Wp

WORKING PAPERS

THE EFFECT OF THE MINIMUM WAGE ON EMPLOYMENT IN BRAZIL
16/10/2017
N° 2017/22

THE EFFECT OF THE MINIMUM WAGE ON EMPLOYMENT IN BRAZIL

Saltiel, F.
Urzúa, S.

CAF DEVELOPMENT BANK OF LATIN AMERICA

Wp

WORKING PAPERS

DEVELOPMENT BANK OF LATIN AMERICA

THE EFFECT OF THE MINIMUM WAGE ON EMPLOYMENT IN BRAZIL

Saltiel, F.
Urzúa, S.

CAF – Working paper N° 2017/22
1610/2017

ABSTRACT

During the economic boom of the early 2000s, most Latin American countries increased their minimum wages. In Brazil, the real minimum wage increased by upwards of 60 percent from 2003 through 2012. In this paper, we take advantage of administrative data to explore whether the minimum wage resulted in negative employment impacts in Brazil's formal sector. We explore different measures of the incidence of the minimum wage across states and examine various empirical specifications, yet find no significant disemployment impacts associated with this policy. On the other hand, we find significant negative impacts in microregions which were less exposed to the commodities boom. Since empirical strategies relying on incidence measures are inherently limited, we additionally exploit the introduction of a 2000 law which allowed states to implement regional wage floors. While these floors vary in scope and size, we find that the five states which implemented this policy included provisions directly targeting workers in the accommodation and restaurant sector. As a result, we adapt Dube, Lester and Reich's (2010) empirical strategy to Brazil and estimate the impact of these floors on employment in this sector by exploiting variation in microregions straddling state borders. As in our initial estimates, we find no significant negative employment impacts arising from the wage floors, indicating that during the early 2000s, the minimum wage did not result in negative employment impacts in Brazil's formal sector. Nonetheless, we caution that this result may not hold in a recessionary context, as shown in our commodity boom-incidence results.

Wp

WORKING PAPERS

EL EFECTO DEL SALARIO MÍNIMO SOBRE EL EMPLEO EN BRASIL

Saltiel, F.
Urzúa, S.

CAF - Documento de trabajo N° 2017/22
16/10/2017

RESUMEN

Durante el auge económico de principios de los años 2000s, la mayoría de los países latinoamericanos aumentaron sus salarios mínimos. En Brasil, el salario mínimo real aumentó más de 60% entre 2003 y 2012. En este trabajo, aprovechamos datos administrativos para explorar si el salario mínimo resultó en un impacto negativo sobre el empleo en el sector formal de Brasil. Exploramos distintas medidas de la incidencia del salario mínimo entre los estados y examinamos varias especificaciones empíricas, pero no encontramos impactos significativos sobre el desempleo asociados con esta política. Por otra parte, encontramos impactos negativos significativos en las microrregiones menos expuestas al boom de las materias primas. Como las estrategias empíricas que se basan en las medidas de incidencia son limitadas, adicionalmente explotamos la introducción de una ley del año 2000 que permitió a los estados implementar pisos salariales regionales. Si bien estos pisos varían en alcance y tamaño, encontramos que los cinco estados que implementaron esta política incluyeron disposiciones dirigidas directamente a los trabajadores del sector de alojamiento y restaurantes. Adaptamos la estrategia empírica de Dube, Lester y Reich (2010) a Brasil y estimamos el impacto de estos pisos salariales en el empleo en este sector explotando la variación en microrregiones que traspasan las fronteras estatales. Al igual que en nuestras estimaciones iniciales, no encontramos impactos negativos significativos en el empleo derivados de los niveles salariales mínimos, lo que indica que a principios de los años 2000s, el salario mínimo no produjo impactos negativos en el empleo en el sector formal de Brasil. No obstante, advertimos que este resultado puede no mantenerse en un contexto recesivo, como se muestra en nuestros resultados de la incidencia del boom de los commodities.

The Effect of the Minimum Wage on Employment in Brazil*

Fernando Saltiel
University of Maryland, College Park

Sergio Urzúa
University of Maryland, College Park and NBER

October 16, 2017

Abstract

During the economic boom of the early 2000s, most Latin American countries increased their minimum wages. In Brazil, the real minimum wage increased by upwards of 60 percent from 2003 through 2012. In this paper, we take advantage of administrative data to explore whether the minimum wage resulted in negative employment impacts in Brazil's formal sector. We explore different measures of the incidence of the minimum wage across states and examine various empirical specifications, yet find no significant disemployment impacts associated with this policy. On the other hand, we find significant negative impacts in microregions which were less exposed to the commodities boom. Since empirical strategies relying on incidence measures are inherently limited, we additionally exploit the introduction of a 2000 law which allowed states to implement regional wage floors. While these floors vary in scope and size, we find that the five states which implemented this policy included provisions directly targeting workers in the accommodation and restaurant sector. As a result, we adapt Dube, Lester and Reich's (2010) empirical strategy to Brazil and estimate the impact of these floors on employment in this sector by exploiting variation in microregions straddling state borders. As in our initial estimates, we find no significant negative employment impacts arising from the wage floors, indicating that during the early 2000s, the minimum wage did not result in negative employment impacts in Brazil's formal sector. Nonetheless, we caution that this result may not hold in a recessionary context, as shown in our commodity boom-incidence results.

*Fernando Saltiel; Department of Economics; University of Maryland, College Park; email: saltiel@econ.umd.edu. Sergio Urzúa; Department of Economics; University of Maryland, College Park and National Bureau of Economic Research; email: urzua@econ.umd.edu. We would like to thank the *Banco de Desarrollo de America Latina* for financial support. We thank the contributions of seminar participants at the Workshop on Understanding the Productivity Gap in Latin America.

1 Introduction

Labor markets in Latin America are characterized by high employment costs and extensive regulations (Heckman and Pages 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 (Kristensen and Cunningham 2006). While this tool is also prevalent in developed countries, the estimated effects of the minimum wage on employment should differ across developed and developing countries, given the existence of a large informal sector in the latter (Welch 1976, Gramlich 1976).

In this paper, we examine the impacts of the minimum wage on various employment measures in Brazil from 2003 through 2012. During this time period, the real national minimum wage grew by 70 percent, far exceeding the Brazil's cumulative economic growth. Engbom and Moser (2017) have shown that the minimum wage has resulted in significant increases in the earnings of low-wage workers and in fact played an important role in reducing inequality during this time period. In terms of employment effects, Broecke and Vandeweyer (2016) have found small impacts, though their analysis relies on data from the Brazilian Monthly Labor Force Survey, which only covers six metropolitan areas in the country. We instead take advantage of matched employee-employer data (RAIS), which covers the universe of workers and firms in Brazil.

Our initial empirical strategy estimates the effects of the minimum wage on aggregate state-level employment in the formal sector and on formal sector firm dynamics, by estimating the impact on rates of firm entry and exit. Moreover, our data source allows to follow the developed country literature and examine the impact on particularly exposed groups. As a result, we estimate employment effects for high school dropouts and for employment in the accommodation and restaurant industry, a sector which is directly affected by the minimum wage.[1][2] We carry out our empirical analysis using three different measures of the bite of the minimum wage at the state level, including the Kaitz index (ratio of the minimum wage to the average wage), a toughness ratio (ratio of

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

[2] The developed country literature has often focused on the impact on teenage employment, as these workers are typically low-wage earners. During our time period of interest, Brazil has undergone a massive educational expansion such that the share of workers with some tertiary education has increased from 11 percent in 1995 to 23 percent by 2014 (Cruces et al. 2015). As a result, the estimated impact on this group of workers could be conflated with differential enrollment trends across states. Our strategy instead focuses on the employment stock of low-educated workers, which is mostly comprised by older individuals who are not affected by this trend.

minimum wage to the median wage) and the fraction of workers affected by a minimum wage increase, and estimate the impacts across different fixed effect specifications. In our empirical results, we find negative employment elasticities of varying magnitudes, but none of them are statistically significant. To examine whether this result is partly driven by Brazil's commodity-driven economic boom during our period of interest, we follow Benguria et al. (2017) and test whether estimated employment effects are larger in microregions less exposed to the boom.[3] As we find larger negative elasticities in less exposed microregions, it is possible that the minimum wage could have larger impacts during a recessionary period.

Since our national level estimates are unable to overcome the inherent limitations of minimum wage incidence measures (Brown 1999), we complement our analysis by exploiting the passage of a 2000 law which allowed Brazilian states to implement wage floors higher than the national minimum wage. Since then, five states have adopted such floors, which at times have exceeded the national minimum in excess of 25 percent. However, these floors affect workers in specific occupations and industries, and the five states' laws cover different categories of workers, making it difficult to compare their impact across states. Nonetheless, all existing floors include provisions directly aimed towards workers in the restaurant and hotel industry. As a result, we estimate the effect of the state-level wage floor on employment in this sector, by adapting the cross-state county-pair strategy proposed by Dube, Lester and Reich (2010) to the Brazilian context. We first identify microregions which lie on state borders and then estimate the effects of the wage floors on hotel and restaurant employment by exploiting the introduction and subsequent increases in these floors after 2003. Although our final sample includes 89 microregions and 69 microregion-pairs, we also carry out our analysis at the municipal level, which expands our sample to include 1,109 municipalities.[4] As there is an ongoing debate as to how binding the state floors are (Corseuil et al. 2013, Terrell 2009, Tepedino 2013), we include an additional measure of the effective wage floor in these states. Similar to our national-level results, we find employment elasticities which are not statistically different from zero at both the microregion and the municipal level, confirming our

[3] We are exploit detailed geographic information in RAIS to estimate the impacts across Brazil's 559 microregions, which "group together economically integrated contiguous municipalities [in the same state] with similar geographic and productive characteristics" (Dix-Carneiro and Kovak 2017).

[4] Since the detail offered by maps of Brazilian states does not allow us to create a set of contiguous-border municipalities, we carry out our analysis at the micro-regional level. There is further reason to believe that focusing on the microregional level is preferrable, as this unit of analysis is similar across states in Brazil and avoids the large heterogeneity in Brazil's municipialities' population and employment patterns.

initial findings of limited employment impacts from minimum wages in Brazil during 2003 through 2012. To the best of our knowledge, this is the first paper which relies on sub-national variation to identify the effects of the minimum wage in Latin America, and further work is needed to better understand the impacts of this policy during economic downturns in the region.

The paper proceeds as follows: Section 2 presents a literature review of relevant papers in this literature. Section 3 discusses the institutional context in Brazil, the relevant minimum wage and wage floor increases, the administrative data sources used in the paper and relevant summary statistics. Section 4 presents our empirical strategy and results of the impacts of the national minimum wage on various employment measures. Section 5 first describes our contiguous microregion border pair strategy and shows our estimated results of wage floors on employment in the accommodation-restaurant sector. Lastly, Section 6 discusses the results and concludes.

2 Literature Review

The employment effects associated with minimum wages have long interested economists. Stigler (1946) argued that in a homogeneous labor market, this policy change would lead perfectly competitive employers to cut employment, particularly that of directly affected workers. Welch (1976) extended this analysis to include an uncovered sector with no minimum wage in place, where the imposition of a wage floor in the covered sector would reduce employment in this sector, but increase it in the uncovered sector through the transition of displaced covered sector workers. This extension is particularly relevant for developing countries like Brazil, where the existence of a large informal sector allows firms to skirt compliance with the salary floor. In a context with heterogeneous workers, firms could additionally respond to the policy change by substituting away from low-wage workers towards more productive ones, implying larger negative employment elasticities for lower paid workers.

In most developing countries, minimum wages are set at the national level and the the ability of sub-national governments to implement larger floors is often limited. As a result, the empirical literature exploring employment effects of minimum wages has largely relied on measures of the policy's "bite", using variables such as the Kaitz index or different toughness ratios. Both Lemos (2006) and Broecke et al. (2016) have conducted reviews of the literature in developing countries

and found mixed results with respect to negative employment impacts. For instance, while Martinez et al. (2001) and Miranda (2013) find no direct effect of the Chilean minimum wage on aggregate employment, Wedenoja (2013) argues the policy had pushed workers to the informal sector. In Colombia, Arango and Pachon (2004) find negative effects on youth employment, whereas Gindling and Terrell (2007a) find negative employment effects in Costa Rica and Gindling and Terrell (2007b) find similar effects in Honduras.

An extensive literature has also analyzed the effects of the minimum wage on employment in Brazil. The minimum wage 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. Various papers focused on the time period following the introduction of the national policy. For instance, Fajnzylber (2001) examined the 1982-1997 period and found a small employment elasticity in the range of -0.10, with larger effects for younger workers. Carneiro (2001) similarly found modest dis-employment effects of minimum wages and Lemos (2004) found the minimum wage compressed the wage distribution in the formal and informal sectors between 1982 and 2000 and had a small negative impact on employment. More recently, Neumark, Cunningham and Siga (2006) found an employment elasticity of -0.07 using survey data from 1996 through 2001. In short, the early literature found the minimum wage resulted in modest to no dis-employment effects. In recent years, as inflation stabilized and economic growth picked up, the national minimum wage has increased significantly. Two recent papers have examined the employment impacts of the recent increases. Jales (2017) follows a density discontinuity design and finds that the minimum wage increase over the 2001-2009 period resulted in the informal sector expanding by an additional 39 percent relative to a counterfactual without such increases.[5] On the other hand, Broecke and Vandeweyer (2016) estimate the impact of the minimum wage using survey data and find that it had no discernible effect on youth employment along with a small negative impact on formality, particularly for low-skilled workers. We next describe how the Brazilian minimum wage has changed in recent years and discuss the introduction of state-level wage floors.

[5] As noted by Broecke et al. (2016), this paper follows a different empirical strategy than most of the existing literature, which may explain the large difference in its estimated effects.

3 Institutional Context and Data Sources

National Minimum Wage

As noted above, the Brazilian national minimum wage 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. In fact, 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. Furthermore, the Ministry of Labor often carries out inspections to ensure that firms are in compliance with minimum wage regulation (Almeida and Carneiro 2009). As a result of these changes, the minimum wage as a fraction of median earnings increased from 54 percent in 2003 to 65 percent by 2012.

Despite the recent increases, few formal sector workers are directly affected by the wage floor. Engbom and Moser (2017) show that only five percent of workers had earnings within 5 percent of the minimum wage in the early 2000s, and this value had increased to just 6.1 percent by 2012. Nonetheless, as the authors show, the policy has had significant spillover effects across the wage distribution, thereby explaining part of the reduction in inequality in the early 2000s. Moreover, as first noted by Souza and Baltazar (1979), the minimum wage may have also affected informal sector wages through the "lighthouse effect". In fact, Camargo, Gonzaga, Neri (2001) have found the minimum wage to be more binding in the informal sector, where 15 percent of workers earn exactly one minimum wage. As a result, any negative employment effects in the formal sector may be potentially attenuated due to the lighthouse effect.

On the other hand, the minimum wage directly affects certain industries and groups in the population. For instance, 24 percent of low-skilled workers in the formal sector (with less than a High School diploma) have monthly earnings around 5 percent of the minimum wage. Similarly, at the industry level, the low-wage nature of the tasks required in the accommodation and restaurant sector implies that workers in this sector are most exposed to the minimum wage. In fact, 39 percent of workers in the hotel and restaurant industry have earnings below 110 percent of the minimum wage. Lastly, as minimum wage changes directly increase labor costs, firms' entry and

exit margins could be directly affected. As a result, our empirical analysis examines the impacts of this policy on firm entry and exit rates and estimates employment effects in the aggregate, for low-skilled workers and in directly affected industries.

Following Lemos (2004), our empirical strategy uses three different measures of the bite of the minimum wage, exploiting variation over time and across states. The first measure is the Kaitz index (Kaitz 1970), which represents the ratio of the minimum wage to average wage, and has been traditionally used in this literature. We complement our analysis by defining the toughness ratio (minimum wage to median earnings) and by using the share of workers affected by a minimum wage increase, which exploits different levels and shapes of the wage distribution across states (Card 1992). As discussed next, we complement our analysis by examining the impact of contemporaneous state-level wage floors, which exceeded the national minimum wage but only affected certain groups of workers.

State-Level Wage Floors

In 2000, the Federal Government instituted a law which allowed 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 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 covered by the floors have varied across states and over time. 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, with Rio de Janeiro initially implementing three different wage floors but eventually moving to nine, and Paraná going from five floors down to three (Corseuil et al. 2013).

Despite the heterogeneous implementation of the wage floor across states, all policies include explicit provisions affecting employment in the accommodation and restaurant industry.[6] The

[6]Terrell (2009) provides extensive evidence as to the different wage floors implemented in each state and the

policies in all five states include direct wage floors for workers employed in the "tourism and accommodation" sector. Meanwhile, Rio Grande do Sul, Sao Paulo and Santa Catarina include floors which directly affect workers in the "food" industry, and Rio de Janeiro and Paraná include a floor for busboys, cooks and servers, which account for a large share of employment in restaurants.[7] As a result, we focus our empirical analysis on the employment effects of the wage floors which directly apply to workers in the hotel and restaurant industry, which is jointly defined as a one-digit sector by Brazil's statistical agency, IBGE (*Instituto Brasileiro de Geografia e Estatística*). We create a state-level wage floor variable, presented in Table 1, which tracks the relevant floor in each state for workers employed in this one-digit industry and compare it to the national minimum wage. Note that 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), our variable includes the lower of the two, though our empirical results are not sensitive to this choice. Lastly, as we carry out our empirical analysis on a quarterly basis, we further exploit within-year variation in the minimum wage and the wage floors.

While our focus on this industry allows us to examine a context which should be directly affected by the policy, there is an ongoing debate in the literature about the effectiveness of the wage floors. Moura and Neri (2008) have argued that there was low compliance with the floor in Rio de Janeiro and in Rio Grande do Sul after the floor were introduced. Similarly, Corseuil et al. (2013) have found significant non-compliance with the floor in Paraná and São Paulo. On the other hand, Tepedino (2013) has found earnings spikes around the floors in the five states and Terrell (2009) has argued that state minimum wages have increased wages for directly affected workers. While the evidence suggests that there may not be full compliance with the policy, firms are subject to various fines and penalties if found guilty of paying formal workers below the floor. In fact, the largest union in Brazil has called on its workers to directly report violations of the floor to the Ministry of Labor, resulting in an indirect cost for firms not meeting the floor. To ensure that our results are robust to this concern, we use an additional measure to account for potential non-compliance by firms, who still face consequences from paying workers below the state-level floor. Our effec-

extent to which they cover different occupations and/or industries. In our work, we have carefully parsed the provisions included in each of these floors and found that they all include provisions directly affecting workers in the accommodation and restaurant industry.

[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.

tive floor variable equals the national minimum wage plus the difference between the state-level and national floor times a share of enforcement at the state-level, which we impute from Corseuil et al.'s (2013) and Tepedino's (2013) analysis. This variable accounts for differential enforcement rate across all five states, but our empirical results are similar using both measures of the wage floor.

Data Sources

In this paper, 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 covering all states in the Brazilian economy. Our empirical analysis at the state level uses data from 26 of the 27 states in Brazil (unidades federativas).[8] We further exploit the rich geographic information included in RAIS and also estimate our results at the microregion level, a similar level to Metropolitan Statistical Areas in the United States. The survey has been administered by the Brazilian Ministry of Labor since 1986, and reached complete coverage of all firms by the national level by 1994. By 2003, the survey covered more than 95 percent of the formal universe of formal sector workers and firms. 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.

RAIS includes unique, time-invariant person identifiers, which allows us to construct a panel of workers over the relevant time period. We observe the start and end month for each job for each worker as well as individual-level characteristics such as their age, gender, educational level, and occupation. Moreover, the data includes a unique establishment-level identifier, which allows us to construct a panel representing the universe of establishments and firms in Brazil, including information on their economic sector.[9] 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. While the RAIS survey is carried out on an annual basis, we observe the dates of entry and exit for all workers, which allows us to construct a measure of all relevant employment indicators at the quarterly level.

[8] Since we have missing data for the state of Pernambuco in 2010, we exclude it from the empirical analysis.

[9] We exclude observations which are missing either the firm or the individual-level identifier or those with missing values for earnings or dates of employment.

We note that our empirical results are robust across annual or quarterly specifications.

For our aggregate state-level 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. For our measure of low-skilled employment, we use the number of full-time equivalent workers who have attained less than a high school diploma. Furthermore, as noted above, our sector analysis focuses on all employment in the accommodation and restaurant sector.[10] Lastly, following Haltiwanger et al. (2013), we define the rate of firm entry in state s at time t as the number of new firms in period t divided by the average of the total number of firms in periods $t-1$ ($N_{s,t-1}$) and t ($N_{s,t}$), and similarly, the firm exit rate at time t equals the number of firms inactive in time t which had been previously active at $t-1$, normalized by the same average.[11] The variables are thus defined as follows:

$$Entry\ Rate_{st} = \frac{New\ Firms_{st}}{1/2 \times (N_{st} + N_{s,t-1})}$$
$$Exit\ Rate_{st} = \frac{Exiting\ Firms_{st}}{1/2 \times (N_{st} + N_{s,t-1})}$$

4 Employment Effects of National Minimum Wage

Empirical Strategy

Since the minimum wage does not vary within Brazil, we can only estimate its impact on employment by using different measures of its incidence in each state. As a result, to ensure the robustness of our results, we use three different measures of incidence, including the Kaitz index, a toughness ratio, and the fraction of workers affected. Our empirical equation is as follows:

$$Y_{st} = \beta_0 + \beta_1\ mw_{st} + \beta_2\ X_{st} + \theta_s + \lambda_t + \varepsilon_{st} \tag{1}$$

In equation (1), Y_{st} represents the various outcomes of interest we are interested in exploring, including state-level employment, employment in the accommodation and restaurant industry,

[10] This sector includes four different six-digit restaurant industries and four different six-digit hotel types.

[11] We note that our analysis on firm dynamics is carried out on an annual basis, to avoid potential measurement error in within-year firm dynamics.

low-skilled worker employment, and firm entry and exit rates. mw_{st} denotes the three incidence variables and, given limited data availability, we only include the state's population as a control variable. θ_s represents state-level fixed effects and λ_t captures time fixed effects. Across all specifications, we cluster our standard errors at the state level. While equation (2) allows us to control for differences in employment levels across states, in order to control for heterogeneity in the evo-lution of employment outcomes across states, we follow the existing literature and re-estimate the model including state-specific linear time trends:

$$Y_{st} = \beta_0 + \beta_1 \, mw_{st} + \beta_2 \, X_{st} + \theta_s + \lambda_t + \delta_s \times t + \varepsilon_{st} \tag{2}$$

Meer and West (2013) have argued that the inclusion of these trends ($\delta_s \times t$) attenuate the estimated impacts of the minimum wage if the policy directly affects employment growth rates rather than levels. As a result, by estimating both equations (1) and (2) we can check the robustness of our results against this concern.

Effects on Total Employment

Table 2 presents the estimated impacts of the minimum wage on formal sector employment at the state level. Since we estimate the model following a log-log specification, the reported coefficients can be interpreted as employment elasticities. The first three columns present the results from equation (1), where we find that a 10 percent increase in the Kaitz index implies a fall in state-level employment of 2 percent, a result which is not statistically significant. On the other hand, when we estimate the effect using the ratio of the minimum wage to the median wage, the estimated elasticity falls to -0.09 and the coefficient is not significant. We find similar results when using the share of workers affected by a minimum wage increase as the incidence variable, such that the estimated impact on employment remains small and not significant. In columns (4)-(6), we present the results from equation (2), in which we find similar results to those in the baseline specification. For both the Kaitz index and the toughness ratio, the estimated elasticities are negative, in the range of -0.15, but not statistically significant. Meanwhile, the fraction affected measure is not associated with a negative impact on employment.

Beyond aggregate employment effects, an additional path through which the minimum wage

could affect formal sector employment is by affecting firm entry and exit rates. For instance, Hopenhayn's (1992) model predicts that an increase in labor costs should result in an increase in firm exit rates while reducing firm entry. In a similar line, Aaronson et al. (2016) propose a model of firm dynamics based on putty-clay technology, where adjustments to employment levels are carried out solely through firm entry and exit. Nonetheless, as there are limited data sources with information on firm dynamics, few papers have explored the impact of minimum wages on this employment margin. Rohlin (2011) found that state minimum wage hikes in the United States discouraged firm entry but had no impact on firm-level exit or on employment in continuing establishments, and Aarsonson et al. (2016) estimated their structural model and found increased restaurant entry and exit following minimum wage hikes. Nonetheless, no previous papers have analyzed this question in a developing country context.

In Table 3 we present the estimated effects of the minimum wage on annual firm entry and exit in Brazil over 2003-2012. In the first four columns, we present the estimated effects on firm entry from equations (1) and (2). In both empirical specifications and across both measures of incidence, we find no discernible impacts of the minimum wage on firm entry rates. For instance, while the estimated impact of the Kaitz index in column (1) is negative, once we include linear trends, the coefficient becomes positive. In columns (5)-(8), we find similar results for firm exit rates, with no significant impacts on the rate of firm exit following minimum wage increases, whether measured through the Kaitz or the toughness ratio.

The empirical results presented in this section have shown the national minimum wage has had no discernible impacts on formal sector employment in Brazil. There are various potential explanations behind this result. For instance, in a monopsonistic labor market, Engbom and Moser (2017) have shown that an increase in the minimum wage could result in wage increases for workers higher along the earnings distribution, thereby reducing the ability of firms to substitute across different types of workers, and thus reducing estimated employment impacts. Furthermore, the Brazilian government implemented various policies to increase employment formalization, which could also explain our findings (Rocha et al. 2016). Nonetheless, as discussed above, the minimum wage does not directly affect a large share of formal sector workers. As a result, we next explore whether this policy had an impact on the employment of the hotel/restaurant industry and that of low-skilled workers.

Effects on Employment of Affected Groups

In Table 4, we first present the estimated impact of the minimum wage on employment in the accommodation and restaurant industry. As noted above, we focus on this sector for two reasons. First, starting with Card and Krueger (1994), a large share of the developed country literature has focused on employment in restaurants, allowing us to provide a better comparison of our estimated impacts to those in the existing literature. Furthermore, a large share of workers in this sector are directly exposed to minimum wage increases. Our estimates from equation (1), presented in the first two columns, show that a 10 percent increase in the Kaitz ratio is associated with a drop in employment in this sector of 5 percent, which is larger than the estimated elasticity for overall employment, and is statistically significant at the 5 percent level. Furthermore, when estimating the equation using the ratio of the minimum wage to the median wage, the estimated coefficient falls and becomes not significant. In our estimates from equation (2), we find similar results. The estimated employment elasticities are lower, and not statistically significant. We note that the existing literature has largely estimated models such as equation (**??**), which implies that the negative impact presented in Column (1) likely represents an over-estimate on the employment effects arising from the minimum wage.

On the individual side, we examine the impacts of the minimum wage on the employment of workers with less than a high school degree, who are more likely to be directly affected by changes in this policy. In our estimates from equation (2), presented in columns (5) and (6), we find large negative impacts of the minimum wage, such that across both the Kaitz and toughness ratio, the estimated employment elasticity exceeds -0.18. However, the results are not significant at the 5 percent level. Moreover, upon including state-level linear trends, the estimated coefficients fall and the coefficients are no longer significant. We further note that the estimated employment impacts associated with the fraction affected variable are small are not statistically different from zero across both specifications.

The results presented in Table 4 are in line with our aggregate employment estimates: across various specifications, there is no evidence the minimum wage had a significant effect on formal sector employment, even for particularly exposed groups. Our results are in line with Broecke and Vandeweyer's (2016) finding of no significant impacts on either formal sector or teenage employment

using PME data. At the same time, we find no large disemployment effects in the hotel and restaurant industry. To the best of our knowledge, this is the first paper which has analyzed the effects of the minimum wage on this sector in Latin America, which allows to examine its impact on a sector which is directly affected by this policy, as has been common in developed countries (Card and Krueger 1992, Card and Krueger 2000, Dube, Lester and Reich 2010).

We have so far found limited impacts of the minimum wage across various employment measures. While there are various potential reasons driving our results, we explore whether the results are partly driven by Brazil's economic expansion during our period of interest, which was largely fueled by a boom in commodity prices. While equations (1) and (2) directly control for time trends in the economy, these specifications do not allow us to discern whether there are heterogeneous effects across regions with differential exposure to the boom in commodities. As a result, we follow Benguria, Saffie and Urzua (2017) and re-estimate these two equations at the microregion level, interacting minimum wage incidence measures with a variable which exploits regional variation in exposure to commodity prices. Our measure of exposure follows from Brazil's 1996 Agricultural Census, where we observe the share of each microregion's land area used in the agricultural sector, allowing us to split the sample of 559 microregions into a low- and a high-commodity-exposure group given the share of land used in this sector.

We present our empirical results in Table 5. Across both empirical specifications, we find larger negative employment elasticities for microregions which were less exposed to the commodity boom in Brazil during 2003-2012. In fact, a 10 percent increase in the Kaitz ratio in column (3) is associated with a drop in formal sector employment of 3.5 percent in less exposed microregions, but only with an employment fall of 1.5 percent in more exposed one, and the latter coefficient is not statistically significant. We find similar results in the first two columns, as there are larger effects for less exposed microregions. While the results presented in Table 5 do not offer conclusive evidence as to the source of limited employment impacts arising from the minimum wage, they indicate that it is possible that there will be larger impacts as Brazil has recently entered a recessionary period, partly driven by a sudden drop in commodity prices. We lastly note that since part of the variation in the Kaitz index and in the toughness ratio is driven by changes in the average and median wage, respectively, there are various limitations with estimating the impact of minimum wages using incidence measures (Brown 1999). As a result, we take advantage of within-Brazil

variation in state wage floors, and present an alternative empirical strategy in Section 5.

5 Employment Impacts of State-Level Wage Floors

Empirical Strategy

The passage of the 2000 law allowing Brazilian states to implement wage floors enables us to exploit variation in this policy within Brazil to examine employment impacts using modern econometric techniques. Nonetheless, as only five states had implemented a floor prior to 2012, there is limited variation to carry out our analysis at the state level.[12] Furthermore, there is significant heterogeneity in the potential effects of the wage floor within each state. For instance, within the state of Sao Paulo, in the microregion of Santos, 1.3 percent of formal sector workers earn wages lower than 1.1 times the minimum wage, whereas 14 percent do so in the Capao Bonito microregion. As a result, any empirical strategy analyzing the employment impacts of the minimum wage needs to correctly account for differences in employment levels and trends across microregions within each state.

Our preferred empirical strategy follows Dube, Lester and Reich (2010). The authors propose exploiting variation in the minimum wage of counties sharing common state borders in the United States, which allows them to identify employment impacts under the assumption that bordering counties are appropriate controls for treated units. By focusing on contiguous counties, this approach directly controls for regional economic shocks affecting both counties across the border, a potential concern for empirical strategies including all counties. In this paper, we adapt their approach to the Brazilian context by identifying bordering microregions in states with wage floors between 2003 and 2012. While microregions represent a coarser level of geography than counties, an important advantage of focusing on this geographical level is that we can compare employment effects across units of similar economic importance, which is not possible at the municipal level, as there is vast heterogeneity in the size of these units across Brazil. Figure 1 displays the location of the microregions included in our sample. Since the states which have implemented wage floors and the non-implementing states bordering one which has are both located in the Southern part

[12] While our preferred empirical strategy focuses on microregion-level estimates of the effects of wage floors on employment, we have separately estimated the effects using state-level variation and found similar results as those presented below.

of Brazil, the microregions included in our analysis belong to this region as well. Bordering microregions are more similar to each other in terms of population, formal sector employment and employment in the hotel and restaurant industry vis-a-vis all microregions in states which have implemented a wage floor. Note that since each unit may belong to more than one pair, our final sample includes 89 microregions and 69 pairs. Moreover, our sample includes a microregion as many times as it borders contiguous units across the border, resulting in a final sample with 5,520 total observations. Our estimating equation is as follows:

$$ln\ y_{mpt} = \beta_0 + \beta_1 ln(floor_{mt}) + \beta_2 ln(pop_{mt}) + \theta_m + \tau_{pt} + \varepsilon_{mpt} \tag{3}$$

In equation (3), the subscript m refers to a microregion, and y_{mpt} measures formal employment in the accommodation and restaurant industry in microrregion m, belonging to border-pair p in year t. θ_m is a microregion fixed effect and τ_{pt} represents pair-year fixed effects, which absorb regional economic shocks in each bordering pair. The first wage floor variable ($floor_{st}$) equals the lowest wage floor applicable to workers in the restaurant and hotel industry. Meanwhile, the second variable, $efloor_{st}$, measures the effective wage floor in each state by accounting for the costs of non-compliance by employers. The intuition is that firms which pay their workers below the mandated wage floor face an additional inspection risk, such that wage floors still affect their employment decisions. We construct the effective wage floor variable by using data on the share of workers earning wages below the relevant wage floor in each state from Corseuil et al. (2013) and Tepedino (2013).[13] Following Almeida and Carneiro (2009), who show that there are differential inspection rates across states in Brazil, we posit the share of workers earning below the wage floor is a proxy for the costs that firms in state s may face for non-compliance. We note, however, that our results are robust across alternative measures of non-compliance. We define the effective wage floor as follows:

$$efloor_{st} = mw_t + (1 - noncompliance_s) \times floor_{st} \tag{4}$$

We estimate equation (3) using the two measures of the wage floor, where the latter variable is created to ensure our results are robust to a potentially non-binding wage floor. Across both

[13] Note that these workers still earn wages above the national minimum wage.

specifications, we follow Dube, Lester and Reich (2010) and cluster standard errors at the state and border-pair level, allowing us to account for serial correlation at the microrregion level. Furthermore, to confirm the robustness of our results, we estimate an additional specification which directly follows standard models in this literature, in which the estimating equation is as follows:

$$ln\ y_{mt} = \beta_0 + \beta_1 ln(mw_{mt}) + \beta_2 ln(pop_{mt}) + \theta_m + \lambda_t + \eta_s \times t + \varepsilon_{mt} \quad (5)$$

We estimate equation (5) using two different samples. The first sample includes all microregions in Brazil and the second one only includes microregions pertaining to the eight states which have either implemented a wage floor or border a state which has. Lastly, as noted above, we re-estimate equation (5) at the municipal level, which allows us to expand our sample to include 1,109 municipalities belonging to a microregion border pair.

Results at Microregion Level

Table 6 presents the estimated employment effects of state wage floors on employment in the accommodation and restaurant sector across three different specifications for two different measures of the wage floor. As in Section 4, we follow a log-log specification, which allows us to interpret the coefficients as employment elasticities. In our preferred strategy, which exploits differences in the wage floor across state borders, we find positive employment effects, such that an 10 percent increase in the wage floor is associated with an employment increase of 1.7 percent at the microregion. Nonetheless, the estimated coefficient is not statistically significant, but it allows us to rule out negative employment elasticities lower than -0.15 at the 95 confidence level. Given the ongoing debate on the extent to which wage floors bind firms' employment decisions, we estimate equation (3) using our definition of the effective wage floor in Column (2). We find similar effects as in the first regression, with a positive point estimate, which allows us to rule out employment elasticities lower than -0.16 at the 95 percent confidence level. Given the sign of our estimated coefficients, it is not surprising that these results are robust to alternative definitions of the effective wage floor variable.

While our results seem to confirm our Section 4 findings, with no significant disemployment impacts associated with the minimum wage or wage floors, the cross-border approach has been

criticized by Neumark, Salas and Wascher (2017), who have argued this strategy fails to account for potential cross-border spillovers and at the same time may not include the appropriate set of counties as controls. Moreover, as ours is the first paper to estimate the impacts of wage floors at the sub-national level in Brazil, we further test the robustness of our results by estimating equation (5). The results presented in Column (3) include all microregions in Brazil. We find similar point estimates as in the first two columns, with a positive employment effect, though not different from zero. In fact, we can also reject employment elasticities lower than -0.21 at the 95 percent confidence interval. We find similar results when using the effective minimum wage variable in Column (4). Nonetheless, as only five states had implemented a wage floor during the time period of interest, this specification includes a large number of microregions with no variation in the floor during 2003-2012. As a result, we re-estimate equation (3) in columns (5) and (6), only including microregions in the eight states which either implemented a wage floor or border one which has. Unsurprisingly, we find no evidence that state-level wage floors are associated with reductions in employment rates at the microregion level. In the last two columns, we provide further robustness of our results by re-estimating our cross-border pair strategy at the municipal level. This allows us to expand our sample, given the few microregions included in the original sample. In Column (7), we present the estimated employment impacts from equation (5), and find a similar employment effects, which are not statistically significant. We find similar results using the effective wage floor variable.

In this section, we have first shown how we can take advantage of recent advances in econometric techniques in the minimum wage literature by applying it to a developing country context, such as Brazil. The cross-border pair strategy has allowed us to exploit variation at the sub-national level, providing additional evidence on the employment impacts of wage floors in Brazil. Across various empirical specifications and definitions of the wage floor, we have found similar results: the estimated employment impacts of regional wage floors are not different from zero, thereby confirming our empirical results for the national minimum wage.

6 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. In this paper, we have explored whether the minimum wage resulted in negative employment effects in the formal sector. Using different measures of its incidence and across estimating various empirical specifications, we have found limited evidence of any negative employment impacts. Furthermore, our administrative data has allowed us to focus on workers and industries which should have been directly affected by the minimum wage, yet we have found no significant impacts in this case, either.

Given the inherent limitations associated with minimum wage incidence variables, we have also taken advantage of variation in wage floors across states in Brazil. While these floors vary in scope across states, we have found that all states include provisions directly targeting workers in the accommodation and restaurant sector. By correctly identifying microregions straddling state borders with differential wage floors from 2003 through 2012, we have been able to adapt the empirical framework proposed by Dube, Lester and Reich (2010) to the Brazilian context. Despite using a different empirical framework as in our minimum wage estimates, we have found no significant employment impacts in the accommodation and restaurant industry associated with regional wage floors either. While our results show no negative employment impacts arising from either the minimum wage or wage floors, we caution for the need to better understand the mechanisms driving this result. For instance, if our results were explained by the presence of monopsonistic employers in Brazil, our results should hold up even in the face of changing economic conditions. On the other hand, we have presented preliminary evidence that the negative employment impacts were significantly larger in regions which were less exposed to the economic boom experienced in the early 2000s. As a result, as the country's external shocks have changed in the past few years, it is possible that formal sector employment will suffer due to the large minimum wage. While there is still further work needed in this area, this paper has provided an important advance towards better understanding the impact of minimum wages in Latin America.

References

Aaronson, Daniel, Eric French, Isaac Sorkin and Ted To. 2016. Industry Dynamics and the Minimum Wage: A Putty-Clay Approach. Working Paper.

Almeida, Rita, and Pedro Carneiro. 2009. "Enforcement of Labor Regulation and Firm Size." Journal of Comparative Economics 37 (1): 28–46.

Arango, A. C., and A. Pachón. 2004. The minimum wage in Colombia: Holding the middle with a bite on the poor. Banco de la República Borradores de Economía, No. 280.

Benguria, Felipe, Felipe Saffie and Sergio Urzua. 2017. Commodity Shocks, Firm-Level Responses and Labor Market Dynamics. Working Paper.

Broecke, Stijn and Marieke Vandeweyer. 2016. Doubling the Minimum Wage and Its Effeects on Labour Market Outcomes: Evidence from Brazil. Working Paper.

Brown, Charles. 1999. Minimum wages, employment, and the distribution of income. in O. Ashenfelter, and D. Card (eds.), Handbook of Labour Economics, Elsevier Science, North-Holland, pp. 2101-2163.

Camargo, J.C., Gustavo Gonzaga, M. Neri 2001. Salário-mínimo, 'efeito-farol' e pobreza. Revista de Economia Política, v. 21, n. 2, 82, 2001.

Card, David. 1992. Do Minimum Wages Reduce Employment? A Case Study of California, 1987-89. Industrial and Labor Relations Review, 46, 38-54.

Card, David and Alan Krueger. 1994. Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania. American Economic Review, 84, 772-793.

Card, David and Alan Krueger. 2000. Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania: Reply. American Economic Review, 90, 1397-1420.

Carneiro, F.G. 2001. An overview of the effects of the minimum wage on the Brazilian labour market. Catholic University of Brasilia, Brasilia.

Corseuil, C.H., M. Foguel and M. Hecksher. 2013. Efeitos dos pisos salariais estaduais sobre o mercado do trabalho: Uma nova abordagem empírica. Ipea Textos para Discussão, No. 1887.

Cruces, G., G. Fields, D. Jaume and M. Viollaz. 2015. The growth-employment-poverty nexus in latin america in the 2000s: Brazil country study, Technical report, WIDER Working Paper 2015-71.

Dix-Carneiro, Rafael and Brian Kovak. 2017. Margins of Labor Market Adjustment to Trade. NBER Working Paper 23595. Cambridge, MA.

Dube, Arindrajit, T. William Lester, and Michael Reich. 2010. "Minimum Wage Effects Across State Borders: Estimates Using Contiguous Counties." Review of Economics and Statistics.

Engbom, Niklas and Cristian Moser. 2017. Earnings Inequality and the Minimum Wage: Evidence from Brazil. Princeton University. Working Paper.

Fajnzylber, P. 2001. Minimum Wage Effects Throughout the Wage Distribution: Evidence from Brazil's Formal and Informal Sectors. Annais do XXIX Encontro Nacional de Economia.

Gindling, T. H. and Katherine Terrell. 2007a. The Effects of Multiple Minimum Wages throughout the Labor Market: the Case of Costa Rica. Labour Economics, 14(3): 485- 511.

Gindling, T. H. and Katherine Terrell. 2007b. Minimum Wages and the Welfare of Workers in Honduras. IZA DP No 2892.

Gramlich, E.M. 1976. Impact of minimum wages on other wages, employment and family incomes. Brookings Papers on Economic Activity, No. 2, pp. 409-451.

Haltiwanger, J., R. S. Jarmin, and J. Miranda. 2013. Who creates jobs? small versus large versus young. Review of Economics and Statistics 95(2), 347–361.

Heckman, James J., Carmen Pages. 2000. The Cost of Job Security Regulation: Evidence from Latin American Labor Markets. NBER Working Paper 7773. June 2000. Cambridge, MA.

Hopenhayn, Hugo. 1992. Entry, Exit and Firm Dynamics in Long Run Equilibrium. Econometrica. 60: 1127-1150.

Jales, Hugo. 2017. Estimating the Effects of Minimum Wage in a Developing Country: A Density Discontinuity Design Approach. Journal of Applied Econometrics, forthcoming.

Kaitz, H. 1970. Experience of the Past: The National Minimum, Youth Unemployment and Minimum Wages. US Bureau of Labor Statistics Bulletin, 1657, 30-54. Machin and Manning. 1994.

Kristensen, Nicolai and Wendy Cunningham. 2006. Do Minimum Wages in Latin America and the Caribbean Matter? Evidence from 19 Countries" World Bank Policy Research Working Paper 3870, March.

Lemos, Sara. 2006. Minimum Wage Effects in a Developing Country. University of Leicester. Working Paper No. 06/I.

Lemos, Sara. 2004. A Menu of Minimum Wage Variables for Evaluating Wages and Employment Effects: Evidence from Brazil. IZA Working Paper No. 1069.

Martinez, C.A., G.M. Morales and P.R. Valdes. 2001. Cambios estructurales en la demanda por trabajo en Chile. Economía Chilena, Vol. 4/2.

Miranda, J. 2013. "Labour demand stability and the minimum wage effect on employment: the Chilean evidence. MPRA Paper, No. 46637.

Moura, R. and M.C. Neri. 2008. Efetividade do salário mínimo estadual: Uma análise via regressões quantílicas para dados longitudinais. Economia Aplicada, Vol. 12/2, pp. 239-273.

Neumark, D., J.M.I. Salas and W. Wascher. 2017. Revisiting the minimum wage-employment debate: Throwing out the baby with the bathwater? Industrial and Labor Relations Review.

Neumark, D., W. Cunningham and L. Siga. 2006. The Distributional Effects of Minimum Wage in Brazil: 1996-2001. Journal of Development Economics.

Rocha, R, L. Racther and Gabriel Ulyssea. 2016. Do Lower Taxes Reduce Informallity? Working Paper.

Rohlin, Shawn M. 2011. State minimum wages and business location: Evidence from a re ned border approach." Journal of Urban Economics 69 (1):103-117.

Souza, P.R. de, and P. Baltar. 1979. Salário mínimo e taxa de salários no Brasil. Pesquisa e Planejamento Econômico, Vol. 10/3, pp. 629-660.

Stigler, George. 1946. The Economics of Minimum Wage Legislation. American Economic Review 36: 358- 365.

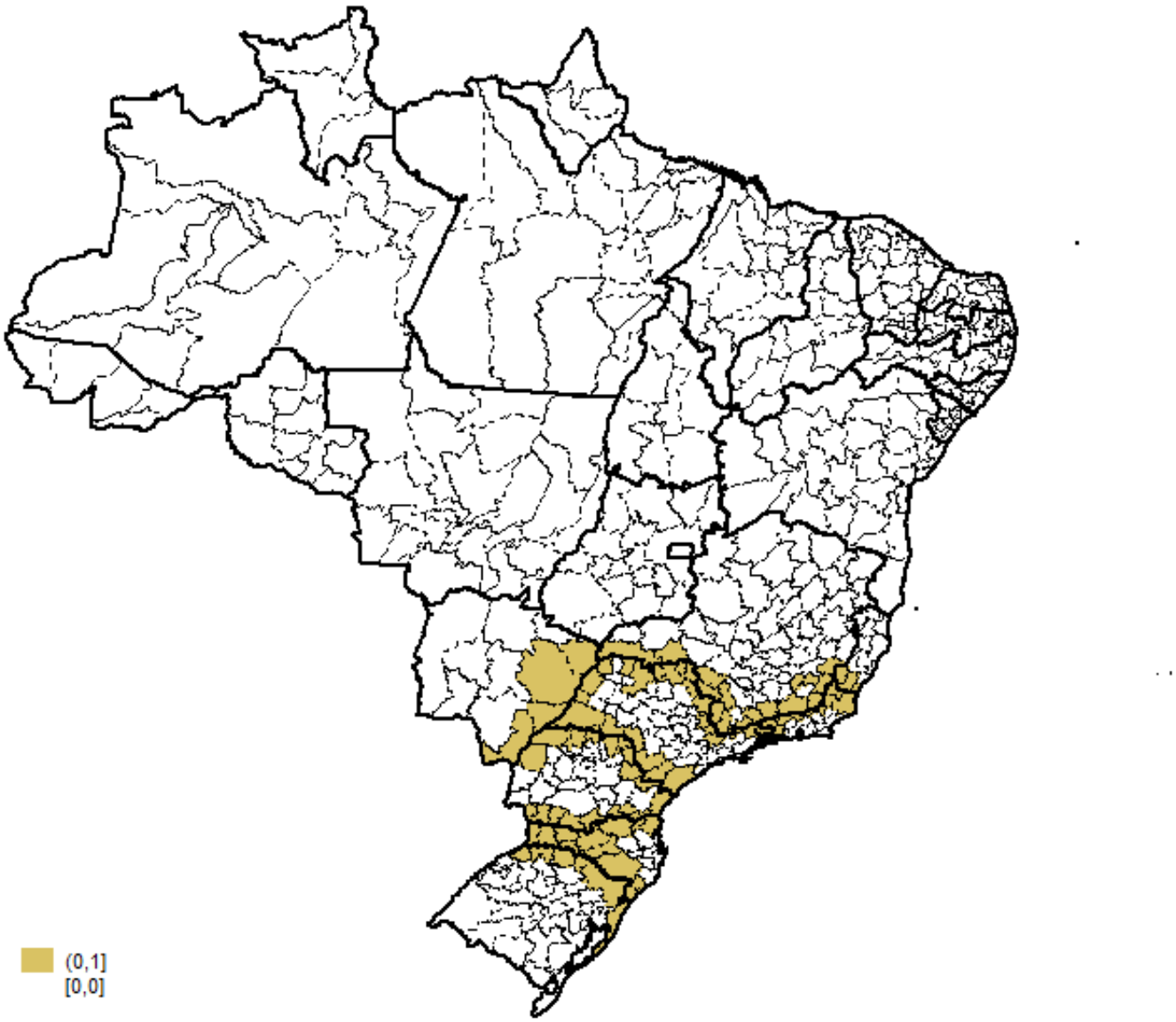
Tepedino, Pedro. 2013. O efeito dos Pisos Salariais sobre o Nível de Emprego no Brasil. Pontifica Universidade Catolica de Rio de Janeiro.

Terrell, Katherine. 2009. Minimum Wages, Enforcement and Informalization of the Labor Market: Evidence from Brazil. Working Paper.

Wedenoja, L. 2013. The employment and wage effects of minimum wages in a context of informality and non-compliance. Paper presented at the Meeting of the Society of Labor Economists in Arlington, Virginia, May 2-3 2014.

Welch, F. 1976. Minimum wage legislation in the United States. in O. Ashenfelter and J. Blum (eds.), Evaluating the Labour Market Effects of Social Programs, Princeton University Press, US.

Figure 1: Microregions Included in Cross-Border Sample



Note: Figure 1 presents a map of all microregions in Brazil. As discussed in the text, microregions are a combination of municipalities in the same state and are commonly used as definitions of local labor markets. The highlighted microregions represent the sample included in our cross-border microregion-pair empirical strategy.

Table 1: National Minimum Wage and State Wage Floors in the Food-Restaurant Sector

Year	Minimum Wage	Rio de Janeiro	Rio Grande do Sul	Sao Paulo	Santa Catarina	Parana
2003	240	275	312	240	240	240
2004	260	305	338	260	260	260
2005	300	326	374	300	300	300
2006	350	370	406	350	350	429
2007	380	424	430	415	380	464
2008	415	470	477	450	415	531
2009	465	512	511	505	465	610
2010	510	582	546	560	587	688
2011	545	640	610	600	630	736
2012	622	730	700	690	700	814

Note: Table 1 presents the evolution of the national minimum wage alongside the wage floor applicable to workers in the hotel and restaurant sectors for states which implemented a floor by 2012. For the years in which one of these five states had not yet implemented a wage floor, we national minimum wage to bind wages from below. The values presented in this table represent the annual average of the minimum wage and the wage floors over four quarters in each year. As discussed in the text, in the specific cases in which two different wage floors apply to workers in this industry, this table includes the lowest value. We note, however, the empirical results are not sensitive to this choice.

Table 2: Effects of Minimum Wage on State-Level Employment

	Baseline Specification			Linear Trend Specification		
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Kaitz Index	-0.217			-0.103		
	(0.186)			(0.106)		
Toughness Ratio		-0.094			-0.179	
		(0.246)			(0.121)	
Fraction Affected			-0.042			0.039
			(0.066)			(0.073)
Log(Population)	1.040	1.559	1.973	-1.135	-1.465	-1.118
	(1.125)	(1.613)	(0.700)**	(0.589)	(0.662)*	(0.454)*
Observations		1,040			1,040	
R^2	0.997	0.997	0.997	0.998	0.998	0.998

Standard errors in parentheses: * p $<$ 0.05, ** p $<$ 0.01, *** p $<$ 0.001

Note: Table 2 presents the estimated impacts of the national minimum wage on formal sector employment at the state level on a quarterly basis from 2003 through 2012. The results include 26 of the 27 states in Brazil. Both the minimum wage measures and the employment variables are defined as natural logarithm variables. Standard errors are robust and clustered at the state level.

Table 3: Effects of Minimum Wage on Firm Dynamics

	Entry Rate				Exit Rate			
	Baseline		Linear Trend		Baseline		Linear Trend	
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Kaitz Index	-0.027		0.094		0.006		-0.007	
	(0.033)		(0.090)		(0.011)		(0.026)	
Toughness Ratio		-0.026		0.076		0.000		-0.014
		(0.032)		(0.064)		(0.0120)		(0.0290)
Log(Population)	-0.343	-0.346	1.019	0.980	0.011	-0.015	-0.471	-0.505
	(0.178)	(0.189)	(0.624)	(0.538)	(0.054)	(0.067)	(0.149)**	(0.170)**
Observations	260				260			
R^2	0.728	0.728	0.797	0.797	0.903	0.903	0.924	0.924

Standard errors in parentheses: * p < 0.05, ** p < 0.01, *** p < 0.001

Note: Table 3 presents the estimated impacts of the national minimum wage on employment dynamics at the state level on an annual basis from 2003 through 2012. The results include 26 of 27 states in Brazil for which we have information on formal sector employment. Firm entry and firm exit rates are defined for each state s and year t as in the text. The minimum wage measures are defined as natural logarithm variables, whereas firm dynamics represent is defined as a percent of employment. Standard errors are robust and clustered at the state level.

Table 4: Effects of Minimum Wage on State-Level Employment of Affected Groups

	Hotel and Restaurant Employment				Low-Skilled Employment			
	Baseline		Linear Trend		Baseline		Linear Trend	
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Kaitz Index	-0.514		-0.108		-0.313		-0.095	
	(0.206)		(0.134)		(0.174)		(0.141)	
Toughness Ratio		-0.390		-0.053		-0.178		-0.078
		(0.235)		(0.132)		(0.206)		(0.150)
Log(Population)	0.020	0.466	-2.086	-1.857	1.834	2.385	-0.676	-0.607
	(0.989)	(1.289)	(0.716)**	(0.690)*	(0.824)*	(1.122)*	(0.793)	(0.917)
Observations	1,040				1,040			
R^2	0.997	0.997	0.997	0.997	0.996	0.996	0.996	0.996

Standard errors in parentheses: * p < 0.05, ** p < 0.01, *** p < 0.001

Note: Table 4 presents the estimated impacts of the national minimum wage on formal sector employment at the state level from 2003 through 2012. The first set of regressions measures total employment in the accommodation and restaurant sector, and the second group of regressions explores total employment of workers with less than a high school degree. The results include 26 of 27 states in Brazil. Both the minimum wage measures and the employment variables are defined as natural logarithm variables. Standard errors are robust and clustered at the state level.

Table 5: Effects of Minimum Wage on Microregion Employment by Commodity Exposure

	Baseline Specification		Linear Trend Specification	
Variable	(1)	(2)	(3)	(4)
Low Exposure × Kaitz	-0.416		-0.336	
	(0.120)**		(0.112)**	
High Exposure × Kaitz	-0.311		-0.097	
	(0.200)		(0.166)	
Low Exposure × Toughness		-0.435		-0.368
		(0.100)***		(0.089)***
High Exposure × Toughness		-0.261		-0.163
		(0.162)		(0.133)
Log(Population)	0.211	0.212	-0.046	-0.048
	(0.295)	(0.297)	(0.119)	(0.118)
Observations	21,560		21,560	
R^2	0.994	0.994	0.996	0.996

Standard errors in parentheses: * p < 0.05, ** p < 0.01, *** p < 0.001

Note: Table 5 presents the estimated impacts of the national minimum wage on formal sector employment at the microregion level on a quarterly basis from 2003 through 2012. The results include 539 of the 559 microregions in Brazil for which we have information on formal sector employment. Both the minimum wage measures and the employment variables are defined as natural logarithm variables. We define exposure to the commodity boom by the microregion's land area used actively in agriculture, as in Benguria, Saffie and Urzua (2017), and split the sample in half by lowly- and highly- exposed microregions. Standard errors are robust and clustered at the state level.

Table 6: Effects of Wage Floor on Employment in Accommodation and Restaurant Industry

	Microregion Estimates						Municipal Estimates	
	Cross-Border Pair		All States		Eight States		Cross-Border Pair	
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Observed Wage Floor	0.176		0.125		0.126		0.177	
	(0.126)		(0.175)		(0.152)		(0.131)	
Effective Wage Floor		0.219		0.155		0.177		0.219
		(0.162)		(0.213)		(0.159)		(0.272)
Log(Population)	0.787	0.787	-0.007	-0.001	0.571	0.566	-0.652	-0.658
	(0.480)	(0.480)	(0.856)	(0.848)	(0.351)	(0.342)	(1.034)	(1.035)
Observations	5,520		21,360		10,600		70,360	
R^2	0.996	0.996	0.982	0.982	0.993	0.993	0.963	0.963

Standard errors in parentheses: * p < 0.05, ** p < 0.01, *** p < 0.001

Note: Table 6 presents the estimated impacts of the state-level wage floors on employment in the accommodation and restaurant industry on a quarterly basis from 2003 through 2012. The columns presented in the first two columns follow the cross-border microrergion-pair empirical strategy. These results include 89 different microregions which belong to 69 different pairs, resulting in a full sample with 5,520 observations. The second set of results includes 539 of the 559 microregions in Brazil for which we have information on formal sector employment. Columns (5) and (6) include 265 microregions in the eight states which have either implemented wage floors or border a state which has. The final two columns re-estimate the cross-border microregion-pair approach at the municipal level, expanding our sample to include 70,360 observations. Both the minimum wage measures and the employment variables are defined as natural logarithm variables. Standard errors are robust and clustered at the state and border-pair level.