MULTIDIMENSIONAL GINI DYNAMICS, THE CASE OF COLOMBIA

2010 - 2024

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Multidimensional social evaluation Gini function dynamics, the case of Colombia 2010 – 2023

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**ABSTRACT**

This paper calculates the Multidimensional Social Evaluation Gini Function using the methodology of Decancq and Lugo (2008), using the National Household Survey (GEIH) of Colombia from 2010 to 2023, over four different dimensions: education, health, formal occupation, and childcare. This paper concludes that inequality is not just a matter of income. It depends on the achievement of several valuable capabilities such as education (years of education), health (Access to health services with opportunity), occupation (formal occupation), and childcare (Access to childcare services) drop inequalities in capabilities but do not translate into reductions in income inequality. Using a Cobb-Douglas function, the multidimensional calculation obtains the standard Gini index. The results show that using a Cobb-Douglas function, the multidimensional calculation obtains a Gini index of 0.1572 when and with =5, 0.39. In all cases, the results are significantly lower than the one-dimensional and traditional Gini index of 0.546. Finally, comparing changes in the measurement, the multidimensional measure decreases at the highest rate.

# INTRODUCTION

Colombia, in terms of income inequality, has shown a positive trend since the 1950s. The results of the social public policies of the different party governments had been cumulative in response to social demands. The need for highly skilled labor in the 1980s and 1990s for a rapid industrialization process resulted in increasing investments in the education sector, generating an increase in infrastructure (public, private, and mixed) such as urban and rural schools, universities, technological and technical educational centers, libraries, etc., and an increase in educational supply. This improvement in terms of inequality was mild and weak and was only affected by the effect of the pandemic in 2020, reflecting the income vulnerability.

In the last two decades, the national Gini coefficient decreased from 0.576 in 2010 to 0.546[[2]](#footnote-2) in 2023, representing a reduction of 5.5%, 4.9% in urban areas[[3]](#footnote-3), and 14.3% in rural areas[[4]](#footnote-4) . This behaviour is remarkable but remains high compared to the rest of Latin America. Compared with the increase of 52,8% in the nominal Gross National Product in the same period, or 129,3% in the income percápita, the income inequality demonstrates the difficulty of absorbing those benefits by the lowest income quantiles.

Those results are interesting to analyse compared to poverty reduction processes. In comparison to the reduction of 5,5% in the income distribution between 2010 and 2023, income poverty decreased by 29%, and the extreme poverty reduction was 26% in the same period. When poverty reduction processes are more dynamic than the same in income distribution, it means that people are overcoming poverty but facing labor market structural barriers for labor income quantile mobility.

Graph 1. Gini coefficient for Colombia, urban and rural areas, 2010 - 2023



Source: Own elaboration using DANE - Encuesta Continua de Hogares (2002-2006) and Gran Encuesta Integrada de Hogares (2002-2024).

Series 2002 - 2011. Encuesta Continua de Hogares (2002-2006) and Gran Encuesta Integrada de Hogares (2008-2012) Expanded data with population projections, based on the results of the 2005 census. Data for 2006 and 2007 are not calculated due to comparability problems in the employment and poverty series because of methodological changes.

Series 2012 - 2023. Gran Encuesta Integrada de Hogares. 2012 - 2020: Expanded data with population projections, based on the results of the 2005 census and splicing adjustment factor 2012-2020. 2022 and 2023: Expanded data with population projections, elaborated based on the results of the 2018 census. These are the official data and correspond to an update of the sampling frame made from the 2018 CNPV, therefore, they should be read carefully.

Between 2008 and 2018, 50% of households received an income of less than 53% of the legal monthly Minimum Wage per household member per month. Analyzing labor income inequality by occupational groups, between 2009 and 2019, the higher inequality exhibited by self-employed individuals with higher education reported a Gini of 0,48. On the other hand, self-employed workers without higher education have lower income inequality with a Gini of 0,35 (Lasso and Vargas, 2024).

In that sense, the slow and soft reduction in income inequality becomes relevant to inquire about the behavior of other dimensions because just paying attention to income generates negative incentives for households to invest in non-monetary aspects of life, jeopardizing governments to take appropriate actions to deliver social services and establish market incentives.

Historically, inequality has studied one distribution vector. However, according to Rawls (1971), Sen (1973), and the Human Development Reports, well-being is considered a multidimensional concept, measured with more variables than income, wealth, or utility[[5]](#footnote-5). Accordingly, Sen incorporated a well-being concept that depends on the capability to achieve valuable functions. A more complex and diversified space requires other dimensions such as health and nutrition, low education and skills, inadequate livelihoods, bad housing conditions, social exclusion, and lack of participation.

Multidimensionality becomes relevant in inequality measure approaches. That is how the above ideas, added to the lack of studies in this field of research, give way to the possibility of extending from the one-dimensional inequality concept to the multidimensional in the special case of Colombia. Therefore, this paper focuses on the effect on Colombian income inequality of calculating a relative multidimensional single parameter Gini inequality measure over four different dimensions: education, health, formal occupation, and childcare, during the period 2010 – 2023. The hypothesis to test is that the multidimensionality measure decreases at a higher rate, being that changes in inequality are more a matter of income than a distribution over capabilities.

# THEORETICAL FRAMEWORK OF INEQUALITY CONCEPTS

Different indices measuring economic inequality exist in the literature. The one-dimensional is the most common and practically used for policymakers. Some measures based on statistical dispersions determine income, consumption, or expenditure deviation among individuals or households within an economy concerning a reference distribution. However, multidimensionality considers more variables than mere income.

Sen believed that a failure in development is more “*a failure of basic capabilities to reach certain minimal acceptable levels*” (Sen, 1992). It means that the ability to live a dignified life, including being nourished, healthy, etc., summarises several key *functionings* and the capabilities to achieve those functionings. Obtaining a measurement of these capabilities needs multidimensional welfare functions. A comprehensive approach is outlined below.

Kolm’s (1977) described the importance of the uniform inequality of a multivariate distribution of goods or attributes across people and developed theorems and desired properties for it. He defined the distributions of the bundles of commodities among individuals, analyzing the demand for more equality in specific consumptions “*specific egalitarianism*” like housing, education, leisure, health, consumption, etc., and its effects on the social welfare function. Finally, he constructed a set of nine formalized theorems that converge to a set of nine desired properties and prove that the multidimensional inequality is a “*function of the uniform inequality of a multivariate distribution of goods or attributes across people*”. It implied two properties.

1. The specificity property. Allocation of one commodity orders the states of society independently from the allocation of the other ones.
2. The egalitarianism property. Societies prefer a more equal distribution to find the egalitarian distribution of bundles.

Atkinson and Bourguignon (1983) described the importance of the correlation between dimensions and investigated a two-dimensional case using income and life expectancy. They used multivariate stochastic dominance to They demonstrate the dominance condition and extended their results to an inequality measure. Considering a social welfare function over different elements of the vector of goods received by every person (xi), they take the distribution of per capita incomes and life expectancy across 61 countries between 1960 and 1970[[6]](#footnote-6).

Christian List (1999) used the last concepts to build two classes of indices: a generalization of the Gini coefficient and a generalization of Atkinson's one-dimensional measure of inequality. He described two main stages: the dominance criteria that may include only partial orderings and the definition of the inequality index that must be consistent with the dominance criteria. He constructed an index considering the transformation of multidimensional distributions into welfare-concentration curves. Moreover, he said that indices are *“sensitive to how uniformly unequal the distribution of goods/attributes across people is”* and *“to how systematically inequalities in different dimensions are cross correlated*”.

Finally, Deqcanq and Lugo (2009) developed a multidimensional social evaluation function and a relative multidimensional single parameter Gini. They compose a two-step approach, first calculating an index of individual well-being and then aggregating these indices into a measure of social well-being. They used the concept that the one-dimensional Gini coefficient is obtained from a rank-dependent social evaluation function to expand it to the multidimensional case[[7]](#footnote-7).

The last is the approach followed in the present document to derive a multidimensional social evaluation function and the relative multidimensional single-parameter Gini inequality measure.

# DL METHODOLOGY

The methodology focused on the normative procedure that derives a well-being inequality measure by determining a multidimensional social evaluation function. The paper leans mainly onto the work of Decancq and Lugo (DL) on normative multidimensional social evaluation function and the relative multidimensional single parameter Gini inequality measure[[8]](#footnote-8).

To organize a set of desirable properties, it requires so establish:

* the distribution matrix ,
* as the set of individuals’ well-being,
* the set of the dimensions,
* is a row vector with the outcomes of an individual, and
* is the column vector with the j-th dimension of well-being,
* as the outcomes of the individual on dimension.

The following are the desirable properties.

Table A. Desirable properties

| **Property** | | **Definition** | **Description** |
| --- | --- | --- | --- |
| Monotonicity | MON | For all **x**, **y** in Rk++: if y > x, then Wk(y) > Wk(x) | All entries of **x** are desirable. If a vector is obtained by increasing at least one entry of another vector, it should be preferred to the initial one. |
| Symmetry | SYM | For all **x** in Rk++, and all k × k permutation matrices P; Wk (P**x**) = Wk(**x**) | Any information of individuals other than the quantities stated in the entries of **x** are unimportant in the aggregation. It assures an impartial treatment of all individuals. |
| Normalization | NORM | For all λ > 0: Wk (λ1k) = λ. | Whenever all entries of **x** are equal to λ, the result should be λ. |
| Separability | SEP | For all **x**, **x′**, **y**, **y′** in Rk++: if there is an L⊂K such that for all l in L **x**l = **y**l and **xl′** = **y**′**l** whereas for all k in K\L, **x**k = **x′**k and **y**k = **y**k′, then Wk(**x**) > Wk(**y**) ⇔ Wk(**x′**) > Wk(**y′**). | Let K be the set of all k entries, and let L be a subset of K, in the comparison of two vectors, the magnitude of the ‘*unconcerned*’ entries in L should not matter. |
| Rank-dependent Separability | RSEP | For all **x**, **x′**, **y**, **y′** in Rk++: if there is an L⊂K such that for all l in L **x**l =**y**l and **x′**l =**y**′l whereas for all k in K\L, **x**k = **x′**k and **y**k = **y′**k, then Wk(**x**) > Wk(**y**) ⇔ Wk(**x′**) > Wk(**y′**). | Being R^k++ the set of ordered vectors, the comparison of two vectors is not affected by the magnitude of common entries in both vectors if the initial ranking is maintained. |
| Weak ratio-scale invariance | WSI | For all **x**, **y** in Rk++ and all positive λ: Wk(x) > Wk(y) if and only if Wk(λx) > Wk(λy). | Rescaling of all entries of the two vectors x and y with the same positive number does not affect their ordering. |
| Strong ratio-scale invariance | SSI | For all **x**, **y** in Rk++ and all positive diagonal matrices Λ: Wk(x) > Wk(y) if and only if Wk(Λx) > Wk(Λy). | Rescaling of all entries of x and y should not lead to a reordering, if they differ across the entries of vectors |
| Weak translation invariance | WTI | For all **x**, **y** in Rk++ and all κ: Wk (**x**) > Wk(**y**) if and only if Wk (**x** + κ1k) > Wk (**y** + κ1k). | Ordering of two vectors by Wk is not affected if a common amount is added to all entries. |
| Replication invariance | REP | For all **x** in Rk++ and all **z** in Rlk++ which is a replication of **x**: Wlk (z) = Wk(x). | Replicating one vector Wlk (**z**) using an original vector Wk (**x**) doesn´t change the wellbeing measure output. |
| Restricted aggregation | RA | For all **x** in Rk++: Wk(**x**) = Wk (Wl (x1..., xl), …Wl′ (xl+1, ..., xk). | Aggregation of the total vector is equivalent to an aggregation in which the outcomes of the better-off subgroup are first aggregated into one aggregate. |
| Uniform Majorization | UM | For all distribution matrices X and Y in Rnxm ++: if Y = BX for some nxn bistochastic matrix B, Y ≠ X, and Y is not a permutation of X, then Wnxm (Y) > Wnxm (X). | If a uniform mean-preserving averaging is carried out in all dimensions, the resulting distribution matrix is socially preferred to the original one. |
| Correlation Increasing Transfer | CIT | For all distribution matrices X and Z, Z is obtained from X through a CIT if X ≠ Z, X is not a permutation of Z, and there are two individuals k and l such that  (i) zjk = max {xkj, xlj} for all dimensions j,  (ii) zjl = min {xkj, xlj} for all dimensions j and  (iii) zi = xi for all i in {k, l}. | In terms of the sensitivity to the correlation between the dimensions of well-being (Atkinson and Bourguignon, 1982), the rearrangement of the outcomes of two individuals, such that one individual gets the highest outcomes in all dimensions, and the other the lowest. |
| Correlation Increasing Majorization | CIM | For all distribution matrices X and Z in Rnxm ++: if Z is obtained from X by a correlation increasing transfer (CIT) then Wnxm (X) > Wnxm (Z). | A distribution matrix Z, obtained from X by any correlation increasing transfer (CIT), is socially inferior. Meaning that if two distribution matrices have identical marginal distributions, the one with lower correlation between dimensions is preferred. |
| Unfair Rearrangement Principle | URP | For all distribution matrices X and Z\* in Rnxm++: if Z\* is obtained from X by the sequence of CIT that makes one individual in Z\* top-ranked in all dimensions, another individual second ranked in all dimensions, and so forth, then Wnxm (X) > Wnxm (Z). | Sequence of correlation increasing transfers makes one individual top-ranked in all dimensions, another individual second ranked in all dimensions and so forth, and leads to social inferior situation. So that, dimensions are perfectly correlated. |

Source: Deqcanq and Lugo (2009).

Determining the multidimensional function requires standardizing and rescaling values so that their minimum value is zero and the maximum is one, using them as limits for every variable in every dimension. The calculation then requires two distinct steps. First, an objective well-being index will be derived to summarize everyone's outcomes across the dimensions of well-being. This objective well-being index reflects the preferences of society over the different dimensions. Second, aggregate the welfare indices across individuals to measure society's well-being based on the individual's position and rank in the total distribution.

# First step. Derive an individual well-being index that aggregates individual’s outcomes across all well-being dimensions.

Deqcanq and Lugo propose two kinds of continuous aggregation function across dimensions Wm. The case (a) is the Constant Elasticity of Substitution (CES) function, where parameter β reflects the degree of substitutability between the dimensions of well-being.

* When β=1 the aggregation function refers to a perfect substitution situation. In a framework of normative values it means that one unit of outcome in one dimension could be trade with another outcome in other dimension by the same amount.
* When β tends to -∞ the aggregation function refers to a perfect complementarity situation. This is an extreme situation where individuals are judged by their worst outcomes.

In the case (b) β = 0 and the aggregation function takes the form of a Cobb-Douglas well-being function, which has unit elasticity of substitution. In the DL methodology, the present situation is the only that satisfies the radio-scale invariance.

The parameter and the positive weights together determine the trade-offs between the different dimensions, where is the elasticity of substitution term between dimensions of well-being and the relative importance of every dimension.

Table B . Aggregation function across dimensions

|  |  |
| --- | --- |
| **Proposition 1** | Aggregation function across dimensions Wm |
| **Aggregation function** | Wm |
| **Definition** | A continuous aggregation function Wm: Rm++ → R++ satisfies   (a) MON, NORM, SEP and WSI, if and only if for each x in Rm++ we have (1), where wj > 0 for all j and the sum of wj =1  (b) MON, NORM and SSI, if and only if for each x in Rm++ we have (2), where wj > 0 for all j and sum of wj =1. |
| **Formula** |  |

Source: Deqcanq and Lugo (2009).

# Second step. Characterizing a class of social evaluation functions to aggregate well-being indices across individuals.

The second aggregation function, across individuals Wn is named the evaluation function. In this step, weighted averages are associated to a single parameter δ, the bottom-sensitivity of the aggregation function. The higher δ, the more weight is given to the bottom of the distribution.

* When δ = 1, the evaluation function becomes the unweight average. In the utilitarian tradition, it means that everyone has the same weight in the aggregation process.
* When δ tends to +∞ is an extreme case where only the worse-off individual is counted (Rawlsian case)[[9]](#footnote-9).
* When δ lies between 0 and 1, the best-off individuals have the more weight.

Table C. Aggregation function across individuals

|  |  |
| --- | --- |
| **Proposition 2** | Aggregation function across individuals Wn |
| **Aggregation function** | Wn |
| **Definition** | A continuous aggregation function Wn: Rn++ → R++ satisfies MON, SYM, NORM, RSEP, WSI, WTI, REP and RA if and only if for each x in Rn++ we have (3), where δ > 0 and ri is a shorthand for ri(x), that is the rank of individual i on the basis of the levels of vector x. |
| **Formula** | (3) |

Source: Deqcanq and Lugo (2009).

In summary, in order to calculate a continuous double aggregation function, first by dimensions, then by individuals, is needed a degree of substitutability β to be smaller than 1 and the bottom-sensitivity δ of the aggregation across individuals Wn should be larger than a lower-bound δ', which “*depends on the initial matrix X, the weighting scheme w and the degree of substitutability β”*. According with DL methodology, the standard Gini social evaluation function is calculated when δ = 2.

Table D . Continuous double aggregation function

|  |  |
| --- | --- |
| **Proposition 4** | Continuous double aggregation function, first by dimensions, then by individuals |
| **Aggregation function** | Wn (Wm) |
| **Definition** | A continuous double aggregation function (4): Rnxm ++→ R ++, where Wm satisfies MON, NORM, SEP and WSI; and Wn satisfies MON, SYM, NORM, RSEP, WSI, WTI, REP and RA.   Given that, double aggregation satisfies:  i) UM if and only if (4) is calculated using β < 1 and δ > 1  ii) CIM if and only if (4) is calculated using δ > δ', where δ' is a threshold depending on the initial matrix, the correlation increasing transfer, w and β. |
| **Formula** | (4) |

Source: Deqcanq and Lugo (2009).

The Multidimensional relative Inequality S-Gini Index I(X) is the calculated using the last two propositions, as definition 2 shows. In this sense, absorbing the one dimensional Gini index definition, the multidimensional Gini represents “*the fraction of the aggregate amount of each dimension of a given distribution matrix that could be destroyed if every dimension of the matrix is equalized while keeping the resulting matrix socially indifferent to the original matrix”* (Deqcanq and Lugo, 2009)

It represents the compound multidimensional social evaluation relation, where i stands for the position of the well-being in the distribution of well-being indices, δ determines the bottom sensitivity, β interprets the degree of substitutability between dimensions and w stands for relative importance of outcomes in the aggregation.

In the social evaluation relation, the Uniform Majorization-Property (UM) limits the relation for β<1 and δ>1. However, it is not sensitive to correlations between dimensions[[10]](#footnote-10) and cannot satisfy the property of Correlation Increasing Majorization-Property (CIM).

Decancq and Lugo define the multidimensional S-Gini inequality index applying the compound social evaluation relation to the scalar of a relative inequality measure , where β<1 and δ>1.

Table E. Multidimensional relative Inequality S-Gini Index

|  |  |
| --- | --- |
|  | Multidimensional relative Inequality S-Gini Index |
| **Aggregation function** | I(X) |
| **Definition** | I(X) is defined as the scalar that solves: Wnxm ((1 - I(X)) Xμ) = Wnxm (X). Where Xμ is the equalized distribution matrix defined such that all the elements in the jth column of the matrix are the dimension-wise mean μ(xj) |
| **Formula** |  |

Source: Deqcanq and Lugo (2009).

# VARIABLES AND DIMENSIONS

A long the multidimensional Gini index, differences between people lead to dissimilarities in their liberty of choices. The current calculation of multidimensional inequality measure takes into account education, health, occupation and child care as capabilities that enhance or restrict the liberty of choice in the household.

To calculate the following variables, in this paper it was used the “Gran Encuesta Integrada de Hogares” from 2010 to 2023 provided by the National Department of Statistics (DANE). Those are annual series, national and regionally representative. Those are surveys designed to monitor employment conditions and general characteristics of the Colombian population.

# Education

In the education dimension, it was constructed a variable indicating the number of years attained by each household member. In the case of people who were studying at the time of applying the survey, the calculation correspond to the years accumulated until the immediately preceding degree to which they are enrolled (Only years approved). In the case of people who are out of school years of education achieved correspond to the cumulative to the last degree achieved. After that the data base was filtered for people over 15 and a household average is calculated.

Table F . Schooling achievement variable structure

|  |  |
| --- | --- |
| Dimension | Education |
| Variable | Schooling achievement |
| Measurement | Years of education completed |
| Question in survey | 1. Are you currently studied? (Attend preschool, school, college or university)  1: Yes, 2: No   2. In what level are you enrolled and currently pursuing degree?  a. Preschool; b. Basic primary (1st – 5th); c. Secondary school (6th. To 9th); d. Tertiary school (10th – 13th); e. Technical education; f. Technological education; g. University (undergraduate); h. Postgraduate   3. What is your highest educational level attained? And the last year or grade passed at this level?  a. None; b. Preschool; c. Basic primary (1st – 5th); d. Secondary school (6th to 9th); e. Tertiary school (10th – 13th); f. Technical untitled; g. Technical entitled; h. Technological untitled; i. Technological entitled; j. University untitled; k. University entitled; l. Postgraduate untitled; m. Postgraduate entitled |
| Type | Continuous |
| Format | Numeric |
| Level of analysis | Household |
| Values | Information of the indicator starts from 0 and its maximum is the highest level of education |

Source: Own elaboration

# Health

It was constructed a variable indicating the access to health care when people have a medical need. It is measured barriers in access to healthcare services effectively. In the case of people who had in the last 30 days had a demand for healthcare, when affiliated at the health system, the calculation included illness, accident, dental problems or any other health problems that hasn't involved hospitalization. It was considered that a person faced barriers in accessing to health services, if people choose a non-institutional attendance, different to a general practitioner, specialist, dentist, therapist or health institution.

In terms of the affiliation to the health system, it is composed by the Health Compulsory Plan (subsidiary or not), which includes medicines and medical procedures, in case of illness, family planning, sterilization and disabilities, between others[[11]](#footnote-11).

Table G. Access to healthcare variable structure

|  |  |
| --- | --- |
| Dimension | Health |
| Variable | Access to healthcare |
| Measurement | Access to health care with opportunity |
| Question in survey | 1. Are you affiliated, is contributor or beneficiary of a social security institution in health? 1: Yes, 2: No  2. In the past 30 days, had some disease, accident, dental problems or any other health problem that has not involved hospitalization?  1: Yes, 2: No   3. To address this health problem, which of the next actions you primarily made?  a. I went to a general physician, specialist, dentist, therapist or health institution; b. I went to a health worker or nurse; c. I went to a chemist, pharmacist, druggist; d. I consulted a tegua, healer, herbalist, people with empirical experience; e. I attended alternative therapies (acupuncture, flower essences, music therapy, homeopathy, etc.); f. I use home remedies; g. I prescribed by myself h. nothing |
| Type | Continuous |
| Format | Numeric |
| Level of analysis | Household |
| Values | Values are 0 if people are not affiliated to the health insurance system, 1 if they are affiliated but don't used it the last month and 2 if they are affiliated and use it the last month due to a disease |

Source: Own elaboration

# Occupation

It was constructed a variable of people working in legal conditions of formality. This means that a person was in a formal employment if she was currently hired and was paying to a pension fund. This indicator needed the information of the occupational activity developed last month and if taken on account to that activity, people contribute to the Colombian social security system. Is important to highlight that, according to the legal framework health insurance must be universal and in terms of formalization it is mandatory, as well as contribution to a pension fund, when workers are formal.

Table H. Formal occupation variable structure

|  |  |
| --- | --- |
| Dimension | Occupation |
| Variable | Formal occupation |
| Measurement | Occupation in the formal sector of the economy paying for a health and / or pension fund |
| Question in survey | 1. In what activity you occupy most of the time last week? a. Working, b. Looking for Work, c. Studying, d. Household chores, f. Permanently incapacitated for work, g. Another activity, which?  2. Are you currently paying to a pension fund?  1. Si, 2. No, 3. Pensioner  3. Are you affiliated, is contributor or beneficiary of a social security institution in health? 1: Yes, 2: No |
| Type | Continuous |
| Format | Numeric |
| Level of analysis | Household |
| Values | Values: 1. Total informality, 2. Unpaid household work, affiliated to the health system, 3. Unpaid students, 4. Unpaid people looking for a job, 5. Workers who contribute to health but not to pension, 6. Workers who contribute to pension and health, 0. Other non-labour activities. |

Source: Own elaboration

# Childhood

Access to a kinder garden is fundamental in early child development. In that sense, it was constructed a variable by household with children between 0 and 5 years, analysing if they have access to care services for early childhood. It is considered that a child under five years do not have access to care services for early childhood, if she don't attend to a community preschool or kinder garden (public or private). This variable is the percentage of early Childs that don't have this care services.

Table I. Access to childcare variable structure

|  |  |
| --- | --- |
| Dimension | Childhood |
| Variable | Access to child care |
| Measurement | Access to child caring services |
| Question in survey | 1. Along the week, where or with whom remains the child most of the time? a. Attends a community preschool or a kinder garden, b. In home with her father and mother, c. At work with her mother and father, d. At home with a nanny, e. The care of a relative over 18 years, f. The care of a relative under 18 years, g. At home alone, h. Other. |
| Type | Continuous |
| Format | Numeric |
| Level of analysis | Household |
| Values | Values: 1. The care of a relative over 18 years, 2. At home with a nanny, 3. a. At work with her mother and father, 4. In home with her father and mother, 5. Attends a community preschool or a kinder garden |

Source: Own elaboration

# RESULTS

The calculus uses the previously described two stages process of Decancq and Lugo. Within this calculation, the well-being measure uses equal positive dimension weights (summing up to 1 and therefore reflecting the equally distributed importance of the different dimensions.

The result shows the evolution of the Gini index for Colombia Idepending on the respective elasticity of substitutability between the dimensions, and the bottom sensitivity. Decanq and Lugo recommend to select β=0, i.e. a Cobb-Douglas wellbeing function. It is useful, in order to consider a unitary elasticity of substitution, and for satisfaction of strong ratio-scale invariance. It guaranty first, that curves don’t cross each other, and second, wellbeing order do not change by rescaling (Decanq and Lugo, 2009) and third, conserve one characteristic of homogeneous functions: implicit interchanges between variables just depend on quotient of these variables, not on their absolute levels.

Literature recommend to use δ=2, being that multidimensional calculation can be comparable with the standard Gini index. In that case I(X) is flat in 0.25 since 2010 and is less that the half of the Income Gini index 0.538. Even if it’s used the extreme case when delta is equal to five, where the more weight is given to the bottom of the distribution, the multidimensional index lies in 0.39. This demonstrates that inequality in Colombia is more a matter of the labour market and wages than a matter of non-income capabilities.

Graph 11. Multidimensional Inequality Gini indices for delta 2 – 5 and Income Inequality Traditional Gini Index



Source: Own elaboration, using Gran Encuesta Integrada de Hogares

In the same way, computing the change in I(X) and the change in the traditional Gini index for just income, it shows that:

1. When delta is equal to two, the measure has a small growth. This positive change shows the same result than the current gini income coefficient.
2. When delta is equal to three, four and five, the measure decreases in the whole period on average at 4%. However, it is not a constant behaviour.
3. However, the level of multidimensional inequality analysed is lower than the Gini calculations for income, evaluating its dynamics, the multidimensional measure decreases at a greatest rate, no matter the level of delta, when is higher than 2.

Graph 12. Changes in Multidimensional Inequality Gini indices for delta 2 – 5 and Income Inequality Traditional Gini Index

Source: Own elaboration, using Gran Encuesta Integrada de Hogares

It is important to have in mind that Colombian government has spent many resources in poverty and extreme poverty alleviation in the last years. In fact, proof of that affirmation is that between 2010 and 2014 poverty has been reduced by 23% and extreme poverty by 34%. Current data describe that poverty is in 28% and extreme poverty in 8%. I the same way, the Multidimensional Poverty Index (MPI) drops at high rates. In the same period it reduced by 28%.

In order to correct income inequalities in Colombia, is important to correct other inequalities on the capabilities set of distribution. Certainly, income dispersion is caused, among others, by the high unemployment rate, a pervasive informal sector, a wide wage dispersion, a lack of education in some sectors of the society, a deficient access to health insurance and attendance, and to a poor attendance for Childhood.

These results show that social investment is important and change people’s life, but don’t have an immediate effect in income distribution. Then, is important to enhance policies that develop labour markets by improving labour supply and productivity. Perhaps its relationship is not that narrow as one can imagine. In terms of social mobility, Colombia needs urgently better-off labour policies.

# CONCLUDING REMARKS

Inequalities in capabilities in Colombia are lower than income inequalities. It suggests that education (years of education), health (Access to health care with opportunity), occupation (formal occupation) and Childcare (Access to child care) are important in Colombia, as much as to invest at higher rates every year. However, changes in that capability inequalities, don’t translates in income inequality reductions. Poverty and extreme poverty in one dimensional and multidimensional indices has been reducing year by year, as well as the multidimensional inequality Gini index, but that’s not the case of the income inequality.

Attached on the capability approach and the diversity of human needs this paper shows that inequality is not just a matter of income but wellbeing depends on the capability to achieve several valuable capabilities as long and healthy life and knowledge. Persons who face multiple deprivations are normally worse off than persons with only few of them are.

Using a Cobb-Douglas function, the multidimensional calculation obtains the standard Gini index of 0.1572 when and of 0.25 with =3 it was 0.30, =4 it was 0.35 and with =5 0.39. In all cases, the results are significantly lower than the one-dimensional and traditional Gini index of 0.539.

Comparing changes in income inequality and inequality in the set of capabilities, the multidimensional measure decreases at a highest rate, no matter the level of delta, when is higher than 2. Always superior in decreasing than income inequality changes. When delta is greater than three, the measure decreases in the period 2012 – 2014 on average at 4%, in a non-continous path. Comparing with income inequality, the later shows lower decreases. But also, the multidimensional measure decreases at a greatest rate, no matter the level of delta, when is higher than 2.

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2. This number means that the loss of welfare because of inequality in the distribution of incomes in Colombia is 54.6% of the welfare level if the overall income is equally distributed. [↑](#footnote-ref-2)
3. Urban areas, in terms of DANE, are sets of edifications and blocks, delimited by streets mainly. In general, counts with essential public goods as connected services of water and sewer, electricity, hospitals and schools, between others. Cities and municipal heads are part of the urban area. [↑](#footnote-ref-3)
4. Rural areas are a wide land with farming activities. It does not count with nomenclatures or streets, neither public services nor facilities. [↑](#footnote-ref-4)
5. Using this definition, to introduce poverty as a multifaceted and multidimensional term, Multidimensional Poverty Index (MPI) came to the academic discussion in 2010. [↑](#footnote-ref-5)
6. The dominance condition describes de idea to show if the investigated parameters are higher in 1970 than they have been in 1960. Dominance criteria evaluate about the causes to change the measure in a particular direction. The properties associated are transfer sensitivity and the transfer principle. [↑](#footnote-ref-6)
7. Garzón and Preisser (2014) used the model refined by Deqcanq and Lugo in Colombia using three dimensions: health, education, and income. That document was the first approximation to a multidimensional inequality measurement calculation in the country. [↑](#footnote-ref-7)
8. The reason of following specifically Decanq and Lugo framework is because their paper fit with the aim of comparing the traditional one-dimensional inequality measure (Gini coefficient) in Colombia with the multidimensional one. [↑](#footnote-ref-8)
9. In this case monotonicity don’t apply. [↑](#footnote-ref-9)
10. Correlation means that if having two matrixes with the same marginal distribution, the one with lower correlation between the dimensions should be preferred. [↑](#footnote-ref-10)
11. The Health Compulsory Plan in Colombia is explicit in the Agreement 30/2012 of the National Health Regulatory Commission (http://www.minsalud.gov.co/salud/POS/Paginas/Acuerdo%2029%20de%202011.aspx). In this variable, 1 stands for having no access and 2 for having access to the health and security system. [↑](#footnote-ref-11)