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# Off-farm Work and Gender Dynamics in Rural Brazil: Implications for Time Use and Household Labor Division

*Trabajo off-farm y dinámicas de género en el Brasil rural: implicaciones para el uso del tiempo y la división del trabajo*

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## Abstract

### Introduction

Gender gaps in time allocation are pervasive in rural areas, where women devote significantly more hours to unpaid domestic work than men. Off-farm employment—work performed outside one's own farm or household—has been identified as both a potential source of income diversification and a mechanism for changing intra-household gender dynamics.

### Objective

This study investigates whether off-farm work affects the allocation of paid and unpaid labor between husbands and wives in rural Brazil and examines the conditions under which such work may reduce or reinforce gender inequalities.

### Methodology

We use microdata from the Brazilian National Household Sample Survey (PNAD), covering rural households from 2002 to 2015. Productive work includes all paid activities (formal or informal), while unpaid work refers to domestic chores and care tasks. We measure differences in time allocation using the dissimilarity index, time allocation ratios, and weekly differences in hours worked. To address potential endogeneity, we exploit state-level climate anomalies as exogenous instruments within a two-stage least squares framework.

### Results

Engaging in off-farm work is associated with a reduction in gender disparities in time use within households, particularly when women participate in non-agricultural off-farm activities. However, in wealthier households off-farm work may reinforce traditional divisions by outsourcing domestic labor to others.

### Conclusions

Off-farm employment in rural Brazil plays a dual role—as a channel for women's empowerment and as a possible reinforcement of existing inequalities—highlighting the need for policies that expand rural economic opportunities while promoting a fairer distribution of unpaid domestic work.

### Keywords:

rural areas; rural development; working time arrangement; resource allocation; hours of work; division of labour; labour; gender roles; gender division of labour; weather; precipitation; temperature.

### JEL Classification:

D13; J22; J16.

## Resumen

### Introducción

Las brechas de género en la asignación del tiempo son comunes en las zonas rurales, donde las mujeres dedican más horas que los hombres al trabajo doméstico no remunerado. El empleo off-farm —trabajo realizado fuera de la propia finca o del propio hogar— se considera tanto una fuente de diversificación de ingresos como un posible motor de cambio en las dinámicas de género intrafamiliares.

### Objetivo

Analizar si el trabajo off-farm incide en la asignación de trabajo remunerado y no remunerado entre esposos(as) en el Brasil rural, y en qué condiciones puede reducir o reforzar las desigualdades de género.

### Metodología

Se emplean microdatos de PNAD, que cubre hogares rurales (2002-2015). El trabajo productivo comprende todas las actividades remuneradas, y el no remunerado, las tareas domésticas. Las diferencias en la asignación del tiempo se miden mediante distintos indicadores. Para abordar la endogeneidad se usan anomalías climáticas como instrumentos exógenos en un modelo de 2SLS.

### Resultados

La participación en trabajo off-farm se asocia con una reducción de las disparidades de género en el uso del tiempo, especialmente cuando las mujeres participan en actividades no agrícolas. En hogares con mayores ingresos, sin embargo, puede reforzar divisiones tradicionales al externalizar el trabajo doméstico.

### Conclusiones

El empleo off-farm en el Brasil rural actúa a la vez como canal de empoderamiento femenino y posible refuerzo de desigualdades existentes, destacando la necesidad de políticas que amplíen oportunidades económicas rurales y promuevan una distribución más equitativa del trabajo doméstico no remunerado.

### Palabras clave:

zonas rurales; desarrollo rural; organización del tiempo de trabajo; asignación de recursos; horas de trabajo; división del trabajo; trabajo; roles de género; división del trabajo por género; clima; precipitación; temperatura.

### Clasificación JEL:

D13; J22; J16.

## 1. Introduction

Gender gaps in time allocation are as widely known as little accounted for. How women and men spend their time inside a household and how differently they do, have consequences for gender inequalities in opportunities, work experience, earnings, and ultimately, well-being (Rubiano-Matulevich & Viollaz, 2019; Giménez-Nadal & Molina, 2022). Estimates show that women carry out three-quarters of unpaid work in the world, corresponding to 12,5 billion hours or US\$10.8 trillion a year (Coffey et al., 2020). When considering various countries altogether, Rubiano-Matulevich and Viollaz (2019) show that women allocate an average of 3.2 more hours per day to unpaid domestic work than men. Gender discrepancies in time use are even higher in rural areas. In 9 Latin American Countries<sup>3</sup>, rural women dedicate even 4 times many hours to unpaid work as urban men. They also work more in the household when compared to urban women or rural men (Nobre et al., 2017). In Brazil, women dedicated 10.6 hours per week more than men to household chores and care in 2019 and 9.6 more hours per week in 2022 (IBGE, 2023).

These differences are rooted in social mechanisms predominantly expressed in rural areas (Blair, 2013; Gasson & Winter, 1992). According to this logic, there is a market specialization in the household. Men are usually responsible for market-paid work in rural households, while women specialize in household chores (Becker, 1973; Folbre, 1986; 1994). This creates a cycle that limits opportunities for higher earnings and better labor market outcomes. On another perspective, female participation in the paid labor market is expected to better balance public household goods, including time allocation, or it could also intensify their workload, a hypothesis we investigate here (Soares, 2016).

In rural areas, in this sense, off-farm work –that is, work outside your own household/farm– is ideally an opportunity for women not only to engage in the labor market and enjoy better

economic outcomes. In fact, off-farm work is an instrument of adaptation for income generation and insurance in case of agricultural shocks, especially for poorer households (Escher et al., 2015). Evidence shows that off-farm work is associated with 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 (Start, 2001; Christiaensen & Martin, 2018). There is considerable empirical evidence on the effects of off-farm work on different household outcomes. For example, off-farm activities are correlated with decreasing income inequalities in rural Brazil (Braga et al., 2020; Ney & Hoffmann, 2008). Off-farm work also affects resource allocation in the household, such as land transfers (Zhou et al., 2020), fertilizer expenditures (Ma et al., 2018), and time allocation in different agricultural activities (Su et al., 2016).

If off-farm work has the potential to impact such household variables, it might also affect the relative bargaining power between spouses in a household. This effect, in turn, could be the channel through 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 households where the spouses work outside their farms time allocation tends to be more balanced between men and women in England. According to the authors, 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 property management if their husbands 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.

Time allocation between paid and unpaid activities is an important issue in rural households since this is usually the space devoted to 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

3 The research used CEPAL data and shows data for Brazil, Colombia, Ecuador, Guatemala, México, Peru, Uruguay and Honduras.

working is accounted for— is a source of poverty that jeopardize individual well-being in different dimensions such as food security and nutrition (Braga & Costa, 2022), health problems (Väänänen et al., 2005), social participation (Bittman, 2002) among many others outcomes (Gershuny, 2011).

This is an issue critical 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<sup>4</sup>); ii) rural women are a more vulnerable group compared to rural men and urban women.

Specifically, this paper seeks to answer if off-farm work changes the allocation of paid and unpaid labor between husband and wives in rural Brazil. For that purpose, we use household-level data from 2002 to 2015 and an identification strategy based on climate anomalies as a source of exogenous variation of off-farm work. To estimate the differences in time allocated to household chores, we use the dissimilarity index proposed by Jahn et al. (1947) and the differences in weekly hours devoted to domestic and total work.

With that in mind, we aim to bring new evidence for the relationship we did not find in the recent literature. The paper is structured as follows: besides these initial remarks, in Section 2, we present the identification and empirical strategy, and the data used, followed by the results in Section 3. Finally, Section 4 concludes.

## 2. Empirical strategy

The main purpose of this work is to estimate the effects of performing off-farm work on time allocation between spouses in rural households in Brazil, measured by the time devoted to reproductive work (domestic chores). Even though performing off-farm work is based on

observable characteristics such as education, income, and living conditions, it also depends on the individual's will, especially given gender roles and constraints that affect rural women. We can assume that differences in people who perform and do not perform off-farm work are due to observable characteristics. In that case, the conditional independence assumption might provide a causal relationship. In this case, including the variables in the control vector would eliminate the selection bias due to observables. Nonetheless, we expect that these persons are different in non-observable dimensions too, such as motivation, information, culture, and others.

An ideal experiment to overcome the selection bias would be randomly assigning the off-farm work between the spouses (generating an exogenous variation in this decision). Given the impossibility of such an experiment, we rely on observational data and an empirical strategy to deal with selection bias due to observables and non-observables. We use data drawn from the *Pesquisa Nacional por Amostra de Domicílios* (PNAD), a household survey that inquiries about the reproductive work through care work and domestic chores. We use the data for couples from 2002 to 2015<sup>5</sup> to analyze the variations over time and across sections.

The main outcome is the difference in time allocated to domestic work between spouses, measured by the dissimilarity index, proposed by Jahn et al. (1947), and applied to time allocation between spouses by Blair and Lichter (1991). This instrument was previously used in the Brazilian context by Botassio and Hoffmann (2020) to measure gender segregation. The index provides a useful summary measure of the household gap, and it is calculated as:

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

4 Research results based on PNAD data (IBGE, 2020).

5 In 2010 the survey was not carried out given the national Census.

Where  $w_j$  and  $h_j$  are respectively the percentage of the wife's and husband's total labor (in weekly hours) devoted to household chores  $j$ .  $D$  indicates the percentage of time that should be allocated to achieve total equality. The upper limit is 1, representing complete segregation; conversely, the lower limit is 0, representing equal time allocated between husbands and wives. In this sense, an increase in  $D$  represents a more segregated scenario.

To analyze the effects of off-farm work on the dissimilarity index, we estimate the equation [1]:

$$y_{i,t} = \alpha + \beta TW_{i,t} + \delta X_{i,t}' + \theta_1 y_t + \theta_2 r_s + \theta_3 y_t * r_t + u_{i,t} \quad [1]$$

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;  $\alpha$  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 years ( $\theta_1 y_t$ ), location ( $\theta_2 r_s$ ), defined by the state the household is located and their interaction ( $\theta_3 y_t * r_s$ ).

Complementarily, we also consider the cases where only the husband performs off-farm work ( $TH_{i,t}$ ) and when other members of the household does ( $TO_{i,t}$ ), such as specifications [2] and [3] respectively:

$$y_{i,t} = \alpha + \beta TH_{i,t} + \delta X_{i,t}' + \theta_1 y_t + \theta_2 r_s + \theta_3 y_t * r_t + u_{i,t} \quad [2]$$

$$y_{i,t} = \alpha + \beta_1 TO_{i,t} + \delta X_{i,t}' + \theta_1 y_t + \theta_2 r_s + \theta_3 y_t * r_t + u_{i,t} \quad [3]$$

The empirical strategy described above assumes that the only difference between individuals who engage in off-farm work and those who do not is due to the observables in  $X'$  and unobservable captured by the fixed effects in time and location levels. Nonetheless, the choice for off-farm working might be correlated with unobservable characteristics. In this case, we could not obtain the actual causal effects.

Beyond the unobservable variables that affect the dependent and independent variables, Cristiane Soares (2016) highlights an imbalance in the reported time allocated to reproductive work depending on whether the informant is a man or a woman. According to the author, the sex and the informant condition (i.e., whether they declare their own information or that of another household member, and whether they are the household head or another family member) influence data quality. Men tend to perceive reproductive work as a female responsibility, which leads them to underreport their own or other men's contributions to such tasks or even to misjudge the magnitude of the work performed<sup>6</sup>.

This issue is even more relevant given that rural women's productive and reproductive labor within households is often perceived as mere "help," as previously discussed. To address this concern, we use an exogenous variation in off-farm work to get the causal effects and validate –or refute– the

6 Soares (2016) 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.

previous findings. 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 for the correction of Omitted Variable Bias (OVB) by selecting a vector of instruments  $Z'$ , which must satisfy two conditions in order to be valid: a) exclusion restriction, which ensures no correlation between  $Z'$  and  $u_i$ , or  $Cov(Z', u_i) = 0$ , and; b) relevance, requiring that  $Z'$  explain the endogenous variable. Both conditions satisfied, the outcome variable  $Y_i$  can be explained through an exogenous variation of the off-farm work (induced by  $Z_i$ ). The estimation is conducted using the Two Stages Least Squares (2SLS) approach: In the first stage, the endogenous variable is explained by the controls included in the equation [1] and the instruments vector:

$$T_i = \psi + \tau X' + \gamma Z' + r_i \quad [4]$$

Afterwards, the main equation (Eq. 1) is estimated with the estimated values obtained from (Eq. 4). Using IV solves the OVB problem – strongly present in gender relations – if the instrument is exogenous and only affects the intrahousehold allocation of time throughout the choice of performing off-farm work.

As instruments, we use agricultural shocks, specifically anomalies in temperature and precipitation at the state level. These shocks should influence time allocation only through the decision of performing or not performing off-farm work. Indeed, agricultural activities are directly affected by climate conditions, particularly in the case of extreme events (Lobell et al., 2011; Schlenker et al., 2005).

If extreme climate events disrupt domestic production, we expect that (rational) individuals will seek alternative sources of income to overcome potential losses. Adaptation strategies, in this sense, are important elements to safeguard households. A range of studies demonstrates how extreme climate effects influence rural households' adaptation strategies, including decisions for well-being, such as education and

job choices (Branco & Feres, 2018; Connolly, 2008).

Also, according to Piedra-Bonilla et al. (2020), Brazilian households adopt more diversification strategies when climate variations increase. Similarly, Bastos et al. (2013) showed that drought effects reduced agricultural value added and led to a decrease in employment and wages in the Brazilian agricultural sector. According to Asfaw et al. (2018), anomalies in rainfall and droughts induce adaptive responses, which result in welfare gains for Nigerian households. Yang and Choi (2007) stated that, given temperature variations, rural domestic income is reduced if the households do not use adaptation strategies. According to Gasson and Winter (1992), rural intrahousehold allocation strategies are influenced by climate conditions in agriculture and household particularities.

It is true –and this evidence suggests– that such extreme events could boost a migratory process, which creates a selection bias, and the interest parameters would still be biased (Beine & Parsons, 2017). However, we expect that the costs associated with migration inhibit couples from dissociating their household and, actually, seeking other forms of living, namely, diversifying work (Noack et al., 2015). Thus, we assume that our instrument explains the choice for off-farm work, which affects household time allocation and allows us to approximate causal effects in the estimations.

We consider anomalies in temperature and precipitation measured as the difference of the state's annual average from its long-term mean, divided by the corresponding long-run standard deviation. For the long term, we consider a period of 30 years, as suggested by Delazeri et al. (2018). This calculation is in line with Nicholson (1993), Beine and Parsons (2017), Mastrorillo et al. (2016), among others, and is expressed as:

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

Where  $Anomalies_{w,s,y}$  corresponds to the temperature or precipitation ( $w$ ) level in state  $s$  in year  $y$ ;

$\mu_{w,s}^{LR}(\text{weather})$  and  $\sigma_s^{LR}(\text{weather})$  are, respectively, the long-run mean and standard deviation of the respective weather variable (temperature or precipitation).

Figure 1 presents the regional averages of temperature and precipitation anomalies. Although we use the state-level climate anomalies as the exogenous variation for estimation purposes, regional aggregation reveals noteworthy patterns. The North and Northeast regions have the highest prevalence of high temperature anomalies, while the South and Southeast regions experience the lowest. On the other hand, the North region faces higher anomalies in precipitation.

Given these patterns, we can expect the effects on off-farm work to be more attenuated in these regions. Not only are the climatic anomalies more frequent in these regions, but they also have higher unemployment and poverty rates, making them more susceptible to suffering from exogenous shocks.

The specific effects of climate anomalies depend on several factors, including opportunities for upward mobility and regional constraints that may limit rural dwellers' access to off-farm work (Reardon et al., 2008). These dynamics are also influenced by the geographical structure of the state analyzed (Noack et al., 2015). Given Brazil's vast size and regional diversity, we do not expect climate anomalies to affect rural workers

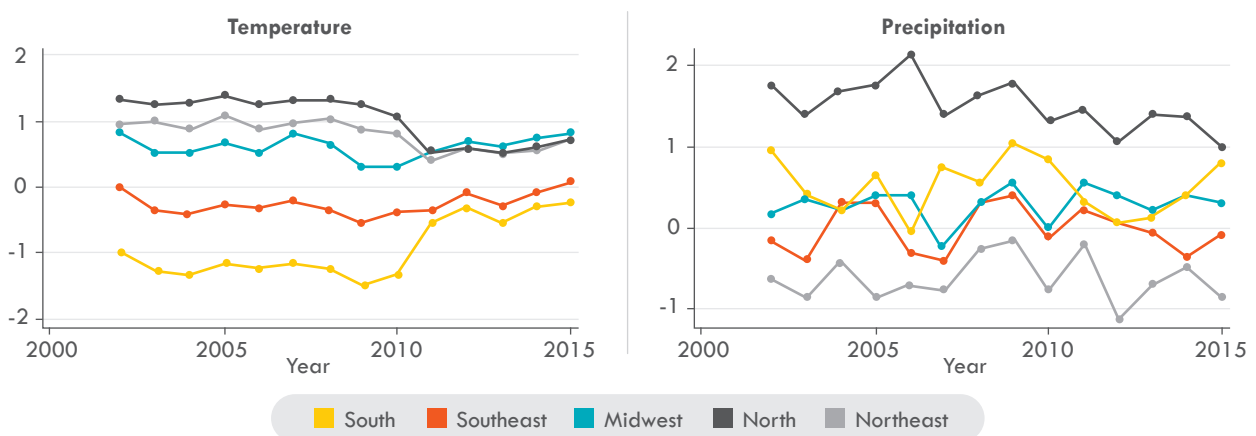
uniformly nationwide. The most important here is that we capture state-level anomalies in the long run, which allows us to control for regional and temporal effects (Marchiori et al., 2012).

## 2.1 Data

We use two datasets covering different periods. First, we use individual and household-level data from the Pesquisa Nacional por *Amostra de Domicílios* (IBGE, 2020). The Instituto Brasileiro de Geografia e Estatística (IBGE) —Brazil's official statistics agency (Brazilian Institute of Geography and Statistics)— is responsible for collecting and disseminating these data. PNAD is the Brazilian National Household Sample Survey. This survey was conducted yearly until 2016 and includes general population characteristics, education, work, income, and housing, among other topics. We use PNAD data from 2002 to 2015, excluding 2010, when the Demographic Census replaced this survey.

We restricted the sample to households located in rural areas, according to IBGE classification (rural agglomeration of urban extension, isolated areas, villages, or rural nuclei). “Husbands” and “wives” are defined as individuals identified as the head of the household or their spouse. The sample is further restricted as follows: we only consider heterosexual couples to address typical gender disparities in the household; we include only couples aged 16 or older to avoid

Figure 1. Yearly average anomalies in temperature and precipitation, by Brazilian region



Source: own elaboration.

capturing child labor; and we exclude observations with missing information on employment or per capita income.

We use weather data from the Terrestrial Hydrology Research Group (Sheffield et al., 2006) for climate anomalies. This database was constructed by NCEP-NCAR (National Center for Environmental Prediction/National Center for Atmospheric Research)<sup>7</sup>, was aggregated at the level of Brazil's federative units (state averages) to match the geographic disaggregation of the PNAD microdata.

Combining these two datasets represents a significant advancement for the literature but also presents some limitations. The main challenge arises because PNAD's smallest level of geographic disaggregation is at the state level, while weather data is available at the minimal level of comparable areas<sup>8</sup>. However, since climatic anomalies have an impact on labor market relations in the broader dimension and incentive migration (Branco & Feres, 2018; Delazeri et al., 2018), using state-level data, in this case, could actually help capture more general effects. Additionally, this limitation is minimized since we consider a 30-year period of variations, which captures the long-term fluctuations.

### 3. Results

In this section, we present the main research findings. In Section 4.1, we discuss our sample, and in Section 4.2, we discuss the results of our estimations.

#### 3.1 Descriptive analyses

This section provides an overview of the sample characteristics. First, in Table 1, we present mean, minimum, and maximum values for the variables of interest.

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

8 The "minimal comparable areas" are groups of municipalities that are consistent across time.

**Table 1.** Mean, minimum (min.), and maximum (max.) values of sample interest variables

	Mean	Min.	Max.
Dissimilarity index	0,59	0	1
Difference productive	-23,75	-149	120
Difference domestic	26,20	-98	99
Difference in total hours	2,45	-145	162
Husband	0,49	0	1
Wife	0,51	0	1
Age wife	42	16	118
Age husband	46	16	108
Study years wife	4,62	1	17
Study years husband	5,54	1	17
Off-farm wife	0,17	0	1
Off farm husband	0,25	0	1

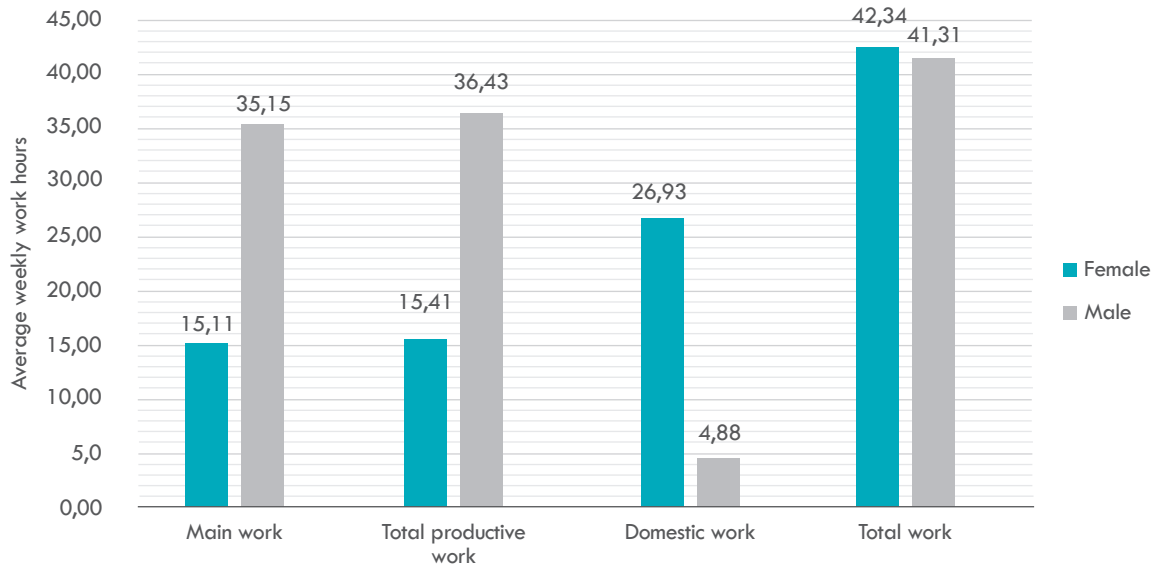
Source: own elaboration.

The sample consists of 51% wives (women who are either the head of the household or a spouse), and they are, on average, younger than men (42 and 46 years old, respectively). Additionally, they have lower levels of education than men and are less engaged in off-farm activities: 17% of rural wives participate in off-farm work, compared to 25% of husbands.

Regarding time allocation, the dissimilarity index is 0.59, indicating that household chores are unequally distributed between men and women (with values closer to one reflecting greater segregation). This is further confirmed by differences in hours allocated: on average, men spend 23.75 more hours per week than women in paid jobs, while women spend 26.2 more hours than men on household chores in rural Brazil. When considering both paid and domestic work, women work an average of 2.4 hours more per week than men.

Figure 2 aggregates PNAD variables into four categories to present the average weekly working hours of men and women over 15 years old in rural Brazil from 2002 to 20. Main work refers to hours in the respondent's principal paid job. Total productive work adds up all paid activities (main and secondary jobs). Domestic work (unpaid) refers to the weekly hours self-reported for household chores and care tasks, as PNAD asks each respondent to estimate the number

**Figure 2.** Average weekly work hours of men and women by type of job in rural Brazil, 2002-2015



Source: own elaboration.

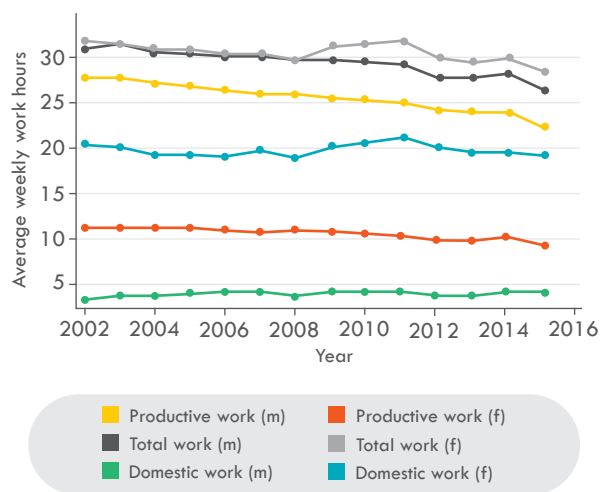
of hours per week usually devoted to these activities. Total work is the sum of total productive work and domestic work. Because PNAD groups “household chores” and “care work” under a single variable, we cannot disaggregate them separately in this version; however, we have clarified in the text and caption that “domestic work” includes both household chores and care duties as defined in the survey.

Additionally, Figure 3 shows the average weekly working hours over the years for male (gray lines) and female (blue lines) residents in rural areas. We observe that the number of hours women dedicate to domestic work has remained relatively stable over the years, while there has been a slight increase in this variable for men. However, the differences are striking and confirm other empirical evidence, which we highlight: i) women spent significantly more hours in household chores than men; ii) on average, women still dedicate more time to reproductive work than to productive work; iii) taking both types of works into account, the total workload—considering household unpaid and paid jobs —, is very similar for men and women.

Figure 3 shows that, on average, men in rural Brazil allocate 35.15 hours per week to their

main job, while women allocate 15 hours per week. This difference remains similar when considering total hours spent in productive work (the sum of main, secondary, and other work). In other words, men spend more than twice the time women dedicate to productive work in rural Brazil.

**Figure 3.** Average weekly hours of work for female (f) and male (m) rural individuals in Brazil, by year (2002-2015)



Source: own elaboration.

However, regarding reproductive work, that is, hours spent in household chores, we see that while women spend approximately 27 hours per week on such tasks, men allocate, on average, less than 5 hours. This means that women dedicate more than five times the number of hours to domestic work compared to men. When accounting for the total amount of work (both reproductive and productive), we find that women actually allocate more of their time to work (42.34 hours per week) compared to men (41.31 hours per week).

Specifically, for those who work off the farm, Table 2 shows that the average age is lower for both wives and husbands, suggesting that off-farm work is a more recent trend, with older individuals tending to focus more on farm-related activities. The sexual division of labor persists among off-farm workers; however, wives dedicate more time to productive activities and less to domestic work, and total working hours are higher for both men and women.

**Table 2.** Descriptive analysis of wives and husbands who perform off-farm work in rural Brazil (2002-2015)

	Wives	Husbands
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%

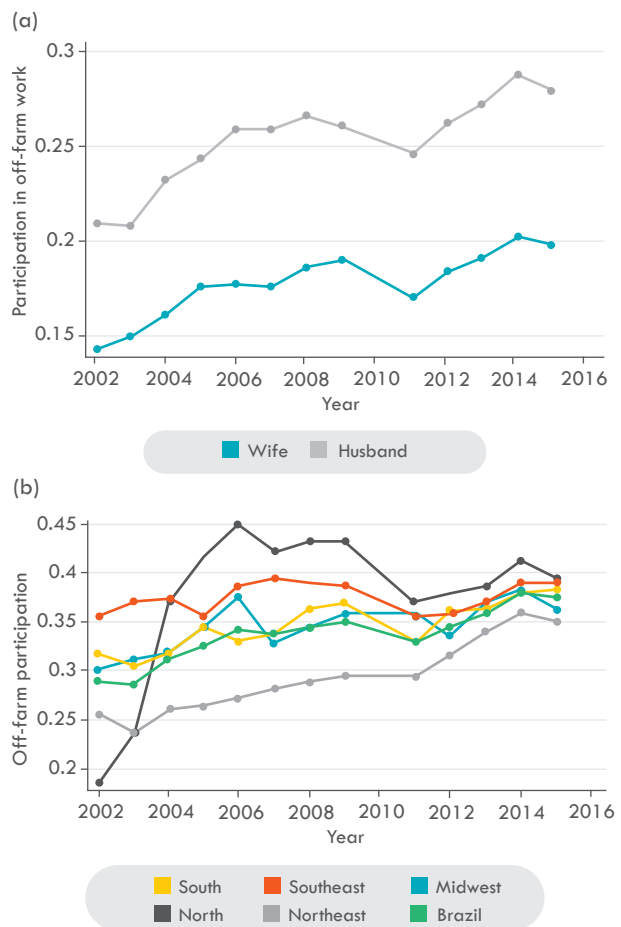
Source: own elaboration.

When disaggregating off-farm work by category, we observe that even these jobs exhibit gender-specific patterns. Most rural women engaged in off-farm work remain in agricultural activities, while men are primarily employed in industrial jobs. Additionally, men are more likely to occupy

managerial and supervisory positions, whereas wives and husbands perform general services.

Figure 4.a confirms that off-farm work is a rising phenomenon that has increased over the years for both husbands and wives. This is especially seen in the North region, where the rate of off-farm work more than doubled between 2002 and 2005 (Figure 4.b). From 2005 to 2010, the regions showed notable differences in off-farm work participation – North and Southeast had the highest rates, while the Northeast region had the lowest. However, from 2013 onward, these rates converged, and the Brazilian average became a more accurate reflection of regional participation in off-farm work, ranging between 35% and 40%.

**Figure 4.** Off-farm engagement of wives and husbands (a) and by regions (b) in rural Brazil



Source: own elaboration.

### 3.2 Estimations results

This section presents the effects of off-farm work participation on time use between spouses in rural Brazil. Table 3 shows OLS estimates of off-farm effects on the dissimilarity index as a means of comparison. Four specifications are considered in columns (a) to (d): (a) the effects of off-farm work performed by wives without controls; (b) the effects of off-farm work performed by anyone in the household, 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 3.** OLS effects of off-farm work on dissimilarity index for rural Brazil

	(a)	(b)	(c)	(d)
Off-farm	-0.32*** (-198.77)	-0.04 ** (23.72)	-0.34*** (-181.62)	-0.06*** (-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. Controls include gender of the head of the household, *percapita* income, color/race, subsistence work, age of spouse and husband and educational attainments of wives.

**Source:** own elaboration.

We see that, on average, as expected, engaging in off-farm work decreases the dissimilarity index, reducing discrepancies in hours allocated between women and men. Off-farm work appears to be a channel through which time allocation within the household could be more equitable – that is, men tend to engage more in household chores, or women tend to dedicate fewer hours to such activities. We also observe that the effects are greater when women perform off-farm work, and these effects maintain their significance even when we control for other observable characteristics.

However, these estimates do not account for the possibility that engaging in off-farm work might correlate with unobservable household or individual characteristics. In other words, the estimated effects might be driven by the unobserved characteristics of those who perform the

off-farm work rather than by the causal effect of the job itself. Therefore, Table 4 presents our results using an exogenous variation in the decision to perform off-farm work. We argue that climate anomalies drive rural residents to seek off-farm jobs, affecting time allocation between paid and unpaid activities between spouses.

Table 4 presents the exact specifications as Table 3, but considers the instrumental variables approach.

**Table 4.** 2SLS effects of off-farm work on dissimilarity index for rural Brazil

	(e)	(f)	(g)	(h)
Off-farm	-0.48*** (-22.14)	0.11** (3.18)	-0.09 (-1.26)	-0.31*** (-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. Controls include gender of the head of the household, *percapita* income, color/race, subsistence work, age of spouse and husband and educational attainments of wives.

**Source:** own elaboration.

Comparing the results from Table 3 and Table 4, we can assert that the average effects of off-farm work were previously underestimated. This indicates that the effects are even more significant when considering precipitation and temperature anomalies. Off-farm work may serve as an empowerment instrument, potentially promoting gender equality in rural areas. The strongest results are observed when wives and husbands engage in off-farm work (4.e) and (4.h).

However, the parameter reverses when the control variables are included and the estimation considers off-farm work performed by any household member (4.f). In this case, engaging in off-farm work increases the dissimilarity index, widening the discrepancy in hours devoted to domestic work among spouses. One possible explanation is that wealthier households might be outsourcing domestic work (likely to another woman) while children could be taking on these

responsibilities in poorer households. Alternatively, if a household member, other than the spouses, engages in off-farm work, the household chores may continue to fall primarily on the wife.

Specification 4.g shows that the effect of the off-farm work performed by the wife is not statistically significant when controls are included. Since most of the off-farm work women perform is in agriculture (see Table 2), the empowerment channel through off-farm work may be weaker. To test this, we estimated the above equation again, including a covariate that indicates the performance of non-agricultural jobs (Table 5).

From Table 5, we see that the effects of off-farm work performed by wives and other household members are strongly related to the type of activity. This means that, although off-farm work and nonagricultural activities are distinct phenomena, they are closely connected, especially when considering less tangible aspects such as empowerment, a subjective dimension of well-being.

To investigate time allocation further, in Table 6, we present the effects of off-farm work on the differences in hours devoted to domestic work by wives and husbands. Table 6 is divided into 6 columns, each representing one estimation. Columns (l), (m) and (n) show the effects on the difference in hours allocated to domestic work by anyone in the household, the wife, and on the total work, calculated as the sum of weekly hours spent on all activities (productive

**Table 5.** 2SLS effects of off-farm work on dissimilarity index for rural Brazil, considering non-agricultural work

	(i)	(j)	(k)
Off-farm	-0.79** (-15.75)	-2.12*** (-11.32)	-0.66*** (-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. Controls include gender of the head of the household, *percapita* income, color/race, subsistence work, age of spouse and husband and educational attainments of wives.

**Source:** own elaboration.

and reproductive work) by anyone in the household, the wife, and the husband, respectively.

We see that, unlike in (4.g), the effects of off-farm work performed by the wife are significant and negative for all estimations. Additionally, in all cases, our parameters confirm our hypothesis: engaging in off-farm work reduces the differences in time devoted to unpaid work among men and women. Specifically, we observe that when women engage in off-farm work, the effects are stronger, further supporting our hypothesis through the differences in hours allocated to domestic chores.

Our findings resonate with ongoing policy debates in Brazil and Latin America on how to reduce gender inequalities in rural areas

**Table 6.** 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*** (-17.27)	-116.35*** (-10.44)	-42.58*** (-20.00)	-66.97*** (-17.43)	-164.02*** (-9.13)	-53.94*** (-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. Controls include gender of the head of the household, *percapita* income, color/race, subsistence work, age of spouse and husband and educational attainments of wives.

**Source:** own elaboration.

while promoting labor diversification. Programs such as PRONAF (National Program for Strengthening Family Agriculture) have traditionally focused on credit and technical assistance for smallholders, but they could be better designed to acknowledge women's multiple roles, including reproductive labor (Valadares, 2021; Schneider et al., 2021). Similarly, conditional cash transfer schemes (such as Bolsa Família and its successors) have already demonstrated positive effects on female autonomy and school attendance (Neves et al., 2022; Santos, 2022; Couto et al., 2021); incorporating explicit time-use considerations into these programs could further ease women's unpaid workload and support their participation in off-farm activities. Beyond existing schemes, our results suggest that policies should integrate gender-sensitive support for rural employment diversification. This could involve expanding childcare and care infrastructure in rural areas, tailoring vocational training to women's off-farm opportunities, and recognizing domestic work as part of rural development strategies.

#### 4. Concluding remarks

In this study, we aimed to address the effects of off-farm work on time allocation between spouses in Brazilian rural households, from a gendered perspective. We used different measures to capture this effect, such as the dissimilarity index, ratio, and differences in the time devoted to household work between men and women. To address endogeneity issues, we combined household data from 2002 to 2015 and climatic anomalies as instrumental variables.

Off-farm work was analyzed as a potential instrument for challenging traditional gender roles—specifically, as a mechanism for women's empowerment, enabling them to participate more actively in household bargaining and to achieve a more equitable distribution of domestic work. Our findings support this hypothesis, showing that when women engage in off-farm work, the effects on reducing gender disparities in time allocation are even stronger (although this variable was not statistically significant for the dissimilarity index).

It is important to emphasize that our results do not suggest that leaving rural areas is the only way to improve women's lives. Instead, they highlight that breaking gender norms is both possible and necessary. Moreover, off-farm employment should be a personal choice rather than a forced response to precarious work conditions or economic vulnerability. Similarly, household chores should not be perceived as inferior or insignificant. On the contrary, reproductive labor is essential for sustaining productive work, and as such, it should not be exclusively a female responsibility. Recognizing and integrating domestic work into broader analyses of time use and labor markets is crucial to advancing gender equality. The prevailing notion that domestic work is inherently "women's work" only perpetuates gender disparities and hinders progress in all spheres, as domestic labor is a fundamental component of social reproduction.

To foster change, interventions should begin early in life by providing concrete opportunities for individual development in rural areas, including access to education and decent working conditions. Acknowledging and valuing the significance of both productive and reproductive work is essential for achieving greater gender equity. A limitation of this study is that it does not fully disentangle informal paid activities from unpaid family labor in agriculture. Further work could build on our approach to address this issue explicitly.

#### Author contributions

**Cicero Braga:** conceptualization, data curation, formal analysis, research, methodology, project management, writing (original draft), writing (draft revision and revision/correction).

**Lorena Costa:** conceptualization, formal analysis, methodology, supervision, validation, writing (original draft).

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## Ethical implications

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