ANDREZZA LUIZA BATISTA

ESSAYS ON MULTIDIMENSIONAL POVERTY AND GENDER IN BRAZIL

Thesis submitted to the Applied Economics Graduate Program of the Universidade Federal de Viçosa in partial fulfillment of the requirements for the degree of *Doctor Scientiae*.

Adviser: Lorena Vieira Costa Lelis

Co-adviser: Mateus de Carvalho Reis Neves

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“Sucesso não é diploma
que o tempo pode estragar.
Sucesso é conhecimento,
é ter algo pra ensinar.”
(Bráulio Bessa)

ABSTRACT

BATISTA, Andrezza Luiza, D.Sc., Universidade Federal de Viçosa, June, 2023. **Essays on Multidimensional Poverty and Gender in Brazil.** Adviser: Lorena Vieira Costa. Co-adviser: Mateus de Carvalho Reis Neves.

This thesis is dedicated to studying Brazil's multidimensional poverty with a gender focus. Specifically, we consider poverty a phenomenon that affects people's live's in several aspects other than income, such as education, employment, and living conditions. Also, we consider that poverty is driven differently by men and women due to social, economic, and cultural gender differences. Hence, the first essay aimed to analyze the multidimensional poverty in Brazil with a breakdown of gender, race, and regional disparities. To do so, a Multidimensional Poverty Index was constructed with eleven indicators (years of schooling, literacy, employment, income, electricity, sanitation, water, garbage disposal, cooking fuel, assets, and overcrowding) within four dimensions (education, employment, income, and living standards). We used data from the National Household Sample Survey (PNAD) from 2004 to 2015. The results found in this chapter indicated that women have higher deprivation than men. They are the majority of people experiencing poverty and suffer a more intense form of poverty than men. Black women and the ones living in rural areas are in a situation even worse. We also found that employment and income are the dimensions that drive multidimensional poverty in Brazil and that women in Brazil have difficulty transforming education into income. Additionally, results showed that women's poverty has been reducing slower than men's. The second essay analyzed whether migration and nonagricultural jobs can be seen as pathways out of multidimensional poverty for individuals from rural Brazil, breaking it down by gender. The relationship between livelihood strategies and multidimensional poverty was estimated by a two-stage least squares estimation considering extreme climate events in temperature and precipitation as instruments for migration and nonfarm performance since they can be considered endogenous. The data used was also the National Household Sample Survey (PNAD) from 2004 to 2015. We used the deprivation score calculated by the Multidimensional Poverty Index method for the dependent variable. The results of this paper suggest that performing nonagricultural activities can act as pathways out of poverty in rural Brazil, reducing deprivation, but only for men, and that migration is irrelevant in explaining the

changes in deprivation. In general, this thesis contributes theoretically and empirically to understanding several facets of poverty in Brazil.

Keywords: Multidimensional poverty. Deprivation. Gender.

RESUMO

BATISTA, Andrezza Luiza, D.Sc., Universidade Federal de Viçosa, junho de 2023. **Ensaios sobre Pobreza Multidimensional e Gênero no Brasil.** Orientadora: Lorena Vieira Costa. Coorientador: Mateus de Carvalho Reis Neves.

Esta tese se dedicou em estudar a pobreza multidimensional no Brasil com enfoque de gênero. Especificamente, considerou-se a pobreza como um fenômeno que afeta a vida das pessoas em vários aspectos além da renda, como educação, emprego e condições de vida. Além disso, considerou-se que a pobreza é impulsionada de forma diferente por homens e mulheres devido às diferenças sociais, econômicas e culturais de gênero. Assim, o primeiro ensaio teve como objetivo analisar a pobreza multidimensional no Brasil com uma desagregação das disparidades de gênero, raça e regional. Para tanto, foi construído um Índice de Pobreza Multidimensional com onze indicadores (anos de estudo, alfabetização, emprego, renda, eletricidade, saneamento, água, coleta de lixo, combustível para cozinhar, patrimônio e superlotação) em quatro dimensões (educação, emprego, renda, e condições de moradia). Foram utilizados dados da Pesquisa Nacional por Amostra de Domicílios (PNAD) de 2004 a 2015. Os resultados encontrados neste capítulo indicam que as mulheres apresentam maior privação do que os homens. Elas são a maioria das pessoas que vivem na pobreza e sofrem uma forma de pobreza mais intensa do que os homens. As mulheres negras e as que vivem no meio rural estão em situação ainda pior. Também foi possível observar que emprego e renda são as dimensões que impulsionam a pobreza multidimensional no Brasil e que as mulheres no Brasil têm dificuldade em transformar educação em renda. Além disso, os resultados mostraram que a pobreza das mulheres tem diminuído mais lentamente do que a dos homens. O segundo ensaio, por sua vez, buscou analisar se a migração e os empregos não agrícolas podem ser vistos como saídas da pobreza multidimensional para os indivíduos do Brasil rural, também fazendo um enfoque de gênero. A relação entre essas estratégias de subsistência e pobreza multidimensional foi estimada pelo método de mínimos quadrados em dois estágios, considerando eventos climáticos extremos de temperatura e precipitação como instrumentos para migração e trabalho não agrícola, uma vez que podem ser considerados endógenos. Os dados utilizados também foram da Pesquisa Nacional por Amostra de Domicílios (PNAD) de 2004 a 2015. Como variável dependente, foi utilizado o *score* de privação calculado pelo método do Índice de Pobreza Multidimensional. Os resultados deste artigo sugerem que a realização de atividades não agrícolas pode atuar como saída da pobreza no Brasil rural, reduzindo a privação, mas apenas

para os homens, e que a migração é irrelevante para explicar as mudanças na privação. De maneira geral, esta tese contribui teórica e empiricamente para a compreensão de diversas facetas da pobreza no Brasil.

Palavras-chave: Pobreza Multidimensional. Privação. Gênero.

SUMMARY

1. INITIAL REMARKS

The United Nations' goal number one in the 2030 Agenda for Sustainable Development is eradicating poverty in all its forms everywhere (UN, 2021). In fact, poverty has been reduced over the years. According to World Bank data, 66% of the world's population lived below the monetary poverty line at the beginning of this century, while in 2018, this proportion was 43% (WORLD BANK, 2022). However, poverty reduction remains challenging for Brazil since the population below the monetary poverty line was over 19% in 2019 (CEPAL, 2021).

In order to achieve such a goal, a notion rising in the literature is that we need to look beyond poverty's monetary facet (BOURGUIGNON; CHAKRAVARTY, 2019; SEN, 2018; NUSSBAUM, 2003). Hence, poverty should be seen as a multidimensional phenomenon, and poverty reduction policies should be done by recognizing poor people's specific needs (BOURGUIGNON; CHAKRAVARTY, 2019; SALAMA, 2012). According to Chakravarty and Silber (2008), multidimensional poverty is the failure to reach the well-being functioning's minimally acceptable level. Moreover, it can present itself in several ways: low consumption, inadequate living conditions, poor health, low life expectancy, lack of access to education, limited knowledge and information, and absence of power in several areas (FERREIRA, 2011). Thus, multidimensional analysis is fundamental to understanding deprivation (ANAND; SEN, 1997). Therefore, assessing multidimensional poverty allows for targeting various deprivations affecting the population, providing information about the relative load of poverty between subgroups, and targeting interventions and programs for those individuals experiencing multiple deprivations simultaneously (RAVALLION, 2011).

Additionally, it is crucial to recognize that there is also a segregation "within" poverty, which means that we should look inside the disadvantaged population. Among people experiencing poverty, women are the ones who present the most significant restrictions in their capacity. They do not have access to decent housing, work, or social protection and are more vulnerable to shocks (BUVINIĆ; GUPTA, 1997). In the literature, the recognition that women and the households headed by them are overrepresented among people experiencing poverty is called the feminization of poverty (BARROS; FOX; MENDONÇA, 1997; BRADSHAW; CHANT; LINNEKER, 2017; BATISTA; COSTA, 2019). According to Batista and Costa (2022), households headed by women in Brazilian metropolitan areas are around 38 p.p. more likely to be poor than male-headed ones. Therefore, it becomes relevant to discern in which

aspects women tend to be more vulnerable than men and which factors contribute to such vulnerability.

In this sense, this thesis' first essay focuses on assessing the multidimensional poverty in Brazil by constructing the Multidimensional Poverty Index. The analysis is done by accounting for characteristics such as people's race and geographical locations, considering the Brazilian states and rural and urban areas. All is done by accounting for people's gender. Also, it evaluates the temporal evolution (2004 to 2015) of the phenomenon in the country. Hence, our goal is to account for individual and territory heterogeneity to better understand poverty in Brazil.

Besides recognizing poverty's multidimensionality and gendered nature, it is necessary to account for the country's heterogeneities since the same policy can have very different results depending on the context. In 2019, about 13% of the population lived in Brazil's rural areas (WORLD BANK, 2022). Of those, 32% were below the poverty line that year, indicating that over 8 million people were poor in rural Brazil in 2019 (CEPAL, 2021). Rodrigues (2014) stated that Brazilian rural areas have the highest poverty incidence, regardless of the measurement used. Therefore, it may be necessary to differentiate between people who live in an urban environment from those who live in a rural environment since the latter experience several other deprivations besides monetary (LUTHER; GERHARDT, 2018).

In addition, the literature points to three main pathways out of poverty for individuals living in rural areas: farming, nonfarm labor[1], and migration. Of those, the most available for people experiencing poverty are nonagricultural activities and migration, which tend to substitute one another (SCOONES, 1998; WORLD BANK, 2008; HELFAND; PEREIRA, 2012). However, if poverty is a multidimensional phenomenon that varies among people and locations, perhaps the ways out of poverty are not unique either. Women and men may be affected in different ways by these pathways. Hence, our second essay verifies if these strategies are relevant to reduce women's poverty in rural Brazil compared to men's. Specifically, we evaluate the relevance of nonagricultural jobs and migration as pathways out of multidimensional poverty in rural Brazil for men and women between 2004 and 2015. Since migration and nonfarm work are endogenous, we use extreme climate events in temperature and precipitation as exogenous variations of these variables.

[1] The non-farm activities are the different activities performed outside the farm and not strictly related to agricultural productivity, such as the tourism, the health, and education sectors.

The 2004 to 2015 period chosen for both essays' analysis was marked by the higher poverty reduction rates in the country's recent history (ROCHA, 2013; 2019). According to Rocha (2013, 2019), there was a sustained decline in monetary poverty due mainly to labor market behavior, the minimum wage increase, and the growth in public transfer policies. Hence, it raises the question if multidimensional poverty followed the same pattern in the period. Also, if different subgroups of the population were affected the same way and if migration and performing nonfarm activities helped reduce the poverty of rural individuals. In this context, this thesis goes beyond a simple yet essential analysis of poverty. It seeks to analyze the process in which it occurs in Brazil, accessing its multidimensionality and particularities, its differences by gender, and the relative importance of the commonly mentioned pathways out for rural areas. With our results, we hope to promote means for discussing public policies necessary to alleviate poverty in its various dimensions in the country while arguing that the pathways out of poverty may not be unique for everybody.

Besides this introductory section, this thesis includes the essay "Gender and the multidimensional poverty index for Brazil" in the second section. The third section is the essay "Livelihood strategies as pathways out of multidimensional poverty in rural Brazil: a gender-sensitive approach." Finally, the last section offers some final remarks.

2. GENDER AND THE MULTIDIMENSIONAL POVERTY INDEX FOR BRAZIL

2.1. Introduction

According to the Instituto Brasileiro de Geografia e Estatística (IBGE, 2022), Brazil had a female population of slightly over 107 million in 2019. Over 6 million were extremely poor, and over 21 million were poor[2] that year (CEPAL, 2021). Compared to 2001, which had over 34 million poor women, these numbers represent an improvement in the Brazilian poverty situation. However, despite progress, it still affects a considerable part of the Brazilian female population.

Regarding the relationship between gender and poverty, Brady and Burton (2016) pointed out that some social, cultural, and economic attributes lead women to face a higher risk of poverty than men. Behind these facts, the primary origin of gendered poverty is the inequality between men and women, which exists in different aspects, such as income distribution, access

[2] Considering the international poverty line of people living with less than US$5.5 a day.

to credit, control over income and assets, and command over property (CAGATAY, 1998; BENNETT; DALY, 2014).

In Brazil, the Femininity Index of Poverty built by the Economic Commission for Latin America and the Caribbean (CEPAL) can shed some light on the gendered nature of poverty. The index is the ratio between the income poverty rate of women on men. Specifically for Brazil in 2001, the femininity index was 105.5, while in 2019, it was 112.6. Values over one hundred mean higher poverty among women (CEPAL, 2021). Hence, not only are women poorer than men in Brazil, but the proportion of poor women compared to men has increased in the last decades. Thus, studying poverty as a gendered phenomenon and its evolution over the years seems relevant.

However, a gender-sensitive approach to poverty analysis involves much more than making a statistical breakdown by gender (NUSSBAUM, 2001). Besides being predominantly female, poverty in Brazil is also multidimensional (FAHEL; TELES; CAMINHAS, 2016; SILVA *et al*., 2016; SERRA; YALONETZKY; MAIA, 2020). Hence, people can experience several deprivations other than income, such as low consumption, inadequate living conditions, poor health, low life expectancy, lack of access to education, limited knowledge and information, and absence of power in several areas (FERREIRA, 2011).

Women are at a disadvantage in several dimensions. They receive lower wages for similar occupations, supply fewer hours at paid jobs due to childcare and household responsibilities, do not receive support as household heads, and are more vulnerable to shocks (KLASEN; LECHTENFELD; POVEL, 2015; BATISTA; COSTA, 2019; BATISTA; COSTA, 2022). In Brazil, the female participation rate in the labor market was only 54.5% in 2019, against 73.7% for males. Their participation in managerial positions in the same year was only 37.4%. In contrast, the number of hours women spend in unpaid work doubled that of men (IBGE, 2021). When intersecting gender and race, the disadvantages are even worse. In 2018, black women in Brazil were paid less than half of white men's wages (IBGE, 2019). Another relevant dimension in which women tend to be disadvantaged is living standards. According to IBGE (2020), the household arrangements of a single mother with children have the most living inadequacies.

This discussion suggests that evaluating poverty by a gender-sensitive approach with a multidimensional focus is valuable. Particularly true for Brazil, which has been through an unstable macroeconomic and political scenario, reversing the downward trend in poverty that

the country had achieved since the 2000s. According to CEPAL (2021) data, poverty[3] decreased in Brazil, reaching its lowest point in 2014 (16.5%). After that, it rose, reaching 20.3% in 2017, and decreased to 19.2% in 2019. These data show how poverty has been unstable in Brazil in recent years, which, according to Vegh *et al*. (2019), responds to the country's recession and highlights the business cycle's effect on social indicators. There is also credible evidence suggesting that economic shocks affect men and women differently (GLEWWE; HALL, 1998; KOSEC; SONG, 2018; BERNIELL; LA MATA; MACHADO, 2020). In fact, according to Batista and Costa (2022), Brazil's response to income shocks is not gender-neutral. Economic shocks can alter the household's vulnerability status, especially those headed by a woman (BATISTA; COSTA, 2022). Hence, given the country's current socioeconomic situation, it is essential to evaluate poverty in its multidimensional and gendered nature. Assessing and identifying which dimensions the most vulnerable groups of society are deprived of is an essential first step toward a well-defined policy.

Multidimensional poverty status might also be different due to regional characteristics since they may impact people's sources of deprivation (BRADY; BURTON, 2016). In fact, Brazil shows significant local heterogeneities that must be accounted for when evaluating poverty: in 2019, 33.5% of the rural population was below the poverty line, an incidence 15.5 percentage points higher than that of urban areas (CEPAL, 2021). When considering the regions, the North and Northeast have been consistently more deprived than the other regions in Brazil (RODRIGUES, 2014).

Likewise, it is necessary to account for the population's ethnic minority groups since, like gender, race stratifies people's lives and can lead to different opportunities. Ethnic minority people, as pointed out by Reskin (2012), usually have fewer years of schooling and scarcer opportunities to achieve higher education. They experience discrimination in the labor market, are segregated into low-income occupations, receive smaller wages for similar work, and have fewer opportunities to achieve higher positions (RESKIN, 2012). Also, black individuals have little to no access to health care and a smaller life expectancy and are frequently segregated into residential locations with a higher incidence of violence and low housing quality (RESKIN, 2012). In Brazil, 32.9% of black people were below the income poverty line in 2018, against only 15.4% of white ones (IBGE, 2019). They represented only 29.9% of managerial positions.

[3] Considering the international poverty line of people living with less than US$5.5 a day.

In this context, this research aims to assess multidimensional poverty in Brazil, by constructing a Multidimensional Poverty Index and breaking it down by gender with attention to race and regional disparities. Specifically, it seeks to construct a index with several dimensions and indicators of deprivation, to evaluate whether women are more multidimensionally poor than men, which dimensions of multidimensional poverty they are more deprived of, if there are race and regional differences in their deprivation, and how their poverty evolved between 2004 and 2015. This period of analysis was a choice made according to available data. Besides, it was marked by the most significant reduction in monetary poverty in recent Brazilian history (ROCHA, 2013; ROCHA, 2019) and a decrease in inequality, with the Gini coefficient of household incomes falling from 0.57 to 0.52 (SKOUFIAS; NAKAMURA; GUKOVAS, 2017). All while gender inequalities rose. In those years, the femininity index went from 106.7 to 116.6 (CEPAL, 2021), reinstating the relevance of understanding gender-specific deprivations.

Our analysis differs from other studies and adds to the literature on four main points. First, we assess the different experiences men and women have of poverty and its multiple dimensions. Second, we evaluate the temporal evolution of multidimensional poverty between 2004 and 2015. Third, we incorporate a race analysis to account for the different experiences black and white individuals have, accounting for the gender differences. Lastly, the differences between rural/urban areas and the 26 states plus the Federal District are included, considering the gender analysis. Therefore, accounting for territory heterogeneities. Thus, the purpose here is to provide subsidies for understanding the poverty phenomenon in Brazil and, consequently, offer a more accurate background to formulate public policies that consider the country's particularities.

The paper is organized as follows; Section 2.2 presents the theoretical framework used to understand the multidimensional nature of poverty. Section 2.3 brings some empirical evidence with a literature review. Section 2.4, in turn, describes the methodology used to achieve our research objectives. The research results are shown in Section 2.5, and Section 2.6 concludes the study.

2.2. Theoretical Framework: The capabilities approach

The one-dimensional approach to poverty, extensively used in the literature, is an approach that aggregates all of an individual's achievements into a single variable, usually well-being or income, and uses an aggregate cutoff point to determine who is poor (KAGEYAMA;

HOFFMANN, 2006; MCLANAHAN; KELLY, 2006). This approach is customary to consider as poor, individuals below a specific cutoff point, such as a poverty line. However, this method does not distinguish the most widely deprived, underestimating the number of poor individuals (ALKIRE; FOSTER, 2011a). Thus, income as a single indicator of well-being is considered limited since it does not incorporate other critical dimensions of poverty (THORBECKE, 2013).

With that in mind, Amartya Sen introduced the capabilities approach as a new view of poverty. According to him, 'real poverty' arises from the deprivation of capacities and freedom. In that sense, the income approach may not be sufficient to compare different realities since it does not account for poverty's relative component. Several variables, such as gender, race, and location, enhance the differences between income and capabilities. However, despite their differences, the two approaches are interconnected and complementary. The capabilities perspective sheds light on the fact that an increase in an individual's capacities heightens their potential to be productive and raise their income, which can be especially important to reduce monetary poverty. Also, an increase in income should give the individual more means to achieve higher capabilities (SEN, 1976; 2018).

This approach is based on the fact that development should be seen as the process of expansion of freedoms. In this perspective, the development would require removing freedom deprivation sources, such as poverty, the absence of economic opportunities, negligence from the public sphere, and excessive state intervention. Without such freedom, individuals live in a critical condition, with no perspectives about the future. Hence, by arguing that development is the expansion of freedom, Sen (2018) claims that reducing deprivations is one way to achieve such freedom. Therefore, according to the author, poverty must be seen as an absence of elementary capabilities instead of only income (SEN, 2018). According to him, capabilities are the basic needs of an individual, such as education, health, well-being, freedom, political engagement, and others.

According to Alam (2011), the capabilities approach contributes to the gender and poverty debate in three main aspects. It helps monitor the differences in fundamental achievements between men and women over space and time, draws attention to gender inequality's regional differences, and helps uncover aspects that persist regardless of economic growth. In turn, Nussbaum (2001, 2003) suggested that the capabilities have a tight relationship with human rights, making it valuable to approach gender inequality issues. Gender inequality, as stated by her, when added to a poverty scenario, result in a severe failure of the central human

capabilities. According to the author, women lack opportunities to play, cultivate cognitive faculties, do not have proper bodily integrity, and live with fear, all of which come from unequal social and political circumstances. Thus, women tend to be the most likely not to live a dignified, full, quality life (NUSSBAUM, 2001; 2003).

When considering the intersection between gender and race, there is an additive effect in the capabilities failure that minority ethnic women suffer. As women, they have less access to the central capabilities than men, and as black, they experience more failure in their capabilities than white people. Thus, the greater risk of poverty these women suffer results from a double disadvantage associated with a combination of two discriminated groups. With that, the magnitude of the gender disadvantage is amplified by the race disadvantage, resulting in double jeopardy for these women (HARDY; HAZELRIGG, 1995). Besides, structural constraints shaped by gender and racial discrimination affect people's access to resources, reflecting their chances to escape poverty (CABANISS; FULLER, 2005). The additive effect in capabilities failure can also happen when considering locational differences. Women in rural areas face unequal gender relations, leading to failure in central human capabilities. They are not prioritized when receiving inheritances, have few employment opportunities, and tend to be the only ones responsible for the housework and childcare (LUTHER; GERHARDT, 2018; RAMUNDO STADUTO; ALVES NASCIMENTO; DE SOUZA, 2013). Therefore, the capabilities approach can help tackle the deprivation suffered by different population subgroups, shedding light on their specific needs. However, according to Nussbaum (2001, 2003), the capabilities approach cannot provide helpful guidance to end gender inequality and poverty if there is no definition of the central capabilities (NUSSBAUM, 2001; 2003).

In that sense, Martha Nussbaum went beyond Sen. She introduced a list of central human functional capabilities, intending to provide a threshold level to citizens' demand from their governments, which is the absolute minimum a person needs to live a quality life (NUSSBAUM, 2001). These capabilities represent the general goals to guide each society to specify its own needs and are (i) life: being able to live a full, normal life; (ii) bodily health: having good health, nutrition, and shelter; (iii) bodily integrity: freedom towards its own body choices, to move freely and the guarantee of security; (iv) senses, imagination, and thought: refer to the freedom to think, imagine, reasoning, express, and use its senses; (v) emotions: refers to develop emotionally, and to attach to people and things; (vi) practical reason: is the ability of critical thinking; (vii) affiliation: is the liberty of social interaction, to love, to not being discriminated or humiliated, to be treated with dignity and respect; (viii) other species: to

live alongside with other species; (ix) play: to laugh, play and enjoy recreational activities; and, finally, (x) control over one's environment: having the right to political participation, hold property, and equal opportunities.

Nussbaum (2003) also highlights that the capabilities approach has an advantage over other approaches to poverty since it considers the individuals' ability to be and to do. With that, it is possible to account for the inequalities inside the families, different from the poverty measures usually made at the household level. Therefore, Sen's approach shifted poverty's unit analysis from household to individual and from the resources' focus to the control over commodities, thus, allowing individuals from the same household to have different perceptions of deprivation (JACKSON, 1998).

This advantage is especially true when considering gender inequalities. Women may live in a household with high income but have no access to or control over it, depriving them of dimensions beyond the monetary one (BRADY; BURTON, 2016; BUDLENDER, 2005). This conception that even women living in non-poor households can be deprived is associated with social and cultural gender roles (JACKSON, 1998). In that sense, Cagatay (1998) argued that besides the bias against women and girls in the household resources' allocation, women face more difficulty than men in transforming capabilities into income and well-being. Hence, household variables may lead to an incomplete analysis of gendered multidimensional poverty.

Thus, when considering Sen's and Nussbaum's perspective to construct a gender-sensitive multidimensional poverty measurement, one needs to use variables at an individual level instead of the typical household level. Understanding this point enriches the comprehension of multidimensional poverty and inequality, covering more grounds for policy creation.

Therefore, according to this framework, poverty should be analyzed as a more complex phenomenon than income absence. When studying it, we should examine the dimensions of where people can be deprived and account for its heterogeneity. More precisely, poverty is a matter of capability failure in a multi-attribute context. Thus, it is essential to approach the multidimensionality of poverty and divide it into subgroups, as we do here.

2.3. The Multidimensional Poverty Index: a background

To understand the dimensions of poverty people experience in Brazil, we used the Multidimensional Poverty Index (MPI), proposed by Alkire and Foster (2011a), which has been

used in the literature due to its simplicity and effectiveness in measuring multidimensional poverty. The MPI can be used to target the poorest, track Sustainable Development Goals, and design policies that directly address the deprivations poor people experience (ALKIRE; SANTOS, 2014). Like any method, the MPI has limitations since it cannot capture all sides of poverty in one index. However, there is an understanding that the index better measures poverty than the income-based approach, as discussed above (ALKIRE; FOSTER, 2011a; RAVALLION, 2011; BOURGUIGNON; CHAKRAVARTY, 2019).

That said, several authors have measured multidimensional poverty and its heterogeneities worldwide. Aguilar and Sumner (2020), trying to understand the world's poor, analyzed some MPI variations and found that the global multidimensionally deprived are primarily children and young adults residing in rural areas. About 90% of poverty is rural, according to them. They have also found that the absence of infrastructure marks rural poverty, while urban poverty is more due to child mortality and poor nutrition. According to the authors, rural multidimensional deprivations in living conditions and education frequently overlap (AGUILAR; SUMNER, 2020).

Bastos *et al*. (2009) showed that in Portugal, women face higher poverty rates than men, and they also experience a more intense and severe form of it, with a higher level and risk of deprivation than men. According to the authors, old, isolated, and single-parent women are most affected by income poverty and multidimensional deprivation (BASTOS *et al*., 2009). For women in Sub-Saharan Africa, the education dimension of the MPI represented the highest source of deprivation (BATANA, 2013). Also, individuals in rural areas are more multidimensionally poor than those in urban areas. In Afghanistan, in its turn, Trani *et al.* (2016) have found that every adult is deprived of at least one dimension of the multidimensional poverty measure. Women living in rural areas and disabled people are in the worst conditions (TRANI *et al.,* 2016).

For Latin American countries, Battiston *et al.* (2013) found that rural areas in El Salvador, Mexico, and Brazil have higher poverty and more disadvantages than urban areas. According to the authors, increasing access to proper sanitation and improving the household head's education should be prioritized in all countries (BATTISTON *et al*., 2013). Santos and Villatoro (2018) estimated that about 28% of the region's population was multidimensionally deprived in 2012. In the authors' words, the living standards dimension is the one that contributes more to overall multidimensional deprivations in the continent. They have also found significant differences between income and multidimensional poverty, suggesting that

the MPI is a more accurate measure of poverty in Latin America (SANTOS; VILLATORO, 2018).

In Brazil, Barros, Carvalho, and Franco (2006) have found that access to knowledge is vastly correlated with access to resources among the dimensions of deprivation. They have also found that the greatest poverty among rural female-headed households is due to their worst living and working conditions. In its turn, Dedecca *et al.* (2012) have shown that rural households are more deprived than urban households in every poverty dimension in the country. In Porto Alegre, a city in the South region, being a woman, out of the formal labor market, with low schooling and economically active age, represents a higher probability of multiple and more profound deprivations (AVILA; BAGOLIN; COMIM, 2012).

With data from 2011, Ferreira and Marin (2016) found that women living in the South of Brazil were the least multidimensionally deprived, while those living in the North were the most deprived. Silva *et al.* (2016) stated that the multidimensionally poor in Brazil in 2012 were the individuals living in the rural areas of the North and Northeast regions, the oldest and the black and brown. According to Oliveira (2018), female-headed households in Northeast Brazil are more multidimensionally deprived than male-headed ones. The author states that the feminization of poverty in the region is not only income-driven, even though the income dimension of the index is their highest deprivation (OLIVEIRA, 2018). Serra, Yalonetzky, and Maia (2020) showed that, in Brazil, both the multidimensional headcount ratio and the adjusted headcount ratio are higher in remote municipalities than in the ones closest to a city. According to them, location matters more for poverty reduction in the country than population size or density. However, their results show that poverty has decreased more sharply in the country's remote areas in the last few years than in the more developed ones (SERRA; YALONETZKY; MAIA, 2020).

Even though multidimensional poverty has been a phenomenon broadly studied in the literature, as we have seen above, the focus on gender with race and location intersections is a new approach for Brazil. Therefore, we differentiate ourselves by comparing the dimensions of the MPI Brazilian women are more deprived than men and considering the different characteristics that could influence their vulnerability status, which will allow the suggestion of more focused public policies. This analysis is fundamental to Brazil, where poverty remains problematic, and women experience more profound deprivations than men.

2.4. Methodology

This section presents the empirical strategy used to achieve our research objective. First, we present the construction of the Multidimensional Poverty Index, divided into subgroups to evaluate which dimension women have been more deprived of than men in Brazil over the years. Next, we present the data used and its specifications.

2.4.1. The multidimensional poverty index

The method used to analyze gender-sensitive multidimensional poverty in Brazil is the Multidimensional Poverty Index (MPI), developed by Alkire and Foster (2011a). The MPI introduces an intuitive approach to identifying who is poor through two cutoff points. The first one identifies whether the person is deprived of any dimension. While the second delimits how many dimensions the person must be deprived of to be considered poor. Thus, the MPI methodology can identify people experiencing poverty and determine which dimensions drive multidimensional poverty among different groups of people (ALKIRE; SETH, 2008).

Therefore, let us set *n* as the number of people and $d \geq 2$ as the number of dimensions considered, representing the several forms of deprivation an individual can suffer. In our case, we used the dimensions proposed by Rippin (2016) based on Nussbaum's (2001) central human functional capabilities, which can be seen in Table 1. Hence, the dimensions and the capability they refer to are (i) education, referring to senses, imagination, thought, and practical reason; (iii) employment, referring to affiliation, control over the environment, and play; (iv) living standards, referring to bodily health and affiliation; and (v) income, which refers to the control over environment capability[4]. Moreover, let $y = [y_{ij}]$ be the achievement matrix, where $y_{ij} \geq 0$ is the achievement of individual *i* in dimension *j*. Each row of *y* lists the individual's *i* achievements, and each column lists the dimension *j* distribution of achievements for a group of individuals. To allow for comparing poverty between populations of different sizes *d* is assumed to be fixed, while *n* can change.

Additionally, let $z_j > 0$ be a cutoff where the person is considered deprived in dimension *j* if they are below that point. Also, setting M as the measure of multidimensional poverty, we have $M = (\rho, M)$, where $\rho\ (y_i;\ z) = 1$ if the person *i* is poor and 0 otherwise, and M (y; z) is the general level of multidimensional poverty. For any given *y*, $g^0 = [g_{ij}^0]$

[4] Rippin (2016) suggested the use of another two dimensions, health, and mobility, which we were not able to insert into our index due to lack of data.

denotes the deprivation matrix associated with *y*, where its *ij*-th entry is 1 when the person *i* is deprived in dimension *j* and 0 otherwise. Let g^1 be a normalized gap matrix, where $g_{ij}^1 = g_{ij}^0 \left(z_j - y_{ij}\right)/z_j$, thus, g^1 can be considered the measure of the extent to which the person *i* is deprived of *j*. Finally, it is considered that $c_i = |g_i^0|$ is the number of deprivations person *i* suffer, and that *g* and *c* are identical for all monotonic transformations of *y* and *z*.

Regarding the weights, Pasha (2017) argues that they should be different since they are based on the dimensions' trade-offs they cause. However, our MPI construction was done by weighting the dimensions equally, such as each indicator in every one of them. The choice for equal weights can be made since equally weighting the dimensions facilitates the interpretation and the use for public policies (ALKIRE *et al.,* 2010; ALKIRE; SANTOS, 2014). So, let *w* be a *d* dimensional vector of positive numbers summing to *d*, where the *j-th* coordinate w_j is the weight associated with dimension *j*. In this case, we will have that $g^\alpha = [g_{ij}^\alpha]$ denotes a *n x d* matrix, where $g_{ij}^\alpha = w_j \left(\left(z_j - y_{ij}\right)/z_j\right)^\alpha$ whenever $y_{ij} < z_j$, and 0 otherwise. Also, here, *c* is the weighted deprivation count, where $c_i = |g_i^0|$ is the sum of weights for the dimensions where *i* is deprived.

Up to this point, we have each person's weighted proportion of deprivation, called the deprivation score. The score enables evaluating which dimension each individual is deprived of and how many dimensions they are deprived of. Thus, allowing for a comparison of deprivations between subgroups of the population, such as gender, race, and location. However, we also want to know who is poor. To identify it, Alkire and Foster (2011a) consider the cutoff level, *k*, to be between two extremes: 1, when the person is deprived in only one dimension, and *d*, if the person is deprived of all dimensions. Thus, for $k = 1, \dots, d$, we have the identification function p_k, where $p_k(y_i; z) = 1$ if $c_i \geq k$ and $p_k = 0$ whenever $c_i < k$. That is, p_k identifies the individual *i* as poor when the number of weighted dimensions *i* is deprived of is at least *k*.

The MPI, thus, can be considered a dual method of identifying poverty as it depends both on the deprivation cutoff, *z,* and the poverty cutoff, *k*. Also, with this measure, we have that an increase in the achievements of a non-poor person does not change the achievement matrix, y_{ij}. Also, the poverty status is not affected by changes in a dimension in which the person is not deprived. In our MPI, the cutoff point, k, is as proposed by Alkire and Santos (2014). So, the person must be deprived of 1/3 (33%) of all the indicators to be considered poor. The dimensions and capabilities they refer to, the indicators, cutoff points, some descriptions

of what we intend to capture with them, and the reference from the literature for each can be seen in Table 1.

Table 1: Dimensions, indicators, and cutoffs of the MPI

Dimension	Capability	Indicator	Weights	Deprived if (cutoff)	Descriptions	Reference
Education	Senses, Imagination, and Thought; Practical Reason	Years of schooling	1/8	Has under nine years of schooling	This indicator captures school dropouts.	Costa, Machado, and Amaral (2018)
		Literacy	1/8	Cannot read or write	Literacy captures if the person has minimal education.	Costa, Machado, and Amaral (2018)
Employment	Affiliation; Control over Environment; Play	Employment	1/4	Have at least one of the following: 1. Activity status as unemployed 2. Wage below minimum[5] 3. Time-poor (works over 10 hours a day, counting paid and unpaid work)[6]	The first one captures individuals who want to work but currently are not. The second one captures the precariousness of work. At the same time, the third one comes from the importance of leisure time.	Rippin (2016)
Income	Control over Environment	Income	1/4	Has an income below the national poverty line[7]	Measures the ability to get along financially.	Rippin (2016)

(continues)

[5] One may think that this indicator is correlated to the income one. However, according to Rippin (2016), the income dimension measures how well a person is able to get along financially, whereas the minimum wage captures the precarious situation of those whose work is not appropriately remunerated.

[6] This dimension is essential when considering the gender-sensitive approach since women tend to be more responsible for housework and caregiving than men (BUVINIĆ; GUPTA, 1997).

[7] For the poverty line, we considered the one proposed by Hoffmann (2000), which considers as poor the individual with a monthly income below half a minimum wage. Due to data available, this variable is a per capita variable, representing a household income instead of an individual.

(continuation)

Dimension	Capability	Indicator	Weights	Deprived if (cutoff)	Descriptions	Reference
Living Standard	Bodily Health; Affiliation	Electricity	1/28	Lives in a household with no electricity	These indicators, together, capture adequate shelter conditions.	Fahel, Teles, and Caminhas (2016)
		Sanitation	1/28	Lives in a household where a toilet is not connected to the sewage collection network or is shared with other households		Fahel, Teles, and Caminhas (2016)
		Water	1/28	Lives in a household that does not have water in at least one room or has water that does not come from a cistern or spring		Fahel, Teles, and Caminhas (2016)
		Garbage disposal	1/28	Lives in a household that does not have an appropriate garbage disposal		Fahel, Teles, and Caminhas (2016)
		Cooking fuel	1/28	Lives in a household that cooks with dung, wood, or carbon		Fahel, Teles, and Caminhas (2016)
		Assets	1/28	Lives in a household with three or fewer assets: radio, television, telephone, fridge, stove, and computer.		Fahel, Teles, and Caminhas (2016)
		Overcrowding	1/28	Lives in a household with three or more people per bedroom		Costa, Machado, and Amaral (2018)

Source: Constructed by the author, based on the literature.

We can measure poverty once the cutoff points, weights, dimensions, and indicators are identified. First, we have the weighted headcount ratio, H, which is the proportion of poor individuals or the incidence of multidimensional poverty and is defined by:

$$H = \frac{q}{n}$$

where

$$q = q(y; z) = \sum_{i=1}^{n} p_k(y_i; z)$$

q is the number of individuals considered poor by the dual cutoff, and n is the total number of individuals in the sample. Even though H cannot be broken down to show how much each dimension contributes to poverty, it can be into subgroups. Hence, with this partial index, we can know the proportion of poor women, men, black, white, rural and urban location, and others in Brazil.

The intensity of multidimensional poverty, A, can drive additional information on the breadth of deprivation experienced by people in poverty. Thus, A is the average deprivation share across people experiencing poverty and is given by:

$$A = \frac{|c_i\ (k)|}{qd}$$

where

$$c_i(k) = p_k(y_i; z)c_i$$

$c_i(k)$ represents the portion of possible deprivations a poor person can experience. With A, we can know the percentage of possible dimensions the average poor individual is deprived of, which can also be broken into subgroups. Therefore, A provides us with the dimensions that women, men, and others are, on average, deprived.

Lastly, we are interested in the multidimensional poverty measure that provides information on the prevalence of poverty and the average extent of a poor person's deprivation. Alkire and Foster (2011a) call it the adjusted headcount ratio, which is given by:

$$M_0 = HA = \mu(g^0(k))$$

Therefore, M_0 is the product of the headcount ratio and the average deprivation share. This measure is sensitive to multidimensional poverty's frequency and breadth (ALKIRE; FOSTER, 2011a). Also, it satisfies dimensional monotonicity, meaning that if a person

becomes deprived in an additional dimension, M_0 will increase. Overall, we have that M_0 reflects the proportion of weighted deprivations that the poor experience out of the total potential deprivations the society could experience (ALKIRE; SANTOS, 2014).

Finally, decomposability is the more significant advantage of this multidimensional poverty measure for our purpose. M_0 can be broken down by indicator, which means that it is possible to evaluate the contribution of deprivations in each indicator to overall poverty, and it can be decomposable by subgroups. Hence, calculating such an index allows us to evaluate the temporal evolution, the geographical differences, the profile, and the various characteristics of multidimensional poverty in Brazil[8].

2.4.2. Data

The data used for the MPI was the Pesquisa Nacional por Amostra de Domicílios[9] (PNAD) provided by the Instituto Brasileiro de Geografia e Estatística[10] (IBGE). The PNAD was[11] an annual survey made of a probability sampling of households. It is a complex and self-weighted sampling plan that ensures that all households have the same probability of selection (SILVA; PESSOA; LILA, 2002). The survey data were collected from a nationally and regionally representative sample of residents, containing individual and household data. Also, its complex sampling character implies that the analysis must be done using the sampling weights to be considered representative of the population. Therefore, this research used the sample's weights, strata, and primary sampling unit (PSU)[12].

This research unit of analysis is the individual since the household analysis could fail to account for gender discrepancies inside the family unit, such as income. However, household variables were used. Additionally, the sample is made only of adults, considering the minimum active age defined by IBGE, which is 15 years old. This age restriction is essential since including children could bias our results due to their incomplete education and lack of employment and income, which are dimensions of our index. Additionally, observations with null information about the multidimensional poverty indicators were dropped. Also, the analyzed period was between 2004 to 2015, representing the first year in which the PNAD

[8] The calculations were made using the Stata program and the MPI command within the program (the command must be installed).

[9] i.e., National Household Sample Survey

[10] i.e., Brazilian Institute of Geography and Statistics

[11] The survey was replaced in 2016 by another survey, named PNAD Contínua, which characteristics did not allow for the use in this thesis.

[12] The variables for weights, strata, and PSU are, v4729, v4617, and v4618, respectively.

sample included all Brazilian states' rural areas[13] and the last year with available data (except for 2010 when the Demographic Census was done instead of this research). Finally, all income variables were brought to 2015 to remove the inflation influence.

2.5. Results

This section presents the research results. Section 2.5.1 explores the sample, describing some poverty and deprivation statistics. Sections 2.5.2 to 2.5.4 present the multidimensional poverty index results aggregated into subgroups. The order is as follows. First, we present the gender analysis, then we follow with the race assessment with a gender focus, and finally, the last subsection shows the location evaluation with a gender emphasis.

2.5.1. The deprivation profile in Brazil

This section explores some poverty and deprivation statistics. Here our focus was on data from 2015, the last year of the analysis, to facilitate the presentation, reading, and understanding of the results. Hence, Table 2 presents the proportion of people from each population subgroup in the sample. As can be seen, there are 243,149 observations, most of which are women, black people, and those living in urban areas, which is consistent with the Brazilian demographics (IBGE, 2022).

The deprivation score column presents each group of people's average weighted proportion of deprivation considering the indicators addressed in this research (years of schooling, literacy, employment, income, electricity, sanitation, water, cooking fuel, garbage disposal, assets, and overcrowding). Therefore, on average, the Brazilian population was deprived of 29.93% of the deprivation indicators in 2015. Meaning that among all the deprivation people could experience in the country (100%), they endure almost one-third of it. In particular, women are deprived of 34.90% of the deprivation indicators, while men are only deprived of 24.92% of them. The same occurs among black people, with a deprivation score of 53.99%, being expressively more deprived than white people (26.07%). Also, people living in rural areas, deprived of 45.39% of the indicators, are more deprived than those living in urban areas, who are deprived of 27.51%. These results are consistent with the literature stating that women, black individuals, and those living in rural areas tend to experience more deprivations

[13] Before that, north state data were not included.

than their counterparts (RESKIN, 2012; BRADY; BURTON, 2016; AGUILAR; SUMNER, 2020).

In addition, Table 2 shows that black women are the most deprived, with an average deprivation of 38.46% of the indicators, while white men are the least deprived, with a deprivation score of 20.99%. Also, even white women (30.89%), the least deprived among women, have a higher deprivation score than black men (28.13%), the most deprived among men. Likewise, considering rural/urban locations, women living in rural areas have the worst score of deprivation, 51.53%. Therefore, based on these data, we can verify that women are, in fact, more deprived than men in Brazil, indicating that Nussbaum's (2001) argument is valid in the country. Thus, gender's unequal social, economic, and political conditions give women unequal human capabilities (NUSSBAUM, 2001).

Table 2: Population, deprivation, and poverty profile - Brazil, 2015

	Population	Deprivation Score	Multidimensional Poverty	Income Poverty
		%		
Women	50.19	34.90	61.46	44.77
Men	49.81	24.92	38.54	22.37
White	46.01	26.07	40.41	29.78
Black	53.99	33.21	59.59	36.88
Rural	13.54	45.39	19.27	44.14
Urban	86.46	27.51	80.73	31.96
White women	23.61	30.89	25.84	40.19
Black women	26.58	38.46	35.62	48.83
White men	22.40	20.99	14.58	18.81
Black men	27.41	28.13	23.97	25.28
Rural women	06.13	51.53	10.30	60.99
Urban women	44.06	32.58	51.16	45.51
Rural men	07.41	40.31	08.97	30.20
Urban men	42.40	22.23	29.57	21.00
Total	243,149	29.93	44.17	33.61

Source: Research results
Note: Income poverty line: R$394.00 monthly income (half a minimum wage).

The multidimensional poverty column in Table 2 presents those individuals deprived of 33% or more of the indicators. As can be seen, 44.17% of Brazil's population was multidimensionally poor in 2015. Among people experiencing multidimensional poverty, 61.46% are women. Therefore, it indicates the existence of a female overrepresentation in poverty, as proposed by the literature (BARROS; FOX; MENDONCA, 1997; LIU; ESTEVE;

TREVIÑO, 2017; BATISTA; COSTA, 2019). Also, most multidimensionally poor people are black (59.59%). Here, it is essential to highlight that being black does not cause poverty but rather the discriminating attitudes towards black individuals that enhance their poverty causes (HARDY; HAZELRIGG, 1995). Hence, being poor is not an intrinsic characteristic of Afro-Brazilian people. However, the poverty phenomenon in Brazil is fundamentally black (CARNEIRO, 2015). Regarding gender and race intersectionality, the data show that black women represent most multidimensionally poor people in Brazil, 35.62%, indicating that race intensifies women's poverty, as Hardy and Hazelrigg (1995) pointed out. Additionally, most poor people live in urban areas (80.73%), where the mass population is in the country (IBGE, 2022). Nevertheless, this does not mean that individuals living in urban areas are poorer than those living in rural ones. The deprivation score, as shown before, can confirm the inverse. Indicating that failing to account for the national context could mislead the poverty analysis, as Costa, Machado, and Amaral (2018) stated.

The proportion of people below the monetary poverty line was calculated as a comparison, as seen in Table 2. The income poverty was calculated using the poverty line proposed by Hoffman (2000), considering a *per capita* monthly income of a half a minimum wage (R$394.00). Hence, as expected, the subgroups considered the poorest remain the same. However, the multidimensionally poor count in the country is higher than the proportion of individuals below the income poverty line, which was 33.61% in 2015. Thus, the Brazilian case confirms the literature's indication that a poverty measurement considering only income is limited and underestimates the number of poor individuals (ALKIRE; FOSTER, 2011; THORBECKE, 2013; SEN, 2018).

Figure 1 reports the evolution of the percentage of multidimensionally poor among the country's total population, men, and women, from 2004 to 2015. As can be seen, the proportion of people experiencing multidimensional poverty has been reducing throughout the years. The proportion went from 75.91% in 2004 to 44.17% in 2015—a reduction of 41.81%. Therefore, we can say that multidimensional poverty had the same reduction pattern as income poverty in the period analyzed. According to Rocha (2013; 2019), Brazil's new economic growth cycle was established in 2004, which decreased the income poverty rates until 2014. According to the author, the period was marked by the minimum wage valorization, the expansion of public income transfers, and the labor market behavior, all contributing to poverty reduction (ROCHA, 2013; 2019).

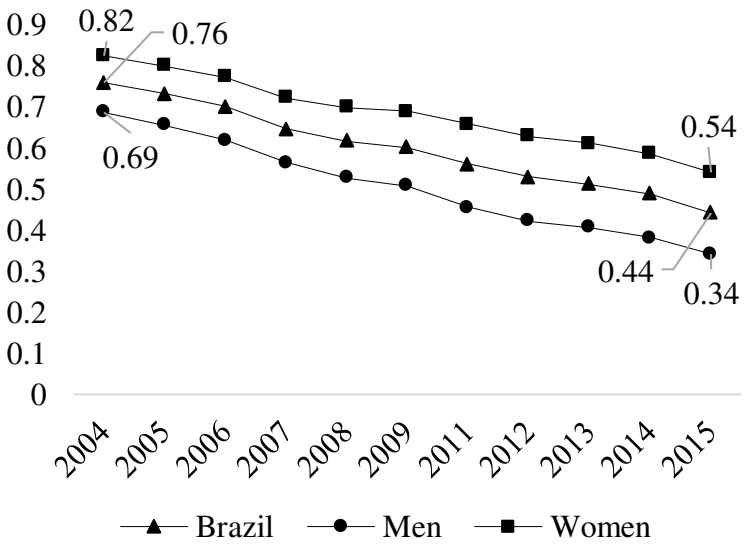

Figure 1: Time evolution of the proportion of people experiencing multidimensional poverty - Brazil, men, and women, 2004 to 2015
Source: Research results

Despite several policies targeting poverty reduction in the period, they seem insufficient in reducing gender inequality. In fact, it has increased (CEPAL, 2021). Figure 1 shows that women have higher poverty rates than men and the total population throughout the period analyzed, and their poverty has been reducing slowlier. While men's multidimensional poverty has reduced by more than 50%, women's has reduced by only over 34% from 2004 to 2015. These combined data suggest that women are multidimensionally poorer and more deprived than men in Brazil and that their status has slowly evolved. These findings lead us to believe that the possibility of a convergence between men's and women's situations is far away. In fact, according to the World Economic Forum's (2021) global gender gap report, considering a series of dimensions, it will take 135.6 years to achieve gender equality worldwide. Therefore, it is safe to suppose that the gender gap in Brazil will not end soon.

Table 3, in turn, presents the proportion of people deprived in each indicator. As can be seen, the ones that stand out in Brazil are employment, with more than 50% of the population deprived of it, followed by years of schooling (45.20%), sanitation (40.76%), and income (33.61%). Even though the order of deprivation in which these indicators appear in the country is curious, it corroborates the need for a multidimensional evaluation embracing more than the income aspect of deprivation. Additionally, according to the data, more individuals living in rural areas than urban areas are deprived of almost every indicator. The only aspect where rural individuals are better than urban ones is overcrowding, indicating they tend to have more space.

As for black people, there are more of them deprived of each indicator than the white. This result validates the data in Table 2 that most multidimensionally poor in Brazil are black.

The gendered analysis of these data draws attention since men are more deprived of education indicators than women. There are 7.75 p.p. more men deprived in years of schooling than women and 1.92 p.p. in the literacy indicator. In contrast, far more women are deprived of employment and income dimensions than men. There is a gap of 23.22 p.p. favoring men in the employment indicator and 22.40 p.p. in the income indicator. These results suggest a gender gap in converting education into work and pay, indicating that women must study more than men to receive the same amount and opportunities. According to Melo and Thomé (2018), this is a characteristic of the Brazilian labor market. According to them, women are more educated and work more with productive and reproductive labor, yet they are segregated into informal market segments, receive less than men for the same job, and have fewer opportunities for carrier growth (MELO; THOMÉ, 2018).

Furthermore, black women are in the worst situation in the employment and income indicators, 66.38% and 48.83%, respectively, followed by white women (56.92% and 40.19%). In contrast, black men are the most deprived of education and living standards indicators. Moreover, rural men and women are the most deprived in each indicator, except the overcrowding one, and rural men are the most deprived in the education and living standards indicators, while rural women are the most deprived in employment and income.

Table 3: Proportion of people, by subgroups, deprived of each indicator - Brazil, 2015

	Years of schooling	Literacy	Employment	Income	Electricity	Sanitation	Water	Garbage disposal	Cooking fuel	Assets	Overcrowding
						%					
Women	41.34	05.17	61.93	44.77	00.09	39.46	03.51	08.25	03.16	02.20	10.29
Men	49.09	07.09	38.71	22.37	00.15	42.06	04.07	10.27	03.98	02.92	09.53
White	38.19	03.83	45.85	29.78	00.04	33.53	02.05	06.14	02.97	01.32	07.01
Black	51.17	08.08	54.20	36.88	00.19	46.92	05.28	11.92	04.08	03.62	12.38
Rural	70.60	15.89	62.94	44.14	00.78	93.93	19.10	62.19	21.87	09.30	09.72
Urban	41.22	04.60	48.39	31.97	00.02	32.43	01.40	00.97	00.70	01.50	09.94
White women	35.07	03.38	56.92	40.19	00.03	32.21	01.88	05.34	02.51	01.11	07.17
Black women	46.90	06.76	66.38	48.83	00.14	45.91	04.97	10.84	03.73	03.16	13.05
White men	41.49	04.30	34.19	18.81	00.05	34.92	02.23	06.99	03.45	01.53	06.84
Black men	55.30	09.36	42.40	25.28	00.24	47.90	05.58	12.95	04.41	04.06	11.73
Rural women	64.53	12.43	75.78	60.99	00.67	93.47	19.00	61.01	21.36	08.46	10.42
Urban women	38.11	04.16	60.00	42.51	00.01	31.95	01.36	00.91	00.63	01.33	10.27
Rural men	75.62	18.75	52.32	30.20	00.87	94.30	19.18	63.16	22.29	10.01	09.13
Urban men	44.45	05.05	36.33	21.00	00.03	32.93	01.43	01.03	00.78	01.68	09.60
Brazil	45.20	06.12	50.36	33.61	00.12	40.76	03.79	09.26	03.57	02.56	09.91

Source: Research results

In summary, from these data, we can highlight the need to account for people's characteristics in the search to alleviate poverty. Because as seen, women are more deprived and multidimensionally poorer than men, which is even worse for black and rural women, and their situation has been evolving at a slower rate than men's. Therefore, neutral public politics cannot have the desired effect. Also, even though there are more educated women than men in Brazil, they are disadvantaged regarding employment and income. Hence, reducing the labor market's gender gap is expected to reduce women's deprivation in Brazil effectively.

2.5.2. Gender and the multidimensional poverty index

The data presented in this section and the next two (5.3 and 5.4) represent the Multidimensional Poverty Index (MPI) results, which is an interaction between the headcount ratio (H) and the intensity of poverty (A). Therefore, the MPI is an acute measurement of poverty. As stated before, the index was constructed with eleven indicators (years of schooling, literacy, employment, income, electricity, sanitation, water, garbage disposal, cooking fuel, assets, and overcrowding) within four dimensions (education, employment, income, and living standards). The dimensions were weighted equally, and the indicators of the same dimension were also weighted equally. Also, the cutoff, *k*, sets an individual as poor if they suffer deprivation of 33% or more indicators.

As shown in Figure 2, 44.20% of the Brazilian population was considered multidimensionally poor (H) in 2015, equivalent to about 90 million people, and they were deprived in 56.33% of the analyzed indicators (A). Subsequently, the MPI for Brazil in 2015 was 24.9%, representing the multidimensionally poor population share, adjusted by the intensity of deprivation they suffer. For that same year, the global MPI calculated by Alkire *et al*. (2015) was 15.7%, with a 29.8% headcount ratio and a 52.6% average intensity of poverty. Hence, according to our analysis, the Brazilian population was more multidimensionally poor and more intensively poor than the average global population. Additionally, when comparing our results to theirs (ALKIRE *et al*., 2015), Brazil has similar poverty measures to lower-middle-income countries, even though it is an upper-middle-income[14] country. Therefore, according to these results, the poverty phenomenon in Brazil, considering all possible dimensions people may be deprived of, must be a focal point for public politics.

[14] Classification made by the World Bank (2023).

Furthermore, considering the gender analysis, Brazil has more multidimensionally poor women, 54.10%, than men, 34.20%, and they are more intensively deprived than men, even though very similar (a difference of 1.67 p.p. favoring men). These differences make women have a larger MPI than men, 11.9 p.p. higher. Therefore, these results validate the data presented before (in Table 2) and the theoretical approach that women are likelier to lack capabilities than men and not live a dignified, full, quality life (NUSSBAUM, 2001, 2003; ALAM, 2011). These results also corroborate other MPI evaluations for Brazil, where women are more multidimensionally deprived than men (AVILA; BAGOLIN; COMIM, 2012; FERREIRA; MARIN, 2016; OLIVEIRA, 2018). Also, it can be deduced that the gendered nature of multidimensional poverty in Brazil is more a product of the high count of poor women than the intensity of deprivation they suffer since A was very similar for men and women. In addition, these results suggest that the dimensions are relevant to evaluate the gender differences in poverty by comparing people that are poor to those that are not. However, they are not as relevant to comparing men and women experiencing poverty. Figure 2 elucidates these differences between gender and compare them to the Brazilian data.

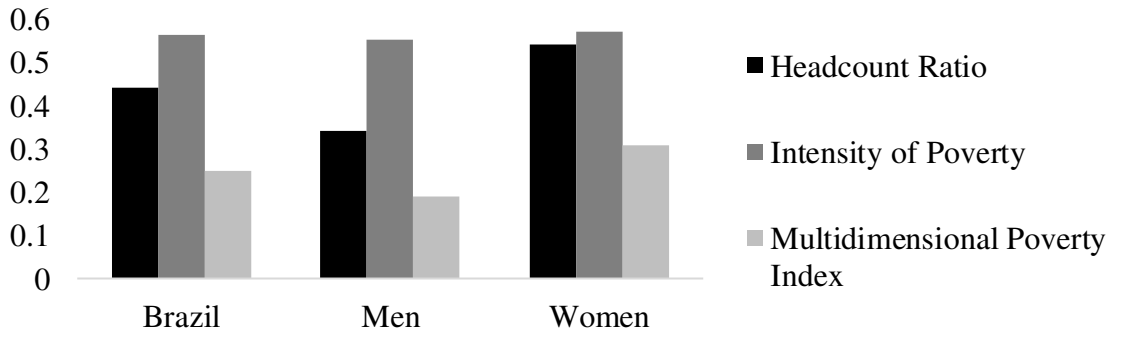

Figure 2: The headcount ratio, the intensity of poverty, and the multidimensional poverty index - Brazil, men, and women, 2015
Source: Research results

Figure 3, in turn, presents the evolution of the headcount ratio, the intensity of poverty, and the multidimensional poverty index, between 2004 and 2015. As can be seen, all three variables have been in a reduction path in the period analyzed. The Brazilian headcount ratio experienced a reduction of 41.77%, while the intensity of poverty and the MPI reduced by 7.65% and 46.22%, respectively. However, similar to the previous section, women's percentage of multidimensionally poor (H) has reduced less than men's, a gap of 15.80 p.p. favoring the last ones. The same happened to the MPI. The men's has reduced by 50.22% over the years analyzed, while women's reduced by only 39.73%.

On the other hand, the intensity of poverty presented some interesting information. As shown in Figure 3, it was on a reduction path until 2006, and then, it became almost constant between 2007 and 2014, rising in 2015. Corroborating the poverty instability in Brazil that the data from CEPAL (2021) showed. A possible explanation for the rise is that 2015 was when Brazil entered an economic crisis, and as Vegh *et al.* (2019) stated, social indicators tend to respond to the business cycle. However, according to Glewwe and Hall (1998), people's poverty status tends not to respond immediately to macroeconomics shocks. Therefore, the economic crisis would take longer to reflect on the poor count (H), but it could suddenly affect how deprived the poor is (A).

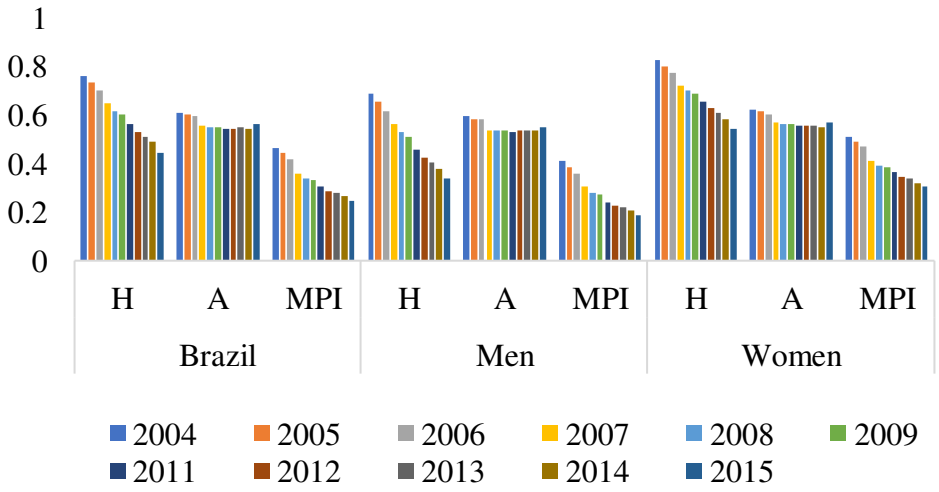

Figure 3: Time evolution of the headcount ratio (H), the intensity of poverty (A), and the multidimensional poverty index (MPI) - Brazil, men, and women, 2004 to 2015
Source: Research results

Additionally, these results could suggest that the more recent years, not accounted for in this research database, would turn multidimensional poverty into a rising path since the economic and political crisis experienced by the country, along with the COVID-19 pandemic, are likely to impact social variables negatively. In fact, according to Estrela *et al.* (2020), gender, race, and class appear as vulnerability conditions to COVID-19 exposure. Also, the data show that the intensity of poverty reduced slightly more for women than for men, which can be related to some advances in women's rights during the period. However, this pattern probably changed in recent years since women tend to be more negatively impacted in moments of crisis than men (GLEWWE; HALL, 1998; IBGE, 2009; BATISTA; COSTA, 2022).

The data presented in Figures 4 and Table 4 represent the contribution of each dimension and indicator to the MPI. It is worth mentioning that these data differ from the ones presented before since Table 3 displayed the percentage of people deprived in each indicator, while this

shows how much each indicator and, therefore, dimension contributed to the MPI calculation considering its weights.

Therefore, as can be seen, the dimension/indicator that contributed more to the Brazilian MPI in 2004 was the employment one. Its contribution has increased to 2015's MPI primarily due to reducing the contribution of education and living standards from 2004 to 2015. In addition, the dimension that contributed the least was the living standards, with the electricity indicator being the one with the lower contribution to the multidimensional poverty measurement. The electricity's modest relevance to the MPI is due to the proportion of the Brazilian population's access to electricity, which in 2019 was 99.80% (IBGE, 2023). According to Freitas and Oliveira (2017), this achievement is due mainly to the "Luz para Todos" program created in 2003 to bring electricity to every Brazilian home, even remotely located.

The importance of the dimensions and indicators remains in the same order when considering men's and women's MPI. However, it is worth mentioning that education, employment, and living standards contribute more to men's measurement of poverty than women's, while income contributes more to women's MPI than men's. These results suggest that reducing the deprivation in employment would be the most effective way to reduce people's multidimensional poverty in Brazil, regardless of gender. Also, improving women's income would have a higher impact on the MPI than improving men's.

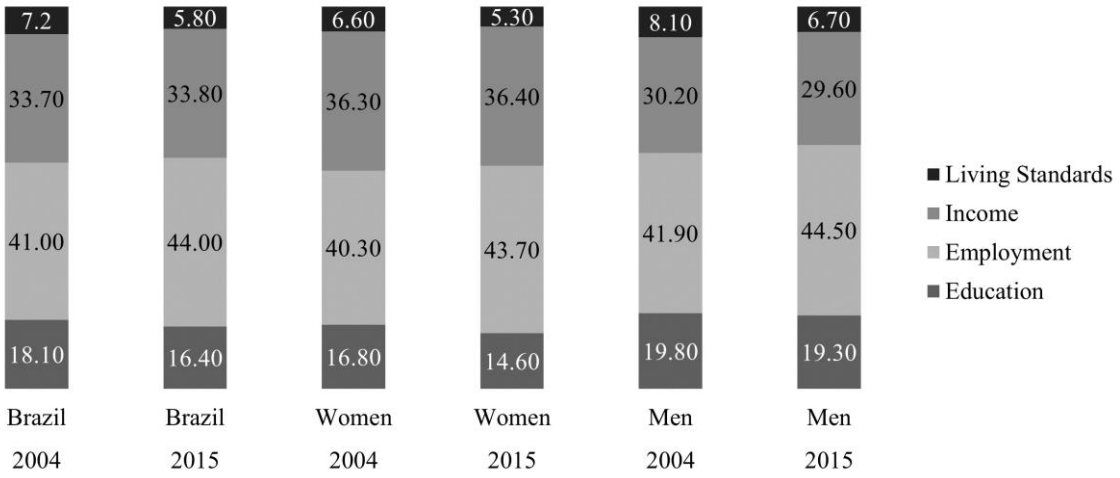

Figure 4: Contribution of each dimension to the multidimensional poverty index - Brazil, men, and women, 2004 and 2015
Source: Research results

Table 4: Contribution of each indicator to the multidimensional poverty index - Brazil, men, and women, 2004 and 2015

Indicator	Weight	Contribution to the MPI					
		2004			2015		
		Brazil	Men	Women	Brazil	Men	Women
K=33%		%					
Years of Schooling	0.125	15.40	16.90	14.30	14.00	15.90	12.80
Literacy	0.125	02.70	02.90	02.50	02.40	03.40	01.80
Employment	0.250	41.00	41.90	40.30	44.00	44.50	43.70
Income	0.250	33.70	30.20	36.30	33.80	29.60	36.40
Electricity	0.036	00.10	00.10	00.10	00.00	00.00	00.00
Sanitation	0.036	03.20	03.50	03.10	03.00	03.30	02.90
Water	0.036	00.50	00.60	00.50	00.40	00.50	00.30
Garbage Disposal	0.036	00.90	01.10	00.80	00.90	01.20	00.80
Cooking Fuel	0.036	00.50	00.60	00.40	00.40	00.50	00.30
Assets	0.036	00.90	01.10	00.80	00.30	00.40	00.20
Overcrowding	0.036	01.00	01.10	01.00	00.80	00.70	00.80

Source: Research results

Hence, to summarize, there are more multidimensionally poor women than men, and they experience a higher intensity of poverty in Brazil—accounting, therefore, for the poverty's overrepresentation of women in the country. Also, women have been improving their poverty status slower than men. Thus, the differences in deprivations experienced by men and women lead them to have different vulnerability paths. Therefore, gender-neutral politics would not be successful in alleviating poverty in Brazil. Finally, improving employment would be the most effective way to reduce the multidimensional poverty index for both men and women.

2.5.3. Gender, race, and the multidimensional poverty index

Failure to account for race's additive effect on deprivations could lead to a misconception of the poverty phenomenon. Therefore, Figure 5 introduces race to the analysis, presenting the headcount ratio, the intensity of poverty, and the MPI by gender, race, and their

interaction[15]. As can be seen, black people have a higher count of multidimensional poor (H), 48.70%, than white people, 38.80%. They also experience a more intensive form of deprivation (A), 57.49% against 54.64%, although very similar. Therefore, Afro-Brazilian people had greater MPI values than white people, 28% versus 21.20%, in 2015, highlighting, once again, that Brazil's poverty phenomenon is black (CARNEIRO, 2015).

Nevertheless, gender appears to influence people's deprivation status more than race. According to the data, the headcount ratio for white women is 48.30%, while black women's is 59.20%, a difference of 10p.p. However, when comparing white men and women, the difference is approximately 20p.p. The same is valid for comparing black men and women. Hence, the gender effect on deprivation is twice the effect of race. This result aligns with Table 2, which shows that regardless of race, women have a higher deprivation score than men. However, there is still structural racism affecting every aspect of black individuals' lives in Brazil, as Carneiro (2015) expressed, which would lead us to expect race to have a more significant influence on people's poverty status than gender.

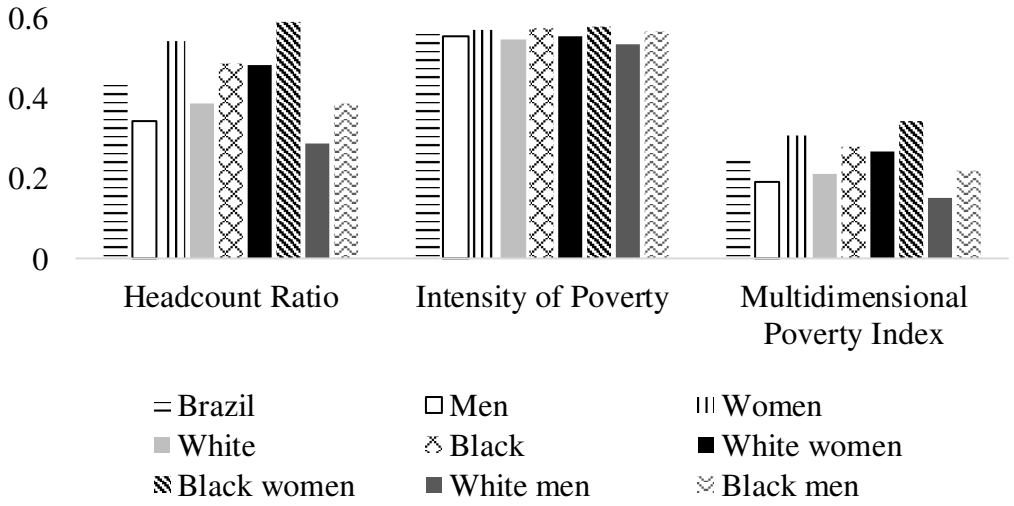

Figure 5: The headcount ratio, the intensity of poverty, and the multidimensional poverty index - Brazil, gender, and race, 2015
Source: Research results

Still, the double jeopardy black women experience in Brazil is unquestionable and consistent with the literature (SANTOS, 2009; SILVA, 2013; CARNEIRO, 2015). They have a headcount ratio of 59.20%, while white men's is 28.70%, a count of 30.5 p.p. favoring the last. This high count leads black women to have the higher MPI value in the country, 34.30%, and white men to have the lower one, 15.30%. Finally, like gender, the intensity of poverty is

[15] More details can be seen in Table 11 in the appendix A.

similar for individuals of the same ethnicity. Therefore, black men and women experience a percentage of deprivation very similar, being slightly higher for women. The same is true for white men and women.

Finally, regarding the contribution of each dimension to the MPI value[16], it is visible that white people in Brazil, regardless of gender, have a higher contribution from the income and employment dimensions to their MPI than black individuals. However, this data does not mean that white people are worse in these dimensions than black people. The only reason is that black individuals' MPI has a higher contribution from the dimensions of education and living standards than the white. Consistent with Gradín (2009) since, according to the author, the discrepancy in poverty levels between white and black people in Brazil is mainly explained by the gap in education and the labor market. Also, the data show, once again, that improving employment, regardless of gender and race, is the more effective way of enhancing people's multidimensional poverty status in Brazil. Nevertheless, increasing women's, black or white, income would significantly impact the MPI more than improving men's.

Therefore, we have seen that women and black people are the most multidimensionally poor in Brazil, shedding light on the greater risk of multidimensional poverty black women suffer since they experience the disadvantages of being from two discriminated groups. Hence, their specific situation should be considered when designing policies to alleviate poverty. Also, the most effective path to reducing their difficulties would be by enhancing their employment and income settings.

2.5.4. Gender, location, and the multidimensional poverty index

Another relevant characteristic of Brazil is its continental size, with territorial divisions full of particularities that differ in economic, social, political, cultural, and physical aspects (COSTA; MACHADO; AMARAL, 2018). Therefore, failing to account for it could conceal relevant information about the multidimensional poverty phenomenon. That being said, Figures 6, 7, and 8 reports the headcount ratio, the intensity of poverty, and MPI across the country, considering the 27 Federal Units[17]. Additionally, Figure 9 shows the rural-urban division of the data.

According to Figure 6, the multidimensionally poor (H) proportion is higher for the Northeast and some Northern states, valid for men and women. In contrast, states in the South

[16] This information can be found in Table 12 in the appendix A.
[17] More information can be seen in Table 13 in the appendix A.

have a lower count of multidimensionally poor individuals. Consistent with the findings of Rodrigues (2004), Ferreira and Marin (2016), and Oliveira (2018). Therefore, the Brazilian state with the higher headcount ratio for the total population in 2015 was Alagoas, 61.70%, while the one with the least multidimensionally poor was Santa Catarina, 31.80%. These results contrast with 'Fahel, Teles, and Caminhas' (2016) results, which found Maranhão to be the state with the higher count and São Paulo and Rio de Janeiro to be the ones with the lower headcount ratio. For women, the highest and lowest counts are in Alagoas, 70.90%, and in the Federal District, 42.10%. While for men, the state with the most multidimensionally poor was Ceará, 53.50%, and the state with the least was Santa Catarina, 21.50%.

Figure 7, in turn, presents the intensity of poverty (A) across the country. As can be seen, differently from the headcount ratio, the variation of this variable is low, consistent with Rodrigues' (2014) and Fahel, Teles, and Caminhas' (2016) results. The places where the poor people experienced the higher percentage of deprivation in 2015 were Maranhão and Alagoas, with a tied value of 60.45%, and the one with the lower percentage of deprivation was São Paulo, with people experiencing 53.51% of deprivation. Similarly, men living in Maranhão are the ones experiencing more deprivation in Brazil, 60.57%, while the ones living in São Paulo are the ones experiencing the least, 52.09%. In its turn, women who live in Pará experience the higher percentage of deprivation in Brazil, 61.08%, and those who live in the Federal District experience the least, 53.92%.

As for the MPI (presented in Figure 8), the multidimensionally poor population share, adjusted by the intensity of deprivation they suffer, the North and Northeast states had Brazil's most acute poverty measurement in 2015. Therefore, the state with the highest MPI value was Alagoas, 37.30%, which is also valid for women, 43.10%, and the one with the highest MPI value for men was Maranhão, 32.10%. Additionally, the state with the lowest MPI value for the total population and men was Santa Catarina (17.40% and 11.30%, respectively), and the one with the lowest MPI value for women was the Federal District with 22.70%. These results are consistent with the literature, which found that individuals living in the North and Northeast states of Brazil are the ones with the worst multidimensional poverty measures, and the ones living in the South are those doing better (RODRIGUES, 2014; FERREIRA; MARIN, 2016; FAHEL; TELES; CAMINHAS, 2016; SILVA *et al*., 2016). Finally, as presented in the previous sections, the dimension most relevant to the MPI calculation[18] is employment, which is valid

[18] This information can be found in Table 14 in the appendix A.

for all 26 states plus the Federal District. Also, for every single one of the states, the income dimension is more relevant for women than men, completing the information presented before.

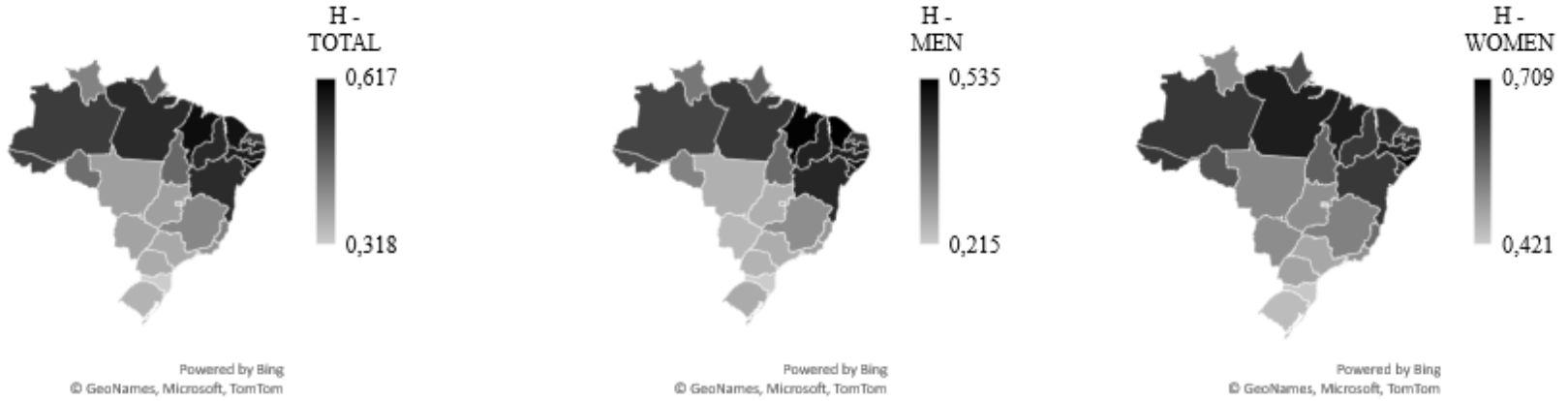

Figure 6: The Headcount Ratio (H) across the country - Total, Men, and Women, 2015
Source: Research results

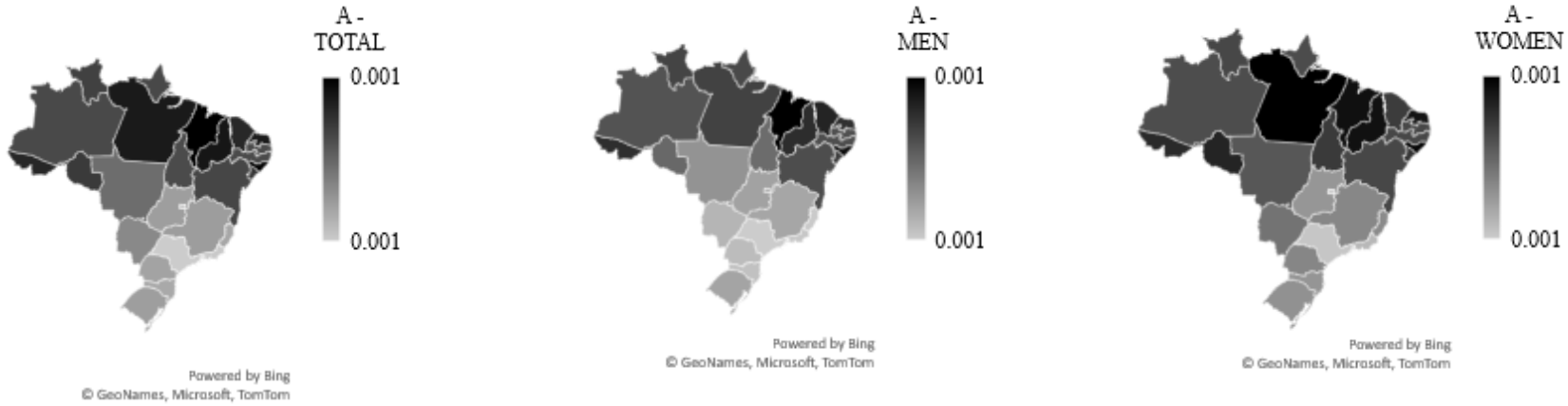

Figure 7: The intensity of poverty (A) across the country - Total, Men, and Women, 2015
Source: Research results

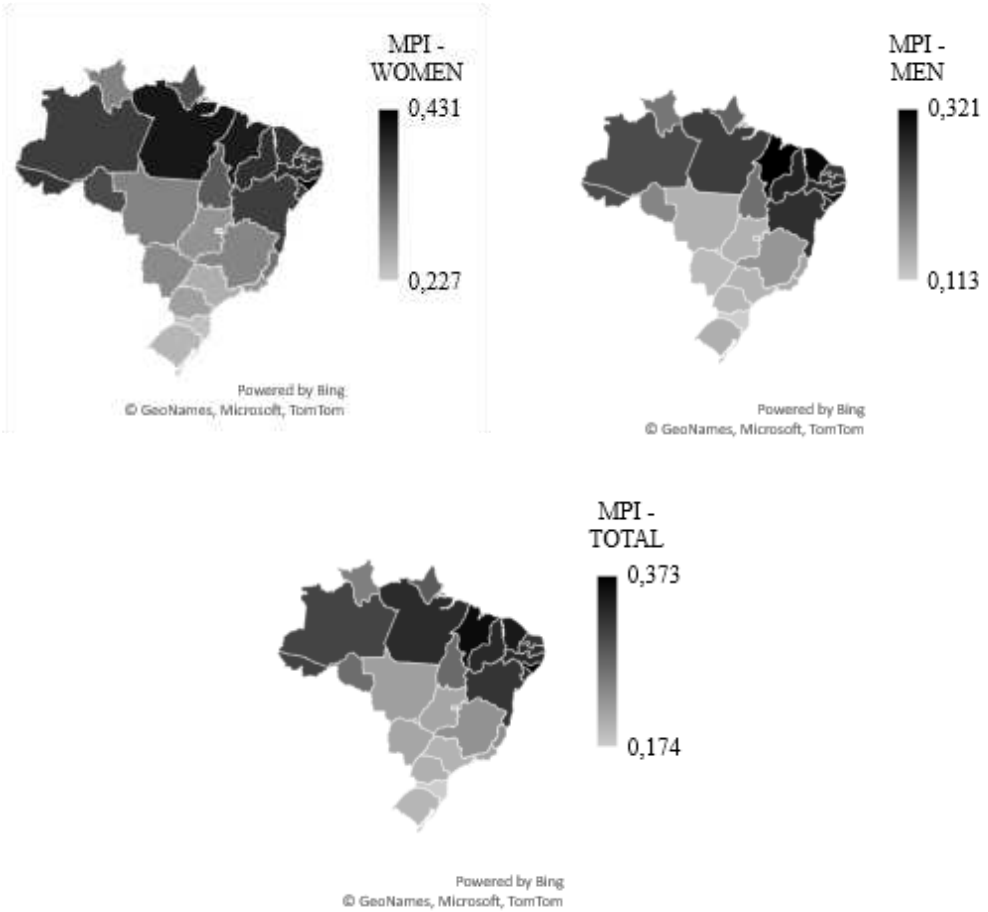

Figure 8: The multidimensional poverty index (MPI) across the country - Total, Men, and Women, 2015
Source: Research results

In addition, Figure 9 presents the data for individuals living in rural and urban locations[19]. As can be seen, the proportion of multidimensionally poor individuals (H) living in the Brazilian rural areas (62.90%) was significantly higher than for those living in the urban areas (41.20%) in 2015. Also, poor individuals in rural areas were more intensively poor than those in the urban, with A being 62.16% for the rural, against 54.85% for the urban. Therefore, the MPI is substantially higher for rural individuals (39.10%) than for urban ones (22.60%). Consistent with Rodrigues (2014), who found that Brazilian rural areas present the highest poverty incidence, regardless of the poverty measurement. Also, it corroborates Fahel, Teles, and Caminhas' (2016) findings that the country's rural areas are expressively multidimensionally poorer than the urban ones.

[19] More details can be seen in Table 15 in the appendix A.

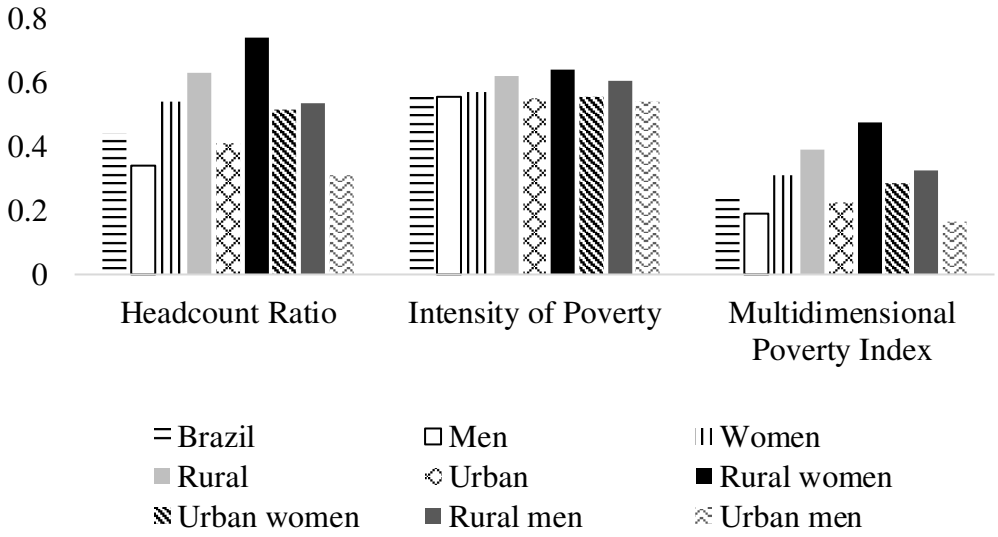

Figure 9: The headcount ratio, the intensity of poverty, and the multidimensional poverty index - Brazil, gender, and rural/urban location, 2015
Source: Research results

As for each dimension's contributions to the MPI value[20], once again, the employment dimension is the one that contributes the most for both rural and urban locations, followed by income. However, it is valid to report that these dimensions have reduced importance for rural areas (compared to urban ones) since the other two dimensions, especially the living standards, have increased importance. Thus, it corroborates the importance of the multidimensional approach to poverty when considering rural individuals' experiences rather than only evaluating income.

The gendered analysis of these data shows an even wider difference between rural and urban individuals since the proportion of multidimensionally poor (H) rural women was 43.40 p.p. larger than that of multidimensionally poor urban men in Brazil in 2015. Rural women were also experiencing the most significant deprivation. They had an intensity of poverty (A) of 63.88% against 60.37% rural men, 55.56% urban women, and 53.90% urban men. Therefore, the higher value of MPI was theirs (rural women), 47.40%. This result suggests that living in rural areas also acts as an additive effect on women's poverty. Corroborating with Silva *et al.* (2016) and Serra, Yalonetzy, and Maia (2020), whose findings suggest that living in remote areas of the country, such as rural municipalities, results in higher multidimensional poverty.

Moreover, each dimension's contribution to the MPI[21] indicates a disadvantage for rural women. Their education dimension has significantly less relevance to their MPI than rural

[20] This information can be found in Table 16 in the appendix A.
[21] Information also found in Table 16 in the appendix A.

men's, while their income dimension has substantially more relevance than men's. Also, these gender differences are higher for rural women than for urban ones. Thus, rural women tend to have even more difficulty transforming education into payment than men and their urban counterparts. The difficulties women face in these areas reflect rural Brazil's patriarchal structure, which increases women's disadvantages inside the family and in the labor market (RAMUNDO STADUTO; ALVES NASCIMENTO; DE SOUZA, 2013).

This section showed heterogeneity among the Brazilian territory with differences between people living in different states and especially between individuals living in rural and urban locations. Amongst the territory, women living in Alagoas, a northeastern state, are worse in the multidimensional poverty measurement. Also, living in rural territories puts women in double jeopardy since they suffer from the disadvantage of being women in Brazil and the deprivations that the rural provide. Therefore, location matters, and it should be accounted for to alleviate poverty in Brazil. Additionally, as stated before, the most effective path to reducing peoples' deprivations, regardless of where they live, especially for women, would be by enhancing their employment and revenue settings.

2.6. Conclusion

This research evaluated the gendered nature of multidimensional poverty in Brazil and its evolution between 2004 and 2015. The Multidimensional Poverty Index (MPI) was constructed with data from the national household sample (the PNAD), considering eleven indicators within four dimensions. The dimensions included were education, employment, income, and living standards. Additionally, to give a more accurate profile of the poverty phenomenon in Brazil, the analysis was also divided by race, Federal Units, and rural/urban locations.

The main results found indicated that poverty has, in fact, multidimensional and gender components in Brazil. First, the relevance of the dimensions evaluated other than income sheds light on the capability failure experienced by Brazilian individuals, highlighting the need to account for poverty's multidimensional nature. Therefore, poverty alleviation policies in the country should be done considering that several aspects affect people's ability to live a quality life. However, our results confirm the interconnection between the capabilities and the income approaches since the income and employment dimensions were the most relevant for every person. Hence, the points requiring more attention for policy creation are (i) the divergence between the number of people searching for jobs and the number of available vacancies; (ii) the

precariousness of work; (iii) the time poverty; (iv) the low minimum wage which is barely sufficient to achieve subsistence; and (v) the difficulty into transforming education into work and payment.

Second, women have higher deprivation scores, meaning they have, on average, a superior proportion of deprivation than men. They represent most people experiencing poverty in Brazil, and most are poor. Also, women suffer from a more intensive form of poverty than men. Hence, the MPI for women in Brazil is higher than for men. Additionally, women's poverty status has been evolving slower than men's. They have more difficulty transforming education into employment and income, and their MPI is more affected by the income dimension than men's. Thus, failing to account for the differences between women's and men's situations in Brazil could lead to policies worsening gender inequalities. In addition to the points highlighted before, Brazil's public policies should focus on giving women more means to enter and grow in the labor market. The discrimination and segregation in the labor market should be tackled with policies as early as school-aged children encouraging girls to pursue STEM (Science, Technology, Engineering, and Math) careers. Finally, women need to have available childcare, and the caregiving they exercise should be accounted for since women's time poverty tends to worsen the discrepancies between their and men's deprivation situations.

The results also showed that Brazil's black women suffer more deprivations than others. These women are even more segregated and discriminated against than white women and encounter more obstacles in the labor market than others. Hence, public policies should try to repair the historical error committed against black individuals, which led to structural racism in the country. The race quotas system is an example of such policies that should be integrated with those suggested before. Another highlight from our results is that location matters for poverty alleviation. Individuals living in Brazil's North and Northeast states and those living in the rural areas are the most multidimensionally deprived. Hence, given the country's size and heterogeneity, local public policies should consider each location's specificities. For example, extending and facilitating access to education for rural individuals can significantly alleviate multidimensional poverty more than urban ones.

Hence, we have seen here that poverty is a complex multi-attribute phenomenon, and, in Brazil, it has a gender, a color, and an address. Thus, neutral public politics cannot have the desired effect when pursuing poverty alleviation. They could even worsen the situation. Therefore, we believe our findings helped the understanding of Brazil's poverty and can assist the design of more focused public policies. However, the available data limited our

multidimensional poverty analysis since other dimensions, such as health, were also relevant to be evaluated. Providing, therefore, both a study limitation and an opportunity for future research.

3. LIVELIHOOD STRATEGIES AS PATHWAYS OUT OF MULTIDIMENSIONAL POVERTY IN RURAL BRAZIL: A GENDER-SENSITIVE APPROACH

3.1. Introduction

Poverty in Brazil has decreased significantly over the past two decades. However, rural poverty is still considerably higher than in urban areas. According to data from the Economic Commission for Latin America and the Caribbean (CEPAL, 2021), in 2019, 32% of the rural population lived below the monetary poverty line[22], against 17% of the urban population.

Besides being at a disadvantage in income, Brazilian rural areas lack in several other dimensions; the families are numerous, they have worse housing conditions, worse educational indicators, inferior healthcare, and depend more on public money transfer programs than their urban counterparts (CAMPOLINA; SILVEIRA; MAGALHÃES, 2009). Statistics show that more than 17% of the rural population was illiterate in 2019, against only 5% of the urban population (CEPAL, 2021). In that same year, only 75% of the rural population had primary water facilities, and only 56% had basic sanitation facilities, compared to 92% and 71% of the individuals living in urban areas, respectively (CEPAL, 2021).

Since rural areas are diverse, it is expected that these poverty dimensions are not experienced the same way by rural people. Women who live in rural Brazil are the poorest in the country. They represent 26.8% of people below the monetary poverty line in the country, against 25.7% of rural men, 17.7% of urban women, and 16.4% of urban men (CEPAL, 2021). The relative disadvantage of rural women may be even higher if we consider the multidimensionality of poverty. Due to the theme's relevance, the multidimensional aspect of rural poverty and its gender is our focus in this paper.

Understanding and quantifying the multidimensional poverty in rural Brazil is essential on its own. In this research, however, we go beyond this relevant exercise and analyze the relative importance of the commonly cited pathways out of poverty. According to the literature, three main rural livelihood strategies are possible pathways out of poverty. These strategies include agricultural intensification, livelihood diversification (including the non-farm economy[23]), and migration (SCOONES, 1998; WORLD BANK, 2008; HELFAND; PEREIRA, 2012).

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[22] Considering the international poverty line of people living with less than US$5.5 a day.

[23] The non-farm economy is a sector with action outside the agricultural market. Non-farm sector can include contruction, health-care, tourism, education, and others. Different from the on-farm income wich is the one generated from farming and agricultural production inside the farm; and from the off-farm sector which includes agriculture-related income coming from beyond the farm (NORONHA, 2019).

World Bank (2008) stresses that agriculture and rural societies are strongly heterogeneous. This pervasive heterogeneity defines differences concerning how each pathway out might work: migration seems to be the best strategy for some people experiencing poverty, but it might take others to urban poverty. Therefore, a natural question is whether the importance of each pathway differs according to gender.

According to Ellis (2003), people's choice of livelihood strategy or how to make a living is affected by the resources available, the risks they face, and the institutional and political context. Therefore, when considering an individual's livelihood strategy, we must consider that several factors will be part of their choice. However, not all strategies will represent a path to overcoming poverty, and they will not all have the same effect on every individual (ELLIS, 2003). Hence, it is crucial to evaluate the livelihood strategies adopted in rural Brazil, if they represent pathways out of poverty, and for whom they are available. Moreover, social norms often limit women's potential to exploit farming, labor, or migration opportunities and reinforce inequalities. Besides that, gender differences in access to assets and mobility constraints are essential determinants of available pathways out of poverty (WORLD BANK, 2008). Hence, shifts in household strategies that might lead to pathways out of poverty are not gender-neutral.

Even though the literature often emphasizes three main strategies for rural poverty reduction, namely farming, nonfarm activities, and migration, in this paper, we are only interested in the last two. Our choice to focus on non-farm options has three main reasons: i) For women, agriculture is still hard to represent as a prominent activity. In Brazil, only 18.6% of rural establishments were managed by women in 2017 (IBGE, 2022). Women still struggle to find space and recognition for their work in agriculture because they are primarily considered helpers in the main work, usually thought to be proceeded by men (TACOLI; MCGRANAHAN; SATTERTHWAITE, 2015). Besides, their role in household decision-making concerning technology adoption, diversification, and other variables affecting farming income is underestimated. ii) Since farming needs credit, knowledge, skills, land, and physical capital that people experiencing poverty do not usually have (HELFAND; PEREIRA, 2012; WORLD BANK, 2008), agriculture can be a successful pathway out of poverty, but only for a minority of rural people experiencing poverty (HELFAND; PEREIRA, 2012). It may be even more challenging for rural women to succeed through farming. iii) Performing non-farm jobs tends to be considered an alternative to migration, so individuals usually choose between the two, justifying studying both.

Hence, this research seeks to analyze if migration and nonagricultural work contribute to reducing multidimensional poverty in rural Brazil and if their effects differ for men and women. Our analysis uses individual-level data from the Pesquisa Nacional por Amostra de Domicílios (PNAD) database between 2004 and 2015. To measure multidimensional poverty, we assembled an index to capture the gender inequalities in deprivation. The index was based on the Multidimensional Poverty Index (MPI) constructed by Alkire and Foster (2011a). Hence, we account for people's deprivation in eleven indicators within four dimensions[24]. Also, the livelihood strategies' variables considered were the inter-municipal migration and the nonagricultural work classified according to the National Classification of Economic Activities (CNAE). Additionally, our empirical strategy exploits an exogenous variation in both variables (migration and nonagricultural performance) using extreme events in temperature and precipitation as instruments.

In evaluating the relative importance of two pathways out of poverty through a gendered perspective and considering a multidimensional measure of poverty, we provide credible evidence to the literature. Little is known about the potential of the abovementioned pathways out of poverty to reduce deprivations in multiple dimensions. Accounting for various forms of poverty is important, especially in cases such as rural Brazil with a pervasive unequal scenario. Evidence is equally scarce on their potential to be successful depending on people's gender. If gender is relevant to the strategy's success, then policies aimed at female rural residents would have more significant effects than neutral ones. This analysis is critical in a country like Brazil, where men and women, especially those living in rural areas, do not have the same opportunities and means to escape poverty. Besides, the construction of our multidimensional poverty measure accounting for several sources of deprivation people may experience in rural Brazil goes beyond the evidence in the literature. Thus, the purpose here is to provide results that help better understand how to overcome deprivation for different individuals in rural Brazil.

The paper is organized as follows; Section 3.2 presents the theoretical framework used to understand the relationship between livelihood strategies and poverty. This section also brings some empirical evidence with a literature review. Section 3.3, in turn, describes the empirical strategy used to answer our research questions and the data used. A descriptive analysis and the estimation results are shown in Section 3.4, and Section 3.5 concludes the study.

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[24] Dimensions: Education, Employment, Income, and Living Standards. Indicators: Years of Schooling, Literacy, Employment, Income, Electricity, Sanitation, Water, Garbage Disposal, Cooking Fuel, Assets, Overcrowding.

3.2. Theoretical Framework and Literature Review

This section discusses the theoretical framework used to understand better the relationship between migration and nonagricultural jobs and multidimensional poverty. Also, we bring the literature to help us analyze the channels through which our chosen livelihood strategies (migration and nonagricultural activities) could affect poverty. By analyzing what determines the choices for these pathways, we can identify how they could work differently for women and men.

3.2.1. The sustainable livelihood approach

In this research, the framework used to understand the relationship between rural livelihood strategies and poverty reduction is the Sustainable Livelihood Approach (SLA) proposed by Scoones (1998). This approach is a concept that has garnered prominence in the ongoing debate about rural development and poverty reduction (ELLIS; BIGGS, 2001; KRANTZ, 2001; SCOONES, 2009). In particular, we want to emphasize the role of two commonly cited pathways out of poverty: migration and non-farm work.

Livelihood strategies are the means, activities, entitlements, and assets by which a rural household or individual makes a living. It is sustainable if the livelihood strategies resist external pressure, improve over time, and impact others (SCOONES, 1998; KRANTZ, 2001). With that in mind, the framework elaborated by Scoones (1998) revolves around four main elements: livelihood resources, livelihood strategies, institutional processes, and organizational studies. Thus, given a particular context, institutions, and organizations available, the framework focuses on understanding combinations of livelihood resources that will result in the individual's ability to choose from the livelihood strategies. Then, those strategies will result in sustainable livelihood outcomes (SCOONES, 1998).

Figure 10 shows that the context, conditions, and trends can be politics, history, economic conditions, climate, demography, and others influencing the livelihood strategy's choice. In turn, livelihood resources are the capital (natural, economic, human, and social) that an individual can combine to form livelihood strategies. The institutional processes and organizational studies (formal and informal) are needed to access livelihood resources, facilitate the capacity to carry out the strategies, and achieve the outcomes. According to this framework, a person's livelihood strategy is a combination of their surroundings, which gives them the means to choose a strategy or an arrangement of strategies that better suits them. These factors

can affect outcomes such as poverty reduction, improved well-being, increased workdays, and sustainable livelihood strategy.

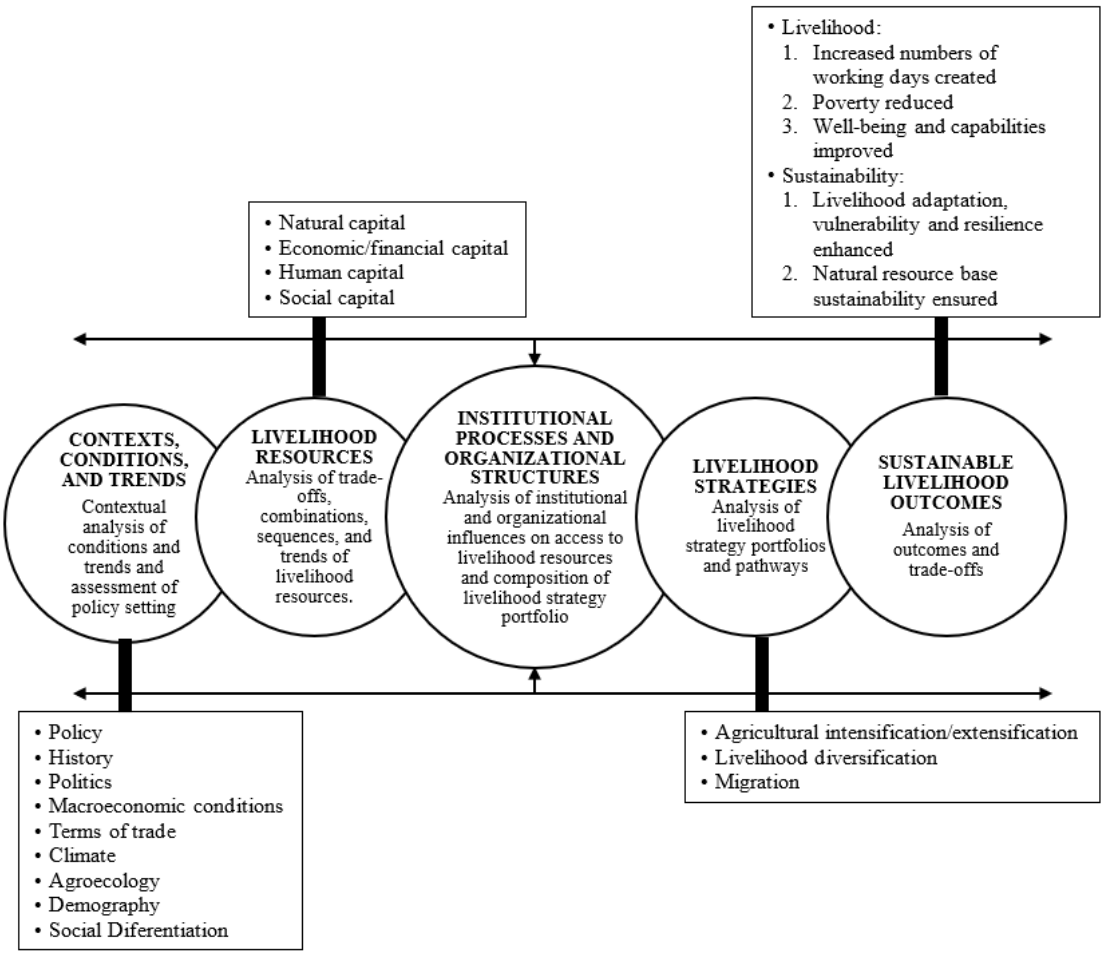

Figure 10: The sustainable rural livelihoods framework
Source: Own elaboration based on Scoones (1998).

Within this framework, three livelihood strategies can be identified. The first one is agricultural intensification/extensification, the income source based on agriculture, with intensive labor or capital. The second one is livelihood diversification, which is any nonfarm income-earning activity. The last is migration, when individuals move away, temporarily or permanently, seeking a livelihood elsewhere (SCOONES, 1998). According to Scoones (1998), households unable to explore agriculture tend to choose diversification through non-agro activities and migration. Additionally, Helfand and Pereira (2012) state that the nonagricultural labor market presence in rural areas can be seen as an alternative to migration since the factors associated with the success of both strategies are very similar. Hence, at an individual level,

rural residents tend to choose to either migrate or engage in the nonagricultural labor market, making these strategies substitutes for one another.

Poverty reduction is one of the possible outcomes of the livelihood strategies choice, and according to Krantz (2001), the framework proposed by Scoones (1998) is an attempt to go beyond the conventional approaches. The use of the sustainable livelihood approach for poverty eradication has three main reasons. First, economic growth can only reduce poverty if people experiencing poverty can exploit the economy's expansion. Second, poverty is a multidimensional issue. Third, people experiencing poverty know their limitations and what needs to be done to improve their situation. Thus, understanding the processes, the sources of limitation, and each dimension's influence on an individual's poverty condition is essential to reducing poverty, and the sustainable livelihood approach accounts for all of that (KRANTZ, 2001). With that in mind, some agencies already use the framework to approach poverty reduction (DFID, 1999; UNDP, 2017).

Finally, as shown in Figure 10, several variables affect a person's choice of livelihood strategy, and among these are the individual's characteristics, such as gender. According to the World Bank (2012), women and men have different labor opportunities, access to credit, and income sources. They also have distinct responsibilities within the family and the household, especially in the Brazilian rural environment, which has a patriarchal inheritance (RAMUNDO STADUTO; ALVES NASCIMENTO; DE SOUZA, 2013). These differences can be important determinants of the available livelihood strategies and, therefore, the pathways out of poverty. Thus, it is essential to make a gendered analysis of the livelihood strategies and their effects on poverty reduction. The following two sections provide additional information about each livelihood and show empirical evidence to help us understand their relationship with poverty and how they can affect men and women differently.

3.2.2. Migration and poverty: an overview

Migration is the process of a person's spatial mobility, which is the movement to a new location that can be initiated due to economic, social, and political factors. Also, the migratory flow can be classified in terms of space (internal or international migration), length of stay (temporary or definitive), and how it happened (if the person was forced to move or it was a choice) (GOLGHER, 2004). Internal migration can also be classified into some categories: rural exodus, which is individuals moving from rural to urban areas; urban exodus, which is individuals moving from urban to rural areas, infrequent in the urbanized world; urban to urban

and rural to rural migration; seasonal migration, which is more frequent among rural workers moving to follow the crops; and return migration that is the move back to their place of origin, usually associated with retirement (GOLGHER, 2004).

When considering the migration process, the primary motivation behind it is the search for better living conditions. In this sense, migration is often seen as a flight from poverty, especially considering the rural-to-urban movement (SKELDON, 2006). However, the relationship between poverty and migration is unclear since population movement may be both the cause and the consequence of poverty (HAAN, 1997; SKELDON, 2006). The arguments favoring migration as a cause of poverty are rooted in the fact that migrants are a large portion of the urban people experiencing poverty and individuals working in informal jobs (AWUMBILA; OWUSU; TEYE, 2014; TACOLI; MCGRANAHAN; SATTERTHWAITE, 2015). However, migration can also be a reaction to poverty or a chosen livelihood strategy to improve income (SCOONES, 1998; AWUMBILA; OWUSU; TEYE, 2014).

In this research, we claim that migration has the potential to be seen as a relevant pathway out of poverty for individuals living in rural areas. In this sense, migration can diversify livelihood and reduce vulnerability risk (ELLIS, 2003). In Figure 11, we can see that the population movement is a strategy that can improve livelihoods and, as a result, alleviate deprivations through two channels. The first is through the labor market, where labor mobility helps individuals improve their conditions. While the second one is through remittances, where the emigrant can send money back home to help improve their family's life. So, migration can be seen as an opportunity for poor people to build their pathways out of poverty (ELLIS, 2003).

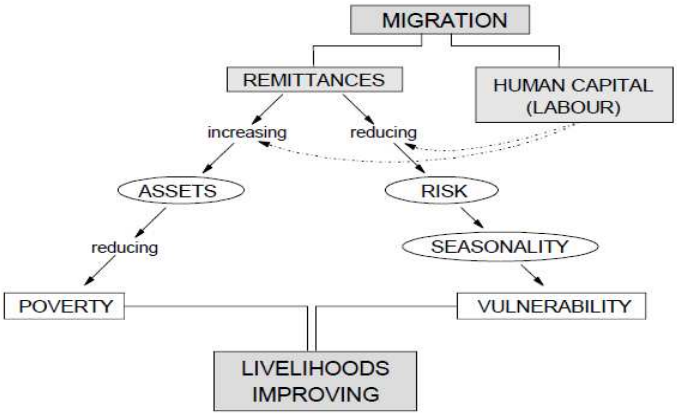

Figure 11: Positive links between migration and improving livelihoods
Source: ELLIS (2003, page 8).

When considering migration as a livelihood strategy choice, Skeldon (2006) argues that migrating individuals are the most innovative, qualified, and dynamic ones in their families

since the households tend to send their most skilled members to pursue a better life. Hence, when migration is a choice rather than a forced movement, it can alleviate poverty (SKELDON, 2006). However, we must be cautious when addressing migration as a choice since some individuals live in such a deprivation status that searching for better living conditions can hardly be described as a choice (ELLIS, 2003). Thus, this forced migration can reinforce the arguments that it is the cause of poverty transfer since, in this case, people have to move without the support and adequate planning (SKELDON, 2006). Therefore, even though migration may be a response to poverty, the poorest individuals do not have the same opportunities to migrate since they have differentiated access to resources and institutions. Also, poverty can affect the distance of the migration movement since it is a costly process, and transportation costs are higher for the furthest locations (SKELDON, 2006; AWUMBILA; OWUSU; TEYE, 2014). So, as we saw, the relationship between poverty and migration is complex.

Besides, migration is a selective, non-homogeneous process where different population groups migrate for distinct reasons that change over time (HAAN, 1997; AWUMBILA; OWUSU; TEYE, 2014). Also, not only poverty but also inequality can affect migration, which suggests that there may be differences in the process for men and women (HAAN, 1997). According to Awumbila and Ardayfio-Schandorf (2008), all the stages of the migratory process are gendered. The motives and determinants of migration may differ among men and women, as well as its processes and impacts—the same as poverty, which is gendered by nature.

When considering individuals living in rural areas, gender differences are even more visible. For women, rural-to-urban migration may offer them independence, and their decision to leave rural areas can be seen as a result of gender discrimination since the countryside usually carries a patriarchal inheritance affecting women's access to opportunities (CHANT, 2004; RAMUNDO STADUTO; ALVES NASCIMENTO; DE SOUZA, 2013). Also, even when women have equal rights in land ownership, inheritance, and credit access, cultural roles usually lead them to be responsible for unpaid care work, thus encouraging them to migrate to the city (TACOLI; MCGRANAHAN; SATTERTHWAITE, 2015). In addition, urbanized cities are typically attractive to them since it has opportunities to work outside the family and have less rigid social rules (TACOLI; MCGRANAHAN; SATTERTHWAITE, 2015). However, migration may not improve women's situation since it may increase their opportunities in the labor market but usually through lower payments and worst positions (AWUMBILA; ARDAYFIO-SCHANDORF, 2008).

On the contrary, Skeldon (2006) argued that the individuals who migrate from rural areas are mainly responsible for productive activities. Also, according to Chant (1998), migration decisions are affected by gender inequality in resource access and their role within the household. Thus, in a society with more defined gender roles, where women tend the be responsible for housework and childcare while men are responsible for productive work, men would be the ones who move in the pursuit of better living conditions. Therefore, even with no consensus if either men or women migrate the most, it seems relevant to consider the gender differences in evaluating migration as a possible pathway out of poverty.

Some empirical evidence of the migration process and its relationship with poverty follow. Historically, men in Sub-Saharan Africa are most likely to migrate for a better life. However, with the increase in divorces, reduced marriage rates, and more women establishing careers, they have become a large part of rural and urban migrants (GUGLER, 1989). In contrast, according to Haan (1997), single men migrate the most in India, and the poorest in rural areas face more difficulties leaving. Also, the unequal distribution of resources is the primary motivation for people to leave the countryside. Likewise, poor households with few working-age individuals and low human capital in China cannot send their members to migrate (DU; PARK; WANG, 2005). According to Du, Park, and Wang (2005), male, younger, and educated individuals are more likely to migrate, and evidence has shown that migration is not a solution to poverty. However, rural-urban migration has helped reduce the income gap between rural and urban areas in the country (DAVIN, 1998).

Evidence shows that migration as a livelihood strategy in Bangladesh has opened up the pathways out of poverty for people in poverty (NARGIS; HOSSAIN, 2006). In Indonesia, long-distance migration is a path out of poverty (TIMMER; WEISBROD; MCCULLOCH, 2007). In Gana, girls and women are the ones that most frequently migrate from rural to urban areas as a strategy to overcome poverty (AWUMBILA; ARDAYFIO-SCHANDORF, 2008; AWUMBILA; OWUSU; TEYE, 2014). Finally, evidence for Paraná, a state in southern Brazil, suggests that the rural-urban migration process is more intense for young women (RAMUNDO STADUTO; ALVES NASCIMENTO; DE SOUZA, 2013).

Summing up, this section showed the complexity of the relationship between migration and poverty and that migration always involves costs, such as transportation and installation. Also, we see that migration is more than an economic decision. It is a social process, meaning individuals with different backgrounds may have different migrations opportunities. Therefore,

we can expect migration to have different relevance as a pathway out of multidimensional poverty for men and women in rural Brazil.

3.2.3. Nonagricultural labor and poverty: an overview

Traditionally, rural households and individuals are expected to only engage in agricultural activities. However, they have increased their participation in the nonagricultural labor market over time. This market is formed by the activities performed outside the farm and not strictly related to agricultural production, such as tourism, health, education, mining, manufacturing, construction, commerce, and transportation (NORONHA, 2019). In Brazil, the rising importance of these occupations results from the rural areas' transformation over the years, which is directly related to the urbanization process that has helped integrate the rural and urban labor markets (CAMPOLINA; SILVEIRA; MAGALHÃES, 2009).

The change in the rural labor market composition and the diversification of income has led nonfarm activities to be considered a pathway to reducing rural poverty (CAMPOLINA; SILVEIRA; MAGALHÃES, 2009). According to Ney (2006), in Latin America, the rural nonfarm sector has been part of the solution to poverty for four main reasons. First, agriculture has been losing space in the labor market in the developing world. Second, income inequality in the agriculture sector is high, making it difficult to be accessed by people experiencing poverty. Third, the nonfarm income helps complement the income of individuals with no or almost no land. Finally, these activities mitigate agriculture instability (NEY, 2006). Therefore, adopting strategies other than agriculture can increase income for individuals in rural areas and boost them out of poverty (IQBAL *et al.,* 2018). Indeed, according to Lanjouw and Feder (2001), nonfarm employment can also help absorb rural labor, slow rural migration, and increase national income growth. Also, these activities may increase the wages in agricultural labor markets by reducing the labor supply (STIFEL, 2010).

According to Start (2001), although nonagricultural jobs can serve as a determinant for household well-being and a pathway out of poverty, their impact could be positive or negative depending on the activity performed. Among the nonfarm livelihood strategies, the market-oriented ones tend to be the most effective in reducing deprivations for rural households, such as increasing income and food security. However, they are only available for a few poor people, usually the least deprived ones (PAUDEL KHATIWADA *et al*., 2017). In this sense, it must be addressed that nonfarm labor as a livelihood strategy does not always have positive outcomes. They can be of two types (REARDON *et al*., 1998; START, 2001). It can be a pull

strategy when individuals enter the sector as a choice. They choose to work in a nonagricultural job if it has a better return relative to the farm sector or in an attempt to diversify income and reduce their vulnerability to risks. In this case, the strategy can increase income and alleviate poverty (REARDON *et al.,* 1998; START, 2001; STIFEL, 2010).

In contrast, when individuals enter the nonagricultural sector as coping and survival mechanisms, they are called push strategies. Landless individuals, those affected by shocks or without access to the credit market, may not have other options. In this case, nonfarm labor as a livelihood strategy may have adverse outcomes, such as increasing inequality (REARDON *et al.,* 1998; START, 2001; STIFEL, 2010). In this sense, Haggblade, Hazell, and Reardon (2010) argue that agricultural households use nonagricultural labor mainly to diversify income, while landless households use it to survive.

Additionally, nonagricultural activities are heterogeneous and highly segmented. Its impact on poverty reduction depends on the capacity of people in poverty to access these activities and the types of them exercised by people experiencing poverty (DE JANVRY; SADOULET; ZHU, 2005). Therefore, its access is affected by power, wealth, gender, class, race, human capital, and location (START, 2001; CAMPOLINA; SILVEIRA; MAGALHÃES, 2009). Also, the gains from nonagricultural activities are positively affected by access to credit, proximity to roads, and market influence (PAUDEL KHATIWADA *et al.,* 2017).

The poorest households are usually confined to low-productivity markets and low-income and low-skilled jobs, which tend to offer them few pathways out of poverty (HAGGBLADE; HAZELL; REARDON, 2010). Therefore, for the most deprived individuals, the nonfarm economy is mainly a way to survive instead of a path to overcome income deprivation. On the other hand, wealthier households may not need income from nonfarm activities but have access to better income sources in the sector. This difference highlights the labor market's entry barriers to the poorest (REARDON *et al.,* 1998). However, it is worth addressing that rural nonagricultural earnings can be viewed as a safety net preventing the most deprived families from worsening their situation since they cannot cope with adverse income shocks (HAGGBLADE; HAZELL; REARDON, 2010). However, this scenario is confined to monetary poverty. It is possible that different dimensions of deprivation are affected by these jobs, even though income does not experience a significant rise. In fact, according to (BRAGA, 2021; SEEBENS, 2009), performing nonfarm activities in rural Brazil act as a way to empower women, which could improve their lives in dimensions other than income.

Access to the most lucrative nonfarm works is also restricted by gender discrimination (HAGGBLADE; HAZELL; REARDON, 2010). For women, nonfarm activities act more as a survival strategy than as a way to increase welfare in the long term (SEEBENS, 2009). In addition, Reardon *et al.* (1998) draw attention to the fact that locations with the least agricultural potential are the ones that would need the nonagricultural sector the most. However, they usually do not have the incentive to attract the sector. Hence, not all individuals have the same opportunities to exercise nonfarm activities and gain from them, suggesting the need to evaluate the livelihood strategy accounting for its heterogeneities. Nonetheless, nonfarm work might improve female bargaining power, which, in turn, may affect their position within a household and impact other dimensions of poverty (BRAGA, 2021).

Evidence for Ghana and Uganda shows that nonfarm income is relevant throughout the income distribution for both men and women (CANAGARAJAH; NEWMAN; BHATTAMISHRA, 2001)—however, the wealthiest benefit more from the sector than the poorest. Also, when considering what led individuals to work in non-farm jobs, Canagarajah, Newman, and Bhattamishra (2001) found that education and regional characteristics are most relevant to determining the search for nonagricultural positions in the countries. In India, the nonfarm sector has not helped reduce poverty because the poorest do not have the assets to engage in such activities as education (LANJOUW; SHARIFF, 2004). Also, women are more likely to work in agricultural activities in the country than nonfarm ones. In contrast, in China, the nonfarm income helped reduce the depth and severity of poverty and inequality in rural areas (DE JANVRY; SADOULET; ZHU, 2005). According to De Janvry, Sadoulet, and Zhu (2005), the nonagricultural economy facilitated the increase in income and living standards of the individuals by absorbing the rural surplus labor.

Stifel (2010) finds a positive relationship between nonagricultural income and welfare in Madagascar, suggesting that the sector has been an important pathway out of poverty for individuals living in rural areas. Similarly, Imai, Gaiha, and Thapa (2015) have found that participating in the nonfarm sector has helped households increase their consumption expenditure in India and Vietnam. Also, it reduced household vulnerability to risks (IMAI; GAIHA; THAPA, 2015). Likewise, evidence for Pakistan suggests that nonfarm activities are a good way of alleviating poverty. However, it increases inequality (IQBAL *et al.,* 2018), which was also the finding of Braga (2021) for Brazil.

In this section, we discussed the central evidence of the impact of non-farm labor on reducing poverty. The evidence around the world, as well as the expected effects, are mixed.

However, it is important to contextualize this strategy as a way of improving multiple dimensions of well-being, not only income, which is especially important when it comes to women's situation in rural areas, who tend to be at a disadvantage in many dimensions.

3.3. Methodology

This section presents the empirical strategy used to answer our research questions. First, we discuss the identification strategy used to verify if migration and nonagricultural activities are relevant pathways out of multidimensional poverty for men and women in rural Brazil. Next, we describe the data used and its specifications.

3.3.1. Empirical strategy

In this paper, we seek to establish the impact of migration and non-farm work on multidimensional poverty, evaluating the possibility that they might work differently for women and men in rural Brazil.

We used the deprivation score calculated by the Multidimensional Poverty Index (MPI) method developed by Alkire and Foster (2011a) to represent multidimensional poverty. The MPI is a methodology used to identify people in poverty and determine which dimensions drive multidimensional poverty among people (ALKIRE; SETH, 2008). Hence, it took four steps to achieve the deprivation score. First, we defined the multidimensional poverty dimensions and their indicators: education (years of schooling and literacy), income, employment, and living standards (cooking fuel, overcrowding, assets, water, garbage disposal, electricity, and sanitation). Second, we defined the cutoff points for each indicator, indicating whether each individual in each indicator is deprived. Third, we selected the weights for each indicator, giving each dimension the same weight and dividing it equally between its indicators. They all should add up to 1. Finally, we created each person's weighted proportion of deprivation, the deprivation score[25], which is the variable representing multidimensional poverty.

The decision of migration and performance of nonfarm work should be randomly assigned through the population to identify their causal impact on poverty. If that were the case, we could assess each strategy's causal effect on poverty by comparing the outcomes of those who adopt and do not adopt the relevant strategy. However, as discussed in previous sections,

[25] The dimensions, indicators, cutoff points, weights, some descriptions of what we intend to capture with them, and the literature reference for each can be seen in Table 17 of the Appendix B and are the same ones used in chapter 1.

people choose to migrate or engage in non-farm work. Individual characteristics such as location, social norms, and several unobserved factors determine this decision, all of which might as well affect their poverty status. People who migrate might have more skills, education, and other characteristics that make the migration successful because of these factors and not precisely due to the fact of having migrated. The same can be said about non-farm labor; people who participate in these markets differ from those who do not participate in several ways. Therefore, simply comparing poverty between these groups cannot disentangle the strategy's causal effect.

Hence, our empirical strategy tries to deal with the selection bias by finding an exogenous variation in both variables through the instrumental variables approach. This identification strategy relies on the hypothesis that the only reason why our instrument affects poverty is through its impact on migration and decisions towards non-farm work. To motivate our discussion, we begin by showing our main equation in (1):

$$y_{i,s,t} = \alpha + \beta_1 M_{i,s,t} + \beta_2 N_{i,s,t} + X'_{i,s,t}\beta_3 + F'_{s,t}\,\beta_4 + \varepsilon_i \qquad (1)$$

where $y_{i,s,t}$ is the deprivation score of the person *i,* from the state *s,* at time *t* (with *t* varying from 2004 to 2015). The deprivation score is a continuous variable representing multidimensional poverty that varies from 0 to 100, where values closer to 100 mean a higher deprivation. $M_{i,s,t}$ and $N_{i,s,t}$ represent the two livelihood strategies, migration (M) and nonagricultural work (N). The migration variable takes the value 1 when the person *i*, from the state *s*, at time *t* migrated, and zero otherwise. We considered intercity migration instead of interstate since the last one is costly, especially for those trying to escape poverty. In turn, the nonfarm work variable assumes value one if the person *i*, from the state *s*, at time *t,* works in a nonagricultural job and zero otherwise. This variable was created considering the National Classification of Economic Activities (CNAE). The non-agro classification includes industry and industry-related activities (construction; trade; food and accommodation; transport, storage, and communication; public administration; health, education, and social services; collective, social, and personal services; domestic services; and other activities). For both variables, migration, and nonfarm performance, we considered individuals performing it for less than four years and more than one year. The choice for the one to four years time frame is because moving out of poverty is a process that can take time, and as stated by the World Bank (2008), the changes in livelihood strategies can take a while to be converted into a decrease in deprivation.

Since the exogeneity of the livelihood strategies may be conditional on observed and unobserved variables, a vector $X'_{i,s,t}$ of individuals' and households' observed characteristics was included. The control variables included are those responsible for making groups differ, such as the individual's gender, race, age, and years of schooling, if they perform more than one livelihood strategy (which is called pluriactivity), if they are heads of households, the number of individuals living in the same household as them, if the household's head has a partner and the presence of retired and children under the age of 5 in the household.

Several variables at the locational level may affect the possibility of migration and nonfarm work, as well as poverty status (social norms, public goods, and institutions). These unobserved variables are potential sources of selection bias. Time conditions are also essential to consider as they define changing circumstances over time that we cannot include as observable variables in our estimation. To deal with these estimation problems, we considered unobserved heterogeneity at the state and year levels while assuming they are fixed over time. Specifically, we included state and years fixed effects in the vector $F'_{s,t}$, as well as the interaction between them (year * state).

Accounting for these observable variables and unobserved heterogeneity at the state level, thus, could reduce the selection bias that contaminates our comparisons but not eliminate it. As seen in the Sustainable Livelihood Approach, the individual's livelihood strategies are affected by several variables, some of which are unobserved characteristics such as skills, ambition, and institutional processes. Our empirical strategy exploits an exogenous variation in both endogenous variables by employing the instrumental variables approach.

Let us call the variables in vector Z' instruments. These variables must satisfy two conditions in order to be valid instruments: i) exclusion, which ensures no correlation between Z' and ε_i, or $Cov\ (Z', \varepsilon_i) = 0$ and; ii) relevance, ensuring that Z' is sufficiently correlated with the endogenous variables. Considering this, we used extreme climatic events (in precipitation and temperature), Z_1 and Z_2 , to generate exogenous variation in the decision to migrate and adopt nonagricultural activities.

Several authors have employed extreme climatic events to explain variations in livelihood strategies. According to Gasson and Winter (1992), the choice of a livelihood strategy can be altered by climatic conditions. Schlenker, Hanemann, and Fisher (2005) and Lobell, Schlenker, and Costa-Roberts (2011) showed that climate variations, such as precipitation and temperature, can directly affect plantations and crops, leading to diversifying livelihood strategies. Marchiori, Maystadt, and Schumacher (2012) and Beine and Parsons

(2017), in turn, have found an impact of climatic factors on the migration process. On the other hand, Yang and Choi (2007) used rainfall variations to instrumentalize income variations. According to the authors, climate variations can affect individuals' livelihood strategies and income, which is similar to the relationship we are studying (YANG; CHOI, 2007).

In Brazil, according to Bastos, Busso, and Miller (2013), increased droughts affect employment and wages, inducing the migratory process. Branco and Feres (2018) have found that drought shocks affect the individual labor allocation in the Northeast region, making them more likely to have more than one job, especially in poor municipalities. Similarly, according to Piedra-Bonilla, Cunha, and Braga (2019) and Braga (2021), Brazilian households choose to diversify their livelihoods to reduce the climatic change-induced risks. Then, we assume that our instruments explain the choice of performing a nonagricultural job and the choice of migration which, in turn, affects the deprivation score. Therefore, allowing us to approximate the causal effect.

That said, we considered anomalies in temperature and precipitation as done by Marchiori, Maystadt, and Schumacher (2012), Beine and Parsons (2017), and Delazeri, Cunha, and Couto-Santos (2018). The measurement is done by the ratio of the difference between current and long-term averages and the long-term standard deviation of temperature and precipitation[26]:

$$anomalies_{w,s,t} = \frac{weather_{w,s,t} - \mu_{w,s}^{LT}(weather)}{\sigma_{w,s}^{LT}(weather)} \quad (2)$$

where $anomalies_{w,s,t}$ refers to the anomalies in temperature or precipitation *(w)* in state *s* at time *t;* $weather_{w,s,t}$ is the current level of temperature or precipitation *(w)* in state *s* at time *t*; and $\mu_{w,s}^{LT}(weather)$ and $\sigma_{w,s}^{LT}(weather)$ represent each weather variable's (temperature or precipitation) long-term average and standard deviation. The long-term average and standard deviation are done considering a 30 years period since climate change is a long-term phenomenon (DELAZERI; CUNHA; COUTO-SANTOS, 2018).

Therefore, the estimation was done using the two stages least squares method (2SLS). In the first stage, each of the endogenous variables (nonagricultural work, $N_{i,s,t}$, and migration, $M_{i,s,t}$) are estimated as dependent variables using the instruments (anomalies in temperature

[26] An individual suffered from the climate anomalies if they live in a location that experienced extreme climate events.

and precipitation), and the observed characteristics (control variables in vector $X_{i,s,t}{}'$ and fixed effects in vector $F_{i,s,t}{}'$) as explanatory variables. First-stage equations are defined as follows:

$$M_{i,s,t} = \alpha + \beta_1 AnomTemp_{s,t} + \beta_2 AnomPrecip_{s,t} + X'_{i,s,t}\beta_3 + F'_{s,t}\beta_4 + \varepsilon_i \quad (3)$$

$$N_{i,s,t} = \alpha + \beta_1 AnomTemp_{s,t} + \beta_2 AnomPrecip_{s,t} + X'_{i,s,t}\beta_3 + F'_{s,t}\beta_4 + \varepsilon_i \quad (4)$$

Subsequently, the equation of interest (equation 1) is estimated considering the estimated values of the migration ($\widehat{M}_{i,s,t}$) and nonfarm ($\widehat{N}_{i,s,t}$) variables from the first stage. The estimations were done separately for the entire population and men and women.

3.3.2. Data

The data used to estimate the relationship of interest combines two datasets. First, we have the Pesquisa Nacional por Amostra de Domicílios (PNAD) provided by the Instituto Brasileiro de Geografia e Estatística (IBGE), which was[27] an annual survey made of a probability sampling of households containing individual and household information. The PNAD's complex sampling character implies that the analysis must be done using the sampling weights to be considered representative of the population. Therefore, we used the sample's weights, strata, and primary sampling unit (PSU)[28] in the estimation.

The sample is restricted to individuals in the Brazilian rural areas, considering the classification by IBGE (rural agglomeration of urban extension, isolated villages, or rural nucleus). The analyzed period was between 2004 to 2015, representing the first year in which the PNAD sample included all Brazilian states' rural areas[29] and the last year with available data (excluding 2010 when the Demographic Census was done instead of this research). Hence, the data for each survey period were stacked to obtain variations in time and cross-section dimensions. Also, we restricted the sample to only adults, considering the minimum active age defined by IBGE, which is 15 years old. This age restriction is essential since including children could bias the deprivation score variable due to their incomplete education and lack of employment and income. Additionally, observations with null information about the multidimensional poverty dimensions were dropped.

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[27] The survey was replaced in 2016 by another survey, named PNAD Contínua, which characteristics did not allow for the use in this thesis.

[28] The variables for weights, strata, and PSU are v4729, v4617, and v4618, respectively.

[29] Before that, the north state's data were not included.

Furthermore, we used precipitation and temperature data from the Terrestrial Hydrology Research Group (THRG) for the climate anomalies variables (SHEFFIELD; GOTETI; WOOD, 2006), and the dataset was constructed by the National Center for Environmental Prediction/National Center for Atmospheric Research (NCEP-NCAR)[30]. The climate events are measured at the minimal comparable areas level. Hence, we aggregated it to match the state level of the PNAD data.

3.4. Results

This section presents the research results. Section 3.4.1 explores the sample, describing some statistics, section 3.4.2 presents the relationship between livelihood strategies and extreme climatic events, and section 3.4.3 presents the estimated results for the relationship between multidimensional poverty and livelihood strategies in rural Brazil.

3.4.1. Poverty and Gender in Rural Brazil: some statistics

Table 5 presents some statistics about the sample. As can be seen, most of the sample are men, black individuals, and live in the northeastern region. The deprivation score represents the population's average weighted proportion of deprivation considering the multidimensional poverty indicators addressed in this research[31]. Therefore, on average, the rural Brazilian population was deprived of 55.25% of the deprivation indicators between 2004 to 2015, meaning that among all the deprivation people could experience in the country's rural areas, they endure more than half of it. The most deprived individuals were women, black people, and those living in the North and Northeast regions, consistent with the literature (RODRIGUES, 2014; BRADY; BURTON, 2016; AGUILAR; SUMNER, 2020).

Regarding livelihood strategies, 5.87% of the sample migrated intercity, and 10.58% performed nonagricultural activities. For both strategies, men and black individuals are the majority of it. Moreover, most individuals who migrated and most individuals performing nonagricultural jobs are located in the northeast region, which could indicate the relationship between these strategies and poverty since the northeast is also the region with the most deprived individuals.

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[30] We thank Dr. Denis Cunha, Dra. Elena Piedra-Bonilla and Lais Rosa Oliveira for treating and making the data available.

[31] The indicators are presented in Table 17 of the appendix B and are: years of schooling, literacy, employment, income, electricity, sanitation, water, cooking fuel, garbage disposal, assets, and overcrowding.

Table 5: Descriptive statistics - rural Brazil, 2004 to 2015

	Sample	Deprivation Score	Migration	Nonagricultural Labor
			%	
Men	52.17	50.88	02.96	05.69
Women	47.83	60.03	02.91	04.89
Black	58.02	58.49	03.48	05.95
White	41.98	50.78	02.40	04.63
North	12.16	57.52	00.95	01.50
Northeast	39.81	61.99	01.67	03.55
South	18.32	47.27	01.24	01.95
Southeast	23.57	50.26	01.43	02.98
Midwest	06.13	50.05	00.58	00.60
Total	361.253	55.25	05.87	10.58

Source: Research Results

Figures 12 and 13 present the time evolution of the deprivation score, migration, and nonagricultural jobs between 2004 and 2015. As shown, the country's intercity migratory process has also declined while the proportion of people performing nonagricultural work increased. The movement of the two livelihood strategies presented in Figure 12 suggests they are alternatives to one another, meaning that people usually choose between them. Also, the deprivation score has been reducing over the years (Figure 13), implying a reduction of the multidimensionally deprived in Brazil's rural areas, a movement consistent with poverty reduction in the country.

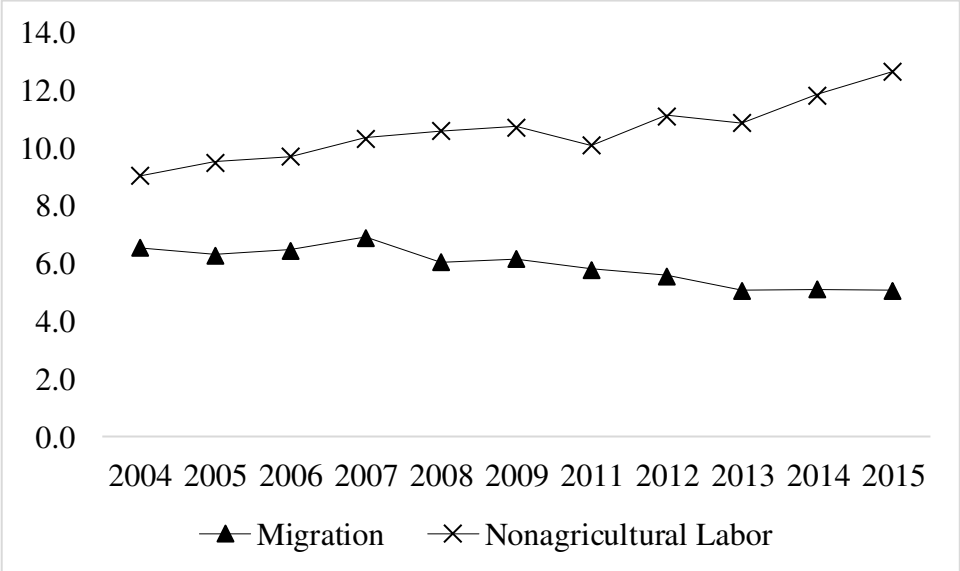


Figure 12: Migration, and nonfarm work time evolution - rural Brazil, 2004 to 2015

Source: Research Results

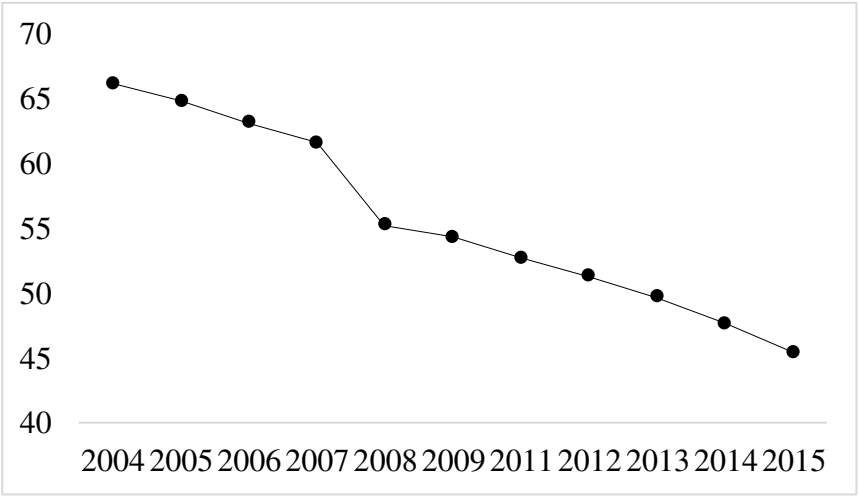
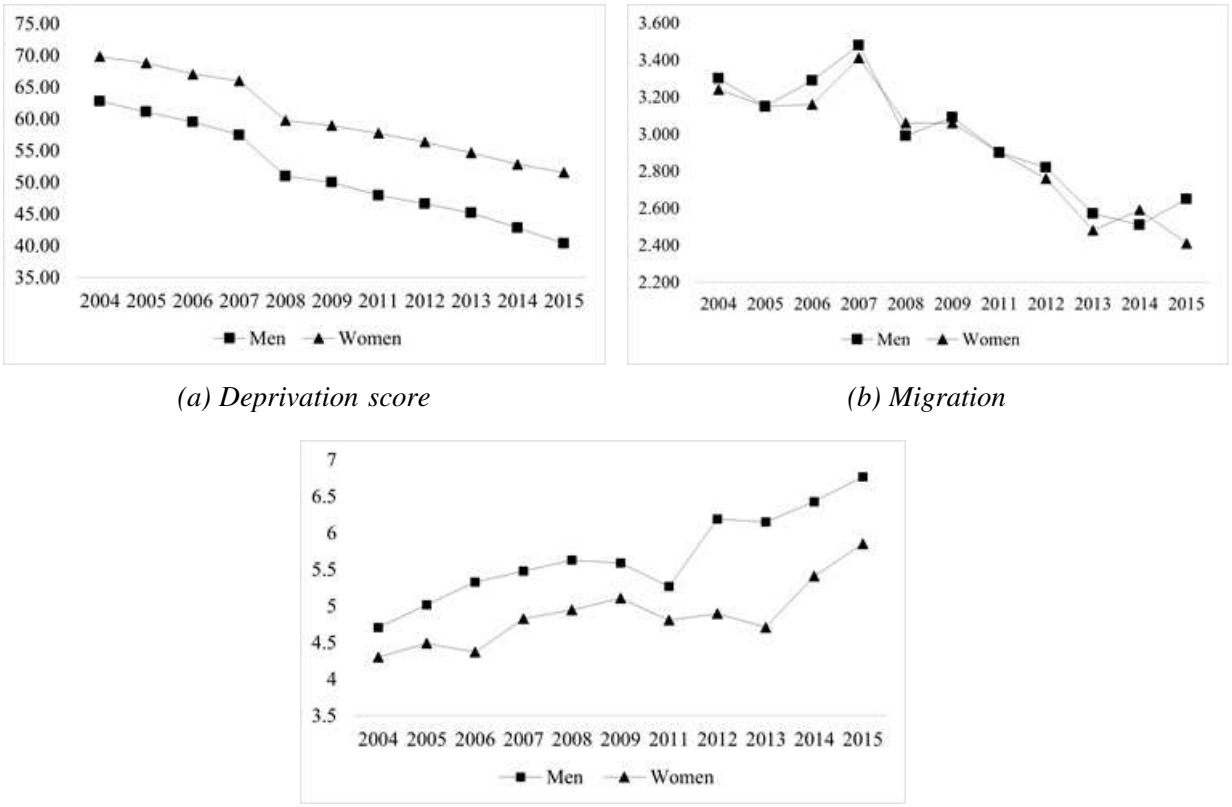


Figure 13: Deprivation score time evolution - rural Brazil, 2004 to 2015
Source: Research Results

When evaluating the gender differences in these variables (Figure 14), it can be seen that women have higher deprivation scores throughout the period, which is evidence of the feminization of poverty in the country. Additionally, it seems that women's poverty has been reducing slower than men's, suggesting that the gender gap in this variable will not end soon. It also indicates that evaluating poverty without accounting for gender can mask inequalities since inequality between men and women in Rural Brazil is increasing despite poverty reduction.

Moreover, the percentage of men and women migrating has been similar throughout the analyzed period. Also, this variable has no clear pattern regarding gender differences. In some years, women have migrated more than men, and the opposite has happened in other years. This lack of pattern regarding gender could indicate that people's gender is not a defining characteristic of the migratory process of rural Brazilian individuals. In its turn, men have systematically performed nonagricultural jobs more than women. This difference could be due to the uneven social, economic, and political conditions women experience in rural areas, which usually leads them to be more responsible for housework and caregiving activities, limiting their opportunities to take advantage of the labor market.



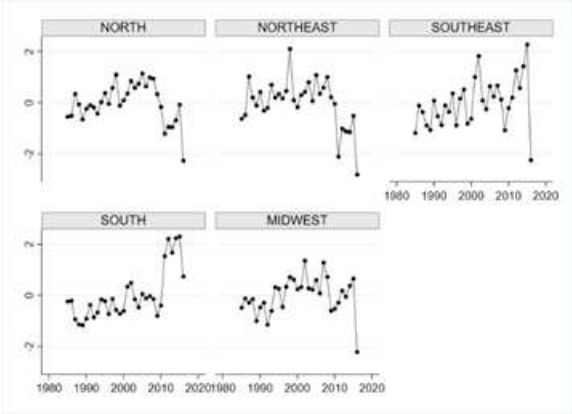
(a) Deprivation score *(b) Migration*

(c) Nonfarm

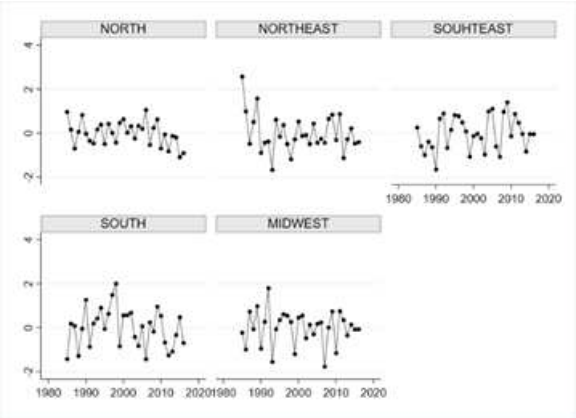
Figure 14: Deprivation score, migration, and nonfarm work time evolution - Men and women, 2004 to 2015
Source: Research Results

3.4.2. Relationship between livelihood strategies and the climate anomalies: a graphic analysis

Regarding the extreme climate events, Figure 15 presents the yearly averages of temperature and precipitation anomalies separated into the Brazilian regions. As can be seen, the North and Northeast regions present the highest occurrence of high-temperature anomalies, while the South and Southeast present the lowest ones. However, in recent years, this pattern seems to be inverting. On the other hand, the North and Northeast regions seem to have the slightest variation in precipitation anomalies compared to the other regions. Hence, it seems reasonable to assume that individuals from different regions can respond differently to weather anomalies. Thus, long-term state-level anomalies are justified since they can control regional and time effects.



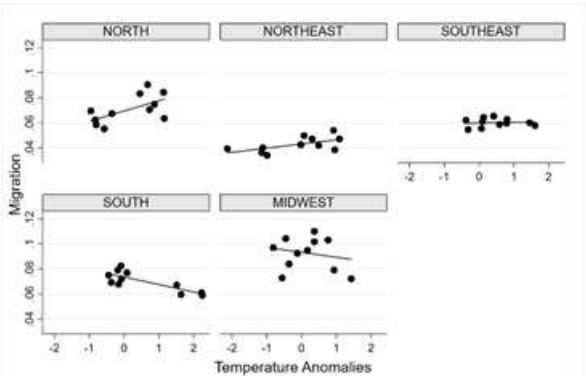
(a) Temperature Anomalies



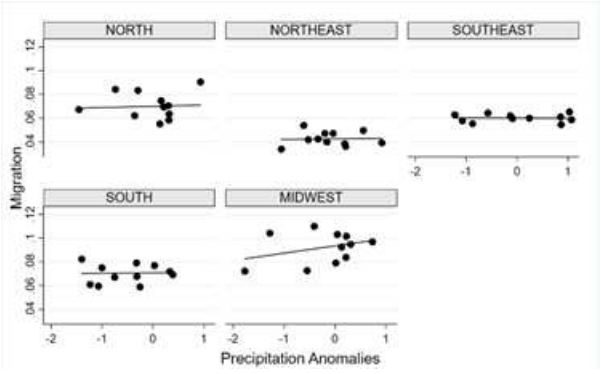
(b) Precipitation Anomalies

Figure 15: Yearly average anomalies in temperature and precipitation - Brazilian regions
Source: Research Results

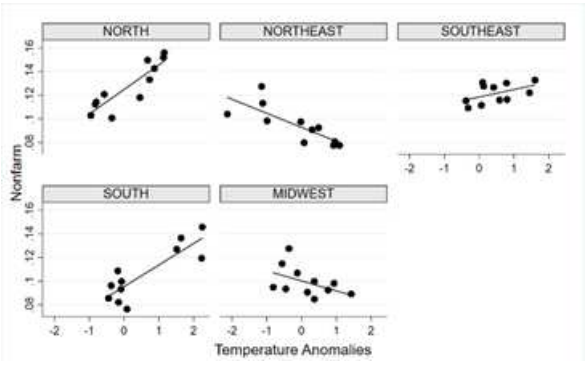
However, our interest in the climate anomalies lies in their relationship with the endogenous interest variables, migration, and nonfarm work performance, which can be seen in Figure 16. The figure shows that there is, in fact, a correlation between livelihood strategies and climate anomalies, which is evident even though the relationship between these variables is not the same for every Brazilian region. For example, higher temperature anomalies in the northern region correlate with more individuals choosing to migrate and perform nonagricultural activities, as we expected. For the Southern region, however, higher anomalies represent a lower percentage of people migrating and performing nonfarm jobs. However, it satisfies the condition needed for the instrument to be relevant, which specifies that it must be sufficiently correlated with the endogenous variables. Therefore, we can attest to the relevance of precipitation and temperature anomalies as exogenous variations for migration and nonfarm performance, allowing us to approximate the actual relationship between them and multidimensional poverty.



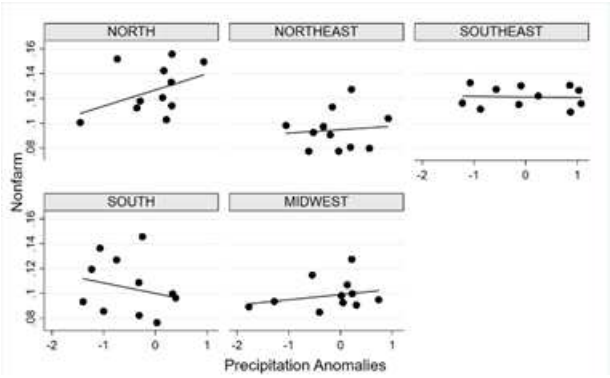
(a) Migration x Temperature Anomalies



(b) Migration x Precipitation Anomalies



(c) Nonfarm x Temperature Anomalies



(d) Nonfarm x Precipitation Anomalies

Figure 16: Correlation between the climate anomalies and the livelihood strategies by regions

Source: Research Results

3.4.3. Relationship between multidimensional poverty and livelihood strategies: estimation results

In this section, we present the impacts of migration and nonfarm work performance on the deprivation score for individuals living in rural Brazil from 2004 to 2015. Table 6 shows these results based on equation (1) estimated with OLS for the entire sample of rural residents, separately for women and men, with and without additional controls for each case. In sum, we have: *(a)* without controls for the entire sample; *(b)* with control variables for the entire sample; *(c)* without controls for women; *(d)* with control variables for women; *(e)* without controls for men, and *(f)* with control variables for men.

Table 6: OLS Effects of Livelihood Strategies on Deprivation Score for Rural Brazil

	Total sample		Women		Men	
	(a)	*(b)*	*(c)*	*(d)*	*(e)*	*(f)*
Migration	-0.0044	0.0086*	0.0046	0.0241***	-0.0068*	0.0009
	(0.0028)	(0.0050)	(0.0031)	(0.0066)	(0.0036)	(0.0066)

Non-farm	-0.1547***	-0.1252***	-0.1796***	-0.1345***	-0.1561***	-0.1233***
	(0.0030)	(0.0027)	(0.0036)	(0.0033)	(0.0036)	(0.0032)
Woman		0.0627***				
		(0.0015)				
Controls	No	Yes	No	Yes	No	Yes
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors in parentheses

**** p<0.01, ** p<0.05, * p<0.1*

Control Variables: Race/Ethnicity, Age, If the individual is the household head, If there are children under 5 in the household, If there are retired and/or pensionist in the household, If the individual is pluriactive, If they have a partner, Years of School, Size of the household.

Source: Research Results

These results are based on the estimation that does not consider the possible omitted variables bias arising from the fact that those who migrate or perform nonfarm work are different from those who do not.

Statistically significant results show that migrating to another municipality increases multidimensional poverty, suggesting that the livelihood strategy is failing to be a pathway out of poverty for the whole sample and women. Instead, it can increase poverty. The effect of migration on increasing poverty may be overestimated if those who migrate have less valued characteristics by the labor market (that make those who migrate poorer even in the absence of the movement). This is a possibility since these estimations do not consider the selection bias. The only estimation that shows a negative effect of migration on poverty is for men, significantly only at a 10% level, without including observable controls.

Results also show that performing nonagricultural activities decreases poverty, even when controlling for additional variables such as gender, race, age, years of schooling, and others. The negative effect of this variable on poverty remains for the whole sample and men and women separately. Regarding gender differences, columns *d* and *f* show that performing nonfarm activities reduces the average deprivation score for men and women in rural Brazil, but the effect is higher for women. However, these results must be cautiously interpreted since they do not account for the endogeneity that might bias our estimates. The effect assigned to nonfarm work could be due to the unobservable variables that jointly determine the option for this kind of work and the deprivation score. Additionally, the gender variable included in the estimation with the whole sample shows that being a woman in rural Brazil increases the deprivation score, indicating higher poverty for women.

Our identification strategy to deal with the endogeneity is based on using climate anomalies as instrumental variables for migration and non-agricultural work. Table 7 shows our first-stage regressions. In this stage, we use the climate anomalies as explanatory variables for both endogenous variables - migration and non-agro activities. The first stage migration results show that our instruments work better for the whole sample than for women's and men's samples. Precipitation anomalies might not explain much of the migration for women. This variable also does not seem to be a powerful explanation for the decision of non-farm performance. Nonetheless, the F-tests show that our instruments do not fail the relevance assumption.

Table 7: 2SLS' first stage estimates - Effects of Climate Anomalies on Livelihood Strategies for Rural Brazil

	Total Sample	Women	Men
	(a)	*(b)*	*(c)*
Migration:			
Precipitation Anomalies	0.0006**	0.0006	0.0007*
	(0.0002)	(0.0004)	(0.0004)
Temperature Anomalies	0.0006**	0.0013***	0.0002
	(0.0002)	(0.0004)	(0.0003)
F-test	1430.20	1182.99	967.32
Prob. F	0.0000	0.0000	0.0000
R^2	0.8518	0.8610	0.8481
Non-farm:			
Precipitation Anomalies	0.0018	0.0026	0.0014
	(0.0017)	(0.0024)	(0.0017)
Temperature Anomalies	0.0052**	0.0073**	0.0042**
	(0.0021)	(0.0027)	(0.0021)
F-test	83.69	85.28	50.01
Prob. F	0.0000	0.0000	0.0000
R^2	0.1238	0.1835	0.0849
Controls	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes

Notes: Standard errors in parentheses

**** p<0.01, ** p<0.05, * p<0.1*

Instrumental Variables: States' average temperature and precipitation anomalies
Control Variables: Race/Ethnicity, Age, If the individual is the household head, If there are children under 5 in the household, If there are retired and/or pensionist in the household, If the individual is pluriactive, If they have a partner, Years of School, Size of the household

Source: Research Results

In the second stage, the estimated values of migration and nonfarm are used as explanatory variables for the multidimensional poverty model. The change in the coefficients of our interest variables from Table 6 to Table 8 provides evidence of the bias in the previous estimation. Once again, gender proved to be relevant to understanding people's deprivation. As can be seen, women are 17.87 percentage points more multidimensionally deprived than men in rural Brazil, which is consistent with the feminization of poverty literature (NUSSBAUM, 2001; BATISTA; COSTA, 2019; BATISTA; COSTA, 2022).

Table 8: 2SLS Effects of Livelihood Strategies on Deprivation Score for Rural Brazil

	Total Sample	Women	Men
	(a)	*(b)*	*(c)*
Migration	3.3463	4.7911	2.9346
	(8.9825)	(33.2952)	(7.9294)
Non-farm	-2.2080	-1.7741	-2.8013*
	(1.4179)	(5.9794)	(1.4859)
Woman	0.1787***		
	(0.0616)		
Controls	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes

Notes: Standard errors in parentheses

**** p<0.01, ** p<0.05, * p<0.1*

Instrumental Variables: States' average temperature and precipitation anomalies

Control Variables: Race/Ethnicity, Age, If the individual is the household head, If there are children under 5 in the household, If there are retired and/or pensionist in the household, If the individual is pluriactive, If they have a partner, Years of School, Size of the household

Source: Research Results

The results suggest that performing a nonagricultural job reduces the average deprivation score in rural Brazil. However, the strategy was only statistically relevant for men (just as the OLS estimation showed). Hence, nonagricultural activities can only be viewed as deprivation reducers for men living in rural Brazil. The null results of the nonagricultural job for women can be related to their difficulties in entering the labor market, especially in rural areas. These results confirm the need to account for gender differences in the deprivation's response to livelihood strategies since our estimates presented in column *a* (considering both men and women together) showed a statistically insignificant effect of nonagricultural jobs on multidimensional poverty. Therefore, the gender-neutral estimative would fail to reveal this strategy's positive effect on reducing men's poverty. Thus, men who chose to perform nonagricultural jobs have lower deprivation scores than those who did not.

Migration, in turn, presented a positive but not statistically significant relationship with the deprivation score. Thus, this result, also found in Table 6, remains even considering the selection bias through our instrumental variables approach. A possible explanation for the lack of significant impact may be that our sample is restricted to rural areas. Hence, the population movement captured by the migration variables does not include the individuals who moved to urban centers. Moreover, the migratory process for rural individuals is more marked by the rural-to-urban movement to pursue better opportunities in the labor market. To test this hypothesis, we estimated the same equation as before using a sample of rural and urban environments. The results presented in Table 9 suggest that migration is, in fact, statistically insignificant in explaining the changes in the deprivation score in Brazil, even when accounting for rural-to-urban movements. Also, the estimation suggests that women, in general, are 15.42 percentage points more multidimensionally deprived than men in Brazil.

Table 9: 2SLS Effects of migration on Deprivation Score for Brazil (rural and urban)

	Total Sample	Women	Men
	(a)	*(b)*	*(c)*
Migration	4.3444	16.4735	2.8733
	(17.4003)	(0.0000)	(11.0039)
Woman	0.1542**		
	(0.0609)		
Controls	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes

Notes: Standard errors in parentheses
**** p<0.01, ** p<0.05, * p<0.1*
Instrumental Variables: States' average temperature and precipitation anomalies
Control Variables: Race/Ethnicity, Age, If the individual is the household head, If there are children under 5 in the household, If there are retired and/or pensionist in the household, If the individual is pluriactive, If they have a partner, Years of School, Size of the household

Source: Research Results

As a robustness check, we tested the hypothesis that the effects of the livelihood strategies could differ if we used another measure of multidimensional poverty as the dependent variable. Hence, two binary variables were created; i) poverty: where we considered poor people the ones with a deprivation score equal to or higher than 0.33, meaning that poor people are the ones experiencing deprivation in more than 33% of the indicators; and ii) extreme poverty: people who are experiencing deprivations in more than 50% of the indicator. Both variables take the value 1 for poverty and extreme poverty and a value 0 otherwise. In this case, the higher the cutoff point used in the index, the fewer people experiencing multidimensional poverty and the more deprivations they suffer. Table 10 presents the results for this estimation,

where columns *(a), (b),* and *(c)* present poverty as the dependent variable, while columns *(d), (e),* and *(f)* present extreme poverty. As seen in the Table, there was no change in the direction of the effect (they remained with the same signal) nor in the statistical significance of the livelihood strategies' coefficients, compared to Table 8. Hence, as seen before, women are 47.27 percentage points more likely to be multidimensionally poor and 47.84 more likely to be multidimensionally extremely poor than men in rural Brazil.

Additionally, the relevance of performing nonagricultural jobs remains only for men. Thus, men working outside the farm are less likely to be multidimensionally poor or extremely poor. Finally, our results showed that we do not have enough evidence to support that there is a relationship between migration and multidimensional poverty in the country.

Table 10: 2SLS Effects of Livelihood Strategies on Poverty and Extreme Poverty for Rural Brazil

	Total Sample	Women	Men	Total Sample	Women	Men
	k = 33% (poverty)			*k = 50% (extreme poverty)*		
	(a)	*(b)*	*(c)*	*(d)*	*(e)*	*(f)*
Migration	12.2456	12.9275	11.8231	9.0490	38.6555	4.7150
	(29.4788)	(95.0146)	(26.1274)	(26.4947)	(230.4936)	(18.3654)
Non-farm	-7.0113	-4.9308	-9.0662*	-6.4682	-11.0095	-6.5438*
	(4.6495)	(17.0763)	(4.8923)	(4.2087)	(41.4283)	(3.4620)
Woman	0.4727**			0.4784***		
	(0.2022)			(0.1837)		
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

*Notes: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

Instrumental Variables: States' average temperature and precipitation anomalies
Control Variables: Race/Etnicity, Age, If the individual is the household head, If there are children under 5 in the household, If there are retired e/or pensionist in the household, If the individual is pluriactive, If they have a partner, Years of School, Size of the household

Source: Research Results

There are some explanations for the null results discussed above: i) migration is indeed not related to multidimensional poverty; ii) our empirical strategy fails to disclose the possible causal effect of migration; iii) our migration variable is not capturing the more relevant rural to urban movement. We believe that if migration were to have any effect on poverty, then it would be shown by our OLS estimates since it is more plausible that they might overestimate the migration importance than otherwise. We found a small impact for the total sample and no

impact for men, even when our estimates might have been overestimated due to omitted variable bias, which could indicate that migration indeed does not affect poverty. However, the OLS estimation for women, including all control variables, showed a significant relationship between these variables. Thus, another possibility is that our empirical strategy based on instrumental variables may suffer from a lack of power, which can be suggested by the instruments' small coefficients in the first-stage equations. A weak instrument could fail to correct the endogeneity of the interest variables. Also, it is still possible that our migration variable is not capturing the main movement that might change peoples' poverty status: from rural to urban areas.

However, the statistically insignificant relationship between migration and multidimensional poverty can indicate that moving somewhere else does not improve nor deteriorate people's vulnerability status. It could mean that there is only a change of location, suggesting that people experiencing poverty will continue to experience poverty if they migrate. In fact, according to Todaro and Smith (2012), in scenarios with a high unemployment rate, there is no guarantee that migration will improve income and successfully change people's deprivation levels. Then, since Brazil is a developing country with a history of a high unemployment rate, our results might suggest that migration is not a suitable choice to overcome multidimensional poverty for rural Brazilian men and women.

Lastly, men living in rural Brazil seem to be the only ones who can effectively use nonagricultural jobs to reduce their deprivation status. This result suggests how unequal the rural environment in Brazil is since performing nonfarm-related activities in the labor market can reduce men's poverty status while not changing women's—reinforcing gender inequalities. However, as explained before, the null effects for women and the sample with both genders can mean that our identification strategy could fail to provide the causal effect between performing nonfarm jobs and multidimensional poverty.

Nevertheless, despite the possible limitations presented by the estimates, we can say that the pathways out of poverty do not act the same for men and women, reinforcing the need to account for gender when analyzing it. Also, every estimation shows how women are overrepresented among people experiencing multidimensional poverty in the country.

3.5. Conclusion

This research aimed to evaluate if performing nonagricultural activities and migrating can be relevant pathways out of multidimensional poverty for men and women in rural Brazil

between 2004 and 2015. We used the deprivation score constructed using the Multidimensional Poverty Index as the multidimensional poverty variable. The estimation was done considering that the relationship between the livelihood strategies (migration and non-agro activities) and the deprivation score is endogenous since the same unobserved characteristics can affect all of them. Hence, the solution to the problem was to use extreme climate events in temperature and precipitation to instrumentalize the livelihood strategies variables.

We have seen that multidimensional poverty has decreased in rural Brazil. However, the inequality between men and women has been increasing, with more multidimensionally poor women than men. Additionally, the estimation results show that women are significantly multidimensionally poorer than men in Brazil (which is valid for rural and urban areas), even when accounting for other observed characteristics. Also, women continue to be the majority of people experiencing multidimensional poverty, even with a change in the poverty measure. These results highlight that poverty eradication policies in Brazil should account for gender inequalities since it has been increasing even in poverty reduction.

We have also seen that migration has been reducing throughout the period analyzed and has no clear pattern regarding gender differences. Also, migration was irrelevant in explaining the changes in deprivation, suggesting that migration can not successfully lift people out of poverty. The results also showed that the percentage of people performing nonagricultural activities has been increasing, and systematically more men are performing them than women. Also, we have seen that performing nonagricultural activities can act as pathways out of multidimensional poverty in rural Brazil, reducing deprivation, but only for men. These results show the unequal scenario in the labor market in rural Brazil. Women are not only under-allocated in it but working outside the farm does not seem relevant to change their vulnerability status. These highlight the pervasive uneven scenario rural women face. The patriarchal inheritance in rural areas leaves them not prioritized when receiving inheritances, having few employment opportunities, and being the only ones responsible for the housework and childcare. Hence, Brazil's public policies for rural areas should focus on giving women more means to enter and grow in the labor market.

These results show the relevance of accounting for gender when evaluating poverty and its possible pathways out. In fact, it confirms the hypothesis that the analyzed strategies to alleviate poverty do not act the same for men and women. However, the analysis presents some limitations. First, the available data could distort migration's effectiveness as a pathway out of multidimensional poverty since we could not distinguish rural-to-urban migration from other

migratory movements. Also, the identification strategy may not have been enough to deal with the endogeneity in the relationships of interest.

However, despite limitations, the evidence presented here draws attention to some points regarding rural multidimensional poverty in Brazil. Despite being the majority of people experiencing poverty, the means to reduce deprivation are not as available for women as they are for men. Hence, disregarding gender disparities in poverty alleviation policies could increase inequalities. Also, policies considering work diversification should be on Brazil's rural development and poverty-eradication agenda since performing nonagricultural labor is relevant in reducing men's deprivations. Focusing on women's access to the labor market could make these jobs suitable to alleviate their poverty as well as it does for men. Furthermore, even though migration is irrelevant in reducing deprivations, the phenomenon must be analyzed cautiously. In the country, policies should focus on assisting individuals who moved from rural to urban areas since most do so to pursue better living conditions and opportunities.

Finally, migration and nonagricultural activities can also differently impact people with distinct levels of deprivation. Hence, an analysis accounting for the poverty distribution instead of the average could provide more information about the possible pathways out of multidimensional poverty. Thus, representing a limitation in our analysis and a suggestion for future research.

4. CONCLUDING REMARKS

Poverty has been reduced worldwide but remains a challenge, especially in Brazil. In fact, in recent years, poverty started to rise again in the country. So, there is no doubt that we should work towards eradicating it. However, to do so, we must understand and analyze the phenomenon more thoroughly to pursue the best way to alleviate it.

In that sense, a recognition gaining relevance in the literature is that poverty is a multidimensional phenomenon with several critical dimensions of deprivation other than income absence. Also, various individuals' characteristics can affect their vulnerability to poverty. One of them, and our main focus in this thesis, is gender. Women have been systematically poorer than men in the country. Besides, even when poverty has been reduced, the gender inequality in it has been rising.

Whit that in mind, this thesis aimed to evaluate the relationship between gender and multidimensional poverty in Brazil. In the first essay, we assessed the multidimensional poverty in the country, accounting for gender, race, and geographical location. Additionally, the second chapter evaluated two possible pathways out of multidimensional poverty for men and women in rural Brazil. Both analyses were done considering the period between 2004 and 2015.

Specifically, in this thesis's first essay, we constructed a Multidimensional Poverty Index (MPI) to evaluate multidimensional poverty in Brazil, considering its gender nature. We calculated the MPI for women and men, accounting for their race and geographic locations, considering the Brazilian states and rural and urban areas. We also evaluated the dimensions and indicators women are more deprived of, their differences from men's, and the temporal evolution of the index. The main results found in this chapter indicated that women have, in fact, higher deprivation than men. They are the majority of people experiencing poverty and suffer a more intense form of poverty than them. Black women and the ones living in rural areas are in a situation even worse. We also found that employment and income are the dimensions that drive multidimensional poverty in Brazil and that women in Brazil have difficulty transforming education into income. Additionally, results showed that women's poverty has been reducing slower than men's.

Given that women in rural areas are the ones experiencing the worst deprivation in the country and that these areas present several other challenges for women, such as an absence of decision-power and opportunities, in the second essay, we aimed to evaluate two possible strategies to help people overcome rural poverty. Hence, we sought to estimate if migration and performing nonagricultural jobs work as pathways out of multidimensional poverty in rural

Brazil and if it affects women and men differently. The identification strategy employed was using climate anomalies events (in precipitation and temperature) to act as exogenous variations in migration and non-farm work. The main results show that women are multidimensionally poorer than men in rural Brazil and that the livelihood strategies work differently for them. Also, we could see that performing nonagricultural activities can reduce men's multidimensional poverty in rural Brazil and that migration is irrelevant in explaining the deprivation changes for both men and women.

Thanks to the analysis done here, we can say that this thesis went beyond a simple assessment of poverty. The evaluation made here helped us understand the process in which it occurs in Brazil, accessing its multidimensionality and particularities, its differences by gender, and the relative importance of the commonly mentioned pathways out for rural areas. According to our results, poverty alleviation policies in the country should be done considering that several aspects affect people's ability to live a quality life. Not accounting for different societal experiences, such as gender-driven ones, could lead to higher inequalities even when reducing poverty. Hence, we shed light on the importance of recognizing the feminization of poverty, women's difficulty in transforming education into income, and the lack of opportunities they face in the labor market, especially in rural areas. Finally, we believe that we helped to promote means to design more accurate public policies since gender-neutral ones cannot have the desired effect when pursuing poverty alleviation.

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Appendix A

Table 11: The headcount ratio, the intensity of poverty, and the multidimensional poverty index - Brazil, gender, and race, 2015

	Headcount Ratio (H)	Intensity of Poverty (A)	Multidimensional Poverty Index (MPI)
$k = 33\%$		%	
Brazil	44.20	56.33	24.90
Men	34.20	55.26	18.90
Women	54.10	56.93	30.80
White	38.80	54.64	21.20
Black	48.70	57.49	28.00
White women	48.30	55.49	26.80
Black women	59.20	57.94	34.30
White men	28.70	53.31	15.30
Black men	38.60	56.74	21.90

Source: Research results

Table 12: Contribution of each dimension to the multidimensional poverty index, by race - Brazil, men, and women, 2015

Dimension	Weight	Contribution to the MPI					
		Black			White		
		Brazil	Men	Women	Brazil	Men	Women
		%					
Education	0.25	17.30	20.30	15.40	14.90	17.60	13.50
Employment	0.25	43.00	43.30	42.90	45.50	46.40	45.00
Income	0.25	32.90	28.90	35.60	35.10	30.70	37.50
Living Standards	0.25	06.70	07.50	06.10	04.50	05.20	04.10

Source: Research results

Table 13: The headcount ratio, the intensity of poverty, and the multidimensional poverty index, by state - Total, men, and women, 2015

	Headcount Ratio (H)			Intensity of Poverty (A)			Multidimensional Poverty Index (MPI)		
	Total	Women	Men	Total	Women	Men	Total	Women	Men
k = 33%					%				
Brazil	44.20	54.10	34.20	56.33	56.93	55.26	24.90	30.80	18.90
North:									
Rondônia	45.60	59.20	32.90	58.55	59.80	56.23	26.70	35.40	18.50
Acre	52.20	63.10	41.60	59.20	59.59	58.65	30.90	37.60	24.40
Amazonas	52.90	63.20	42.90	58.03	58.39	57.11	30.70	36.90	24.50
Roraima	42.70	51.20	34.80	58.31	58.59	57.76	24.90	30.00	20.10
Pará	55.50	66.80	44.80	59.64	61.08	57.81	33.10	40.80	25.90
Amapá	49.10	60.10	38.40	58.04	58.40	57.55	28.50	35.10	22.10
Tocantins	46.60	57.40	37.10	57.94	59.06	56.06	27.00	33.90	20.80
Northeast:									
Maranhão	59.80	66.60	53.00	60.54	60.51	60.57	36.20	40.30	32.10
Piauí	55.70	63.00	48.40	59.78	60.48	58.68	33.30	38.10	28.40
Ceará	59.00	64.60	53.50	59.15	58.98	59.07	34.90	38.10	31.60
Rio Grande do Norte	53.70	61.60	45.60	59.59	60.39	58.55	32.00	37.20	26.70
Paraíba	57.10	65.70	48.40	57.97	58.60	57.23	33.10	38.50	27.70
Pernambuco	57.60	66.40	48.50	57.99	58.58	57.32	33.40	38.90	27.80
Alagoas	61.70	70.90	52.30	60.45	60.79	60.04	37.30	43.10	31.40
Sergipe	56.40	64.10	48.50	58.69	59.28	57.94	33.10	38.00	28.10
Bahia	55.40	63.00	47.60	58.12	58.57	57.35	32.20	36.90	27.30

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	Headcount Ratio (H)			Intensity of Poverty (A)			Multidimensional Poverty Index (MPI)		
	Total	Women	Men	Total	Women	Men	Total	Women	Men
k = 33%					%				
Southeast:									
Minas Gerais	41.90	52.70	31.30	55.13	56.36	53.67	23.10	29.70	16.80
Espírito Santo	42.90	55.70	29.90	54.78	56.19	52.17	23.50	31.30	15.60
Rio de Janeiro	40.10	50.90	28.50	53.62	54.62	52.28	21.50	27.80	14.90
São Paulo	37.00	47.30	26.30	53.51	54.12	52.09	19.80	25.60	13.70
South:									
Paraná	36.60	47.90	25.40	54.92	56.37	52.76	20.10	27.00	13.40
Santa Catarina	31.80	42.80	21.50	54.72	55.84	52.56	17.40	23.90	11.30
Rio Grande do Sul	35.40	44.30	26.60	55.08	55.98	53.76	19.50	24.80	14.30
Midwest:									
Mato Grosso do Sul	37.80	51.00	24.70	55.82	57.06	53.04	21.10	29.10	13.10
Mato Grosso	38.40	51.70	25.90	56.77	58.03	54.44	21.80	30.00	14.10
Goiás	38.30	50.70	26.00	55.09	55.82	53.85	21.10	28.30	14.00
Distrito Federal	34.50	42.10	26.10	53.62	53.92	53.26	18.50	22.70	13.90

Source: Research results

Table 14: Contribution of each dimension to the multidimensional poverty index, by state - total, men, and women, 2015

	Education			Employment			Income			Living Standards		
	%											
	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women
North:												
Rondônia	16.50	19.90	14.50	42.40	43.70	41.70	32.30	27.00	35.40	08.80	09.40	08.40
Acre	15.20	18.20	13.10	41.70	41.50	41.80	33.70	29.60	36.50	09.50	10.70	08.60
Amazonas	13.70	16.00	12.10	42.80	43.10	42.60	34.40	30.70	36.90	09.20	10.20	08.40
Roraima	14.80	17.80	12.60	42.20	42.00	42.40	33.90	30.30	36.50	09.00	09.80	08.50
Pará	16.30	19.90	13.90	41.30	42.20	40.70	31.40	25.80	35.20	11.00	12.20	10.20
Amapá	13.40	16.10	11.60	42.80	42.80	42.80	33.40	30.20	35.50	10.50	10.90	10.20
Tocantins	16.40	20.90	13.40	42.60	43.40	42.10	32.70	26.80	36.90	08.20	09.00	07.70
Northeast:												
Maranhão	17.20	20.70	14.30	40.30	39.90	40.60	31.30	27.20	34.60	11.30	12.20	10.60
Piauí	18.70	21.70	16.50	40.80	41.00	40.60	30.50	26.70	33.30	10.00	10.70	09.50
Ceará	18.50	21.80	15.70	41.70	41.20	42.00	31.30	27.60	34.40	08.60	09.40	07.90
Rio Grande do Norte	18.00	21.60	15.50	41.60	42.00	41.40	32.80	28.00	36.10	07.50	08.30	07.00
Paraíba	19.20	22.40	16.80	42.40	42.70	42.20	32.00	27.60	35.10	06.40	07.20	05.80
Pernambuco	18.20	21.40	15.90	42.50	42.50	42.40	32.50	28.50	35.30	06.80	07.50	06.30
Alagoas	19.70	22.60	17.60	40.90	40.90	40.90	31.60	28.10	34.10	07.80	08.40	07.40
Sergipe	18.50	21.90	16.10	42.00	42.20	41.80	32.30	28.10	35.40	07.10	07.80	06.70
Bahia	18.30	21.90	15.80	42.40	42.30	42.40	32.00	27.30	35.30	07.30	08.50	06.50

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(continuation)

	Education			Employment			Income			Living Standards		
	%											
	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women
Southeast:												
Minas Gerais	17.00	19.50	15.60	44.70	45.70	44.10	33.90	29.60	36.40	04.40	05.10	03.90
Espírito Santo	16.60	19.60	15.10	45.50	47.40	44.50	34.20	29.00	36.80	03.70	04.00	03.60
Rio de Janeiro	14.60	16.50	13.70	46.50	47.90	45.80	36.00	32.80	37.60	02.90	02.90	02.90
São Paulo	14.00	15.50	13.30	46.80	48.00	46.20	37.20	34.50	38.70	01.90	02.00	01.90
South:												
Paraná	15.80	18.40	14.50	45.30	47.10	44.40	34.70	29.70	37.20	04.20	04.80	03.90
Santa Catarina	15.50	17.80	14.30	45.40	47.00	44.60	33.30	28.80	35.60	05.80	06.40	05.50
Rio Grande do Sul	16.70	18.60	15.60	45.00	45.80	44.50	32.20	28.80	34.20	06.10	06.80	05.70
Midwest:												
Mato Grosso do Sul	16.80	20.10	15.30	44.50	46.20	43.70	32.50	27.30	34.80	06.20	06.40	06.10
Mato Grosso	15.40	19.90	13.10	43.60	44.90	42.90	33.10	26.80	36.30	07.90	08.40	07.60
Goiás	15.40	18.70	13.80	45.20	46.00	44.80	34.20	29.90	36.40	05.20	05.40	05.00
Distrito Federal	12.20	13.70	11.30	46.50	46.70	46.30	39.30	37.70	40.20	02.10	01.90	02.20

Source: Research results

Table 15: The headcount ratio, the intensity of poverty, and the multidimensional poverty index - Brazil, gender, and rural/urban location, 2015

	Headcount Ratio (H)	Intensity of Poverty (A)	Multidimensional Poverty Index (MPI)
$k = 33\%$		%	
Brazil	44.20	56.33	24.90
Men	34.20	55.26	18.90
Women	54.10	56.93	30.80
Rural	62.90	62.16	39.10
Urban	41.20	54.85	22.60
Rural women	74.20	63.88	47.40
Urban women	51.30	55.56	28.50
Rural men	53.50	60.37	32.30
Urban men	30.80	53.90	16.60

Source: Research results

Table 16: Contribution of each dimension to the multidimensional poverty index, by rural/urban location - Brazil, men, and women, 2015

Dimension	Weight	Contribution to the MPI					
		Rural			Urban		
		Brazil	Men	Women	Brazil	Men	Women
		%					
Education	0.25	19.50	23.00	16.70	15.50	18.00	14.10
Employment	0.25	38.50	38.80	38.20	45.50	46.40	45.00
Income	0.25	28.20	23.40	32.20	35.30	31.70	37.30
Living Standards	0.25	13.80	14.90	12.90	03.70	03.90	03.50

Source: Research results

Appendix B

Table 17: Dimensions and indicators of the MPI

Dimension	Indicator	Deprived if (cutoff)	Weights	Descriptions	Reference
Education	Years of schooling	Has under nine years of schooling	1/8	This indicator captures school dropouts.	Costa, Machado, and Amaral (2018)
	Literacy	Cannot read or write	1/8	Literacy captures if the person has minimal education.	Costa, Machado, and Amaral (2018)
Employment	Employment	Have at least one of the following: 1. Activity status as unemployed 2. Wage below minimum[32] 3. Time-poor (works over 10 hours a day, counting paid and unpaid work)[33]	1/4	The first one captures individuals who want to work but currently are not. The second one captures the precariousness of work. At the same time, the third one comes from the importance of leisure time.	Rippin (2016)
Income	Income[34]	Has an income below the national poverty line[35]	1/4	Measures the ability to get along financially.	Rippin (2016)

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[32] One may think that this indicator is correlated to the income one. However, according to Rippin (2016), the income dimension measures how well a person is able to get along financially, whereas the minimum wage captures the precarious situation of those whose work is not appropriately remunerated.

[33] This dimension is essential when considering the gender-sensitive approach since women tend to be more responsible for housework and caregiving than men (BUVINIĆ; GUPTA, 1997).

[34] All income variables were brought to 2015 to remove the inflation influence.

[35] For the poverty line, we considered the one proposed by Hoffmann (2000), which considers as poor the individual with a monthly income below half a minimum wage.

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Dimension	Indicator	Deprived if (cutoff)	Weights	Descriptions	Reference
Living Standard	Electricity	Lives in a household with no electricity	1/28	These indicators, together, capture adequate shelter conditions.	(FAHEL; TELES; CAMINHAS, 2016)
	Sanitation	Lives in a household where a toilet is not connected to the sewage collection network or is shared with other households	1/28		Fahel, Teles, and Caminhas (2016)
	Water	Lives in a household that does not have water in at least one room or has water that does not come from a cistern or spring	1/28		Fahel, Teles, and Caminhas (2016)
	Garbage disposal	Lives in a household that does not have an appropriate garbage disposal	1/28		Fahel, Teles, and Caminhas (2016)
	Cooking fuel	Lives in a household that cooks with dung, wood, or carbon	1/28		Fahel, Teles, and Caminhas (2016)
	Assets	Lives in a household with three or fewer assets: radio, television, telephone, fridge, stove, and computer.	1/28		Fahel, Teles, and Caminhas (2016)
	Overcrowding	Lives in a household with three or more people per bedroom	1/28		Costa, Machado, and Amaral (2018)

Source: Constructed by the author, based on the literature.