Does an Increasing Minimum Wage Reduce Formal Sector Employment? Evidence from Brazil*

Fernando Saltiel[1] and Sergio Urzúa[2]

[1]Duke University
[2]University of Maryland and NBER

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Abstract

Between 2003 and 2012, Brazil's real minimum wage increased by 62 percent. In this paper, we take advantage of matched employer-employee data and examine whether this increase resulted in negative impacts in the formal labor market. The empirical analysis is carried out at the local labor market level. Our main identification strategy relies on geographical variation in the incidence of the minimum wage. We first document substantial heterogeneity in the incidence both across and within states. We find limited overall disemployment effects, but unravel larger negative employment elasticities for groups and sectors more exposed to minimum wage increases. We complement our analysis by exploiting the introduction of regional wage floors in five states directly targeting workers in the restaurant and accommodation industry. Across different empirical strategies, we show that wage floors successfully raised salaries at bottom of the wage distribution. However, in this case, we fail to find significant impacts on employment outcomes.

Keywords: Minimum Wage, Labor Market Regulations, Employment Effects.

*Fernando Saltiel; Department of Economics; Duke University; E-mail: fernando.saltiel@duke.edu. Sergio Urzúa; Department of Economics; University of Maryland, College Park and National Bureau of Economic Research; E-mail: urzua@econ.umd.edu. We would like to thank the *Banco de Desarrollo de America Latina* for financial support. We thank Felipe Montaño Campos for excellent research assistance. We thank the contributions of seminar participants at the Workshop on Understanding the Productivity Gap in Latin America, Buenos Aires, Argentina, 2016 for useful comments and suggestions. Web Appendix: http://econweb.umd.edu/~urzua/WebAppendixSU_MW.pdf

1 Introduction

Labor markets in Latin America are characterized by high employment costs and extensive regulations (Heckman et al., 2000). A common feature in the region is the existence of legislated minimum wages, which, while varying in scope and extent across countries, directly affect wages of formal sector workers (Maloney et al., 2003; Kristensen and Cunningham, 2006). While this tool is also prevalent in developed countries, the estimated effects of the minimum wage on employment may differ across developed and developing countries, given the existence of a large informal sector in the latter.

In this paper, we examine the impacts of the minimum wage on various employment measures in Brazil, the seventh largest economy in the world. Between 2003 and 2012, its real national minimum wage grew by 62 percent, far exceeding the country's cumulative economic growth in this time period (48 percent based on GDP, PPP constant 2011 dollars). As such, the Kaitz index, which measures the ratio of the minimum wage to the median wage, grew from 45 percent in 2003 to 58 percent in 2012. Moreover, in 2000, the Federal government instituted a law allowing states to implement wage floors affecting employment in specific industries and occupations. To explore the effects of the national minimum wage and regional wage floors on employment outcomes, we take advantage of matched employee-employer data (RAIS), which covers the universe of formal sector workers and firms in Brazil for the 2003-2012 period. Moreover, RAIS includes firms' sector classification as well as rich geographic information on local labor markets (microregions), allowing us to consider heterogeneous employment effects by exposure to the minimum wage.[1]

To identify the effects of the minimum wage on formal sector employment, we first follow the existing literature and leverage state-level variation in the incidence of the minimum wage, as measured by the Kaitz index. We find that an increase in the minimum wage is associated with negative employment elasticities, which are not statistically significant, fitting in with previous findings presented by Lemos (2004, 2009a,b), Neumark et al. (2006), and Broecke and Vandeweyer (2016), among others. Nonetheless, using RAIS data we find substantial within-state variation in the incidence of the minimum wage, as states explain less than half of the variance in microregion-level Kaitz indices. As a result, we conduct our empirical analysis at the microregion level, and find employment elasticities which are not different from zero.

The lack of disemployment impacts may be explained by the lack of incidence in the minimum wage, as fewer than 5% of workers earned wages around the minimum wage (Engbom and Moser, 2018). We thus estimate employment elasticities for two groups highly exposed to minimum wages: workers in the restaurant and accommodation industry and high school dropouts. We find larger (negative) elasticities in the range of -0.12-0.27, yet these are smaller under alternative incidence measures (Lemos, 2009a) and are largely insignificant. Lastly, we note that Brazil's economic growth was fueled by a large commodity-price increase and regions were dif-

[1] In particular, we exploit detailed geographic information in RAIS to estimate the impacts across Brazil's 558 microregions, which "group together economically integrated contiguous municipalities [in the same state] with similar geographic and productive characteristics" (Dix-Carneiro and Kovak, 2017).

ferentially exposed to this shock. As a result, the minimum wage may result in heterogeneous employment effects across areas less exposed to the boom. We follow Benguria et al. (2018) and use data from the 2000 Census to measure microregion-level exposure to the commodity shock. We find larger negative employment elasticities in microregions less exposed to the boom, indicating important within-country heterogeneity in the estimated effects in light of macroeconomic conditions in Brazil during our time period of interest.

We further analyze the impacts of regional wage floors on labor market outcomes. Since 2000, five Southeastern states have implemented such floors, and these laws cover different categories of workers, making it difficult to compare their impact across states. Nonetheless, we show that existing floors include provisions directly aimed towards workers in the restaurant and accommodation industry.[2] Since the existing literature has argued about whether wage floors successfully raise wages (Terrell, 2009; Tepedino, 2013; Corseuil et al., 2015), we also consider their impact on this outcome. We first estimate wage floor regressions including all microregions in the country following the existing minimum wage literature (Card and Krueger, 1994, 2000) and find that wage floors successfully raise wages among low-wage workers in the restaurant and accommodation industry. On the other hand, we do not find evidence that wage floors result in significant disemployment effects. We consider the robustness of the results by restricting the analysis to Southeastern states and find similar earnings and employment effects.

However, wage floors may be set endogenously to labor market outcomes in the restaurant and accommodation sector. To address this concern, we follow Dube et al. (2010, 2016) and implement an alternative empirical strategy which compares outcomes in microregions with different wage floors lying on state borders. In this setting, the endogeneity concern is assuaged if states do not set wage floors in light of labor market outcomes in microregions lying on the state border. As such, this strategy compares outcomes in areas facing similar aggregate shocks, but with different wage floors. We identify 89 microregions on state borders which faced different floors at some point between 2003 and 2012.[3] We document that bordering microregions are more similar vis-a-vis any other region in the sample, thus constituting valid controls. In this design, we find similar earnings effects as in the full sample, indicating wage floors increased wages in the restaurant and accommodation sector. We do not find significant disemployment effects.[4] Moreover, we examine whether the implementation of wage floors results in cross-state spillovers, but fail to find evidence of such impacts. We additionally consider the robustness of our results to a matching estimator, which identifies the closest-matched microregion for each treated microregion, finding similar results as in the other two specifications. As a result, the combination of limited disemployment effects arising from both the minimum wage and regional wage floors

[2] The restaurant and accommodation industry is defined as a one-digit sector in Brazil.

[3] These microregions constitute 138 microregion-pairs, as microregions may be paired with more than one counterpart across the border.

[4] While the U.S. literature has debated about the validity of this design due to differences in the estimated employment elasticities between the cross-border microregion (county) pair design and the standard minimum wage specification (Neumark et al., 2014; Allegretto et al., 2017; Neumark and Wascher, 2017), the robustness of our results to both specifications indicates that such concerns are not relevant in the Brazilian context.

leads us to conclude that neither policy reduced formal sector employment in Brazil between 2003 and 2012.

This paper makes various contributions to the literature on the employment impacts of minimum wages in developing countries. First, within the Brazilian context, by focusing the empirical analysis at the microregion level, we show that state-level incidence measures miss an important source of variation. As such, the estimated employment elasticities across state- and microregion-level specifications differ significantly. Furthermore, focusing the empirical analysis at this more granular level allows us to consider heterogeneous impacts by exposure to the commodity boom. And since RAIS data includes detailed information on industrial composition, we can examine the impacts of the minimum wage on industry-level employment outcomes, thus overcoming potential measurement error concerns in survey data. In this way, this paper complements an extensive literature exploiting variation in the incidence of the minimum wage to estimate employment impacts in Brazil (Fajnzylber, 2001; Camargo et al., 2001; Lemos, 2004; Neumark et al., 2006; Lemos, 2009a,b; Broecke and Vandeweyer, 2016; Jales, 2018) and in Latin America more generally (Strobl and Walsh, 2003; Arango and Pachón, 2004; Khamis, 2013; Maurizio and Vazquez, 2016). We extend the existing literature by carrying out the analysis at the microregion level and examining heterogeneous impacts by industrial exposure to the minimum wage — fitting in with existing work in the United States focusing on the restaurant industry (Card and Krueger, 1994, 2000; Neumark and Wascher, 2000; Dube et al., 2010). Lastly, by considering differential impacts by initial exposure to the commodity boom we also contribute to previous work exploring the interaction between labor market regulations and macroeconomic conditions (Micco et al., 2006; Bassanini et al., 2009; Caballero et al., 2013).

Second, by estimating the impact of wage floors on employment outcomes, this paper contributes to a growing literature exploiting within-country variation in minimum wage policies in developing countries, including Gindling and Terrell (2007, 2009, 2010); Alaniz et al. (2011); Ham (2018); Wong (2019), among others. We present credible evidence regarding the impact of wage floors across the wage distribution in the restaurant and accommodation industry, extending previous findings presented in Terrell (2009), Tepedino (2013) and Corseuil et al. (2015). Moreover, we address potential endogeneity concerns in the implementation of the wage floors by adapting the cross-border county-pair design in Dube et al. (2010, 2016) to the Brazilian context. We show that cross-state microregions constitute credible controls. We present the first estimated employment elasticities of wage floors, failing to find significant disemployment effects. Our results are robust to concerns raised by Neumark et al. (2014) and Neumark and Wascher (2017).

The paper proceeds as follows. Section 2 discusses the institutional context in Brazil, the relevant minimum wage and wage floor increases, the administrative data sources used in the paper and summary statistics. Section 3 presents our empirical strategy and results of the impacts of the national minimum wage on various employment measures. Section 4 describes our contiguous microregion border pair strategy and displays our estimated results of wage floors on employment in the accommodation-restaurant sector. Section 5 discusses the results and concludes.

2 Institutional Context and Data Sources

2.1 Institutional Context

National Minimum Wage. The minimum wage in Brazil was initially implemented in 1940 at the state level, becoming uniform at the national level in 1984, with no sub-minimum or differentiated minimum wage rates for specific groups of workers. The minimum wage covers workers employed in the formal sector and the Ministry of Labor often carries out inspections to ensure that firms comply with minimum wage regulations (Almeida and Carneiro, 2009). However, the prevalence of the informal sector, accounting for half of employment in Brazil (Dix-Carneiro and Kovak, 2019), implies that firms may skirt compliance with the minimum wage by employing informal workers. Nonetheless, the minimum wage may still affect informal sector wages through the posited "lighthouse effect" (Baltar and Souza, 1979), in which minimum wage increases result in corresponding changes in informal sector wages.[5] As a result, any negative employment effects in the formal sector may be potentially attenuated due to the lighthouse effect.

While the value of the real minimum wage had varied substantially across high and low inflationary periods in Brazil in the 1980s and 1990s (Lemos, 2006; Neumark et al., 2006), it has undergone a significant increase in recent years. Between 2003 and 2012, the real minimum wage grew by a total of 62 percent, reaching a value of 622 Brazilian Reais (410 PPP-adjusted U.S. dollars) per month by the end of the period.[6] In the context of Brazil's sustained economic growth in this time period, we consider whether the minimum wage became more binding over time by exploiting the Kaitz index ($Kaitz_t = \frac{MW_t}{w_t^{p50}}$), where w_t^{p50} measures median formal sector wages in Brazil in year t.

The Kaitz index, which captures the ratio of the minimum wage to median monthly earnings, grew from 45 percent in 2003 to 58 percent in 2012 (Figure 1). This change was accompanied by a 50 percent increase in the size of the formal sector, which incorporated upwards of 40 million workers between 2003 and 2012. We note that since only 4-6% of formal sector workers earned salaries within a 5 percent band of the minimum wage in this time period (Engbom and Moser, 2018), the disemployment impacts arising from minimum wage increases may be muted in the full sample. Our empirical analysis thus considers heterogeneous impacts across workers, industries and regions differentially exposed to minimum wage increases.

State-Level Wage Floors. In 2000, the Federal Government of Brazil instituted a law allowing states to introduce wage floors above the national minimum wage, which could selectively apply to certain occupations and/or industries. Since then, five states have introduced such policies: Rio de Janeiro in 2000, Rio Grande do Sul in 2001, Paraná in 2006, São Paulo in 2007 and Santa

[5] Fajnzylber (2001); Camargo et al. (2001); Lemos (2004) provide evidence of this phenomenon in Brazil. Gindling and Terrell (2007) present similar evidence in Costa Rica and Maloney et al. (2003) do so across Latin America.

[6] In 2006, the government introduced a rule to increase the minimum wage by the sum of inflation in the previous year and the average GDP growth rate in the two previous years. This rule has been renewed twice since and the minimum wage increases have often exceeded the minimum mandated by law.

Catarina in 2009. These states are all located in the Southeast region of the country and are among the richest states in Brazil. While this policy could theoretically allow us to exploit within-country variation in wage floors in our empirical analysis, estimating their impact is not straightforward, as the occupations and industries vary across states. For instance, while Rio de Janeiro's law defines the wage floor by occupational categories, Rio Grande do Sul's policy is defined at the industry level. Moreover, these policies include various wage floors for different categories of workers, and these categories have shifted over time (Corseuil et al., 2015).

Despite the heterogeneous implementation of the wage floor across states, all policies include explicit provisions affecting employment in the restaurant and accommodation industry. In Appendix A, we show that Rio Grande do Sul, Sao Paulo and Santa Catarina include floors which directly affect workers in the "restaurant" and "tourism and accommodation" industries. Meanwhile, Rio de Janeiro has a specific floor covering busboys, cooks and servers — who account for a large share of employment in restaurants — and tourism and accommodation workers. Likewise, Paraná includes a floor for workers in a one-digit occupational group which accounts for the majority of employment in the restaurant and accommodation industry.[7] In this context, we create a state-level wage floor variable, presented in Figure 2, which tracks the relevant floor in each state for workers employed in this one-digit industry and compare it to the national minimum wage.[8] As shown in the figure, since wage floors are adjusted in different months across states, we analyze outcomes on a quarterly basis, to correctly measure within-year variation in these floors. Lastly, given the ongoing debate in the literature about the effectiveness of the wage floors (Terrell, 2009; Tepedino, 2013; Corseuil et al., 2015), our empirical analysis examines the extent to which regional floors affect wages.

2.2 Data Sources

We use data from the Relação Anual de Informações Sociais (RAIS) database for the 2003-2012 period. RAIS contains linked employee-employer data from a mandatory annual survey filled by all registered firms in the formal sector in Brazil, thus constituting a Census of formal sector employment in the country.[9] We observe firms' geographic location down to the municipality level, which allows us to construct employment measures at various levels of geographic aggregation.[10] As such, RAIS data allows us to extend the minimum wage literature in Brazil — which

[7]Since other workers in this sector earn higher wages than busboys and servers (such as managers), we consider these floors as binding for any formal employment in the restaurant industry. Since the restaurant and accommodation industry is defined as a one-digit sector in Brazil, we focus our empirical analysis on the impacts of regional wage floors on employment outcomes in this sector.

[8]In the specific cases in which two different provisions apply to workers in this sector — such as in Rio de Janeiro, where one floor applies to busboys and a higher one applies to servers, as well as Rio Grande do Sul and Parana with different floors for restaurant and accommodation workers — our variable includes the lower of the two, though our empirical results are not sensitive to this choice. These results are available upon request.

[9]The survey has been administered by the Brazilian Ministry of Labor since 1986, and reached complete coverage of formal sector firms by 1994. As the Ministry of Labor has been known to levy fines on late and/or inaccurate reports, firms tend to hire specialized accountants to ensure the correct completion of the RAIS survey, resulting in highly accurate data.

[10]There are 5,570 municipalities in Brazil, which are aggregated into 558 microregions and 27 states.

has largely analyzed state-level outcomes — to examine employment outcomes at finely defined geographic levels. In particular, we focus on Brazil's 558 microregions, comprised of contiguous municipalities with similar economic characteristics, which represent local labor markets resembling commuting zones in the United States.[11]

The administrative nature of RAIS allows us to observe the start and end month for each job for each worker as well as individual-level characteristics such as their age, gender, educational attainment, and occupation, allowing us to consider heterogeneous outcomes across workers' observed characteristics.[12] In terms of earnings measures, RAIS includes information on average gross monthly labor earnings including regular salary payments, holiday bonuses, performance-based and commission bonuses, tips, and profit-sharing agreements. Lastly, we observe firms' industry, which we use to construct employment and earnings measures across economic sectors.[13] For our aggregate employment measure, we use the number of full-time equivalent workers during the reference quarter, which adjusts for workers who were not employed for all three months in the quarter and/or for those working less than the standard 44 hours per week. We complement RAIS with data from Brazil's Statistical Agency (IBGE) to construct annual microregion-level population, economically active population (aged 15-59), population density and real GDP per capita measures. Furthermore, we follow Benguria et al. (2018) and use data from Brazil's 2000 Demographic Census to construct microregion-level exposure to the subsequent commodity boom.[14]

3 Employment Effects of National Minimum Wage

3.1 State-Level Analysis

While the minimum wage does not vary within Brazil, there is substantial cross-state heterogeneity in its binding nature, as shown by state-level Kaitz indices presented in Table B.1. For example, the ratio of the 2003 minimum wage to the median wage in low-income northeastern states such as Ceara and Piaui exceeds 60%, while remaining below 36% in Sao Paulo. In this context, the existing literature in Brazil has leveraged over time changes in state-level Kaitz-like incidence ratios to identify the employment impacts of the minimum wage (Lemos, 2004, 2009a,b; Broecke and Vandeweyer, 2016). In fact, the third column of Table B.1 shows that while the Kaitz index increased in all states between 2003 and 2012, there are differential increases across the country. Nonetheless, the minimum wage increase in this time period successfully increased earnings across high-

[11]Previous work in the international trade literature has focused its analysis at the microregion level (Adão, 2015; Dix-Carneiro and Kovak, 2017, 2019) given substantial heterogeneity in labor market outcomes within states. As a result, household survey data, such as the Pesquisa Nacional por Amostra de Domicilios (PNAD), which captures geographic information at the state level, cannot account for such heterogeneity.

[12]While RAIS data is collected on an annual basis, observing the dates of entry and exit for all workers allows us to construct measures of relevant wage and employment outcomes at the quarterly level.

[13]Our industry-level analysis focuses on all employment in the restaurant and accommodation sector, which includes four different six-digit restaurant industries and four different six-digit hotel types.

[14]We define commodity exposure by calculating employment shares in the following 14 commodity-based industries: cereals, cotton, sugarcane, soybeans, citrus, coffee, cacao, bovine meat, ovine meat, poultry meat, coal, oil and gas, metallic minerals, and precious metals, which account for a sizable share of commodity-based employment in Brazil.

and low-income states, such as Rio de Janeiro and Piauí, respectively (Figure B.1). To examine the effects of the minimum wage on employment outcomes, we first follow the existing literature and estimate the following regression:

$$y_{st} = \alpha + \sum_{k=1}^{K} \gamma_k [\ln(kaitz_{st})]^k + \alpha_1 X_{st} + \lambda_t + \sum_{\rho=0}^{P} \theta_s t^{\rho} + \varepsilon_{st}, \quad (1)$$

where y_{st} represents state-level annual employment outcomes, $kaitz_{st}$ represents the Kaitz index, and we include polynomials of order K accounting for potential miniregion-specific effects (Lee, 1999; David et al., 2016; Engbom and Moser, 2018). In X_{st} we control for labor supply shifters (economically active population) and macroeconomic conditions (state-level real GDP); λ_t captures year fixed effects and θ_s includes state fixed effects ($\rho = 0$) along with linear time trends ($\rho = 1$), depending on the specification. We cluster standard errors at the state level.

Equation (1) represents the reduced form version of an employment-demand equation — since this specification includes median wages in the denominator, it could be understood as an approximation of a relative demand equation of low-skilled workers relative to their higher-skilled counterparts. In equation (1), we recover the employment impacts of the national minimum wage by exploiting over time variation in how the minimum wage drives changes in state-level Kaitz ratios (Neumark and Wascher, 1992, 1994; Card and Krueger, 1995; Kambayashi et al., 2013; Dolton et al., 2015; Caliendo et al., 2018). Formally, we assume that the variation coming from the Kaitz ratio is conditionally mean independent of the error term. To the extent that our specifications control for year and microregion fixed effects, minimum wages are set at the national level and average/median wages respond to within-period and local shocks, this exogeneity assumption should fit reasonably well to the Brazil context.

The first panel of Table 1 presents the estimated impacts of the minimum wage on formal sector employment at the state level. The first column indicates that a 10 percent increase in the Kaitz index is associated with a 2.5 percent decrease in formal sector employment, yet the coefficient is not statistically significant. In the second column, to capture potential non-linearities in this relationship we include a second-order polynomial and present the estimated marginal effects evaluated at the minimum wage evaluated at the mean. We find a slightly larger, yet insignificant, point estimate (-0.293). In the last two columns, we consider an alternative incidence measure capturing the ratio of the minimum wage to average wages in each state.[15] Unlike the first two columns, the estimated point estimates are smaller than -0.02 and remain insignificant, fitting in with evidence in Lemos (2009a) showing different employment impacts depending on the minimum wage variable being considered. To assess the robustness of these results, we additionally include state-level linear trends. The estimated results, presented in Table B.2, similarly show negative employment elasticities for the Kaitz ratio in the range of -0.23, which are significantly smaller when considering the Kaitz-mean index.[16] Our results fit in with the existing literature in Brazil, which has

[15]Throughout the rest of the paper, we refer to this measure as the Kaitz-mean measure.

[16]The inclusion of state linear trends implies that the employment elasticities are identified from differences in the

largely found limited disemployment impacts arising from the minimum wage.[17]

Nonetheless, state-level estimates miss an important source of heterogeneity in the incidence of the minimum wage. In Figure B.2 we present microregion-level Kaitz indices in 2003, which show substantial within-state variation. For instance, within the state of Sao Paulo, the Kaitz index in the Sao Paulo microregion equals 16 percent, while exceeding 41 percent in the Birigui microregion. In fact, a variance decomposition exercise indicates that states account for less than 40% of the variation in 2003 microregion-level Kaitz indices. Our preferred empirical strategy thus extends the existing literature in Brazil by leveraging changes in microregion-level incidence measures.

3.2 Microregion-Level Analysis

Figure 3 displays changes in the Kaitz index at the microregion level between 2003 and 2012. While the incidence of the minimum wage increased in most regions, there is significant heterogeneity both within and across states, as the Kaitz index fell in 118 microregions — generally located in the Northeast part of the country. Our empirical strategy exploits variation in this incidence measure over time. We thus re-estimate equation (1) at the microregion level as follows:

$$y_{mt} = \alpha + \sum_{k=1}^{K} \gamma_k [\ln(kaitz_{mt})]^k + \alpha_1 X_{mt} + \lambda_t + \sum_{\rho=0}^{P} \theta_m t^\rho + \varepsilon_{mt} \tag{2}$$

where X_{mt} includes the same covariates as in equation (1), measured at the microregion level, λ_t includes year fixed effects and, as previously explained, $\theta_m t^\rho$ encompasses microregion fixed effects along with time trends. Standard errors are clustered at this level. We present the results in Table 2. The first column shows that a ten percent increase in the Kaitz ratio does not have a significant impact on formal sector employment, as the implied elasticity equals -0.04. In the second column, we add a quadratic term of the Kaitz ratio and present the marginal effects evaluated at the mean. The estimated elasticity remains statistically indistinguishable from zero. The last two columns present evidence using the Kaitz-mean index, which similarly show estimated employment elasticities which are not statistically different from zero. The estimated employment elasticities at the microregion level are largely similar across the two incidence measures, which was not the case when conducting the analysis at the state level.

Heterogeneity by Industry and Education. While the estimated employment impacts presented so far are not different from zero, this result may be driven by the limited incidence of the mini-

Kaitz index (and employment outcomes) vis-a-vis state-level trends in the 2003-2012 period. As noted by Dube et al. (2010), including state-linear trends aims to account for endogenous minimum wage increases in the context of negative employment levels and trends. However, since we consider a nationally-set minimum wage, this is not a significant concern in our context.

[17] For instance, Lemos (2004); Neumark et al. (2006); Lemos (2009b,a) and Broecke and Vandeweyer (2016) use data from an employment survey covering six metropolitan regions in Brazil and find employment elasticities which are generally smaller than -0.10, with varying statistical significance.

mum wage in the full sample. We thus extend the analysis to groups with higher exposure to minimum wage increases, first focusing on workers with less than a high school degree, 24 percent of whom have monthly earnings below 110 percent of the minimum wage. At the industry level, we focus on employment impacts in the restaurant and accommodation sector, as the low-wage nature of the tasks required in this industry implies high exposure to minimum wage increases. In fact, 39 percent of workers in this sector earn monthly salaries below 110 percent of the minimum wage. We note that the analysis of heterogeneous impacts across highly-exposed groups relies on the same identifying variation as for the full sample. Specifically, we examine whether differential changes in the incidence of the minimum wage results in disparate impacts in employment outcomes for these two groups.

We estimate equation (2) using formal sector employment in the restaurant and accommodation industry and present the results in the first panel of Table 3. We find that 10 percent increase in the Kaitz index is associated with an employment reduction in this sector of 2.7 percent, which is larger than the estimated elasticity for overall employment, yet not statistically significant at the ten percent level. In the second column, the quadratic specification shows a similar estimated elasticity, in the range of -0.25, which remains insignificant. In the last two columns, we consider the effects using the Kaitz-mean index. In the linear specification (column 3), we find a statistically significant negative employment elasticity (-0.27), which becomes insignificant in the quadratic specification (column 4). We note that while the estimated employment elasticities in this sector vary in statistical significance, the magnitude of the elasticities are larger than in the full sample, thus fitting in with a higher incidence of the minimum wage in this sector.

In the second panel of Table 3, we present the corresponding impacts on formal sector employment of workers with less than a high school degree. The first two columns indicate that a ten percent increase in the Kaitz index leads to a 1.5 and 1.1 percent reduction in formal sector employment for these workers in the linear and quadratic specifications, respectively, yet the estimated elasticities are not different from zero. In fact, the Kaitz-mean results (columns 3 and 4) confirm the lack of significant employment impacts for low-skilled workers.[18] These results fit in with recent findings by Broecke and Vandeweyer (2016), who use employment survey data from six metropolitan regions in Brazil and find limited employment impacts on teen employment.

Heterogeneity by Commodity Sector Exposure. We have so far found limited employment impacts arising from the minimum wage. Nonetheless, during our time period of interest, Brazil's economy underwent a significant economic boom, which may mute the potential effects of the minimum wage during a downturn. While equation (2) directly controls for time trends in the economy, it does not allow us to discern whether there are heterogeneous effects across regions with differential exposure commodity boom, which was the key driver of Brazil's economic success in 2003-2012 (Benguria et al., 2018). As a result, we re-estimate equation (2), interacting min-

[18] The estimated employment elasticities across the full sample and in the industry and education sub-samples remain insignificant upon the inclusion of microregion linear trends. These results are available upon request.

imum wage incidence measures with the commodity exposure variable defined in Section 2 as follows:

$$y_{mt} = \alpha + \sum_{k=1}^{K} \gamma_k [\ln(kaitz_{mt})]^k + \sum_{k=1}^{K} \eta_k [\ln(kaitz_{mt})]^k \times low_m + \alpha_1 X_{mt} + \lambda_t + \sum_{\rho=0}^{P} \theta_m t^\rho + \varepsilon_{mt} \tag{3}$$

Microregion-level exposure to the commodity boom is defined using employment shares in the 2000 Census. We classify microregions as high- or low-exposure, and low_m is a dummy variable for low-exposure areas. We estimate equation (3) using a linear specification of the Kaitz index, include microregion linear time trends and cluster standard errors at the microregion level.

We present our empirical results in Table 4 for aggregate formal sector employment, employment in the restaurant and accommodation industry and low-skilled employment. Across the three employment indicators, we find larger negative employment elasticities in microregions which were less exposed to the commodity boom in Brazil during 2003-2012. For instance, the first column shows that a 10 percent increase in the Kaitz index was associated with a 3.1 percent reduction in formal sector employment in less-exposed microregions. We similarly find negative employment elasticities across the industry and education employment measures, with varying statistical significance. In the last three columns, we further show the results are robust to using the Kaitz-mean index. All in all, as we find larger employment effects in less exposed microregions — which again indicates that a minimum wage which is set nationally may have disparate impacts within a country, depending on local economic conditions. We remark that the identification of the employment impacts presented so far relies on over-time changes in the Kaitz ratio at the microregion level. We thus complement this analysis by taking advantage of the introduction of state-level wage floors in the next section.

4 Employment Impacts of State-Level Wage Floors

The passage of the 2000 Law allowing Brazilian states to implement wage floors — and subsequent implementation by five states — allows us to exploit variation in this policy within Brazil to examine its impact on labor market outcomes. As discussed in Section 2, since the floors implemented by all states included a direct component targeting employment in the restaurant and accommodation industry, we examine the effect on labor market outcomes in this sector. Since the existing literature has debated whether state wage floors effectively raised wages (Terrell, 2009; Tepedino, 2013; Corseuil et al., 2015), we follow Cengiz et al. (2019) and examine the impact across the wage distribution in this industry. We further consider potential disemployment impacts arising from the regional wage floors. In light of substantial heterogeneity in labor market outcomes within states, we focus on microregions exhibiting positive employment in this sector each year in the sample. Our first empirical strategy leverages variation in the wage floors across microregions over time.[19] We estimate the following regression:

$$y_{mt} = \beta_0 + \beta_1 \ln(floor_{st}) + \beta_2 X_{mt} + \lambda_t + \sum_{\rho=0}^{P} \gamma_m t^{\rho} + \varepsilon_{mt} \quad (4)$$

where y_{mt} represents a wage or employment outcome in the restaurant and accommodation industry, $floor_{st}$ captures the binding floor affecting employment in this sector in year-quarter t, X_{st} follows equation (1) and controls for the economically active population and real GDP, λ_t denotes year-quarter fixed effects $\gamma_m t^{\rho}$ includes microregion fixed effects along with microregion-level time trends. We cluster standard errors at the state level, as wage floors are set by states.

We present results in Table 5. The first three columns display the estimated impact of the wage floors at different percentiles of the wage distribution in the restaurant and accommodation industry. We find that a 10% increase in regional wage floor increases salaries at the 10^{th} percentile of the wage distribution by 1.8%. We additionally find a statistically significant impact on 25^{th} percentile wages, which increase by 1.3% following a 10% increase in the wage floor. The estimated wage impact fades out by the median of the distribution, however.[20] We remark that the estimated coefficients on the wage distribution fit in with the implementation of the wage floors, which have largely focused on low-wage occupations within this sector, as shown in Appendix A. As a result, our analysis clarifies previous discrepancies in the literature regarding the wage impacts of these policies, as the effects can only be identified with data encompassing the wage distribution across targeted industries.

Since wage floors effectively increase targeted workers' wages, in the last column we also analyze whether they affect employment outcomes. The estimated impact of regional wage floors on employment in the restaurant and accommodation sector is not statistically different from zero. Similar to Dube et al. (2010), the estimated effect allows us to rule out negative employment elasticities lower than -0.30 at the 95% confidence level. Since only five high-income Southeastern states adopted wage floors, in Table B.3, we examine the robustness of the results by limiting the sample to these states, as well as Espirito Santo, Minas Gerais and Mato Grosso do Sul which constitute three contiguous states to wage floor adopters. We similarly find that wage floors increased wages at the bottom of the distribution while resulting in limited employment impacts.

Cross-Border Microregion Pair Design. A potential concern about the empirical strategy implemented in equation (4) is that wage floors could be set endogenously to employment trends in the restaurant and accommodation sector. We thus consider an alternative empirical strategy robust to this concern. Following Dube et al. (2010, 2016), we compare employment outcomes in microregions lying on state borders with different wage floors during our time period of inter-

[19] We conduct our empirical analysis at the quarterly level given the staggered implementation of the wage floors throughout the year, as shown in Figure 2.

[20] As a result, the extent of wage spillovers arising from the regional wage floors are not as extensive as for the national minimum wage (Engbom and Moser, 2018).

est.[21,22] Focusing on state-border microregions addresses the endogeneity concern if states do not set wage floor policies solely in response to employment outcomes in these microregions. As a result, we compare microregions facing similar aggregate shocks with different wage floors across the state border. Moreover, as these microregions lie on opposite sides of a state border, they may be more similar in observed characteristics vis-a-vis microregions in the rest of the country. We provide evidence on this point below.

While there are 558 microregions in Brazil, only five states implemented wage floors between 2003 and 2012. Since our empirical strategy relies on microregions on state borders with differential wage floors, the cross-state sample includes 89 microregions largely located in the Southeastern part of the country (Figure 4). Since these microregions may have more than one adjacent microregion across the state line, they can be part of multiple cross-border pairs. In fact, the 89 microregions in our sample belong to 138 unique cross-state border pairs. In Table 6, we present summary statistics for the full microregion sample as well as the CBMP sample. Microregions in the cross-state design tend to have smaller populations, lower population density and formal sector employment, while having higher GDP per capita and higher formal sector monthly salaries.[23]

Despite the differences in observed characteristics across the two samples, the identifying assumption in this set-up is that bordering microregions constitute valid controls across states. To assess the validity of this assumption, we follow Dube et al. (2016) and test for differences in observed characteristics between contiguous microregions and the rest of the sample.[24] We implement this test by comparing the absolute difference in observed characteristics between each microregion in the CBMP sample and (i) its bordering microregion pair, (ii) every non-contiguous microregion not in the same state.[25] We present the estimated results in Table 7. In the first and second columns, we show average absolute differences in labor market outcomes, economic activity and population measures across non-contiguous and contiguous microregions, respectively. Across all variables, microregions in the CBMP sample are more similar with their bordering pairs than with non-contiguous microregions, and these differences are statistically significant at the 1% level.[26] In fact, using bordering microregions as controls instead of the full sample reduces the av-

[21] Dube et al. (2010, 2016) focus their empirical analysis on counties with different minimum wages across state borders in the United States. We focus our analysis at the microregion level — which represent a coarser level of geography than counties — to compare employment effects across units of similar economic importance.

[22] Throughout the rest of the paper, we refer to this strategy as the cross-border microregion-pair (CBMP) approach.

[23] Across the full and CBMP samples, employment in the restaurant and accommodation industry accounts for 3% of all formal sector employment, and average wages in this sector are 25% lower than in the rest of the economy.

[24] We consider the following variables: microregion-level population, economically-active population, population density, GDP per capita, formal sector employment size along with median and average salaries in the formal sector.

[25] Non-contiguous out-of-state microregions represent the alternative control group. We implement the test as follows. First, we compare each microregion in CBMP sample against its bordering microregion and calculate the absolute difference in each relevant covariate. We then calculate the absolute differences in observed characteristics for each of the 89 microregions in the CBMP sample against each possible out-of-state microregion, yielding a total of 39,840 pairings. For each microregion in the sample, we thus can thus calculate the average difference against (i) bordering microregions and (ii) all other microregions. We cluster standard errors multidimensionally on both microregions in the cross-state microregion pair.

[26] For instance, while the average difference in median salaries with bordering pairs equals 83 Reais, the corresponding difference with non-contiguous microregions exceeds 115 Reais.

erage gap across these seven variables by 37.4%, indicating that bordering microregions constitute more adequate controls for recovering the labor market impacts of wage floors. Our estimating equation is as follows:

$$y_{mpt} = \alpha_0 + \alpha_1 ln(floor_{st}) + \alpha_2 X_{mt} + \gamma_m + \tau_{pt} + \varepsilon_{mpt} \quad (5)$$

where y_{mpt} measures a wage or employment outcome in microregion m, belonging to border-pair p in year-quarter t. γ_m is a microregion fixed effect and τ_{pt} represents pair-year-quarter fixed effects, which absorb regional economic shocks in each bordering pair. As in equation (4), we first cluster standard errors at the state level, as wage floors are determined by states. However, microregions in the CBMP sample may be included more than once. Thus, the presence of the same microregion across multiple border pairs would introduce a mechanical correlation across pairs. To control for this, we further cluster standard errors at the border-segment level — comprised of all microregions in each border in the CBMP sample — using multidimensional clustering.[27]

We present results in Table 8. In the first three columns, we show the estimated impacts of wage floors across the wage distribution in the restaurant and accommodation sector. Similar to the results presented in Table 5, a 10% increase in regional wage floors lead to a 1.9% increase in wages at the 10^{th} percentile of the wage distribution in this sector. While the estimated coefficient is smaller than in the full sample, it remains statistically significant. The estimated impacts on wages in the 25^{th} and 50^{th} percentiles remain positive, but are not statistically significant, fitting in with the results in the full microregion sample. We lastly examine whether wage floor increases lead to disemployment impacts in microregions in the CBMP sample. We present the results in the last column of Table 8, where we find that the employment elasticity associated with wage floors is not statistically different from zero. In fact, we can rule out employment elasticities lower than -0.15 at the 95% confidence level.[28] Despite the difference in contexts, our estimated employment elasticities are remarkably similar to those found in the United States (Dube et al., 2010, 2016).

In this context, spillover effects constitute a potential threat to identification in the cross-border microregion sample. For instance, the implementation of high wage floors in one state may lead workers in the contiguous state to migrate to the state with the higher floor and thus mute potential disemployment impacts. To test for the presence of spillover effects, we compare the wage and employment impacts on border microregions to those in the interior of each state, which are unlikely to be affected by spillovers. In particular, we estimate the following regression:

$$(y_{mpt} - \overline{y_{st}}) = \alpha_0 + \alpha_1 ln(floor_{st}) + \alpha_2 (X_{mt} - \overline{X_{st}}) + \gamma_m + \tau_{pt} + \varepsilon_{mpt} \quad (6)$$

where $\overline{y_{st}}$ refers to the average employment (or earnings) of restaurant workers in the interior microregions of state s in year-quarter t and serves as a control for possible spillover effects. In

[27] For instance, all microregions on both sides of the Parana-Santa Catarina border represent a border-segment, as do the microregions in the Sao Paulo-Minas Gerais border.

[28] The estimated results presented in Tables 5 and 8 are robust to including for time-varying population density, industry value-added and quadratic terms of all control variables. Our Web Appendix presents these results.

equation (6), α_1 thus captures the impact of the wage floor in the border-pair microregion relative to its state interior, compared to the contiguous microregion across the border.[29] Table B.4 presents the findings. We first note that wage floors do not result in significant spillover effects on earnings outcomes in the restaurant and accommodation industry (columns 1-3). In the last column, we show that there are not any associated spillover effects on employment in this industry, fitting in with evidence presented in the United States.

To further assess the robustness of our results, we introduce an additional empirical approach, which largely follows a matching design. For each of the 89 treated microregions in the border-pair sample, we consider the full set of microregions in other states as potential 'donor' (control) units, and identify the microregion which is most similar to each treated unit along the seven characteristics included in Table 7 — effectively amounting to a nearest-neighbor matching approach (Neumark et al., 2014).[30] In Table B.5, we show that our matching approach substantially reduces the differences across treated and control units vis-a-vis both the corresponding differences in the full and CBMP samples.[31] Armed with a closely-matched control for each treated microregion, we estimate the employment impacts of the minimum wage following equation (4). We present the estimated results in Table B.6. The estimated impacts of a wage floor increase on the distribution of wages in the restaurant and accommodation industry are remarkably similar to the results presented in Tables 5 and 8: a 10% increase in regional wage floor increases salaries at the 10^{th} percentile of the wage distribution by 1.7%. The last column further shows that a wage floor increase does not lead to significant disemployment impacts in this sector. These results fit in with the main results presented in the text and in Tables 5-8.

Across a variety of samples, control variables and empirical strategies, we have so far found that wage floors successfully raised wages at the bottom of the wage distribution in Brazil's restaurant and accommodation sector while resulting in limited disemployment impacts. While these results could indicate the existence of non-competitive labor market in Brazil's restaurant and accommodation industry (Manning, 2003; Giuliano, 2013; Azar et al., 2019), our results do not imply that the estimated employment elasticities are in fact equal to zero. Yet the empirical evidence documented in this section allows us to rule out the largest negative employment elasticities previously found in the minimum wage literature (Neumark et al., 2008, 2014). We thus remark that our results indicate that Brazil's regional wage floors did not result in significant employment losses in the restaurant and accommodation sector.

[29] Dube et al. (2010) argue that $\alpha_1 < 0$ indicates an amplification effect, in which firms in high floor areas would move to the lower wage-floor microregions, thus exacerbating the wage floor disemployment effects. On the other hand, $\alpha_1 > 0$ implies an attenuation effect, which could arise in a model with search costs where the imposition of a wage floor leads workers in the paired-microregion to bargain for higher wages. The wage increase in both microregions may reduce employment thus muting the disemployment effect from the wage floor.

[30] For each microregion in the CBMP sample, we thus search for the corresponding out-of-state microregion which is most similar across these characteristics. We allow for the same microregion to be selected as a control more than once and treated microregions may act as 'controls' for other treated microregions if they are most similar across the seven characteristics. As such, our matching sample includes 141 unique microregions in Brazil.

[31] This result follows directly from the fact that the matching estimator explicitly aims to reduce these differences.

5 Conclusion

Latin American countries have an extensive number of regulations in place aimed at protecting formal sector workers. Chief among them is the minimum wage, which, while varying in size across the region, underwent significant increases in most countries during the sustained economic expansion of the early 2000s. Brazil is a prime example of this trend, with an almost-doubling of the real minimum wage from 2003 through 2012, coupled with the introduction of regional wage floors. In this paper, we have taken advantage of administrative data to explore whether the minimum wage or the regional wage floors have resulted in negative employment effects in the formal sector. Since the incidence of the minimum wage varies significantly within states, our empirical analysis has focused at the microregion level. We fail to find significant disemployment impacts from the minimum wage on aggregate formal sector employment. Moreover, we find larger negative employment elasticities for more exposed groups — including workers in the restaurant and accommodation industry and high school dropouts, yet the coefficients vary in statistical significance. Lastly, in light of Brazil's commodity-induced economic growth in the early 2000s, we consider heterogeneous effects of the minimum wage across microregions differentially exposed to the boom, and find larger negative employment elasticities in less exposed areas. As such, we remark the importance of analyzing potential heterogeneity in the impacts of the minimum wage.

We have further taken advantage of the introduction of regional wage floors aimed at employment in specific industries and occupations. Five states have introduced such floors since 2000, and all floors included components directly targeting employment in the restaurant and accommodation industry. Using different empirical strategies — including standard minimum wage regressions, a cross-border microregion pair design and a matching strategy, we have shown that these floors successfully raised earnings towards the bottom of the wage distribution, yet had no associated disemployment impacts. Moreover, we have shown a lack of spillover effects associated with the introduction of these floors.

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Tables and Figures

Table 1: Employment Impact of State-Level Minimum Wage Incidence

	State-Level Formal Employment			
	(1)	(2)	(3)	(4)
Kaitz Ratio	-0.257	-0.293	-0.015	-0.016
	(0.232)	(0.272)	(0.165)	(0.192)
Real GDP	-0.006	-0.008	-0.008	-0.008
	(0.010)	(0.009)	(0.010)	(0.010)
Population (15-59)	-0.162	0.027	-0.006	-0.000
	(1.443)	(1.400)	(1.443)	(1.450)
Polynomial (K)	One	Two	One	Two
Kaitz Definition	MW/Median		MW/Mean	
Observations	270	270	270	270

Standard errors in parentheses: * p < 0.10, ** p < 0.05, *** p < 0.01. Note: Table 1 presents the estimated impacts of the national minimum wage on formal sector employment at the state level from equation (1). The Kaitz index is defined as the ratio of the minimum wage to the state-level median wage in the first two columns and relative to average wages in the last two columns. Odd-numbered columns follow a linear specification of the Kaitz ratio, and even columns include a quadratic term to account for non-linearities. Annual-measures of real GDP and economically-active population are constructed from IBGE data and defined as the natural logarithm of these variables. Standard errors are clustered at the state-level.

Table 2: Employment Impact of Microregion-Level Minimum Wage Incidence

	Microregion-Level Formal Employment			
	(1)	(2)	(3)	(4)
Kaitz Ratio	-0.044	-0.005	0.021	0.058
	(0.267)	(0.270)	(0.096)	(0.121)
Real GDP	-0.036**	-0.048**	-0.037**	-0.037**
	(0.016)	(0.019)	(0.016)	(0.018)
Population (15-59)	3.994	3.200	3.480	2.773
	(3.780)	(4.113)	(2.654)	(3.003)
Polynomial (K)	One	Two	One	Two
Kaitz Definition	MW/Median		MW/Mean	
Observations	5580	5580	5580	5580

Standard errors in parentheses: * p < 0.10, ** p < 0.05, *** p < 0.01. Note: Table 2 presents the estimated impacts of the national minimum wage on formal sector employment at the microregion level from equation (2). The Kaitz index is defined as the ratio of the minimum wage to the microregion-level median wage in the first two columns and relative to average wages in the last two columns. Odd-numbered columns follow a linear specification of the Kaitz ratio, and even columns include a quadratic term to account for non-linearities. Annual-measures of real GDP and economically-active population are constructed from microregion-level IBGE data and defined as the natural logarithm of these variables. Standard errors are clustered at the microregion level.

Table 3: Estimated Employment Effects by Industry and Education

Panel A. Restaurant and Accommodation Employment

	Restaurant and Accommodation			
	(1)	(2)	(3)	(4)
Kaitz Ratio	-0.278	-0.248	-0.271**	-0.137
	(0.173)	(0.176)	(0.117)	(0.176)
Real GDP	-0.039	-0.048	-0.038	-0.041
	(0.037)	(0.041)	(0.037)	(0.041)
Population (15-59)	-3.140	-3.759	-3.513	-6.085
	(4.315)	(4.554)	(4.091)	(4.888)
Polynomial (K)	One	Two	One	Two
Kaitz Definition	MW/Median		MW/Mean	
Observations	5580	5580	5580	5580

Panel B. Low-Skilled Employment

	Less than HS Graduate			
	(1)	(2)	(3)	(4)
Kaitz Ratio	-0.153	-0.117	0.005	-0.010
	(0.257)	(0.257)	(0.092)	(0.114)
Real GDP	-0.024	-0.034*	-0.024	-0.024
	(0.018)	(0.020)	(0.019)	(0.020)
Population (15-59)	1.575	0.850	0.286	0.566
	(4.184)	(4.522)	(3.208)	(3.556)
Polynomial (K)	One	Two	One	Two
Kaitz Definition	MW/Median		MW/Mean	
Observations	5580	5580	5580	5580

Note: Table 3 presents the estimated impacts of the national minimum wage on formal sector employment outcomes at the microregion level from equation (2). The first panel estimates the impact on formal sector employment in the restaurant and accommodation industry. The second panel presents results for aggregate employment of workers with less than a high school degree. The Kaitz index is defined as the ratio of the minimum wage to the microregion-level median wage in the first two columns and relative to average wages in the last two columns. Odd-numbered columns follow a linear specification of the Kaitz ratio, and even columns include a quadratic term to account for non-linearities. Annual-measures of real GDP and economically-active population are constructed from microregion-level IBGE data and defined as the natural logarithm of these variables. Standard errors are clustered at the microregion level.

Table 4: Heterogeneous Employment Effects by Commodity Exposure

	Full	Industry	Low-Skilled	Full	Industry	Low-Skilled
	(1)	(2)	(3)	(4)	(5)	(6)
Kaitz × Low Commodity	-0.312***	-0.210	-0.438***	-0.317***	-0.289*	-0.321***
	(0.091)	(0.163)	(0.150)	(0.060)	(0.146)	(0.111)
Kaitz × High Commodity	0.273	-0.043	0.184	-0.052	-0.074	0.004
	(0.390)	(0.253)	(0.340)	(0.252)	(0.312)	(0.192)
Real GDP	0.198***	0.133***	0.187***	0.184***	0.123**	0.181***
	(0.040)	(0.046)	(0.042)	(0.039)	(0.048)	(0.041)
Population (15-59)	0.313	0.805	-0.059	0.310	0.858	-0.091
	(0.449)	(0.589)	(0.555)	(0.466)	(0.577)	(0.570)
Kaitz Definition		MW/Median			MW/Mean	
Observations	5580	5580	5580	5580	5580	5580

Standard errors in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Note: Table 4 presents evidence on the heterogeneous impacts of the national minimum wage on formal sector employment outcomes at the microregion level from equation (3) across baseline commodity exposure at the microregion level. Commodity exposure is defined by the microregion's employment shares in commodity-based industries, as in Benguria et al. (2018). We split the sample in half by lowly- and highly- exposed microregions, as discussed in Section 2. The first and fourth columns present the impact on aggregate employment, the second and fifth column estimate the effect on formal sector employment in the restaurant and accommodation industry, the third and sixth columns presents results for employment of workers with less than a high school degree. The Kaitz index is defined as the linear ratio of the minimum wage to the microregion-level median wage in the first three columns and relative to average wages in the last three columns. Annual-measures of real GDP and economically-active population are constructed from microregion-level IBGE data and defined as the natural logarithm of these variables. Standard errors are clustered at the microregion level.

Table 5: Estimated Impacts of Regional Wage Floors on Restaurant and Accommodation Industry Outcomes

	w_{p10} (1)	w_{p25} (2)	w_{p50} (3)	Employment (4)
MW	0.176***	0.135**	0.088	-0.073
	(0.030)	(0.058)	(0.062)	(0.116)
Real GDP	-0.024*	0.003	0.025	0.094**
	(0.014)	(0.011)	(0.019)	(0.045)
Population (15-59)	-0.283	-0.209	-0.057	0.931**
	(0.231)	(0.161)	(0.188)	(0.396)
Observations	21120	21120	21120	21120

Standard errors in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Note: Table 5 presents evidence on the estimated effects of regional wage floors on formal sector wage and employment outcomes in the restaurant and accommodation industry at the microregion level. The estimated results follow from equation (4) and consider outcomes by year-quarters. Columns (1)-(3) present the estimated impacts on the distribution of wages in this sector, focusing on the 10^{th}, 25^{th} and 50^{th} percentile, respectively. The last column presents the estimated effects on employment in this sector. The "MW" variable is defined as the lowest regional wage floor affecting employment in the restaurant and accommodation sector, as discussed in Section 2. Annual-measures of real GDP and economically-active population are constructed from microregion-level IBGE data and defined as the natural logarithm of these variables. Standard errors are clustered at the state level.

Table 6: Summary Statistics: Microregion-Pair Sample

	All-Microregion Sample		Microregion-Pair-Sample	
	Mean	SD	Mean	SD
	(1)	(2)	(3)	(4)
Population, 2003	323,690	844,422	220,764	151.562
Population (15-59), 2003	203,294	554,488	140,559	99,279
Population Density, 2003	95.51	344.84	49.85	36.46
GDP per Capita, 2003 (Reais)	6,166	4,549	8,377	3,441
Formal Sector Employment	65,050	256,435	44,291	40,048
Median Monthly Salary (Reais)	623.49	110.83	655.97	81.74
Formal Employment: Sec. 8	2,255	10,831	1,270	1,463
Median Salary: Sec. 8 (Reais)	481.12	64.76	514.15	45.56
Observations	558		89	
Number of Microregion Pairs			138	

Note: Table 6 presents sample means and standard deviations for all microregions in Brazil (columns 1 and 2, respectively) and for those in the cross-border microregion pair sample (columns 3 and 4). Microregion-level population, population (15-59), population density and real GDP per capita are constructed from IBGE data. Employment and earnings outcomes are measured in RAIS data at the microregion level.

Table 7: Mean Absolute Differences in Covariates between Microregions in Contiguous versus Other Pairs

	Non-Contiguous Pair	Contiguous Pair	Gap	Percentage Gap
	(1)	(2)	(3)	(4)
Formal Sector Employment	69,520	41,160	28,360	40.8
	(2,936.8)***	(4,296)***	(3,514.6)***	
Median Monthly Salary (Reais), 2003	117.5	83.7	33.9	28.8
	(3.82)***	(7.02)***	(6.30)***	
Average Monthly Salary (Reais)	227	156	71	31.3
	(7.26)***	(13.10)***	(10.54)***	
GDP per Capita, 2003	6.51	4.92	1.59	24.5
	(0.65)***	(0.86)***	(0.51)***	
Population, 2003	285,066	185,546	99,520	34.9
	(11,197)***	(19,277)***	(15,262)***	
Population (15-59), 2003	186,915	121,889	65026	34.8
	(7,693)***	(12,771)***	(10,134)***	
Population Density, 2003	96.97	30.35	66.6	68.7
	(3.171)***	(4.78)***	(3.74)***	

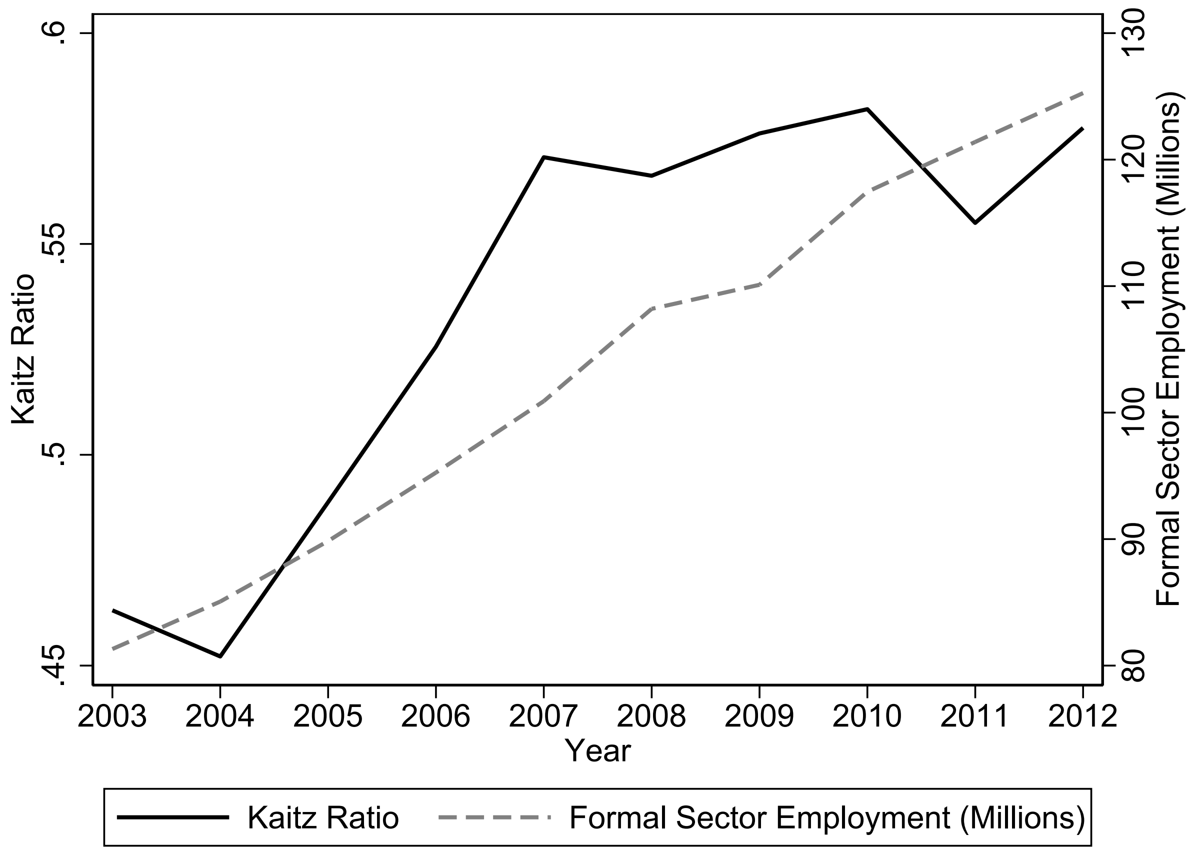
Standard errors in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Note: Table 7 compares outcomes in microregions across the border pair to those in the out-of-state sample, constituting 39,840 potential pairs. As discussed in Section 4, we calculate the absolute differences between each bordering microregion and (i) its border pair and (ii) each potential out-of-state non-contiguous microregion. We then collapse the data at the microregion-pair level and calculate the average difference in the variables across the bordering microregions and non-contiguous areas, clustering standard errors on each microregion on the border. Microregion-level population, population (15-59), population density and real GDP per capita are constructed from IBGE data. Employment and earnings outcomes are measured in RAIS data at the microregion level.

Table 8: Estimated Impacts of Regional Wage Floors on Restaurant and Accommodation Industry Outcomes: Cross-Border Microregion Pair Design

	w_{p10}	w_{p25}	w_{p50}	Employment
	(1)	(2)	(3)	(4)
MW	0.187*	0.134	0.133	0.029
	(0.088)	(0.103)	(0.088)	(0.087)
Real GDP	-0.007	0.000	-0.022	-0.043
	(0.017)	(0.025)	(0.024)	(0.028)
Population (15-59)	0.501	0.495	0.757*	1.381***
	(0.272)	(0.313)	(0.322)	(0.363)
Observations	5,520	5,520	5,520	5,520

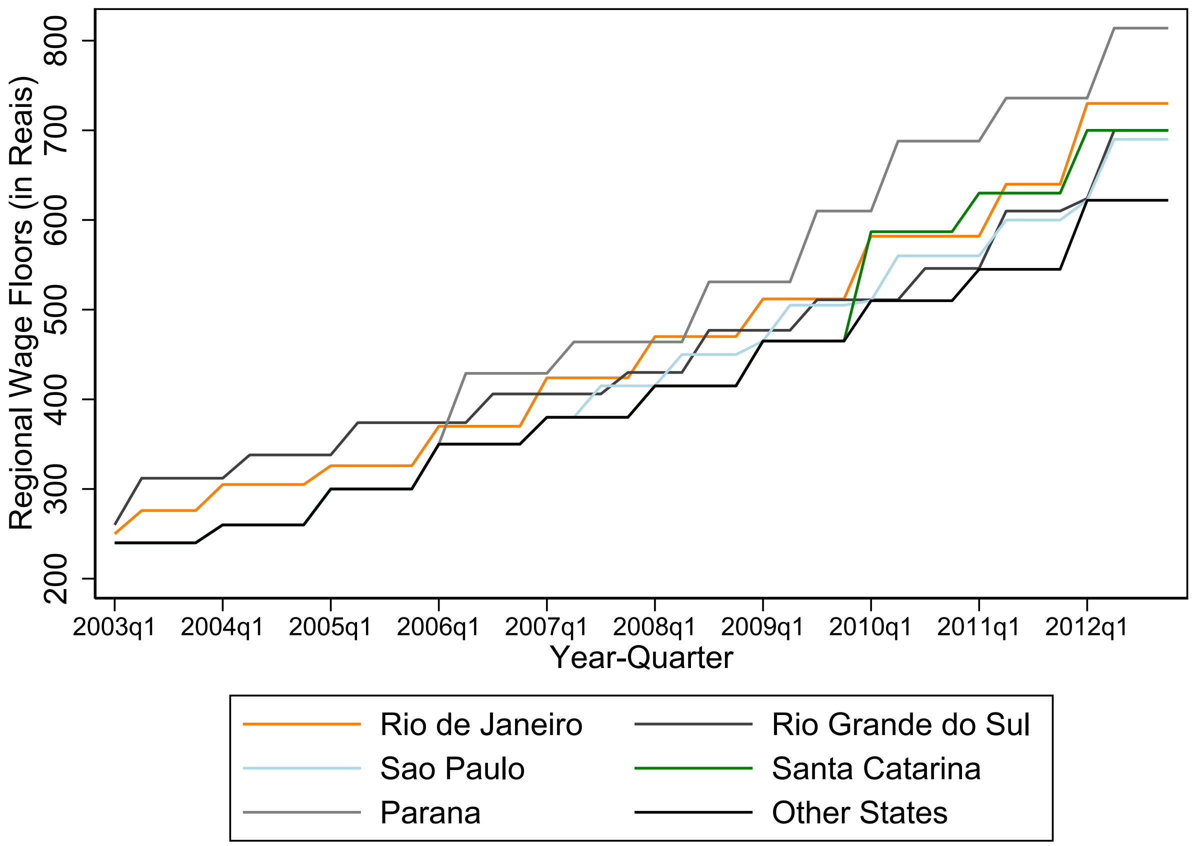
Standard errors in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Note: Table 8 presents evidence on the estimated effects of regional wage floors on formal sector wage and employment outcomes in the restaurant and accommodation industry following the cross-border microregion pair design presented in equation (5). Columns (1)-(3) present the estimated impacts on the distribution of wages in this sector, focusing on the 10^{th}, 25^{th} and 50^{th} percentile, respectively. The last column presents the estimated effects on employment in this sector. The "MW" variable is defined as the lowest regional wage floor affecting employment in the restaurant and accommodation sector, as discussed in Section 2. Annual-measures of real GDP and economically-active population are constructed from microregion-level IBGE data and defined as the natural logarithm of these variables. Standard errors are clustered multidimensionally at the state level and border-segment level.

Figure 1: Kaitz Index and Formal Sector Employment: 2003-2012



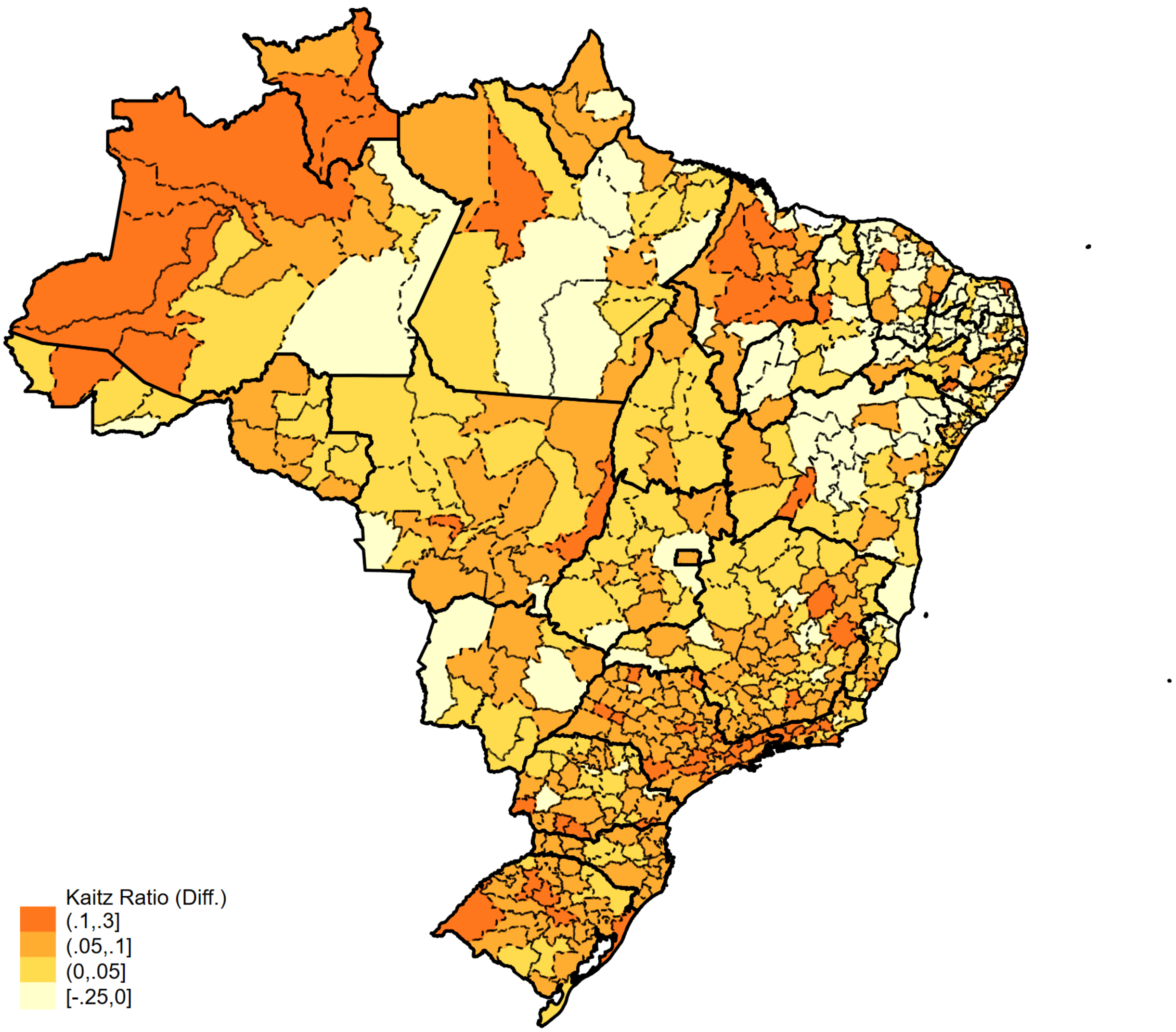
Note: Figure 1 presents the annual Kaitz index, defined as the ratio of the national minimum wage to median formal sector monthly earnings. We define the formal sector size as the annual full-time equivalent number of formal sector workers. Both values are calculated using RAIS data for the 2003-2012 period.

Figure 2: Regional Wage Floors



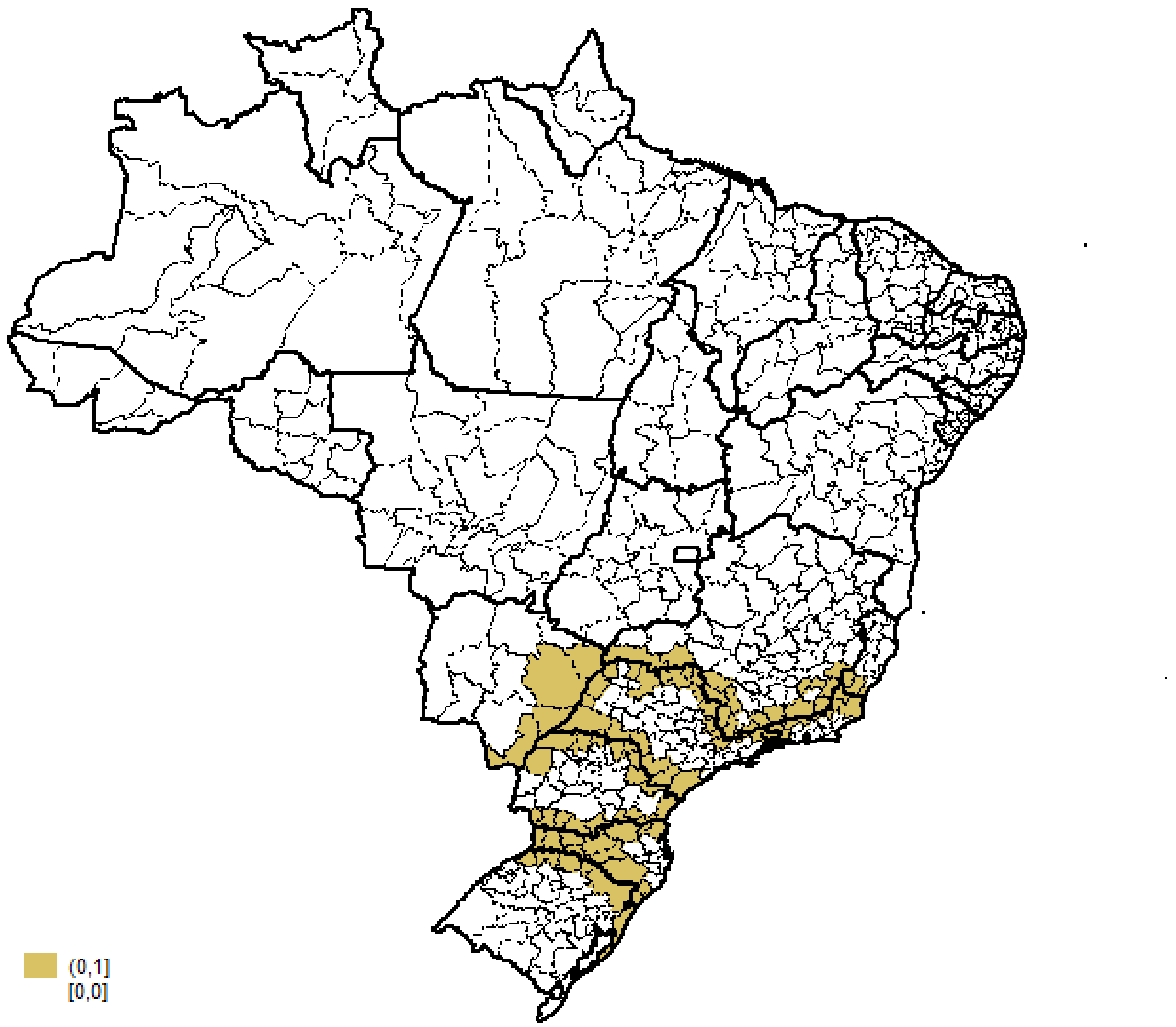
Note: Figure 2 presents the level of the lowest regional floor affecting employment in the restaurant and accommodation industry in each state in Brazil. These values are measured quarterly, given the frequency of adjustment of the wage floors. For the non-implementing states, the wage floors are determined by the national minimum wage, as discussed in Section 2.

Figure 3: Change in Kaitz Index by Microregion: 2003-2012



Note: Figure 3 presents presents a map of all microregions in Brazil. We show the change in the microregion Kaitz index — defined as the ratio of the national minimum wage to median microregion-level formal sector monthly earnings — between 2003 and 2012. The Kaitz index is calculated using RAIS data.

Figure 4: Microregions Included in Cross-Border Microregion Pair Sample



Note: Figure 4 presents a map of all microregions in Brazil. The highlighted microregions represent the sample included in our cross-border microregion-pair (CBMP) empirical strategy presented in Section 4. These microregions faced differential wage floors in the restaurant and accommodation industry at some point between 2003 and 2012.

Appendix

A Regional Wage Floors

	Rio grande do Sul (2003-2012)
Floor I	Workers employed in agriculture, extractive industries, fishing, domestic services, accommodation, construction, music, equestrian establishments and messengers.
Floor II	Workers employed in the following industries: clothing and footwear, spinning and weaving, leather goods, cardboard, newspaper, health services.
Floor III	Workers employed in the following industries: furniture, chemical and pharmaceutical, film, food, commerce.
Floor IV	Workers employed in the following industries: mechanical, metallurgical, glass, porcelain, residential buildings, jewelry and gemstone cutting and school administrators.

Note: This table presents the various wage floors pertaining to industry categories in Rio Grande do Sul.

	Rio de Janeiro (2003-2007)
Floor I	Agricultural and forestry workers
Floor II	Domestic employees, maintenance service workers, commercial companies, messengers, general assistants, unskilled commerce workers and barboys.
Floor III	Mail service workers, cooks, busboys, servers, cashiers, dishwashers, barbers, hairdressers, machine operators, agricultural and forest workers, woodworkers, food and beverage workers, footwear manufacturers, salespeople, health workers, security service workers along with tourism and accommodation workers.
Floor IV	Construction workers, public transportation, miners, painters, bricklayers, rubber and plastic industry workers and waiters.
Floor V	Administrators, metalworkers, plumbers, welders, drivers, musical instrument manufacturers, operators of construction and mining machinery and bartenders.
Floor VI	Accountants, secretaries, typists, communication services, telephone operators, network workers, sales supervisors, housekeepers, foremen, steel workers, tobacco workers, radio/TV/sound/cinema workers, machine assemblers, electricians and industrial production supervisors.

Note: This table presents the various wage floors pertaining to occupational categories in Rio de Janeiro in 2003-2007.

Rio de Janeiro (2008-2012)	
Floor I	Agricultural and forestry workers
Floor II	Domestic employees, maintenance service workers, commercial companies, messengers, general assistants, unskilled commerce workers and barboys.
Floor III	Mail service workers, cooks, busboys, servers, cashiers, dishwashers, barbers, hairdressers, machine operators, agricultural and forest workers, spinners, food and beverage workers, footwear manufacturers, salespeople, health service workers, security workers and tourism and accommodation workers.
Floor IV	Construction workers, public transportation, miners, painters, bricklayers, rubber and plastic industry workers and waiters.
Floor V	Administrators, metalworkers, plumbers, welders, drivers, musical instrument manufacturers, operators of construction and mining machinery and bartenders.
Floor VI	Secretaries, typists, communication services, telephone operators, network workers, sales supervisors, housekeepers, foremen, steel workers, tobacco workers, radio/TV/sound/cinema workers, machine assemblers, electricians and industrial production supervisors.
Floor VII	Workers in technical accounting services
Floor VIII	Elementary school teachers, electronics and telecommunications technicians
Floor IX	Lawyers and accountants

Note: This table presents the various wage floors pertaining to occupational categories in Rio de Janeiro in 2008-2012.

Parana (2007-2009) - Defined by one-digit occupation groups	
Floor I	Agricultural and forestry workers.
Floor II	Service workers, salespeople (covers restaurant and accommodation workers).
Floor III	Repair and maintenance workers.
Floor IV	Administrative service workers.
Floor V	Workers in the production of industrial goods and services.
Floor VI	Medium Level Technicians

Note: This table presents the various wage floors pertaining to occupational categories in Parana in 2007-2009.

Parana (2010-2012)	
Floor I	Agricultural and forestry workers.
Floor II	Service workers, salespeople (covers restaurant and accommodation workers), repair and maintenance workers, administrative service workers.
Floor III	Workers in the production of industrial goods and services.
Floor IV	Medium Level Technicians.

Note: This table presents the various wage floors pertaining to occupational categories in Parana in 2010-2012.

	Sao Paulo (2007-2012)
Floor I	Domestic service workers, agricultural and forestry workers, fishermen, conservation service workers, office assistants, unskilled commerce employees, barboys, elevator operators, messengers, unskilled mine workers.
Floor II	Machine operators, woodworkers, mail service workers, barbers, hairdressers, salespeople, bricklayers, food preparation workers, paper manufacturing, security services, tourism and accommodation, waiters, painters, plumbers, welders, jewelers, office machine operators, typists, telephone operators, network workers, spinners foremen, metalworkers and machine builders.
Floor III	Health service workers, transport and communication services, sales supervisors, commercial agents, radio/TV/sound/cinema workers.

Note: This table presents the various wage floors pertaining to occupational categories in Sao Paulo in 2007-2012.

	Santa Catarina (2009-2012)
Floor I	Agriculture and livestock workers, extractive industries, fishing, domestic service workers, construction workers, musical equipment workers and messengers.
Floor II	Workers in the following industries: clothing and footwear, spinning and weaving, leather goods, paper, newspapers, communications and furniture.
Floor III	Workers in the following industries: chemical and pharmaceutical, film, food, commerce, trade agents.
Floor IV	Workers in the following industries: mechanical and electrical materials, glass, crystals, mirrors, ceramics and porcelain, rubber artifacts, insurance, tourism and accommodation, jewelry, school administrators, transport drivers and health workers.

Note: This table presents the various wage floors pertaining to industry categories in Parana in 2007-2009.

B Tables and Figures

Table B.1: Kaitz Index by State

	Kaitz Index		
	2003	2012	Change: (2012-2003)
	(1)	(2)	(3)
Acre	0.436	0.531	0.094
Alagoas	0.567	0.680	0.112
Amapa	0.419	0.554	0.136
Amazonas	0.400	0.562	0.162
Bahia	0.440	0.608	0.168
Ceara	0.632	0.746	0.115
Distrito Federal	0.282	0.467	0.185
Espirito Santo	0.473	0.567	0.094
Goias	0.508	0.601	0.092
Maranhao	0.545	0.570	0.025
Mato Grosso	0.472	0.578	0.106
Mato Grosso do Sul	0.539	0.599	0.060
Minas Gerais	0.568	0.622	0.053
Para	0.463	0.583	0.120
Paraiba	0.545	0.679	0.134
Parana	0.536	0.587	0.052
Pernambuco	0.545	0.647	0.101
Piaui	0.609	0.695	0.086
Rio de Janeiro	0.401	0.545	0.143
Rio Grande do Norte	0.623	0.684	0.061
Rondonia	0.405	0.481	0.076
Roraima	0.427	0.578	0.150
Rio Grande do Sul	0.407	0.531	0.124
Santa Catarina	0.497	0.564	0.068
Sao Paulo	0.355	0.484	0.129
Sergipe	0.603	0.664	0.061
Tocantins	0.395	0.514	0.120

Note: Table B.1 presents the state-level Kaitz index — defined as the ratio of the national minimum wage to median microregion-level formal sector monthly earnings — for each state in Brazil in 2003 and 2012. In the third column, we present the difference across the 2003 and 2012 indices. The Kaitz index is calculated using RAIS data.

Table B.2: Employment Impact of State-Level Minimum Wage Incidence

	State-Level Formal Employment			
	(1)	(2)	(3)	(4)
Kaitz Ratio	-0.232	-0.235	-0.042	-0.042
	(0.261)	(0.259)	(0.190)	(0.177)
Real GDP	0.013*	0.015*	0.013*	0.013*
	(0.007)	(0.008)	(0.007)	(0.007)
Population (15-59)	-1.337	-1.327	-1.149	-1.160
	(1.761)	(1.938)	(1.970)	(2.408)
Polynomial	One	Two	One	Two
Kaitz Definition	MW/Median		MW/Mean	
Observations	270	270	270	270

Standard errors in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Note: Table B.2 presents the estimated impacts of the national minimum wage on formal sector employment at the state level from equation (1), including a linear trend in state-level outcomes. The Kaitz index is defined as the ratio of the minimum wage to the state-level median wage in the first two columns and relative to average wages in the last two columns. Odd-numbered columns follow a linear specification of the Kaitz ratio, and even columns include a quadratic term to account for non-linearities. Annual-measures of real GDP and economically-active population are constructed from IBGE data and defined as the natural logarithm of these variables. Standard errors are clustered at the state-level.

Table B.3: Estimated Impacts of Regional Wage Floors on Restaurant and Accommodation Industry Outcomes: Eight State Sample

	w_{p10}	w_{p25}	w_{p50}	Employment
	(1)	(2)	(3)	(4)
MW	0.149***	0.103**	0.047	0.004
	(0.035)	(0.036)	(0.032)	(0.079)
Real GDP	-0.015	0.002	0.008	0.023
	(0.017)	(0.010)	(0.004)	(0.024)
Population (15-59)	-1.456*	-0.879*	-0.294	0.861
	(0.716)	(0.440)	(0.379)	(0.841)
Observations	10600	10600	10600	10600

Standard errors in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Note: Table B.3 presents evidence on the estimated effects of regional wage floors on formal sector wage and employment outcomes in the restaurant and accommodation industry across all microregions in the five states with wage floors along with the three contiguous states. The estimated results follow from equation (4) and consider outcomes by year-quarters. Columns (1)-(3) present the estimated impacts on the distribution of wages in this sector, focusing on the 10^{th}, 25^{th} and 50^{th} percentile, respectively. The last column presents the estimated effects on employment in this sector. The "MW" variable is defined as the lowest regional wage floor affecting employment in the restaurant and accommodation sector, as discussed in Section 2. Annual-measures of real GDP and economically-active population are constructed from microregion-level IBGE data and defined as the natural logarithm of these variables. Standard errors are clustered at the state level.

Table B.4: Cross-Border Microregion Pair Design: Spillover Test

	w_{p10} (1)	w_{p25} (2)	w_{p50} (3)	Employment (4)
MW	0.084	0.040	0.051	-0.010
	(0.058)	(0.038)	(0.085)	(0.099)
Real GDP	0.010	0.019	-0.026	-0.036
	(0.018)	(0.022)	(0.018)	(0.054)
Population (15-59)	-0.185	-0.271	0.728	0.823*
	(0.273)	(0.297)	(0.387)	(0.411)
Observations	5520	5520	5520	5520

Standard errors in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Note: Table B.4 presents evidence on potential spillover effects arising from the implementation of wage floors in the cross-border microregion pair design presented in Section 4. We present the estimated results from equation (6). We subtract the average outcomes in the microregions in the interior of the state from the outcome in the bordering microregion, and follow the same procedure for control variables included in X_{mt}. Columns (1)-(3) present the estimated spillover effects across on the distribution of wages in the restaurant and accommodation industry, focusing on the 10^{th}, 25^{th} and 50^{th} percentile, respectively. The last column presents potential employment spillover effects. The "MW" variable is defined as the lowest regional wage floor affecting employment in the restaurant and accommodation sector, as discussed in Section 2. Annual-measures of real GDP and economically-active population are constructed from microregion-level IBGE data and defined as the natural logarithm of these variables. Standard errors are clustered multidimensionally at the state level and border-segment level.

Table B.5: Mean Absolute Differences in Covariates between Microregions in Matched, Contiguous and Non-Contiguous Pairs

	Non-Contiguous Pair (1)	Contiguous Pair (2)	Matched Pair (3)
Formal Sector Employment	69,520.9	41,160	8,894.9
	(28,389)	(41,489)	(12,746)
Median Monthly Salary (Reais), 2003	117.5	83.7	12.18
	(39.91)	(64.64)	(13.59)
Average Monthly Salary (Reais)	227.0	156.0	22.13
	(77.26)	(138.94)	(25.02)
GDP per Capita, 2003	6.51	4.92	0.657
	(7.18)	(8.55)	(0.967)
Population, 2003	285,066.5	185,546.3	43,658.8
	(89,852.2)	(166,345.7)	(56,312.4)
Population (15-59), 2003	186,915	121,889.4	26,828.5
	(62,125.6)	(110,455.2)	(35,586.4)
Population Density, 2003	96.97	30.35	25.49
	(24.50)	(39.82)	(28.84)

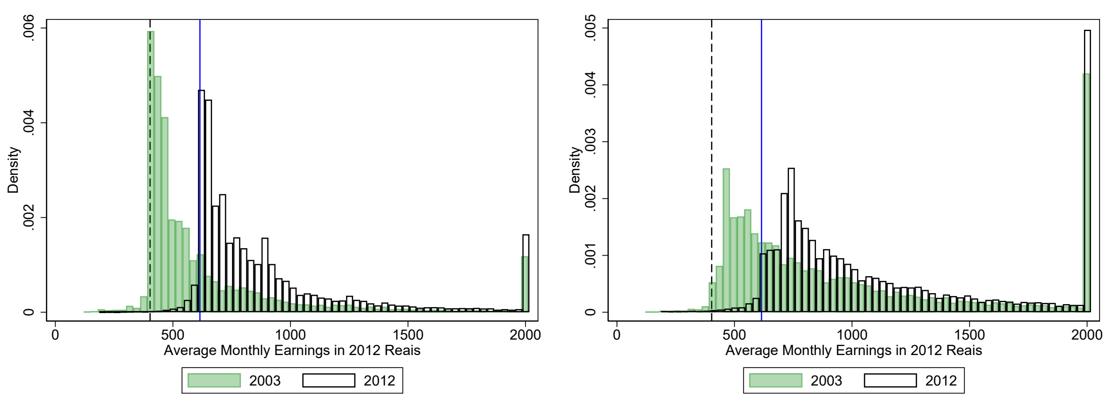
Note: Standard errors in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Table B.5 compares outcomes in microregions across the border pair to those in the out-of-state sample, constituting 39,840 potential pairs. We additionally compare outcomes to the 'matching' sample presented in Section 4. For both the CBMP and 'matching' samples, we calculate the absolute differences between each bordering microregion and (i) its border pair and (ii) each potential out-of-state non-contiguous microregion. We then collapse the data at the microregion-pair level and calculate the average difference in the variables across the bordering microregions and non-contiguous areas in the CBMP sample (where we cluster standard errors on each microregion on the border). In the 'matching' sample, we instead calculate the average difference in these variables across matched pairs relative to all other microregions and cluster standard errors on each microregion in the matched pair.

Table B.6: Estimated Impacts of Regional Wage Floors on Restaurant and Accommodation Industry Outcomes: Microregion-Matching Design

	w_{p10} (1)	w_{p25} (2)	w_{p50} (3)	Employment (4)
MW	0.167***	0.100**	0.067*	0.038
	(0.014)	(0.039)	(0.032)	(0.109)
Real GDP	0.010	0.023	0.021	0.043
	(0.013)	(0.016)	(0.015)	(0.068)
Population (15-59)	-0.559	-0.075	0.356	-0.234
	(0.683)	(0.456)	(0.359)	(0.288)
Observations	6560	6560	6560	6560

Note: Standard errors in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Note: Table B.6 presents evidence on the estimated effects of regional wage floors on formal sector wage and employment outcomes in the restaurant and accommodation industry following the matching estimator presented in Section 4. Columns (1)-(3) present the estimated impacts on the distribution of wages in this sector, focusing on the 10^{th}, 25^{th} and 50^{th} percentile, respectively. The last column presents the estimated effects on employment in this sector. Standard errors are clustered at the state level.

Figure B.1: Monthly Earnings Distribution in Piauí and Rio de Janeiro, 2003-2012

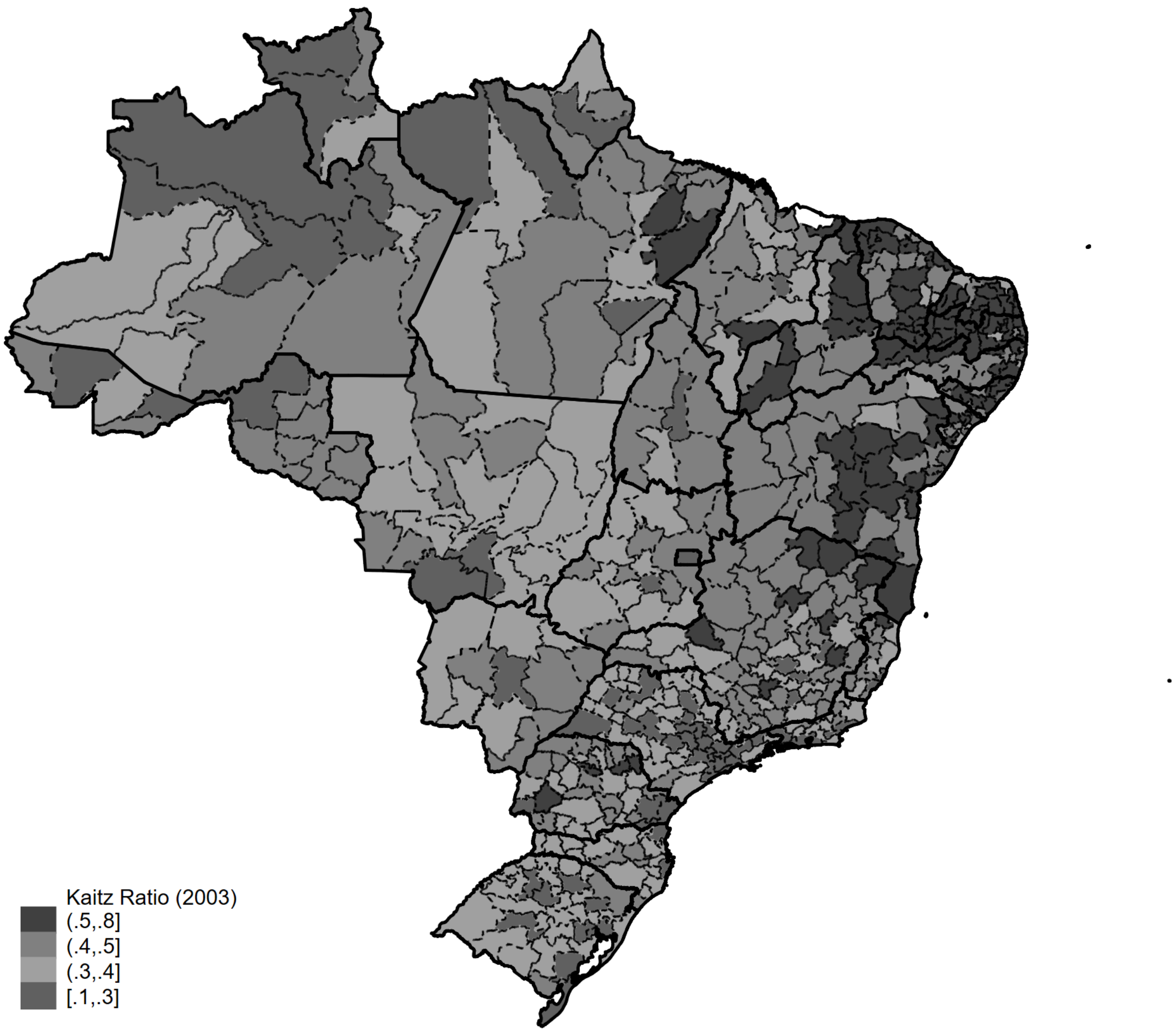


(a) Piauí

(b) Rio de Janeiro

Note: Figure B.1 presents the estimated distribution of formal sector monthly earnings in Piauí and Rio de Janeiro in 2003 and 2012. Monthly earnings are measured in 2012 real Reais, such that the 2003 minimum wage corresponds to 403 Reais in 2012. We truncate the earnings distribution at 2000 Reais for expositional convenience.

Figure B.2: Microregion-Level Kaitz Index: 2003



Note: Figure B.2 presents a map of all microregions in Brazil. We present the Kaitz index — defined as the ratio of the national minimum wage to median microregion-level formal sector monthly earnings — for each microregion in Brazil in 2003. The Kaitz index is calculated using RAIS data.