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# Assessing distributional changes of multidimensional poverty reduction in Colombia

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## Abstract

Colombia has recently adopted the multidimensional poverty index (MPI) proposed by Alkire and Foster (2007), and it is used to assess the achievements of the social public policy. Since 2010, the National Administrative Department of Statistics (Departamento Administrativo Nacional de Estadística - DANE) annually reports the incidence of multidimensional poverty. According to the results based on Quality of Life Surveys (QLS), one can conclude that poverty rates in Colombia have decreased significantly at the national, urban, and rural levels, and across seven regions between 2010 and 2013.

However, little has been said about the distributional changes of poverty reduction. Alkire and Seth (2014a) have proposed a separate decomposable inequality measure, in order to capture inequality in deprivation counts among the poor and among population subgroups (urban/rural, regions, races, etc.) and to understand if the poverty reduction during this period has reached the poorest of the poor.

For the Colombian case, we replicate this methodology using the 2010 and 2013 QLS, obtaining results to assess inequality among the poor at the national, rural and urban levels and across seven regions. The main questions we aim to answer, in words of Alkire and Seth (2014b:21) , are: What has happened to inequality among the poor? Has the poverty reduction been pro-poorest?

The results show that reductions of incidences at the national, rural and urban levels and across seven regions have been accompanied by a reduction in inequality among the poor. This reduction is important especially at the rural level and in three out of the seven regions. Also, when analyzing poverty reduction, not through the incidence but using the value of MPI, one can say that it is has been pro-poorest.

Taking into account that the MPI is actually used for designing and monitoring social public policy, incorporating not only the incidence but also inequality will help reach the poorest of the poor. Further research should address inequality using previous QLS, as well as Population Census data. This will allow a more in-depth analysis in terms of time and the evolution of multidimensional poverty spatial patterns when analyzing at a more disaggregated level (municipalities).

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# Introduction

Colombia adopted the multidimensional poverty index (MPI) proposed by Alkire and Foster (2007, 2011), and it is used to assess the achievements of the social public policy. Since 2010, the National Administrative Department of Statistics (Departamento Administrativo Nacional de Estadística - DANE) annually reports the incidence of multidimensional poverty. According to the results based on Quality of Life Surveys (QLS), one can conclude that poverty rates in Colombia have decreased significantly at the national, urban, and rural levels, and across seven regions between 2010 and 2013.

However, little has been said about the distributional changes of poverty reduction. Alkire and Seth (2014a; 2014b) have proposed a separate decomposable inequality measure, in order to capture inequality in deprivation scores among the poor and among poor and non-poor, as well as population subgroups (urban/rural, regions, races, etc.). This measure also helps understand if poverty reduction has reached the poorest of the poor.

For the Colombian case, we replicate this methodology using the 2010 and 2013 QLS, obtaining results to assess inequality at the national level and two subgroups: rural and urban levels and across seven regions. The three main questions we aim to answer are: What has happened to inequality among the poor? What has happened to inequality among the poor and non-poor? What has happened to inequality in subgroups? Has the poverty reduction been pro-poorest?

The results show that reductions of incidences at the national, rural and urban levels and across seven regions have been accompanied by a reduction in inequality among the poor and among the poor and non-poor, at the national level and almost all subgroups (urban/rural and regions). Also, the changes in the distribution of deprivation scores among the poor reinforces inequality results pointing out that poverty reduction in Colombia have been pro-poorest.

This paper is divided into three main parts. The first one presents the Colombian multidimensional poverty measure (incidence and intensity), the inequality measure proposed by Alkire and Seth (2014a; 2014b) and the data used. The second one presents the results and finally we address some conclusions.

## I.    Methodology and Data

### 1.1   Multidimensional Poverty: Incidence and Intensity

The Multidimensional Poverty Index (MPI) developed by Alkire and Foster (2007, 2011) and adapted for Colombia by the National Planning Department (Angulo et al, 2011), identifies poor peoples' experiences of deprivation along fifteen variables grouped in five dimensions: education of household members; childhood and youth conditions; health; employment; and access to household utilities and living conditions.

This index has a nested weighting structure where each dimension is equally weighted (0.2). A person is identified as multidimensionally poor ($q$) when deprivation scores are at least 0.33 (or 5/15). Incidence is defined as the share of poor population: $H = q/n$ and intensity is the average deprivation score among the poor: $A = \left[\sum_{i=1}^{q} a_i\right]/q$, where $a_i$ is the deprivation score of person i.

### 1.2 Inequality Measure

The measure proposed by Alkire and Foster is based on a counting approach; this means poor are identified by counting the number of deprivations among different indicators and dimensions, so the way to capture inequality is by observing changes in the distribution of deprivation scores. It is relevant to analyze four types of situations: a) inequality in deprivation scores among the poor; b) inequality in deprivation scores among the poor and non-poor; c) inequality in deprivation scores within sub-groups (urban/rural and regions); and d) inequality in deprivation scores between sub-groups (Alkire and Seth, 2014a).

The measure proposed by Alkire and Seth (2014a; 2014b) is a separate decomposable inequality measure – a positive multiple of "variance" – that captures the distribution of deprivation scores. Inequality is measured using the following equation:

Equation 1

$$I(x) = \frac{\alpha}{t} \sum_{i=1}^{n} [x_i - \mu(x)]^2$$

Where:

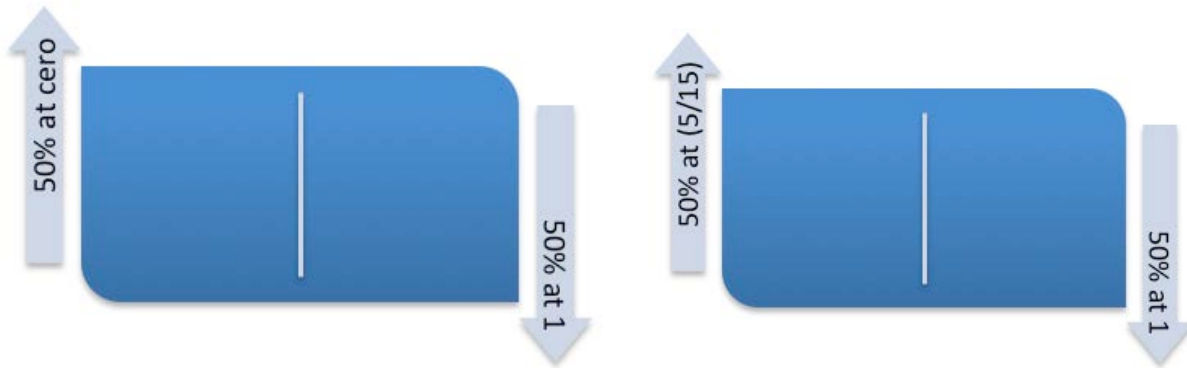$x_i$      is the deprivation score of the $i$-th person for $i$=1, 2,…n
$\mu(x)$      is the average deprivation score
$t$      is the population, where $t \leq n$
$\alpha$      is the value that bounds inequality between [0,1]

The minimum value of inequality $I(x)$ is 0 when all $x$ takes the same value and the maximum value when half of the population presents the maximum value of deprivation (1) and the other half the minimum value (0); therefore, it is equal to ¼ of the range.

The coefficient $\alpha$ makes $I(x)$ range between 0 and 1, and it is the inverse of the maximum variance. When we take the whole population then deprivation scores range between 0 and 1, if half of the population has 0 as deprivation score and the other half has 1, then the average is ½ and the maximum variance is ¼, as said before. Then $\alpha$ is equal to 4. When we take only the poor then deprivation scores range between 5/15 and 1, if half of the population has 5/15 as deprivation score and the other half has 1, then the average is 2/3 and the maximum variance is 1/9, then $\alpha$ is equal to 9.

Illustration 1



Average = (1/2)          Average = (2/3)
Maximum variance = (1/4)  Maximum variance = (1/9)

Now, inequality can be analyzed by sub-groups; in this case we will study inequality for the urban/rural levels and seven regions. Equation 2 shows how it is desegregated. The first term is the Total Within-group inequality, which is the sum of the share of group $l$ in total population multiplied by the inequality $I(x^l)$. The second term is the Between-group inequality, which is the sum of the share of group $l$ in total population multiplied by the square difference between the average score of deprivation of group $l$ and the average score of deprivation of the total population; all this multiplied by $\alpha$, that will take the value of 4 if taking the whole population or 9 if it's only the poor.
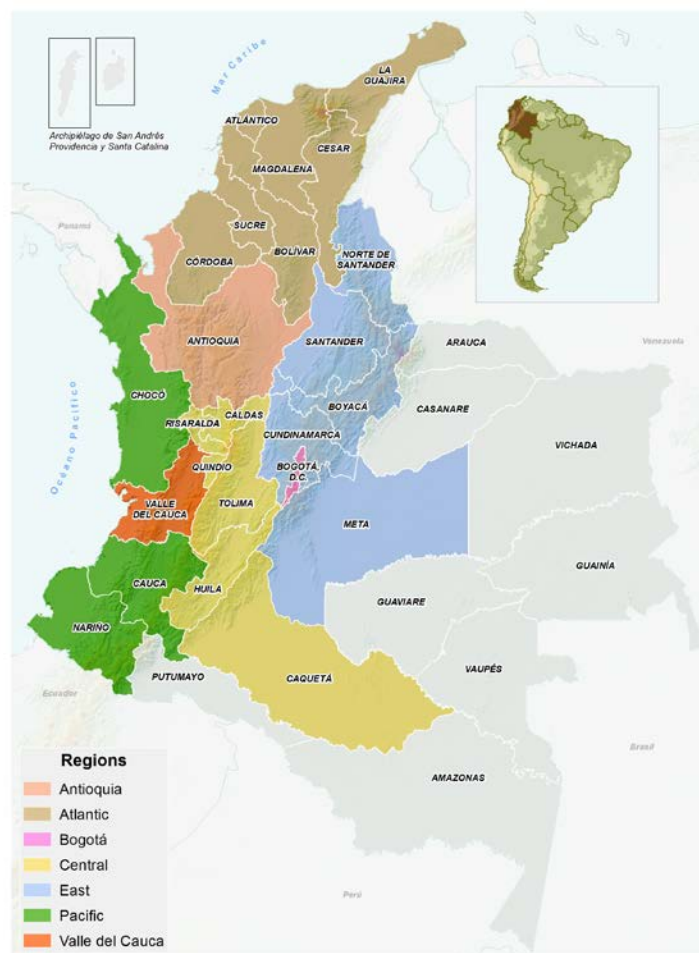
Equation 2

$$I(x) = \left[ \sum_{l=1}^{m} \frac{t^l}{t} I(x^l) \right] + \alpha \sum_{\varrho=1}^{m} \frac{t^l}{t} [\mu(x^l) - \mu(x)]^2$$

Total Within-group          Between-group

### 1.3 Data

The multidimensional poverty incidence, intensity and inequality were calculated using the 2010 and 2013 Quality of Life Surveys (QLS) for the national, urban, and rural levels, and seven regions (Map 1).

Map 1 Quality of Life Survey Regions



## II. Results

2.1 Incidence and Intensity

Between 2010 and 2013 multidimensional poverty incidence and intensity decreased at all levels and all regions (Table 1). At the national level incidence decreased by 5.6 percentage points and intensity by 0.007 points, at the urban by 5.0 percentage points and 0.003 points and at the rural by 7.2 percentage points and 0.015 points, was the largest reduction.

Table 1 Multidimensional poverty incidence and intensity

| Levels | Incidence | | | Intensity | | |
|---|---|---|---|---|---|---|
| | 2010 | 2013 | 2013-2010 | 2010 | 2013 | 2013-2010 |
| **Total** | 30.4 | 24.8 | -5.6 | 0,432 | 0,424 | -0,007 |
| **Urban** | 23.5 | 18.5 | -5.0 | 0,421 | 0,418 | -0,003 |
| **Rural** | 53.1 | 45.9 | -7.2 | 0,448 | 0,433 | -0,015 |

By regions, incidence and intensity have also declined during the period 2010-2013. The Atlantic region and Valle del Cauca decreased the most in terms of incidence and intensity, by 8.1 percentage points and 7.9 in incidence and 0.012 and 0.027 in intensity, respectively; and the lowest reductions in incidence occurred in Bogota and the East region, 3.4 and 3.8 percentage points, respectively; but in terms of intensity the lowest reductions occurred in the Pacific region and Antioquia, 0.001 and 0.002 points, correspondingly (Table 2).

Table 2 Multidimensional poverty incidence and intensity by regions

| Regions | Incidence | | | Intensity | | |
|---|---|---|---|---|---|---|
| | 2010 | 2013 | 2013-2010 | 2010 | 2013 | 2013-2010 |
| Atlantic | 45.5 | 37.4 | -8.1 | 0,454 | 0,442 | -0,012 |
| East | 28.6 | 24.8 | -3.8 | 0,423 | 0,412 | -0,011 |
| Central | 31.2 | 26.1 | -5.1 | 0,423 | 0,418 | -0,005 |
| Pacific | 42.7 | 37.6 | -5.1 | 0,437 | 0,436 | -0,001 |
| Bogota | 12.1 | 8.7 | -3.4 | 0,396 | 0,403 | 0,007 |
| Antioquia | 27.8 | 22.4 | -5.4 | 0,420 | 0,418 | -0,002 |
| Valle del Cauca | 24.1 | 16.2 | -7.9 | 0,419 | 0,392 | -0,027 |

The previous results point out that there are less poor and also that poor households lowered their deprivation scores.

## 2.2 Inequality

In order to answer our main questions: What has happened to inequality among the poor? What has happened to inequality among the poor and non-poor? What has happened to inequality in subgroups? Has the poverty reduction been pro-poorest?, we replicate the methodology proposed by Alkire and Seth, described in section 1.2.

Between 2010 and 2013, inequality decreased at the national level (Table 3). By subgroups, we have similar behavior of inequality. At the urban and rural levels, inequality reduced during the period and major reductions happened at the rural level. Still inequality is higher at the urban level (Table 4).

By regions, the lowest inequality in 2013 corresponds to Bogota and Valle del Cauca; however in the last one and the Atlantic region inequality decreased the most, compared to other regions. Antioquia, even though having a similar inequality to the national level, had the lowest decreased. The Pacific region, however, increased inequality levels between 2010 and 2013, along with having high inequality levels compared to other regions different from the Atlantic region (Table 4).

Table 3 Inequality among the poor and non-poor

| Levels | 2010 | 2013 | 2013-2010 |
|---|---|---|---|
| Total | 0.0849 | 0.0781 | -0.0068 |

Table 4 Inequality among the poor and non-poor by subgroups

| Subgroups | 2010 | 2013 | 2013-2010 |
|---|---|---|---|
| Urban | 0.0760 | 0.0709 | -0.0051 |
| Rural | 0.0718 | 0.0646 | -0.0072 |
| Atlantic | 0.0965 | 0.0882 | -0.0083 |
| East | 0.0717 | 0.0664 | -0.0053 |
| Central | 0.0744 | 0.0711 | -0.0033 |
| Pacific | 0.0753 | 0.0780 | 0.0028 |
| Bogota | 0.0591 | 0.0519 | -0.0072 |
| Antioquia | 0.0786 | 0.0765 | -0.0021 |
| Valle del Cauca | 0.0757 | 0.0596 | -0.0161 |

Now, it is desirable to understand to which extent inequality is due to the effect of between or within-groups inequality. Results indicate that in both subgroups the major share corresponds to the within-groups inequality, consistent with the incidence gaps between rural/urban and regions. Reductions during the period 2010 and 2013 occurred in both cases in between-groups inequality (Table 5).

Table 5 Share of the Between-group and Within-group inequality among the poor and non-poor

| Subgroups | Between-groups | | Within-groups | |
|---|---|---|---|---|
| | 2010 | 2013 | 2010 | 2013 |
| Urban/Rural | 11.6% | 11.1% | 88.4% | 88.9% |
| Regions | 9.6% | 9.1% | 90.4% | 90.9% |

On the other hand, replicating the methodology only among the poor shows that inequality decreased at national level between 2010 and 2013 (Table 6). By subgroups, contrary to the previous case, inequality is higher at the rural level than the urban level. Nevertheless, reduction in inequality was only present at the former (Table 7).

Across regions, inequality is highest in the Atlantic and Pacific regions in 2010 and 2013; and the lowest in Bogota for both years. Yet major reductions in inequality among the poor occurred in Valle del Cauca, as happened before in among the poor and non-poor, followed by the East region. In the Pacific region, as well as the previous case, inequality increased during this period (Table 7).

Table 6 Inequality among the poor

| Levels | 2010 | 2013 | 2013-2010 |
|---|---|---|---|
| Total | 0.0643 | 0.0578 | -0.0065 |

Table 7 Inequality among the poor by subgroups

| Subgroups | 2010 | 2013 | 2013-2010 |
|---|---|---|---|
| Urban | 0.0536 | 0.0544 | 0.0008 |
| Rural | 0.0759 | 0.0613 | -0.0147 |
| Atlantic | 0.0730 | 0.0706 | -0.0023 |
| East | 0.0605 | 0.0429 | -0.0176 |
| Central | 0.0598 | 0.0478 | -0.0120 |
| Pacific | 0.0714 | 0.0789 | 0.0075 |
| Bogota | 0.0357 | 0.0295 | -0.0062 |
| Antioquia | 0.0485 | 0.0472 | -0.0013 |
| Valle del Cauca | 0.0549 | 0.0280 | -0.0269 |

Looking at shares, results indicate that in both subgroups the major share corresponds to the within-groups inequality, but it is larger than in the previous case (among the poor and non-poor). Reductions during the period 2010 and 2013 happened in both cases in between-groups inequality (Table 8). In both cases, these reductions show somehow convergence among subgroups.

Table 8 Share of the Between-group and Within-group inequality among the poor

| Subgroups | Between-groups | | Within-groups | |
|---|---|---|---|---|
| | 2010 | 2013 | 2010 | 2013 |
| Urban/Rural | 4.4% | 3.9% | 95.6% | 96.1% |
| Regions | 2.4% | 0.8% | 97.6% | 99.2% |

Results show that inequality only among the poor, as well as among the poor and non-poor in Colombia decreased between 2010 and 2013, at all levels and almost all regions (excepting the Pacific region). However, when comparing the inequality among the poor and non-poor with inequality only among the poor, we have two scenarios.
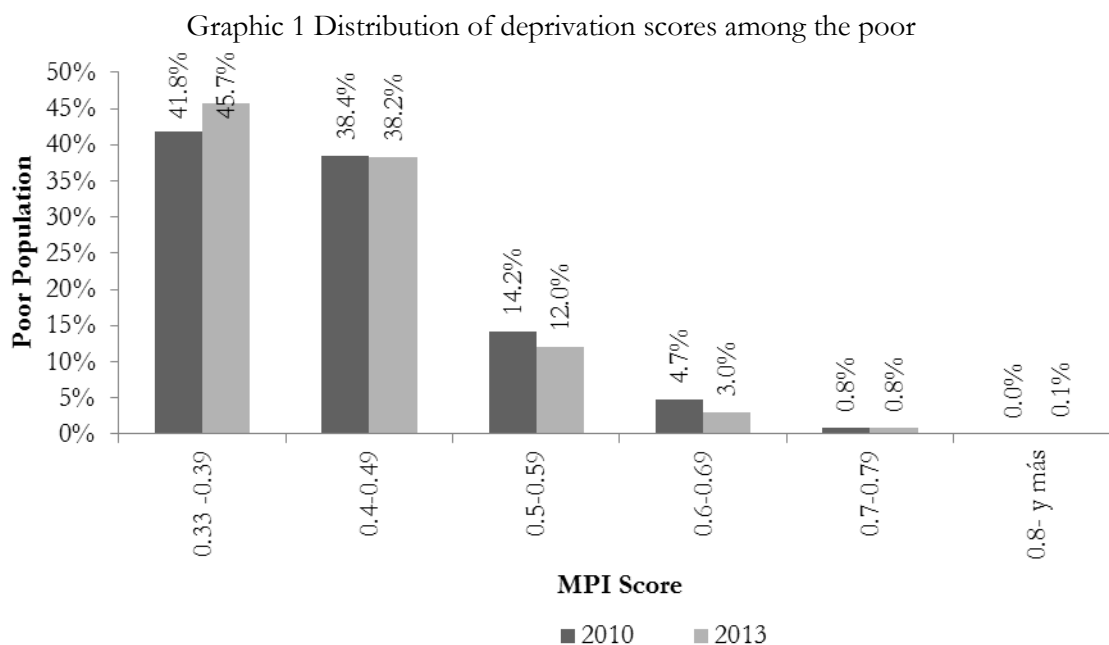
One can say that there are major differences at the national levels and subgroups. For example, at the national level inequality in 2010 and 2013 among the poor was 0.0643 and 0.0578, respectively; and among the poor and non-poor was much higher 0.0849 and 0.0781, respectively. On one hand, this means that there are less differences in deprivation scores among the poor; somehow we could say that poor are more homogeneous. On the other hand, when analyzing the whole population inequality is higher than in the last case; this means that there are more differences in deprivation scores when analyzing poor and non-poor. This situation is similar at urban level and for all regions except the Pacific region.

When comparing results at the rural level and the Pacific regions, it is noticeable that there are not big differences in terms of inequality among the poor and non-poor, and only among the poor: in 2010 at the rural level was 0.0718 and 0.0759 and in 2013 was 0.0646 and 0.0613, respectively; in 2010 in the Pacific region was 0.0753 and 0.0714 and in 2013 was 0.0780 and 0.0789, respectively. Showing that the distribution of deprivation scores among the whole population and among the poor are less scattered.
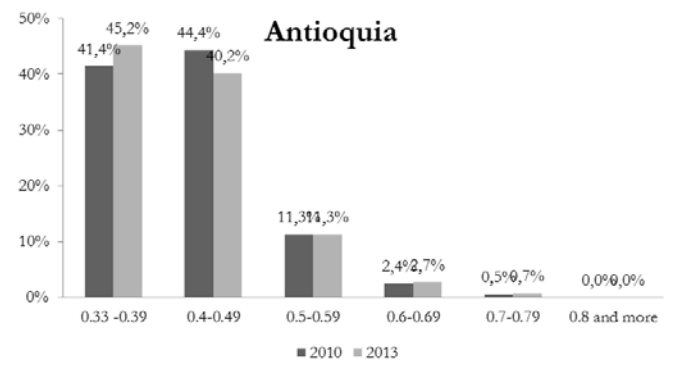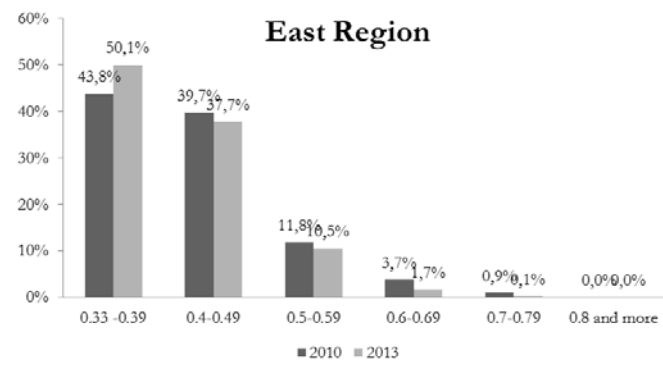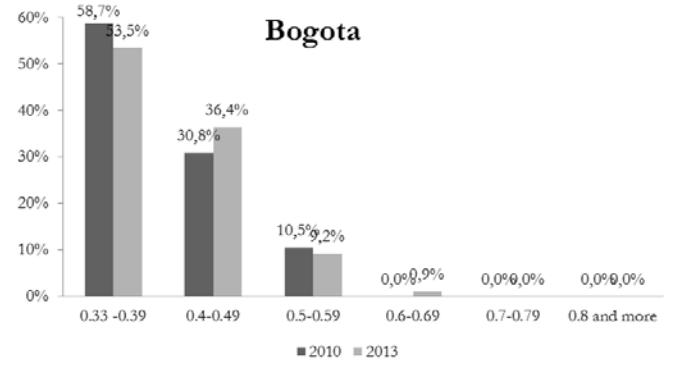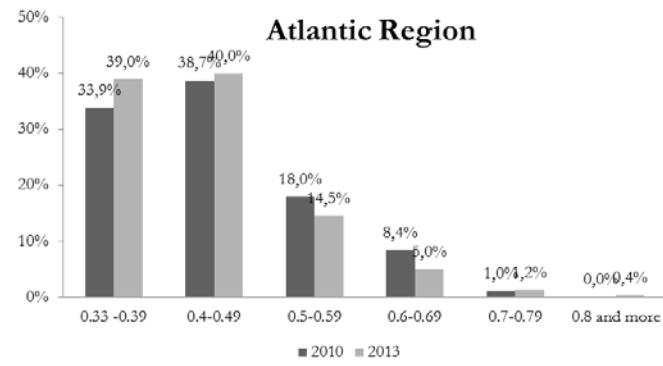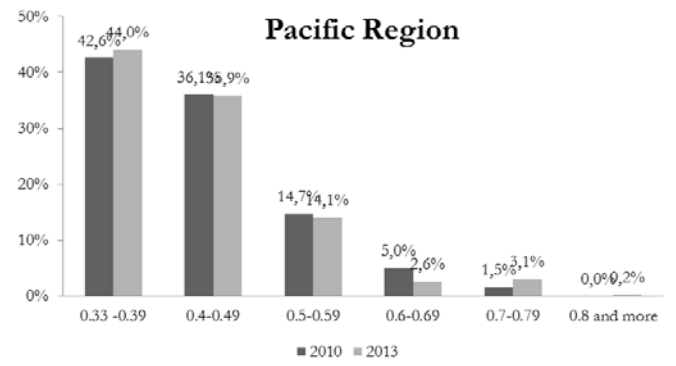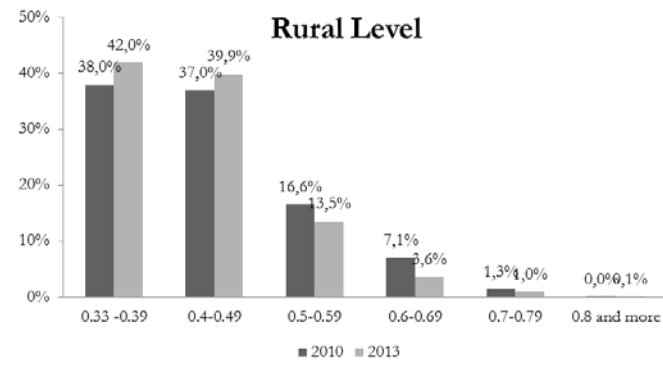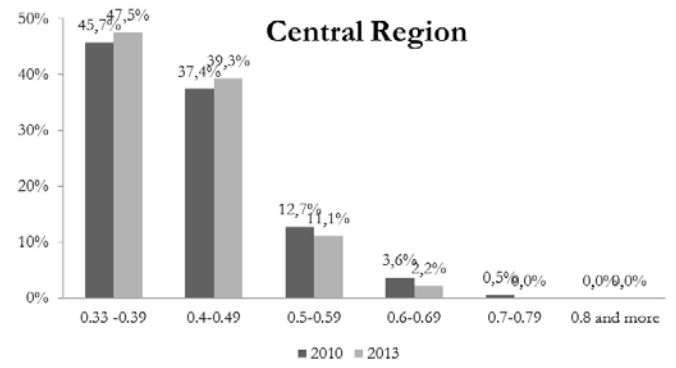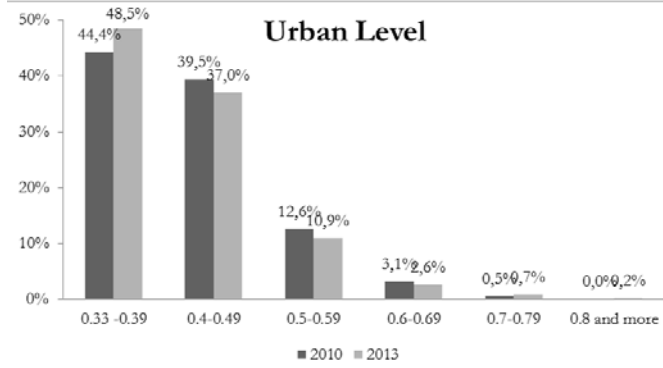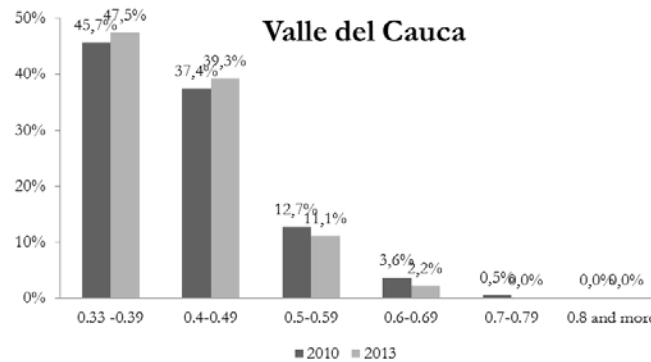
2.3 Distribution of deprivation scores

In order to reinforce previous results, Graphic 1 presents the distribution of deprivation scores among the multidimensionally poor in 2010 and 2013. The ranges of deprivation scores are represented on the horizontal axis and the percentage of population that faces such deprivation scores on the vertical axis. For both years, the graphic indicates that poor's deprivation scores concentrates in ranges 0.33-0.39 and 0.40-0.49; also, between 2010 and 2013 there is a higher percentage of poor population at lower levels of deprivation scores [0.33, 0.39], suggesting that there have been a reduction of deprivation scores among the poor in Colombia, confirming the results presented of the previous section.

The Graphic 2 shows the distribution of deprivation scores among the poor by subgroups in 2010 and 2013. The ranges of deprivation scores are represented on the horizontal axis and the percentage of population that faces such deprivation scores on the vertical axis. Even though at the national level there is a clear reduction of the share in the highest scores, a more desegregated analysis indicates that there are three kinds of situations: a) as in the national level, poor's deprivation scores increased their share in the ranges 0.33-0.39 and 0.40-0.49 in rural level, Atlantic, Pacific and Central regions, and Valle del Cauca; b) at the urban level, East region and Antioquia scores increased the concentration only in the lowest range 0.33-0.39, while others decreased their share; c) and in Bogota the share of the range 0.33-0.39 decreased, while the share of the range 0.40-0.49 increased. We can say that inequality reduction have been strictly pro-poorest at the rural and urban levels, as well as almost all regions (except Bogota).

Graphic 1 Distribution of deprivation scores among the poor



Graphic 2 Distribution of deprivation scores among the poor by subgroups

## Urban Level



2010 | 2013

- 0.33 -0.39: 44,4% | 48,5%
- 0.4-0.49: 39,5% | 37,0%
- 0.5-0.59: 12,6% | 10,9%
- 0.6-0.69: 3,1% | 2,6%
- 0.7-0.79: 0,5% | 0,7%
- 0.8 and more: 0,0% | 0,2%

## Central Region



2010 | 2013

- 0.33 -0.39: 45,7% | 47,5%
- 0.4-0.49: 37,4% | 39,3%
- 0.5-0.59: 12,7% | 11,1%
- 0.6-0.69: 3,6% | 2,2%
- 0.7-0.79: 0,5% | 0,0%
- 0.8 and more: 0,0% | 0,0%

## Rural Level



2010 | 2013

- 0.33 -0.39: 38,0% | 42,0%
- 0.4-0.49: 37,0% | 39,9%
- 0.5-0.59: 16,6% | 13,5%
- 0.6-0.69: 7,1% | 3,6%
- 0.7-0.79: 1,3% | 1,0%
- 0.8 and more: 0,0% | 0,1%

## Pacific Region



2010 | 2013

- 0.33 -0.39: 42,6% | 44,0%
- 0.4-0.49: 36,1% | 35,9%
- 0.5-0.59: 14,7% | 14,1%
- 0.6-0.69: 5,0% | 2,6%
- 0.7-0.79: 1,5% | 3,1%
- 0.8 and more: 0,0% | 0,2%

## Atlantic Region



2010 | 2013

- 0.33 -0.39: 33,9% | 39,0%
- 0.4-0.49: 38,7% | 40,0%
- 0.5-0.59: 18,0% | 14,5%
- 0.6-0.69: 8,4% | 5,0%
- 0.7-0.79: 1,0% | 1,2%
- 0.8 and more: 0,0% | 0,4%

## Bogota



2010 | 2013

- 0.33 -0.39: 58,7% | 53,5%
- 0.4-0.49: 30,8% | 36,4%
- 0.5-0.59: 10,5% | 9,2%
- 0.6-0.69: 0,0% | 0,9%
- 0.7-0.79: 0,0% | 0,0%
- 0.8 and more: 0,0% | 0,0%

## East Region



2010 | 2013

- 0.33 -0.39: 43,8% | 50,1%
- 0.4-0.49: 39,7% | 37,7%
- 0.5-0.59: 11,8% | 10,5%
- 0.6-0.69: 3,7% | 1,7%
- 0.7-0.79: 0,9% | 0,1%
- 0.8 and more: 0,0% | 0,0%

## Antioquia



2010 | 2013

- 0.33 -0.39: 41,4% | 45,2%
- 0.4-0.49: 44,4% | 40,2%
- 0.5-0.59: 11,3% | 11,3%
- 0.6-0.69: 2,4% | 2,7%
- 0.7-0.79: 0,5% | 0,7%
- 0.8 and more: 0,0% | 0,0%

Valle del Cauca

## III. Conclusions

Following Alkire and Seth (2014a; 2014b) for multidimensional poverty it is desirable to evaluate the incidence, intensity and inequality, even with a counting approach method. In Colombia, between 2010 and 2013 major improvements have been made in terms of inequality and intensity, but before this paper little have been said about inequality.

Replicating the methodology proposed by Alkire and Seth (2014a; 2014b) we obtained: a) inequality in deprivation scores only among the poor; b) inequality in deprivation scores among the poor and non-poor; c) inequality in deprivation scores among sub-groups (urban/rural and regions); and d) inequality in deprivation scores between sub-groups.

According to results we can conclude that inequality only among the poor and among the poor and non-poor reduced during the period 2010-2013 and reductions have been pro-poorest. Even though there have been major improvements in reducing inequality, important differences across subgroups persist. Taking into account that the MPI is actually used for designing and monitoring social public policy, incorporating not only the incidence but also inequality will help reach the poorest of the poor. Therefore, policy makers should not only focus in reducing incidence, but also intensity and inequality.

Further research should address: a) statistical significance of changes in inequality, for more robust results; b) in depth analysis of convergence between urban/rural and regions; c) inequality using previous QLS and for each year between 2010-2013; d) and more disaggregated information using the Population Census data, for a more in-depth analysis in terms of time and the evolution of multidimensional poverty spatial patterns when analyzing at a more disaggregated level (municipalities).

## IV. BIBLIOGRAPHY

Alkire, S., & Foster, J. (2007) "Counting and Multidimensional Poverty Measurement" OPHI Working Paper 7.
Alkire, S., & Foster, J. (2011) "Counting and Multidimensional Poverty Measurement" Journal of public economics. August 2011, Pages 476-487.
Angulo, R., Díaz, C. Y., & Pardo, P. R. (2011). Índice de Pobreza Multidimensional para Colombia. Departamento Nacional de Planeación.
Seth, S., & Alkire, S. (2014a). Measuring and decomposing inequality among the multidimensionally poor using ordinal data: A counting approach. OPHI Working Paper 68, Oxford Poverty and Human Development Initiative, University of Oxford.
Seth, S., & Alkire, S. (2014b). Did Poverty Reduction Reach the Poorest of the Poor? Assessment Methods in the Counting Approach (Vol. 77, p. 3). OPHI Working Paper.

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