CÍCERO AUGUSTO SILVEIRA BRAGA

ESSAYS ON WORK DIVERSIFICATION AND INEQUALITIES IN RURAL 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.

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Thesis submitted in partial fulfillment of the requirements for the Degree of *Doctor Scientiae* in the Graduate Program in Applied Economics at the Federal University of Viçosa, Brazil.

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“Esta terra que cresce mato, que cresce caatinga, o buriti, o dendê, não é nada sem trabalho. Não vale nada. (...) a terra só tem valor se tem trabalho. Sem ele, a terra é nada”.

(Itamar Vieira Júnior em Torto Arado)

ABSTRACT

BRAGA, Cícero Augusto Silveira, D.Sc., Universidade Federal de Viçosa, August 2021. **Essays on Work Diversification and Inequalities in Rural Brazil.** Adviser: Lorena Vieira Costa. Co-adviser: Mateus de Carvalho Reis Neves.

This work dedicates to study diversification of agricultural work and its effects on inequalities in rural Brazilian households. Specifically, it studies non-agricultural work, that is, those occupations that are not categorized within the spectrum of agricultural activities; it also studies the relationships of working outside the farm, or off-farm, characterized by activities that are not carried out in agricultural establishments. In the first chapter, specifically, the objective is to analyze how non-agricultural jobs and income affect income concentration in Brazil. For this, we use data from the National Household Sample Survey (PNAD) for rural households in 2019. The analysis of income concentration is obtained from an unconditional quantile analysis, which allows observing, from different functional forms, the effects of non-agricultural work under different household income quantiles. Complementarily, we estimate the effects on the Gini Index and constructed the Lorenz Curve in order to observe the distribution of agricultural and non-agricultural income. Finally, we estimate an ordered probabilistic model to analyze the effects of non-agricultural work on social classes based on an adaptation of the Brazilian Economic Classification Criteria (CCEB). The results show that, in fact, work and non-agricultural income are associated with an increase in per capita household income, especially for the poorest. Therefore, an effect of reducing inequalities from this practice of diversification is confirmed. Not only, the results call attention to carefully observing the particularities that lead individuals to participate in non-agricultural activities. Later, in the second chapter, we analyze the effects of off-farm work on time use in rural households in Brazil from a gendered perspective. Following the assumptions of Feminist Economics, the work uses PNAD data between 2002 and 2015 to control local and temporal effects. In addition, to establish causal effects, it uses climatic anomalies in temperature and precipitation through an instrumental variables approach. The estimates consider households formed by heterosexual couples and the effects are observed from the difference in hours allocated between wives and husbands for domestic activities, the ratio between them and also the Blair Dissimilarity Index. The results show that off-farm work is responsible for smoothing gender disparities in Brazilian households, reinforcing how mechanisms for breaking paradigms and social structures are important to establish new relationships that enhance gender equity. Not only, it shed light on

the importance of domestic work in Brazilian households and how gender inequalities still perpetuate. In general, the thesis contributes theoretically and methodologically to understanding empirical relationships that arise with economic and social changes in rural Brazil. It reinforces the different particularities and potential of individual strategies and demands in the search for an improvement in well-being.

Keywords: Work diversification. Income concentration. Time use.

RESUMO

BRAGA, Cícero Augusto Silveira, D.Sc., Universidade Federal de Viçosa, agosto de 2021. **Ensaios sobre a diversificação do trabalho e desigualdades no Brasil rural.** Orientadora: Lorena Vieira Costa. Coorientador: Mateus de Carvalho Reis Neves.

Este trabalho se dedicou em estudar a diversificação do trabalho agrícola e seus efeitos sob desigualdades em domicílios rurais brasileiros. Especificamente, estuda o trabalho não agrícola, ou seja, aquelas ocupações que não são categorizadas dentro do espectro de atividades agropecuárias; também estuda as relações do trabalho fora da fazenda, ou *off-farm*, caracterizado pelas atividades que não são realizadas em estabelecimentos agrícolas. No primeiro capítulo, especificamente, objetiva-se analisar como os trabalhos e as rendas não agrícolas afetam a concentração de renda nos domicílios brasileiros. Para isso, utiliza-se dos dados da Pesquisa Nacional por Amostra de Domicílios (PNAD) do ano de 2019 para os domicílios rurais. A análise da concentração de renda é obtida a partir de uma análise quantílica incondicional, que permite observar, a partir de diferentes formas funcionais, os efeitos do trabalho não agrícola ao longo da distribuição de rendas domiciliares. Complementarmente, estima-se estes efeitos no Índice de Gini e constrói-se a Curva de Lorenz no intuito de observar a distribuição das desigualdades das rendas agrícolas e não agrícolas no rural brasileiro. Finalmente, estima-se um modelo probabilístico ordenado para analisar os efeitos do trabalho não agrícola sobre as classes sociais observadas a partir de uma adaptação do Critério Classificação Econômica Brasil (CCEB). Os resultados mostram que, de fato, o trabalho e as rendas não agrícolas estão associados a um aumento da renda domiciliar *per capita*, sobretudo para os mais pobres. Confirma-se, portanto, um efeito de redução das desigualdades a partir desta prática de diversificação. Não somente, os resultados chamam atenção para observar atentamente as particularidades que levam os indivíduos a participarem de atividades não agrícolas. Posteriormente, no segundo capítulo, analisa-se os efeitos do trabalho *off-farm*, ou seja, aquele realizado fora dos estabelecimentos agrícolas sobre o uso do tempo nos domicílios rurais do Brasil a partir de uma perspectiva de gênero. Seguindo os pressupostos da Economia Feminista, o trabalho utiliza dos dados da PNAD entre 2002 e 2015 para controlar efeitos locais e temporais. Complementarmente, para estabelecer efeitos causais, utiliza-se das anomalias climáticas em temperatura e precipitação sob a abordagem de variáveis instrumentais. As estimações consideram os domicílios formados por casais heterossexuais e os efeitos são observados a partir da diferença de horas alocadas entre esposas e maridos para as atividades

domésticas, a razão entre elas e também o índice de dissimilaridade. Os resultados mostram que o trabalho *off-farm* é responsável por suavizar as disparidades de gênero nos domicílios brasileiros, reforçando como mecanismos de quebra de paradigmas e estruturas sociais são importantes para estabelecer novas relações que potencializam a equidade de gênero. Não somente, lança luz para a importância do trabalho doméstico nos domicílios brasileiros e de como as desigualdades de gênero ainda perpetuam. De maneira geral, a tese contribui teórica e metodologicamente para entender relações empíricas que surgem com as mudanças econômicas e sociais no meio rural brasileiro. Reforça-se as diferentes particularidades e potencialidades das estratégias e demandas individuais na busca por uma melhoria no bem-estar.

Palavras-Chave: Diversificação do trabalho. Concentração de renda. Uso do tempo.

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1. INITIAL REMARKS

Economic changes demand from economic agents – individuals, firms and governments – strategies to assure themselves in the presence of external shocks, such as climatic shocks, unemployment or demographic transitions, for example; also, to expand their portfolio to guarantee well-being and maximize utility. A notorious adaptation strategy present in rural areas is to diversify income sources and to engage in non-agricultural activities or even off-farm work. According to Piedra-Bonilla, Cunha and Braga (2019), agricultural diversification are divided in two main groups: those that are categorized as agricultural and non-agricultural activities that, in turn, can be carried out within the farm (on-farm activities) or outside (off-farm activities). Among the combinations, different forms of work are established, such as temporary work (off-farm agricultural activity), rural services such as tourism (on-farm agricultural activity) or non-agricultural autonomous work (off-farm non-agricultural activity).

In this work we investigate two of those categories. The first one, analyzed in Chapter 1, studies nonagricultural jobs and its incomes. It regards all the work classified as nonagricultural in accordance with the *Brazilian Jobs Classification* (CBO). The second adaptation strategy analyzed in Chapter 2 is the off-farm work, that is, all the activities carried out by rural individuals outside their own farm – agricultural or not.

The theme became especially relevant in early 1980s, when measures of agricultural income became insufficient to accurately measure gains in rural households, given that the sources of income and the allocation of work are substantially varied, considering agricultural and non-agricultural activities (FULLER, 1983; ROBSON; GASSON; HILL, 1987). However, even though the subject is quite auld, there are several terms and categories used to understand the work diversification as a strategy, such as part time farming, pluriactivity, non-agricultural jobs and income, off-farm work, among others. According to Schneider (2009), the lack of consensus and the breadth of the theme is not only epistemological, but political principally in the international literature. Also, as the studies in the area advanced, some empirical and theoretical delimitations became clearer, requiring careful readings and specific inferences from the studied phenomena.

A notorious practice and broadly studied in the literature is the pluriactivity, which individuals or families engage in both agricultural and non-agricultural activities in rural areas, (BRYDEN; FULLER, 1988; NEWBY, 1987). This a very common practice and is present in more than 50% of Brazilian rural establishments (ESCHER et al., 2015), and it requires a convergence in labor market organizations in order to guarantee that both activities could be

properly carried out (NEVES, 1997). However, on one hand, lack of adequate conditions for the concomitant exercise of agricultural and non-agricultural activities (such as the shocks cited above), can lead to an expulsion of rural workers from agricultural activities, who now exercise, in their totality, non-agricultural activities. On another hand, rural workers, specially the less educated, could still dedicate to agricultural activities, but outside their own farm, that is, working off-farm.

Exclusive non-agricultural activities and off-farm work are individual choices taken based on several variables and have different impacts on distinct outcomes. Start (2001) summarized some of the impacts, mechanisms and dimensions that these practices can operate, showed in Table 1:

Table 1 - Mechanisms, dimensions and impacts of non-agricultural work on well-being

Mechanism	**Dimension of well-being**	**Negative Impacts**	**Positive Impacts**
Low return 'residuals' sectors	Income	Low returns, limited possibility to graduate from poverty	Acts to check falling wages rates in agriculture
Informal, Non-regulated and away from home jobs	Work Conditions	Poor work standards; stress and travel time to work	Acts as coping strategy and safety net
Diversification of off-farm possibilities; more profitable sectors	Inequality	Excludes those with less access to resources (like physical and human capital)	Allows regional growth, possibly reaching the poorer through externalities.
Casual labor markets	Security	Insecure work and prominent possibility of unemployment; difficult of collective action	Efficient for business and growth, alloying a degree of livelihood flexibility
Non-local and multi spatial opportunities	Social and Political Empowerment	Migratory labor forces are dispersed and foreign, reducing bargain base and demographic changes in both rural and urban areas	Provides opportunities for experiences outside agrarian economies and could allow new skill and contacts accumulation and break traditional institutional structures.

Source: Constructed by the author, based on Start (2001).

In Table 1 five mechanisms are presented and, even though they are interconnected, we divide them in two major groups, studied in two different chapters. In this thesis, we aim to explore some of these relations, and analyze their theoretical and empirical appliance in two different chapters.

The first chapter focus on the income and inequality dimension of well-being. Reardon, Berdegué and Escobar (2001) state that the effects of off-farm work – considering both agricultural and non-agricultural jobs – are getting attention for job policies in rural areas since income from off-farm jobs exceed the self-employment and farm wage in Latin America. Also, even though it represents a higher share in household incomes, they are lower in absolute terms compared to wealthier household.

Studying income concentration in rural areas is especially important in Brazil, where there are still huge inequalities that not only define vulnerability of certain groups, but also reinforces the economic mechanisms of access to credit, rural extension, or even access to basic needs, like electricity (DONG; HAO, 2018). In this sense, the first chapter aim to contribute to the theme's literature in the discussion of non-agricultural incomes and work, considering demographic and individual particularities, and how it affects income concentration (or distribution).

Additionally, in the second chapter, we aim to bring a Feminist Economics approach discussing how the practice affects the division of reproductive work in the household. Evidences show that the insertion of women in the labor market is accompanied by a total work overload, since they start to perform a double workday, considering paid work and domestic activities (NOBRE et al., 2017). Hence, the burden of domestic tasks and its proper division could be a channel to analyze female empowerment and well-being whereas the unpaid work is still mostly performed by women (FOLBRE, 2006). Certainly, off-farm work especially when performed by women, may be responsible for altering this relationship since, as noted by Yang (1997), there is a spillover learning effect resulting from this activity. In other words, off-farm work, as it is a form of diversification in rural relations, may be responsible for changes in cultural structures affecting the allocation of resources in households such as a redivision of the time allocated for household chores. That said, the second chapter will analyze the off-farm work and the social and political empowerment dimension of well-being (see Table 1).

Summarily, in this thesis we aim to analyze how these work dynamics relate and impact inequalities in rural areas in Brazil. Since it is an increasingly recurring strategy, it is important to understand its particularities in order to guarantee well-being and respectable work conditions for rural residents, especially for the poorest. To do so, the analysis is proposed

through two different perspectives divided in two essays, which seeks to answer: (i) are non-agricultural activities carried out by rural residents responsible for altering the income distribution and, therefore, income inequalities in rural Brazil? and; (ii) does off-farm work alter time allocation in households, reducing gender disparities?

This thesis is structured as it follows: besides these initial remarks, Chapter 2 presents the first essay, and Chapter 3 the second. Chapter 4 offers some final remarks.

2. NON-AGRICULTURAL JOBS AND INCOME INEQUALITY IN RURAL BRAZIL

2.1 Initial Remarks

Brazilian rural households have been through several social, economic, and demographic transformations in recent years, leading rural residents to seek adaptation strategies. One of the strategies stems from work agricultural diversification, which can relate to rural and non-rural activities (SCHNEIDER, 2009). The latter mainly encompasses nonagricultural work, which can play two major roles: to gain scope economies expanding their portfolio in diversified markets (including the labor market) and an adaption strategy to overcome exogenous shocks and random variations in agriculture by guaranteeing an external and less volatile source of income (Piedra-Bonilla et al., 2020).

The choice of non-agricultural jobs is associated with their different individual particularities and the returns of such activities, which depend on the level of human and physical capital invested. According to Start (2001), even though nonagricultural jobs can serve as a determinant for household well-being and a concrete path to overcome poverty, their impact could be positive or negative depending on the activity performed. In this sense, nonagricultural jobs can increase per capita income in rural households or, on the other hand, they could be responsible for increasing inequality since wealthier families can access better markets and, therefore, reinforce a scenario of disparities among families (LIMA, 2008; MOREIRA, 2010; NEY; HOFFMANN, 2008).

The study of income concentration in rural areas is especially important in Brazil, where massive inequalities persist in the labor market and not only define the vulnerability of certain groups, but also reinforce the economic mechanisms of access to credit, rural extension, or even access to basic needs like electricity and water supply (DONG; HAO, 2018; FREITAS et al., 2018; NEVES et al., 2020). Helfand, Rocha and Vinhais (2009) showed that, in the last decade, even though rural poverty and income concentration in Brazil have decreased, it still more than double compared to urban areas. This scenario does not have a unique explanation and varies from time to time, but still are an agenda to explore in order to properly address public policies and guarantee well-being in its various perspectives (SERRA, 2017).

In this paper, we contribute to the literature by discussing income inequality using different approaches and the access to non-agricultural labor market by rural residents, exploring several mechanisms and particularities – individual and regional – that contribute to disparities in both

access to labor market and income disparities. We consider as nonagricultural jobs those works that are not related to farming (agriculture or livestock) activities.

That said, we seek to answer if nonagricultural jobs impact income inequality in rural areas in Brazil. For this purpose, we use data drawn from the *Pesquisa Nacional por Amostra de Domicílios Contínua* 2019 (PNAD-C), at individual level and estimate the effects through an Unconditional Quantile Regression approach, as proposed by Firpo et al., 2009. Additionally, we apply the Oaxaca (1973) and Blinder (1973) decomposition to check how the particularities of labor market explain disparities in overall income. As complementary analysis, we constructed the Gini index for all Brazilian states and a general Lorenz Curve; besides, we create an index of social classes based on *Economic Classification Criterium Brazil* (CCEB), and estimated the effects of nonagricultural jobs through and ordered probit.

Following this introductory section, the paper is organized as follows: in Section 2 we provide the background on rural labor market and rural inequality. Section 3 describes the theoretical model; Section 4 presents the methodology and data considered for the estimations. In Section we 5 explore the results and Section 6 concludes.

2.2 Background

The study of inequality in its various dimensions is important especially for developing countries. Evidence for rural areas, however, tends to be centered on the productivity and efficiency approach, where individual and labor market characteristics are often neglected. In this section, we provide an overview that highlights different findings regarding rural specificities and labor market relations, specifically concerning work diversification and inequality.

According to Reardon et al. (1998), non-agricultural sector (its incomes and jobs) is a key theme to understand the dynamics of rural poverty and inequality, given that non-agricultural income constitutes a great part of rural revenues. The nonagricultural sector must be considered in public policies for rural employment because it affects the poorest in different ways. First, because working is elementary to overcome poverty and agricultural activities have several limitations to overcome rural unemployment. Second, if the non-agricultural activities before and after agricultural production[1], works well, there is a reduction of costs for the farmers, allowing the continuance of agricultural production. Third, it guarantees that the most

[1] Nonagricultural incomes not only compose the overall household budget, but also, are directed related to extra farm components of the food system, given that it provides goods and services, such as inputs for agricultural production, and also the post-production, in processing and distribution of agricultural production.

vulnerable farms overcome several risks in agricultural production, such sequels, floods, pests, besides generates income for purchasing agricultural inputs (REARDON; CRUZ; BERDEGUÉ, 1998).

In Brazil, Ney and Hoffmann (2008) studied the impact of rural and non-rural income on wealth distribution and found that these incomes are responsible for respectively decreasing and increasing rural inequality. The authors showed that for poor families, indeed, the main option is restricted to casual and low-wages jobs, given the lack of accumulated capital.

Access and owning the land also have an ambiguous interpretation. On one hand, land scarcity may lead rural individuals to compensate income insufficiency through non-agricultural jobs. However, on the other hand, there is a clear barrier since it limits the capacity to ascend to better positions (REARDON, 1999). The relationship is not uniform and varies according to individuals and environment characteristics (NEY; HOFFMANN, 2008).

This discussion is substantiated at three main challenges and paradoxes summarized by Reardon, Cruz and Berdegué (1998). The first one, in micro level, is based on the conflict of incentives and capacities. The incentives – such as income costs and risks, for example – are divided in *attraction factors*, given by the possibility of rural residents ascend to better occupations and, therefore, higher income and; the *expulsion factors* usually related to an income demand in order to compensate the lack of credit access (still very common in Latin America)[2], need for income diversification, purchase agricultural inputs, and others. Even though the workers, and the household in general, have strong incentives, there are some capacities needed to insert in better nonagricultural opportunities, such as educational skills, specific knowledge and abilities, some liquidable wealth – like land ownership –, the geographical location and logistical conditions access to such activities.

Furthermore, even though off-farm work and particularly non-agricultural activities are paths through which individuals in rural areas prospect a new way of life, it is crucial that public policies guarantee well-being and equal opportunities in rural areas. According to Christiaensen and Martin (2018), the growth inside agriculture activities is two to three times more effective at reducing poverty and others welfare measures than those external to the agricultural sector. This applies to the poorest members of society and differs depending the activity performed. In this sense, the study of the effects of non-agricultural activities and income inequality intersects with who performs this labor and, further, pinpointing the type of activity could lead to policy

[2] For a discussion of the impacts of rural credit in income inequality in Brazil see Neves et al. (2020).

implications not only about rural areas, but also to a general model of development for the country.

Kageyama and Hoffmann (2000) explored the effects of schooling, poverty and access to assets in rural households in Brazil. The authors show that in household where some individuals are engaged in non-agricultural activities, there are notable positive differences in overall well-being compared to those that dedicate exclusively to agricultural production and this, alongside with regional location, are the bottom line to discuss poverty and vulnerability among rural households. Also, they found that as the poorest have limited access to education and credit, they tend to obtain the most unskilled and worst-paid jobs.

Summerly, poorer workers are more prone to insert in nonagricultural activities due to the expulsion factors and the wealthiers due to the attraction factors, since they tend to have more assets in the list of capacities and, therefore, engage in works with more human and physical capital. It must be reinforced that in Latin-American the lack of agricultural infrastructure (such as proper roads and communication channels, schools and transportation, among others) is a limiting factor that feed a cycle of vulnerability (REARDON; BERDEGUÉ; ESCOBAR, 2001), since it does not allow rural dwellers – specially women and the youngest – to achieve fully potential to develop a more diversified utility options.

In this sense, even though some individuals have several attraction or expulsions factors that makes them pursue to non-agricultural employment, or even have several of the listed capacities, other obstacles can prevent them to engage in non-agricultural activities. This is especially true in some specific regions, which leads to the second paradox, based on a meso level.

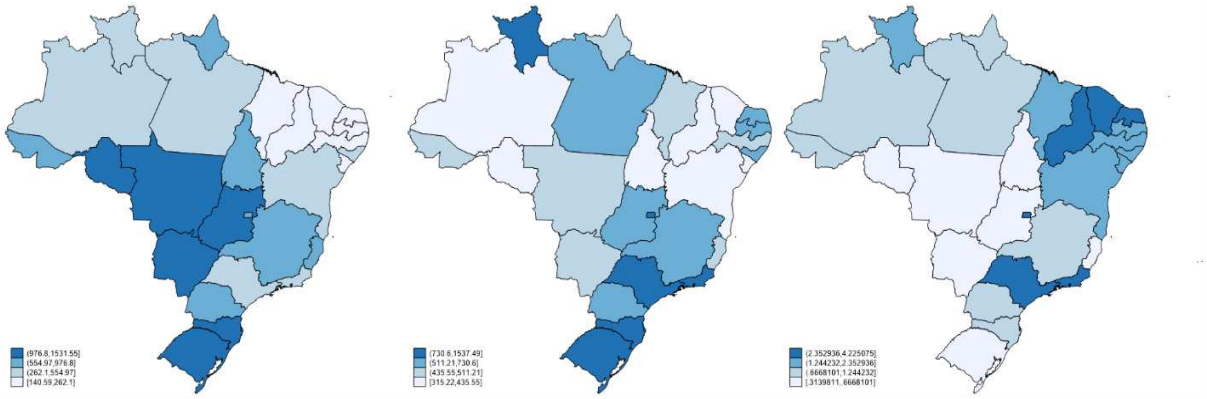
On one hand, places with fewer agricultural and infrastructure resources have a higher demand of nonagricultural to compensate poverty levels. On the other hand, there are several limitations for the growth of a proper nonagricultural sector and also a lower purchase power. In this sense, rural poverty in fragile agricultural sectors limits the development of better nonagricultural opportunities through demand and supply (REARDON; CRUZ; BERDEGUÉ, 1998). Naturally, the opposite also applies, and more developed regions tend to have a better nonagricultural sector, and, therefore, better opportunities, which reinforces the cycle of concentration and disparities.

In Brazil, these meso disparities are significantly marked. Moreira (2010) shows that the increase in non-agricultural activities and income in Southern region in Brazil – the industrial and economical center in the country – is related to a higher technological level and its demanded jobs, such as administrative, cleaning, maintenance and others. Also, some states of

this region have an increasingly ecological tourism and leisure. On the contrary, in the Northeast region, nonagricultural jobs are mainly related to domestic works, given the lack of agroindustries and the sugarcane sector, prominent activity in the region, faces several instabilities (NASCIMENTO, 2004).

In order to illustrate these differences of rural income distribution in Brazil, Figure 1 illustrates the distribution of non-agricultural (Fig 1.a) and agricultural (Fig 1.b) income in Brazil, as well as the ratio between them (Fig 1.c).

Figure 1 – Average monthly individual nonagricultural, agricultural income and its ratio in rural Brazil, 2019



(a) Agricultural Income (b) Nonagricultural Income (c) Income Ratio

Source: Research results based on PNAD 2019.

Figure 1 shows that Midwest states contain the highest level of agricultural incomes by individuals in rural household (Fig. a). This is also the region that has the least number of people working on their own or for self-consumption and, at the same time, the highest incidence of permanent employees. The distribution of non-agricultural incomes (Fig. b), on the other hand, confirms the regional disparity in which Federal District, South, and Southeast regions have the highest level of nonagricultural income in rural household, while the North and Northeast have the lowest. Image (c) displays the ratio between nonagricultural income over agricultural income, that is, darker states reflect a higher share of nonagricultural income compared to the agricultural ones in rural household.

We see that, even though Northeast states have lower prevalence of both source of income (1.a and 1.b), nonagricultural incomes have greater participation in household in these regions, given that they have the highest share (darker tones). However, in these states the incidence of precarious and informal agricultural jobs is greater, reinforcing that regionality plays a major role in defining how non-agricultural incomes are related to disparities in rural Brazil. Not only, it points a demand for labor market policies in both agricultural and nonagricultural areas.

Midwest states, on the other hand, presents the opposite: the lighter tones in Figure 1 shows that, indeed, agricultural incomes are more prevalent compared to nonagricultural.

In Brazil, this discussion is closely related to the third paradox, defined in a macro level, marked by the differences at an aggregated level of agricultural production and the globalization process, such as the opening and development of internal and external markets. This discussion is straightforward, since each region is strongly marked by their social and economic setting, as showed above.

There are also some particularities concerning the type of work individuals perform, whether agricultural or not and the level of human and physical capital such jobs demand. Such particularities reflect how the labor market is structured and, therefore, how it impacts on income level. Also, it must be pointed that these singularities are manifested differently in Brazilian regions, given that the process of modernization and industrialization is very specific, and marked by the productive structure of each region. Table 2 presents the distribution of rural workers among the Brazilian regions based on 2015 PNAD data.

Table 2 Occupational Distribution of Rural Workers in Brazil, 2015

Occupation	North	Northeast	South	Southeast	Midwest
Agricultural	65.01%	64.45%	59.48%	60.94%	61.80%
Directors	0.88%	0.85%	1.35%	1.75%	2.24%
Science and Arts	3.35%	2.38%	3.50%	1.91%	2.95%
Technicians	2.68%	2.47%	2.43%	2.11%	1.68%
Managers	1.30%	1.53%	3.14%	3.00%	2.59%
General Services	9.32%	9.79%	8.96%	13.24%	15.92%
Trade Services	4.46%	5.01%	3.06%	2.92%	2.70%
Industrial	12.87%	13.37%	17.89%	14.03%	9.97%
Army	0.14%	0.14%	0.17%	0.10%	0.15%
Other	-	-	0.03%	-	-
Observations	5,679	9,997	3,628	3,935	1,966

Source: Braga, Neves and Costa (2020).

The data shows that occupations are distributed similarly in different regions of Brazil. The incidence of agricultural work is greater in the North and Northeast regions, where 65% and 64% of the rural population are dedicated exclusively to agricultural activities. In both regions, among nonagricultural activities, those related to services and industrial activities are the most prevalent. The South, in turn, is the region with the lowest incidence of exclusively agricultural workers and the highest concentration in industrial activity. The Southeast and Midwest regions employ approximately 61% of the population in agricultural activities and, like the other regions, among non-agricultural activities the main concentration of workers is in the service

and industrial sectors. Table 3 illustrates the subdivisions of agricultural activities among the regions.

Table 3 Position of Workers Employed in Agricultural Activities in Brazil, 2015

	North	Northeast	South	Southeast	Midwest
Permanent employee in auxiliary services	0.41%	0.82%	0.32%	0.49%	6.16%
Permanent employee in agriculture, forestry, or raising cattle, buffalo, goats, sheep, or pigs	10.32%	9.63%	11.37%	23.97%	32.42%
Permanent employee in other activity	0.54%	0.31%	1.85%	0.70%	1.95%
Temporary employee	6.70%	10.73%	3.05%	6.53%	2.81%
Self-employed in auxiliary services	2.48%	2.50%	1.39%	1.48%	4.99%
Self-employed in agriculture, forestry, or cattle, buffalo, goat, sheep, or pig farming	32.27%	25.46%	38.51%	23.93%	18.94%
Self-employed in other activity	5.37%	4.56%	2.27%	0.33%	2.03%
Employer in auxiliary services	0.08%	-	-	-	0.08%
Employer in agriculture, forestry, or cattle, buffalo, goat, sheep, or pig farming	1.27%	0.62%	1.11%	2.67%	2.03%
Employer in other activity	0.08%	0.02%	0.32%	-	-
Unpaid worker and member of the household	14.26%	10.42%	16.92%	13.01%	8.26%
Another unpaid worker	0.08%	0.19%	0.05%	0.04%	0.08%
Worker producing for self-consumption	26.14%	34.75%	22.84%	26.85%	20.27%
Observations	3,703	6,441	2,163	2,436	1,283

Source: Braga, Neves and Costa (2020).

According to Table 3, a small portion of rural residents are employers, indicating that the management of rural establishments – especially large ones – are carried out by urban residents: while 13% of the workers engaged in agricultural activities who reside in urban areas are employers, the maximum proportion of rural employers are in Southeast (2,67%) or Midwest (2,03%). Most permanent employees are engaged in activities related to agriculture, forestry, or animal husbandry. It indicates that better-paid (or more profitable) agricultural job positions are not held by rural workers. The concentration is even higher in the Midwest and Southeast. On the other hand, the lowest proportion of permanent employees is in the Northeast region, which has the highest percentage of individuals who have temporary jobs. This is an important indication of vulnerability since jobs and, therefore, incomes are more uncertain. In any cases, most rural individuals, in all regions, are farm workers who produce for their own consumption or perform agricultural activities on their own. In this sense, there is still a significant contingent of unpaid workers within households.

Studies of rural income concentration and inequality have also been carried out for other countries. For example, in China and Pakistan, different income origins impact wealth distribution differently, which depend on the type of income and the nonagricultural job in

which individuals are engaged on (ADAMS, 1994; WAN, 2001). In face of these elements, it is possible to affirm that the development of non-agricultural activities linked to rural areas could be endogenous, that is, urges from rural demands or exogenous, linked to urban demand. They are also linked to the agricultural modernization and consumption dynamics (NEY; HOFFMANN, 2008).

In Table 4, we show some of the links and mechanisms which non-agricultural work is demanded and applied examples in rural areas.

Table 4 - Links, Mechanisms and examples of nonagricultural work demand

Links	**Mechanism**	**Examples**
i. Agricultural Production	Agricultural production demands non-agricultural goods and services and attracts investments in local rural industries	- Inputs Market - Transportation services - Mechanical repairs - Agroindustry
ii. Rural dwellers consumption	Rural areas population demands goods and services produced in or off-farm	- Small markets - Overall domestic services (sewing, household repairs, others) - Transportation
iii. Public services	Jobs generated from public services in rural areas	- Teachers - Health professionals
iv. Urban consumption	Urban areas population demands goods and services that can only be produced in rural areas	- Food and other agricultural products - Tourism (beaches, fields, ecotourism) - Handcrafting - Domestic services - Civil construction
v. Urban Labor Market	Some individuals live in rural areas given life quality and lower costs, but are urban workers	- Civil construction - Domestic services - Commerce - Industry

Source: Adapted from Ney and Hoffman (2008)

In the next section we will explore the theoretical framework that explains the choosing of engage in nonagricultural jobs by rural residents and how it can impact income concentration in rural areas.

2.3 Theoretical Framework: Choosing to Engage in Nonagricultural Work

In developing countries, households in rural areas are more exposed to market imperfections, in a sense that a theoretical framework could not treat the market as one in which perfect competition takes place. In their seminal paper, Yutopoulos and Lau (1974) stated that in the presence of market failures, it is possible to find households based on a non-separability

model. This means that household decisions regarding production and consumption affect each other because they are made simultaneously. In other words, they have a pure profit-utility maximization, which includes their utility and well-being (consumer theory) and production profits (firm theory) (DE JANVRY; SADOULET, 2006).

In this sense, we follow the agricultural household model proposed by Bardhan and Udry (1999), where households face imperfections in both land access and labor markets. Suppose, therefore, an economy without a market for land and involuntary unemployment in the rural labor market, where agricultural jobs are too costly for the individuals (in terms of salary, inputs or other constraints). In this case, we will interpret it as engaging in nonagricultural work. The household problem is:

$$Max\ U(c,l), c, l, L^H, L^F \geq 0$$

s.t.

$$pc = F(L^f + L^h, E^A) - wL^h + wL^m$$

$$l + L^f + L^m = E^L$$

$$L^m \leq M,$$

Where c is the consumption level and *l* the leisure, L^h is the hired workforce used on the farm, L^f represents the family workforce used on the farm; *pc* is the budgetary restriction (price of inputs and consumption) L^m is the time spent engaged in paid activities, E^L is the individual endowment of time, E^A represents the cases where there is no land market, and M represents the maximum time allocated for such paid activities. These work activities can take different formats and be modeled based on distinct particularities.

Here, it will be considered a general form, where $L^m \leq M$ is not binding and the general restriction becomes $pc + wl = F(L, E^A) - wL + wE^L$, where L is the total labor time used on the farm. In such cases, the separation property holds. Therefore, the theoretical framework must account for the possibility in engaging in both agricultural or nonagricultural market but also consider the family and individual structure and how expulsion and attraction factor plays.

Since our objective is to illustrate the effects of nonagricultural work on income concentration, we can consider a model where the family composed by two *i* individuals maximizes its utility subject to agricultural and non-agricultural income (LEE, 1998; LIMA, 2008), such as:

$$\max U(T_{d1}, T_{d2}, C; J) \qquad (1)$$

s.t. $$C = f\left(p;\ T_{agr1}, T_{agr2}; H, Z_{agr}\right) + g\left(T_{nag1}, T_{nag2}; H, Z_{nag}\right) + OSI \quad (2)$$

$$T_i = T_{di} + T_{agri} + T_{nagi}, i = 1{,}2 \quad (3)$$

$$T_{agri}, T_{nagi} \geq 0, i = 1{,}2 \quad (4)$$

where T is the time allocated for household tasks and leisure (*d*), agricultural (*agr*) and non-agricultural activities (*nag*); C is goods consumption; J represents family characteristics; f and g relate consumption as a function of agricultural and non-agricultural income, respectively; p is a price vector; Z is the input for agricultural and nonagricultural activities; OSI are other sources of income, such as public transfers, retirement, and others; *H* represents human capital that affects agricultural and nonagricultural income and Z are other variables that impacts on income level.

This maximization problem shows that the family's utility is defined by the time allocated to household tasks and leisure, consumption, and family characteristics (Eq. 1). Families mainly face two constraints: budgetary (Eq. 2), related to their different sources of income and the variables related to it and temporal (Eq. 3), which depends on the allocation of time in work and leisure. Furthermore, the model assumes that the time allocated on agricultural and nonagricultural jobs could be zero (negativity constraint – Eq. 4). Given the possibility of a corner solution, it is possible to build a *Lagrangian* equation, such as:

$$\begin{aligned} L = {} & U(T_{d1}, T_{d2}, C; J) \\ & + \lambda\left[f\left(p;\ T_{agr1}, T_{agr2}; H, Z_{agr}\right) + g\left(T_{nag1}, T_{nag2}; H, Z_{nag}\right) + OSI - C\right] \\ & + \gamma_1\left[T_1 - T_{d1} - T_{agr1} - T_{nag1}\right] + +\gamma_2[T_2 - T_{d2} - T_{agr2} - T_{nag2}] \end{aligned}$$

According to the work structure in the household (agricultural or nonagricultural), from the Lagrange's equation above, the optimization can take different forms. Here we consider families in which some individuals could perform nonagricultural jobs and others do not. That said, it can be assumed that $T_{agr}, T_{nag} \geq 0$. In summarizing the main mathematical proceedings, we can simplify the time shadow price of each family member in engaging in agricultural and nonagricultural jobs as $W_1 = \gamma_1/\lambda$ and $W_1 = \gamma_2/\lambda$. Furthermore, the consumption equation would be:

$$
\begin{aligned}
C + W_{1nag}T_{d1} + W_{1agr}T_{d1} + W_{2nag}T_{d2} + W_{2agr}T_{d2} \\
&= W_{1nag}T_1 + W_{2nag}T_2 + W_{1agr}T_1 + W_{2agr}T_2 \\
&+ \left[f\left(p; T_{agr1}, T_{agr2}; Z_{agr}\right) - \left(W_{1agr}T_{agr1} + W_{2agr}T_{agr2}\right)\right. \\
&\left. - \left(W_{1nag}T_{agr1} + W_{2nag}T_{agr2}\right)\right] + g\left(T_{nag1}, T_{nag2}; H; Z_{nag}\right) + OSI
\end{aligned}
\tag{5}
$$

Simplified, Equation (5) can be rewritten as

$$C + L = VT + \pi^* + S + OSI,$$

which means that consumption and leisure (C+L) are equal to the sum of the work value measured by agricultural and nonagricultural income (VT); agricultural profits (π^*), represented by the revenues and costs of the trade-off between working on agricultural activities or not; and the wage gained from nonagricultural jobs (S) or other source of incomes (OSI). We see, then, that individuals take into account the possibilities of earnings in both agricultural and nonagricultural jobs, other incomes, and their preferences in consumption and leisure when deciding to adopt a diversification strategy in terms of work.

This model summarizes some of the paradoxes we presented in the previous section. That is because the choice to engage in nonagricultural jobs depends first on the ability to leave the farm, which, in turn, depends greatly on income. In this sense, the attraction and expulsion factors are individually considered since the expected outcome (income from nonagricultural activities) depend on the capacity in ascending better positions than in agricultural labor. This capacity is related to both human and physical capital accumulation (educational attainment, mobility capacity, regional features) and also several unobserved characteristics (individual motivation, willing to engage in other activities and abilities despite agricultural) can explain the individual motivation to participate in such activities.

In this sense, the empirical model should take into account the characteristics in which rural dwellers intrinsically differ in opting to insert in labor market. That said, in the next section we explore the empirical strategy to properly estimate the effects of nonagricultural work participation on income concentration, considering both observed and omitted particularities.

2.4 Identification Strategy

Our research investigates how nonagricultural correlates to income inequality in rural areas. In order to properly and broadly address the issues, we explore three different methodologies. First, in Section 2.4.1, we present the method to decompose this inequality through income quantiles and also in the observed and unobserved characteristics. To do so, we follow the Unconditional Quantile Regressions combined with an Oaxaca-Biden decomposition through

Recentered Influence Functions. Second, in Section 2.4.2, we show the construction of the Gini Index and the Lorenz Curve for all Brazilian states, in order to explore regional differences in the agricultural job performance. Finally, in section 2.4.3 we adapted the CCEB methodology to our sample, considering the probability of changing social classes defined mainly by an assets approach. We estimate these last results analyzing ordered probit coefficients and its marginal effects. All variables used are present in the respective section and Section 4.4 presents the database and address endogeneity issues.

2.4.1 Identification strategy: decomposing inequalities

We show that engagement in such agricultural or nonagricultural activities depends on individual characteristics and job quality, which varies given the background and motivations of individual workers. In this sense, even though income from nonagricultural work may be responsible for an overall increase in household income, its effects can be unbalanced throughout the households and also increases inequality. The estimation must consider two important features in order to obtain proper effects: i) individuals in wealthier households have different incentives to take part in nonagricultural labor market than those in the poorest households (ESCHER et al., 2015); and ii) agricultural and nonagricultural jobs have particularities that influence intra-household resource allocation (START, 2001).

A method that has gained attention in the literature analyzing inequality is Unconditional Quantile Regressions (UQR). Proposed by Firpo, Fortin, and Lemieux (2009), this technique allows for an estimation of the marginal effects of covariates on quantiles of any functional income – similar to what the Ordinary Last Squares (OLS) method does for averages. The UQR allows not only within-group, but also between-group comparisons. That is, we can investigate whether nonagricultural work is responsible for reducing income dispersion within different quantiles, but also the overall inequality measured by the different income strata in rural areas. This method has been used to analyze the effects of rural extension and credit on income concentration in rural areas (FREITAS et al., 2018; NEVES et al., 2018), income inequality in Brazilian regions (MADEIRA, 2017), gender wage gaps (BLAU; KAHN, 2017), and labor market and inequality (MAURIZIO, 2014), among other applications.

The UQR approach is based on an influence function concept known as the Recentered Influence Function (RIF), with expectations equal to $v(F_Y)$, which is extended to different types of measures beyond quantiles of the outcome variable (here, household income). For the quantiles, the dependent variable in the regression is represented by Equation (6):

$$RIF(Y; q_\tau, F_Y) = \frac{q_\tau + (\tau - 1\{Y \leq q_\tau\})}{f_Y(q_\tau)} \quad (6)$$

where q_τ represents the distribution of the τ-th quantile of income distribution *Y*. After estimating the sample quantile q_τ through the density $f_Y(q_\tau)$, it forms a dummy variable $1\{Y \leq q_\tau\}$, which indicates whether the income is below q_τ. Then it is possible to run an OLS regression of the new dependent variable on the covariates.

To properly observe the effect of income on different groups, Firpo (2007) proposed an extension of the Oaxaca-Binder approach, which decomposes the mean income difference into observed and unobserved characteristics considering the quantiles and variance (NEVES et al., 2020; OAXACA, 1973). To do so, two groups of workers can be assumed, divided by those who perform nonagricultural jobs (group *A*) and those whose jobs are agricultural related (group *B*). Such decomposition makes it possible to identify the difference in the income distribution of g groups based on income quantiles (Eq. 7):

$$\Delta v = v(F_{yA}) - v(F_{yB}), \quad (7)$$

where $v(F_{yg})$ is the statistic of income distribution of groups g (*A* and *B*). The term Δv is divided in order to check the return effect (intrinsic difference between groups Δv_R) and the composition effect (difference in observable individual characteristics Δv_X), such as (Eq. 8):

$$\Delta v = \Delta v_R + \Delta v_X. \quad (8)$$

Equation (8) is obtained by re-estimating the RIF regressions for both groups, which leads to $v(F_{yA})$ and the counterfactual $v(F_{yB})$ (Eq. 9):

$$v(F_{yg}) = E[RIF(y_g; v_g)|X, T = \mathrm{g}] = X_g \beta_g, \quad (9)$$

where g=*A*, *B* represents the two different groups: nonagricultural workers (Group A) and agricultural workers (Group B). Here, β is the parameter of interest that represents the impact of the nonagricultural work in the different income quantiles. To estimate β, a probit model is used to obtain weighting factors that are used afterward in the RIF regressions through an OLS model.

The estimation uses the new command *oaxaca_rif* in Stata (RIOS-AVILA, 2020) adapted from the *oaxaca* classic decomposition (JANN, 2008). This combination allows us to, additionally to the quantile function, use the Gini index as a functional statistic (FIRPO; PINTO, 2016), represent by:

$$RIF(y, Gini_Y) = 1 + \frac{2}{\mu_Y^2} R_Y - \frac{2}{\mu_Y}[y\{1 - F_Y(y)\}]$$

In sum, this method allows for the identification of the influence of individual characteristics on the choice to perform nonagricultural work and how on and nonagricultural work differs in terms of their impact on household inequality. Even though the process of choosing a job naturally leads to a biased estimator,[3] we don't declare a causal effect to properly answer the research question. We focus on understanding how individuals and jobs characteristics are correlated with income disparities on quantile distribution. All variables are constructed for households considering both regional and individual characteristics and are equally considered for both quantile and Gini specifications in UQR models, as presented in Table 5.

Table 5 Variables and Description

Variable	Description
Household Per capita Income	Sum of all job incomes and other sources, divided by the number of dwellers
Work Income	Individual income from work.
Household Head	=1 if the individual is household head; 0 otherwise
Spouse	=1 if the individual is the spouse in the household; 0 otherwise
Woman	=1 if the individual is woman; 0 otherwise
White	=1 if the individual is white; 0 otherwise
Children	Number of household members aged 15 years old or less in the household
Elderly	Number of household members aged 60 years old or more in the household
Education	Dummies for the highest educational level (illiterate, elementary school, high school and tertiary education).
Region	Dummies for each Brazilian region where the household is based (North, South, Northeast, Southeast, Midwest)
Unemployed	=1 if the individual is unemployed; 0 otherwise
Programa Bolsa Família (PBF)	=1 if the individual is a beneficiary of *PBF*, main income transfer program in the country
Retirement	Individual income from retirement

[3] Since it is not possible to observe some characteristics that led the individual to make a particular choice, there will be a correlation between the error term and the parameter of interest that makes it endogenous and, therefore, biased.

Other Benefits	Individual income from other benefits, such as public providence or social programs (except PBF), unemployment insurance, child support and donations, rent or scholarships.
Job Sectors	Dummies for job categories: i. agriculture, livestock, forest production and fishery; ii. industry; iii. Construction; iv. vehicles (trade and repair); v. transport, storage and mail; vi. food and accommodation; vii. information, communication, real state and administrative activities; viii. public administration, defense and social security; xi. education, human health and social services; x. other services and undefined; xi. domestic work.

Source: IBGE (2019)

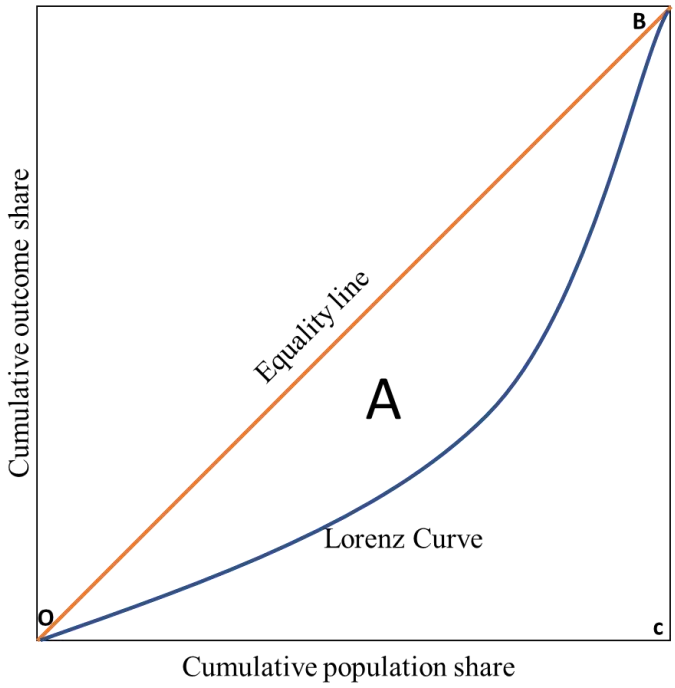
2.4.2 Gini Index Analysis

In line with Ney and Hoffmann (2008), we applied the Gini index disaggregation for agricultural and nonagricultural income to compare how these different sources of income is defined among the quantiles. Also, we draw the Lorenz Curve, which illustrates the shape a given distribution and the degree of inequality of an outcome (JANN, 2016). The curve is expressed such as:

$$L_X(p) = \frac{\int_{-\infty}^{Q_X^p} y dF_X(x)}{\int_{-\infty}^{\infty} x d\, F_X(x)}$$

where X is the outcome variable and $F_X(x) = \Pr(X \leq x)$ is its distribution function. The quantile function is the inverse of the distribution function $Q_X(p) = F_X^{-1}(p) = \inf\{x | F_X(x) \geq p\}$, with $p \in [0,1]$. The Lorenz Curve structure is illustrated in Fig. 2:

Figure 2 – Representation of a generic Lorenz Curve



There are some important features displayed in Figure 2. Vertical axis shows the outcome distribution while in horizontal axis, the population. Line OB (orange) is the line of perfect equality, a case where all the individuals have the same outcome. That is, if every individual in the sample has the same income, then its proportion would be the same as the population, and represented by this line. The polygonal OCB represent the other extreme, where all the outcome is appropriated by one individual. Those two cases are hypothetical and we expect that all Lorenz Curves be situated in the triangle OCB, in the example represented by the blue line in Figure 2.

In this sense, the closer the estimated Lorenz curve is to the diagonal line, more equally distributed is the income. The area "A", between the equality line and the Lorenz Curve, is directly compared to the Gini values. By definition, the Gini index values is two times the area between this line and the one estimated. So, if the Lorenz Curves matches the equality line (totally equality) Gini would be zero. In the other extreme, of total inequality, Gini equals 1. That is, Gini Index are always between zero and 1, and higher values means a higher income concentration.

We will consider in our estimations the income from agricultural and nonagricultural jobs in rural household. Lorenz Curve are calculated to rural as a whole, while Gini Index was disaggregated by states and regions, besides considering household per capita income.

2.4.3 Brazilian Economic Classification Criterium (*CCEB*)

As complementary analysis, we will analyze rural inequality through social classes. Usually, these classes are represented through income strata (Section 2.4.1). However, there is a whole discussion on how poverty – and inequality – is multidimensional and must consider the capabilities and access to goods and services, for example (BANERJEE; DUFLO, 2011; COOK, 2011; SEN, 2001; SERRA, 2017). In this sense, the Brazilian Association of Research Enterprises (ABEP), proposed the Brazilian Economic Classification Criterium *(CCEB)* (*Critério de Classificação Econômica Brasil*), an index to define broader social classes based on purchase power.

This index was originally created considering household income strata and on the maximum likelihood of 35 indicators (mainly assets and educational level) and four covariates of region, location and the number of children and elderly. It bases on the number of assets, which receives specific points. The sum of these points results on an algorithm that allows the division of the sample in strata – or classes (ABEP, 2020; KAMAKURA; MAZZON, 2016). This methodology has been used to classify the population for different studies outcomes, such as

educational attainment and its specificities (BANDEIRA et al., 2006; SILVA et al., 2017), health and psychological relations (FRANCA; CARDOSO; ARAÚJO, 2017; SILVA; ALVES, 2019) and social interactions and life quality (NASCIMENTO et al., 2016), for example.

The data used in this work only identify the existence or not of an asset, and not the quantity, as the original index. In this sense, we adapt the methodology by applying the average points related to the number of assets in the original methodology. When applicable, we used the same punctuation criterium, for example in terms of education and number of bathrooms. The variables used and its individual values are presented in Table 6:

Table 6 - Variables, data and values used to create the adapted CCEB

Variable	Description
Schooling Level of Household Head	Points for the highest educational level of the household head. =0 if illiterate, =1 if incomplete elementary school, =2 if completed elementary school, =4 if completed high school, =7 if tertiary education
Number of Bathrooms	Number of bathrooms in the household. =0 if 0, =3 if 1, =7 if 2, =10 if 3, =14 if 4 or more.
Fridge	=3.7 if there is a fridge in the household.
Freezer	=4.5 if there is a freezer in the household.
Washing Machine	=4.5 if there is a washing machine in the household.
TV	=3.5 if there is a television in the household.
PC	=7 if there is a microcomputer in the household.
Internet	=7 if there is access to internet in the household.
Car	=6.75 if there is a car in the household.
Motorcycle	=2.5 if there is a motorcycle in the household.
Water	=4 if there is t in the water distribution is from a general network.
Electricity	=2 if there is at least one source of electricity in the household.

Source: IBGE (2019)

Using these values, the upper limit for our adapted CCEB is 66,5 and the lower is 0. Then, based on the observed distribution of our sample we define four different classes given by the strata: 0 – 14; 15 – 28; 29 – 42; >42.

It is clear that such methodology is an adaptation and fails to properly divide the sample in classes, given the changes required. However, the exercise here is to see, as a complementary analysis, if the performance of nonagricultural jobs – defined as above, is correlated with a change in social strata based on the household asset composition. In this sense, we considered a model where the dependent variable represents the four categories, such as:

$$Y = 1 \; if \; Y^* \leq 14;$$

$$Y = 2 \; if \; 14 < Y^* \leq 28;$$

$$Y = \; 3 \; if \; 28 < Y^* \leq 42;$$

$$Y = 4 \; if \; Y^* > 42.$$

where Y^* is the latent variables and the values (14; 28; 42) are respective thresholds. We assume that Y^* follows a linear regression model and the probability to the individual be in a given category, is given by the probability that Y^* is in a range determined by the threshold. Assuming that there's an error term normally distributed u_i, we estimate the following equation through an ordered probit model (BRAGA, 2018):

$$CCEB_i = \gamma + \tau NAJ_i + \theta_j X'_{ji} + u_i$$

where $CCEB_i$ represents the four classes for the individual i, γ is a constant, τ is the interest parameter and NAJ is a dummy variable that equals to 1 when the individual performs nonagricultural jobs and 0 otherwise. X'_{ji} is a vector of household and individual characteristics – defined as in Section 4.1 – and θ_j is the respective parameters of j variables. We will also consider five different estimations by adding groups of variables: 1 is the baseline model, that only consider NAJ_i; (2) adds individual variables; (3) regional variables; (4) work features; and (5) all variables are included.

In this model, the interpretation of our parameter of interest, is straightforward: if τ is positive, we can assume that perform nonagricultural jobs increases the probability of being in a higher category, that is, nonagricultural jobs are correlated to a higher social stratification. We also analyze the marginal effects which indicate the correlation of this job and the probability to be in each category.

2.4.4 Sample and endogeneity

The data used in all estimations is from the Continuous National Household Sample Survey PNAD-C 2019 (*Pesquisa Nacional por Amostra de Domicílios Contínua)*. This database aims to monitor fluctuations and the evolution of the workforce and several individual and household characteristics (IBGE, 2019a). The survey is representative for households in Brazil and it is carried out yearly. We use "*Visita 1"*, which contains information about habitation, household and individual characteristics and also detailed information about workforce and income from different sources.

Some restrictions were applied to the sample: we excluded pensioners, domestic workers and its relatives who live in the household in order to properly match revenues and household per capita income; kept only individuals over 16 years, but calculated the number of children (less than 16 years old) in the household and; restricted the sample to households based in rural areas. All variables are listed and descripted in Table 5.

It is clear for us that none of the methodologies described are capable of provide causal effects. To do so, we must have considered a sample where the jobs were randomly allocated and, or, use methodologies that capture exogenous – and random – variations. However, the method described in Section 4.1 not only accounts the effects from observed characteristics, but also, the unobserved, which allow us to infer about possible endogeneity resulted from the latter characteristics. In this sense, although our results could not be literally (or causally) interpreted, they present important features and relations that must be considered for inferring about labor market relations and income concentration specificities.

2.5 Results

In this section we present our research results. In Section 2.5.1, we descriptively explore our sample, and characterize rural works and unemployed individuals. In Section 2.5.2, we present the quantile effects and explore the inequality decomposition into observable and unobservable characteristics. In Section 2.5.3 we interpret the Gini Index and Lorenz Curve for both agricultural and nonagricultural income and, in, Section 2.5.4 we present the results based on the CCEB approach.

2.5.1 Rural Incomes and Individual Characteristics

In this section we outline the main characteristics of our population of interest: all rural residents who are more than 15 years old. Table 7 shows descriptive statistics of the main variables, considering those who perform agricultural and non-agricultural activities and those who are unemployed in 2019.

Table 7 - Average Statistics (mean) and Standard Deviation (Std. Dev.) for Agricultural and Nonagricultural workers and unemployed residents in rural Brazil, 2019

	Agricultural Jobs		**Nonagricultural Jobs**		**Unemployed**	
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Household *Percapita* Income	874,35	1234,90	953,47	1.147,78	632,39	801,36
Agricultural Income	1.156,23	2.465,27	-	-	-	-
Nonagricultural Income	-	-	1.334,40	1.729,42	-	-
Household Head	0,550	0,498	0,438	0,496	0,371	0,483
Spouse	0,404	0,491	0,507	0,500	0,538	0,499
Women	0,219	0,414	0,454	0,498	0,624	0,484
White	0,370	0,483	0,361	0,480	0,288	0,453
Age	42,55	14,86	38,28	12,82	45,94	20,85
Number of Dwellers	3,56	1,75	3,57	1,58	3,62	1,80
Children	0,865	1,17	0,893	1,07	0,812	1,16
Elderly	0,387	0,687	0,268	0,580	0,688	0,837

Illiterate	0,158	0,365	0,064	0,245	0,243	0,429
Elementary	0,101	0,301	0,050	0,218	0,103	0,304
High School	0,257	0,437	0,143	0,350	0,193	0,395
Tertiary	0,503	0,500	0,750	0,433	0,473	0,499
North	0,186	0,389	0,128	0,334	0,129	0,336
Northeast	0,323	0,468	0,409	0,492	0,557	0,497
Southeast	0,200	0,400	0,229	0,420	0,151	0,358
South	0,203	0,403	0,172	0,378	0,115	0,319
Midwest	0,088	0,283	0,062	0,241	0,048	0,214
Programa Bolsa Família	0,083	0,277	0,108	0,310	0,173	0,379
Retirement	0,131	0,337	0,055	0,229	0,337	0,473
Other Benefits	0,048	0,214	0,042	0,200	0,080	0,272
Industry	-	-	0,185	0,388	-	-
Construction	-	-	0,106	0,308	-	-
Vehicles	-	-	0,177	0,381	-	-
Transportation	-	-	0,045	0,207	-	-
Food and Accommodation	-	-	0,062	0,241	-	-
Information	-	-	0,045	0,207	-	-
Public Administration	-	-	0,050	0,218	-	-
Education and Health	-	-	0,142	0,349	-	-
Other Jobs	-	-	0,039	0,193	-	-
Domestic	-	-	0,150	0,357	-	-
Number of Observations	24,702		19,498		46,315	

Source: Research Results

We see that income from nonagricultural work is, in average, higher (R$1.334,40) than those from agricultural work (R$1.156,23). Naturally, household per capita income is higher for those with nonagricultural jobs (R$953,47) compared to those strictly agricultural (R$874, 35) or unemployed (R$632,39). Unemployment is more common among the spouses, while the higher proportion of head of households is seen in agricultural jobs. Also, we see that women represent only 21,9% of agricultural workers are more proportionally unemployed than men. However, the are 45,4% of nonagricultural workers, indicating that, indeed, these activities are a diversified source of income for rural household. This interpretation is similar for non-white workers: there are fewer white people unemployed, but also slightly less present in nonagricultural jobs. Younger people tend to be more present in nonagricultural jobs, and the average age among the unemployed and agricultural works is similar (approximate 46 and 43 years old respectively).

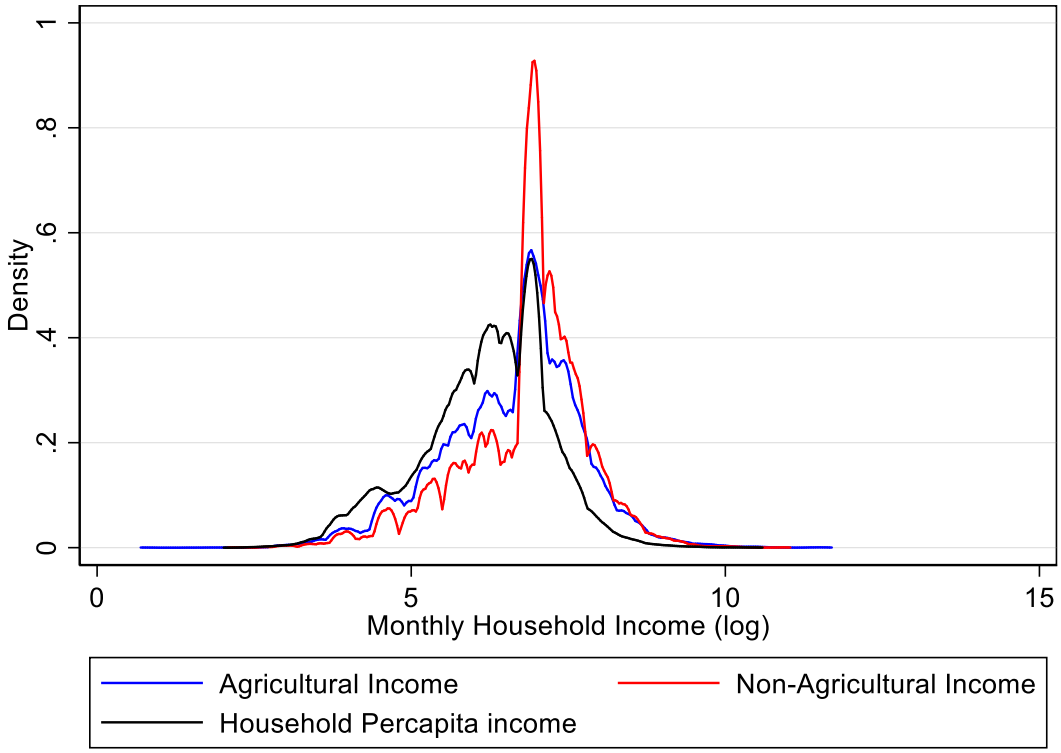
All household have, in average 3,6 dwellers and, 68% of unemployed household are composed by elderly (over 60 years old individuals), probably due to retirement. Regarding educational attainment there are a great part of individuals with tertiary education, and, in general, most part of this workers are engaged in nonagricultural activities, while the most part

of illiterate people are unemployed. Individuals with complete high school are more engaged in agricultural activities. Midwest and South region have more worker in agricultural activities than in nonagricultural and 55,57% of the unemployment individual reside in Northeast.

Among the nonagricultural occupations, most part of workers have industrial and vehicles jobs related, followed by domestic and education or health jobs. A fewer proportion is engaged in public administration (5%), information (4,5%) and transportation jobs (4,5%).

Figure 3 shows the income distribution in rural households divided by agricultural and nonagricultural income and the average household per capita income. We consider the logarithm income, and their difference are statistically significant. From Figure 3 we can see that average values could indeed mask specific effects: not only nonagricultural income has a peak around the seventh quantile, but also is slightly to the right of the other incomes. That is, agricultural income is more centered in the poorer household, while nonagricultural is on the wealthier.

Figure 3 - Monthly Household Income in Rural Brazilian Households, 2019



Source: Research results.

That said, we cannot ignore the difference in distribution of the types of income and also its concentrations among the household. In the next section we present the results of quantile estimators.

2.5.2 Income Inequality and Non-Agricultural Jobs

In this section we present the estimated results of the effects of income from non-agricultural jobs on total household income. Table 8 depicts the coefficients for the groups of agricultural workers (Group 1) and nonagricultural (Group 2). The coefficient *difference* shows the differences among the two groups. The coefficient *explained* and *unexplained* show, the composition of such difference regarding the observable and unobservable effects, respectively.

Table 8 Effects of Nonagricultural Jobs on Rural Income Inequality in Brazil, represented by quantile household per capita income and the Gini Index, 2019

	q10	**q25**	**q50**	**q75**	**q90**	**Gini**
Group 1	5.173***	5.880***	6.812***	7.328***	7.748***	0.0921***
	(291.34)	(455.50)	(977.37)	(861.78)	(766.69)	(166.53)
Group 2	5.567***	6.310***	7.088***	7.385***	7.852***	0.0752***
	(357.24)	(402.53)	(1616.16)	(1030.80)	(703.10)	(133.30)
Difference	-0.394***	-0.431***	-0.276***	-0.0565***	-0.104***	0.0169***
	(-16.66)	(-21.21)	(-33.50)	(-5.08)	(-6.90)	(21.43)
Explained	-0.515***	-0.479***	-0.107***	-0.0418**	-0.142***	0.0130***
	(-16.48)	(-17.92)	(-14.28)	(-3.14)	(-6.59)	(10.74)
Unexplained	0.122***	0.0480*	-0.169***	-0.0148	0.0377	0.00390**
	(3.50)	(2.05)	(-21.40)	(-1.04)	(1.64)	(2.66)
_cons	-0.0561***	2.682***	-1.476***	-0.320**	0.683***	-0.00642
	(-4.23)	(15.65)	(22.62)	(-3.21)	(4.01)	(-1.01)

Notes: t statistics in parentheses
*** p<0.05, ** p<0.01, *** p<0.001**
Group 1= agricultural jobs and Group 2=nonagricultural jobs

Source: Research results.

From Table 8 we see that indeed, both source of incomes (Group 1 and Group 2), are responsible for an increase in household per capita in all income strata. The average increase is higher for those in the group of nonagricultural jobs, that is, these incomes contribute more the households per capita income compared to those strictly agricultural. This difference is more attenuated for the lower quantiles 25 and 50, which correspond to a difference of respectively 53,88% and 31,78%[4], while in the upper quantile the difference is 11,96%. Therefore, we state that nonagricultural income is indeed responsible for decreasing income inequality, since they have a higher contribution specially for the poorest.

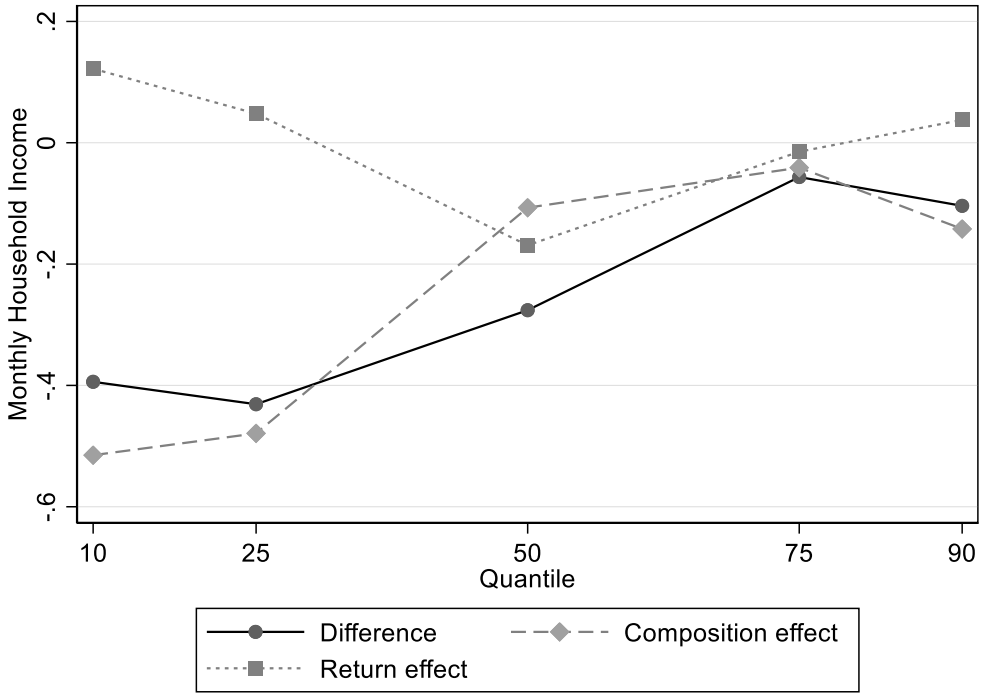
Gini decomposition reinforces this interpretation, since the group of agricultural jobs have a higher coefficient. The positive difference coefficient indicates that agricultural incomes in

[4] The calculation is based on ={[exp(0.431)-1]*100} and ={[exp(0.276)-1]*100}

the household increases income concentration compared to those from nonagricultural jobs. Additionally, we can explore whether the difference is based on observed variables, that is the composition effects or unobservable (return effects).

We see that these effects have different impacts on *percapita* household income. On one hand, the explained coefficients go in line with the difference ones, that is, they are, indeed, responsible for a negative difference between the groups. The main differences are explained by the educational level, regional effects and the job category (see all the covariates effects on Tables 13 and 14 in the Appendix). On another hand, the unobservable effects are actually responsible for a positive difference among the coefficients in the quantiles 10, 25 and 50. For the higher quantiles (75, 90), the composition effect was not statistically significant. This relationship in explored in Figure 4.

Figure 4 - Oaxaca-Blinder Decomposition of Return and Composition Effects on Monthly Rural Household Income in Brazil, 2019



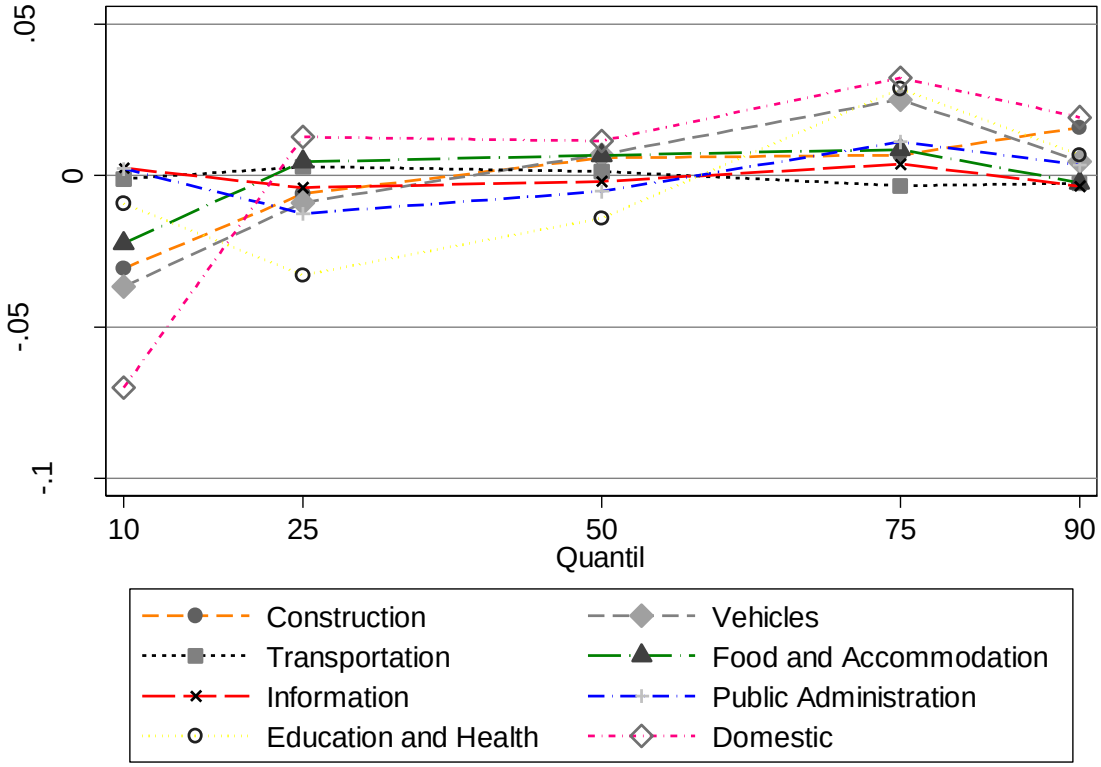
Source: Research results

We see that different observed characteristics influence rural household inequality. However, as we have pointed out in the theoretical section, there is an individual choice regarding participation in the labor market and engagement in specific jobs defined by unobservable characteristics. By definition, such characteristics cannot be measured and are captured by the error term. In this subsection we address this problem by decomposing inequality through return and composition effects of the covariates.

We show that in the first two quantiles, the return and composition effects have different interpretation: while observable characteristics increases the difference among the groups, the unobservable ones actually decrease it. It leads us to thinks that, intrinsically, poorest rural individuals do not have differences in terms of willing to perform a more profitable activity but, indeed, the expulsion factor may keep them away of certain opportunities that puts them in worse position in agricultural activities. Conversely, in the median (quantile 50) the return effects act strongly in the difference compared to the composition effects.

Differences in work categories are shown in Figure 5 in order to explore these particularities.

Figure 5 - Oaxaca-Blinder Decomposition of Return Effects of Work Categories on Monthly Rural Household Income in Brazil, 2019



Source: Research results

The work category that outstands in Figure 5 is the domestic work. This type of work is mainly made by women which, especially for the poorest could be the only option to increase household revenues. However, for the upper quantiles, the parameter is higher and positive. Actually, most of the parameters are negative in the lowest quantile and positive in the highest. That is, for the poorest, work categories increase the observable difference in household *percapita* income while in the wealthiest it decreases.

In order to explore other features of inequality, in the next section we present the complementary analysis.

2.5.3 Gini Index and Lorenz Curve

In this section we explore rural inequality through two broadly known analysis in the literature: the Gini index and the Lorenz Curve. First, we constructed the Gini Index considering the income from agricultural and nonagricultural jobs. In order to compare to average income, we also present the Gini results considering the rural household *per capita* income. The results are presented to all Brazilian regions and also to their respective states. In red, we stressed the values which nonagricultural income Gini index is bigger than the agricultural ones (Table 9).

Table 9 - Gini Index disaggregated for Nonagricultural and agricultural income and Household per capita income in rural Brazil, 2019

	Nonagricultural Income	Agricultural Income	Household Per Capita Income
North	**0,479**	**0,491**	**0,496**
Rondônia	0,429	0,417	0,412
Acre	0,543	0,404	0,553
Amazonas	0,388	0,56	0,485
Roraima	0,392	0,419	0,499
Pará	0,403	0,505	0,494
Amapá	0,403	0,342	0,439
Tocantins	0,425	0,346	0,435
Northeast	**0,419**	**0,488**	**0,453**
Maranhão	0,427	0,405	0,484
Piauí	0,434	0,483	0,462
Ceará	0,421	0,523	0,431
Rio Grande do Norte	0,406	0,443	0,443
Paraíba	0,473	0,461	0,44
Pernambuco	0,382	0,463	0,428
Alagoas	0,429	0,464	0,465
Sergipe	0,464	0,401	0,427
Bahia	0,409	0,43	0,433
Southeast	**0,413**	**0,402**	**0,439**
Minas Gerais	0,428	0,51	0,428
Espirito Santo	0,366	0,503	0,404
Rio de Janeiro	0,351	0,403	0,422
São Paulo	0,369	0,355	0,449
South	**0,346**	**0,481**	**0,395**
Paraná	0,449	0,386	0,416
Santa Catarina	0,442	0,504	0,351

Rio Grande do Norte	0,306	0,386	0,407
Mato Grosso do Sul	0,383	0,487	0,417
Midwest	**0,433**	**0,374**	**0,412**
Mato Grosso	0,366	0,373	0,387
Goiás	0,403	0,362	0,41
Distrito Federal	0,452	0,433	0,475

Source: Research results

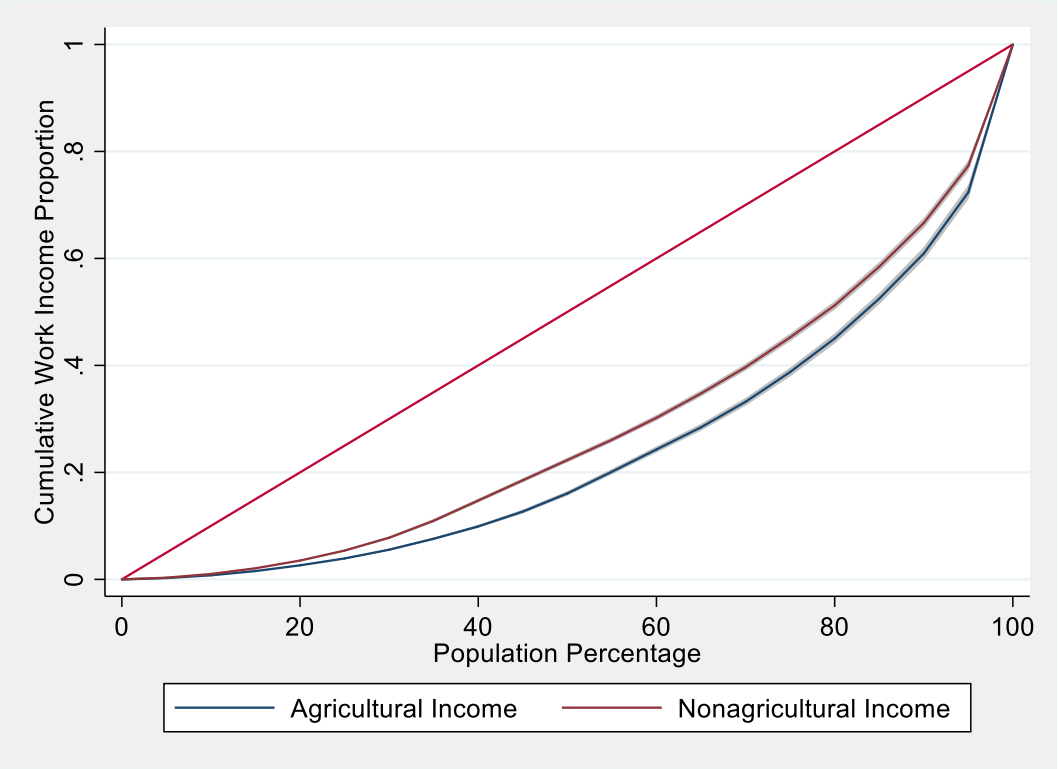
Gini index varies between 0 and 1, where 0 represents perfect equality and 1 the completely opposite. That is, higher Gini index values equals to a higher concentration income. In general, only 10 - out 27 - states and the Federal District have the nonagricultural income more concentrated compared to agricultural. Again, the results corroborate the hypothesis that nonagricultural income are associated with a decrease in income inequalities in rural areas.

Specifically, we see that in Southeast and Midwest regions nonagricultural jobs have higher Gini Index compared to the other regions. This result goes in line with the meso disparities explained in Section 2. These two regions have the most developed industrial economic structure in the country. Therefore, probably the work demand in these regions is more disparate in terms of human and labor capital intensity. This interpretation is enforced given the states disaggregation. We see that, for example, in Southeast region, only São Paulo presents this relationship, which is the most industrial state in the country.

Also, it clearly states the importance of considering regional specificities, given that, in all regions, at least one state has the nonagricultural work reinforcing income concentration compared to agricultural ones. Such specificities must be individually analyzed, considering the characteristics, such as agricultural and industrial structure and type of jobs required. These differences were analyzed in Southeast region by Moreira (2010) and in Northeast region by Lima (2008) and Mariano e Lima (2009). Madeira (2017) specifically analyzed the differences in income inequality and its determinants in both regions, and she found that mostly individual characteristics alongside with expansive public policies for economic growth in the regions are responsive for the main differences.

In Figure 6 we illustrate this relationship for Brazilian average through the Lorenz Curve. The pink diagonal line expresses the scenario of equality (Gini=0), where the cumulative income proportion matches the cumulative population percentage. In this sense, the closer the estimated Lorenz curve is to the diagonal line, more equally distributed is the income (perfect equality line).

Figure 6 - Lorenz Curve for Agricultural and Nonagricultural income for rural residents, Brazil 2019



Source: Research results

We see that agricultural income (blue line) are more distant to the perfect equality line then the nonagricultural one (purple line). Therefore, we can again state that nonagricultural income contributes to diminish income concentration in rural areas. This distance is especially bigger among the quantiles 0,3 and 0,9, which also confirm that incentives and expulsion factors acts differently in different classes. We explore the socioeconomics classes impacts in the next section.

2.5.4 Criterio Brasil

In this section, we present the analysis of rural inequality through the social classes defined by the *CCEB*. First of all, in Table 10, we show the frequencies and percentage of rural individuals in the respective classes, where 1 is the lower and 4 is the higher, that is, higher classes concentrate those individuals with more assets and educational level in the households.

Table 10 – Classes of CCEB, Frequency (Freq.) and Percentage (%) divided in agricultural and nonagricultural jobs and unemployed in Brazil rural area residents, 2019

Class	Freq.	Percent (%)	Freq.	Percent (%)	Freq.	Percent (%)
	Agricultural Jobs		Nonagricultural Jobs		Unemployed	
1	3,786	15.33	1,483	7.61	8,853	19.11
2	11,727	47.47	8,237	42.25	25,866	55.85
3	7,798	31.57	7,96	40.82	10,105	21.82
4	1,391	5.63	1,818	9.32	1,491	3.22

For all categories, the majority is centered in classes 2 and 3, the average ones. Taking the extremes, in the lower category (1) the most prevalent are those unemployed, followed by who perform agricultural jobs. By contrast, on the other extreme, the higher category (4), the highest concentration is those who dedicate to nonagricultural jobs. This relationship reflects two scenarios. The first one, the overall middle classes centered individuals, goes in line with CCEB average results, in which 66,2% of the Brazilian population is centered between classes 3 and 6 (out of 7). This result shows that, even though the methodology was significantly adapted, the classes division made in this work is similar to the original one. Also, it shows that a bigger part of the population is located in the two bottom classes, indicating that rural wealth distribution is quite unbalanced. Not only, we see that individuals engaged in nonagricultural jobs, not only are more distributed among the classes, but also, have lower presence in class 1 and higher in class 4, which demonstrate that they are, indeed, better off compared to those engaged in agricultural jobs.

Table 11 shows the coefficients of nonagricultural jobs on household per capita income. Five models are displayed: a baseline model with only the interest variable (1), a model with individual characteristics (2), with regional characteristics (3), work features (4) and all variables considered (5)[5].

Table 11 - Nonagricultural Jobs and Classes (CCEB) in Rural Brazil, 2019

	(1) Baseline Model	(2) Individual Characteristics	(3) Regional Characteristics	(4) Work Features	(5) All Variables
Nonagricultural Jobs	0,5137***	0,4269***	0,4947***	0,1109***	-0,0436***
	(0.0088)	(0.0092)	-0,009	(0.0213)	(0.0213)
Observations	90,515				

The first four models show that, indeed, the performance of nonagricultural jobs increase the probability of being in a higher class. In other words, individuals engaged in nonagricultural

[5] We also estimated the effects of the covariates combined (individual + regional; individual + work; regional + work). The interpretation remains the same.

jobs are more prone to be in the higher categories than in the lower. Individually, we see that individual, regional and work characteristics are correlated with a social ascending, considering the presence of assets in the household. We also estimated the effects of the group of covariates combined (individual + regional; individual + work; regional + work). The interpretation remains the same.

An intriguing point here is that, when all variables are considered (model 5), the effect is, although really close to zero, negative. The interpretation is, therefore, the opposite. The possible explanation for this fact is that, when all the covariates take place, the CCEB approach, based on assets and educational level, is better explained by the other household configuration, which reflects more on the overall economic status. In this case, the work specificity – agricultural or not –could not explicitly be correlated with purchase choices – although, as we showed, it is with the educational levels – since, as the previous sections show, it corresponds to a great part of the agricultural income. Not only, we must consider that this adapted methodology reflects on the presence or not of the listed items, and not the quantity, which gives a broader view in class stratification.

Finally, in Table 12, we presented the marginal effects, that shows the chances of an individual who dedicates to agricultural activities be in a given class.

Table 12 - Marginal Effects of Nonagricultural Jobs and Classes (CCEB) in Rural Brazil, 2019

Classes	Baseline Model	Individual Characteristics	Regional Characteristics	Work Features	All Variables
1	-0,102606	-0,07627	-0,08335	-0,02447	0,008043
	(0,00155)	(0,00147)	(0,00135)	(0,00455)	(0,00419)
2	-0,09243	-0,08256	-0,10114	-0,01629	0,007077
	(0,00211)	(0,00224)	(0,00236)	(0,00339)	(0,00351)
3	0,1294603	0,120004	0,141641	0,02987	-0,01289
	(0,00219)	(0,00258)	(0,00259)	(0,00573)	(0,00659)
4	0,0655755	0,038828	0,042854	0,010881	-0,00223
	(0,0015)	(0,00111)	(0,00111)	(0,00221)	(0,00111)

Notes: All parameters statistically significant at p<0.01

We see that the relationship showed above applies to the changing in class 2 to 3. For example, nonagricultural jobs are correlated with a decrease in the probability of being in lower classes in 10.26 percentual points (p.p.) and 9,24 p.p. in classes 1 and 2 respectively (specification 1). On the other hand, it increases in 12.96 p.p. and 6.56 p.p. to be in classes 3 and 4, respectively. The interpretation is extensive to the other estimations. The exception is

for the estimation with all variables, in which for classes 1, 2 and 4 the marginal effects are close to zero. The probability of being in class 3 in the same estimation is 1,3 p.p.

2.6 Concluding Remarks

In this paper we analyzed the effects of nonagricultural jobs on inequality in rural areas of Brazil. Specifically, we estimated the effects of non-agricultural jobs incomes on monthly household revenues using household data from 2019. Our empirical strategy used the Recentered Influence Function (RIF) approach in income quantiles and, additionally, we decomposed the effects on return and composition as proposed by Oaxaca-Blinder to address unobservable effects on income differentials. As complementary analysis we observed the Gini Index and Lorenz Curve decomposed and also an ordered probit model to address the probability of changing social classes based on a household assets approach.

We showed that engagement in nonagricultural activities by rural residents increases average income for all income strata. Furthermore, it is responsible for decreasing income inequality, since they specially contribute for an increase of revenues for the poorest. Our results also confirmed that unobservable characteristics play a major role in income inequality when labor market impacts are analyzed. As a result, we have argued that basic infrastructure and proper education must be provided to avoid a brain drain in rural areas. Further, access to markets and rural assurance must be provided, such as rural credit and subsides to guarantee that producers and other agricultural workers do not suffer from adverse circumstances and exogenous shocks. Guarantees of social reproduction in all spheres in rural areas and the prevention of flight from rural areas is imperative to improve the living conditions of its residents and for economic development more broadly.

That said, public policies must be combined in terms of i) providing formal and technical education, particularly for young people and ii) regulating agricultural jobs in order to avoid precarious conditions. These categories could uniformize the access possibility to any job and, also, the choice of performing nonagricultural jobs would be based on an individual choice and not the expulsion factors. Additionally, nonagricultural work could actually alleviate such inequalities if democratic access was guaranteed; that is, with adequate conditions and opportunities for all. For further research, we suggest analyzing the gender effects on the rural labor market, such as explore the endogeneity in education and informal employment.

APPENDIX

Table 13 - Quantile Explained Effects of the Covariates on the Household Per Capita Income

	Q10	Q25	Q50	Q75	Q90
ln_work_in~e	0.0108***	-0.414***	-0.104***	-0.148***	-0.206***
	(19.31)	(-22.87)	(-22.81)	(-22.40)	(-21.25)
household_~d	0.00232***	-0.0145	0.00270	0.0162***	0.0370***
	(6.93)	(-1.85)	(1.13)	(3.50)	(5.05)
spouse	-0.00111***	0.00596	-0.00285	-0.00267	-0.0202**
	(-3.81)	(0.83)	(-1.30)	(-0.64)	(-3.13)
woman	0.000354	0.00108	0.00128	0.0171***	-0.00942
	(1.02)	(0.15)	(0.60)	(4.07)	(-1.31)
white	-0.00000473	0.0000532	0.00000455	-0.0000283	-0.0000908
	(-0.12)	(0.12)	(0.12)	(-0.12)	(-0.12)
children_h~d	0.00000209	-0.000374	0.0000771	-0.000117	0.0000341
	(0.11)	(-0.87)	(0.61)	(-0.50)	(0.09)
elderly_ho~d	0.000134	-0.00664**	-0.00153*	0.0000761	0.00172
	(1.20)	(-3.08)	(-2.47)	(0.06)	(0.81)
illiterate	0.00108***	-0.000901	-0.00233	0.00515	0.0136**
	(3.44)	(-0.12)	(-1.09)	(1.49)	(2.66)
elementary	0.000224	-0.000714	0.00160	0.000215	0.00211
	(1.31)	(-0.18)	(1.40)	(0.12)	(0.79)
highschool	0.0000782	0.00246	0.00237	-0.00161	-0.00471
	(0.22)	(0.28)	(0.95)	(-0.39)	(-0.75)
tertiary	-0.00218**	0.00444	-0.00849	-0.0223*	-0.00660
	(-2.82)	(0.23)	(-1.57)	(-2.52)	(-0.49)
norte	-0.000236	-0.00656**	-0.00408***	-0.00586***	0.000245
	(-1.87)	(-2.67)	(-5.38)	(-4.05)	(0.09)
nordeste	0.000886***	-0.00396	0.00382***	0.0151***	0.00802*
	(5.11)	(-1.24)	(3.91)	(7.17)	(2.26)
sudeste	0.000109	-0.00205	-0.000604	0.00160*	0.00260
	(1.82)	(-1.82)	(-1.79)	(2.23)	(1.95)
sul	-0.0000758	0.00146	0.000581*	0.00178**	-0.00252*
	(-1.61)	(1.66)	(2.11)	(2.76)	(-2.21)
pbf	-0.000967***	0.0161***	0.00407***	-0.00783***	-0.0163***
	(-9.43)	(8.08)	(7.84)	(-8.90)	(-10.42)
retirement	0.00111***	-0.0175***	-0.00299**	0.00866***	0.0153***
	(5.04)	(-4.47)	(-2.81)	(4.22)	(4.09)
other_bene~s	0.000190***	-0.00283***	-0.000612**	0.000953**	0.00259***
	(3.59)	(-3.47)	(-3.20)	(2.94)	(3.33)
construction	0.00102***	0.000518	0.00603***	0.00189	0.00904*
	(5.76)	(0.13)	(5.18)	(0.82)	(2.30)
vehicles	0.00136***	-0.00782	0.00600***	0.0197***	0.00349
	(5.02)	(-1.47)	(3.77)	(6.42)	(0.67)

transporta~n	-0.000180	0.00457*	0.00131*	-0.00489***	-0.00451
	(-1.59)	(2.14)	(2.10)	(-3.66)	(-1.72)
food_accom~n	0.000576***	0.00295	0.00586***	0.00687***	-0.000290
	(4.33)	(1.02)	(7.02)	(4.80)	(-0.12)
information	-0.000133	-0.00321	-0.00196**	0.00223	-0.00422
	(-1.01)	(-1.58)	(-3.11)	(1.63)	(-1.60)
public_adm~n	0.000125	-0.0121***	-0.00594***	0.00800***	0.00295
	(0.89)	(-5.72)	(-8.79)	(5.38)	(1.06)
education	0.00112***	-0.0344***	-0.0178***	0.0151***	0.00759
	(4.05)	(-7.12)	(-11.83)	(4.91)	(1.35)
domestic	0.00275***	0.00890	0.0106***	0.0310***	0.0269***
	(11.58)	(1.67)	(6.79)	(11.10)	(6.74)

Source: Research results

Table 14 - Quantile Unexplained Effects of the Covariates on the Household Per Capita Income

	Q10	**Q25**	**Q50**	**Q75**	**Q90**
ln_work_in~e	0.0537***	-2.561***	1.452***	0.467***	-0.786***
	(4.70)	(-20.66)	(31.16)	(6.54)	(-5.70)
household_~d	0.000382	-0.0603	0.0115	0.0412	-0.0286
	(0.22)	(-1.62)	(0.69)	(1.64)	(-0.82)
spouse	-0.000337	-0.0262	-0.00759	0.0153	-0.00706
	(-0.38)	(-1.35)	(-0.87)	(1.17)	(-0.40)
woman	0.000615*	0.00589	0.00937***	0.00760*	-0.00663
	(2.19)	(1.16)	(4.08)	(2.13)	(-1.32)
white	0.00159**	-0.0147	-0.00265	0.0294***	0.0143
	(2.85)	(-1.43)	(-0.60)	(4.03)	(1.30)
children_h~d	-0.0000217	0.000628	0.00631	-0.00449	-0.00629
	(-0.04)	(0.06)	(1.52)	(-0.71)	(-0.68)
elderly_ho~d	0.000944	0.00465	-0.00160	0.00300	0.0156
	(1.81)	(0.51)	(-0.43)	(0.51)	(1.68)
illiterate	-0.00108	-0.0155	-0.0000797	-0.00650	-0.0132
	(-1.79)	(-1.14)	(-0.02)	(-0.93)	(-1.36)
elementary	-0.000679	0.00195	-0.00399	-0.00433	-0.00744
	(-1.81)	(0.23)	(-1.36)	(-1.03)	(-1.29)
highschool	-0.0000365	-0.00954	-0.00940	0.00737	0.0109
	(-0.04)	(-0.43)	(-1.19)	(0.63)	(0.65)
tertiary	0.00138	-0.0402	0.000795	0.0122	0.0431
	(0.81)	(-1.04)	(0.06)	(0.59)	(1.47)
norte	-0.00230***	0.0370***	-0.0393***	-0.0564***	0.00147
	(-4.27)	(3.86)	(-10.22)	(-8.12)	(0.13)
nordeste	0.00329***	-0.0177	-0.0795***	-0.0602***	0.111***
	(3.36)	(-1.04)	(-11.14)	(-4.80)	(5.54)
sudeste	-0.00341***	0.0340***	-0.0149***	-0.0858***	-0.0182
	(-5.92)	(3.47)	(-3.64)	(-10.73)	(-1.40)

sul	0.000816	-0.00920	-0.0180***	-0.0587***	0.0447***
	(1.36)	(-0.94)	(-4.50)	(-7.36)	(3.31)
pbf	-0.000594**	0.0134***	0.00108	-0.00560**	-0.00910***
	(-3.06)	(3.46)	(0.74)	(-2.97)	(-3.76)
retirement	-0.000391	0.0184*	0.00167	0.00225	-0.00304
	(-0.87)	(2.39)	(0.60)	(0.49)	(-0.40)
other_bene~s	-0.000226	0.00449	0.00181	0.00142	-0.000581
	(-1.08)	(1.37)	(1.52)	(0.71)	(-0.16)

Source: Research results

3. EFFECTS OF OFF-FARM WORK AND CLIMATE SHOCKS ON TIME USE IN RURAL BRAZIL

3.1 Introduction

Agricultural diversification such as performing off-farm work is a concrete strategy for rural residents to overcome the rising challenges of living in rural areas. In fact, these are instruments of adaptation for income generation and assurance in case of agricultural shocks, especially for poorer households (ESCHER et al., 2015). The effects of performing off-farm work, that is, the portion of paid work performed by rural dwellers outside off the farms, have been broadly studied in the literature. According to Start (2001), off-farm work affects several well-being outcomes, such as generating income externalities for the poorest and providing social and political empowerment through new opportunities and skills accumulation, education, migration, among others.

If off-farm work has the potential to impact such household variables, it is expected that it might also affect the relative bargaining power between spouses in a household. This effect, in turn, could be the channel which one might see different labor supply behaviors in response to the performance of such jobs. In this spirit, Gasson and Winter (1992) found that, in England, households where the spouses work outside their farms, time allocation tend to be more balanced between men and women considering paid jobs and domestic work[6].

This balance is hard to achieve especially for rural women, for whom the failure to consider the time spent in unpaid activities as work is particularly harmful. Women are usually mainly responsible for care work and household activities (reproductive work), while men dedicate mostly for the so-called "productive work", which is monetized and, therefore, valued. This difference makes the female contribution for the economy invisible and it is associated with a considerable work burden and smaller average wages, which, in turn, leads to fewer time for leisure and well-being.

Time allocation between paid and unpaid activities is an important issue in rural households since this is usually the space devoted for agricultural production and, in such cases, the productive and reproductive work is easily confounded. Also, it is well known that the lack of time to rest or leisure – once the time spent working is accounted for – is a source of poverty that jeopardize individual well-being in different natures such as food security and nutrition (BRAGA, 2018), health problems (VÄÄNÄNEN et al., 2005), social participation (BITTMAN, 2002) among many others outcomes (GERSHUNY, 2011).

[6] We found no other studies that dedicated to investigate this relationship.

Ignoring those facts lead to two major economic problems. First, it affects household well-being in its different aspects but, specially, restrain women to achieve basic rights and, therefore, contributes to gender disparities. Second, it misled a major contribution for the economy arisen from female work and disregard the role of women in the work sphere. In fact, Oxfam estimates shows that women carry out three-quarters of unpaid work in world, which corresponds to 12,5 billion hours and a contribution of US$10.8 trillion a year, more than three times the size of the global tech industry[7] (COFFEY et al., 2020). In Brazil, according to Jordana Jesus (2018), reproductive work corresponded to 10,4% of GDP in 2013.

This is an issue particularly important in Brazil for two main reasons: i) off-farm work has been widely adopted by rural residents as a source of income diversification (in 2018 35% to 40% of workers, in all Brazilian regions, performed off-farm work, two times more compared to 2002 in some regions[8]); ii) rural women are usually shown to be a more vulnerable group compared to rural men and also urban women. For example, Brazilian data show that they are poorer, less educated and face more food insecurity, (BRAGA, 2018; NOBRE et al., 2017).

There is a direct association between this vulnerable scenario for women and household time allocation, as stated by the Feminist Economics theory (SABBATO, 2009). In this perspective, by providing evidence on the effects of the off-farm work on time allocation between spouses, we also offer an indication of its effect on women vulnerability concerning their bargaining power and income (which, in turn, are powerful tools for their well-being).

Specifically, in this paper we seek to answer how off-farm work affects time allocation in rural households in Brazil, considering the division of work – paid and unpaid – among husbands and wives. For that purpose, we use household level data from 2002 to 2015 and an identification strategy based on the use of climate anomalies as a source of exogenous variation of off-farm work. In order to estimate the differences in time allocated in household chores, we use the dissimilarity index proposed by Jahn et. al. (1947), and also the differences in weekly hours devoted to domestic and total work.

With that in mind, we aim to bring new evidences for the relationship which we did not find in the recent literature. Also, we present time use analysis through different perspectives, allowing comparisons and analytical perspectives for the theme. Furthermore, we advance in stablishing causal effects by adopting time and region variations through an exogenous shock (instrumental variable approach).

[7] Based on minimum wages.
[8] Research results based on PNAD data (IBGE, 2019a).

The paper is structured as follows: besides these initial remarks, in Section 3.2 we present a literature review of theoretical framework of intrahousehold resource allocation from a Feminist Economics perspective, and empirical and theoretical evidences of time use and work diversification. In section 3.3 we show the identification and empirical strategy and the data used, followed by the results in Section 3.4. Finally, Section 3.5 concludes.

3.2 Gender, Time Use and Work Diversification: Empirical Evidences and Theoretical Framework

In this section we discuss theories and empirical evidence concerning labor market and time allocation through a gendered perspective. In this sense, in section 3.2.1. we follow the Feminist Economics approach to provide theoretical insights on the issue. Section 3.2.2 presents empirical evidences on time use, valuing and its allocation in the households. In Section 3.2.3 we discuss some of the main evidences regarding the relationship between off-farm work and well-being outcomes of the rural households.

3.2.1 Theoretical Framework: Time Allocation and the Feminist Perspective of Economic Theory

Time as a resource was first studied by Margaret Reid, in 1934, when she recognized household as both producer and consumer and defined housework as being productive (FERBER, 2003). However, it was formalized in mathematical terms and widely known from Becker's (1965) seminal “Theory Of The Allocation of Time”. It is currently pointed out as when, for the first time, *time* was part of the consumption choices of the families in the utility maximization, where households are both consumers and producers. The theory states that the family produces commodities by combining inputs of goods and time, minimizing costs, as in the traditional Theory of the Firm, while the maximization of the utility function is based on commodities production subject to prices and a constraint on resources. In this theory, the resources are measured by the “full income”, that is, the sum of revenues, time and goods used to obtain individual utility. Also, commodity prices consider the goods costs and time inputs.

The mainstream assumption of fixed proportions is dropped by the author and some additional implications are added, such as the division of labor within families. Becker shows that the allocation of time is not only efficiently allocated for commodity production, but also among the different members in the household. This allocation could happen through two ways: i) time spent at consumption would be more used by those members who are less efficient at market activities and; ii) the more efficient at market activities a member is, more flexible is the reallocation of time among the other members at the consumption activities. In short, “the

allocation of the time of any member is greatly influenced by the opportunities open to other members" (BECKER, 1965, p. 21).

Later on, Becker (1991) in his Treatise on the Family shows that the division of labor in households and families should be set considering the members comparative advantages. The proven theorem states that:

> If all members of an efficient household have different comparative advantages, no more than one member would allocate time to both the market and household sectors. Everyone with a greater comparative advantage in the market than this member's would specialize completely in the market, and everyone with a greater comparative advantage in the household would specialize completely there (BECKER, 1991, p. 50).

The specialization, according to the author, must consider explicit and intrinsic characteristics. In this sense, since women are responsible for bearing and feeding a child, they have a biological investment that should be worthwhile. The argument is that sex of household members is determinant for the production of household and market commodities. Therefore, an hour of household or market time of women is not a perfect substitute for an hour of the time of men, which for the author explains why women should dedicate their time to household chores, while men invest their time to market activities (BECKER, 1991).

Becker's theory remained as the mainstream in Family Economic and is still considered by some authors as a guide to interpretating empirical events. However, his untimely assumptions are not helpful anymore in providing insights to families in modern societies. For example, he ignores unmarried and same sex couples, and presupposes marriage as necessary fact for adults. Among others critics, Ferber (2003) points that this theory – such as other neoclassical – rejects the assumption that individuals differently allocate the resources in the household, given distinct preferences.

The idea that all the household decisions are made by an altruistic member (the so-called "benevolent dictator") is questioned by new approaches, such as the collective models that brings to light individual preferences of household members (ALDERMAN et al., 1995; BOURGUIGNON; CHIAPPORI, 1994). Even though this perspective allows to model different household behaviors, here we chose to follow the Feminist Economics theory, in order to properly address gender issues and its particularities.

According to Cristina Carrasco (1999), the Feminist Economics was introduced in the XIX century as a critic to the Neoclassical and Marxist paradigms and their way to understand women's socioeconomic status. On one hand, neoclassical models try to rationalize traditional roles of the sexes within the families and in the marker to justify – and somewhat reinforces –

the status quo. On the other hand, Marxism is criticized for guiding the analyses through a supposedly gender-neutral convergence of economic interests between working classes.

In addition to the methodological and epistemological criticism, Feminist Economics has been broadly studying different topics through the last five decades, such as domestic work, the different aspects of women's participation and discrimination, economic policies, gender and development, among others. Basically, it questions the androcentric bias of economics seen in the main researches, where women and their main activities are omitted and excluded, failing to analyze specific restrictions and conjunctures (CARRASCO, 1999).

According to Hildete Melo and Marta Castilho (2009), the discussion starts pointing out that different life conditions of men and women are not a product of a biological destiny, but of social constructions that are based on work and expressed through a social division of labor between the sexes. In this sense, we rescue the definition of household production, which, according to Margaret Reid:

> consists of those unpaid activities which are carried on, by and for the members, which activities might be replaced by market goods or paid services, if circumstances such as income, market conditions and personal inclinations permit the service being delegated to someone outside the household group (REID, 1935).

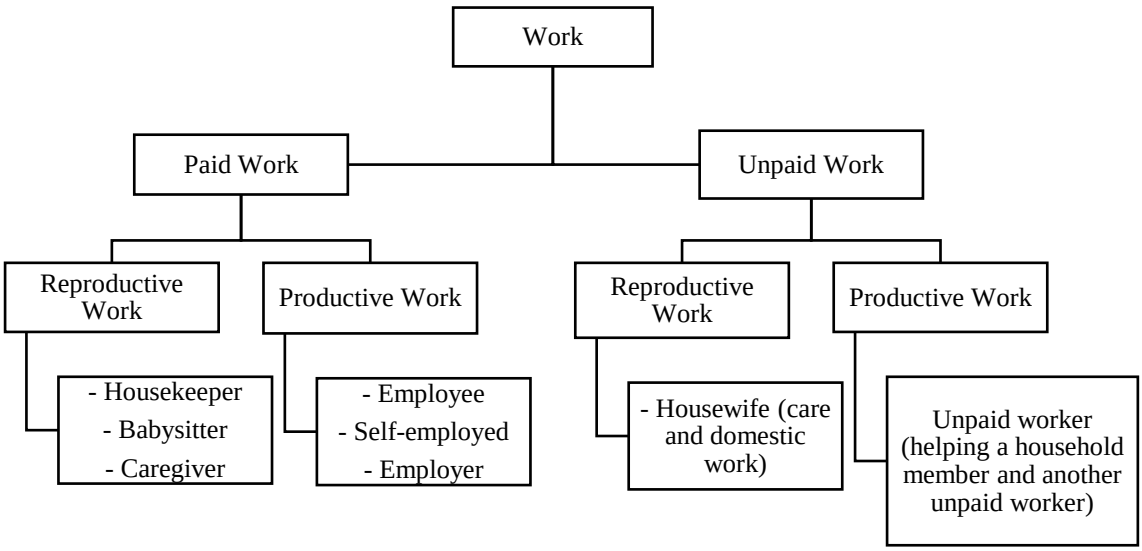
However, the concept of “sexual division of labor”, which was consolidated during industrializing period, underestimate the female work in the family. That is because domestic work is considered as “non-work”, since production is linked to “production of goods” and work with “employment”. Such perception embodies a linear association between male activity and market production and female and domestic family activity, which, for its turn, highlights the invisibility of women's work (MELO; CASTILHO, 2009). In this sense, it is entrusted to women the reproductive and unpaid – work – while men are responsible for the “productive”, paid work.

According to Danielle Kergoat (2003), the sexual division of labor has two organizing principles. First, the separation principle, that is, some works are for women and others for men. Secondly, the hierarchy principle, where the work of a man is worth more than of a woman. The author states that studying this topic goes beyond a simple inequality inference, and it articulates the real work reflecting on the process by which societies use to differentiation to rank these activities. However, it is clear that the unpaid work is essential in order to labor market system to work.

When women mostly dedicate for the “reproductive work”, on one hand, they allow companies (and other market institutions) benefit from the fact that someone is at home taking care of the children and domestic chores, with no cost; on the other hand, other members of the household can guarantee their paid jobs since they will have the food prepared, the clothes washed and house tidy (MELO; MORANDI; DWECK, 2020). In this sense, the (female) domestic work implies in an individual (and female) cost, for a public benefit.

In Figure 7, translated from Cristiane Soares (2016), we show that there is a pattern in jobs where the majority of workers are women. When we understand work in its broad concept, the productive and reproductive work can be paid or not. It was already shown that reproductive chores are mainly a female activity. Regarding the productive work, it is clear that female participation in labor market has increased in the last decades. However, the evidences shows that they are still majority in low prestige and precariousness jobs, besides facing a glass ceiling (BRASIL, 2018; ITABORAÍ; RICOLDI, 2016; SOARES, 2020)[9].

Figure 7 - Labor division from a gendered perspective



Source: Adapted from Soares (2016)

The last category presented in Figure 7 represents the unpaid productive work, which affects especially rural women. Specifically for rural women, Lorena Moraes and colleagues

[9] Glass ceiling is a concept that represents an invisible barrier that prevents certain groups from crossing a higher level in labor market hierarchy. An indicator that represents this phenomenon in public service in Brazil, is the gender distribution of management and advisory positions in the federal government. In the 4 lower categories, women represents in average 44% of workers, while in the highest, they are only 18,7% (BRASIL, 2018).

(2020) affirm that this division constitutes a double invisibility of work because it is a daily process of erasing the centrality of female tasks in agricultural production, often considered as "help" to what is considered to be "men's work in the fields", through the subjugation of domestic work and care to the category of non-work. In the same sense, according to Neuma Aguiar (2020), rural women is concentrated in a group of "purely domestic" work, which denotes a social organization deviated from a rural patriarchy, and such specialization is associated to the conditions of rural life.

It must be noted that rural women usually work on their domestic agricultural production to self-consumption and trade in informal markets, in a sense that it is not computed to the GDP (FAO, 2012). For example, in Brazil throughout a passbook, rural women wrote down their production and its destination (consumption, trade, donation and sales) (WEITZMAN et al., 2020). The information gathered showed that the economic contribution of women is at the same time, significant and erased in traditional measures (being invisible even in the household). As a result, rural women not only have a major role in the reproductive work, but also in the maintenance of the households as whole.

In this work we seek to analyze rural household and how work diversification can transform time allocation among its members. Besides presenting different measures and inferences of time use, especially for household chores, we show that when performing off-farm work, rural women break social structures that defines a gendered separation of work and are more prone to bargain the intrahousehold resource allocation. Specifically, we are main interested in the allocation of work time and the division of work in the household among men and women.

That said, in the next subsection we present some empirical evidence and appliances of time use theories, highlighting its importance and how it affects the overall well-being in the household. Additionally, we bring some discussion on the mechanisms which off-farm work impacts different outcomes, and how it relates with the division of time.

3.2.2 The allocation of Time

As we showed above, time use and gender analysis are complementary subjects. In order to empirically address the unbalanced time allocation in the household, several theories and approaches urged in the literature. A prominent topic in the literature is the "poverty in time" analysis. This theory lays on the idea that intrahousehold resources such as time available for non-work activities is as important as income to guarantee psychological, social and physical well-being (WILLIAMS; MASUDA; TALLIS, 2016).

The first model of poverty in time dimension was proposed by Vickery (1977), who stated that if either time or money available to the household falls below a threshold, the household is considered to be poor. Besides that, minimal levels of time and money are not sufficient inputs by themselves to change poverty status. That is, neither money nor time alone are capable of guarantee the individual's well-being. Not surprisingly, female headed household tend to be poorer in time and income dimensions, especially in developing countries (AGUIRRE; FERRARI, 2013).

Nowadays, time poverty is analyzed using measures of time allocation based in a triangle shape, as reviewed by Gershuny (2011): paid work, unpaid work and leisure. Other authors consider discretionary (or residual) measures (BITTMAN, 2002; WILLIAMS; MASUDA; TALLIS, 2016; ZILANAWALA, 2016), which allows to define thresholds for time scarcity. For example, Chatzitheochari and Arber (2012) consider as "time-poor" those economically active individuals whose free time falls below 60% of the median free time of the working population. From their perspective, it should be considered cultural elements and available resources to a proper enjoyment of free time.

A prominent methodology in the international agenda to evaluate domestic work through a creation of a satellite account embodied to the System of National Account (SNA)[10]. The first imitative was the development of the "Household Production and Consumption Proposal for a Methodology of Household Satellite Accounts" by Statistical Commission of the United Nations, which approved an extension of the SNA (EUROSTAT, 2013).

Valuing the output of unpaid – reproductive – work is a hard task, given it does not have, *a priori*, a market price. Nancy Folbre (2015) systematized the main approaches available to value the non-market work[11]:

a) Estimating the market value of both unpriced inputs and outpus, using a price of a replacement service on an hourly basis and multiplying that wage rate times the number of hours of unpaid work. For instance, if a woman spend in average 2 hours a day with cleaning tasks and the cost of hiring someone to do the same task is $1 and hour, the value of her time would be $2/day. An annual estimate yould be $730 added value ($2 * 365 days). This is the most used method of valuation.

[10] The System of National Accounts (SNA) presents information on the generation, distribution and use of income in the country. Satellite accounts are extensions of the National Account System and they allow elaborating analyzes on the profile and the evolution of a sector in a comparable way to the total economy, measured by the SNA. In Brazil, the most known satellite accounts studies health and tourism (IBGE, 2019b).

[11] For a mathematical perspective of time valuation, see Melo, Morandi and Dweck (2020)

b) Opportunity cost measure, by inputing the market wage the person engaged in unpaid work would earn if the time were allocated to paid activities. However, this approach have some limitations, given that it is not consistent with national accounts principles and it values the housheold work based on a possible different type of work. However, it is good to observe how individuals maximize their own utility allocating their time in the aimed activities.
c) The output-based approach seeks to evaluate the activities based in the market price, for example comparing the price of a similar meal prepared at home and in a restaurant (subtracting all the inputs).

Specially after the EUROSTAT document, several countries in the North Globe started to valuate and deeply investigate time use issues. Moreover, time poverty, besides of being a female issue, is a problem even more present in developing countries (LIU; ESTEVE; TREVIÑO, 2017; SABOOR; MANZOOR; KHAN, 2016), where labor market is usually less regulated and economic opportunities tend to be more unbalanced (LOPEZ-ACEVEDO; FREIJE-RODRIGUEZ, 2020; WORLD ECONOMIC FORUM, 2019).

The effort of valuating domestic work in Brazil was performed by Jordana Jesus (2018). The author estimated the age, production and time transfer profiles and distinguished three main patterns between men and women regarding time use in Brazilian households. She found, by valuing the domestic work using the paid domestics work as reference, that unpaid work – household chores and care work – represented in 2013 10,4% of GDP. Additionally, the results showed that women, since childhood, spend almost their whole lifetime as liquid transfers of time use in all income levels, while men are, in all ages and income strata, liquid consumers, that is, they consume more than produce domestic work.

The discrepancies are even higher in rural areas. As shown in the Atlas of rural women in 9 LAC countries[12], rural women perform even 4 times more hours to unpaid work than urban men. They also work more in the household when compared to urban women or rural men (NOBRE et al., 2017). As showed in previous section, the main differences are explained for distinct social mechanisms, which, according to Blair and Lichter (1991) is centered in time availability, power theory and gender role ideology. Such mechanisms are even higher and are structurally defined in rural areas (GASSON; WINTER, 1992). Since men usually are the ones responsible for paid work in rural households, they tend to have less available time for other

[12] The research used CEPAL data and shows the relationship for Brazil, Colombia, Ecuador, Guatemala, México, Peru, Uruguay and Honduras.

activities compared to women. As a consequence, men are responsible for providing income which give them a higher status in the household decision making (bargaining power). This *status quo* leads women to specialize in household chores. Our hypothesis here goes through these three possibilities, that is, off-farm work can change household time allocation and balance the division of time among spouses (since it might change the relative bargaining power between spouses).

Taken as a whole, we see that time poverty is a problem that affects mainly women in developing countries. This burden is even higher in rural areas, where gender relations tend to be stricter. Even though some advances can be pointed out regarding the rights of rural women in Latin America, lots of obstacles must be overcome in order to achieve a proper female autonomy. In this sense, looking into their particularities and how the structures that define gender inequalities are built on, is a first step to draw policies and generate data to properly address the matter. That said, in the next section we present the evidences of how off-farm work is capable of altering household resources allocation and how it may affect women in rural areas.

3.2.3 Gender, Work and well-being

Female participation in labor market, as explained by Cristiane Soares (2020), can be responsible for a double movement: on one hand, it reduces economic dependence, since there is a source of income for her own; on another hand, it intensifies their responsibility with domestic chores, since their total workload increases. Such increase is due to a sum of hours of work dedicated in the labor market, where they perform productive work, and the household chores at home, which remain their duty. Luana Pinheiro et al. (2019) emphasize the physical and emotional harms caused by the double journeys – performance of both productive and reproductive work –, given the repetitiveness, exhaustion and absorption required. According to the authors, in Brazil, domestic workers perform the same activity for 50 hours a week, on average, and they are mainly in informal works and are paid 92% of the minimum wage, averagely.

The reproduction of gender norms that defines individual roles based on gender are specially seen in rural areas. To change the scenario, external changes are needed, for example through work diversification. According to Start (2001), off-farm work is related with household well-being in different dimensions, such as income, work conditions, inequality, security in labor markets and as an instrument for social and political empowerment. Through

these mechanisms, rural areas residents who work outside their farm might be able to develop new skills and contacts, which can, potentially, break social structures inside their families.

There are considerable empirical evidences on the effects of off-farm work on different household outcomes, even though just a few studies have considered the gendered approach. For example, off-farm activities are correlated with decreasing income inequalities in rural Brazil (BRAGA; NEVES; COSTA, 2020; NEY; HOFFMANN, 2008) and it is pointed by Christiaensen and Martin (2018) as a strategy for rural poverty reduction. Off-farm work also affects resources allocations in the household, such as land transfers (ZHOU et al., 2020) fertilizers expenditures (MA; ABDULAI; MA, 2018) and time allocation in different agricultural activities (SU et al., 2016).

Specifically from a gendered perspective, Gasson and Winter (1992) showed that off-farm work can increase women's bargaining power through two main mechanisms: the first is related to their own income and the second is due to their greater involvement in the property management if it is their husbands who take such jobs. Women's bargaining power, in its turn, would have the potential to lead to a more equitable time allocation among work, leisure and other activities in the household.

Research on gender roles, and its particularities in rural areas has shown how the work of "farm wives" and the value of their contribution to the farm were ignored in conventional analysis (RURAL DEVELOPMENT COMISSION, 1991). Earlier researches show that "rurality itself influenced women's involvement in employment, not only through the practical barriers (…) but also through the social and cultural expectations surrounding women's roles" (LITTLE; PANELLI, 2003, p. 5).

Also, according to Martine Dirven (2016), since women are less likely to access land, they have a personal incentive (and also from their parents) to specialize in non-agricultural jobs, being agricultural activities a last instance choice, despite an associated migration process for urban areas given the lack of opportunity in rural areas. Miriam Nobre et al. (2017) showed that increasing information access and education could change the youth expectation for life. In Latin America, according to the authors, it led to a decline in unpaid family work and a rise in non-agricultural rural jobs (even though 51% of young people perform agricultural jobs and 30% is unpaid).

Such scenario helps to set several disparities that are strongly observed in the unbalanced division of work in the household. Given that the reproductive work in the households is unpaid and, therefore, not considered as a proper economic activity, rural women face a dependency of a male partner – figure of a partner of the father – reinforcing the

panorama of female vulnerability in the long term. In this sense, off-farm work and non-agricultural activities could be an instrument for disrupting such structure, especially for young girls.

Naturally, these relations depend on several characteristics such as educational achievement, human and capital accumulation, income and others that create an attraction factor for a possibility of ascending. Likewise, the insertion in diverse labor market could be driven by the lack of opportunities in rural areas and the need to overcome poverty and vulnerabilities (REARDON; CRUZ; BERDEGUÉ, 1998). It is imperative that such characteristics are taken into account to properly measure the effects of off-farm work in household overcomes.

To address this matter in Brazilian rural household, in the next section we present the empirical strategy and methodological procedures used to analyze how off-farm work can change time allocation in the household and how it affects gender disparities.

3.3 Empirical Strategy

The main purpose of this work is to estimate the effects of off-farm work on time allocation in rural households in Brazil, measured by the time devoted to reproductive work (domestic chores). It is clear that, even though the choice of performing off-farm work is based on observable characteristics such as education, income and living conditions, for example, it also depends of the individual willing, especially given gender roles and constraints that affects rural women, as shown above. If we are able to assume that differences in households that perform and don't perform off farm work are due to observables characteristics, then the conditional independence assumption might be used to provide us with a causal relationship. In this case, the inclusion of the variables in the control vector would eliminate the selection bias due to observables.

An ideal experiment to overcome the selection bias would be to randomly assign the off-farm work between the households (generating an exogenous variation in this decision). Given the impossibility of such experiment, we rely on observational data together with an empirical strategy that try to deal with the selection bias due to observables and non-observables. In this sense, we use data drawn from the *Pesquisa Nacional por Amostra de Domicílios* (PNAD), a household survey that inquire the reproductive work through care work and domestic chores. We use the data for couples from 2002 to 2015[13] which allows us to analyze the variations on time and also in cross-sections.

[13] In 2010 the survey was not carried out given the national Census.

Our outcome, that is, the difference in time allocated in domestic work between spouses, is measured by the dissimilarity index, proposed by Jahn et. Al. (1947), and applied to time allocation between spouses by Blair and Lichter (1991). It was confirmed as a valid measure to gender segregation in Brazil by Botassio and Hoffmann (2020). The index provides a useful summary measure of household gap and it is calculated as

$$D = \frac{1}{2}\sum_{j=1}^{k} |w_j - h_j|$$

where w_j and h_j are respectively the percentage of the wife's and husband total labor (in weekly hours) devoted to household chores *j*. *D* indicates the percentage of time that should be allocated in order to achieve total equality. The upper limit is 1, which represents completely segregation; conversely, the lower limit is 0 and represents that the time allocated between husbands and wives are equal. In this sense, an increase in *D* represents a more segregated scenario. We also consider two complementary analysis: first we will consider the total time in both productive and reproductive work. Second, we estimate the effects of off-farm work on the difference

To analyze the effects of off-farm work in the dissimilarity index, we estimate the following equation:

$$y_{i,t} = \propto + \beta TW_{i,t} + \delta {X_{i,t}}' + \theta_1 y_t + \theta_2 r_s + \theta_3 y_t * r_t + u_{i,t} \quad (10)$$

where $y_{i,t}$ is the dissimilarity index in the household *i* in year *t*. Our variable of interest, $TW_{i,t}$, is a dummy variable that indicates if the woman performs off-farm work, defined by those residents in rural areas whose work was not carried out in a farm or their own household; $\propto$ is a constant; $X_{i,t}$ is a vector of individuals and households observed characteristics, such as the *percapita* income, the age and years of study of both spouses, and dummy variables that indicates if the household is headed by a woman and if one of the spouses works for subsistence. Also, we add fixed effects of year ($\theta_1 y_t$), location ($\theta_2 r_s$) defined by the state the household is located and their interaction ($\theta_3 y_t * r_s$).

Complementarily, we will also consider the cases where only the husband performs off-farm work ($TH_{i,t}$) and when other member of the household does ($TO_{i,t}$), such as specifications (11) and (12) respectively:

$$y_{i,t} = \propto + \beta TH_{i,t} + \delta {X_{i,t}}' + \theta_1 y_t + \theta_2 r_s + \theta_3 y_t * r_t + u_{i,t} \quad (11)$$

$$y_{i,t} = \propto + \beta_1 TO_{i,t} + \delta {X_{i,t}}' + \theta_1 y_t + \theta_2 r_s + \theta_3 y_t * r_t + u_{i,t} \quad (12)$$

The empirical strategy described above is based on the assumption that the only reason why households that perform or not off farm work are different is due to the observables in X'. The choice for off-farm working, nonetheless, might be correlated with unobservable characteristics. In this case, we wouldn't be able to obtain the true causal effects. Besides the unobservable variables that affects both dependent and independent variables, as stated Cristiane Soares (2020), there is an unbalance in the declaration of time allocated for reproductive work if the informant is a men or a woman. According to the author, the sex and the informant condition (that is, if the informant is declaring their own information or other member, and also if she/he is the head of household, or a family member, for example), affects in the quality of the data, given that men associate reproductive work as a female task and don't see themselves, or other men, as responsible for that, or even don't have a proper magnitude of the work done[14]. It is even more relevant considering that the productive and reproductive work of rural women in their households is seen as a "help", as we explained before. That said, we use an exogenous variation in off-farm work in order to get the causal effect and validate – or not – the previous effects.

3.3.1 Robustness estimations: correcting Omitted Variable Bias using Instrumental Variables

Since some unobserved characteristics (E_i) can affect both y_i and T_i, our parameter of interest would be biased. A possible solution to this problem, according to Angrist and Pischke (2008) is the use of instrumental variables. Specifically, we use climate anomalies (in precipitation and temperature) as an exogenous shock to the performance of off-farm work, represented by a vector Z'.

This approach allows the bias correction of Omitted Variable Bias (OVB) by selecting a variable vector Z' called instruments, which must satisfy two conditions in order to be valid: a) exclusion restriction, which assures no correlation between Z' and u_i, or $Cov\ (Z', u_i) = 0$, and; b) relevance, ensuring that Z' explain the endogenous variable. Both conditions satisfied, the outcome variable Yi can be explained through an exogenous variation of the off-farm work (induced by Zi). The estimations can be made by two stages least squares method (2SLS): in the first step, the endogenous variable is explained by the controls included in the equation (10) and the instruments vector:

[14] Soares (2020) shows that, in 2015, in the cases of a man self-informant the rate of domestic work made is 62%, while if it is a man informing about the other dweller, the rate reduces to 42,3%. That is, the rate of domestic work performed strongly reduces when the work is done by someone different than the informant. The results also reflect the average journey in hours dispended.

$$T_i = \psi + \tau X' + \gamma Z' + r_i \quad (13)$$

Afterwards, the main equation (Eq. 10) is estimated with the estimated values obtained from (Eq. 13). Using IV solves the OVB problem – strongly present in gender relations – as long as the instrument is exogenous and only affect the intrahousehold allocation of time throughout the choice of performing off-farm work. Certainly, agricultural activities are directly affected by climate conditions, especially in case of extreme events (LOBELL; SCHLENKER; COSTA-ROBERTS, 2011; SCHLENKER; MICHAEL HANEMANN; FISHER, 2005).

If domestic production is affected by extreme climate events, we expect that (rational) individuals seek other sources of income to overcome possible losses. Adaptation strategies, in this sense, are important elements to protect households. Indeed, according to Elena Piedra-Bonilla, Cunha and Braga (2020), households tend to adopt more diversification strategies when climate variations are higher in Brazil. Bastos, Busso and Miller (2014), for its turn, showed that drought effects reduced agricultural value added and led to a decrease in employment and wages in Brazilian agricultural sector. According to Asfaw, Pallante and Palma (2018) , anomalies in rainfall and droughts induce adaptations responses, which results in welfare gains in Nigerian household.

Also, Yang e Choi (2007) stated that given temperatures variations, the rural domestic income is reduced if the households don't use adaptation strategies. According to Gasson and Winter (1992), rural intrahousehold allocation strategies are influenced by climate conditions in the agriculture and households particularities. There is a range of studies that explain how extreme climate effects can alter the adaptation of rural households seeking for well-being, such as education and jobs choices, for example (BRANCO; FERES, 2018; CONNOLLY, 2008).

It is true – and these evidences suggest – that such extreme events could boost a migratory process, which create a selection bias and the interest parameters would still be biased (BEINE; PARSONS, 2017). However, we expect that the costs associated with migration process inhibit couples to dissociate their household and, actually, seek for other forms of living, namely, diversifying work (NOACK et al., 2015). Then, we assume that our instrument explains the choice for off-farm work which, for its turn, affects household allocation of time and therefore, allow us to approximate to causal effects.

We consider anomalies in temperature and precipitations, measured as the difference of the state's annual average from their long-term average, divided by the corresponding long-run standard deviation. For the long term we consider a period of 30 years, as suggested by

Delazeri, Cunha and Couto-Santos (2018). This calculation is in line with Nicholson (1993), Beine and Parsons (2015), Mastrorillo et al. (2016), among others, and is expressed by:

$$Anomalies_{w,s,y} = \frac{weather_{w,s,t} - \mu_{w,s}^{LR}(weather)}{\sigma_S^{LR}(weather)}$$

where $Anomalies_{w,s,y}$ corresponds to the level of temperature or precipitation (w) in the states *s* in year *y;* $\mu_{w,s}^{LR}(weather)$and $\sigma_S^{LR}(weather)$ are, respectively the long run average and standard deviation of either weather measure (temperature or precipitation).

3.3.2 Data

In order to address endogeneity issues, as stated before, we use two datasets considering different periods. First, we use individual and household level data from the *Pesquisa Nacional por Amostra de Domicílios* (IBGE, 2020). The survey was carried out yearly until 2016 and contains general characteristics of the population, education, work, income and housing, among others. We use data from PNAD 2002 to 2015 – except for 2010, when the Demographic Census replaced this survey.

We restricted the sample for household located in rural areas, according to IBGE classification (rural agglomeration of urban extension, isolated, villages or rural nucleus). The definition of "husbands" and "wives" is defined by those who are head of household or spouses in the household. Some restrictions to the sample are: we only consider heterosexual couples in order to address gender disparities in the household; we kept the couples with 16 or more years old, so we do not capture infant work and; we dropped observation with null information about work or per capita income.

For the climate anomalies, we use weather data extracted from Terrestrial Hydrology Research Group (SHEFFIELD; GOTETI; WOOD, 2006). The database was constructed by NCEP–NCAR (National Center for Environmental Prediction/Nacional Center for Atmospheric Research)[15].

Combining these two databases is a great advance for the literature, but also presents some limitations. That is because the minor disaggregation for PNAD is defined in state level, while weather data is defined in minimal comparable areas[16]. However, given that climatic

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

[16] The "minimal comparable areas" are groups of municipalities that are consistent across time.

anomalies impact on labor market relations in a wider dimension and incentive migration (BRANCO; FERES, 2018; DELAZERI; CUNHA; COUTO-SANTOS, 2018), using state level data, in this case, could actually capture more general effects. Furthermore, this limitation is minimized since we consider a 30 years period of variations, which capture the long-terms fluctuations.

3.4 Results

In this section we present the main research results. Section 4.1 we present sample analysis and in Section 4.2 the estimations coefficients and discussion.

3.4.1 Descriptive Analyses

In this section we bring some features from the sample that corroborates our theoretical approach and characterize the individuals considered in the estimations. First, in Table 15 we present mean, minimum and maximum values for the variables considered in the sample.

Table 15 - Mean, minimum (min.) and maximum (max.) values of sample interest variables

	Mean	**Min.**	**Max.**
Dissimilarity index	0,5857	0	1
difference productive	-23,7543	-149	120
difference domestic	26,2037	-98	99
difference in total hours	2,4487	-145	162
husband	0,4943	0	1
wife	0,5057	0	1
age wife	41,90	16	118
age husband	46,33	16	108
study years wife	4,62	1	17
study years husband	5,54	1	17
Off-farm wife	0,1775	0	1
off farm husband	0,2529	0	1

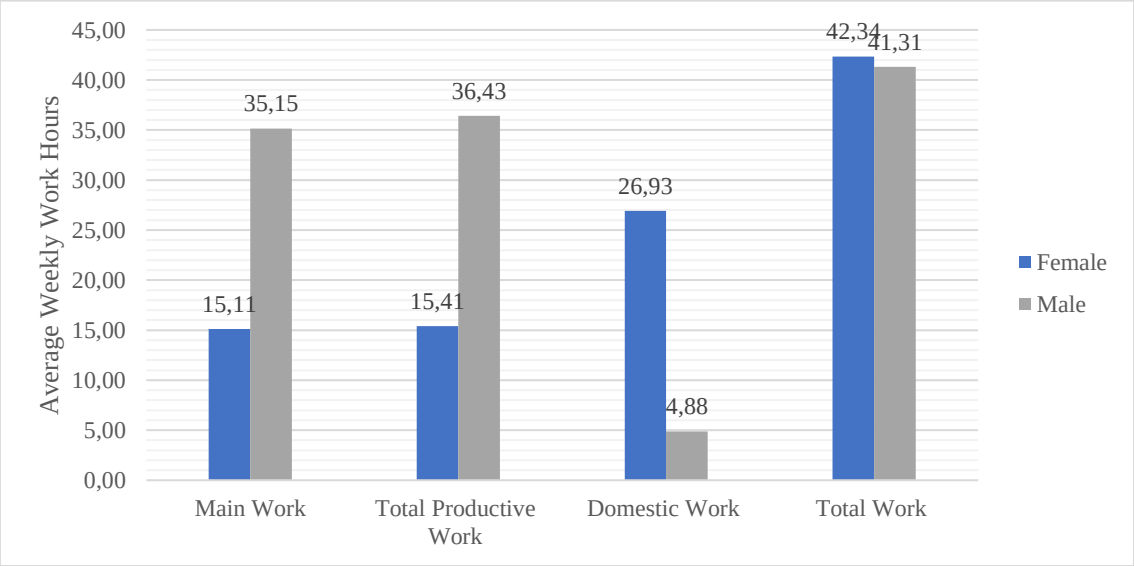
Source: Research results

The sample is composed by 50,57% of wives (which are women head of household or spouses), and they are averagely younger than men (42 and 46 years old respectively). Also, they study less than men and are less inserted in off-farm activities: 17,75% of rural wives are inserted in off-farm activities and 25,29% of husbands are. Regarding the time allocation, we see that the dissimilarity index is 0,58 which indicates that, indeed, the hours allocated for household chores are segregated between men and women (closer to one). This is confirmed

by the differences in hours allocated. In average, men dedicate 23 hours more than women to paid jobs, while women dedicate 26 hours more than men to household chores. Considering both paid and domestic work, women in average work 2,4 weekly hours more than men.

To properly see such effects, in Figure 8 we present the weekly average work hours of men and women above 15 years old in rural Brazil, considering the sample of 2002-2015.

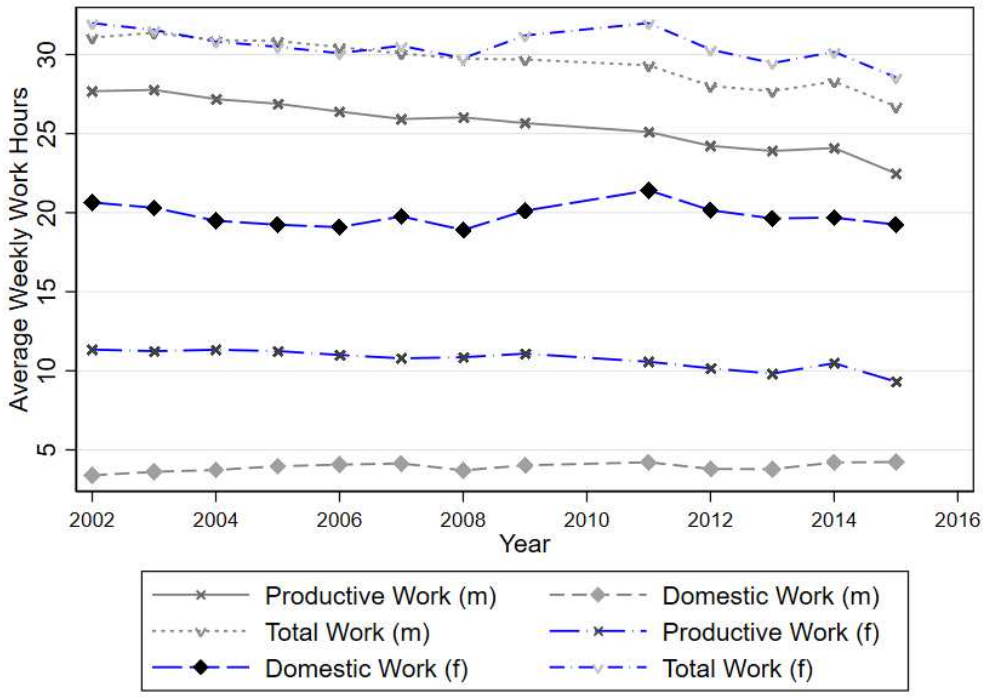
Figure 8 - Average weekly work hours of men and women by type of job in rural Brazil, 2002-2015.



Source: Research results.

Additionally, Figure 9 shows the average weekly hours of work through the years by male (gray lines) and female (blue lines) residents in rural areas. We see that the number of hours of domestic work performed by women maintained similar through the years, while there was a slight increase in this variable for men. However, the differences are very explicit and confirm the other empirical evidences, which we highlight: i) women spent significantly more hours in household chores compared to men; ii) women, in average, still dedicate more to reproductive work than to productive; iii) taking both types of works into account, we see that the total working time – considering household unpaid and paid jobs –, is very similar for men and women.

Figure 9 - Average Weekly Hours of Work for female (f) and male (m) rural individuals in Brazil, by year (2002 - 2015)



Source: Research results

Figure 9 shows that men in rural Brazil, in average, allocates 35,15h/week in its main job, while women allocate 15h/week. This difference remains similar considering the total hours spent in productive work (sum of main work, secondary work and other work). That is, men spend more than two times the time spent in productive work by women in rural Brazil. However, regarding the reproductive work, that is, hours spent in household chores, we see that while women spend approximately 27h/week in such work, men allocate, in average, less than 5 hours. This difference means that women dedicate more than 5 times the number of hours for domestic work compared to men. Accounting the total amount of work (reproductive and productive) we see that, in fact, women allocate more of their time to work (42,34 hours/week) compared to men (41,31 hours/week).

Specifically, for those who works outside the farm, we see, from Table 16 that the average age is smaller for both wives and husbands, which indicates that off-farm work is actually a new trending activity and older people tend to dedicate more to activities on the farm. The sexual division of work tends to remain among those off-farm workers, however, wives dedicate more to productive activities and less to domestic work and the total hours of work is higher for both men and women. Disaggregating the off-farm work in categories (CBO), we

see that even the off-farm work performed have gender specificities. Most rural women who perform off-farm work are still related to agricultural activities, while men are mostly inserted in industrial jobs. Also, men are more present in activities related to management and direction, and both wives and husbands perform general services.

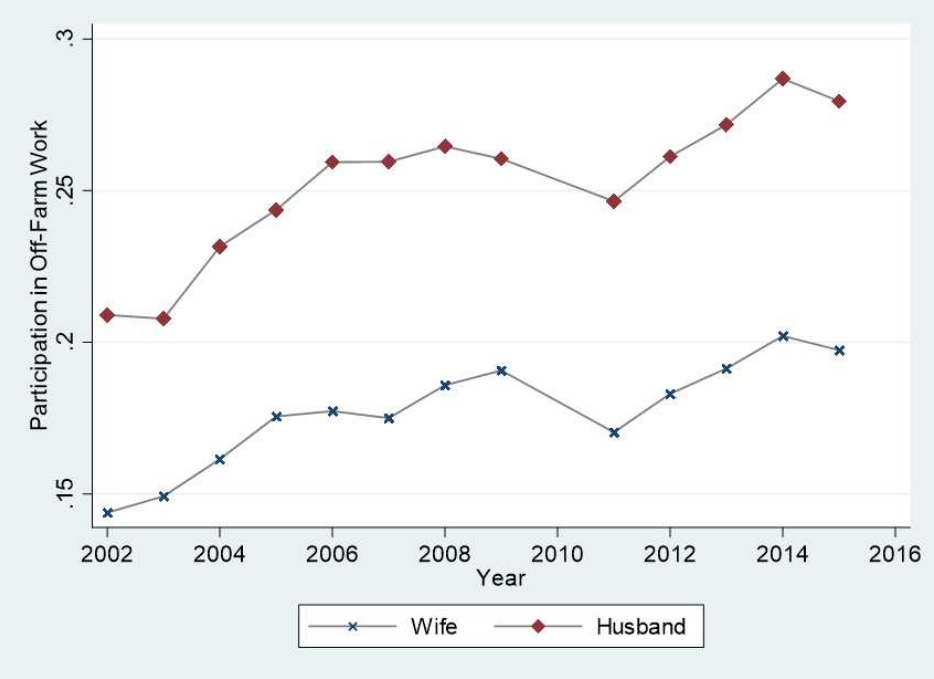
Table 16 - Descriptive analysis of wives and husbands who perform off-farm work in rural Brazil (2002 - 2015)

	Wives	**Husband**
age	37,68	40,02
study years	8,33	6,57
hours productive	34,14	45,14
hours domestic	24,42	4,53
work total hours	58,57	49,67
Directors	0,88%	1,82%
Art and Sciences	1,71%	1,75%
Technicians	2,42%	3,05%
Managers	1,99%	2,39%
General Services	15,12%	15,11%
Trade Services	7,51%	8,02%
Agricultural	39,00%	12,60%
Industrial	31,01%	54,55%
Army	0,38%	0,68%

Source: Research results

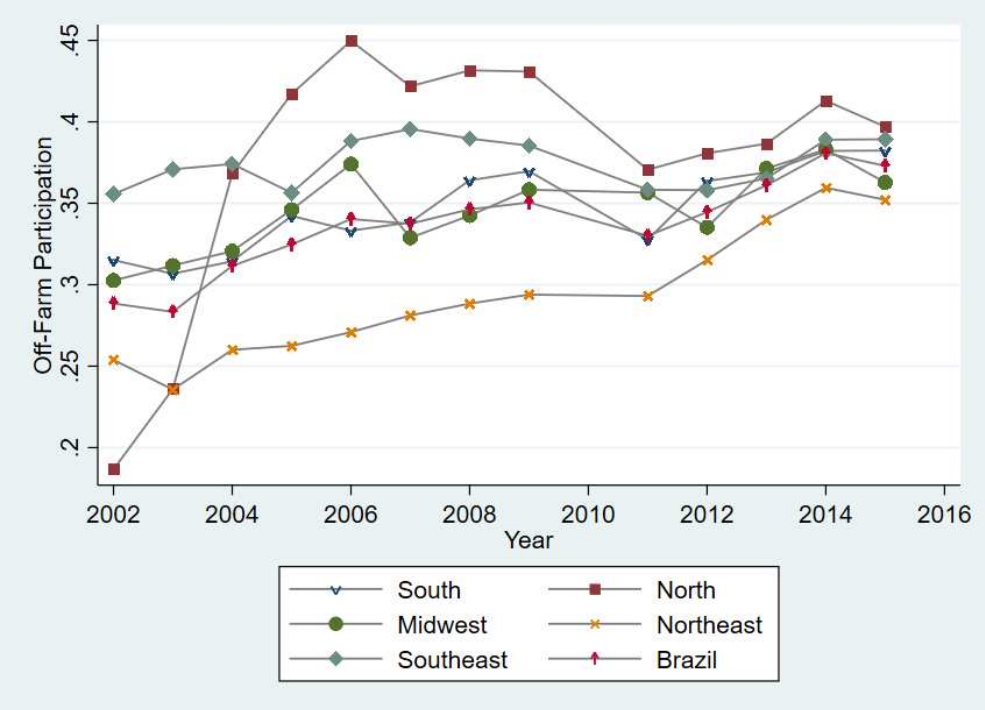
Figure 10 shows that off-farm work is actually a rising phenomenon and it has been increasing throughout the years for both husbands and wives. This is specially seen in the North region, which from 2002 to 2005 more than doubled the rates in off-farm work more than two times (Figure 11). From 2005 to 2010 the regions presented notable differences in the performance of-farm work - North and Southeast presented the highest rates, while Northeast region the lowest. However, from 2013 ahead, these rates converged and Brazilian average reflect properly all the regions participation in off-farm work (among 35% and 40%).

Figure 10 - Off-Farm Engagement of Wives and Husbands in Rural Brazil



Source: Research results

Figure 11 - Off-Farm Engagement in Brazilian Regions From 2002 to 2015

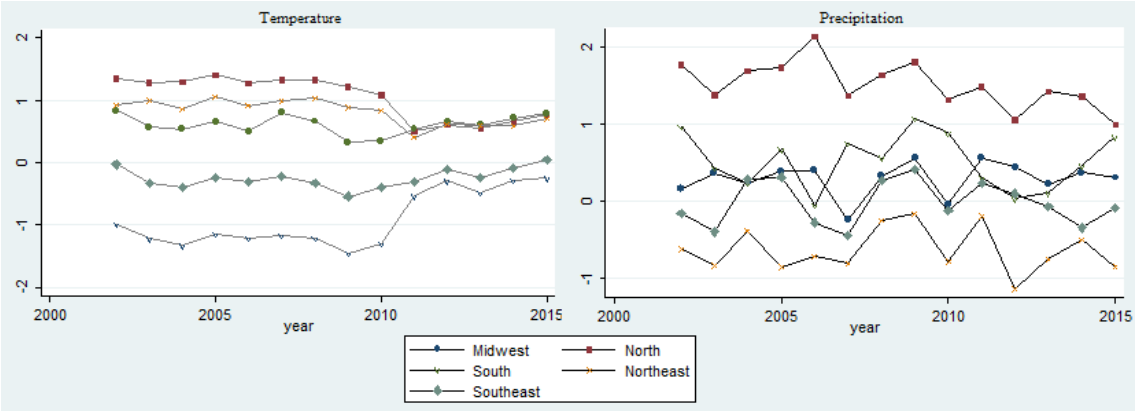


Source: Research results

Finally, we present the regional averages in temperature and precipitation anomalies (Figure 12). Even though for estimation purposes we use state level of climate anomalies as the exogenous variation, the aggregation by regions indicates some interesting features. We see

that North and Northeast regions have the highest prevalence of high temperature anomalies, while South and Southeast the lowest. On another hand, North region highlight given its higher anomalies in precipitation. Therefore, we can expect that the effects on off-farm work are higher for these regions, since not only the climatic anomalies are more present in these regions, but also, since they have higher rates of unemployment and poverty, they are more susceptible from suffering from exogenous shocks.

Figure 12 - Yearly Average Anomalies in Temperature and Precipitation, by Brazilian Region



The specifics effects of climate anomalies will depend on several variables, such as the possibilities to ascend to better positions and regional restrains that could depart rural dwellers from off-farm work (REARDON et al., 2008). These relationships are also linked to the geographical structure of the state analyzed (NOACK et al., 2015). Since Brazil is such a huge country, we could not expect that the effects of climate anomalies would similarly affect rural workers on the whole country. The most important here is that we capture state level anomalies in the long-run, which is capable of control these regional and time effects (MARCHIORI; MAYSTADT; SCHUMACHER, 2012).

3.4.2 Estimations Results

In this section we show the coefficients of interest estimated from the OLS (Table 17) and 2SLS regressions on the dissimilarity index (Tables 18 and 19) and the differences in hours allocation (Table 20). The effects on covariates and first-stage results are available under consultant. First, from Table 4 we see the effects of off-farm on the dissimilarity index through an OLS estimation. Four specifications are considered in columns (a) to (d): (a) the effects of off-farm work performed by the wives without controls; (b) the effects of off-farm work performed by anyone in the household and with controls added; (c) the effects of off-farm

performed by the wives with controls and; (d) effects of off-farm work performed by men with controls.

Table 17 - OLS Effects of Off-Farm Work on Dissimilarity Index for rural Brazil

	(a)	(b)	(c)	(d)
Off-Farm	-0.3279***	-0.0462 **	-0.3399***	-0.0613***
	(-198.77)	(23.72)	(-181.62)	(-9.31)
Controls	No	Yes	Yes	Yes
Worker	Wife	Anyone	Wife	Husband
Number of Observations	144346			
Notes: t statistics in parentheses *** p<0.05, ** p<0.01, *** p<0.001**				

Source: Research results

We see that, in average, as expected, engaging in off-farm work indeed decreases the dissimilarity index, that is, decreases the discrepancies in hours allocated. Therefore, we can confirm our hypothesis that off-farm work indeed is a channel which time allocation in the household could be more equitable, that is, men tend to engage more in household chores or women tend to dedicate less hours to such activity.

In order to overcome endogeneity issues, we also estimated the results through 2SLS. For all estimations, the Durbin-Wu-Hausman endogeneity test confirm that we cannot accept the hypothesis of exogeneity of our interest estimator, justifying the use of instrumental variables approach. Also, the F statistics are larger than the critical values, rejecting the hypothesis that our instruments are weak or, in another words, we have good instruments for off-farm work (confirmed by the Sargan test).

Table 18 presents the same specifications from Table 17, but considering the instrumental variables.

Table 18 – 2SLS Effects of Off-Farm Work on Dissimilarity Index for rural Brazil

	(e)	(f)	(g)	(h)
Off-Farm	-0.4852***	0.1131 **	-0.0997	-0.3089***
	(-22.14)	(3.18)	(-1.26)	(-9.31)
Controls	No	Yes	Yes	Yes
Worker	Wife	Anyone	Wife	Husband
Number of Observations	144346			
Notes: t statistics in parentheses *** p<0.05, ** p<0.01, *** p<0.001** **Instrumental Variables: States average precipitation and temperature anomalies.**				

Source: Research results

From Table 18 we see that, comparing to Table 17, we can affirm that average effects of off-farm work are underestimated. It means that these effects considering the precipitation and temperature anomalies are even greater, that is, off-farm work is a real empowerment instrument that could be responsible for gender equality in rural areas. The results are stronger when wives and husbands perform (18.e) and (18.h).

However, when we added the control variables and consider the work performed by anyone in the household (18.f), the parameter invert and, in fact, the performance of off-farm work increases the dissimilarity index or, in other words, increases the discrepancy in hour devoted to domestic work among spouses. This could also be explained because wealthier household could be paying for the domestic work to be done (must probably another woman) and for the poorer ones, the children could play this role. Another explanation is that, since another member that not necessarily the spouses engage in off-farm work, the household chores continue to be done by the wife. We also must take into account that household *percapita* income could be endogenous, given that part of it is a result of performing off-farm work.

An interesting feature is that, when off-farm work is performed by the wife (5.g), there are no significantly effects associated with the dissimilarity index. An option to further investigate these relationships is to estimate the specific effects of off-farm over other members' time allocation. Another hypothesis is that, since most part of off-farm work performed by women is agricultural (see Table 16), the empowerment channel through off-farm work could act is weakier. To test it, we estimated the above equation adding a covariate that indicates the performance of nonagricultural jobs (classified by CBO):

Table 19 – 2SLS Effects of Off-Farm Work on Dissimilarity Index for rural Brazil considering non-agricultural work

	(i)	**(j)**	**(k)**
Off-Farm	-0.7903 **	-2.1274***	-0.6615***
	(-15.75)	(-11.32)	(-17.62)
Controls	Yes	Yes	Yes
Non-agricultural	Yes	Yes	Yes
Worker	Anyone	Wife	Husband
Number of Observations		144346	
Notes: t statistics in parentheses *** p<0.05, ** p<0.01, *** p<0.001** **Instrumental Variables: States average precipitation and temperature anomalies.**			

Source: Research results

From Table 19, we see that the effects of off-farm work performed by the wives – and also the other members – are strongly related to the type of activity. It means that, despite being

different phenomenon, off-farm work and nonagricultural activities, are closely related, especially if we investigate less palpable relations, such as empowerment, a subjective dimension of well-being.

To further investigate the allocation of time, in Table 20 we present the effects of off-farm work on the differences of hours devoted to domestic work by the wife and the husband. Table 20 is divided in 6 columns, in which each one represents one estimation: columns (l), (m) and (n) we see the effects in the difference of hours allocated to domestic work by anyone in the household, the wife and the husband, respectively. Columns (o), (p) and (q) we see the effects in the total work, calculated by the sum of weekly hours dispended in all works (productive and reproductive), by anyone in the household, the wife and the husband, respectively.

Table 20 – 2SLS Effects of Off-Farm Work on Differences of Work Hours among spouses in Rural Brazil

	(l)	(m)	(n)	(o)	(p)	(q)
Off-Farm	-42.76***	-116.35***	-42.58***	-66.97***	-164.02***	-53.94***
	(-17.27)	(-10.44)	(-20.00)	(-17.43)	(-9.13)	(-20.13)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Time Difference	Domestic	Domestic	Domestic	Total	Total	Total
Worker	Anyone	Wife	Husband	Anyone	Wife	Husband
Number of Observations	155495					

Notes: t statistics in parentheses
*** p<0.05, ** p<0.01, *** p<0.001**
Instrumental Variables: States average precipitation and temperature anomalies.

Source: Research results

We see that, differently from (18.g), the effects of off-farm work performed by the wife is significant for all estimations. Also, for all combinations our parameters confirm our hypothesis: performing off-farm work reduce the differences in the time devoted to work among men and women. Specifically, we see that when women perform off-farm work the effects are really high, confirming our hypothesis also through the differences in hours allocated for domestic chores.

3.5 Concluding Remarks

In this work we aimed to address the effects of off-farm work on time allocation between spouses in Brazilian rural household, from a gendered perspective. We used different measures to capture this effect, such as the dissimilarity index, ratio and differences of the time

devoted to household work between men and women. Also, we corrected endogeneity issue using household data for 2002 to 2015 and climatic anomalies as instrumental variables.

Off-Farm work, here, was used as an example of an instrument to break traditional standards or, more specifically, as an empowerment channel which women could be more active in the bargain process and more equitable allocate the domestic work. Our results confirm the hypothesis and, especially when women are engaged in off-farm work, the effects on the difference in hours allocated are even higher (this variable showed not statistically significant result for the dissimilarity index).

It must be noted that, regarding these results, we do not mean that leaving the country is the only option that could change women's lives. However, it does shows that breaking some paradigms are possible – and urgent. Also, performing off-farm work should be an individual option and not a mandatory way to overcome work precariousness or vulnerabilities in general. In the same reasoning, household chores should not be seen as an inferior nor negligible activity, on the contrary: reproductive work is essential for continuity of the productive work. And, for that reason, it must not be an exclusively female activity and should be taken into account when analyzing time use and labor market, in general. The social mainstream that domestic work is a "female work" only contributes to feed the gap between men and women and walk backwards in terms of gender equality in all spheres since domestic work is a necessary condition for social reproduction.

In this sense, these changes must start in early life through concreate options for individual development in rural areas, such as education and proper work conditions. Recognizing and valuing the importance of the productive work is fundamental.

4. FINAL REMARKS

In this thesis we aimed to demonstrate the significant role of work diversification over inequalities in rural areas. Specifically, in Chapter 1 we investigate how nonagricultural work and income impact income concentration in rural areas. In Chapter 2, we address a gendered analysis on intrahousehold time allocation among spouses in rural Brazilian household. Both essays use household level data and different periods were considered.

We bring the discussion on work diversification in order to highlight that it is not a unique phenomenon and its particularities have different implications on how individuals organize themselves in terms of labor, but also in the mechanisms which they affect household resource allocation. In Chapter 1 we focused in nonagricultural work, since it represents a source of income that, in general, is independent of the farmer own productivity – even though its enrollment is directly related to a local level of agricultural development – and, therefore, could compose household average income differently from agricultural revenues. In Chapter 2, in its turn, we analyzed off-farm work, represented by those works carried outside the farm (including agricultural jobs performed in different locations) and how it could embody an empowerment channel which couples allocate time for productive and reproductive work more equitably in rural areas.

In general, we show that, regarding well-being outcomes, there is no unanimity on how work diversification acts. For example, from Chapter 1, we see that even though nonagricultural work potentially increase household average income in rural areas, its effects are disproportional among classes and somehow is responsible for decreasing inequalities. From another perspective, we see that off-farm work could potentially be an empowerment channel which gender disparities could be diminished. Taken together, the results shows that individual characteristics must be consider to explore specific implications, since there are different channels and motivations that could lead one to engage in such activities.

Therefore, since it is not could be not generalized, nor simplified in a single category, it should not be concluded that nonagricultural activities, nor off-farm work are superior or individuals engaged in these jobs are better off – and the opposite is also true. There is no perfect substitution among these activities and labor market policies should take into account that, indeed, work diversification is a phenomenon to discuss rural development. Additionally, individuals must have the chance to choose whether they dedicate for agricultural or nonagricultural activities, in their own farm or outside it. In same line, gender disparities must

be on the agenda of rural development, in order to promote more equitable scenarios. The main – and first – step to achieve both goals is through an inclusive and quality education.

The work also has some limitations. For example, we could not capture more specificities on the work performed or the work environment that could explain differences in income. Also, to properly study female empowerment and gender disparities it must be consider features that nation data could not capture. However, the work also brings several contributions to the literature and public policies subsidies. First are the methodological specificities. In Chapter 1 we present a disaggregation into individual characteristics that differ agricultural and nonagricultural workers, besides bringing other perspectives of income inequality, such as the Gini Index and classes stratifications. In Chapter 2, we established causal relationship through a polled 12 years data and instrumental variables. Also, we bring into perspective different dimensions and approaches for a prominent rural movement and how it affects rural composing.

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