % of the household's economically active population (EAP) holding formal employment. This would mean that a household where 100 % of members hold an informal job has a deeper deprivation than a household where only 10 % of its members face this deprivation. Note, however that the proportion of 'eligible' household members differ across indicators—for example, the school attendance indicator in the childhood and youth dimension has a different number of eligible members (hence denominator of the normalized gap) than the formal employment indicator.

The total household gap across indicators is calculated as the weighted average size[12] of all the gaps over all the indicators on which the household is deprived.

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[12] Weights are rearranged according to the number of indicators within each dimension.

Finally, the mean gap over all deprived households is calculated. As the denominators differ, the mean gap can be roughly interpreted as the (weighted) average proportion of the eligible household members in each indicator who are actually deprived in the indicators. Multiplying $M0$ by the mean gap will lead to a reduction in the value of the poverty measure in all situations, except that in which all eligible household members are deprived in all dimensions (the mean gap is 100 %). Thus, in a sense the $M1$ corrects the $M0$ measure by adjusting the adjusted headcount ratio even more precisely to reflect the true proportion of *individuals* in Colombia who are poor, given intra-household differences. Note that care must be exercised in interpreting the $M1$ and $M2$. The reason is that the values may change due to differences in household size and composition. In areas in which all households are single people, the mean gap will always be 100 %; as the size of households increases, the mean gap is likely to be lower. This is the same if there was one versus many children.

Based on the same empirical techniques as outlined in Sect. 2.10, we select the value $k = 36\%$ for the calculation of $M1$ and $M2$. Also, using the same statistical criteria as for the case of H and $M0$, we find the robust band of k values, which is calculated as the interval [9, 45 %].

As for the poverty incidence measurements reported previously, we plot results for all possible values of k, including those outside the robust range, as a dominance analysis exercise. $M1$ and $M2$ are plotted in Figs. 3 and 4, for all values of k and for 4 years between 1997 and 2010. Out of all previous years for all value of k inside the robust band (and for most values outside), 2010 dominates. As a result, we can assert that both the adjusted poverty gap and severity decrease between 1997 and 2010, regardless of the selected k.

$M1$ and $M2$, calculated for the total national at $k = 36\%$, are presented in Table 6, as first and second row respectively. Both decrease substantially between 1997 and 2010; $M1$ decreases from 0.23 to 0.09, and $M2$ from 0.21 to 0.08. This is an important reduction, as it implies that the households classified as poor are not only facing a lower proportion of deprivations in Colombia, but also that the magnitude of their deprivations is lower. In other words, the proportion of household members facing deprivations has decreased.

The last two columns of Table 8 indicate the decrease in $M1$ and $M2$ between the year 1997 and 2010. The decrease in the two indices is similar, both in terms of the magnitude of the drop (0.14 and 0.12) and the percentage decrease (59 and 61 %). Comparing these with the percentage reductions in H (50 %) and $M0$ (55 %), this suggests that a reduction
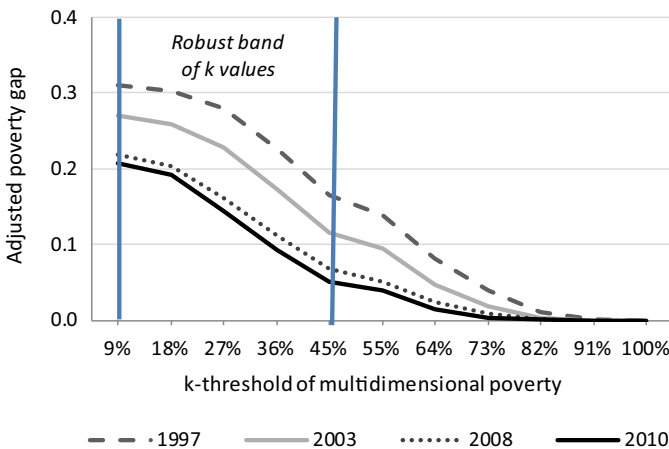

Fig. 3 Multidimensional poverty gap ($M1$) for different values of k, 1997–2010. *Source*: LSMS
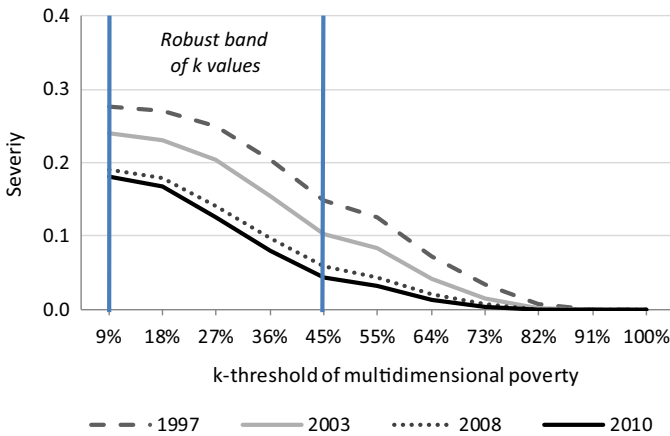
Fig. 4 Multidimensional poverty severity ($M2$) for different values of k, 1997–2010.
Source: LSMS

Table 6 Multidimensional poverty gap ($M1$) and severity ($M2$). Total national and by area. 1997–2010, for $k = 36\%$

		1997	2003	2008	2010	2010–1997 reduction (p.p.)	2010–1997 % reduction
Total national							
(1)	Gap (M1)	0.23	0.18	0.11	0.09	0.14	59
(2)	Severity (M2)	0.21	0.16	0.1	0.08	0.12	61
Multidimensional poverty gap (M1) by area							
(3)	Urban	0.19	0.14	0.09	0.08	0.11	60
(4)	Rural	0.34	0.28	0.18	0.15	0.19	56
(5)	Rural/urban diff	0.15	0.14	0.09	0.07	0.08	4
(6)	Rural/urban ratio	1.77	1.96	1.95	1.96		
Multidimensional poverty severity (M2) by area							
(7)	Urban	0.17	0.12	0.08	0.07	0.10	61
(8)	Rural	0.31	0.25	0.16	0.13	0.18	57
(9)	Rural/urban diff	0.14	0.13	0.08	0.06	0.08	4
(10)	Rural/urban ratio	1.84	2.04	2.04	2.03		

Source: LSMS

in the intensity of poverty has accompanied a reduction in the incidence of poverty. However, the percentage decreases in $M1$ and $M2$ are too similar to say with any confidence that reductions in the intensity of poverty have been greater for the very poorest people.

Tables 6 also show disaggregated $M1$ and $M2$ by urban and rural areas [Rows (3)–(10)]. The poorer living conditions of the rural population are once again evident, with both measures being almost twice as high in rural as in urban areas. In both urban and rural areas, $M1$ and $M2$ decreased between 1997 and 2010, and the magnitude of the decrease was larger in rural areas. However, expressed as a percentage of the original levels, the magnitude of the decrease was larger in urban areas. Looking at the rows (6) and (10) of Table 6, this is reflected in an increase over time in the rural/urban poverty ratio: on both

measures, it increases by about 0.2 over the period concerned. The comparable increases in H and $M0$ are 0.6 and 0.4, respectively. This indicates that with whatever measure we use, there has been increasing disadvantage for rural areas relative to urban areas. This increase in urban/rural inequality is less marked when the depth and severity of poverty are taken into account, and it indicates that some progress has been made in reducing the most severe poverty in rural areas. However, the fact that urban/rural inequality is increasing on all measures indicates that greater and better efforts are required in terms of targeting public policy towards the rural poor.

3.5 Comparing Multidimensional, Income and Subjective Poverty

This section compares the percentage of poor and non-poor population according to the CMPI and the income-based and subjective poverty measures. Figure 5 shows the distribution of the national population across each category: both income poor and CMPI poor, only CMPI poor, only income poor and non-poor by both criteria. It is worth noting that for the case of multidimensional poverty, we use the figures produced with the selected k-threshold of 33 %.

To result from reductions in incidence of both multidimensionally poverty and income poverty, between 1997 and 2010, the proportion of population facing both multidimensional and monetary poverty decreased in this period by almost 20 % points. While in 1997, 41 % of the population was both income and multidimensionally poor; in 2010, this proportion reaches only 20 %.

We observe an increase in the percentage of the non-poor population by both measures. While in 1997, 32 % of the population was neither income nor multidimensionally poor; in 2010, this proportion increased 17 % points, reaching 49 % of the Colombian population.

Between 1997 and 2010 the proportion of population differently classified by both measures, multidimensional poverty and income poverty, has remained fairly stable around 29 %. However, while in 1997 the greater proportion of differently classified population was mainly CMPI poor but income non-poor, in 2010 the greater proportion of this population corresponds to income poor population. In other words, whereas the percentage of the multidimensionally poor but non-income poor population decreased from 20 to
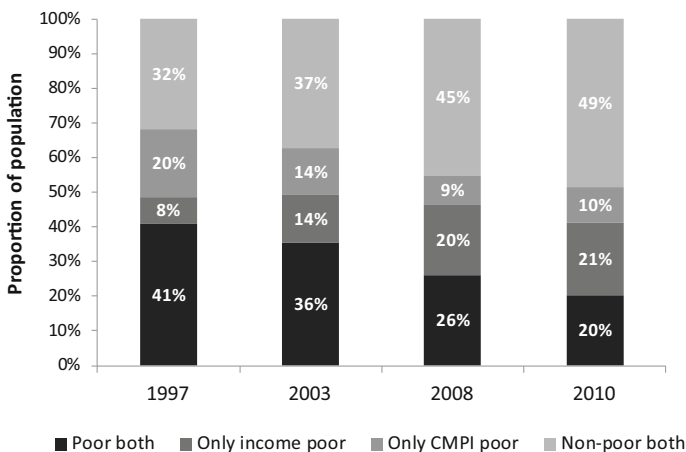

Fig. 5 Proportion of population by poverty category: multidimensional poverty and income-based poverty. *Source*: LSMS
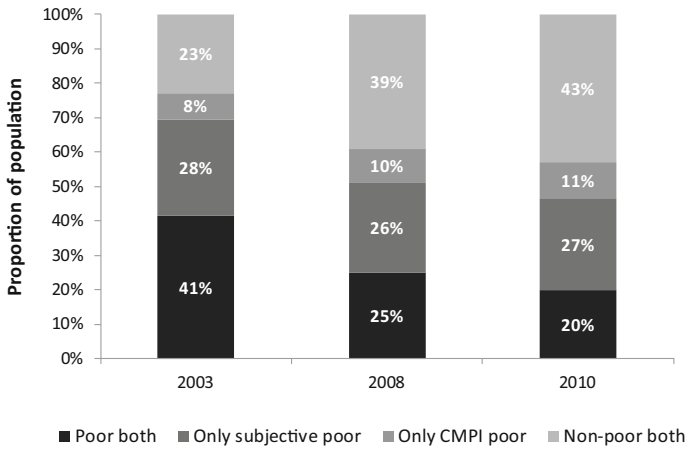
Fig. 6 Proportion of population by poverty category: multidimensional poverty and subjective poverty.
Source: LSMS. *Note*: The subjective poverty measure is not available in the 1997 LSMS

10 % between 1997 and 2010, the percentage of multidimensionally non-poor that are under the poverty line (poor by income) increased in this period from 8 to 21 %. These results might imply that in spite of households experiencing better living conditions (e.g. health, education, and housing conditions), income-generating programmes have not been sufficient to increase the monetary resources at home.

When comparing subjective poverty with multidimensional poverty, we observe similar results for the population being poor and non-poor by both measures. Between 2003 and 2010, the percentage of people that are multidimensionally poor and perceive themselves as poor (subjective poverty) decreased from 41 to 20 %. The non-poor population by both measures, on the other hand, increased from 23 to 43 %. For the remaining groups, however, results were different from the comparison made above. As can be seen in Fig. 6, the percentage of people multidimensionally non-poor that are subjectively poor remained relatively constant in this period at around 27 %. The latter might probably indicate that subjective poverty is more commonly associated with income than with living condition indicators.

4 Policy Applications

The CMPI was developed as a tool for tracking the success of public policy. This section outlines some of the ways in which it has been applied by Colombian government agencies, and it also outlines other possible applications.

4.1 A National Index to Track Overall Poverty, Including Sectoral Goals

Given that the indicators included within the CMPI index have been selected on the basis that they may be altered by public policy, the CMPI can be used to measure the achievements of poverty reduction strategies set forth in the National Development Plan (NDP). Thus, the Colombian government decided to include several targets derived from

Table 7 Multidimensional poverty incidence (H) goal for the NDP

Measure	2008 (baseline)	2014	Difference
Headcount ratio (CMPI)	34.7 %	22.5 %	−12.2 %
Absolute number of poor people by CMPI	15,421,703	10,701,692	−4,720,011
Absolute number of non-poor people by CMPI	29,029,444	36,960,095	7,930,651

Source: LSMS

the CMPI in its 2010–2014 NDP. Targets based on the headcount ratio are shown in Table 7: for example, one goal was to decrease H from a baseline of 34.7–22.5 % by 2014.

Each government department set its own targets for improvement (see Table 9 in the "Appendix"). Following this, the aggregate effect of these improvements was simulated using the CMPI algorithm on the LSMS data, with a random assignment of improvements over the poor population. The resulting counter-factual estimate of H became the overall poverty target for the NDP; the target numbers of poor and non-poor people shown in Table 7 are also the result of this exercise. Additionally, although the government's CMPI goal is expressed in terms of the headcount ratio (H), the same methodology also allows for estimation of the adjusted headcount ratio ($M0$), the adjusted poverty gap ($M1$) and the multidimensional poverty severity ($M2$).

4.2 Micro-Simulations of the Effects of Public Policy

The direct relationship between the CMPI and the NDP offers additional advantages in terms of policy design. One example is the possibility of estimating the cost of reducing multidimensional poverty through different areas of social expenditure, as performed by Conpes (2012). This is possible since there is precise budgetary information for the accomplishment of NDP goals. Another advantage is the possibility of measuring regional achievements as components of progress towards the aggregate goal.

Also, the method of micro-data imputation may be used in the construction of counterfactual scenarios to evaluate the effect of public policy on CMPI behaviour. For example, the effect on multidimensional poverty from the implementation of a policy on a specific dimension could be analysed. By inputting the microdata on the expected effect of the policy on a specific dimension, while holding everything else constant, one may uncover the impact of public policy on multidimensional poverty reduction in that dimension. Similarly, it offers the possibility of analysing the effectiveness of the targeting of social programs by simulating different achievements according to the targeting instrument.

4.3 Geographical Targeting

With the purpose of improving information on poverty at the municipal level in Colombia, a CMPI proxy[13] was constructed using Census data from 2005. New poverty maps for

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[13] Due to differences between the information available in the LSMS and the Census, some of the indicators used to calculate the CMPI at the municipal level were adapted according to Census data 2005: (1) the long-term unemployment indicator is replaced by the economic dependence rate, (2) a proxy for adequate nutrition is constructed for the childcare indicator, which considers a household in deprivation if the child did not receive any of the three basic meals one or more days of the previous week due to lack of money, and (3) access to healthcare services refers to the previous 12 months.

Colombia have been constructed from the information obtained, which have become a source for geographic targeting. This information has been used for prioritizing investment projects funded by transfers from the national level to the municipalities and was also used for differentiating conditional transfers for the program "Mas Familias en Accion" across regions.

Multidimensional Poverty Incidence (H) at the municipal level is shown in Fig. 7. A clear imbalance is seen between the urban and rural areas in terms of poverty and quality of life. Urban areas have a lower percentage of multidimensionally poor people than rural areas. Only 11 % of municipalities in Colombia have a headcount ratio of less than 50 %. On the opposite side, 30 % of municipalities have an incidence of more than 80 %.

Consequently, on average, a poor household in the central area faces fewer deprivations. Households in most municipalities (60 %) suffer, on average, less than 50 % of all possible deprivations. In only 6 % of municipalities do households suffer, on average, 60 % of all possible deprivations.

4.4 Social Promotion of Families from the Extreme Poverty Reduction Strategy—UNIDOS

The main strategy used by the Colombian government for the reduction of extreme poverty is the UNIDOS safety net. It operates through the joint work of governmental agencies, municipalities and families to promote income generation, wealth and improvement in life conditions.
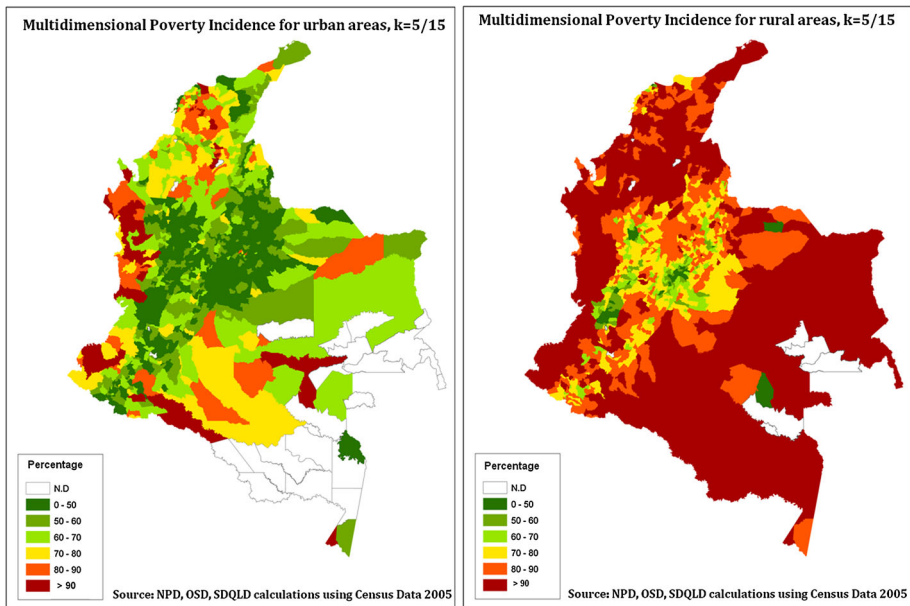
Fig. 7 Multidimensional poverty gap ($M1$) and severity ($M2$) for different values of k across municipalities, 1997–2010

In 2007, when the program began its operation, a household was eligible if it belonged to the poorest 1,500,000 households according to the SISBEN score, or in case it was catalogued as either a displaced or an indigenous household. After this first targeting process, there were no more families included within the safety net. However, UNIDOS is not a permanent program of support. Rather, it is dependent on a family's living conditions; therefore, once the situation of extreme poverty is resolved by the family, the accompanying support ends. Consequently, nowadays the CMPI (specifically the headcount ratio, H) is used to help in identifying current beneficiary households that are eligible to be "promoted", that is, current UNIDOS families whose living conditions are sufficiently favourable as to allow them to generate means of self-sufficiency without the network's support.

This promotion mechanism is done in two stages; firstly, the CMPI is used as a means of geographical targeting of municipalities with potential families to be promoted. In this matter, municipalities with potential families to be promoted are the ones that belong to the 2nd and 3rd quintiles of the municipal CMPI headcount ratio (as described in Sect. 4.3 above).

The second stage of the promotion mechanism occurs at the household level. Together with a measure of income sufficiency, the CMPI is used to verify whether the family is not in extreme poverty by income (whose income is below the extreme poverty line) or is multidimensional poor ($k = 33\%$). These settings satisfy the sufficient conditions for a household to leave the program, although the necessary condition to be promoted from the UNIDOS safety net is the fulfilment of the achievements prioritized by the household itself in its Family Plan.

5 Possible Further Development of the CMPI

A number of unexplored topics arose from the exercise carried out for selecting the CMPI dimensions, indicators and weights, as well as from the experience of presenting the results and methodology in different seminars. This section includes a discussion of such topics and improvements to consider for the near future regarding the design of the CMPI.

In general terms, the possibility of including indicators to measure the quality of basic services needs to be discussed. In countries like Colombia, where health services, education and public utility coverage have greatly improved, there is a need for finding new indicators that capture deprivation in those aspects, beyond coverage. In this way, the inclusion of indicators on the quality of services is considered.

Indicators related to the quality of employment could offer more information on the population's living conditions. In the case of Colombia, place of employment, number of working hours and type of contract were analysed as possible indicators to be included; however, a consensus on the parameters for selecting of the cut-off point under which a person is considered deprived was difficult to establish. There was, for example, difficulty in establishing a direct relation between the 14 categories[14] in the survey for place of employment and the deprivation condition. On the other hand, these indicators have a

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[14] At a company or hired individual's location, at a rented or own location, at home, in someone else's home, on the street, in a kiosk or stand, door to door, in a vehicle (taxi, car, bus, motorboat, boat), in a mine or quarry, in a construction site, in a farm or land, owned, rented or crop shared, somewhere else (ocean or river).

strong correlation to formal employment; therefore, in the case of Colombia, these indicators were excluded from the index in order to avoid capturing the same phenomena thought several indicators and consequently producing duplication.

Other aspects, such as security, dignity and subjective and/or psychological well-being, are frequently discussed as possible dimensions to be considered as part of the index. In the report from the Commission on the Measurement of Economic Performance and Social Progress CMEPSP (2009), presided over by Stiglitz, Sen and Fitoussi, for example, the eight minimum dimensions that should be simultaneously considered to measure well-being were the following: (1) material living standards (income, consumption and wealth), (2) health, (3) education, (4) personal activities including work, (5) political voice and governance, (6) social connections, (7) environmental conditions and (8) economic and physical security.

It is worth noting that the possibility of including these aspects is limited to the availability of information in the survey. Therefore, it is important to move toward the inclusion of the required information in the survey used.

On the other hand, in relation to the weighting system, several approaches to set weights in a multidimensional context exist. Although the current version of the CMPI already compared three alternative weighting systems, other normative or hybrid approaches might be worth exploring. This is the case of weighting structures that correspond to budget allocation for each dimension, or weights determined according to revealed preferences. Battiston et al. (2009) and Santos et al. (2010), for example, assigned weights based on the Voices of the Poor study, in which the poor population was asked about their assessment of different dimensions.

6 Concluding Remarks

This paper describes the elements and features that were used when designing the CMPI launched by the Colombian government in August 2011. This paper also outlines public policy applications for the index and describes the main results in terms of trends of poverty rates within the whole country and across urban and rural areas. It is worth highlighting that at the time of this paper's writing, the CMPI was being used as public policy tool in the Colombian context to track deprivations across the country, to monitor public policies by sector and to design the poverty reduction goals of the 2010–2014 national development plan.

Multidimensional indices of poverty involve the selection of a parameter k, as a threshold of deprivation. We selected values for this parameter based on statistical criteria, empirical analysis and comparability with other work in the area; however, our analysis included dominance techniques, which showed that our estimates were robust to different choices of k. We find that multidimensional poverty in Colombia decreased between 1997 and 2010, and this finding is robust over a wide range of values of k.

Larger reductions in poverty were observed over the 5-year period between 2003 and 2008, compared to the preceding 5-year period between 1997 and 2003. This may be explained by the large increase education coverage (at all levels), access to childcare services and health insurance coverage between 2003 and 2008, which thus contributed to a reduction in household deprivation rates, which is still ongoing.

In contrast, the indicators that are most difficult to change quickly via public policy, and consequently those that continue to show the greatest proportion of deprivation, are formal employment and educational achievement for the population 15 and older. In 2010, 81 % of households faced deprivation in formal employment. This means that in 81 % of households, at least one employed member held an informal job. On the other hand, 55 % of households faced deprivation from sufficient educational achievement for people 15 and older; that is, in 55 % of households, the average educational achievement of people 15 and older was less than nine academic years.

The analysis of urban and rural areas shows that regardless of the reduction in all multidimensional poverty measurements (*H, M0, M1* and *M2*) in both urban and rural areas, imbalances remain. In fact, the imbalance between urban and rural areas has steadily increased for all analysed multidimensional measures between 1997 and 2010, particularly with regard to the rural/urban ratio for the multidimensional poverty headcount (*H*), which increased from 1.7 to 2.2.

Finally, regarding the multidimensional poverty gap (*M1*) and severity (*M2*), a greater reduction in severity (*M2*) is observed, suggesting that poverty reduction achievements have reached the poorest population through targeting.

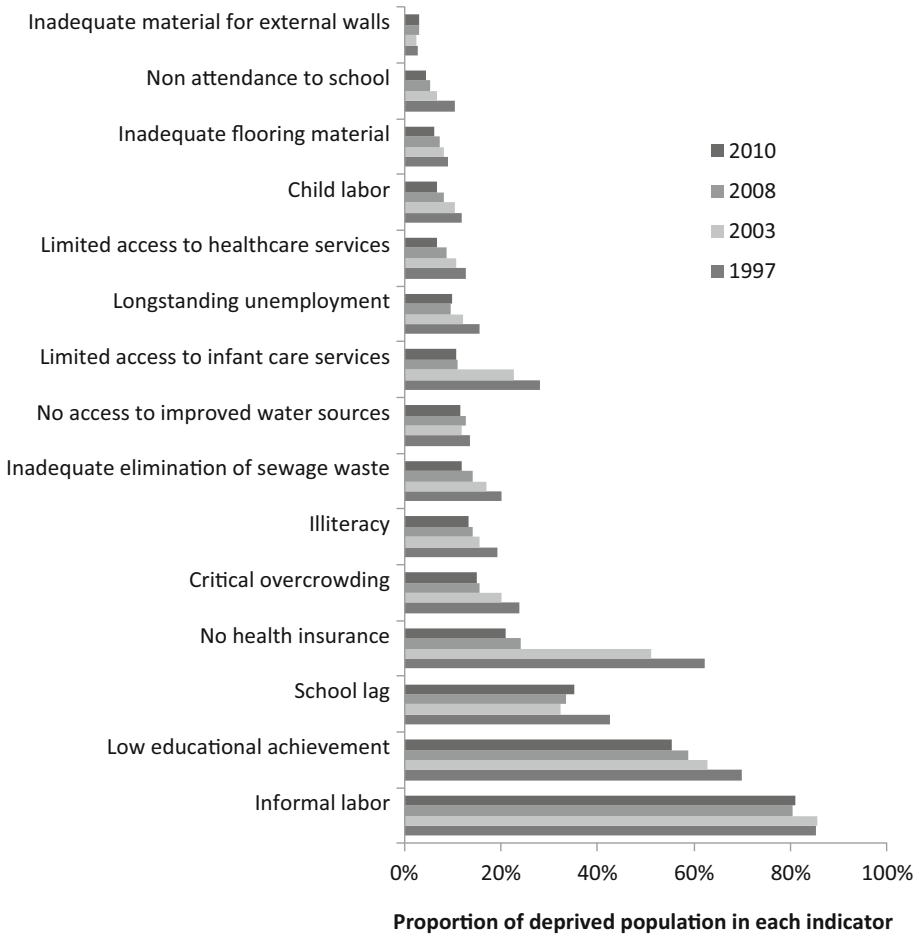# Appendix

See Figs. 8, 9, 10, 11 and Tables 8, 9.

Fig. 8 Proportion of deprived population across the CMPI considered indicators, 1997–2010 Raw headcount ratios. *Source*: LSMS
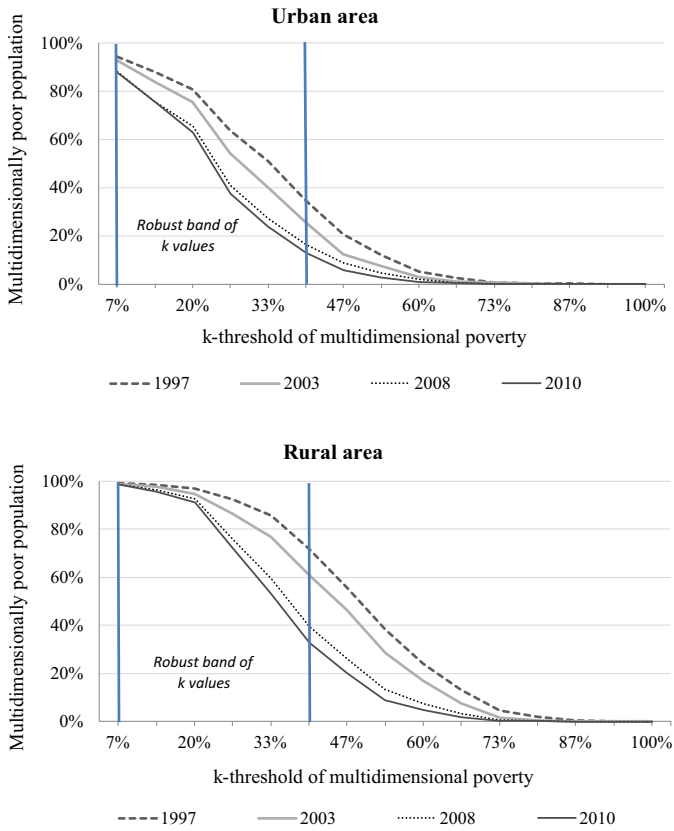
Fig. 9 Multidimensional poverty headcount ratio H for different values of k, urban and rural areas.
Source: LSMS

Urban area

Rural area
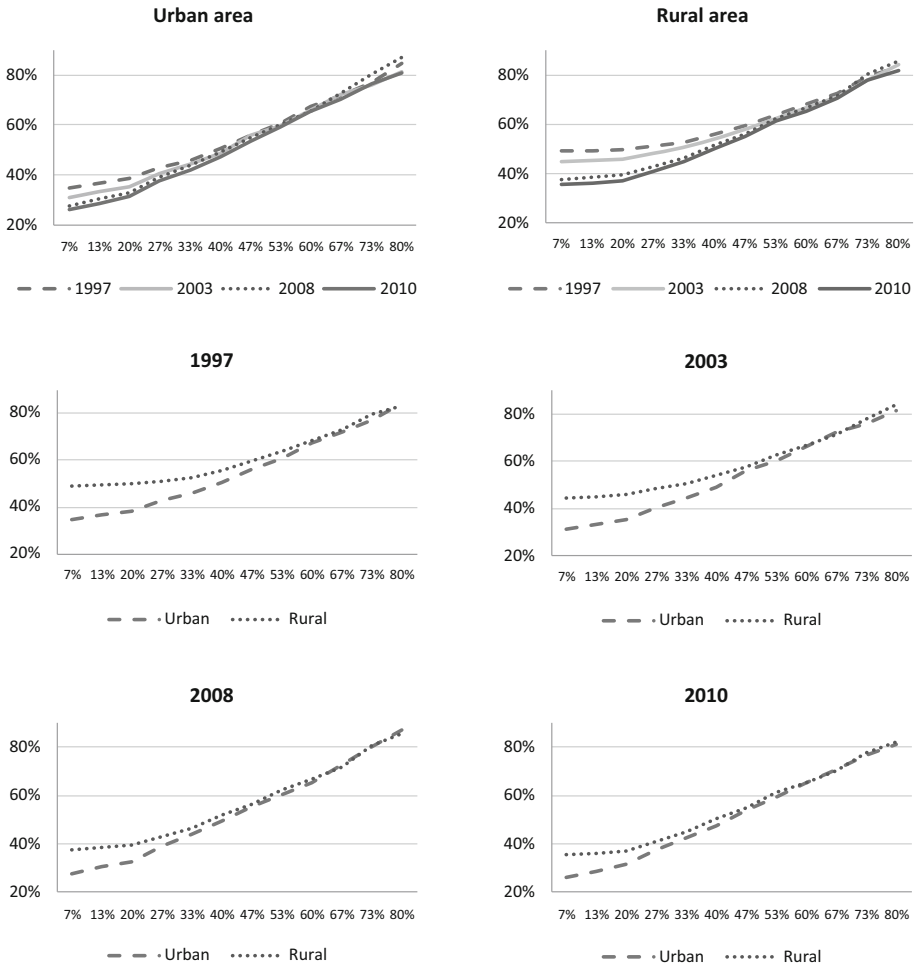
1997

2003

2008

2010

Fig. 10 Average deprivation rate suffered among the poor population (A) for different values of k, urban and rural areas.
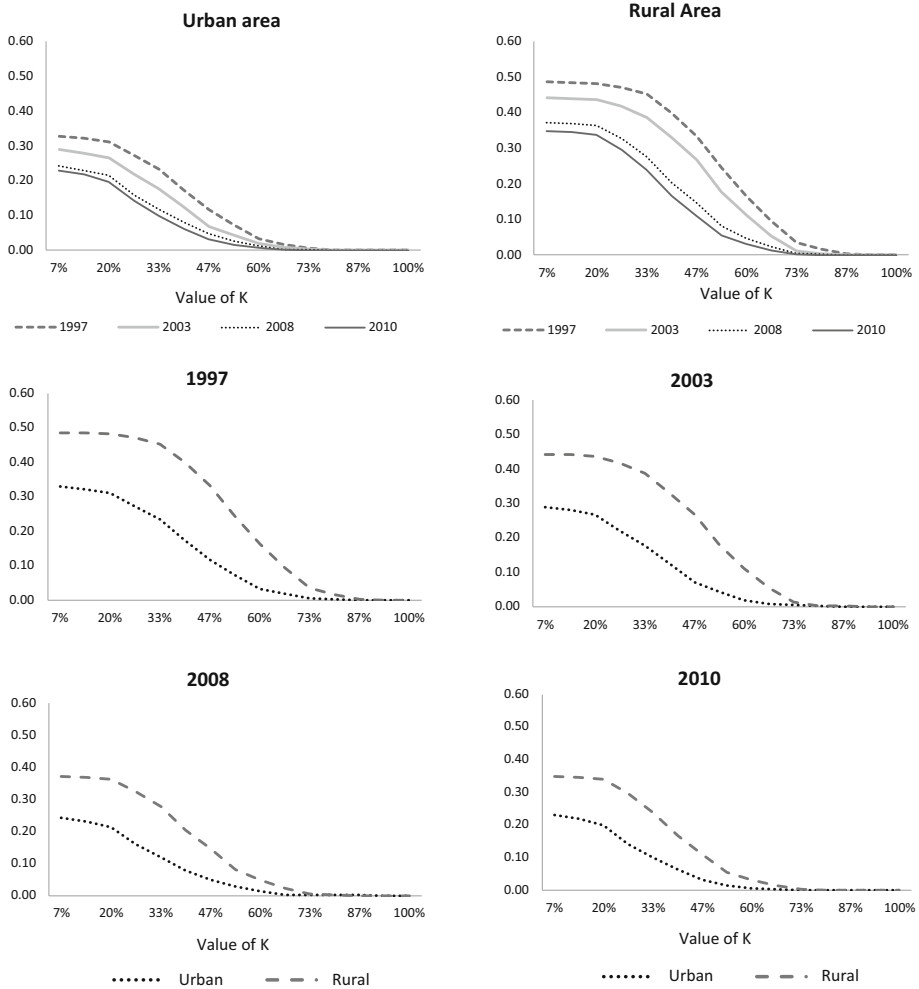*Source*: LSMS

Fig. 11 Adjusted multidimensional headcount poverty ratio ($M0$) for different values of k, urban and rural areas.
Source: LSMS

Table 8 Indicators' redefinition for calculating the adjusted gap in each dimension in which poor households are deprived

Variable	Cutoff point for each indicator	Poverty gap calculation
Education (9 + years of schooling)	Household ave. 9 years	$\left(1 - \dfrac{People\ 5\ years\ old\ and\ over\ with\ 9\ or\ more\ schooling\ years}{People\ 15\ years\ old\ and\ over\ in\ the\ household}\right) \times 100$
		Note: The cutoff point for the calculation of H is a household average of 9 years of education, while the poverty gap is calculated as the percentage of adults who have fewer than 9 years of education. This means that some households which are not classified as deprived on this indicator for the purposes of H, will have one or more adult members with fewer than 9 years of schooling, and thus would be indicated as having a poverty gap on this indicator. However, the gap for these households is not included in the calculations of M1 and M2, because gaps are defined only for households deprived on each dimension
Literacy	100 %	$\left(1 - \dfrac{People\ 15\ years\ old\ and\ over\ that\ know\ how\ to\ read\ and\ write}{People\ 15\ years\ old\ and\ over\ in\ the\ household}\right) \times 100$
School attendance	100 %	$\left(1 - \dfrac{Children\ between\ 6\ and\ 16\ years\ old\ attending\ school}{Children\ between\ 6\ and\ 16\ years\ old}\right) \times 100$
No school lag	100 %	$\left(1 - \dfrac{Children\ between\ 7\ and\ 17\ years\ old\ with\ no\ school\ lag}{Children\ between\ 7\ and\ 17\ years\ old}\right) \times 100$
Access to childcare services	100 %	$\left(1 - \dfrac{Children\ between\ the\ ages\ of\ 0\ and\ 5\ in\ the\ household\ with\ simultaneous\ access\ to\ health,\ nutrition,\ and,\ education}{Children\ between\ 0\ and\ 5\ years\ old}\right) \times 100$
Children not working	100 %	$\left(1 - \dfrac{Children\ between\ 12\ and\ 17\ years\ old\ that\ are\ not\ working}{Children\ between\ 12\ and\ 17\ years\ old}\right) \times 100$
No one in longterm unemployment	100 %	$\left(\dfrac{Longterm\ unemployed}{Economically\ Active\ Population}\right) \times 100$
Formal employment	100 %	$\left(1 - \dfrac{Employed\ and\ affiliated\ to\ a\ pensions\ fund}{Adjusted\ Economically\ Active\ Population}\right) \times 100$
		Note: As previously explained long-term unemployed are removed from the denominator in order to avoid counting them in deprivation twice. On the other hand, children under the age of 18 who hold a job are also eliminated in order to be congruent with the non child labor policy
Health insurance	100 %	$\left(1 - \dfrac{People\ over\ 5\ years\ old\ with\ health\ insurance}{People\ over\ 5\ years\ old}\right) \times 100$

Table 8 continued

Variable	Cutoff point for each indicator	Poverty gap calculation
Access to health services	100 %	$\left(1 - \dfrac{\text{People with access to a health institution, doctor or dentist}\atop{\textit{in case of need}}}{\text{People in need of health care}}\right) \times 100$
Critical overcrowding	*Urban*: three or more people per room	$\left(1 - \left(\dfrac{(\textit{Number of rooms} \times 3) - 1}{\textit{Total household members}}\right)\right) \times 100$
	Rural: more than three people per room	$\left(1 - \left(\dfrac{(\textit{Number of rooms} \times 3) - 1}{\textit{Total household members}}\right)\right) \times 100$

Table 9 CMPI association with NDP sector goals

CMPI		National Development Plan Goals 2010–2014		
Dimension	Variable—indicator	NPD indicator	Baseline 2009	Goal 2014
Household educational conditions	Average education achievement	Average number of completed school years by the population between the ages of 15 and 24	9.15 completed school years	9.80 completed school years
	Literacy	Illiteracy rate (15 and older)	6.70 %	5.70 %
Childhood and youth conditions	School attendance	Gross rate of secondary school coverage	79.27 %	91.0 %
	No school lag	School desertion rate per year (preschool, elementary and secondary)	5.15 %	3.80 %
	Access to childcare services	N.A		
	Children not working	Number of boys, gilds and adolescents (5–17 years of age) in the job market	1,768,153	1,149,300
Health	Health insurance	Affiliated to a contributory system	18,116,769	19,593,047
		Coverage of a subsidized system	90.27 %	100.00 %
	Access to health services	N.A		
Access to public utilities and housing conditions[a]	Access to water source	Water service coverage 91.79 households	94.12 % households	
	Adequate elimination of sewer waste	Sewer service coverage	87.48 % households	90.76 % households
	Adequate flooring	Percentage of households with shortfalls in building materials	9.40 %	6.70 %
	Adequate exterior walls			
	No critical overcrowding	Percentage of households with critical overcrowding	12.50 %	8.20 %

[a] 2014 goals for access to public utilities and housing conditions dimension were agreed upon by the Division of Urban Development of the National Planning Department

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