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The Impact of the Minimum Wage on Unemployment, Informality, and Inactivity in Brazil from 2012 to 2015

Impactos do salário mínimo sobre a desocupação, a informalidade e a inatividade no Brasil no período 2012 a 2015

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Abstract: This study investigates whether real minimum wage adjustments between 2012 and 2015 affected unemployment, informality, and labor force inactivity rates in Brazil. To that end, panel data models were estimated using microdata from the Continuous National Household Sample Survey (PNADC - *Pesquisa Nacional por Amostra de Domicílios Contínua*). Contrary to expectations, the results show that real increases in the minimum wage were associated with a reduction in the informality rate. Regarding unemployment, the findings suggest that higher real minimum wages tended to raise unemployment rates for both men and women. Additionally, minimum wage increases contributed to a decline in female labor force participation.

Keywords: Minimum wage; Unemployment; Informality; Inactivity.
JEL Classification: J21, J31, J46

Resumo: O objetivo deste estudo foi analisar se as variações reais do salário mínimo no período 2012-2015 afetaram as taxas de desocupação, informalidade e inatividade no Brasil. Para tal, foram estimadas equações com dados em painel retirados da PNAD Contínua. Os resultados mostraram que, diferente do esperado, aumentos reais no salário mínimo estiveram associados a uma redução na taxa de informalidade. Com relação ao desemprego, os resultados indicaram que aumentos reais no salário mínimo tenderam a aumentar a taxa de desocupação de homens e mulheres. Além disso, provocaram a saída de mulheres da força de trabalho.

Palavras-chave: Salário Mínimo; Desocupação; Informalidade; Inatividade.
Classificação JEL: J21, J31, J46

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1. Introduction

The earliest records of wage regulation laws date back to 14th-century Europe. However, the concept of a minimum wage—the lowest legally mandated remuneration that a worker must receive for time spent producing goods and services—emerged only in the late 19th century, shortly before the onset of World War I. New Zealand and Australia were the first countries to officially adopt minimum wage laws, doing so in 1904 (Muniz, 2010).

In Europe, such legislation only began to be implemented in the early 20th century, with England becoming the first European country to establish a minimum wage in 1909. Across the Americas, the United States was the first country to express interest in adopting minimum wage regulations, with the earliest rules introduced in 1912 (Saboia, 1985).

During its 26th Convention in Geneva, held in 1928, the International Labour Organization (ILO) committed, alongside several countries—including Brazil—to implementing wage floors (Süssekind, 1998). However, the law that officially established and implemented a minimum wage system in Brazil was only enacted in 1936, under the presidency of Getúlio Vargas.

The Decree-Law No. 2,162, dated May 1st, 1940, was responsible for establishing the first minimum wage levels by region across the Brazilian territory. By 1984, the minimum wage was nationally unified, and in 1988, Article 7 of the new Federal Constitution established the minimum wage as a right of both urban and rural workers (Brasil, 1988).

At both the international and national levels, the wage system was designed to ensure that workers were legally free to negotiate the conditions under which they would work. Proponents of the minimum wage argue that, without regulation, the labor market's supply-and-demand dynamics would push workers to accept precarious conditions and wages below what would be necessary for the subsistence of their households (Muniz, 2010).

The minimum wage has been used as a policy tool to reduce income inequality in Brazil. To this end, a minimum wage appreciation policy was introduced during President Lula's first term in office. According to Brito, Foguel, and Kerstenetzky (2015), the Brazilian economy experienced a reduction of approximately 12.2% in the Gini index—a measure of income concentration—between 1995 and 2015, calculated using per capita household income. The authors claim that the main drivers of this decline were government transfer programs and the policy of minimum wage appreciation.

One of the key campaign proposals of presidential candidate Luiz Inácio Lula da Silva in 2002 was the implementation of a minimum wage appreciation policy. Following his election victory, discussions on the adoption of such a policy began in 2004 (Brito; Foguel; Kerstenetzky, 2015). After a series of negotiations between representatives of labor unions and the legislative and judicial branches, the decision was made in 2006 to adopt a permanent minimum wage appreciation policy. This new policy established that minimum wage adjustments should exceed inflation levels in order to guarantee real income gains for workers. Accordingly, adjustments were to be based on the National Consumer Price Index

(INPC - *Índice Nacional de Preços ao Consumidor*) for the previous year, along with the Gross Domestic Product (GDP) growth from the two years preceding the reference year (DIEESE, 2008).

In February 2011, Law No. 12,382 was enacted. In addition to setting the minimum wage for 2011, it formally established the adjustment policy as a long-term measure. This law remained in effect until 2019 (Brasil, 2011). According to Carrança (2023), the minimum wage experienced a significant real increase following the end of hyperinflation with the implementation of the Real Plan. During the eight years of President Fernando Henrique Cardoso's administration, the real increase was 40%; under President Lula, it rose by 62.4%; and during the five and a half years of President Dilma Rousseff's tenure, it increased by 18.6%. More recently, in August 2023, the Brazilian government reinstated the policy of annual minimum wage appreciation, adopting the same adjustment rule previously outlined in Law No. 12,382 (Teixeira; Cavalcante, 2023).

Despite the well-intentioned policy objective of the minimum wage, certain strands of economic theory suggest that establishing a wage floor (or raising its level) functions as a price floor policy and may reduce the demand for labor in the formal sector—which is subject to regulation and enforcement—thereby increasing unemployment (Welch, 1974; Mincer, 1976; Gramlich, 1976). Workers excluded from the formal sector—typically those with lower productivity—may be pushed into informality as a means of subsistence, remain unemployed while waiting for a formal job opportunity, or exit the labor force altogether.

Considering the above, the objective of this study is to analyze whether real variations in the minimum wage value between 2012 and 2015 generated side effects such as increases in unemployment, informality, and inactivity rates in Brazil. To this end, quarterly data from the Continuous National Household Sample Survey (PNADC – *Pesquisa Nacional por Amostra de Domicílios Contínua*) were used. This analysis period was chosen for two reasons: 1) although Law No. 12,382 was approved in 2011, the PNADC was definitively implemented in 2012; and 2) the law remained effective until 2019; however, from 2016 onward, due to the economic crisis that impacted the country, the minimum wage stopped increasing in real terms and its value was adjusted solely for inflation (Welle; Furno; Bastos, 2022). For this analysis, panel data regression models were estimated for men and women, considering Brazilian federative units as the cross-sectional units.

Existing literature has extensively examined the effects of minimum wage fluctuations on employment, informality, and labor force participation. For instance, Gindling and Terrel (2009) investigated the impact of minimum wage increases on unemployment and informal employment in Honduras between 1990 and 2004. Similarly, Mondragón-Vélez, Peña, and Wills (2010) explored how minimum wage hikes influenced the size of Colombia's informal sector over the period 1986–2006. Comola and Mello (2011) analyzed the relationship between variations in the minimum wage-to-average wage ratio (Kaitz index) and formal and informal employment levels among men and women in Indonesia from 1996 to 2004.

Muravyev and Oshchepkov (2013), using panel regression models, assessed the effects of changes in the Kaitz index between 2001 and 2010 on employment and informality among youth and adults in Russia. Their findings reveal that minimum wage increases tend to raise unemployment rates among young workers, while exhibiting no significant effects on adult employment. Canelas (2014), also employing panel data, examined the relationship between minimum wage and informality in Ecuador from 2000 to 2012. The study found no statistical evidence that increases in the minimum wage led to a transition of workers from the formal to the informal sector. Using cross-sectional and panel regression analyses, Vázquez, Esquivel, and Hernández (2017) investigated whether the adoption of a minimum wage increase policy affected the probability of workers being informal or unemployed in Mexico during 2012 and 2013. While the cross-sectional analysis revealed no significant effects on employment, the panel data analysis suggested that the likelihood of being informal or losing a job decreased. Finally, Boffy-Ramirez (2019) applied panel regression techniques to analyze the impact of minimum wage changes on unemployment and labor force participation in the United States from 1990 to 2017. The findings showed no evidence that minimum wage increases raised unemployment but did indicate a decline in labor force participation.

Among the studies examining the impacts of the minimum wage on the Brazilian labor market, notable contributions include those by Carneiro (2004), Soares (2005), Souza Júnior and Targino (2005), and Jales (2015). Carneiro (2004) analyzed the effects of the minimum wage on formal and informal employment using monthly data from the Monthly Employment Survey (PME – *Pesquisa Mensal do Emprego*) covering 1982 to 2002, employing time series regression analysis. The study found a negative impact of the minimum wage on formal employment and a positive effect on informal employment, both in the short and long term. Soares (2005), on the other hand, estimated the probability of a worker becoming non-employed (either unemployed or leaving the labor force) as well as the likelihood of transitioning from the informal to the formal sector following minimum wage increases, analyzing the periods 1982–1985 and 1995–1999. Using monthly PME data, a Probit model, and Kernel Propensity Score Matching analysis, Soares observed that the negative effects of the minimum wage on employment (formal and informal) were more pronounced in the late 1990s than in the early 1980s. No evidence was found that increases in the minimum wage led to transitions from the formal to the informal sector.

Souza Júnior and Targino (2005) studied the effects of real minimum wage variations on labor shifts toward unemployment, informality, and inactivity. They used monthly data from the PME covering August 1994 to December 2002 for four Metropolitan Regions (Recife, Porto Alegre, Rio de Janeiro, and São Paulo) and applied the vector autoregression (VAR) model. For all four regions, they observed that increases in the minimum wage raised unemployment rates and generated labor market entry. Additionally, they found an increase in the level of informality in the Rio de Janeiro and Porto Alegre Metropolitan Regions, a decrease in São Paulo, and no effect in Recife. Finally, Jales (2015) sought to identify the effects of the minimum wage on the distribution of workers between the formal and informal sectors in Brazil. To do so, he estimated model parameters

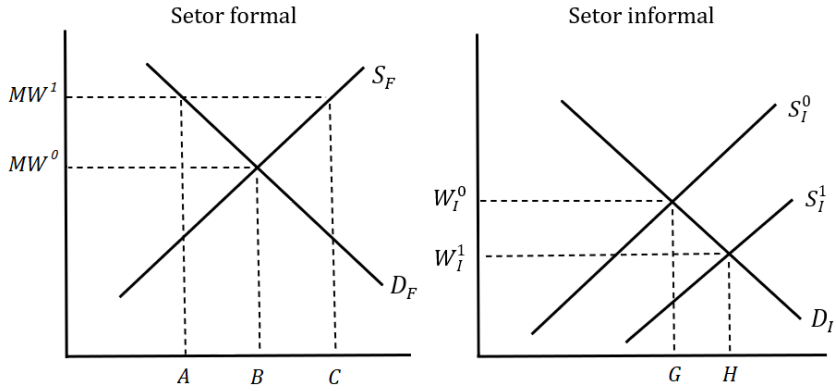
using nonparametric Kernel methods with data from the National Household Sample Survey (PNAD – *Pesquisa Nacional por Amostra de Domicílios*) from 2001 to 2009. The results indicated that the minimum wage increased the informal sector by 39% compared to a situation where the minimum wage did not exist.

The justifications for the present study include the following differences compared to previous Brazilian studies: a) it analyzes the effects of the minimum wage on the labor market during the 2012–2015 period, when Law No. 12,382 was in effect, aiming to promote real increases in the Brazilian minimum wage; b) it considers the effects of minimum wage variations on informality, unemployment, and inactivity—Carneiro (2004) and Jales (2015), for example, analyzed only the effects on informality; c) it uses the real minimum wage as the main explanatory variable—Soares (2005), for instance, used nominal minimum wage data; d) it employs PNADC data, which covers the entire national territory—except for Jales (2015), all the aforementioned Brazilian studies used PME data, which cover only six metropolitan regions; e) it applies panel data regression methods that allow controlling for time-invariant effects affecting explanatory variables—Carneiro (2004) and Souza Júnior and Targino (2005) used time series analyses; f) it includes important control variables that also affect employment, activity, and formality, such as per capita income, percentage of the population attending school, individual's household status, and presence of children and elderly in the household—of the cited Brazilian studies, only Carneiro (2004) used a control variable (and only Brazilian GDP); and g) it separately analyzes the effects for men and women, given their distinct insertion in the formal and informal labor markets—none of the cited Brazilian studies considered this distinction.

2. Effects of minimum wages on employment

This section discusses how the minimum wage and other variables influence employment and labor force participation. The analysis of how real minimum wage adjustments can affect employment, participation, and informality levels is grounded in the Dual Sector Theory developed by Welch (1974) and later refined by Mincer (1976) and Gramlich (1976). While the protective intent behind minimum wage policies may appear commendable, Dual Sector Theory suggests that increases in the real minimum wage can have unintended side effects, particularly in formal employment. These effects are illustrated in Figure 1. Assume that at an initial real minimum wage level MW^0, there is no unemployment in the formal sector—formal employment stands at point B (see part *a* of Figure 1). In the informal sector, by contrast, the initial wage is lower, at W_I^0, and employment stands at G (see part *b* of Figure 1). Thus, even in this initial situation, informality exists, as many workers do not have sufficient productivity to be hired in the formal sector at wage MW^0.

Figure 1: Effects of an increase in the real minimum wage



Source: adapted from Gramlich (1976).

Now suppose the government increases the real minimum wage from MW^0 to MW^1. This leads to an increase in the quantity supplied of labor in the formal sector to point *C*, while labor quantity demanded contracts to point *A*—since the marginal product of labor beyond point *A* falls below the cost of hiring. As a result, the formal sector faces unemployment equivalent to the distance between A and C.

These workers who became unemployed in the formal sector now have three options. One option is to remain unemployed while continuing to search for another formal job—particularly if they have access to alternative sources of income, such as unemployment insurance or household support. Another group, unable to afford waiting for a formal vacancy, may seek informal employment. This shift increases the labor supply in the informal sector from S_I^0 to S_I^1, driving down wages from $W_I^0$to W_I^1 (part *b* of Figure 1). Some individuals may also choose to become self-employed—taking on informal jobs as freelancers (or joining the gig work economy). This usually involves operating without formal registration—i.e., not enrolling in the Corporate Taxpayer Identification Number (CNPJ – *Cadastro Nacional de Pessoas Jurídicas*) or contributing to the national social security system.

A third possibility is to give up looking for a job, particularly if informal opportunities offer wages below their reservation wage or if they can rely on other income sources. In this case, these individuals exit the labor force and are classified as inactive.

It should be noted that these listed effects happen assuming that the demand for work remains unchanged. However, if the labor demand curve in the formal sector were to shift to the right at the same time (as would occur during a period of economic growth and/or increased labor productivity), unemployment in the formal sector—as well as the migration of workers into informality and inactivity—would be less significant. In an extreme case, if the new demand curve intersected the supply curve at the MW^1 level, no formal jobs would be lost, and there would be no transition into informality or inactivity. Conversely, if the demand curve shifted to the left (as typically occurs during an economic

downturn), both unemployment in the formal sector and the migration of workers to the informal sector or out of the labor force would be greater.

After presenting the Dual Sector Theory, other factors that influence labor force participation, employment, and formality can be identified. There are several reasons why individuals of working age may remain outside the labor force (inactive). One of the main ones—particularly for younger individuals—is the need to pursue education. From the perspective of a human capital investment decision, many young people choose to remain out of the labor market to dedicate themselves exclusively to studying, as the present value of future earnings is expected to outweigh the short-term forgone income and the direct costs of education (Becker, 1964).

Another common reason for remaining out of the labor market is the responsibility of caring for the household, young children, or elderly individuals—a role typically undertaken by women. Although women's labor market opportunities have improved, fertility rates have declined, and alternatives for child care (such as daycare centers) are available, many women still remain outside the labor force. This is largely due to persistent cultural norms that continue to assign women primary responsibility for household and caregiving duties (Madalozzo; Martins; Shiratori, 2010, Myrrha; Wajnman, 2007). In the case of married men, being the household reference person encourages labor market participation, especially when they have young children, as they are culturally regarded as responsible for providing for the family (Fernandes; Picchetti, 1999, Oliveira; Scorzafave; Pazello, 2009).

Other factors that may contribute to an individual remaining outside the labor force include the presence of alternative sources of income and physical or mental incapacities that prevent employment. Earnings from interest and dividends on financial investments, rental income from properties, pensions, or retirement benefits, for instance, may lead some individuals to stay out of the labor market (Fernandes; Picchetti, 1999, Oliveira; Scorzafave; Pazello, 2009).

Unemployed individuals are those who wish to work but cannot find a job (or have found one but have not yet started working). Unemployment primarily affects younger individuals, who typically have a low stock of human capital (limited schooling and, especially, little labor market experience). There are also those who face difficulties finding employment in their field of training or work. Another factor hindering job search is the lack of availability for full-time work. This impacts the employability of young people who are studying and women who care for the home and/or children but could work part-time. The presence of alternative sources of income may also allow individuals to spend more time searching for the “ideal” job—i.e., one that matches their skills and education and offers a good salary. Individuals who are the main reference person in the household—especially married men with children—often end up accepting the first job opportunities that arise, even if they are not ideal, due to the cultural expectation of providing for the family (Fernandes; Picchetti, 1999, Oliveira; Scorzafave; Pazello, 2009).

Informality, in turn, is a typical phenomenon in developing countries. It is usually associated with low labor productivity, low capital intensity in production, and lack of

regulation. One of the consequences of informality is the absence of social security protection for workers—which in Brazil includes rights such as retirement, sickness & accident leaves, survivor pensions, and maternity leave (Hirata; Machado, 2008). Informality serves as an alternative to unemployment for low-productivity workers who are unable to find a job in the formal sector. The existence of a legally mandated minimum wage (a wage floor) in the formal sector—which is subject to enforcement—leads firms to reject workers whose productivity falls short of covering their cost (wages plus labor charges). As a result, individuals with low education and/or limited experience (i.e., low-skilled workers) are often excluded from the formal sector. As an alternative, they tend to take up informal employment, either as unregistered employees or informal self-employed workers (e.g., street vendors)[1].

In addition to a minimum productivity threshold, the formal sector typically demands full-time availability (e.g., an eight-hour workday) (Reis; Costa, 2016). Thus, individuals who are unavailable for full-time employment—such as students and women who must dedicate part of their time to housework, childcare, and/or elder care—also face difficulties entering the formal labor market. In the case of women, many tend to seek occupations with higher informality rates, such as domestic work (the cultural expectation that they are responsible for household duties also influences their career choices), as well as other activities in the service sector (Theodoro; Scorzafave, 2011; Madalozzo; Martins; Shiratori, 2010; Myrrha; Wajnman, 2007).

3. Methodology

To analyze the impact of minimum wage variations on the Brazilian labor market, this study uses a panel data regression model with quarterly PNADC data from 2012 to 2015 (IBGE, 2024). The choice of this time frame is justified by two key factors: the full implementation of the PNADC in 2012, and the fact that the minimum wage experienced real increases up to 2015—despite the minimum wage appreciation policy established by Law No. 12.382 remaining formally in force until 2019.

As noted by Wooldridge (2006), panel data combine cross-sectional and time-series dimensions, allowing for the observation of the same units across multiple time periods. One of the main advantages of using panel data is the ability to control for unobservable characteristics. According to Gujarati and Porter (2011), panel data also tend to exhibit greater heterogeneity, and provide more informative datasets—with greater variability, lower collinearity among variables, more degrees of freedom, and increased estimation efficiency. The authors also highlight that panel data are particularly well-suited for analyzing labor market dynamics and assessing the effects of minimum wage policies on employment.

[1] It is important to note, however, that not all informal workers are low-skilled. Some qualified individuals choose informality voluntarily—such as self-employed professionals who find in informal work better alignment with their skills, higher pay, or tax avoidance (RAMOS, 2007).

The estimated equations in this study follow the structure below:

$$y_{it} = \alpha_i + X_{it}\beta + \varepsilon_{it} \quad (1)$$

where i denotes the 27 Brazilian federative units (26 states and one federal district) and t represents the 16 quarters from 2012 to 2015. Three different equations were estimated, in which the dependent variables y_{it} are defined as follows:

1) Unemployment rate: the percentage of unemployed individuals relative to the total labor force (i.e., employed plus unemployed individuals). This variable was constructed using PNADC's variable VD4002 (Employment status);
2) Informality rate: the percentage of informal workers relative to the total number of employed individuals. Individuals were classified as informal workers if they were private-sector employees without a formal contract, domestic workers without a signed employment contract, or informal self-employed workers—i.e., those not registered with CNPJ (variable V4019) and/or not contributing to a social security institute (V4032). The total number of employed individuals includes these informal workers, as well as private-sector employees with a signed employment contract and domestic workers with a formal contract. This classification was based on information from variable VD4009 (Occupational position and employment category of the main job). Since this study seeks to assess whether changes in the minimum wage led to the displacement of formal private-sector employees into informal work (either as employees or self-employed), the calculation of the informality rate excludes public sector employees, military personnel, civil servants, employers, formal self-employed workers, and contributing family workers.
3) Inactivity rate: percentage of people outside the workforce in relation to the working-age population. It was created using the information of variable VD4001 (Condition in relation to the workforce);

In Equation 1, X_{it} is a vector of explanatory variables, which includes the real minimum wage (the main variable of interest) and control variables mentioned in Section 2 of this article, as detailed below:

- Real minimum wage: calculated by deflating the national minimum wage using the quarterly Broad National Consumer Price Index (IPCA – *Índice Nacional de Preços ao Consumidor Amplo*) for each federative unit, as provided in the PNADC dataset. This variable allows to verify if variations in the real minimum wage in the analyzed period affected the unemployment, informality and inactivity rates in Brazil. The expected sign of the associated coefficients is positive, indicating that real increases in the minimum wage raise the rates being analyzed;
- Real earnings from the main job: obtained by deflating the average usual monthly earnings from the main job (VD4016, PNADC) for the formal and informal workers considered in this study. The deflation used the quarterly IPCA

for each federative unit. Increases in average worker income (caused by increases in labor productivity, economic growth, etc.) are expected to be associated with reductions in unemployment, informality, and inactivity rates;

- School: percentage of the population in each federative unit attending school (V3002). Individuals who study often face challenges entering the labor market, particularly in full-time positions. Thus, higher values of this variable are expected to be associated with higher rates of unemployment, informality, and inactivity;
- Head of household: percentage of individuals in each federative unit identified as the head of the household they reside in (constructed using variable V2005). Individuals in this position are typically responsible for supporting household members, ideally through stable and quality employment. Therefore, higher proportions of household heads are expected to be associated with lower rates of unemployment, informality, and inactivity;
- Children in the household: percentage of households, by federative unit and quarter, with children aged 10 or younger. This variable was created by identifying households with children using variable V2009 (Age of household members at the reference date) and a household identifier built from UPA (Primary Sampling Unit), V1008 (Household selection number), and V1014 (Panel). The literature shows that the presence of children increases unemployment and inactivity among women, who are traditionally seen as responsible for childcare. Among those who do enter the labor market, many seek part-time jobs, which are often informal. For men, the pattern tends to be the opposite: as they are culturally seen as responsible for supporting their children, having children at home implies the need of employment;
- Elderly in the household: percentage of households with residents over the age of 65. This regressor was also constructed using variable V2009 and the same household identifier mentioned above. Caregiving responsibilities for the elderly, like for children, usually fall on women. Therefore, a higher proportion of households with elderly individuals is expected to be associated with higher rates of unemployment, informality, and inactivity among women.

The regressions were estimated separately for men and women, as their labor market participation patterns and responses to the explanatory variables differ significantly. Additionally, the sample is restricted to urban residents aged 16 to 65—that is, the working-age population considered eligible for formal employment.

4. Results and Discussion

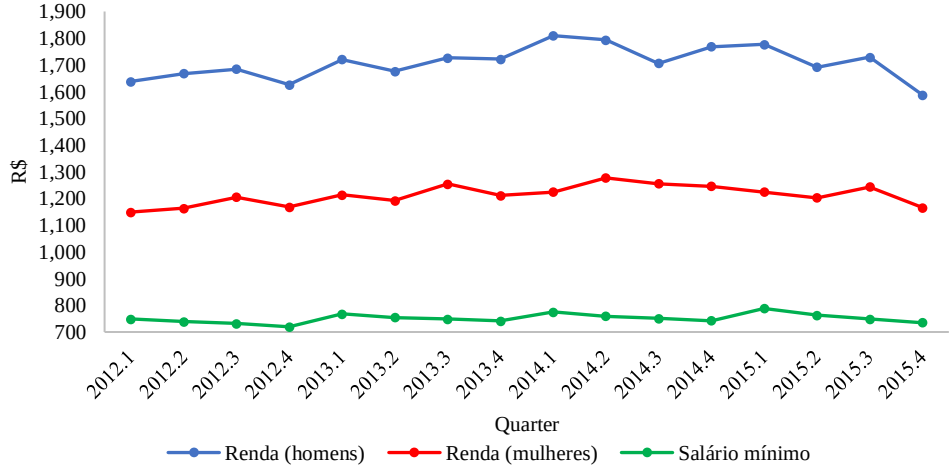
This section first presents the general characteristics of the dataset, followed by the econometric results.

4.1. Data Analysis

Figure 2 shows that the minimum wage experienced real increases throughout most of the period from 2012 to 2015. Comparing the first quarters of each year—since adjustments have been made in January since 2010—the real value of the minimum wage (in constant prices of the first quarter of 2015) rose by 2.6% from 2012 to 2013 (from R$747.84 to R$766.96), by 1% from 2013 to 2014, and by 1.7% from 2014 to 2015, reaching R$788.00 in the first quarter of 2015. However, due to the sharp increase in inflation in 2015 (which reached 10.7%), the minimum wage fell in the fourth quarter of 2015 to a real value lower than in the first quarter of 2012 (R$735.09).

Figure 2 also shows that the average monthly real earnings from the main job (in prices of the first quarter of 2015) for the formal and informal workers included in this study tended to rise until 2014 and declined afterward, due to the economic crisis and rising inflation that affected the country. Average monthly earnings for men—historically higher than for women—reached their peak in the first quarter of 2014 (R$1,809.54), representing a 10.5% increase relative to the first quarter of 2012. Among women, the highest value was observed in the second quarter of 2014 (R$1,276.92), 11.1% higher than in the first quarter of 2012. After this period, real earnings showed a downward trend: among men, earnings fell to R$1,587.81 in the fourth quarter of 2015, a 3% decline compared to the beginning of the period. For women, the drop in earnings was less pronounced, with the fourth-quarter 2015 value (R$1,164.97) standing 1.4% above that of the first quarter of 2012.

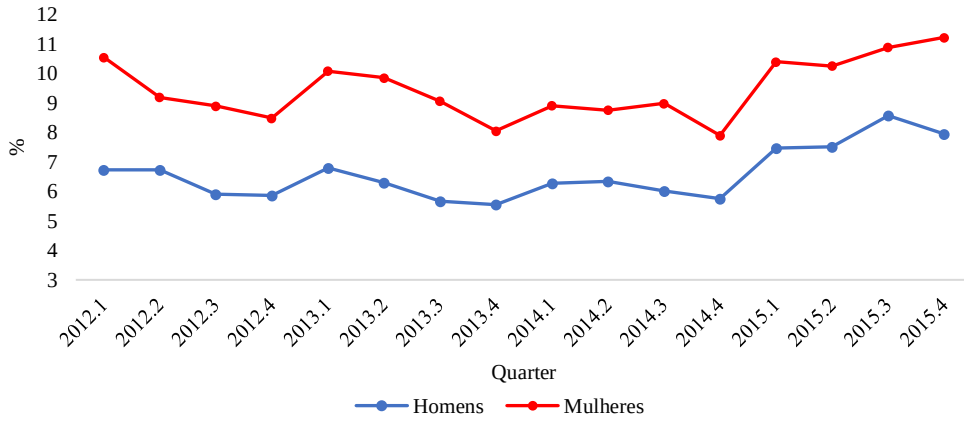
Figure 2: Real average earnings from main job and real minimum wage in Brazil by quarter (2012–2015)



Source: own elaboration based on PNADC microdata from 2012 to 2015.

Figure 3 shows the evolution of the unemployment rate in Brazil over the period. The male unemployment rate tends to be lower than the female rate, and both show a downward trend until the middle of the period: the male rate fell from 6.7% in the first quarter of 2012 to 5.5% in the fourth quarter of 2013; the female rate started at 10.5% and declined to 7.9% by the fourth quarter of 2014. From that point onward, rates began to rise due to the crisis, reaching 8.6% in the third quarter of 2015 for men and 11.2% for women in the fourth quarter of the same year. Historically, women face greater difficulties than men in securing employment. Among the reasons are the need to find jobs that allow balancing work with household and childcare responsibilities (as women are still seen as responsible for these tasks) and the reluctance of many employers to hire women (due to beliefs that men perform better at work, concerns over pregnancy and potential job abandonment, etc.).

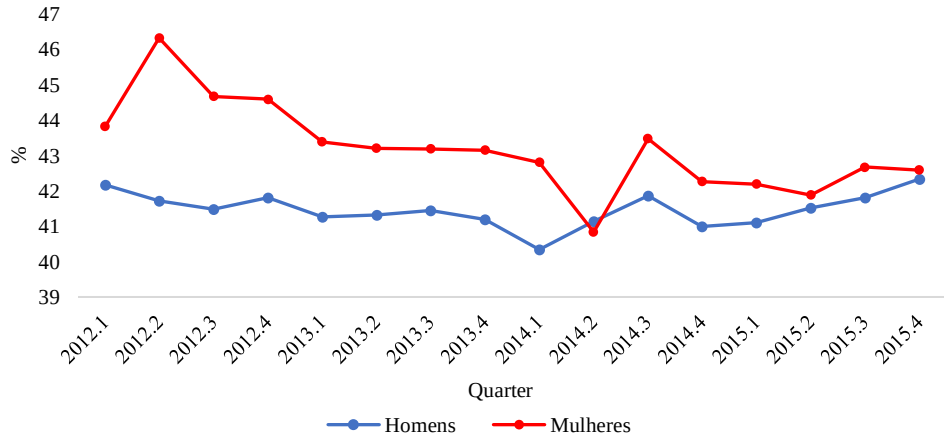
Figure 3: Unemployment rate in Brazil by quarter (2012–2015, %)



Source: own elaboration based on PNADC microdata from 2012 to 2015.

Figure 4 shows that the female informality rate is generally higher than the male rate, but this gap tended to narrow over the analysis period. Informality exhibited a trend similar to unemployment: it initially declined until mid-2014 and then began to rise again. For women, the rate dropped from 46.3% (second quarter of 2012) to 40.8% (second quarter of 2014) before increasing to 42.6% (fourth quarter of 2015). For men, it was 42.2% in the first quarter of 2012, fell to 40.3% in the first quarter of 2014, and rose to 42.3% in the fourth quarter of 2015.

Figure 4: Informality rate in Brazil by quarter (2012–2015, %)

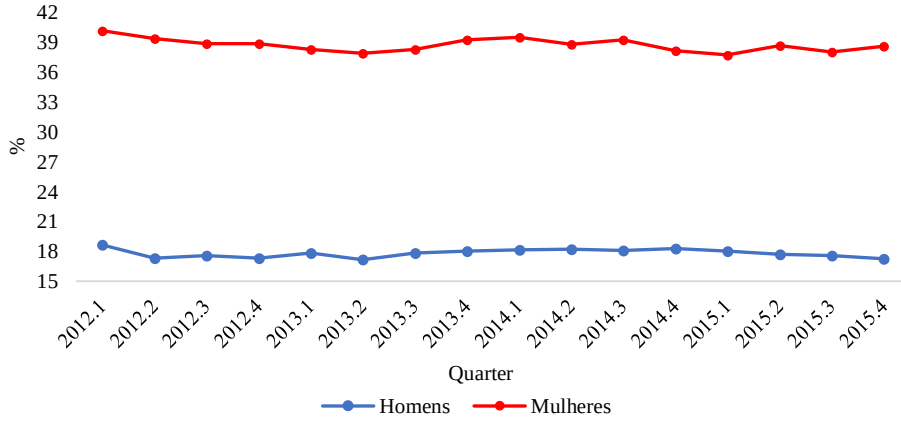


Source: own elaboration based on PNADC microdata from 2012 to 2015.

The inactivity rate (percentage of people outside the labor force relative to the working-age population) is consistently higher for women than for men in Brazil, as many

women opt out of the labor market to care for the household and children. Initially, there is a slight decline in the rate for both sexes between the first quarter of 2012 and the second quarter of 2013: the male rate falls from 18.6% to 17.2%, while the female rate drops from 40.1% to 37.9% (Figure 5). Afterward, the rates rise in 2014 and show a slight decrease in 2015, ending the year at 38.6% for women and 17.3% for men.

Figure 5: Inactivity rate in Brazil by quarter (2012–2015, %)



Source: own elaboration based on PNADC microdata from 2012 to 2015.

PNADC data also show that the share of the male sample attending school declined from 14.1% (first quarter of 2012) to 12.8% (fourth quarter of 2015). Among women, this decrease was from 14.9% to 13.0%. The percentage of men who are heads of their households fell slightly from 52.0% to 51.8%, while the percentage of women heads of household rose from 27.2% to 30.6%. The proportion of men living with children aged 10 or younger decreased from 39.4% to 36.2%, and among women, it dropped from 40.9% to 38.3%. Regarding elderly residents (people aged 65 and older), 12.3% of men lived in such households in the first quarter of 2012, falling to 10.8% in the fourth quarter of 2015. Among women, this share declined from 13.2% to 11.9%.

Table 1 confirms, reinforcing the information from Figure 3, that the average unemployment rate for the period 2012–2015 was higher for women than for men. On average, 6.6% of men and 9.5% of women sought employment but were unable to find a job during this period in Brazil. Unemployment rates were higher in states of the Northeast and North Regions (e.g., 9.8% for men in Rio Grande do Norte and 17.1% for women in Amapá) and lower in states from other regions, with Santa Catarina standing out, with average unemployment rates of 3.3% for men and 4.2% for women during the period.

The average informality rate in Brazil during this period was 41.5% for men and 43.2% for women. As with unemployment, informality is higher in the states of the North and Northeast Regions. For example, in Maranhão, an average of 67.3% of men and 70.9% of women worked informally during the period. Again, Santa Catarina (28.1% for men and

26.6% for women) and other southern states exhibited the lowest informality rates for both sexes.

Table 1: Average values of unemployment, informality, and inactivity rates and of main job earnings, by federative unit and sex (2012–2015)

Location	Unemployment (%)		Informality (%)		Inactivity (%)		Earnings (R$)	
	M	F	M	F	M	F	M	F
Brazil	6.6	9.5	41.5	43.2	17.8	38.7	1,707.45	1,212.56
Rondônia	4.6	7.5	49.9	46.1	17.4	42.8	1,453.04	979.07
Acre	8.0	12.6	58.2	58.7	21.9	43.3	1,224.45	872.33
Amazonas	8.2	14.2	54.4	55.6	18.0	42.9	1,394.92	1,093.28
Roraima	5.2	11.8	59.5	57.6	17.8	37.2	1,220.37	942.99
Pará	7.2	11.9	60.3	66.5	17.2	42.7	1,199.95	836.13
Amapá	9.6	17.1	58.1	59.6	18.0	41.1	1,267.93	915.40
Tocantins	7.2	9.9	58.1	59.5	18.1	42.4	1,265.16	833.78
Maranhão	7.5	11.7	67.3	70.9	21.3	47.0	946.80	717.90
Piauí	6.8	9.0	59.7	66.5	19.5	40.2	980.23	676.31
Ceará	7.5	9.0	56.2	61.2	22.2	45.2	1,067.52	819.84
Rio Grande do Norte	9.8	11.7	52.9	55.6	21.1	44.2	1,093.53	802.84
Paraíba	7.8	12.0	59.0	64.3	20.0	44.2	1,012.11	729.18
Pernambuco	8.0	11.5	48.8	52.5	22.7	47.0	1,353.37	1,034.07
Alagoas	9.7	13.8	49.0	57.2	25.7	52.0	1,045.62	788.59
Sergipe	9.0	11.7	52.4	56.6	18.9	42.3	1,177.43	835.20
Bahia	9.5	13.9	55.2	59.1	17.1	36.6	1,171.36	842.29
Minas Gerais	6.3	8.9	41.7	42.2	17.3	35.5	1,554.65	1,028.93
Espírito Santo	7.2	9.8	38.7	40.1	17.0	37.5	1,671.82	1,085.76
Rio de Janeiro	6.1	9.3	36.9	41.3	19.4	42.3	1,838.24	1,337.56
São Paulo	6.9	9.5	31.5	33.9	16.5	35.7	2,237.15	1,566.73
Paraná	4.0	6.2	35.2	34.9	15.5	35.9	1,854.99	1,245.40
Santa Catarina	3.3	4.2	28.1	26.6	18.0	35.5	1,892.40	1,337.79
Rio Grande do Sul	4.9	7.2	34.6	34.9	17.2	34.2	1,780.36	1,243.90
Mato Grosso do Sul	4.6	6.7	44.0	46.9	15.8	37.4	1,595.15	1,010.53
Mato Grosso	4.3	6.7	43.7	44.2	14.3	40.3	1,722.70	1,110.43
Goiás	4.9	7.8	44.2	48.0	14.8	37.7	1,668.71	1,094.96
Distrito Federal	8.1	10.7	34.6	34.5	17.5	33.4	2,128.92	1,569.52

Source: own elaboration based on PNADC microdata from 2012 to 2015.
Note: M = male and F = female.

The average share of women outside the labor force in Brazil during the 2012–2015 period (38.7%) was more than twice that of men (17.8%). Consistent with the patterns observed for unemployment and informality, the highest inactivity rates were concentrated in the states of the North and Northeast regions. For instance, in Alagoas, an average of 25.7% of men and 52.0% of women of working age were inactive over the period. Among

the federative units with lower inactivity rates, Mato Grosso exhibited an average male inactivity rate of 14.3%, while the Distrito Federal recorded 33.4% female inactivity.

Beyond facing reduced labor market opportunities, women also received lower average earnings. The average real monthly earnings for the analyzed occupational positions amounted to R$ 1,707.45 for men and R$ 1,212.56 for women during the period. The North and Northeast regions again showed the most unfavorable outcomes. In Maranhão, average earnings for men and women were R$ 946.80 and R$ 717.90, respectively, whereas in São Paulo these figures reached R$ 2,237.15 and R$ 1,566.73, respectively.

Table 2 shows that, on average, 13.4% of males and 13.7% of females aged 16 to 65 attended school in Brazil during the analyzed period. The states in the North and Northeast regions exhibited the highest shares of the population attending school, while those in the Southeast and South had the lowest. For instance, in Roraima, 19.2% of males and 22.6% of females attended school. Conversely, in São Paulo, these proportions were 12.2% and 11.5%, respectively. The higher schooling rates in the North and Northeast reflect their higher fertility rates, resulting in a proportionally larger young population compared to other regions. This partially explains the higher unemployment, informality, and inactivity rates observed in these regions, as many individuals forego work to study, and others willing to work lack full-time availability or possess limited experience.

In Brazil, 51.8% of males were heads of household on average during the period, compared to 29.3% of females. In the federative units of the North and Northeast, the share of male heads of household was generally lower than the national average, while that of females was higher.

Among Brazilian women, the share of those living in households with children and elderly individuals (39.7% and 13.2%, respectively) was higher than among men (37.9% and 12.2%). As expected, the regions with the highest proportion of adults living with children were those with higher fertility rates—namely, the North and Northeast. In Amapá, for instance, 52.5% of men and 57.8% of women lived in households with children. Interestingly, these are also the regions with the highest female unemployment, informality, and inactivity rates. The Northeast stood out as the region with the highest shares of men and women living with elderly individuals. In Alagoas, for example, 15.8% of men and 17% of women resided in households with elderly persons. Again, interestingly, the Northeast also exhibited the highest rates of informality and inactivity among women in Brazil.

Table 2: Percentage of the population attending school, responsible for the household, and living with children and elderly in the household, by federative unit and sex (average for the period 2012–2015)

Location	School (%)		Head (%)		Children (%)		Elderly (%)	
	M	F	M	F	M	F	M	F
Brazil	13.4	13.7	51.8	29.3	37.9	39.7	12.2	13.2
Rondônia	15.8	18.8	54.1	29.8	41.9	44.6	7.1	8.0

Acre	19.0	21.0	46.3	35.1	48.8	52.0	8.6	8.9
Amazonas	17.6	19.4	41.9	30.8	49.7	53.5	10.4	10.7
Roraima	19.2	22.6	43.8	35.3	51.8	56.5	8.8	8.5
Pará	15.9	18.0	46.3	28.6	47.0	49.7	11.5	12.2
Amapá	17.7	19.6	42.9	32.3	52.5	57.8	10.1	9.9
Tocantins	16.8	17.7	50.3	31.4	45.7	49.1	9.9	10.5
Maranhão	14.6	15.5	42.4	32.1	47.6	50.3	13.9	14.5
Piauí	15.8	16.8	46.7	29.5	42.0	43.6	14.4	16.0
Ceará	13.7	14.4	46.1	31.6	41.9	43.9	13.7	14.1
Rio Grande do Norte	14.7	15.0	50.2	27.5	39.7	42.3	13.1	13.9
Paraíba	14.7	16.4	50.7	28.5	42.9	44.3	13.6	14.3
Pernambuco	13.7	12.7	49.1	32.3	37.7	39.7	12.3	13.4
Alagoas	15.0	16.0	49.3	30.6	47.8	49.7	15.8	17.0
Sergipe	15.7	16.1	48.9	32.2	43.2	45.3	12.4	13.5
Bahia	14.5	16.3	50.6	31.8	39.6	42.5	11.7	12.5
Minas Gerais	12.8	13.1	54.1	26.5	36.0	38.2	13.3	14.0
Espírito Santo	12.5	13.2	54.5	29.7	39.6	41.2	12.4	13.1
Rio de Janeiro	12.7	12.2	52.6	31.5	32.5	34.4	13.7	15.3
São Paulo	12.2	11.5	52.6	27.2	34.7	36.1	12.0	13.1
Paraná	12.3	13.1	56.4	26.9	38.7	39.5	11.1	12.8
Santa Catarina	12.4	13.2	55.5	27.7	37.2	37.9	11.1	12.4
Rio Grande do Sul	12.8	13.1	53.0	33.1	34.3	35.2	11.8	12.8
Mato Grosso do Sul	13.1	15.5	55.4	30.2	41.8	44.5	11.4	12.0
Mato Grosso	14.4	16.9	52.5	30.6	42.1	44.9	10.0	11.2
Goiás	13.1	14.2	56.0	28.4	39.5	41.2	9.5	10.5
Distrito Federal	17.5	17.2	47.0	34.8	37.7	39.4	10.4	11.9

Source: own elaboration based on PNADC microdata from 2012 to 2015.
Note: M = male and F = female.

4.2 Econometric Results

This subsection presents the econometric results and examines whether real increases in the minimum wage between 2012 and 2015 affected unemployment, informality, and inactivity rates in Brazil. Before discussing the estimation results, it is worth noting that the panel data regressions were based on fixed effects models, as indicated by the Hausman test and the Breusch-Pagan Lagrange Multiplier test. In addition, robust models were estimated to address the heteroscedasticity problem pointed out by the modified Wald test.

Regarding unemployment, the results presented in Table 3 are consistent with the Dual Sector Theory: increases in the real value of the minimum wage tended to raise unemployment rates for both men and women during the period under analysis. Informality rates, contrary to expectations, tended to decline in response to real increases in the minimum wage. As for inactivity, no significant effect was found among men. Among

women, however, real growth in the minimum wage appears to have contributed to an increase in exits from the labor force.

For men, each R$10 real increase in the minimum wage during the period under analysis tended to raise the unemployment rate by 0.19 percentage points (p.p.) in the current quarter and by 0.11 p.p. two quarters ahead[2]. For women, the effect was also positive but only contemporaneous (0.22 p.p.). This positive relationship between the minimum wage and unemployment was also identified by Souza Júnior and Targino (2005) in their analysis of four Brazilian metropolitan areas, and by Gindling and Terrel (2009) in the case of Honduras. On the other hand, these findings differ from those reported by Vázquez, Esquivel, and Hernández (2017) for Mexico, and by Boffy-Ramirez (2019) for the United States, both of which found no evidence that minimum wage increases lead to higher unemployment.

Regarding informality, the results were contrary to expectations for both men and women: real increases in the minimum wage were associated with reductions in informality rates. This effect was significant in the current quarter for both sexes, and with a one-quarter lag for women. These findings diverge from the positive relationship between minimum wage and informality reported by Carneiro (2004) for Brazil, by Souza Júnior and Targino (2005) for the metropolitan regions of Rio de Janeiro and Porto Alegre, and by Mondragón-Vélez, Peña, and Wills (2010) for Colombia. However, they are consistent with the results found by Vázquez, Esquivel, and Hernández (2017) for Mexico, as well as by Souza Júnior and Targino (2005) for the São Paulo metropolitan area.

Explaining how real increases in the minimum wage could lead to reductions in informality is not a straightforward task—especially considering that the informal sector is commonly viewed as a fallback for those excluded from formal employment. Vázquez, Esquivel, and Hernández (2017) argued that increases in the minimum wage may have raised incentives for workers to transition from the informal to the formal sector in Mexico. This explanation, however, seems rather implausible, as it suggests that participation in the formal or informal sector is primarily a matter of individual choice.

Table 3: Estimation results

Explanatory variables	Male			Female		
	Coefficient	Standard Error	p-value	Coefficient	Standard Error	p-value
Unemployment						
Real minimum wage (t)	0.019	0.004	0.000	0.022	0.007	0.005
Real minimum wage (t–1)	0.000	0.004	0.975	-	-	-
Real minimum wage (t–2)	0.011	0.005	0.046	-	-	-

[2] Lagged values of the minimum wage were included in the regressions as explanatory variables in order to assess whether the effects of changes in the wage floor take time to materialize and whether such effects, if any, persist across subsequent quarters. The total number of lags included in the models was based on the statistical significance of the estimated effects.

Real monthly earnings	–0.002	0.001	0.023	–0.002	0.001	0.048
School	0.080	0.041	0.060	0.102	0.093	0.282
Head of household	–0.005	0.037	0.889	–0.079	0.057	0.176
Children in household	–0.051	0.034	0.145	0.091	0.048	0.071
Elderly in household	0.075	0.049	0.143	0.055	0.069	0.433
Constant	–12.004	6.776	0.088	–8.141	5.841	0.175
R^2 within	0.119			0.071		
R^2 between	0.330			0.332		
R^2 overall	0.245			0.234		
Informality						
Real minimum wage (t)	–0.020	0.008	0.016	–0.020	0.010	0.068
Real minimum wage (t–1)	–0.008	0.008	0.330	–0.037	0.012	0.005
Real monthly earnings	–0.003	0.001	0.084	–0.010	0.003	0.002
School	–0.210	0.146	0.164	0.011	0.125	0.929
Head of household	–0.175	0.054	0.003	–0.036	0.097	0.713
Children in household	0.001	0.105	0.996	0.036	0.099	0.722
Elderly in household	0.030	0.086	0.728	–0.049	0.100	0.624
Constant	85.362	9.058	0.000	103.820	15.317	0.000
R^2 within	0.068			0.124		
R^2 between	0.748			0.781		
R^2 overall	0.561			0.649		
Inactivity						
Real minimum wage (t)	0.006	0.005	0.299	–0.048	0.024	0.051
Real minimum wage (t–1)	-	-	-	0.048	0.022	0.039
Real minimum wage (t–2)	-	-	-	0.008	0.008	0.361
Real minimum wage (t–3)	-	-	-	0.020	0.009	0.048
Real minimum wage (t–4)	-	-	-	0.058	0.024	0.024
Real minimum wage (t–5)	-	-	-	–0.054	0.022	0.020
Real monthly earnings	–0.001	0.001	0.393	–0.004	0.002	0.092
School	0.169	0.051	0.003	0.222	0.087	0.016
Head of household	–0.081	0.042	0.069	–0.083	0.076	0.285
Children in household	–0.055	0.033	0.103	0.132	0.049	0.012
Elderly in household	0.069	0.056	0.231	0.132	0.087	0.141
Constant	17.944	4.304	0.000	14.646	20.163	0.474
R^2 within	0.069			0.101		
R^2 between	0.353			0.351		
R^2 overall	0.231			0.299		

Source: research results.

Rima (1981) mentions the possibility that a minimum wage increase could reduce the supply of labor in the informal sector. This would occur if workers left informal jobs to seek positions in the formal sector, which becomes more attractive as the minimum wage rises—shifting from informal employment to unemployment. However, for this to happen, workers would need some alternative source of income to support themselves while searching for formal jobs, a scenario that seems unlikely for most informal workers in Brazil.

Another possible explanation for the results could draw on the argument by Neri, Camargo, and Gonzaga (2001), who suggest that the minimum wage also serves as a benchmark for earnings in the informal sector. They observed a high percentage of informal workers earning exactly the minimum wage—what they called the "lighthouse effect." Thus, if the minimum wage exceeds the equilibrium wage in the informal sector, it could also trigger unemployment among informal workers. Even so, for increases in the minimum wage to lead to a reduction in informality, informal employment would need to be more negatively affected than formal employment—an outcome that seems counterintuitive, especially if the informal sector is viewed as a fallback option for those who lose formal jobs. In addition, the methodological approach used in this study does not allow verification of whether this was the case (the effects on formal and informal employment were not analyzed separately).

An analysis of the other statistically significant coefficients in Table 2 reveals that increases in average real monthly earnings (which may reflect higher labor productivity and/or economic growth, for instance) tend to reduce both unemployment and informality rates among men and women. As an illustration, a R$ 10 increase in women's average monthly earnings is associated, on average, with a 0.1 percentage point reduction in the female informality rate. Higher earnings are also linked to lower female inactivity rates, although this effect is not statistically significant for men.

As expected, a higher proportion of men enrolled in school is associated with an increase in the male unemployment rate, reflecting the challenge of finding jobs that allow for work-study balance. Young, single men who attend school may prefer part-time jobs to accommodate their studies. However, such jobs are relatively scarce, particularly in the formal sector. In addition, limited work experience among young men may further hinder their access to employment opportunities. The results also showed that the higher the proportion of men and women attending school, the higher the inactivity rate (on average, a 1 p.p. increase in the share of women attending school implies a 0.22 p.p. increase in their inactivity rate, for example). It was also observed that, contrary to expectations, school attendance does not affect the female unemployment rate nor the informality rates of men and women.

Furthermore, the higher the percentage of men who are heads of household, the lower their informality and inactivity rates tend to be. In other words, being head of household increases men's need to find stable employment to support their families. On the other hand, being head of household does not affect the unemployment rates of men and women, nor the informality and inactivity rates of women.

As expected, the presence of children aged 10 or younger in women's households increases their unemployment and inactivity rates (for instance, a 1 p.p. increase in the share of women living with children raises the female inactivity rate by 0.13 p.p., on average). In households with young children, women (mothers and/or older sisters) tend to forego labor market participation to care for children or face difficulties finding jobs that allow them to balance work and childcare (such as part-time work). For men, children in the household tend to reduce inactivity, reflecting the increased necessity to work to support

the family. Results also indicated that the presence of children does not significantly affect male unemployment or informality rates for both sexes. Contrary to expectations, the presence of elderly individuals (aged 65 and over) in the household did not statistically affect unemployment, informality, or inactivity rates for men or women during the analyzed period.

5. Conclusion

The objective of this study was to analyze whether real changes in the minimum wage led to side effects on unemployment, informality, and inactivity rates in Brazil. To that end, quarterly data from the PNADC for the period 2012–2015 were employed. Panel data regression models were estimated, using Brazilian federative units as cross-sectional units.

The findings suggest that, contrary to some results in the literature, real increases in the minimum wage were associated with a reduction in informality rates during the period under analysis. One possible explanation is that, during those years, sectors generating formal employment performed well, allowing for the real appreciation of the minimum wage without an associated increase in informality. In the case of unemployment, results were consistent with the Dual Sector Theory: real increases in the minimum wage tended to raise unemployment rates among both men and women. Thus, the findings suggest that the rise in the minimum wage did not cause a shift of workers from the formal to the informal sector, but may have led to job destruction in either or both sectors by raising labor costs for firms. Moreover, real increases in the minimum wage were found to reduce women's participation in the labor force. That is, some of the women who lost their jobs may have given up on seeking new employment. This is a particularly concerning outcome, given that women's labor force participation is already historically lower than that of men.

Although the goal of the minimum wage policy was to increase earnings among formal workers, it inadvertently led—by increasing labor costs—to higher unemployment among both men and women, and to a withdrawal of women from the labor force. In this context, public policy should prioritize measures that raise workers' earnings without adversely affecting employment or labor force participation. A robust investment in education, as proposed by Human Capital Theory, would be more effective in achieving these objectives, as it would enhance labor productivity and, consequently, worker earnings—while producing long-term, sustainable effects. This policy should include the eradication of illiteracy and improvements in the quality of education from the early years, following the example of countries like South Korea.

Finally, further studies are recommended to examine separately the effects of the minimum wage on formal and informal employment, in order to better understand the mechanisms behind the observed reduction in informality. Additionally, the same type of analysis could be replicated for specific spatial or regional contexts, such as metropolitan areas with similar or distinct labor market and production structures.

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