Multidimensional poverty in Brazil: evidences for rural and urban areas

Pobreza multidimensional no Brasil: evidências para as áreas rurais e urbanas

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Abstract: This paper studied the behavior of multidimensional and income poverty, as well as its determinants in Brazil, in addition to rural and urban areas, based on information from the 2019 National Continuous Household Sample Survey (PNADC). The Alkire-Foster methodology was used in the construction of a Multidimensional Poverty Index (MPI), in addition to the logit model to estimate the impacts of determinants related to household characteristics on poverty. The health and sanitation dimension was the one that contributed the most to the MPI, followed by the education and housing dimensions. Unidimensional poverty was greater than multidimensional and rural poverty was also greater. Among the determinants of poverty, being in households with non-white heads, younger, unmarried, unemployed, less educated and in the North and Northeast regions increased the chances of poverty. In addition, while female heads reduced the chances of multidimensional poverty, it increased the chances of the unidimensional one.

Keywords: poverty, capabilities, Alkire-Foster method, welfare.

Resumo: Este trabalho estudou o comportamento da pobreza multidimensional e de renda, bem como seus determinantes no Brasil, evidenciando as diferenças entre as áreas rurais e urbanas com base nas informações das Pesquisas Nacionais por Amostra de Domicílios Contínua (PNADC) de 2019. Foi utilizada a metodologia Alkire-Foster na construção de um Índice de Pobreza Multidimensional (IPM), além do modelo *logit* para estimar os impactos na pobreza de determinantes relacionados a características domiciliares. A dimensão saúde e saneamento foi a que mais contribuiu com o IPM, seguida da dimensão educação e condições habitacionais. A pobreza unidimensional foi maior do que a multidimensional, além disso, a pobreza nas áreas rurais foi também maior. Entre os determinantes da pobreza, estar em domicílios com chefes não brancos, mais jovens, não casados, desempregados, menos escolarizados e ser das regiões Norte e Nordeste aumentaram as chances de pobreza. Além disso, domicílios com chefes mulheres tiveram menores chances de pobreza multidimensional, embora mais chances de pobreza unidimensional.

Palavras-chave: pobreza, capacidades, método Alkire-Foster, bem-estar.

1 INTRODUCTION

One of the most relevant global debates is about a fundamental issue of human condition - poverty, which reaches an expressive part of the world population. Report from UNO released in 2016 about the objectives of sustainable development shows that 13% of world population still live in extreme poverty, 800 million people suffer from starvation and 2.4 billion don't have access to basic sanitation (Organização das Nações Unidas, 2016). They are individuals not only devoid of monetary assets, but exposed to diverse social misfortunes. According to online data published by *Our World in Data* and monitored by *Oxford University*, global extreme poverty has been reduced throughout 200 years[1]. However, it is widely known that poverty is more alarming in less developed countries and that the phenomenon is proportionally higher in

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[1] Using poverty line of U$ 1.9 a day, there was 965 million people in extreme poverty in 1820 (representing 89% of world population). This number changed to 1.9 billion in 1990 (representing 35.8% of world population) and decreased to 734 million in 2015 (representing 10% of world population). In other worlds, the number of people over poverty line passed from 117.4 million in 1820 (11% of the total) to 3.4 billion in 1990 (64.2%) and 6.6 billion in 2015 (90% of the total) (Roser & Ortiz-Ospina, 2016).

rural areas than in urban ones. Yet, especially in mid-2000s, unidimensional rural poverty was expressively reduced and among the main factors for this reduction were the drop of income inequality and economic growth (Helfand et al., 2009).

According to information released by the report by the United Nations Development Program (UNDP) and *Oxford Poverty and Human Development Initiative* (OPHI), *Global Multidimensional Poverty Index 2019: Illuminating Inequalities,* children are the ones who suffer the most with poverty. One out of three children around the world is multidimensionally poor compared to one out of six adults. Establishing the multidimensional character of poverty, according to the same report, 64.5% of children in sub-Saharan Africa are poor and suffer severe deprivations as lack of access to drinkable water, to education, to food safety or decent housing (United Nations Development Programme, 2019).

In Brazil, measurement and analyses of poverty are turning increasingly more relevant facing empirical evidences of accelerated drop of extreme poverty in the country, especially income poverty in the 2000s. According to the World Bank, the rate of people surviving with less than US$ 1.9 a day in the country was reduced from 20.6% in 1990 to 3.7% in 2012 (World Bank, 2016). However, according to *Síntese de Indicadores Sociais: Uma análise das condições de vida da população brasileira 2019*, this population increased in 2015, especially when the income line changed from US$ 5.50, as internationally defined for countries with upper-middle income (Instituto Brasileiro de Geografia e Estatística, 2019a)[2]. Still, according to this report, between 2018 and 2019, poverty measured by the line of US$ 5.50 was reduced from 25.3% to 24.7%, whereas extreme poverty remained in 6.5%.

For Silva & Araújo (2015), who analyzed poverty in Brazil from 2014 to 2012, economic growth explained most of reduction of poverty observed during the period, outnumbering positive contribution of smaller income inequality. Thus, modest and even negative economic growth during mid-2010, in 2015 and 2016, could also have impacted the increase of poverty in the country.

In fact, the discussion about poverty multidimensionality gets more relevance from contributions of the Indian philosopher and economist Amartya Sen. Since 1980, the author has established a relation between poverty and human development based on the idea of social justice and with focus on the principles of capability and individual liberty (Sen, 2000). In this line, one of the most recent approaches used to measure multidimensional poverty is the one set by Sabina Alkire and James Foster (Alkire & Foster, 2009; Alkire & Santos, 2010), whose perspective has allowed a more detailed identification of deprivations caused by poverty (Yu, 2013; Mosaner, 2016; Alkire et al., 2017; Vieira et al., 2017; Silva et al., 2020; Serra et al., 2021).

On the other hand, poverty approach under the perspective of income insufficiency, favoring monetary aspects, is based on a line of defined poverty (Chakravarty, 1990; Zheng, 1997). In Brazil, this approach of poverty as income insufficiency was consolidated as the most used on empiric studies to measure population in situation of poverty, once the relation of income and the other socioeconomic dimensions is usually present among the results (Soares, 2009; Mello, 2018).

According to data from Brazilian Demographic Census, in 2012, 20.8% of the population in rural areas lived with monthly per capita domiciliary income up to R$ 70.00, whereas the perceptual was 3.7% in urban areas (Instituto Brasileiro de Geografia e Estatística, 2012). Cunha (2009), when analyzing the evolution of inequality and poverty during the period of 1981 to 2005, observed reductions in both measurements since the implementation of *Plano Real* and

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[2] Brazil is classified among the countries with upper-middle income, based on per-capita Gross National Income – GNI, for which World Bank suggests a line of US$ 5.50 PPC to classify people in poverty (Instituto Brasileiro de Geografia e Estatística, 2019a).

specially from 2001 on. In addition, the proportion of poor people showed reduction of 6% in rural areas and 1.3% in urban ones from 2001 to 2005. Also, there is a difference in deprivations related to other dimensions aside from income, especially between rural and urban areas.

In this context, it is important to study poverty not only through a monetary perspective, but also under a multidimensional one. Therefore, the objective of this paper is to create a Multidimensional Poverty Index and estimate its determiners, considering information from Brazilian Continuous National Sample Survey of Households from 2019. Besides considering Brazil as a whole, it is also expected to obtain estimates for rural and urban segments.

Following poverty in its multiple dimensions is essential to design and implement actions that improve life conditions of the population that suffers major deprivations. Conceptualizing poverty as a multidimensional phenomenon and applying this concept to empirical analysis is a process that must be carried out in order to identify actions that can solve and easy the precarious situation in which millions of people around the world still live.

Thus, the present paper is organized in four topics besides this introduction. In section 2, it is conducted a brief and empirical conceptual review of the contributions about poverty approach. In section 3, methodologies to analyze multidimensional and unidimensional poverty are presented, as well as their determiners. Section 4 brings the results of estimates and their discussion. Lastly, the final considerations are presented.

2 THEORETICAL FOUNDATIONS

Even with the common idea that reduction of poverty is an important objective of development policies in many countries, there is no agreement regarding its definition. Through the years, new conceptual perspectives, especially during the twentieth century, have identified poverty as a multidimensional phenomenon (Laderchi et al., 2003).

Until the 1950s, poverty was understood as the lack of income to supply only the physical needs of individuals (Townsend, 1993). This approach was elaborated by nutritionists and it was called survival or biological. However, since 1970, the United Nations Organization (UNO) adopted a new concept that broadened poverty approach when adding other basic needs as basic sanitation, health, education and culture (Crespo & Gurovitz, 2002). Thus, to Rocha (2006), the unmet basic needs method goes beyond food and survival, incorporating other needs of the individuals.

Therefore, no-income poverty embraces the unmet basic needs method (UBN), emerged in the mid-1970s and derived from reports from *International Labour Organization* (ILO) which focuses initially on better labor conditions for the population. Since 1980, the concept of UBN started being used in Latin-American studies, encompassing a group of basic needs required for a minimally acceptable life style for poor population, broadening the concept of poverty and taking into consideration other types of deprivations besides the low income (Mejía-Escalante, 2015; Boltvinik, 2013). Thus, those who don't have their basic needs met are considered poor, needs such as food, clothing, housing, household utensils, mobile, drinkable water, garbage collection, sewage, public transport, education, health and housing, among others (Salama & Destremau, 1999; Rocha, 2006; Silva et al., 2011).

Another contribution of the concept of poverty happened through capabilities approach, which pioneer was Amartya Sen; it treats poverty on the fields of social justice, equalities and inequalities, political implications and social relevance (Sen, 1993). According to Sen (2000, p. 109), "... *a pobreza deve ser vista como privação de capacidades básicas em vez de tão*

somente como baixo nível de renda, que é o critério tradicional de identificação de pobreza[3]. This perspective about poverty doesn't deny the existence of low income as one of the main sources of human deprivation, however, the unidimensional view doesn't totally clarify the phenomenon of poverty.

According to this point of view, poverty is defined by deprivation of capabilities when, besides unfit income, the individual suffers from lack of basic individual rights that cover a group of essential goods and services needed to develop each person's potentialities, such as access to proper education, health conditions, housing, water and sewage infrastructure. To the author, poverty is a multidimensional phenomenon, it is not possible to create policies to fight poverty only related to income increase, as its causes are associated to many economic, social and political factors. However, the author also states that both conceptions (unfit capabilities and low income) are associated as the income is necessary to obtain capability. The higher the capabilities, the higher the person's productive competence is and, as a result, the higher the chance to obtain better income. Therefore, this relation is essential to erase income poverty.

Thus, nowadays, poverty is seen as a complex phenomenon and with multiple dimensions that mutually influence themselves. This perspective contributes to public policies when it provides more information. For example, an improvement in education can bring good results in health and in the perspective of raising income as better healthy promotes well-being and helps generate income for poor individuals.

Many studies were conducted in Brazil and around the world analyzing the different faces of poverty through different methods. The common idea about poverty as a multidimensional phenomenon has induced an increasing number of empirical studies that follow this approach. This emphasis is due to the understanding that, besides the different manners they are manifested, the different dimensions of poverty interact in many ways, mutually reinforcing themselves.

Internationally, many studies proposed to measure multidimensional poverty. Santos et al. (2015) estimated a Multidimensional Poverty Index (MPI) for seventeen countries in Latin America through Alkire-Foster method (AF) for the years of 2005 and 2012, using monetary and non-monetary indicators. Data were taken from domiciliary surveys conducted in those countries and uniformed by CEPAL. The five dimensions (housing, basic services, lifestyle, education and jobs and social protection) defined by the authors encompassed thirteen indicators, as room density, sanitation and housing, electricity and years of education, among others. Results showed a significant reduction of poverty in the area since 2005, however, about 28% of the population were still multidimensionally poor in 2012, with great variation when the countries are compared. Among the analyzed dimensions, lifestyle leads the group, representing about 30% of total poverty, which includes an indicator of durable goods and another for insufficient income for basic survival needs, as food. On the other hand, the four remaining dimensions hold similar contribution, although there are variations among the countries, with emphasis on education, which shows higher contribution than housing and basic services in most of the analyzed countries.

Aiming to quantify and examine multidimensional poverty in rural areas of the city of Hechi, in People´s Republic of China, Wang & Wang (2016) used similar dimensions to Santos et al. (2015). The authors used the Alkire-Foster method for four dimensions, which were measured through eight indicators: housing (house security), health (health of the members), education (adult illiteracy and enrollment of children in school age) and life conditions (drinkable water, sanitary facilities, electricity and feel). Data regarding rural poor people from Hechi in 2013 were

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[3] In English: Poverty must seen as lack of basic capabilities instead of just low income, which is the traditional criterion to identify poverty (Sen, 2000, p. 109).

obtained from *Official Department of Poverty Alleviation*. However, differently from Santos et al. (2015), the authors verified that rural multidimensional poverty has increased impressively in at least one of the four analyzed dimensions. Deprivations related to the indicators housing insecurity, family health and adult illiteracy stood out.

Santos & Ura (2008) also used the Alkire-Foster method on data from *Lifestyle Survey* for the year of 2007 when analyzing poverty in rural and urban areas in Bhutan. The indicators were sorted in five dimensions (income, education, access to electricity, access to drinkable water and bedroom availability) and estimates were obtained for rural and urban areas of the country. Regarding rural area, it was also considered access to roads and land ownership. In the study, important deprivations were identified in relation to access to education, electricity and the amount of bedrooms. The authors also observed that 37% of rural and urban population of Bhutan lacked at least two of the five analyzed dimensions and lack of access to roads was a significant element of multidimensional poverty in rural areas. Thereby, similar to results from Wang & Wang (2016), the authors concluded that multidimensional poverty in Bhutan is essentially a rural problem, what doesn't exclude urban poverty as an apparent issue. Alkire & Fang (2019), who analyzed information from 1989 to 2009 in China, observed that both unidimensional and multidimensional poverty have higher incidence among women, married people and people with more years of education, the opposite happens to younger individuals and minorities.

During the second semester of 2019, the *United Nations Development Program* (UNDP) and *Oxford Poverty and Human Development Initiative* (OPHI) presented a global report about Multidimensional Poverty Index (MPI) of the year of 2019, which traced a detailed picture of poverty in 101 countries and 1119 sub-national areas, corresponding to 76% of the world population (United Nations Development Programme, 2019). Data from the report showed that about 21.3% of the world population were in situation of multidimensional poverty besides the monetary one and children were the most affected age once they were deprived of basic elements such as drinkable water, sanitation, suitable nutrition and basic education. Sub-Saharan Africa is the most noticeable one, since 63.5% of the children are multidimensionally poor. In other countries that belong to this region (Burkina Faso, Chad, Ethiopia, Niger and South Sudan), 90% of the children younger than ten years old are multidimensionally poor. It is believed that children is the most vulnerable group regarding poverty as the places with most poor people are also the ones with higher fertility level, then, more children are born from families already in poverty.

In a Latin-American context, Brazil, even with deprivations, showed a lower multidimensional poverty level when compared to other countries analyzed by the report. The country presented 49.8% of multidimensional poverty related to health deprivation, as lack of suitable nutrition and infant mortality rate, while 27.3% is related to Brazilian people lifestyle, taking into account elements as access to drinkable water, electricity, housing and sanitation. The remaining 22.9% of this rate is due to lack of education, verified through children's school attendance and the quality of the school years of the members of Brazilian families.

In a national sphere, Fahel et al. (2016) used data from *Pesquisa Nacional por Amostra de Domicílios* (*National Household Sample Survey*) for the years of 2002, 2007, 2012 and 2013 to estimate MPI for Brazil, aiming to analyze the incidence and the intensity of poverty in the country through AF method. The aspects studied by the authors were sorted as: education, measured by the years spent at school and the attendance; health, measured by the indicator infant mortality; and lifestyle, measured by indicators cooking fuel, electricity, water, acquired goods, basic sanitation and waste treatment. Results showed a reduction on MPI in Brazil from

7% to 2% between 2002 and 2013, particularly due to indicators regarding education. Besides, the authors detected that the macro-regions North and Northeast have steeper multidimensional poverty level caused by indicator basic services of sanitation (waste, sewage and water). They also found that all indicators were worst in rural areas than in the urban ones.

When analyzing the years of 1992 and 2004, Kageyama & Hoffmann (2006) used the micro-data from *National Household Sample Survey* to examine poverty in Brazil. Through articulation of income and indicators (running water, bathroom and electricity), the authors considered the individual as unit of analysis, defining it in three groups: non-poor, poor (type I and II) and extremely poor. The first group (non-poor) is formed by those individuals with an income above minimum salary and at least two of the items related at their homes. In the second group, poor type I are those with income lower half minimum salary and at least one item at their houses, while in group poor type II are those with income above half minimum salary and at least one item at their houses. The third and last group is the one of extremely poor individuals (income lower than half a minimum salary and no item at their houses). Among the main results of the study, it was observed that poverty type II and extreme poverty were reduced during the period, while poverty type I remained constant. When disaggregating the regions, it is emphasized that 85% of the population classified as extremely poor were in the Northeast in 2004 (Kageyama & Hoffmann, 2006).

Based on micro-data from *Brazilian Census 2000* and *2010*, Serra (2017) created a Multidimensional Poverty Index for Brazil, comparing results of the urban, intermediate and rural micro-regions. Among the chosen regions, differently from other national studies, the author sorted only two to obtain the effects of poverty: lifestyle and education. Results showed, as in other national studies about poverty, that the differences regarding deprivations in rural areas e non-rural (intermediate and urban ones) remain elevated in spite of improvements on all evaluated indicators. Substantial advancement occurred in access to electricity and durable consumer goods in rural areas, however, there are still severe deficiencies related to sanitation and basic education among the population aged from fifteen or older.

Another paper that used data from *Brazilian Demographic Census* to create a Multidimensional Poverty Index was the one by Brambilla & Cunha (2021), taking the years of 1991, 2000 and 2010 as base and considering six dimensions: health and sanitation, education, housing, labor, income and demography. While housing and demography were the ones that contributed the most for multidimensional poverty, health and sanitation and income favored its reduction. The authors also highlighted that reduction of poverty was more intense from 2000 to 2010 than 1991 to 2000. Lastly, in spite of the changes, there was higher number of cities with elevated MPR in the North and Northeast of the country and low MPR in the South and Southeast regions. Costa & Costa (2016) used data from *Brazilian Demographic Census* from 2010 to analyze Brazilian cities and observed that, although public policies reach individuals from urban and rural areas the same way, they produce better results in urban areas; it suggests that the characteristics of each place should be incorporated for greater success in reducing deprivations.

Silva et al. (2017b) observed in their study higher proportion of multidimensional poverty for the North of Brazil from 2006 to 2013. Reduction of poverty in the area was due to public policies implemented by federal government that represented a reduction in income inequality. Additionally, it was observed less intensity of poverty in metropolitan areas, where deprivation happened less intensively. These evidences, which indicate more intensity of poverty in rural areas and less in metropolitan ones, were also found by Albuquerque & Cunha (2012), who analyzed the state of Paraná in the years of 1995 and 2009. For Fahel & Teles (2018), reduction of multidimensional poverty in the state of Minas Gerais from 2009 to 2013 occurred in a

national and state context of amplification of social protection in a period with origin in the Constitution of 1988.

Thus, theoretical and empiric literature about multidimensional poverty has incorporated important contributions during the past decades. While it has been theoretically consolidated the relevance of different deprivations for the well-being of the individuals, besides income and food, empirically there is an effort to measure and understand the nature of this social issue. Among the dimensions, those related to health, education, housing and labor have stood up. On the other hand, the intensity stood out more in rural areas than in urban and metropolitan ones. Besides, minorities and younger people have been more impacted by multidimensional poverty, while women, more educated and married people have suffered lower incidence.

3 METODOLOGY

This paper aims to analyze the behavior of poverty in Brazil in the year of 2019, partitioning it in rural and urban areas. The multidimensional approach of poverty has based on Alkire-Foster method (AF), proposed by Sabina Alkire and James Foster and which is used by the United Nations Organization (UNO) to create the Multidimensional Poverty Index (MPI) through PNUD in their annual reports (Alkire & Foster, 2009; Alkire & Santos, 2010; United Nations Development Programme, 2019). Besides, it is used the binary response logistic regression model, as *logit* model, to identify the main determiners of poverty, both multidimensional and unidimensional, complementing the analysis of the theme, the same empiric strategy used by Alkire & Fang (2019).

3.1 DATA

Micro-data used to calculate multidimensional poverty compost indicator and variables of *logit* model are available through *Instituto Brasileiro de Geografia e Estatística - IBGE* (Brazilian Institute of Geography and Statistics) and *Pesquisa Nacional por Amostras de Domicílios Contínua - PNADC* (Continuous National Sample Survey of Households) from the year of 2019.

In order to create the indicators, the unit of analysis and identification is the household. Moreover, it was adopted the Alkire-Foster approach to build the Multidimensional Poverty Index (MPI), considering its characteristics and applications in many studies about poverty.

3.2 METHODS

3.2.1 Measuring multidimensional poverty: the Alkire-Foster method (AF)

The creation of the multidimensional poverty index (MPI) involves choosing identification strategies, aggregation procedures, dimensions and weighted structures. Alkire et al. (2015) define in their work *Multidimensional Poverty Measurement and Analysis* the detailed process to elaborate the AF methodology, which is run in two steps: identification (establishment of patterns to determine poverty) and aggregation (gathering information about poor people in an index).

In a situation with n households in a group of d dimensions, the action of household i in dimension j can be represented by a negative real number such as $x_{ij} \in R^+$ for every $i = 1, ..., n$ and $j = 1, ..., d$. This, x_{ij} is the realization of i household in dimension j. In the sequence, it is necessary to define the first cutting line, so z_j is the deprivation cutting point for dimension

j, which is defined as the minimum performance needed in order to a household not to be deprived, such as household *i* is considered deprived in dimension *j* if, and only if, $x_{ij} < z_j$ (Alkire et al., 2015). Thus, it is necessary to calculate the deprivation status of each household for each dimension g_{ij}^0. If x_{ij} is lower than z_j, then *i* household is deprived in dimension *j*, then $g_{ij}^0 = 1$, otherwise, $g_{ij}^0 = 0$.

When measurement of multidimensional poverty is analyzed the, it becomes necessary to assign a weight for each dimension, what represents its relative contribution to compound the poverty index. Thus, the relative weight assigned to dimension *j* is called *wj*, such as $w_j > 0$ for every *j* = 1, ..., *d*. The group of weights assigned to every *d* dimensions is presented by weight vector *w* = (w_1, ..., w_d), hence the sum of relative weights is like one: $\sum_{j=1}^{d} w_j = 1$. After defining the *w* weight vectors and the deprivation status values for matrix g^0, the elements are grouped and it is obtained the deprivation score c_i, in which $c_i = \sum_{j=1}^{d} w_j g_{ij}^0$. Thus, $0 \leq c_i \leq 1$, being the score like zero for a household without any deprivation and the value one for deprivation in any dimension (Alkire et al., 2015).

In order to sort households as multidimensionally poor or non-poor, besides the deprivation cutting lines (z_j), it is necessary to define a second line (*k* poverty line) that represents the minimum score that a household should present to be considered multidimensionally poor, in which $0 < k \leq 1$. A household is considered poor if its deprivation score is like or greater than the poverty cut, in other words, if $ci \geq k$ (Alkire et al., 2015). As stated by Alkire et al. (2015), in global MPI a household is identified as poor if they show a deprivation score greater or like 1/3 or 33.33% of the (weighed) indicators that compound the index.

The following step after the process of identification of poor households is the aggregation of information about poverty. In order to do so, it is necessary to consider deprivations of non-poor households from matrix g^0 (in other words, those whose deprivation score is lower than poverty cutting line *k*) and have their score replaced by 0, such as $g^0(k)$. It is also necessary to censor the deprivation score vector in a way that, if the household is poor, $c_i(k) = c_i$, otherwise, $c_i(k) = 0$.

During the aggregation phase, the calculation of the multidimensional poverty index (MPI) or measurement *M* (the proportion of households weighed by the intensity of poverty) can be expressed as a product of two partial measurements/indexes: the multidimensional poverty incidence (*H*), which is related to the proportion of the population that is multidimensionally poor, and the average intensity of poverty (*A*), which represents the relative number of deprivations that the poor households suffer simultaneously. Thus, the MPI is the product of both partial indexes ($M = H \times A$).

The choice of dimensions and indicators that compound the index is very important as they must be able to clearly and concisely show the conditions of the households. The dimensions showed in this paper highlight the diverse aspect that represent a proper life style besides the income and that are a guide to measure poverty as a multidimensional phenomenon. Following the steps of Alkire & Santos (2010), this paper uses three dimensions and ten indications in order to elaborate a multidimensional poverty index. All indicators have a maximum value of 1 (deprived) and minimum value of 0 (no deprived). Regarding the weights, it was adopted the same orientations proposed by Alkire & Santos (2010) to PNUD to obtain their MPI, so it was assigned the same weight for the three dimensions (1/3 = 33.33%). Therefore, when considering the described method, the ten indicators, three dimensions and the weights used in this study can be observed on Table 1.

Table 1 - Dimensions, indicators, deprivation conditions and weights for Brazilian multidimensional poverty index

Dimensions	Indicators	Who is deprived?	Weight (%)
Education	Years of education	Household in which no sixteen-year-old or older resident has at least eight years of education	16.66
	School attendance	Household in which at least one child within seven and seventeen years old doesn't attend school	16.66
Health and basic services	Water supply	Household without running water in at least one room or it is not supplied by public net, well or spring	8.33
	Waste destination	Household without direct waste collection (e.g.: waste disposed in buckets, burned or burred, thrown in the sea/rivers or empty lots)	8.33
	Electricity	Household without electric lightning (net, generator or solar electricity)	8.33
	Basic sanitation (Bathroom)	Household with toilets not connected to sewage system or rainwater drainage network (e.g. rudimentary cesspits) or community toilet (shared by households)	8.33
Housing	Resident/bedroom density	Household with three or more residents per bedroom	8.33
	Roof material	Household which main material of the roof is not tile, concrete slab or planed hewn timber	8.33
	Cooking fuel	Household without gas or electricity as cooking fuel	8.33
	Durable consume goods	Household without one or more of these items: refrigerator, television (colored or black and white), telephone (landline or cellphone), laundry machine, computer and vehicle.	8.33

Source: Authors' own.

Also, in order to compare with multidimensional poverty, it was adopted poverty lines based on *Programa Bolsa Família* – PBF (Bolsa Familia Program) to size the proportion of unidimensional poor people whose poverty lines correspond to R$ 189.00 (poverty) and R$ 89.00 (extreme poverty) for the year of 2019 (Ministério do Desenvolvimento Social, 2021). The choice of poverty lines from PBF are due to their functionality in studies about the theme (Rocha, 2011; Souza et al., 2019; Campello & Neri, 2013) and also because the program has great importance in diagnosing poverty confrontation.

3.2.2 Logistic regression model

The *logit* model is used to analyze the relation between a binary dependent variable (or dichotomous) and a group of explanatory variables, which can be binary or continuous and is applied in cases when it can be observed the occurrence or not of a determined event. Its application enables to estimate the probability of such event, as well as evaluate the relative importance of these variables so that the event occurs (Greene, 2012).

In this study, the dependent variable shows two possibilities: the household is in situation of multidimensional or unidimensional poverty or not. Thus, results of the estimates must be understood in terms of chances of being in poverty, then it is possible to analyze the profile

of people affected by the phenomenon of poverty in Brazil, presenting the characteristics of household as well as its locations (urban or rural).

In order to analyze the occurrence of an event when the dependent variable is binary, after estimating the coefficients, results must be within the range of zero to one. However, in cases when event projection only allows two possibilities (being poor or not, for example), if the linear probability model is used, there can be some problems as estimates out of the zero-to-one range and even heteroscedastic mistakes (Greene, 2012). In order to avoid such adversities, the conditional probability is modeled from a positive response [Prob(Y=1│X)] through a logistic cumulative distribution function, which is, according to Greene (2012), determined by

$$Prob\left(Y=1|X\right)=\frac{e^{\beta'X}}{1+e^{\beta'X}}=\frac{1}{1+e^{-\beta'X}},$$

in which X is the independent or explicative variable matrix and β is the coefficient vector estimated by regression. Hence, the conditional probability of no occurrence is defined by:

$$Prob\left(Y=0|X\right)=(1-Prob(Y=1|X).$$

Based on the two previous equations, in order to express the results in terms of odds ratio, it is necessary to conduct a logistic transformation to align the relation between the dependent variable and the group of explicative variables. Therefore, the ratio between probabilities, also called odds ratio, is defined by the chance of occurrence of the event in opposite to the change of no-occurrence, as showed by equation:

$$\frac{Prob\left(Y=1|X\right)}{1-Prob\left(Y=1|X\right)}=\frac{1}{e^{-\beta'X}}=e^{\beta'X}.$$

Regarding explanatory variables, for this analysis the estimated odds ratio points out the difference between the event occurrence and the base category. The variables used when estimating the logistic model were also obtained through micro-data from *Continuous National Sample Survey of Households* from 2019 and they can be seen on Table 2.

According to Wooldridge (2010), the analysis of the signs of the estimated coefficients shows information about the direction of the changes in the chances when an explanatory variable is modified. Thus, when the coefficient has a positive value, the chance of the household to be in poverty is higher than the base category, while the negative coefficient points out that this probability is lower.

On the following step, the natural logarithm is applied in ration between the probabilities:

$$ln=\left[\frac{Prob\left(Y=1|X\right)}{ü-Prob\left(Y=\ X\right)}\right]=\beta'X.$$

Thus, the logistic transformation was performed aiming to align the relation between the dependent variable and the explanatory ones in such way that the Napierian logarithm of ratio between the probabilities, or *logit*, is a linear ratio on explanatory variables and parameters. This way, as the logistic function varies within 0 and 1, it becomes suitable to model the risk of occurrence of certain phenomenon.

Table 2 - Description of variables used on logistic regression model

Variables	Description
Multidimensional or unidimensional poor	1, poor household, 0 otherwise
Urban	1, urban region, 0 otherwise
Rural	1, rural region, 0 otherwise
Metropolitan	1, metropolitan region, 0 otherwise
Without education or less than one year	1, without education or less than one year, 0 otherwise
Incomplete elementary school or equivalent	1, with incomplete elementary school, 0 otherwise
Complete elementary school or equivalent	1, with complete elementary school, 0 otherwise
Incomplete high school or equivalent	1, with incomplete high school, 0 otherwise
Complete high school or equivalent	1, with complete high school, 0 otherwise
Incomplete higher education or equivalent	1, with incomplete higher education, 0 otherwise
Higher education	1, with complete higher education, 0 otherwise
Woman	1, if woman, 0 otherwise
Up to 24 years old	1, up to 24 years old, 0 otherwise
25 to 49	1, from 25 to 49 years old, 0 otherwise
50 to 64	1, from de 50 to 64 years old, 0 otherwise
65 or older	1, 65 or older, 0 otherwise
Non-white	1, if black, brown or native, 0 otherwise
Married	1, if married, 0 otherwise
Unemployed	1, if unemployed, 0 otherwise
Northeast	1, Northeast region, 0 otherwise
Southeast	1, Southeast region, 0 otherwise
South	1, South region, 0 otherwise
Central West	1, Central West region, 0 otherwise

Source: Authors' own.

In order to verify the chance of a household to be or not in situation of multidimensional or unidimensional poverty, the binary response model *logit* was used. It shows as the main objective to quantify and identify the factors that exert greater influence to determine the probability of poverty in Brazil (urban or rural areas). It is necessary to delimit a cutting line to determine the incorporation or not of poverty and then define its chances. All results were obtained for Brazil and urban and rural areas.

Thus, considering the empiric literature and especially Alkire & Fang (2019), variables about individual characteristics of the individuals and heads of the household (as gender, age, color or race, educational levels, marital status and professional conditions) were included as well as variables about the demographic areas where the household is located. As reference categories for each variable, the first level of education, male gander, age up to 24 years old, white or Asian, not married, not unemployed and living in the Northeast and in metropolitan areas were used, these categories were left out for the estimates in the next section. It is important to point out that the group of selected variables aims to reflect structural aspects of poverty.

4 RESULTS AND DISCUSSION

Although poverty has been reduced in Brazil for the past decades, it can be verified that cases or significant deprivation perpetuation in some indicators are still present. The evidences about this situation in Brazil are presented in Table 3, that also brings the proportion of deprived households in poverty indicators for the whole country and rural and urban areas as well as

the proportion of unidimensional poor people, the multidimensional poverty index (MPI), the incidence and the intensity of poverty in 2019.

Table 3 - Proportion of deprived population in indicators, multidimensional poverty index (MPI), incidence, intensity and proportion of unidimensional poor people in Brazil, urban and rural areas, 2019

Indicators	Brazil	Urban area	Rural area
Education	0.197	0.163	0.408
Attendance	0.018	0.017	0.027
Water supply	0.017	0.005	0.094
Waste destination	0.166	0.082	0.704
Electricity	0.003	0.001	0.015
Sanitation	0.312	0.229	0.842
Density	0.085	0.082	0.107
Material	0.007	0.003	0.034
Fuel	0.014	0.006	0.065
Goods	0.003	0.001	0.016
Multidimensional poverty			
MPI	0.022	0.006	0.123
Incidence	0.061	0.018	0.334
Intensity	0.363	0.350	0.368
Unidimensional poverty			
R$ 189.00	0.083	0.064	0.207
R$ 89.00	0.055	0.043	0.129

Source: Authors' own, based on data from PNADC (Instituto Brasileiro de Geografia e Estatística, 2019c).

Generally, rural households show more deprivations on the ten indicators. Initially, regarding dimension education, both indicators have similar behavior for the three locations: Brazil, urban and rural areas. However, education stands out with the highest proportion of deprivation, reaching 41% of deprivation on rural areas and 16% on the urban ones.

Regarding the dimension health and basic service, the proportion of households deprived of indicator basic sanitation riches 31% in Brazil, 23% for urban areas and 84% for the rural ones. Besides this indicator, the proportion of households deprived of suitable dispose of waste also stands out, with 8% for urban areas but 70% for rural ones. When the housing is verified, it can be noted that the proportion of households deprived in indicator bedroom density is the most significant, about 10% on the three locations. Unsuitability of cooking fuel stands out in 6.5% of the rural households.

When considering these indicators, Brazil as a whole presented an MPI of 2%, while rural areas have a level of 12% and urban household, 0.6%. Regarding a unidimensional perspective of poverty based on monetary line from *Bolsa Familia Program* for the year of 2019, which is R$189.00 (poverty) and R$89.00 (extreme poverty), it was observed for rural households rates of 20% for poverty and 13% for extreme poverty. For Brazil and urban areas, the rates are lowers than 8% on both monetary lines. When the proportions for 2019 of multidimensional and unidimensional poor people are compared, there was higher proportion of households in situation of unidimensional poverty than multidimensional for the three locations.

Therefore, although social programs to fight poverty during the past decades as *Bolsa Familia Program* and *Benefício de Prestação Continuada - BPC* (Continuing Benefit Conveyance) have contributed to easy the vulnerability suffered by the population, there is still a large amount of people in situation of poverty. Regarding health and basic services dimensions, besides the *Sistema Único de Saúde – SUS* (Unified Health System), the *Programa Farmácia Popular*

(Popular Pharmacy Program), created in 2004, also stands out as an important program. In relation to housing dimension, *Minha Casa, Minha Vida* program, from 2009, was a relevant initiative. For education, it was created *Fundo de Manutenção e Desenvolvimento da Educação Básica e de Valorização dos Profissionais da Educação* - FUNDEB (Funding for Maintenance and Development of Basic Education and Valorization of Education Professionals) in 2006 and *Programa Universidade para Todos – Prouni* (University for All Program) in 2004. In addition, in rural areas it could also be observed *Programa Luz para Todos* (Light for All Program), from 2003, which has contributed to reduce deprivations for poorer population.

For Moreira et al. (2009), who analyzed the years of 1995 to 2005, although poorer rural workers were attended by Bolsa Familia Program, many times they were moved from their original place to other where they could not reproduce the same traditional life conditions. Wanderley (2014) stated the importance of small farmers and familiar agriculture for agricultural production and employment in Brazil, even when facing a rural development model for agricultural production and employment that have privileged income and land concentration, although, according to the author, since 2003, there have been an amplification of public policies directed to the most vulnerable farmers.

Table 4 brings the results for the year of 2019 of the logistic regression that estimates the odds ratio of a household in Brazil and urban and rural areas to be in situation of unidimensional or multidimensional poverty[4]. Initially, as observed in descriptive analysis, the chances of poverty are smaller for urban households, but this difference is smaller in unidimensional analysis once the urban household infrastructure is better than the rural one, which impacts multidimensional analysis more deeply. Results also show that living in metropolitan areas reduces the chances of poverty. In results for Brazil, the risk ratio of being multidimensional poor in urban area is 92% lower than for rural area. Likewise, results for urban and rural areas show that chances of poverty are smaller among households whose heads live in metropolitan area in a proportions that varies from 30 to 47%.

In Brazil, regarding the variables associated to the personal characteristic from the heads of the house or reference people, it is observed that households whose reference person is a woman, in a multidimensional point of view, have smaller chances of poverty than those headed by men, being the proportion: 21% (Brazil), 22% (urban areas) and 18% (rural areas). However, under the unidimensional aspect, poverty is greater among those households headed by women and estimates show that chances of poverty for Brazil and urban and rural areas are 23%, 24% and 14% greater for these households headed by women, respectively.

Evidences show that women have higher educational levels than men even for rural areas, however, they don't receive the same income or opportunities, as example, this fact justifies the higher probability of unidimensional poverty for this group (Osório, 2004; Cunha, 2008; Ribeiro, 2009; Instituto de Pesquisa Econômica Aplicada, 2013). In case of Chine, Alkire & Fang (2019) observed lower levels of poverty for women both for multidimensional and unidimensional aspects. In case of Brazil, Silva et al. (2017a) also identified lower levels of multidimensional poverty among women.

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[4] Values presented on Table 4 are in odds ratio, which implicates subtraction of 1 and multiplication of the value for 100 to find the effect of each odds ration poverty variable.

Table 4 - Multidimensional or unidimensional poverty risk ration – Brazil, urban and rural areas, 2019

Variables		Brazil		Urban areas		Rural areas	
		Multidimensional	Unidimensional	Multidimensional	Unidimensional	Multidimensional	Unidimensional
Area	Urban	0.079***	0.442***				
	Metropolitan	0.562***	0.698***	0.590***	0.730***	0.532***	0.518***
Education	Incomplete elementary school or equivalent	0.728***	1.021	0.557***	1.072	0.788***	0.919
	Complete elementary school or equivalent	0.062***	0.785***	0.034***	0.797*	0.074***	0.720**
	Incomplete high school or equivalent	0.055***	0.684***	0.012***	0.700**	0.074***	0.671***
	Complete high school or equivalent	0.031***	0.397***	0.016***	0.392***	0.038***	0.435***
	Incomplete higher education or equivalent	0.019***	0.255***	0.009***	0.252***	0.028***	0.326***
	Complete higher education	0.017***	0.162***	0.009***	0.161***	0.023***	0.220***
Gender	Woman	0.786***	1.230***	0.782***	1.245**	0.819***	1.142***
Age	25 to 49 years old	0.522***	0.804***	0.537***	0.850	0.543***	0.799*
	50 to 64 years old	0.581***	0.295***	0.341***	0.340***	0.698**	0.256***
	65 or older	0.512***	0.022***	0.246***	0.037***	0.656***	0.008***
Color or race	Non-white	1.078	1.291***	1.278**	1.373***	1.051	1.185**
Marital status	Married	0.646***	0.634***	0.844*	0.457***	0.580***	1.060
Profession	Unemployed	0.866	6.791***	0.784	7.570***	0.898	4.837***
Region	Northeast	0.738***	0.976	1.157	0.969	0.623***	1.039
	Southeast	0.378***	0.381***	0.287***	0.447***	0.403***	0.291***
	South	0.393***	0.261***	0.248***	0.309***	0.414***	0.213***
	Central West	0.676***	0.339***	0.379***	0.425***	0.884	0.195***
	Constant	4.273***	0.704***	0.429***	0.245***	3.870***	0.708*

Source: Authors' own, based on data from PNADC. Note: * significant to 10%, ** significant to 5% and *** significant to 1%.

Evidences show that women have higher educational levels than men even for rural areas, however, they don't receive the same income or opportunities, as example, this fact justifies the higher probability of unidimensional poverty for this group (Osório, 2004; Cunha, 2008; Ribeiro, 2009; Instituto de Pesquisa Econômica Aplicada, 2013). In case of Chine, Alkire & Fang (2019) observed lower levels of poverty for women both for multidimensional and unidimensional aspects. In case of Brazil, Silva et al. (2017a) also identified lower levels of multidimensional poverty among women.

Regarding color and race, results signed that heads of the household who declared being non-white have higher chances to be in poverty than white people on the three locations and two perspectives (multidimensional and unidimensional). The percentage for the chance of poverty is higher regarding the income aspect, especially for residents of urban areas who have higher chances of poverty for both multidimensional (28%) and unidimensional (37%) perspectives. There are many elements that worked so that African descendants were in a socioeconomic vulnerability, among them are lower income on labor market and lower educational levels (Soares et at., 2007; Zucchi & Hoffmann, 2004). In face of the social inequality context of 2021 and some experiences during the first decade of the XXI century in Brazil, it can be mentioned the enactment of Law nº 12.711, referred as *Lei das Cotas* (Quotas Act) and that resulted in the access to public and federal higher education in Brazil, establishing a quota of 50% of enrollments in federal universities for individuals who are black, native, low income and attended high school at public schools. This affirmative action policy was also adopted by university in state level and helps to broaden the opportunities for individuals considered deprived of higher education, avoiding passing poverty from generation to generation.

Generally, regarding marital status, it was verified that households with married heads have lower chance of poverty for both perspectives than people who are not married. In Brazil, estimates suggest that married people have 35% (multidimensional) e 37% (unidimensional) less chances when compared to not-marrieds. In urban areas, the chances of being in poverty are also lower among married heads, reaching the proportion of 16% (multidimensional) and 54% (unidimensional). In case of the rural areas, the risk of multidimensional poverty is likely lower (42%). However, when the unidimensional aspect is analyzed, the risk is lower (6%) among married people, but result is not statistically significant, suggesting that there is no difference between married and not-married people in this case.

Regarding age, it was observed in general that as the head of the household gets older, their chances to be in situation of poverty are lower – especially for unidimensional aspect – for each year of their lives. Individuals aged 65 or older stand out, representing lower chances of poverty than heads of the household aged up to 24 years old: Brazil (98%), urban areas (96%) and rural areas (99%). This result is similar to the studies of Silva Júnior & Sampaio (2010), who observed lower proportions of poor people aged from 61 to 70 (10% of poor people) when compared to younger individuals as the ones from zero to five years old (45% of poor people).

Regarding educational characteristics, estimates point to a negative association between education and poverty condition; it means that the higher the educational level of the head of the household, the lower the chance of poverty especially under the multidimensional approach. This behavior was also detected by Alkire & Fang (2019) when they analyzed the dynamics of multidimensional and unidimensional poverty in cities of China. The authors highlighted that, when the heads of the household have higher education, chances or poverty are reduced. Among the considered educational levels, in general, the one with higher coefficient (the one whose individuals have higher chances of not being poor) includes those who have complete higher education. Households whose heads are on this educational level show better chances (98%) on the three locations when compared to those whose heads have no education or less than one year of school (reference category).

In relation to professional conditions of the head of the household, results suggest that when they are unemployed the chance of poverty is higher, especially the unidimensional one. The recessive effect of 2014-2016 and the slow economic recovery of Brazilian economy on the following years resulted in deep outcome for labor market, especially regarding the growth of unemployment rate. Data from PNADC 2019 highlighted that, between 2012 and

2014, unemployed workforce remained in 6 million, varying in 41% in 2015 and reaching 9 million. It continued to grow in 2016, with a variation of 36%, totaling about 122.3 million of unemployed people (Instituto Brasileiro de Geografia e Estatística, 2019b). Results for Brazil show that when a head of the household is unemployed, the risk to fit in unidimensional poverty is 579%. On urban and rural areas, the chance of unidimensional poverty is 657 and 384%, respectively. For the multidimensional approach, chances are lower, with rates between 10 and 21% for Brazil, urban and rural areas.

On the other hand, regarding the region where the household is and taking the North region as reference, it was observed that in the other locations the chances of unidimensional and multidimensional poverty are lower in every region except the urban and rural areas of the Northeast for multidimensional and unidimensional poverties, respectively, which showed rates of 16 and 4%. In fact, the North and Northeast regions of the country have historically stood out as the most vulnerable (Osório, 2019; Brambilla & Cunha, 2021). However, the lowest chances of poverty are in the South and Central West of the country for the unidimensional aspect and in the South and Southeast for the multidimensional.

Hence, in general, results from this study are aligned to the literature and show persistent vulnerabilities in Brazilian society, as well as deprivations to be overcome in education, health, sanitation and household infrastructure. Therefore, it is necessary to expand public policies aimed at them in order to reduce the deprivation suffered by the population.

5 CONCLUSIONS

This paper aimed to analyze the situation of multidimensional poverty for the year of 2019 in Brazil and in its rural and urban areas. In order to do so, it was created a Multidimensional Poverty Index (MPI) through ten indicators, besides, logistic regressions were estimated to verify the characteristics of household poverty, considering the impacts of a group of socioeconomic variables on determining multidimensional and unidimensional poverty.

Brazil presented a PMI of 2% and for urban and rural areas this rate was 1% and 12%, respectively. For the dimension education, although the proportion of households with children and adolescents who don't attend school was about 2%, this fact needs more attention as it is one important cause of poverty in the long-term. For the dimension health and basic services, sanitation and suitable waste disposal are still worrying, considering the consequences for the health of the population. Lastly, for housing, unsuitability of the bedroom stood out.

Results for monetary poverty were higher to the multidimensional one, it means that the proportions of unidimensional poor people on poverty line (R$ 189.00) and extreme poverty line (8R$ 89.00) in Brazil were estimated in 8% and 5%, respectively. These results are aligned to the expected once multidimensional analysis focus on deprivations that are the most essential for life and social well-being. This situation is more intense in rural areas, considering both multidimensional and unidimensional approaches.

Estimates of regression models show that chances of multidimensional poverty are higher in households whose reference people are women and chances of unidimensional poverty are also higher for women, what can be explained by the low income they generally receive. In addition, poverty reaches more often households whose reference people are not white, unemployed, not married and less educated. Lastly, poverty reaches more intensively the North and Northeast regions. Thus, it can be concluded that poverty has a defined profile related to aspects like race, regions, access to labor market, which perpetuate as poverty conditioning.

Thus, although the incidence of poverty has been reduced during the past years in Brazil, it is still worrying, especially for rural areas. Hence, this paper allowed identifying much heterogeneity on indicators of deprivation on Brazilian households regarding education, basic services and housing. Therefore, it is suggested that poverty specificities are expanded on discussions about social and economic development as part of a public agenda aimed to improved life conditions of the population in the country.

6 ACKNOWLEDGEMENTS

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