

POVERTY DISTRIBUTION AMONG THE BRAZILIAN STATES: A MULTIDIMENSIONAL ANALYSIS USING CAPABILITIES AND NEEDS APPROACHES

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Abstract

Multidimensionality in poverty analysis and the individual heterogeneity in people characteristics are important aspect considered by the Capability and Human Needs approach. However the majority of empirical studies and public policies dealing with poverty problems in Brazil are still based on conventional poverty measures -usually poverty lines. Such measures are not able capture neither the spatial specificities nor the multidimensional aspects of poverty. Brazil, due to its large extension is a heterogeneous country in both - potentialities and in social problems. Such aspects must be taken in to consideration in poverty analysis and public policies formulation. The main objective of this paper was to identify the spatial distribution (or concentration) of Brazilian poverty using multidimensional indicators based on Capability and Human Needs perspective. The results show that poverty is has different spatial distribution according to the different dimensions.

Key-words: Poverty, Capability and Human Needs, Multidimensionality, Spatial Distribution

Resumo

Reconhecer que a pobreza é um fenômeno multidimensional e contemplar essa multidimensionalidade na construção dos indicadores é um aspecto importante quando se trabalha com as abordagens das Capacitações e das Necessidades Humanas. No entanto, a maioria dos estudos sobre pobreza no Brasil, apesar de reconhecerem que a pobreza é um fenômeno multidimensional, acabam por reduzir a análise ao aspecto renda (linhas de pobreza). Tais medidas apresentam limitações no que se refere à capacidade de captar as especificidades espaciais e os aspectos relativos a dimensões específicas. O Brasil, por ser um país muito grande é bastante heterogêneo tanto nas potencialidades quanto nos problemas que enfrenta. Tais aspectos devem ser considerados nas análises da pobreza e na formulação das políticas públicas. O principal objetivo deste trabalho foi identificar a distribuição espacial (ou concentração) da pobreza no Brasil usando indicadores multidimensionais baseados nas Abordagens das Capacitações e das Necessidades Humanas. Os resultados mostram que a distribuição espacial varia de acordo com a dimensão considerada na análise.

Palavras-chave: Pobreza, Capacitações e Necessidades Humanas, Multidimensionalidade, Distribuição Espacial.

JEL Classification: I32, D63 e O15

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1. Introduction

In an attempt to propose a different perspective of analysis for social problems, Sen (1985a, 1985b, 1985c, 1992, 1997, 1999) and Nussbaum (2000) deepened the understanding of the complexity involved in poverty analysis. Their arguments call attention to its quantitative and qualitative dimensions. According to such view, poverty is a multidimensional phenomenon, which is composed by deprivation in a set of categories such as the capability to achieve valuable 'functionings': to fulfil basic needs, to have freedom, rights, inclusion, opportunities and so forth.

Having the above arguments in mind, it is clear that the conventional and one-dimension indicators, such as GDP and income per capita are not sufficient and efficient to measure poverty. However, the official and traditional way to measure poverty is strongly focused on income indicators, in both - absolute and relative measures. It happens not only in public policy formulations, but also in communication channels and academic researches. During the last years, there were important institutional and individual efforts focusing on the poverty problem. Among these attempts, in Brazil, we can highlight Rocha (2003) who presents an evolution of the income poverty aspects in Brazil from the 1970s to the 1990s. The Brazilian Poverty Map, a study which was carried out by FGV (2003), shows how the income deprivation is geographically placed within the Brazilian states, regions and in both rural and urban areas. Nonetheless, in the process of constructing the indicators above mentioned, the only dimension used was the income.

Even being a country known by its ethnical and cultural diversity, natural beauty and richness of resources, when the focus is the living conditions of its population there is no beauty in the Brazilian picture. The diversity and complexity involved in poverty analysis, is not only frequently left aside, but it is also not properly understood. Very often, poverty in Brazil is seen as a derived problem from the chronic income inequality. Other times poverty issues are associated, or even reduced to the famine problem. Both, inequality and famine are important dimensions to be taken into consideration, they are, however, not sufficient to explain the complexities involved in such issue. As Justino and Niimi (2004) show, the inequalities are not only related to the income dimension but are also related to health, education, political participation and opportunities. Among others, Silveira et. all (2004) show that poverty, famine and under-nutrition are distinct phenomena and are not necessarily highly correlated to lack of income.

In spite of the importance and utility of the existing studies and actions which are taking place in Brazil, there is still the need to go further and to deepen the knowledge about the different characteristics of poverty. In other words, even the Brazilian studies that conceptually accept and understand poverty as a multidimensional phenomenon end up evaluating only the income perspective. The lack of a multidimensional assessment is clear and it can be one of the reasons explaining the low efficacy of the Brazilian strategies adopted to reduce poverty. Even the world-wide known Hunger Zero program, which has the aim to eliminate famine among the Brazilian poor population, uses as a poor identification strategy the poverty line.

The income based measure defenders have the argument that income has a high correlation with the other dimensions of poverty and they also believe that income is an easier indicator to be used due to the difficulties of working with multidimensional indicators. On the other hand, Klasen (2000: 34) analyzing the multidimensional aspects of poverty in South Africa shows that "about 30% the most deprived people would not be identified by the expenditure poverty measure". Considering the diversity and complexity of the problem, we are proposing an attempt to measure poverty in a multidimensional way, taking into consideration not only the income and resources aspects, but also

and most importantly, looking at people's needs, capabilities as it can be seen in the methodological description.

In so far, the main aim of this paper is to identify the spatial characteristics of poverty around the Brazilian States. To reach such aim we depart from the United Nations capability poverty measure (CPM) and the Human Poverty Index (HPI) ideas and its methodology which are international alternatives to measure basic capabilities and needs. The contribution of our paper is to expand the index to the state level and also to build a broader index including a set of information which, in our view, fits better to the inter-state Brazilian reality.

The paper is organized in four parts. In part two we present the theoretical and methodological foundations of the paper. The third part refers to the empirical analysis and results. The final part presents some final considerations.

2 – Theoretical and methodological aspects

2.1 - Human Needs and Capability Approaches

The literature related to the Human Needs Theory and the Capability Approach (henceforth CA) seems to work over the same purpose, and there are differences in their arguments and language used. However in practical ground, specially using secondary data, it is, many times difficult to find the boundary between the approaches. To better clarify the similarities and differences, we present a short description of the origins and foundation of each approach in the following paragraphs.

The Human Needs Theory is originated from the arguments developed by thinkers such as Hegel, Kant and Marx. Its consolidation is a result of the contribution from different academic fields. Because of that, the existing definitions and arguments are diverse. The development and systematisation of the definitions used in what could be called 'the first stage' of evolution of this theory can be attributed to Minogue, Marcuse (1938), Maslow (1943,1954), Taylor (1943,1959), Fromm(1932), Fitzgerald (1977), Springborg (1981), and Wiggins (1991).

During this first stage the idea behind human needs was related to needs as natural and spontaneous requirements or preconditions for moral, cultural and survival demands. The satisfaction of human needs was considered important once it could give people the opportunity to develop human powers and potentialities. In other words, needs satisfaction would promote the capacities for thinking, acting, willing, loving, enjoying and suffering (Springborg, 1981). According to Minogue, 'human need' is something which, by definition, has a right to be fulfilled.

The second stage in the Human Needs discourse was well-known as the Basic Need Theory (BNT). During this stage, the idea was to use the human need definition as a strategy to development policies and poverty alleviation. International Organisations, such as the International Labour Organisation (ILO) and the World Bank took the flag of human needs. However, due to practical reasons the idea of human needs was biased by imperatives from practice. The public policy implementation was much more centred in the promotion of resources and commodities possession than in certain aspects intrinsic to human needs. To a certain extent, we could argue that this second stage represented an operationalisation of the first stage by which, the broader Human Needs Theory became the Basic Needs Theory. The most important contributions considering BNT were by Mouly and Kuznin (1978), Ul Haq (1980), Streeten (1981) and Stewart (1988).

Gaspar's (2004) argues that the Needs Approach reached a peak of prominence in the development policies in the late 1970s, and it was marginalised in the 1980s by the neo-liberalism - the 'modern

resource allocation theory', focused on preferences based on money - which accuses the needs analyses of being rigid, asocial and authoritarian. In addition to that, a range of criticisms emerged, questioning the efficacy of the Basic Needs Theory as an alternative to development ethics. The main criticism of the BNT addresses the reduction of the concept to its operational aspects and the formulation of policies that promote exclusively the improvement in commodities possession. Among such criticisms, we can find SEN (1984,1985,1994) who argues that:

- 1) Basic Needs are usually defined in terms of commodities.
- 2) Commodities are assessed 'as if' they had the same value for every person;
- 3) Basic needs are interpreted in terms of minimum quantities;
- 4) 'Need' is a passive concept;
- 5) The Needs Theory does not work against inequalities;
- 6) The BNT does not attach any explicit importance to the question of positive freedom, and tends to identify commodity requirements independently of personal features and external circumstances (Sen, 1994).

From the limitations and criticisms faced by the second stage of the Human Needs Theory two new approaches emerged from the debate on development ethics, 1) the re-thinking of the Human Needs Theory and 2) the Capability Approach.

The third stage of the Human Needs Theory, or the New Human Need(s) Theory, has contributions by Max-Neef (1989,1991,1992), Doyal and Gough (1991), Gasper (1996,2004), Gough (2002) and Hamilton (2003). It is worth emphasising the high degree of diversity and richness found in these different contributions. The same feature shaped the debate during the first stage of development of the HNT.

It is within this context that the CA emerged as an alternative to both the HNT and the BNT. Even being considered by authors such as Gasper (2004) as a refinement or evolution of the Basic Needs Theory, the CA has some distinctive features that allow it to be characterised as a new approach. In particular, it provides a methodology that supports the use of broader informational spaces, including the space of needs. Its most distinguishing aspect is its emphasis on freedom, autonomy and agency as fundamental aspects of human life. Sen acknowledges the existence of links between the CA and previous development approaches. However, according to him, the CA is fundamentally different from other approaches in the sense that it does not rely upon (1) an expansion of goods and services; (2) an increase in utilities, or (3) meeting basic needs (Sen, 1984).

It is then possible to consider Sen's Capability Approach as an evolution and an alternative to previous approaches, including the HNT. Among the most known and accepted similarities between the CA and the HNT it is possible to mention a rejection of the Utilitarian Approach and a view of people's well-being as the main objective of development (Sen, 1984 and Streeten,1981).

The CA has been put forward by Professor Amartya Sen (1992, 1999 among other publications) and Professor Martha Nussbaum (1999, 2000) as an alternative framework to conventional approaches to normative analysis. It has been argued that the CA is rich, broad, inclusive and open (conceptually, philosophically and foundationally) and that it has a wide range of practical applicability.

The conceptual core of the CA is the idea that good life will be reached when human beings are free to choose and able to get what they have reasons to consider important to do or to be. In this sense, human development means human flourishing. Moreover, poverty means lack of basic freedoms to reach what is considered essential 'doings' or 'beings'.

In fact, the CA evolves from Sen's early criticisms of welfarism and resource possession as appropriate informational basis for normative evaluations. Trying to justify the importance to move on from resource, due to its impossibility to capture the conversion problem, SEN (1985:6) argues that "in getting an idea of the well-being of the person, we clearly have to move on to 'functionings', to wit, what the person succeeds in doing with the commodities and characteristics at his or her command".

According to Sen, functionings are the achievements of a person, which can show up the person's state. And he differentiates functioning from usual well-being indicators based on Utilitarian foundations. He argues that "a functioning is thus different both from (1) having goods (and the corresponding characteristics), to which it is posterior, and (2) having utility (in the form of happiness resulting from that functioning), to which it is, in an important way, prior" (SEN, 1985:7).

According to SEN (1999), the capability idea is even closer to the concept of freedom, because

...for many evaluative purposes, the appropriate "space" is neither that of utilities (as claimed by welfarists), not that of primary goods (as demanded by Rawls), but that of the substantive freedoms – the Capabilities – to choose a life one has reason to value. (1999:74).

And he adds,

A person's "capability" refers to the alternative combinations of functionings that are feasible for her to achieve. Capability is thus a kind of freedom: the substantive freedom to achieve alternative functioning combinations (or, less formally put, the freedom to achieve various lifestyle) (SEN, 1999:75).

The approach in vogue is a comprehensive one, dealing with a range of important issues. In a very general sense, the CA has some key foundational objectives, aiming to constitute an alternative to:

- 1) the Utility Based Approach and its subjective foundations bases,
- 2) the Economic Development Theory and the use of Income Based Approaches, usually uni-dimensional indicators;
- 3) the Primary Good and/or the Basic Needs Theory and its commodity based indicators;
- 4) Political theories such as Libertarianism and Rights-Based Approaches.

2.1 - Poverty measurement in the UNDP system – CPM, HPI-1 and HPI – 2

The controversies about the meaning of well-being, human development, quality of life are usual among social scientists. As a result there are narrow possibilities of choosing indicators to represent it properly. Much has been argued about the essential or proper conditions that could potentially enable individuals to live rewarding and fulfilling lives. It is important to note that there is no academic consensus about the criteria, or informational spaces, to be used in representing well-being and choosing indicators.

On the one hand, it could be argued that the formulation of public policies requires parameters and that 'measurement' is useful to evaluate conditions related to equality, opportunities and social justice. Without a sense of magnitude, it is difficult to point out the importance of justice as an aspect in development discussions.

The most known and used measure dealing with poverty is the poverty line concept, which has already received a huge amount of criticism. Trying to contribute for the solution of the limitations of the poverty lines, the United Nations Program has been working on a new way of measuring poverty. Such attempt follows the same rationality used to build the Human Development Index and

was supposed to measure very basic capabilities. In the following paragraphs it is possible to see a short history of poverty measures based on the Capability Approach.

Conceptual and statistical issues related to poverty were emphasised in the first HDR, but paradoxically the subject was left aside in the following years. Only in 1996, six years later, the subject was reintroduced and a capability poverty measure (CPM) was developed. The justification for construction of such a measure was based on the inadequacy of income as the only poverty or well-being indicator of the poor. It was argued by UNDP that:

What is needed is a more people-centred measure of poverty that recognises that human deprivation occurs in a number of critical dimensions. Lack of income is just one dimension, and it is focused on means rather than ends. The capability poverty measure (CPM) is a multidimensional index of poverty focused on capabilities” (HDR, 1996:109).

The CPM was supposed to measure only very basic capabilities, the essential ones required for individuals to function as human beings. As presented,

Deprivation in capabilities is the result of lack of opportunity – signifying that society has not provided people with access to the means to develop or maintain essential human capabilities” (HDR, 1996:109).

Furthermore, as argued by UNDP,

The capability poverty measure is a simple index composed of three indicators that reflect the percentage of the population with capability shortfalls in three basic dimensions of human development: living a healthy, well nourished life, having the capability of safe and healthy reproduction and being literate and knowledgeable (HDR, 1996:109)

The indicators that composed the CPM were:

- The percentage of children under five who are underweight,
- The percentage of births unattended by trained health person,
- The percentage of women aged 15 years and above who are illiterate,

The CPM, according to UNDP, differed from the HDI, because the CPM focuses on people’s lack of capabilities rather than on the average level of capabilities in a country. The CPM has not included the income dimension in its composition. The CPM measure uses international standards to establish the thresholds required for a poverty classification. The CPM was calculated for 101 developing countries with the aim to work as a policy-laden indicator (HDR 1996). UNDP produced in 1997 a successor for the CPM measure: the Human Poverty Index (HPI)

The HDR 1997 built the Human Poverty Index (later known as HPI-1) based on previous ideas put forward by the Capability Poverty Measure. According to UNDP, the HPI is broader than the CPM and follows more closely the HDI methodology. The perspective of the HPI differs from that of the HDI once it focuses on deprivation, while the HDI is built within a conglomerative perspective. To be consistent with this perspective, the indicators chosen for the HPI are different from the ones used by the HDI, even when measuring deprivation in the same dimensions. The dimensions used to identify human deprivation are longevity, knowledge and living standards.

- 1) Longevity is measured by the percentage of people expected to die before the age of 40 (P_1),
- 2) Knowledge is assessed by the percentage of adults who are illiterate (P_2),

3) Living standards is a composite index that consists of three variables (P_3). The percentage of people with access to safe water (P_{31}), the percentage of people with access to health services (P_{32}), and the percentage of malnourished children under five (P_{33}).

The variable P_3 is a result from averaging the three aspects mentioned above as follows:

$$P_3 = \frac{P_{31} + P_{32} + P_{33}}{3}$$

The final HPI formula is

$$HPI = \left[\frac{1}{3} (P_1^3 + P_2^3 + P_3^3) \right]^{\frac{1}{3}}$$

The HPI index, as it was built in 1997, was designed in order to identify the basic deprivations in developing countries. According to the HDR, there is no possibility to build a general poverty index that could be used efficiently in all (rich and poor) countries. As it was pointed out in the HDR: “The nature of poverty in rich countries deserves a specialised study – and a more specialised index – focusing on those deprivations particularly relevant for those countries” (1997:18).

Since 2001, ‘access to health services’ data is missing and the standard of living dimension is measured by using only two indicators – the percentage of the population not using improved water sources and the percentage of children under five who are underweight. Calculating HPI-1 is more straightforward than calculating the HDI. The indicators used to measure the deprivations are already normalised between 0 and 100 (because they are expressed as percentages), so there is no need to create dimension indices as for the HDI (HDR, 2001:241)

The HPI-2

To better reflect the particularities from different realities of poverty in distinct groups of countries, the 1998 HDR divided the HPI into two different indexes - one for developing countries – the HPI-1 and one for developed (industrialised) countries – the HPI-2. The HPI-1 (developing countries) was kept exactly as it was in 1997.

The index for the developed countries concentrates on four dimensions. Three dimensions are the same as those used in the HDI and in the HPI-1. The added dimension was social exclusion. The variables are represented as follows:

- 1) Longevity - percentage of people expected to die before the age of 60 (P_1),
- 2) Knowledge - percentage of adults who are functionally illiterate (P_2),
- 3) Living standard - percentage of people living below the poverty line set at 50% of the average personal income (P_3)
- 4) Social exclusion - rate of long term unemployment of the labour force (P_4)

In 1999 the knowledge dimension started to be assessed by the percentage of people who are functionally illiterate as defined by OECD.

2.3 - Methodology for the multidimensional poverty index

Even being aware of the broad set of indicators available, the main aim of this paper is to understand poverty distribution among the Brazilian states using a multidimensional composed index. To reach our aim, we chose four groups of valuable functioning, which are: Be minimally nourished, healthy, safe and have minimal knowledge.

The dimensions we chose are in accordance with the ONU, Klasen (2000), Nussbaun (2000), Martineti (2000), Lelli (2001), Alkire (2002), Ian and Gough, etc empirical application of the Capability Approach, which can be considered fundamental human needs and basic capabilities at the same time.

To build the index, it was necessary to adopt some adaptations to the methodology used to calculate the human poverty index. The income dimension was not included in our index, once our aim is to identify deprivation in valuable functioning or human need satisfaction. Income is a very important resource, but not a human need in itself. The technical steps of the index are presented below.

The multidimensional poverty index is a composed index, built from four sub-indexes, using data about health, nourishment, education, safety, as you can see below.

The multidimensional index was built using needs and capabilities indicators. In other words, our attempt was to aggregate indicators about availability of resources and also to verify the effectiveness of the conversion process from resources into human capabilities. For the construction of each index we tried to use both kinds of indicators when they were available.

For example, the health index was built using indicators reflecting two kinds of resources availability (number of doctors and beds per one thousand people); and two achievements or results indicators (infant mortality and life expectancy). The safety indicator has one resource (number of police officers) and one result (number of homicides) indicator. The education index is composed of the formal education average and functional illiteracy. The food security index is composed of people's perception of their situation and the real condition of food acquisition.

1) The health index.

With the health index, the intention is to capture the Brazilian people deprivation in relation to health services access. We used three indicators. The first, measuring the availability of beds and doctors per thousand people. The second measures children under-five mortality and the last measuring life expectancy.

1.1) Health services supply. This sub-index is built using data about the number of beds and doctors for thousand people. The parameters used to define the thresholds are the recommendations from the World Health Organization (WHO), which define 4.5 beds per thousand people as a reasonable number and one doctor per one thousand people. The index was calculated using a linear fuzzy function, with the following specifications.

$$\mu_A(x) = \begin{bmatrix} 0 & \text{if } x \leq x_{\min} \\ \frac{(x - x_{\min})}{(x_{\max} - x_{\min})} & \text{if } x_{\min} < x < x_{\max} \\ 1 & \text{if } x \geq x_{\max} \end{bmatrix}$$

1.1.1) Beds supply³ index was normalized to have values from zero to one. Taken the WHO recommendation number as a parameter we used 4.5 beds per thousand people to define the 0.5 weight and arbitrate values for minimal and maximum boundaries (keeping the same distance above and below the 4.5). So the thresholds are as follows.

$$\mu_A(x) = \begin{cases} 0 & \text{if } x \leq 1,5 \\ \frac{(x-1,5)}{(7,5-1,5)} & \text{if } 1,5 < x < 7,5 \\ 1 & \text{if } x \geq 7,5 \end{cases}$$

1.1.2) Doctors Supply index was also defined to vary from zero to one. The WHO recommendation was again used to define the 0.5 value (being 1 doctor per one thousand people). From that parameter we define the maximum and minimum values as shown in the functioning below.

$$\mu_A(x) = \begin{cases} 0 & \text{if } x = 0 \\ \frac{(x-0)}{(2-0)} & \text{if } 0 < x < 2 \\ 1 & \text{if } x \geq 2 \end{cases}$$

The health supply index is the aggregation of these two sub-indexes, each having the weigh of 1/2 in the final health index. The final index shows that states which have a 0.5 rate or above have the minimum recommended by WHO in health services supply. The health service provision index is:

$$HS = \frac{HS_{beds} + HS_{doctores}}{2}$$

1.2) Under-five children mortality: this index is calculated using the state rate of children mortality. The parameters where built using international average. The minimum value was defined using the average children mortality rate within the 30 most developed countries, which have 4,7 death per thousand children born. And the maximum was defined using the average mortality rate of the 30 least developed countries, which is 114.28 deaths per each thousand children born alive. The average mortality rate was calculated from a ranking published by the United Nation Organization using data from 192 countries⁴ during the period of 2000-2005.

$$\mu_A(x) = \begin{cases} 0 & \text{if } x \geq 114,28 \\ \frac{(x-114,28)}{(7,5-1,5)} & \text{if } 114,28 < x < 4,70 \\ 1 & \text{if } x \leq 4,70 \end{cases}$$

³ To avoid distortions only public hospital beds were used, since the majority of the population does not have access to private health insurance plans (76% according to IBGE). Had we used the total number of beds available, we would be disguising a scenario of hospital beds availability.

⁴ The UN has only considered countries with a population larger than 100 thousand inhabitants.

1.3) Life expectancy index: the index was built from the average life expectancy for each Brazilian state. As well as the children mortality index, the parameters were defined using the average life expectancy from the least and most developed countries. The average life expectancy within the 30 most developed countries is 79.2 years and the life expectancy in the 30 least developed countries is 43 year. The average was calculated based on the United Nations ranking for 192 countries 2000-2005.

$$\mu_A(x) = \begin{bmatrix} 0 & \text{if} & x \leq 43 \\ \frac{(x-43)}{(79,2-43)} & \text{if} & 43 < x < 79,2 \\ 1 & \text{if} & x \geq 79,2 \end{bmatrix}$$

The final health index is an aggregation of the three presented sub-indexes as follows: Each sub-index weighs of 1/3.

$$HI = \frac{HS + IMI + VI}{3}$$

2) The safety index. The safety index has the aim to compare the level of safety using two indicators, one measuring the protection (number of police officers per inhabitant), and the other measuring the level of violence, which is measured by a proxy composed of the number of homicides rate added to the number of homicide attempts rate (per 100 thousand inhabitants).

2.1) The violence component is composed of the sum of the rate of homicides plus the homicide attempts rate in each Brazilian state. We believe these two indicators can work as good *proxies*⁵ for the violence level. There is no international recommendation parameter for this indicator. Therefore, it was necessary to define arbitrarily a minimum and maximum. We considered as acceptable (the best situation) the situation where there is no violence, which means that the value 'one' would be attributed only to states which have no homicides. And a maximum, or out of control, can be considered the situation where the homicides are above the national average.

$$\mu_A(x) = \begin{bmatrix} 0 & \text{if} & x \geq 89,43 \\ \frac{(x-89,43)}{(0-89,43)} & \text{if} & 89,43 < x < 0 \\ 1 & \text{if} & x = 0 \end{bmatrix}$$

2.2) The protection indicator was obtained using the sum of the civil police officers added to the military police officers number in each state. The international recommendation is that it is necessary to have one police officer per each 250 inhabitants. Using such information as being the reasonable number, we considered 250 police officers as 0.5 and arbitrarily defined the maximum and the minimum (equidistant from 250). The index was built as shown below.

$$\mu_A(x) = \begin{bmatrix} 0 & \text{if} & x \geq 450 \\ \frac{(x-450)}{(50-450)} & \text{if} & 450 < x < 50 \\ 1 & \text{if} & x \leq 50 \end{bmatrix}$$

⁵ Only murder was taken into consideration since the other categories of homicides do not necessarily reflect a violent situation. At the same time, homicide attempts were also considered in the calculation as they reflect a scenario of violence.

In summary, the safety index can be mathematically represented as follows:

$$SI = \frac{SI_{\text{homicide}} + SI_{\text{policeofficers}}}{2}$$

3) The knowledge component. The Knowledge component is composed of two indicators. The first one is the percentage of adults who are functionally illiterate (as used in the human poverty index) and the second is the average years of schooling per person over 25 years old.

3.1) The functional illiteracy index was built from the percentage of people who are older than fifteen years of age and are functionally illiterate.

$$FI = (1 - \% \text{FuncionalIlliteracy})$$

3.2) The schooling index. The schooling index was constructed using the average years of school for the population above 25 years old. The parameters to build the index were defined as follows: We took the average time necessary to finish the undergraduate school level (15 years) as the maximum and completely illiterate (zero years of school) as the minimum. Formally:

$$\mu_A(x) = \begin{cases} 0 & \text{if } x = 0 \\ \frac{(x-0)}{(15-0)} & \text{if } 0 < x < 15 \\ 1 & \text{if } x \geq 15 \end{cases}$$

The knowledge index was defined composing the last two sub-indexes, and can be written as follows:

$$EI = \frac{FI + SI}{2}$$

4) The food insecurity index: This index is based on a survey carried out by the Brazilian Institute of Geography and Statistics – IBGE. The referred survey has classified the Brazilian state population in four groups:

- a) People who are in food security: In this group are the people which have no food restrictions;
- b) People facing psychological food restriction: group composed of people who think they can have food restrictions soon, but have not had food restrictions in the last four weeks;
- c) People facing moderate food insecurity: in this group are the people who have no restrictions in the amount of food. However, the quality of the food is not adequate.
- d) People who are in severe or deep food insecurity. Defined as the situation where people have both – insufficiency and low quality food.

Using the above mentioned information, we build the food insecurity index given different weight for each situation as follows:

- a.1) FI=1 in situations where the whole population has food security;
- a.2) FI=0,79 when 100% of the population suffers only from physiological insecurity.
- a.3) FI=0,49 when 100% of the population suffers from moderate food insecurity
- a.4) FI=0 if 100% of the population faces severe food insecurity.

Using the above weight we build the composed food insecurity index as follows:

$$FII = (\%PeopleFS)(1,00) + (\%PeoplewithSFI)(0,79) + (\%PeoplewithMFI)(0,49) + (\%PeoplewithSFI)(0,00)$$

The insecurity index was built to have values from 0 to 1 and can reflect the intensity of the food insecurity among the Brazilian states.

The final aggregate Multidimensional Poverty Index (MPI) is an average of the previous sub-indexes.

$$MPI = \frac{HI + SI + KI + FSI}{4}$$

3 - Incidence of poverty in Brazil

3.1 An overview using conventional indicators.

Poverty and inequalities in Brazil are usually identified using one-dimensional indicators as the ones presented in the following table. However, if the aim is to better understand and to define proper public policies, it is necessary to have indicators which are more focused on the characteristics of the poverty problem and able to differentiate in which dimensions the population is more deprived.

Using the conventional poverty lines we can see that a huge percentage of the population is below the indigence and poverty line. According to such indicator the states in the North and the Northeast region have the highest percentage of the population living in absolute poverty. If we take the inequality indicator, Gini index for example, we can see that inequality is almost homogeneously distributed around the country. The Gini index is above 0,5 in almost all states (except one), which shows that poverty, at least in its relative conception, is a reality everywhere. Keeping this situation unchanged; even eradicating absolute poverty the relative poverty will still survive. Taking the HDI, which is a composed index, we can see that the majority of the states are classified as having middle human development and only five states have high human development⁶. It is important to highlight that among the states considered as developed, are the economically developed, industrialized and more educated states (within such states the inequalities are high in both senses economically and geographically) – the HDI is not able to capture these particularities.

⁶ Once HDI measures achievements in very basic capabilities, we assume that low human development means that the state is poor.

Table 1 – Conventional indicators measuring poverty (poverty line), inequality (Gini index) and Human Development (human development index).

	% people below the indigence line - (2003)	% of people below poverty line - (2003)	Gini index (2003)	Renda domiciliary per capita (R\$) (2003)	IDH (2000)
Brazil	13	33	0,57		
North	17	46	0,58		
Acre	23	51	0,59	270,71	0,69
Amapá	23	46	0,58	243,86	0,75
Amazonas	22	51	0,55	208,26	0,71
Pará	18	48	0,52	207,01	0,72
Rondônia	12	37	0,50	251,31	0,73
Roraima	17	42	0,52	239,41	0,74
Tocantins	22	54	0,56	201,34	0,71
Northeast	28	58	0,58		
Alagoas	39	69	0,60	149,57	0,64
Bahia	30	60	0,60	192,01	0,68
Ceará	25	54	0,58	181,95	0,70
Maranhão	37	67	0,57	141,66	0,73
Paraíba	28	59	0,56	170,50	0,66
Pernambuco	32	61	0,59	188,61	0,70
Piauí	38	63	0,60	155,32	0,65
Rio Grande do Norte	25	57	0,56	177,30	0,70
Sergipe	26	55	0,57	197,63	0,68
West centre	6	22	0,57		
Distrito Federal	11	28	0,62	546,41	0,84
Goias	8	27	0,53	276,79	0,77
Mato Grosso	9	28	0,55	276,34	0,77
Mato Grosso do Sul	7	26	0,54	294,93	0,77
Southeast	6	22	0,54		
Espirito Santo	8	27	0,56	287,49	0,76
Minas Gerais	9	27	0,55	278,48	0,77
Rio de Janeiro	7	26	0,55	395,69	0,80
São Paulo	7	22	0,54	415,48	0,82
South	6	20	0,52		
Paraná	8	26	0,53	343,96	0,78
Rio Grande do Sul	9	26	0,54	404,45	0,81
Santa Catarina	4	16	0,48	391,99	0,82

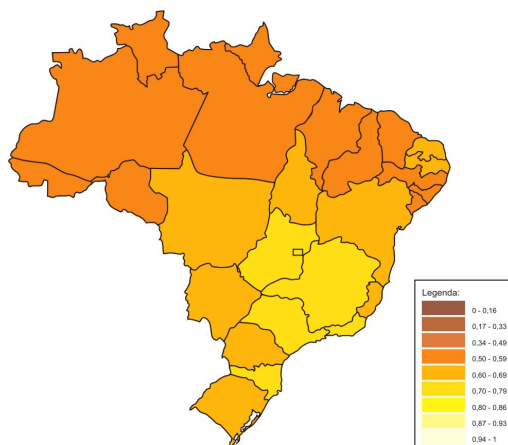
3.2 – Results from the Multidimensional analysis.

Concerning the interpretation of the index, we decided to follow the HDI standard, which means that when the value of the index is placed from 0 to 0,49 the state is classified as poor. Values from 0,50 to 0,79 refers to states classified as having a moderate level of poverty and states where the value is 0,8 or above are classified as having low levels of poverty. However, willing to facilitate the analysis and the interpretation of the states condition, we proposed additional intervals, splitting each initial interval in three parts.

We start our analysis by the health index, which shows that all Brazilian states can be classified as having a moderate level of poverty. In such dimension there is no state presenting satisfactory conditions. The interesting aspect is that the majority of states are between 0,5 and 0,59, which means they are slightly above the threshold and far from being considered out of poverty. There is also a significant number of states within the interval from 0,6 to 0,69 (9 states), which is an intermediary position between reaching the low level of poverty and following to very poor group. Only 5 states can be considered as being close to reach the low level of poverty in the health

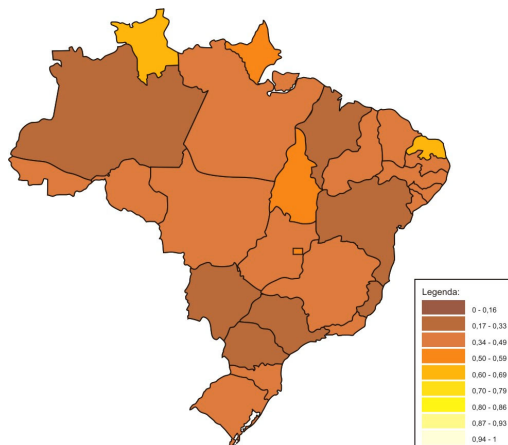
dimension. Looking at the sub-indexes of the health index, we can see that the worse situation is concerning the supply of health services, which are far from reaching the minimal recommended. However, the children mortality and life expectancy for the North and the Northeast states are also below the recommended.

Map 01. Health Index.



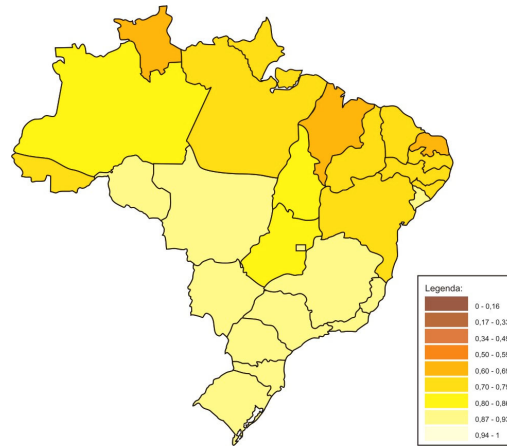
The safety index shows a much worse situation. According to such dimension the great majority of states are classified as being severely poor - index below 0,5. Only five states are classified as having a moderate level of poverty, among those only two have poverty multidimensional index above 0,6. Among the poor states, there are five states which present safety index below 0,33. Such situation is confirmed in both indicators used, which means that there are low number of police officers and high level of crimes.

Map 02 – Safety deprivation



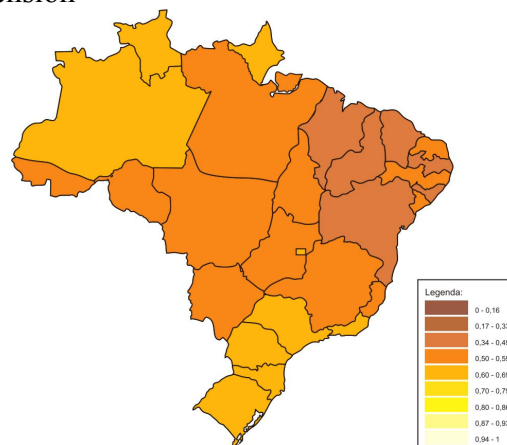
The food security index shows a better situation around the country. As it is possible to see in map 03, there are only three states which present food security index below 0,7. The North and the Northeast states are all below 0,8, which means the food insecurity is moderate. The food dimension shows a clear division within the country, presenting low levels of food insecurity in the South and the Southwest states, and a worse condition in the North and the Northeast.

Map 03 – Food insecurity index.



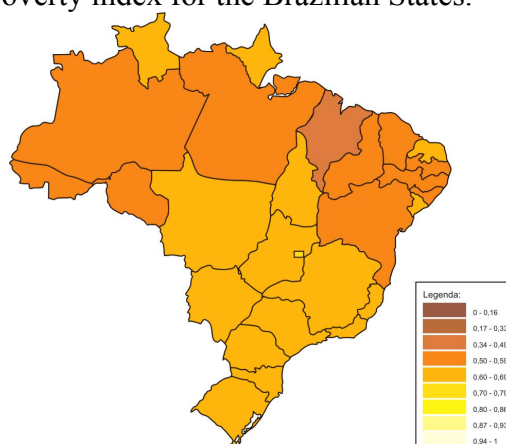
The Education index shows a different spatial reality, which means the deprivation is not highly correlated. There are eight states which present education index above 0,6 and only the capital of the country presents an index above 0,70. According to this dimension the country can be grouped in three blocks, not placed together: One composed by states in the South and the North. One grouping states in the Centre of the Country and some in the Northeast, and the high levels of poverty are in the Northeast states.

Map 04 – The education dimension



The multidimensional aggregate index shows that the country as a whole faces moderate levels of poverty, in so far, it can be split into two different groups of states. The South, the Southwest and two states in the North, and two states in the Northeast can be considered as being in a better condition. The majority of the Northeast states and the North region are closer to be considered severely poor.

Map 05 – Multidimensional poverty index for the Brazilian States.



The above presented maps and table 2 below show the distribution of poverty around the country, according to our multidimensional index and its sub-indexes. The most interesting aspect is that the states are grouped differently according to the dimension considered. The most homogeneous aspect is safety, which reflects that violence is spread all around the country.

Table 02 – Multidimensional Poverty Index for the Brazilian states.

	ISA (2003)	IVI (2003)	IRA (2003)	IED (2003)	GENERAL INDEX (2003)
Brazil	0,68	0,38	0,84	0,59	0,62
The North region	0,55	0,40	0,76	0,59	0,58
Acre	0,59	0,37	0,70	0,54	0,55
Amapá	0,54	0,59	0,76	0,62	0,63
Amazonas	0,56	0,24	0,82	0,65	0,57
Pará	0,54	0,36	0,72	0,57	0,55
Rondônia	0,51	0,35	0,88	0,58	0,58
Roraima	0,59	0,64	0,63	0,61	0,62
Tocantins	0,60	0,52	0,80	0,51	0,61
The Northeast region	0,59	0,38	0,72	0,46	0,54
Alagoas	0,56	0,45	0,77	0,42	0,55
Bahia	0,61	0,32	0,74	0,46	0,53
Ceará	0,57	0,39	0,71	0,47	0,54
Maranhão	0,57	0,32	0,63	0,43	0,49
Paraíba	0,60	0,45	0,71	0,45	0,55
Pernambuco	0,59	0,38	0,75	0,50	0,55
Piauí	0,55	0,43	0,71	0,41	0,52
Rio Grande do Norte	0,62	0,64	0,68	0,50	0,61
Sergipe	0,58	0,46	0,88	0,52	0,61
The Southeast region	0,73	0,35	0,89	0,64	0,65
Espírito Santo	0,68	0,23	0,88	0,59	0,60
Minas Gerais	0,70	0,37	0,87	0,57	0,63
Rio de Janeiro	0,71	0,39	0,88	0,67	0,66
São Paulo	0,73	0,31	0,90	0,66	0,65
The South region	0,67	0,35	0,90	0,63	0,64
Paraná	0,69	0,32	0,89	0,61	0,63
Rio Grande do Sul	0,64	0,34	0,89	0,64	0,63
Santa Catarina	0,70	0,45	0,93	0,64	0,68
The Mid West region	0,69	0,49	0,87	0,60	0,66
Distrito Federal	0,70	0,58	0,89	0,73	0,72
Goiás	0,70	0,42	0,85	0,58	0,64
Mato Grosso	0,63	0,44	0,87	0,57	0,63
Mato Grosso do Sul	0,67	0,29	0,88	0,57	0,61

4 - Final Considerations

The main contribution of the paper was to point out the importance of a multidimensional analysis when the country has heterogeneous characteristics and needs. As was possible to see poverty is heterogeneously distributed around the country according to some of the dimension and homogeneously distributed according to other. Such results show that public policies cannot be applied without detailed information about the problems within each state.

The MPI also shows that in some dimensions, for example health and food insecurity, the distribution of deprived people is consistent with the monetary indicators. However, taken education and safety the distribution around the states is diverse and not highly correlated to income measures.

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