Labor Market Effects of the Venezuelan Refugee Crisis in Brazil*

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Abstract

We use administrative panel data on the universe of Brazilian formal sector workers to investigate the labor market effects of the Venezuelan refugee crisis, focusing on Roraima state, which experienced a sharp, localized refugee inflow. Using difference-in-differences, we compare outcomes for Roraima workers to those from similar northern states without refugee arrivals. We find that hourly wages of Brazilians in Roraima increased by approximately 2% with no overall evidence of employer-initiated job separations. Wage gains were more pronounced in sector-occupation pairs with limited refugee presence and non-tradable sectors, consistent with demand-driven mechanisms. We also find suggestive evidence of labor complementarities.

Keywords: Refugees, immigration, labor markets, Brazil, Venezuela, wages

JEL Codes: F22, J15, J24, J31, J40, J61

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1 Introduction

In recent years, forced displacement has become a pressing global challenge, with implications for labor markets, social protection systems, and local economic development. As of 2023, more than 110 million people have been forcibly displaced worldwide, including over 36 million classified as refugees who have fled conflict, persecution, or economic collapse in their home countries (UNHCR, 2023). While these flows are often discussed through a humanitarian lens, they also constitute large, unexpected shocks to local labor markets, particularly in regions with limited fiscal and administrative capacity. Understanding how refugee arrivals shape labor market outcomes is therefore critical for both academic and policy debates, especially as many receiving countries face their own economic constraints and political sensitivities.

The Venezuelan humanitarian crisis is one of the largest displacement events in recent history. Following a sharp decline in oil revenues and years of government mismanagement, Venezuela experienced a prolonged economic and institutional collapse that led more than seven million people to flee the country (UNHCR, 2023). By 2018, Brazil received approximately 50,000 refugee applications, nearly all concentrated in Roraima, a remote border state in the Amazon region. The magnitude of the inflow was striking; refugees accounted for roughly 8% of Roraima's population, placing immediate strain on public services and administrative systems (Reuters, 2018). This setting offers a rare opportunity to study how refugee arrivals affect labor markets in low-capacity environments, contexts that host much of the world's displaced population but are often overlooked in empirical research.

This paper examines how large-scale refugee inflows affect labor market outcomes in regions with limited absorptive capacity. We study a natural experiment in northern Brazil, where the border state of Roraima experienced a sudden and concentrated influx of Venezuelan refugees during the 2010s. Its geographic isolation from the rest of the country and the externally determined nature of the inflow, shaped by international borders rather than local labor conditions, make it a compelling setting for causal analysis. Our empirical approach relies on a difference-in-differences design that compares changes in formal sector outcomes in

Roraima to those in neighboring states with similar geographic and economic characteristics but without incidence of refugee arrivals.

Our analysis is based on linked employer-employee data from *Relação Anual de Informações Sociais*[1] (RAIS), which captures the universe of formal sector employment relationships in Brazil. RAIS allows us to track individual workers and firms, distinguish Brazilian nationals from refugees, and observe detailed information on occupation, sector, tenure, and wages.[2] This level of granularity is rare in low- and middle-income countries, particularly in border regions, and allows us to overcome many of the measurement limitations that have constrained prior research on refugee impacts in developing country contexts.

The identifying assumption is that, absent the refugee inflow, trends in the treatment and control groups would have evolved similarly, an assumption we assess using event study estimates. To strengthen causal inference, we employ a doubly robust estimation strategy that weights fixed effects regressions with inverse propensity scores, allowing for more credible comparisons and reducing sensitivity to selection on observables.

We find that the Venezuelan refugee crisis led to a statistically significant increase in wages for Brazilian formal sector workers in Roraima. Our preferred specification indicates a wage gain of approximately 2%. Event study estimates support the validity of the parallel trends assumption and reveal that wage gains grew progressively over time, coinciding with the rising presence of Venezuelan refugees in Roraima.

We explore several potential mechanisms to better understand the drivers of these wage gains. The positive effects were strongest for formal workers in occupation-sector pairs with limited overlap with Venezuelan entrants, as well as for those with more than a high school education. In contrast, workers in sectors with higher exposure to refugee inflows experienced smaller, though still positive, wage changes, suggesting some degree of labor market competition. The largest gains were concentrated in non-tradable sectors, consistent

[1]Roughly translated to Annual Report of Social Information.

[2]Tenure is the number of years under current employer.

with a demand-side mechanism. Increased local consumption from the refugee population likely raised labor demand in these sectors, generating broader wage improvements for native workers.

We find a small but statistically significant effect on the probability of holding a managerial position among natives, implying potential complementarities. Moreover, there is no evidence of increased job separations among Brazilian workers, suggesting that the selective retention of higher-wage workers or job separation for lower-wage workers did not drive the observed wage gains.[3] We find that new entrants to the formal labor market also experienced wage gains, indicating that the benefits extended beyond incumbents. Overall, these patterns reflect improvements in formal labor market outcomes, consistent with a demand-driven channel linked to refugee-induced increases in local consumption and the subsequent increase in labor demand.

The labor market effects of refugee inflows in the broader literature are empirically ambiguous.[4] Refugees may increase competition for jobs, particularly in low-skilled segments of the labor market (Borjas, et al., 1997); however, they may fill labor shortages, specialize in complementary tasks, or stimulate local demand through increased consumption Peri (2016). This mixed evidence is often attributed to data limitations and a failure to account for heterogeneity in labor supply elasticities across regions and sectors (Dustmann, Schönberg, and Stuhler, 2016). As a result, disentangling heterogeneous effects of refugee inflows on native employment and wages remains an open area of investigation.

Our findings suggest that the overall increase in labor demand, largely driven by the consumption of refugees who are not immediately integrated into the formal labor market, offsets more localized adverse effects stemming from labor substitution. While we document some evidence of adverse impacts across sectors and demographic groups, the aggregate effects

[3]We define job separation as a situation in which the employer initiates the termination of an employee's contract with the company. This definition excludes voluntary departures by the employee and includes discharges, with or without a justifiable cause, so long as the separation is involuntary from the employee's perspective.

[4]For instance, see the Mariel Boat Lift literature (Card, 1990; Borjas, 2003; Clemens and Hunt, 2019).

point toward a net positive or neutral outcome. These results align with papers reporting positive or no adverse effects on native wages or employment (Hunt, 1992; Friedberg, 2001; Tabellini, 2020).

Less is known about the labor market effects of refugee inflows in developing countries, which host the majority of the world's refugees but often operate with weaker institutions and limited absorption capacity. The empirical evidence from these contexts yields mixed results. Some studies document negative effects on native employment or wages (Maystadt and Verwimp, 2014; Tumen, 2016), while others report neutral or positive outcomes when refugees complement native labor or stimulate local demand (Calderón-Mejía and Ibáñez, 2016; Ruiz and Vargas-Silva, 2016; Taylor, et al., 2016; Alix-Garcia, et al., 2018; Maystadt and Duranton, 2019; Fallah, Krafft, and Wahba, 2019).

Studies on the Venezuelan refugee crisis have focused on Colombia and Peru, reporting mixed effects on native employment and wages (Morales and Pierola, 2020; Caruso, Canon, and Mueller, 2021; Bahar, Ibáñez, and Rozo, 2021; Delgado-Prieto, 2021; Lebow, 2022; Groeger, León-Ciliotta, and Stillman, 2024; Lombardo, et al., 2025). To the best of our knowledge, The study by Ryu and Paudel (2022) is the only one addressing the labor market effects of the Venezuelan crisis in Brazil, using household survey data and a synthetic control approach to evaluate the Venezuelan refugee crisis in Roraima. The study finds declines in labor force participation and employment but no effect on wages. However, their data, *Pesquisa Nacional por Amostra de Domicílios Contínua* (PNAD-C), do not distinguish between Brazilians and Venezuelans, likely biasing estimates toward zero. Moreover, the underlying survey has limited representativeness in less populous regions like Roraima, where the sample is small and concentrated in the state capital.

Our paper contributes to the literature on refugee impacts and labor markets in developing countries in several key ways. First, we provide the first rigorous microdata-based analysis of refugee inflows in Brazil, a major host country that remains largely absent from the empirical literature. Unlike prior work focused on urban settings in higher-income countries, Brazil's

experience with the Venezuelan refugee crisis was concentrated in Roraima, a remote and low-capacity border region where the scale of arrivals far exceeded local institutional capacity.

Second, we use comprehensive administrative panel data covering the universe of formal sector workers in Brazil. These data allow us to track individual wage trajectories, distinguish between natives and refugees, and explore heterogeneous effects with precision, which improve on household surveys that conflate natives and refugees and lack representativeness in frontier regions, including our study states.

Third, we document meaningful heterogeneity in the effects of refugee inflows across sectors and worker characteristics. Wage gains were concentrated among more educated workers and in occupation-sector pairs with limited overlap with refugees, consistent with complementarities and low substitution risk. At the same time, the largest gains occurred in non-tradable sectors, where employment is closely tied to local demand. This pattern suggests that refugee-induced consumption likely increased labor demand in locally oriented industries, amplifying the positive wage effects for certain groups of native workers. These findings help fill a critical gap in the literature and challenge the assumption that refugee arrivals necessarily harm native workers, particularly in fragile regions where both risks and channels of adjustment may differ from those in more developed settings.

We organize the remainder of the paper as follows. Section 2 provides the background. Section 3 describes the data. Section 4 discusses our empirical methodology. Section 5 presents the results. Section 6 concludes.

2 Background

2.1 The Venezuelan Refugee Crisis

Until the early 2000s, Venezuela had one of the highest GDP per capita in Latin America, which was closely tied to oil exports (EIA, 2019; Haider, 2020). However, the drop in oil prices in the early 2010s severely impacted the Venezuelan economy. Coupled with prolonged

government mismanagement, this led to an unprecedented humanitarian crisis marked by hyperinflation, widespread shortages of food and medicine, and rising crime. Although Venezuelans began emigrating as early as 2011, the exodus accelerated dramatically from the second half of the 2010s. The United Nations High Commissioner for Refugees (UNHCR) estimated that by 2022, more than four million Venezuelans were living as refugees, primarily in neighboring South American countries. By the end of 2021, Brazil hosted approximately 260,000 Venezuelan refugees.

In 2019, the International Organization for Migration (IOM) and the Migration Policy Institute (MPI) surveyed thousands of Venezuelan refugees in 11 Latin American and Caribbean countries (Echeverría-Estrada, 2020). Among those in Brazil, nearly 60% were women, 55% were between 25 and 45 years old, and 60% had completed secondary education. Important to our geographical setting, all respondents had entered Brazil by land through Roraima. Prior to migration, 65% were employed, of whom 32% self-employed, while 26% were non-employed non-students and 5% were students. After arrival, 40% were employed in 2019 (29% self-employed), 5% were students, and 55% were non-employed non-students, a group that includes both the unemployed and those out of the labor force.

2.2 Geographic Context

Geography plays a central role in explaining Venezuelan migration patterns to Brazil and, as we will later explain, forms the basis of our identification strategy. Figure 1 displays a map of Brazil and Venezuela. The Amazon Rainforest covers the entire northern region of Brazil, making most of the Venezuela-Brazil border nearly impassable. The only viable land route is the BR-174 highway, which runs from the Venezuelan border through the state of Roraima. This route became the main corridor for overland migration.[5] According to the Brazilian Federal Police, more than 50,000 Venezuelans entered and remained in Roraima in

[5]This is supported by survey data from the International Organization for Migration (Echeverría-Estrada, 2020).

2017 alone, representing about 8% of the state's population.[6,7]

The BR-174 passes through Boa Vista, the capital of Roraima, which quickly became the main destination for arriving refugees. While all 15 municipalities in Roraima[8] experienced some level of refugee exposure, Boa Vista received the overwhelming majority of Venezuelans. Once in Roraima, Venezuelans could travel only as far as northern Amazonas by land. Beyond that point, the remaining roads are mostly unpaved, and reaching the southern states requires crossing thousands of miles through the Amazon. This isolation meant the effects of the refugee inflow were highly localized within Roraima.

The influx quickly overwhelmed the state's limited infrastructure, especially in health, education, and social services (Oliveira, 2019). In response, the federal government suspended Roraima's administrative autonomy in December 2018 and temporarily took over governance of the state. Despite the challenges, the federal government adopted a relatively generous response. It established nine shelters, eight of them in Boa Vista, and issued temporary work permits that allowed Venezuelans to seek formal employment for up to two years (Ramsey and Sánchez-Garzoli, 2018; Ryu and Paudel, 2022). The government also tried to relocate refugees to other states like Rio de Janeiro and São Paulo, although this strategy had limited impact during our study period. To avoid potential confounding from these efforts, we restrict our analysis to the period before the federal takeover in 2018.

Roraima's geographic isolation provides a natural experiment. The state was exposed to a large refugee inflow, while other demographically and economically similar states in

[6]Those who could afford air travel typically flew to cities like Rio de Janeiro and São Paulo. However, these migrants represented a small, more economically advantaged subgroup of the broader refugee population. The vast majority of Venezuelans fleeing the crisis lacked the financial resources for air travel and instead crossed the border overland through Roraima (Lopes, 2018).

[7]The Brazilian Institute of Geography and Statistics (IBGE) reports for 2015 populations of approximately 506 thousand in Roraima, 804 thousand in Acre, and 751 thousand in Amapá.

[8]Municipalities are Brazil's smallest administrative units, roughly analogous to counties in the United States. The country has 5,571 municipalities in total. In our study region, the state of Roraima contains 15 municipalities, while the control states of Acre and Amapá contain 16 and 22, respectively. Figure B.1 displays the municipalities of Roraima, along with the relative intensity of Venezuelan refugee presence in the formal market across them. Figure B.2 presents the municipal divisions of Acre and Amapá, which serve as control states in our empirical design. Each figure also highlights the major federal highways that connect these border states to neighboring countries.

the region were not. We focus on two such comparison states in Brazil's northern region: Acre and Amapá. All three states are sparsely populated, with most residents living in small urban centers. Each capital is connected to a neighboring country by a single road. Acre is connected to Bolivia, and Amapá borders French Guiana. Importantly, Amapá has no inland road connection to the rest of Brazil; it can only be reached by plane or by boat through the Amazon Basin system.

Although previous studies such as Borjas, et al. (1997) and Borjas (2006) warn against relying solely on geographic variation to identify immigration effects due to potential spillovers, our unique geographic setting reduces such concerns. The remoteness and poor transportation infrastructure in Brazil's northern region create high mobility costs that limit both migration between states and movement within them. As a result, labor market in Roraima remained isolated during the refugee influx, strengthening the validity of our identification strategy.

3 Data

3.1 Administrative Data

Our primary data source is *Relação Anual de Informações Sociais*[9] (RAIS) administered by the Brazilian Ministry of Labor and Employment. RAIS provides near-universal coverage of Brazil's formal labor market, offering rich panel data on individual workers and their establishments, including information on employment status, occupation, industry,[10] and contractual monthly wages.[11]

We restrict our sample to the years 2007 through 2018 to capture a sufficiently long pre-

[9]Roughly translated to Annual Report of Social Information.

[10]Throughout this paper, "economic sector," refers to the type of business in which a firm operates (*e.g.*, retail, construction, or restaurants). "Occupation" refers to the specific role held by the worker within that sector, such as janitor, accountant, or waiter.

[11]Our analysis excludes public sector employees, as their wage structures are typically governed by separate institutional mechanisms and are less responsive to local labor market conditions. We also excluded workers with temporary contracts.

and post-treatment periods. We define the start of treatment as 2014, based on observed migration patterns in Figures 2a and 2b, which show a noticeable rise in foreign inflows to Roraima beginning that year, despite the sharpest increase occurring only around 2016. This conservative timing choice helps ensure that pre-trends are well identified; if anything, it should bias our estimates toward zero by attenuating the estimated treatment intensity in the early post-period.

Each individual in RAIS is uniquely identified through the PIS (Social Integration Program) number, the Brazilian equivalent of a Social Security Number. This identifier enables us to construct worker-level panels and track individuals over time across jobs and regions. In addition, companies are identified with their national firm identifiers (CNPJ). The raw dataset is comprised of contracts generated between the employee and the firm in a given year. Therefore, individuals may have multiple contracts in a single year. Following Lavetti and Schmutte (2023), we keep the oldest job of that person for a given year, and keep the highest payment as a tie-breaker if an individual has more than one job in the given year. Our primary outcome variable is the log of the worker's hourly wage, constructed by dividing the contractual monthly salary by the total number of contractual hours worked in that month. All monetary values, unless stated otherwise, are expressed in constant 2010 Brazilian Reais.

We draw on a rich set of sociodemographic characteristics available in RAIS. Sex, age, and job tenure are directly observed. Educational attainment is captured through dummy variables that indicate whether a worker has less than a high school education, a high school diploma, or a college degree or higher. Occupational and industry classifications follow the standards of the Brazilian Institute of Geography and Statistics (IBGE). Occupation is represented by a vector of dummy variables based on the first three digits of the Brazilian Occupation Code (CBO), while industry is defined analogously using the first two digits of the National Economic Activity Code (CNAE).

A key geographic variable in our analysis is the municipality code, which is reported in RAIS according to the standards of IBGE. In less densely populated states, particularly

those in the northern border region, such as Roraima, there is considerable heterogeneity in population size across municipalities. This variation is especially relevant in our setting, as Venezuelan refugees are disproportionately concentrated in the capital municipality of Boa Vista. As a result, treatment exposure may vary substantially within the state, and our empirical strategy, as we will explain in the next section, accounts for this spatial heterogeneity by using municipality fixed effects and clustering standard errors at the municipality level.

3.2 Summary Statistics of Roraima and Control States

Table 1 uses the RAIS data to summarize key socioeconomic and demographic characteristics of Brazilian individuals in the formal sector in the treated state of Roraima and the control states of Amapá and Acre in 2007-13, the period preceding the influx of Venezuelan refugees. Average log hourly wages were similar across groups, 1.55 in Roraima and 1.57 in the control states, corresponding to monthly earnings of approximately 818.76 and 834.51 Brazilian Reais (2010 value), respectively, for a standard 40-hour workweek. For comparison, Brazil's statutory monthly minimum wage in 2013 was 678.00 2010 BRLs. Section C.1 further discusses wage trends between the treatment and control states.

The demographic profiles of the two groups are broadly comparable. The average formal sector worker in Roraima is 31 years old, while in the control states the average is 32. Educational attainment is slightly higher in Roraima: 11% of workers hold a college degree, 60 have completed high school, and 28.9% have not completed high school. Male workers represent 57% of the labor force in Roraima, compared to nearly 66% in the control states.

Panel B presents the five most common formal sector occupations in Roraima and their corresponding shares in the control states. The occupational structure is similar across regions, with retail sales occupations, such as cashiers and shop assistants, dominating both groups, followed by building maintenance workers, administrative assistants, food service workers, and workers in construction-related roles.

Panel C highlights the top five sectors in the formal labor market. Retail trade is the most

common sector for formal employment in both Roraima and the control states, accounting for nearly 30 percent of formal workers in 2007-2013. Other leading sectors include construction, education, building services, and wholesale trade. The similarity in occupational and sectoral distributions supports our identifying assumption that, had the control states been exposed to the same refugee inflow, migrants would likely have been absorbed into comparable jobs and industries.

3.3 Immigrants in RAIS

A key premise of our analysis is that the concentration of refugees in Roraima was driven by the state's geographic isolation and the high transportation costs that made onward travel to other regions prohibitively expensive for most migrants. In RAIS, employers are required to report workers' nationality, which allows us to identify where Venezuelans who entered the formal sector are located. Figure 2a displays the annual share of Venezuelans in the formal labor market, grouped by treatment and control states. In 2017, Venezuelans made up about 2% of Roraima's formal labor force, a figure that rose to approximately 5% in 2018. In contrast, no Venezuelan workers were observed in the control states of Amapá or Acre. In Section C.2, we compare the demographic and economic characteristics of Venezuelans and Brazilians in 2018.

It would be problematic for our setting if any other nationality in addition to Venezuelans had a substantial growth in population, either in Roraima or the control states. It would undermine our assumption that foreign population growth in the region is solely due to the Venezuelan crisis. We construct Figure 2b by aggregating data on all immigrant nationalities other than Venezuelans and plotting their proportion in the formal labor market for treatment and control states. As the figure shows, there is negligible growth in the control states and no significant growth in Roraima following 2014. We attribute this less than 1% growth in Roraima to Venezuelans who may have dual citizenship or foreigners, such as Colombians, that also left Venezuela and went to Roraima. Nevertheless, these non-zero values should not

pose a threat to our identification strategy.

A key limitation of our data is that RAIS captures only formal sector employment, excluding informal work and non-employment, both of which are common among recent migrants. As a result, the data cannot rule out the possibility that some Venezuelans settled in control states but worked informally, making them invisible in RAIS. To address this concern, in Appendix D we examine refugee application data, which show that only Roraima experienced a large and sustained increase in applications over the study period. While these data cannot fully eliminate the possibility that some Venezuelans entered informal jobs elsewhere, they indicate that the overwhelming inflow was concentrated in Roraima and largely absent from the control states. This helps reassure us that our control states were not meaningfully exposed to the refugee inflow, so any differences we observe are unlikely to be driven by hidden informal-sector settlement outside Roraima.

4 Empirical Strategy

4.1 Main Specification

To quantify the labor market effects of the Venezuelan refugee influx, we estimate the following difference-in-diferences (DID) specification comparing labor market changes in Roraima with contemporaneous changes in comparable states unaffected by significant refugee inflows:

$$y_{imst} = \beta(RR_s \times Post_t) + x'_{it}\alpha + r'_{mt}\lambda + \theta_i + \mu_m + \alpha_t + \varepsilon_{imst} \tag{1}$$

where the dependent variable y_{imst} denotes the log hourly wage of individual i, working in municipality m from state s at time t. Our primary coefficient of interest is β, which captures the causal effect of exposure to Venezuelan immigration following the onset of the crisis after 2013. The treatment is represented by the interaction term $RR_s \times Post_t$, where RR_s equals 1 if the individual is located in Roraima, and $Post_t$ equals 1 for years after the baseline year

of 2013. The coefficient β thus measures the wage impact of the immigration shock specific to Roraima in the post-crisis period.

Vector x_{it} includes individual-level time-varying covariates such as age, age squared, and tenure. Individual fixed effects θ_i absorb all time-invariant worker characteristics, including unobserved ability and background. Municipality fixed effects μ_m control for geographic-specific wage differences and help account for internal migration.[12] Year fixed effects α_t account for common macroeconomic shocks.

We include a municipality level shift-share-style variable, r_{mt}, usually referred to as 'Bartik-style control', to account for changes in local economic conditions and labor demand shocks potentially influencing the wages. We explain the creation of this variable in Appendix E. As the sample period spans the 2014 Brazilian economic crisis (mid-2014 to late-2016), the control helps to isolate the effects of the local economic shocks arising from the economic crisis. Finally, the term ε_{imst} represents idiosyncratic events uncorrelated with observables specified in our model. We cluster standard errors at the municipality level, which accounts for potential serial correlation and unobserved shocks within municipalities over time. This also provides a conservative adjustment given the heterogeneity of immigration patterns and labor market responses across municipalities within the state of Roraima.[13]

Despite the geographic isolation and similarities across regions, we address potential selection on observables by weighting all regression specifications using inverse propensity scores (IPW). These scores are estimated via a logistic regression that models the probability of being in the treatment group as a function of observed covariates. Additional details on the propensity score specification are provided in Appendix F.

[12]If there were no inter-municipality movements of workers, individual fixed effects alone would absorb all time-invariant location-specific differences. However, our data show that during the sample period, 5% of workers moved between municipalities within the same state, while only 0.06% moved across the three study states. Within-state inter-municipality movement was 2.4% in Roraima, 5.2% in Acre, and 6.8% in Amapá. Therefore, we include municipality fixed effects alongside individual fixed effects to control for time-invariant characteristics at the municipality level.

[13]Figure B.1 shows that the concentration of refugees in the formal labor market across Roraima's municipalities is highly heterogeneous. For instance, in 2018, over 20% of the border municipality of Pacaraima' formal labor market consisted of Venezuelan refugees.

Our identification strategy exploits the sharp and exogenous influx of Venezuelan refugees into Roraima beginning in 2014. This influx was driven by the escalating humanitarian crisis in Venezuela and by the geographic constraint that made Roraima the main feasible entry point by land. This setup allows us to compare post-influx labor market outcomes in Roraima with those in similar northern states, Amapá and Acre, that did not receive refugee inflows. The key identifying assumption is that, in the absence of the crisis, trends in wages and employment would have followed similar paths across these states. We assess this assumption using event study estimates.

4.2 Event Study Specification

To capture potential heterogeneity in treatment effects over time, driven by differences in the intensity of the immigration shock, we estimate an event study specification that allows treatment effects to vary dynamically across periods.

$$y_{imst} = \sum_{\substack{t=2007 \\ t\neq 2013}}^{2018} \beta_t (RR_s \times Year_t) + x'_{it}\alpha + r'_{mt}\lambda + \theta_i + \mu_m + \alpha_t + \varepsilon_{imst} \tag{2}$$

where while all other variables are the same as Equation (1), in this case β_t measures the exogenous variation in wages for year t compared to the baseline year of 2013.

Ideally, the estimated effects prior to the immigration shock should be statistically indistinguishable from zero, indicating the absence of pre-trends. In contrast, post-shock periods should exhibit significant deviations. Hence, the event study serves two key purposes: first, to validate the parallel trends assumption underlying our identification strategy; and second, to illustrate how wage effects evolve dynamically in response to the influx of immigrants. Event study regressions are also weighted by the IPW estimations.

4.3 Heterogeneity

We examine heterogeneity in the effects of refugee influx on our outcome variable along several dimensions by estimating Equation (3), where Z_i introduces the source of heterogeneity. Specifically, we explore variation by sectoral and occupational exposure to Venezuelan workers, education level, and whether a worker is employed in a representative sector classified as regionally or nationally tradable or non-tradable.

$$y_{imst} = \beta_1 RR_s + \beta_2 Z_i + \beta_3 (RR_s \times Z_i) + x'_{imt}\alpha + r'_{mt}\lambda + \theta_i + \mu_m + \alpha_t + \varepsilon_{imst} \tag{3}$$

In Equation (3), coefficient β_1 captures the effect of the refugee influx on the outcome variable for the reference group of Z_i (the omitted category). Coefficient β_2 reflects the average difference in outcomes between group Z_i and the reference group, independent of treatment or time. Our main parameter of interest, β_3, measures how the effect of the refugee influx on formal wages differs for individuals in group Z_i relative to the reference group.

5 Results

5.1 Average Wage Effects

To analyze the effects of the Venezuelan refugee crisis in Roraima, we estimate Equation (1) exploiting within-worker variation in logarithmic hourly wages in Roraima following the start of the refugee crisis, relative to individuals in control states. Table 2, Panel A, reports our coefficient of interest, β, which captures the impact of the refugee crisis on wages in the formal labor market. Across columns (1) to (4), we sequentially introduce worker and year fixed effects, individual-level controls, municipality fixed effects, and the shift-share-style control of local labor demand shocks associated with the Brazilian recession. The results suggest that, on average, Roraima experienced a modest wage increase following the refugee influx. Our preferred specification, shown in column (4), which includes the entire set of

controls and fixed effects, indicates that the refugee crisis led to a 2% increase in wages for Brazilian formal market workers in Roraima.

These results rely on the assumption that, in the absence of treatment, the average log hourly wages for the treated group would have moved in the same direction as the average outcome for the control group. In other words, prior to the refugee crisis, wages in Roraima and in the control states should have been trending similarly, and any divergence between them after the crisis can be interpreted as the effect of the crisis rather than other factors. To assess this, we estimate the event study regression illustrated in Equation (2) using 2013 as the baseline year for comparison. If the parallel trends assumption holds, then the coefficients for years 2007-12 should be statistically indistinguishable from zero.

Figure 3 shows the event studies for the formal market using our preferred specification. Across all event study regressions, the pre-treatment coefficients are small in magnitude and statistically insignificant, which provides support for the parallel trends assumption. Although the pre-treatment year coefficients are slightly negative in direction, they are not statistically different from zero.

The event studies also reveal dynamic effects of the refugee crisis. In the few years immediately following the start of the crisis (e.g., 2014, 2015, and 2016), the differences in wages in the formal labor market between the treatment and control groups begin to increase, although they remain statistically insignificant. However, the magnitude of the wage differences increases progressively over time, with notable divergence observed by 2017 and 2018. By 2018, the estimated coefficient reaches around 5% and is statistically significant at the 1% level.

This trend coincides with the gradual increase in both the number and share of Venezuelans participating in Roraima's formal labor market, as shown in Figure 2a.[14] The share rises from nearly 0% immediately following the start of the crisis in 2014 to approximately 5% of

[14]Figure B.3 shows event study results for four specifications, where we incrementally add fixed effects, covariates, and shift-share control to account for local labor demand shocks.

the entire formal labor market in Roraima by 2018. The trend also aligns with the number of refugee status requests filed in Roraima each year, as shown in Figure D.1. The number of refugee requests was close to zero in 2015 and did not rise sharply until 2018. By 2018, the number of refugee status requests had reached almost 30,000. The dynamic patterns we observe, specifically the larger wage increases coinciding with greater refugee presence, are consistent with the interpretation that the refugee influx contributed to rising wages for Brazilian workers in Roraima.

Because our fixed effects models include only workers observed in both the pre- and post-periods, they exclude individuals who entered the formal labor market after the refugee crisis began. To assess whether these new entrants experienced similar wage dynamics, we estimate separate models for new formal labor market entrants, as described in Appendix G. We find a 2.5% wage increase among new entrants in Roraima relative to control states, suggesting that wage gains were not limited to incumbents.

Our findings contrast with those of Ryu and Paudel (2022), who use cross-sectional PNAD-C data to examine the Venezuelan refugee crisis and find a decline in labor force participation in Roraima but no significant effect on wages. As we discussed above, a key limitation of their approach is that the PNAD-C does not allow researchers to distinguish between Brazilian workers and recently arrived Venezuelan refugees. As a result, their estimates may conflate the outcomes of refugees, who were more likely to be unemployed or in low-wage, transitory jobs, with those of native workers. This may lead to overstated participation declines and understated wage effects. In contrast, we use the universe of formal-sector workers from linked administrative records and are able to distinguish Brazilian and non-Brazilian individuals. This allows us to isolate the labor market effects on Brazilian workers specifically, showing modest but statistically significant wage gains.

5.2 Heterogeneity by Sector-Occupation and Education

We now examine heterogeneity in the wage effects along two dimensions by estimating equation (3), where Z_i introduces the dimension of heterogeneity. Specifically, we explore heterogeneity by sectoral and occupational exposure to Venezuelan workers, and by education. Sector-occupation exposure helps identify segments of the formal labor market that are most likely to experience direct competition with refugee workers, and whether wages respond differently in those segments. Similarly, education-level differences may reflect underlying complementarities or substitutability in skills between native and refugee workers.

First, we examine wage heterogeneity across sectors and occupations with higher shares of Venezuelan workers in the formal labor market. Using 2018 data, the final year in our sample and the year with the highest number of Venezuelans observed, we identify the five sectors and five occupations with the largest shares of Venezuelan workers. We then interact the sectors and occupations to identify what we call the 'high-exposure sector-occupation pair.'

In equation (3), β_1 captures the difference in the outcome variable (log hourly wagess) between Roraima and the control states in post-treatment years for sector-occupation pairs that are *not* highly exposed to Venezuelan workers. The coefficient β_2 estimates the effect of being in a high-exposure sector-occupation pair across all states all years, regardless of treatment. Our primary coefficient of interest, β_3, measures the additional effect on formal market wages for individuals in Roraima, post-treatment, who are employed in high-exposure sector-occupation pairs.

Similarly, for the education-level heterogeneity analysis, Z_i are two dummy variables indicating whether the individual has a high school education and a college education respectively, where the comparison group is individuals without a high school degree. As shown in Table C.1, approximately 75.2% of Venezuelan workers entering the formal labor market had completed high school but had not attended college, making this the modal education group among Venezuelan immigrants. We are interested in seeing whether wages for this group were differentially affected by the crisis.

Panels B and C of Table 2 present the results of the heterogeneity analysis. Panel C reports the effects by sector-occupation exposure, while Panel C reports the effects by education level. Our preferred specification, shown in column (4) of Panel B, indicates that following the refugee crisis, Roraima workers employed in sector-occupation pairs *not* exposed to Venezuelan workers experienced a 2.4% increase in formal wages (β_1), which is statistically significant at the 1% level. However, compared to these sector-occupation pairs, those exposed to Venezuelan workers experienced a slightly smaller wage increase, by 1.7 percentage points, although the effect remained positive in direction (β_3).

Another notable observation is that sector-occupation pairs that experienced a greater influx of Venezuelan workers tended to have lower formal wages. On average, these sector-occupation pairs had wages approximately 5.2% lower than those that did not experience a Venezuelan influx (β_2).

Panel C presents the heterogeneous effects by education level. Our preferred specification, shown in column (4), indicates that Roraima workers with less than a high school education experienced a 1.6% increase in wages following the refugee crisis (β_1). Compared to this group of workers, those with a high school degree did not have a statistically significant difference in wage effects (β_3). It is interesting to note that pre-crisis wage differences between workers with and without a high school education (β_2) were not statistically distinguishable from zero. Following the refugee crisis, those with a college degree or higher experienced a 7.5% differential increase in formal wages compared to our base group. These patterns indicate that Venezuelans, a majority of whom have a high school degree, may have been relatively closer substitutes for low-education native workers in the labor market, which may explain why this group experienced a smaller, but still positive, increase in formal wages.

These findings highlight that the effects of large-scale migration are not evenly distributed across the labor market. Variation by sector, occupation, and education suggests that some groups of workers are more affected than others. Nonetheless, our results indicate that, at least within the formal sector, no group of Brazilian workers experienced clear wage losses as

a result of the refugee influx.

5.3 Consumption and Labor Demand

One potential mechanism through which refugee inflows affect local labor markets is by increasing demand for goods and services, particularly in sectors that cater to local consumption rather than regional or national markets. To test whether increased consumption is a potential mechanism driving up wages for Brazilian workers, we compare formal wage responses between tradable sectors (which serve regional or national demand) and non-tradable sectors (which primarily serve local demand).[15]

We define tradable sectors to include crop and animal production, forestry and logging, fishing and aquaculture, mining and quarrying, and all manufacturing industries. These sectors typically produce goods that are sold beyond the local economy and have relatively limited interaction with refugee driven consumption. By contrast, non-tradable sectors include locally consumed services and are less exposed to inter-regional trade.

Table 3 presents the results from estimating Equation 3, where Z_i is an indicator for employment in a non-tradable sector. In our preferred specification (column 4), we find that the refugee inflow decreased formal wages by 1.6% in tradable sectors. The interaction term indicates that this effect was 4.0 percentage points higher in non-tradable sectors.

Although consumption-driven wage effects are most apparent in non-tradable sectors, it is important to note that these sectors also employed the majority of formal-sector Venezuelan workers in 2018. As shown in Table C.1, retail trade accounted for 39.70%, restaurants for 13.70%, and civil construction for 7.1% of Venezuelan formal-sector employment. Despite this concentration, we still observe relatively larger wage gains for Brazilian workers in non-tradable sectors, suggesting that increased local consumption was strong enough to offset potential substitution effects from the refugee inflow. This pattern supports the interpretation that demand-side forces contributed meaningfully to wage growth, even in sectors with high

[15]We thank the anonymous reviewer for suggesting this analysis.

refugee participation.

5.4 Labor Complementarity

Recent empirical work finds that immigrant inflows can raise the marginal productivity and demand for native high-skill labor. Ottaviano and Peri (2012) document complementary task specialization between immigrants and natives in U.S. cities, while Peri (2016) shows that migrants filling lower-skill roles can boost the productivity and employment of natives in higher-skill occupations. An increase in the share of Brazilian workers in managerial positions following the influx would thus be consistent with a reallocation of native labor toward tasks that are typically complemented by lower-skilled labor.

To better understand whether the Venezuelan refugee influx had such complementary effects on native workers, we examine changes in the likelihood of holding a managerial position. If Venezuelan workers primarily entered lower-skill jobs, their presence may have enabled Brazilian workers to move into supervisory or higher-responsibility roles. Identifying such upward occupational mobility offers insight into whether the labor market adjusted through complementarity rather than substitution.

We define a managerial position using the RAIS occupation classification system. Specifically, we classify workers as managers if they fall within the "managers" category based on the Brazilian Classification of Occupations (CBO), which includes roles related to planning, supervision, and management across industries.

Table 4 reports the estimated difference-in-differences effects of the Venezuelan refugee crisis on the probability of being a manager in a formal labor market. Across all specifications, we find a small but statistically significant increase of about 0.2 to 0.3 percentage points in the likelihood of being a manager for formal sector workers in Roraima relative to nearby control states. Given the pre-treatment managerial share of approximately 2.9% in Roraima, this corresponds to a relative increase of about 7 to 10%. While the point estimates are modest, the 7 to 10% relative increase represents a sizable gain in higher-responsibility positions,

consistent with potential occupational upgrading among native workers. These estimates are robust to the inclusion of demographic characteristics, municipality fixed effects, and controls for local labor demand shocks.

However, we caution against a straightforward interpretation of this result as labor complementarity. These changes could reflect endogenous occupational sorting, such as the possibility that non-managers are more likely to lose their jobs during economic shifts while managers retain theirs. If job separation disproportionately affects lower-tier workers, the share of managers could rise mechanically. While this is a plausible channel, as we will show in the next section, our broader results do not show general increases in job separation in Roraima following the refugee influx, which mitigates this concern. Nonetheless, we cannot rule out compositional adjustments, and therefore interpret these findings as suggestive but not conclusive evidence of occupational upgrading driven by complementarity.

5.5 Job Separations

While overall wage effects show a positive relationship between the refugee influx and earnings, such wage gains could in part be driven by selective retention, where only higher-paid or more productive workers remain employed, rather than broad-based improvements in labor market conditions. In this case, average formal wages could rise when lower-wage workers are displaced or pushed out of the formal sector. To assess whether this type of displacement occurred, we compare job separation patterns among Brazilian workers between Roraima and control states in the formal labor market.

We define a job separation as an employer-initiated termination of a worker's contract, regardless of whether there is just cause, and excluding voluntary departures by the employee. Operationally, we classify a worker as having separated if the reported reason for leaving is employer-initiated and the worker is no longer employed with the same employer in the following year, regardless of whether they remain in the formal labor market. This captures cases where the contract was not renewed or the worker exited to another employer or out of

formal employment entirely. While this measure does not directly capture unemployment, it serves as a proxy for formal sector exit from the original job.[16]

We perform our analysis using the linear probability model version of Equation (1), where the outcome variable is a binary indicator equal to one if the individual experienced job separation the following year. Table 5 presents the results of this analysis. Panel A shows the aggregate job separation effects. We find that the refugee crisis had no statistically significant effect on job separations, with point estimates statistically close to zero. This suggests that the observed wage increases were not driven by the job separation of lower-wage workers from formal employment but instead reflect real improvements in labor market outcomes for Brazilian workers. In other words, the refugee influx did not lead to a survival bias in our overall effects result.

We test for heterogeneity in job separations based on sector-occupation exposure to Venezuelan immigrants. We define high-exposure sector-occupation pairs as in the previous analysis, selecting the top five occupations within the top five sectors where Venezuelans were most represented post-treatment. Panels B and C show the results. We find that Brazilian workers in these highly exposed labor market segments experienced higher job separation rates than their peers. The differential magnitude of the effect remains modest at approximately 1.9 percentage points, corresponding to a 6% increase relative to the group's pre-treatment separation rate of 32.4%, which was already high at baseline.

The fact that Brazilian workers in high-exposure segments experienced both higher job separation rates and declining wages suggests that the observed wage effects in these segments are not due to selective retention, but rather reflect direct competitive pressures stemming from increased immigrant labor supply.

Likewise, Panel C presents the results of testing for heterogeneity in job separation effects by education level. Our preferred specification in column (4) shows that the refugee crisis slightly increased job separation among workers with less than a high school education (β_1).

[16]To ensure separations are observable, we exclude 2018 from the analysis.

However, the interaction terms (β_3) are statistically indistinguishable from zero, indicating that Brazilian workers with a high school or college education did not experience significantly different job separation effects compared to those with less than a high school education.

Overall, these findings suggest that while the refugee crisis did not lead to widespread job separation in the formal labor market, its effects were more concentrated in specific segments of the labor market where overlap between Venezuelan and Brazilian workers was greatest. Workers in high-exposure sector-occupation pairs experienced modestly higher job separation rates and small wage declines, consistent with mild competitive pressures in those areas. Nonetheless, the absence of widespread job separation and the continued wage gains in the broader workforce suggest that any adverse effects were limited and likely outweighed by strong aggregate labor demand.

6 Conclusion

This paper examines the formal labor market effects of a large and sudden refugee inflow into a low-capacity setting. We study the case of Roraima, a geographically isolated Brazilian state that experienced a sharp and externally driven influx of Venezuelan refugees during the 2010s. Using administrative panel data and a difference-in-differences framework, we find that the refugee shock led to a statistically significant 2% increase in formal labor market wages for Brazilian formal sector workers. These gains increased over time, coinciding with the increasing presence of refugees in the state.

We explore several mechanisms behind this wage effect. Heterogeneity analyses reveal that workers in sector-occupation pairs with high exposure to refugee inflows experienced small wage declines and modestly higher job separation rates, consistent with mild competitive pressures. In contrast, more educated Brazilian workers and those in segments with limited overlap with refugees experienced larger wage gains. We also find stronger wage growth in non-tradable sectors in the formal labor market, consistent with a demand-side mechanism

in which increased local consumption by refugees increased labor demand. We also observe a small increase in the share of Brazilian workers in managerial roles, suggesting occupational upgrading. Finally, even new labor market entrants benefited during the crisis period, experiencing wage gains comparable to those of incumbent workers. These findings suggest that the refugee influx had broadly positive effects on native labor market outcomes, with limited adverse impacts concentrated in specific labor market segments.

This paper makes several key contributions to the literature on refugee impacts and labor markets in developing countries. First, we provide the first rigorous analysis of refugee inflows in Brazil—a major host country that remains largely absent from prior empirical work—using linked administrative microdata on the universe of formal sector workers. Second, it uses comprehensive administrative panel data on the universe of formal sector workers, enabling precise identification of natives and refugees, individual wage trajectories, and heterogeneity across regions and worker types. Third, it documents meaningful variation in wage effects, with gains concentrated among more educated natives and in non-tradable sectors, suggesting complementarities and demand-driven mechanisms linked to refugee-induced consumption.

A limitation of our analysis is that the administration data we use captures only the formal sector, omitting informal labor dynamics that are particularly relevant in the context of mass migration. Since many Venezuelan migrants likely entered the labor market informally while awaiting work authorization, we complement our main analysis by applying the same empirical strategy to nationally representative survey data (PNAD-C). We present this analysis in Appendix H This extension allows us to examine wage effects in the informal sector, where we find broadly negative impacts on observed workers. These results point to heightened vulnerability among informal workers and offer limited but suggestive evidence of labor market linkages between the formal and informal sectors. That said, household survey coverage in this region of Brazil is sparse and does not distinguish natives from refugees, so these results should be interpreted with caution.

Future research should explore how native workers respond to refugee inflows by exam-

ining internal spatial displacement across Brazil, particularly whether relocation leads to occupational downgrading or labor market detachment. Linking administrative data across states would help capture these dynamics and assess broader equilibrium effects. Another important direction is evaluating Brazil's *Operação Acolhida* (Operation Welcome) Program, which relocated Venezuelan refugees from border regions to areas with greater economic capacity. Little is known about the selection and sorting patterns behind relocation and how they shape outcomes in both origin and destination regions, particularly if higher-skilled or more attached refugees are more likely to move.

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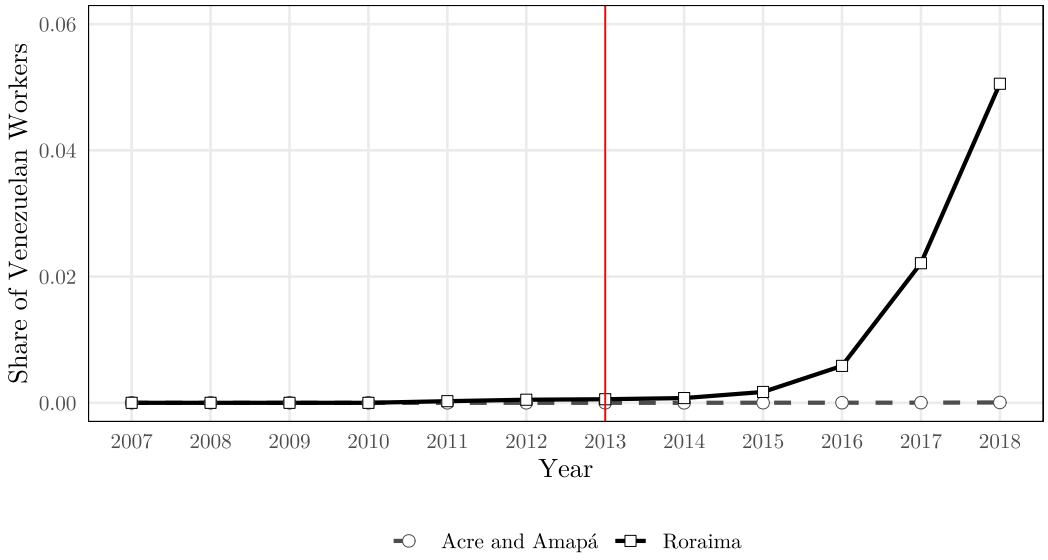
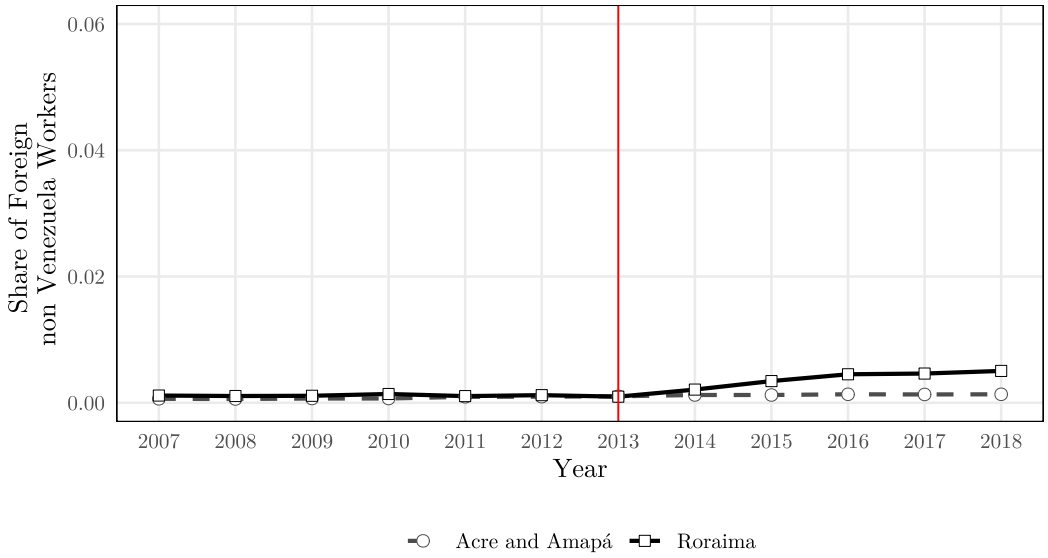
Figures and Tables

Figure 1: Map of Brazilian States and Venezuela

Notes: Brazil is shown in white, while other South American countries are in gray. The treatment state, Roraima, the control states, Acre and Amapá, and Venezuela, are labeled on the map. The red dashed line running along the north-south axis represents the BR-174 Highway, which connects Venezuela with northern Brazil through the state of Roraima.



(a) Proportion of Venezuelans in Roraima and Control States' Labor Market



(b) Proportion of Foreign Non-Venezuelans in Roraima and Control States' Labor Market

Figure 2: Foreign Workers in Roraima and Control States over Time

Notes: The vertical axis shows the share of observed foreign workers, calculated by dividing the number of observed foreign workers by the total number of workers each year. Panel (a) shows Venezuelan workers; Panel (b) shows non-Venezuelan foreign workers. The baseline year, 2013, is marked with a vertical red line.

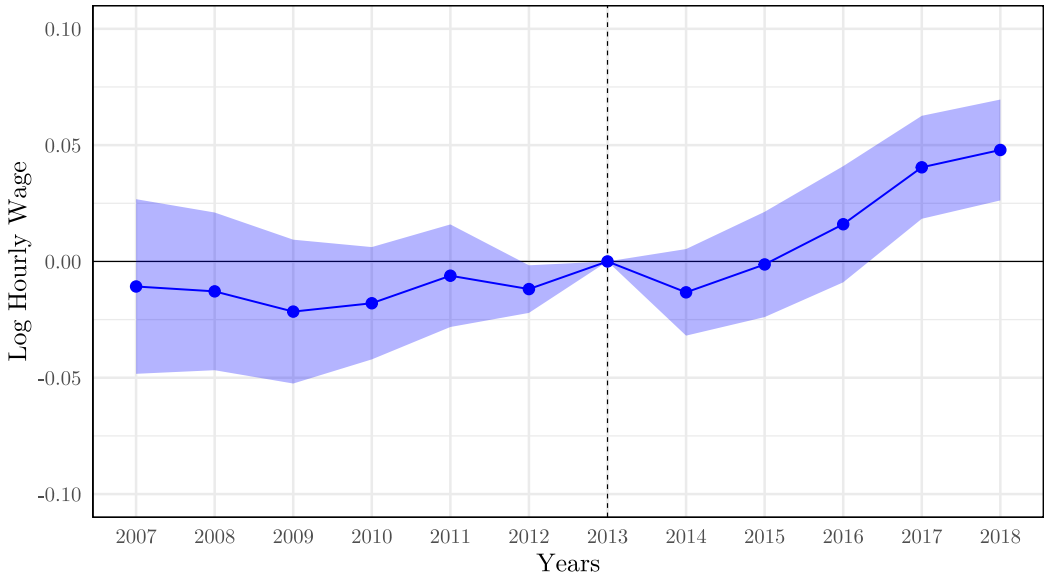


Figure 3: Event Study: Effects of the Venezuelan Refugee Crisis on Brazilian Workers' Wages

Notes: This figure plots the event study coefficients from equation (2) with log hourly wages as the outcome variable. The baseline year for comparison is 2013, the year preceding the onset of the Venezuelan refugee crisis. The blue shaded region represents the 95% confidence interval.

Table 1: Descriptive Statistics of the Formal Labor Market between Roraima and Amapá and Acre (2007-2013)

	Roraima	Amapá and Acre
Panel A: Demographics		
Total observations	332 203	1 173 311
Distinct firms	7,305	22,296
Distinct workers	115,796	381,792
Mean log hourly wage	1.55	1.57
Variance of log hourly wage	0.44	0.37
Male workers (%)	57.1	65.7
White workers (%)	23.5	17.5
Mean age (years)	31.2	32.1
College education (%)	11.0	9.4
High school education (%)	60.2	51.8
No high school education (%)	28.9	38.8
Panel B: Occupation Distribution (%)		
Retail Salespersons	15.30	13.30
Building Maintenance Workers	10.00	9.60
Administrative Assistants	8.10	7.30
Food Service Workers	6.70	4.30
Building Maintenance Workers	3.70	6.10
Panel C: Sectoral Distribution (%)		
Retail Trade	29.70	27.40
Construction of Buildings	8.70	8.40
Building Services and Landscape Activities	8.20	2.90
Education	5.40	4.40
Wholesale Trade	4.70	4.50

Notes: Data from RAIS 2007 to 2013. Occupations extracted from the first 3 digits of the Brazilian Code of Occupation. Sectors extracted from the first 2 digits of the National Code of Economic Activities.

Table 2: DID Estimates on the Effects of Venezuelan Immigration on Log Wages

	Log Hourly Wages			
	(1)	(2)	(3)	(4)
Panel A: Aggregate Wage Effects				
RR × Post	0.023***	0.020***	0.020***	0.020***
	(0.005)	(0.006)	(0.006)	(0.005)
R^2 Adj.	0.770	0.773	0.774	0.774
RMSE	0.253	0.251	0.250	0.250
Panel B: Heterogeneity by Sectors				
RR × Post	0.025***	0.024***	0.024***	0.024***
	(0.006)	(0.007)	(0.007)	(0.007)
High Exposure	−0.059***	−0.053***	−0.052***	−0.052***
	(0.011)	(0.011)	(0.011)	(0.011)
RR × Post × High Exposure	−0.011	−0.016**	−0.017**	−0.017**
	(0.008)	(0.008)	(0.008)	(0.008)
R^2 Adj.	0.770	0.773	0.774	0.774
RMSE	0.253	0.251	0.250	0.250
Panel C: Heterogeneity by Education				
RR × Post	0.005	0.015***	0.016***	0.016***
	(0.004)	(0.005)	(0.005)	(0.005)
High School	−0.008	−0.002	−0.001	−0.001
	(0.006)	(0.006)	(0.006)	(0.006)
College	0.166***	0.165***	0.166***	0.166***
	(0.004)	(0.003)	(0.003)	(0.003)
RR × Post × High School	0.011**	−0.006	−0.006	−0.007
	(0.005)	(0.004)	(0.005)	(0.005)
RR × Post × College	0.088***	0.075***	0.075***	0.075***
	(0.004)	(0.003)	(0.003)	(0.003)
R^2 Adj.	0.770	0.773	0.774	0.774
RMSE	0.253	0.251	0.250	0.250
Worker FE	X	X	X	X
Year FE	X	X	X	X
Controls		X	X	X
Municipality FE			X	X
Shift-Share Labor Demand Control				X
No. of Observations	2,779,399	2,779,399	2,779,399	2,779,399
No. of Clusters	53	53	53	53

Notes: All regressions use 2007–18 data on the universe of formal market workers from the Brazilian states of Roraima, Acre, and Amapá. Panel A presents estimates from the difference-in-differences regression model specified in equation (1). Panels B and C estimate heterogeneous effects by immigrant exposure at the occupation-sector level and education level, respectively, using equation (3). Treat variable equals 1 if a worker is from Roraima from year 2014 or later. Column (1) regression includes worker and year fixed effects. Column (2) additionally controls for demographic characteristics, including age, age-squared, and tenure. Column (3) additionally includes municipality fixed effects. Column (4) also controls for shift-share measure of local economic conditions to control for 2014–16 recession. All specifications use the IPW weights generated using a logistic regression that includes race, age, age-squared, education level, and gender as predictors. High Exposure is a dummy variable that equals 1 if a worker is employed in a top 5 occupation in a top 5 economic sector with Venezuelan presence in the post-treatment years. High School is a dummy variable that equals 1 if a worker has a high school education. College is a dummy variable that equals 1 if a worker has a college education or higher. Standard errors in parentheses are clustered at the municipality level. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

Table 3: DID Estimates on the Effects of Venezuelan Immigration on Log Wages by Tradable and Non-Tradable Sectors

	(1)	(2)	(3)	(4)
RR × Post	−0.016	−0.016	−0.017*	−0.016*
	(0.011)	(0.011)	(0.009)	(0.009)
Non-Tradable	−0.009	−0.008	−0.004	−0.003
	(0.013)	(0.012)	(0.011)	(0.011)
RR × Post × Non-Tradable	0.042***	0.040***	0.040***	0.040***
	(0.010)	(0.010)	(0.009)	(0.009)
R^2 Adj.	0.770	0.773	0.774	0.774
RMSE	0.253	0.251	0.250	0.250
Worker FE	X	X	X	X
Year FE	X	X	X	X
Demographic Controls		X	X	X
Municipality FE			X	X
Shift-Share Labor Demand Control				X
R^2 Adj.	0.770	0.774	0.774	0.774
RMSE	0.253	0.251	0.250	0.250
Num.Obs.	2 779 399	2 779 399	2 779 399	2 779 399
Num.Clusters	53	53	53	53

Notes: All regressions use 2007–18 data on the universe of formal market workers from the Brazilian states of Roraima, Acre, and Amapá. All regressions present estimates from the difference-in-differences regression model specified in equation (1). Treat variable equals 1 if a worker is from Roraima from year 2014 or later. Column (1) regression includes worker and year fixed effects. Column (2) additionally controls for demographic characteristics, including age, age-squared, and tenure. Column (3) additionally includes municipality fixed effects. Column (4) also controls for shift-share measure of local economic conditions to control for 2014–16 recession. Non-Tradable is a dummy variable that equals 1 if an individual works in a non-tradable sector. We consider the following as tradable sectors: crop and animal production, forestry and logging, fishing and aquaculture, mining and quarrying, and all manufacturing industries. All specifications use the IPW weights generated using a logistic regression that includes race, age, age-squared, education level, and gender as predictors. Standard errors in parentheses are clustered at the municipality level. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

Table 4: DID Estimates on the Effects of Venezuelan Immigration on a Worker Assuming a Managerial Role

	(1)	(2)	(3)	(4)
RR × Post	0.003***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
R^2 Adj.	0.548	0.549	0.549	0.549
RMSE	0.096	0.096	0.096	0.096
Num.Obs.	2 779 399	2 779 399	2 779 399	2 779 399
Worker FE	X	X	X	X
Year FE	X	X	X	X
Municipality FE			X	X
Demographic Controls		X	X	X
Shift-Share Labor Demand Control				X
Num.Clusters	53	53	53	53

Notes: All regressions use 2007–18 data on the universe of formal market workers from the Brazilian states of Roraima, Acre, and Amapá. All estimates are from the linear probability version of the difference-in-differences regression model specified in equation (1). The outcome variable is a dummy variable that equals 1 if a worker is in a managieral role. The treatment variable equals 1 if a worker is from Roraima from 2014 onward. Column (1) includes worker and year fixed effects. Column (2) adds demographic controls (age, age-squared, tenure). Column (3) includes municipality fixed effects. Column (4) adds a shift-share control for local economic conditions during the 2014–16 recession. All specifications use IPW weights from a logistic model using race, age, age-squared, education, and gender. Standard errors in parentheses are clustered at the municipality level. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

Table 5: DID Estimates on the Effects of Venezuelan Immigration on Job Separation

	Job Separation			
	(1)	(2)	(3)	(4)
Panel A: Aggregate Job Separation Effects				
RR × Post	0.003	0.006	0.006	0.005
	(0.007)	(0.007)	(0.007)	(0.007)
R^2 Adj.	0.122	0.128	0.129	0.129
RMSE	0.371	0.370	0.369	0.369
Panel B: Heterogeneity by Sectors				
RR × Post	0.000	0.001	0.001	0.001
	(0.007)	(0.007)	(0.007)	(0.006)
High Exposure	0.020***	0.019***	0.019***	0.020***
	(0.005)	(0.005)	(0.005)	(0.005)
RR × Post × High Exposure	0.013***	0.019***	0.019***	0.019***
	(0.003)	(0.002)	(0.002)	(0.002)
R^2 Adj.	0.122	0.128	0.129	0.129
RMSE	0.371	0.369	0.369	0.369
Panel C: Heterogeneity by Education				
RR × Post	0.008	0.017	0.018	0.017*
	(0.011)	(0.011)	(0.011)	(0.010)
High School	−0.034***	−0.022*	−0.021*	−0.021*
	(0.011)	(0.011)	(0.011)	(0.011)
College	−0.118***	−0.097***	−0.096***	−0.096***
	(0.011)	(0.015)	(0.015)	(0.015)
RR × Post × High School	−0.010	−0.015	−0.016	−0.016
	(0.010)	(0.010)	(0.010)	(0.010)
RR × Post × College	0.008	−0.013	−0.013	−0.014
	(0.008)	(0.011)	(0.011)	(0.011)
R^2 Adj.	0.123	0.129	0.129	0.129
RMSE	0.371	0.369	0.369	0.369
Worker FE	X	X	X	X
Year FE	X	X	X	X
Controls		X	X	X
Municipality FE			X	X
Shift-Share Labor Demand Control				X
Num.Obs.	2 539 848	2 539 848	2 539 848	2 539 848
No. of Clusters	53	53	53	53

Notes: All regressions use 2007–18 data on the universe of formal market workers from the Brazilian states of Roraima, Acre, and Amapá. Panel A presents estimates from the linear probability version of the difference-in-differences regression model specified in equation (1). Panels B and C estimate the linear probability version of the heterogeneous effects by immigrant exposure at the occupation-sector level and education level, respectively, using equation (3). Treat variable equals 1 if a worker is from Roraima from year 2014 or later. Column (1) regression includes worker and year fixed effects. Column (2) additionally controls for demographic characteristics, including age, age-squared, and tenure. Column (3) additionally includes municipality fixed effects. Column (4) also controls for shift-share measure of local economic conditions to control for 2014–16 recession. All specifications use the IPW weights generated using a logistic regression that includes race, age, age-squared, education level, and gender as predictors. High Exposure is a dummy variable that equals 1 if a worker is employed in a top 5 occupation in a top 5 economic sector with Venezuelan presence in the post-treatment years. High School is a dummy variable that equals 1 if a worker has a high school education. College is a dummy variable that equals 1 if a worker has a college education or higher. Standard errors in parentheses are clustered at the municipality level. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

APPENDICES

A Brazilian Formal Labor Market

For Brazilian firms to operate legally, they must be registered with the National Legal Persons Registry (CNPJ), which requires owners to declare the firm's activities and formalize their operations. Entities that are not registered with a CNPJ are classified as informal. High registration costs and bureaucratic hurdles contribute to high levels of informality in Brazil's poorer regions, including the North Region.

Although firms are legally required to hire workers through formal contracts that ensure access to social security and other labor protections, these regulations are frequently bypassed in low-income areas, including the Northern Region of Brazil. Employers often hire workers informally to reduce costs and expedite hiring, despite the risk of legal penalties. Importantly, informal hiring is not limited to unregistered firms; many legally registered firms also engage in informal employment practices (Ulyssea, 2018). Around the time of our study, approximately 45% of total employment in Roraima was informal; that is, workers were employed without a formal labor contract, based on estimates from household survey data (Azeredo, 2019).[17] RAIS does not capture this segment of the labor market, as it includes only formal, registered employment relationships.

Mercosul (or Mercosur in Spanish) is an economic bloc of South American countries, including Venezuela and Brazil, whose citizens are entitled to free entry and access to formal labor markets in other member countries, subject to authorization. In principle, this arrangement facilitates the integration of Venezuelans into the Brazilian labor market. In practice, however, the process is not immediate. To obtain work authorization, Venezuelan refugees must submit specific paperwork and undergo background checks, a process that often takes several months. As a result, many are unable to access formal employment immediately

[17]Figure A.1 illustrates trends in the share of informal workers as a proportion of the total employed population over time in 2012-18 using the PNAD-C dataset. The figure shows that informal employment shares are comparable between the treatment and control states throughout the study period. The sharp increase after 2014 is related to the economic recession Brazil experienced from that year. We address this concern using shift-share controls in our regression.

upon arrival, particularly in the context of high administrative burdens and limited state capacity.

As the number of new arrivals increased, delays in processing work authorizations became more severe. These administrative bottlenecks, combined with urgent financial needs, likely pushed many refugees into informal employment. As a result, labor market interactions between refugees and native Brazilians became segmented. While some refugees eventually entered the formal sector, many remained in informal jobs.

Our primary analysis focuses on the formal labor market, where wages and employment contracts are officially recorded and regulated through protections such as minimum wage laws, severance pay, and social security. To better understand broader labor market dynamics, especially the interaction between formal and informal employment, we supplement our findings with additional evidence from survey data on informal labor outcomes, presented later in the paper.

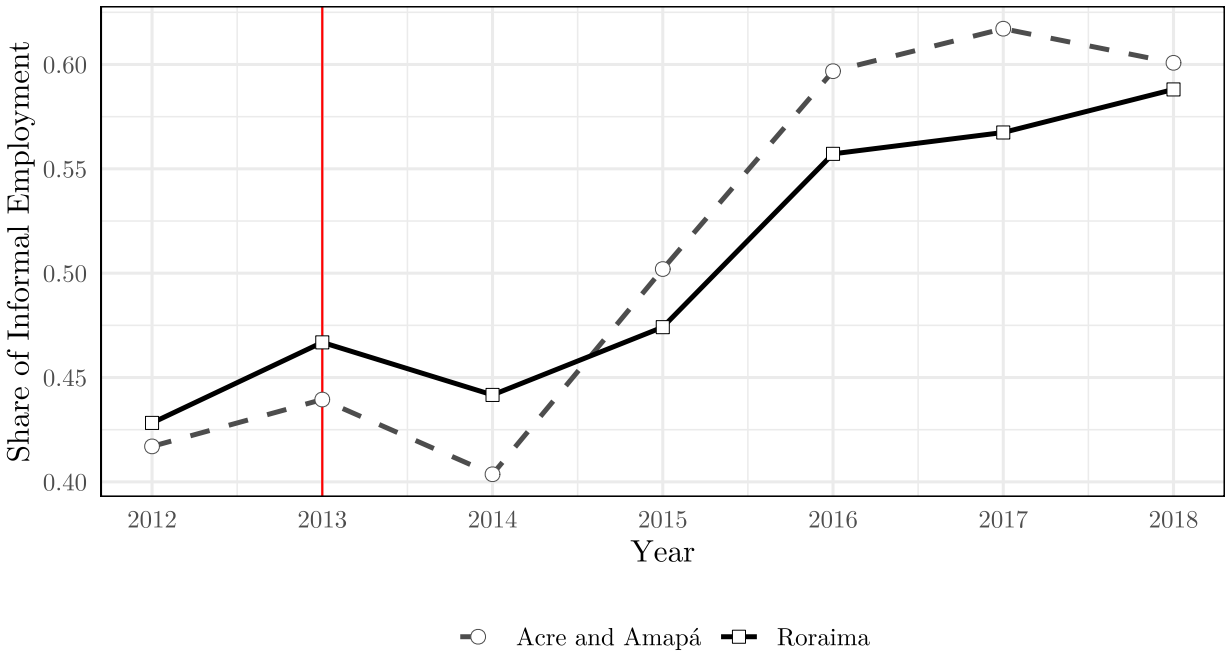


Figure A.1: Informal Workers as a Share of the Labor Market

Notes: Informality is measured using the PNAD-C household survey and includes individuals who are: (i) private-sector employees without a formal contract; (ii) domestic workers without a formal contract; (iii) contributing family workers; (iv) employers without a CNPJ (*Cadastro Nacional de Pessoas Jurídicas*); and (v) self-employed individuals (own-account workers) without a CNPJ. The figure displays the share of informal workers, calculated as a proportion of all employed individuals, across the treatment state (Roraima) and the control states (Amapá and Acre) from 2012 to 2018.

B Other Figures

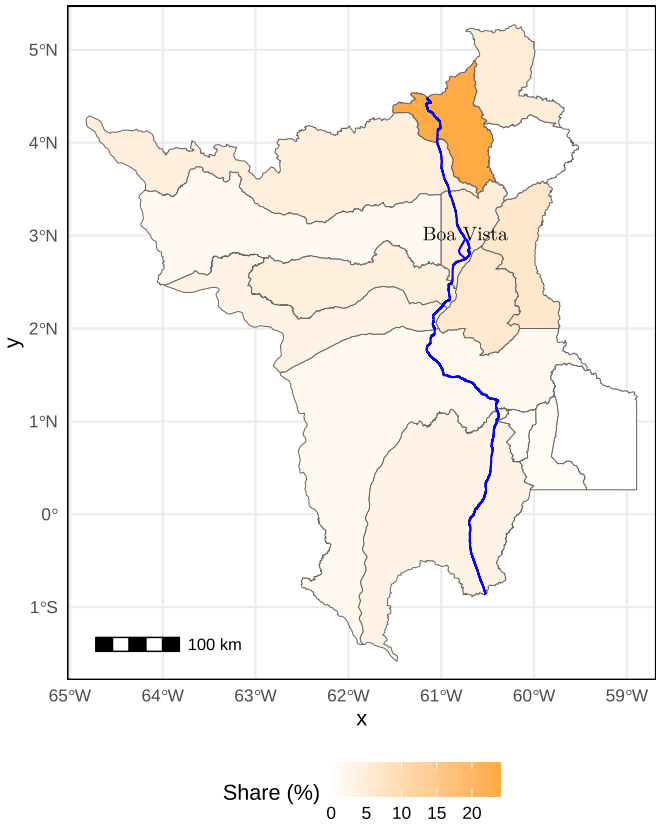
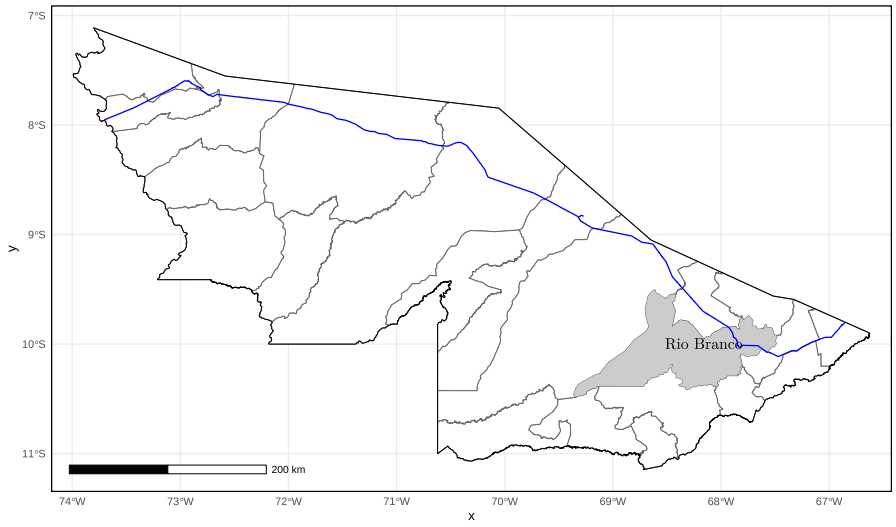
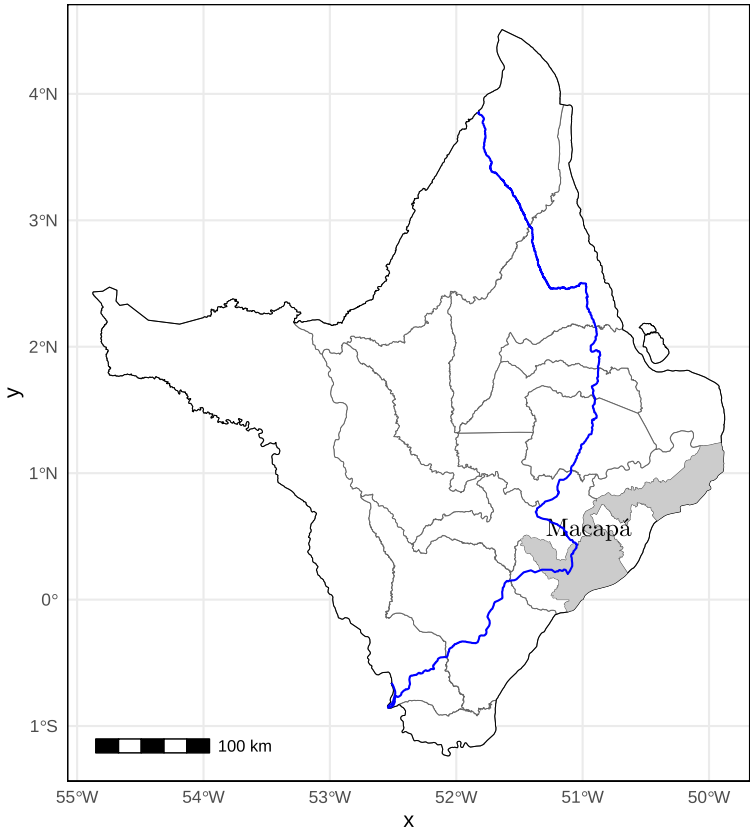


Figure B.1: Share of Venezuelans in the Formal Market per Roraima's Municipalities (2018)

Notes: The heatmap displays the share of Venezuelan workers in RAIS for 2018. Geopolitical divisions correspond to the municipalities of Roraima, with the state capital, Boa Vista, labeled. The blue line crossing the state from north to south represents the Brazilian federal highway BR-174.

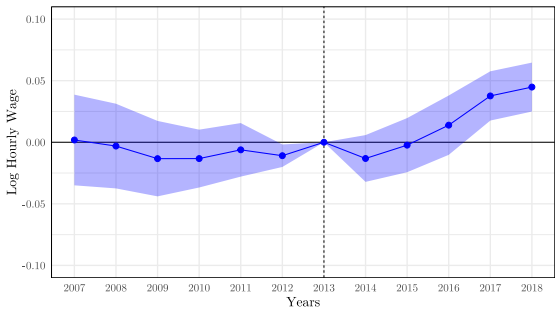


(a) Acre municipalities and BR-364 highway.

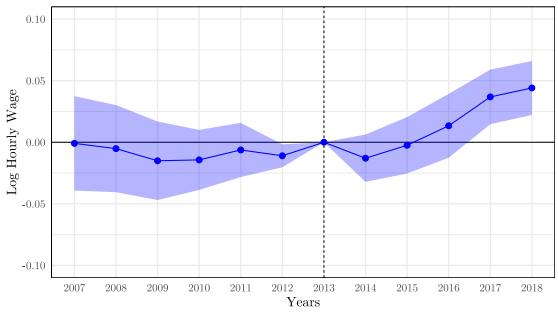


(b) Amapá municipalities and BR-156 highway.

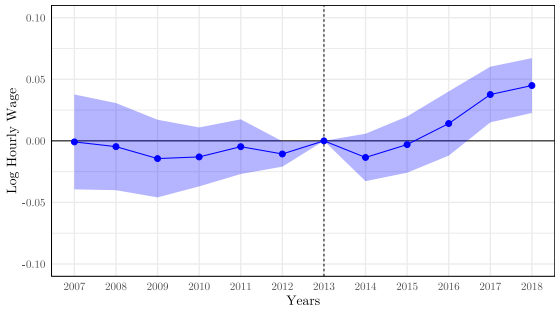
Figure B.2: Municipality maps of the control states. Each panel shows the municipal boundaries, labels the state capitals, and highlights the main federal highways (blue lines) for Acre and Amapá.



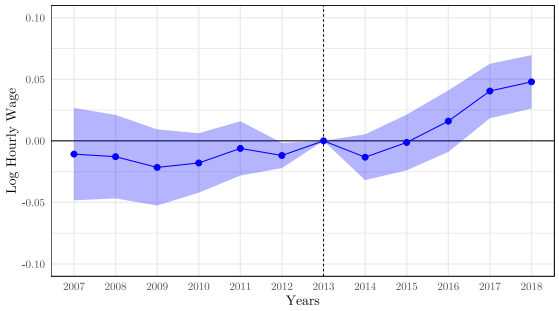
(a) Baseline Model with Worker and Year FEs



(b) Demographic Covariates Added



(c) Municipality FEs Added



(d) Local Labor Demand Shock Control Added

Figure B.3: Event Study: Effects of the Venezuelan Refugee Crisis on Brazilian Workers' Wages

Notes: These figures plot the event study coefficients from equation (2) with log hourly wages as the outcome variable. Figure (i) uses only the worker and year fixed effects. Figure (ii) additionally controls for demographic characteristics. Figure (iii) additionally includes municipality fixed effects. Finally, figure (iv) additionally includes a shift-share-style variable that controls for the local labor demand shocks. The baseline year for comparison is 2013, the year preceding the onset of the Venezuelan refugee crisis. The blue shaded region represents the 95% confidence interval.

C Additional Summary Statistics

C.1 Wage Trends

As a preliminary exercise, we examine whether formal sector wage trends for Brazilian workers are comparable between the exposed state of Roraima and the selected control states, Amapá and Acre. Figure C.1 displays the evolution of median monthly wages from 2007 to 2018 for both groups. Prior to the immigration shock in 2013 (marked by the red vertical line), wage trends in Roraima closely tracked those of the control states, supporting the plausibility of the parallel trends assumption that underlies our identification strategy.

Following the start of the shock, both groups experienced a brief slowdown in formal sector wage growth, likely reflecting broader macroeconomic conditions. However, wages in Roraima recovered more rapidly in subsequent years, eventually overtaking those in the control states. We also show in Figure C.2 that this dynamic is consistent across the distribution: wage trends at the 25th and 75th percentiles follow similar trajectories, suggesting that the effects are not concentrated at any particular percentile.

While these patterns reinforce the validity of our control group, it is important to note that Brazil entered a recession beginning in 2014. This poses a potential confounding threat to our estimates, as macroeconomic downturns can significantly affect payments in the formal labor market. To address this, as we will explain in the methodology, our empirical specifications include shift-share controls that account for labor demand shocks, helping to isolate the effects of immigrant inflows from broader cyclical variations.

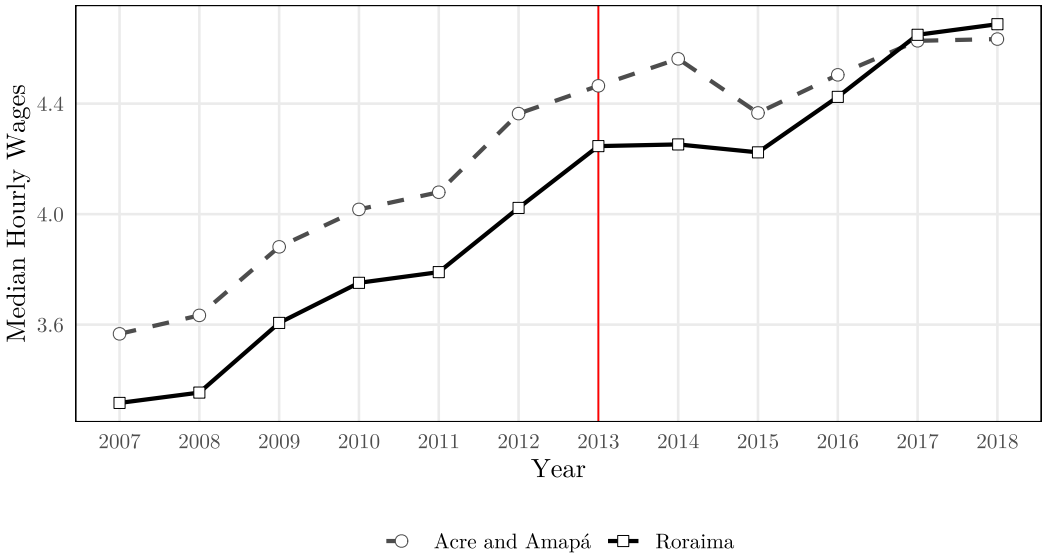
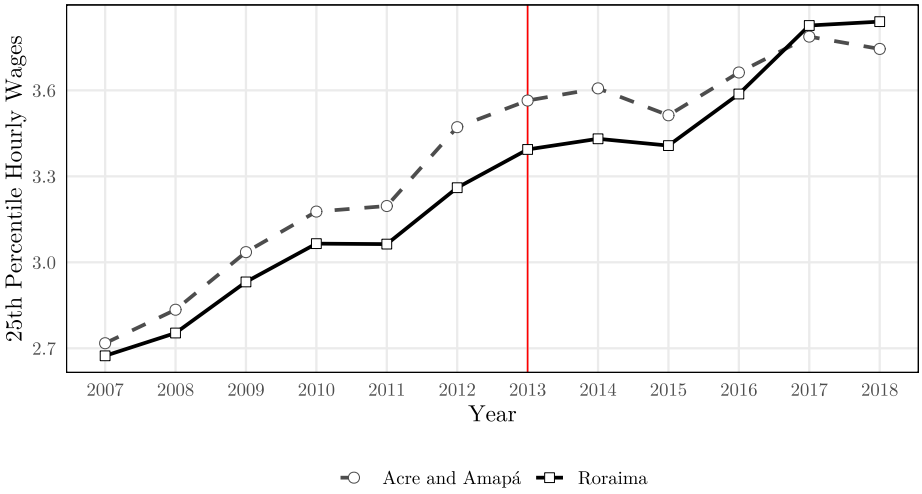
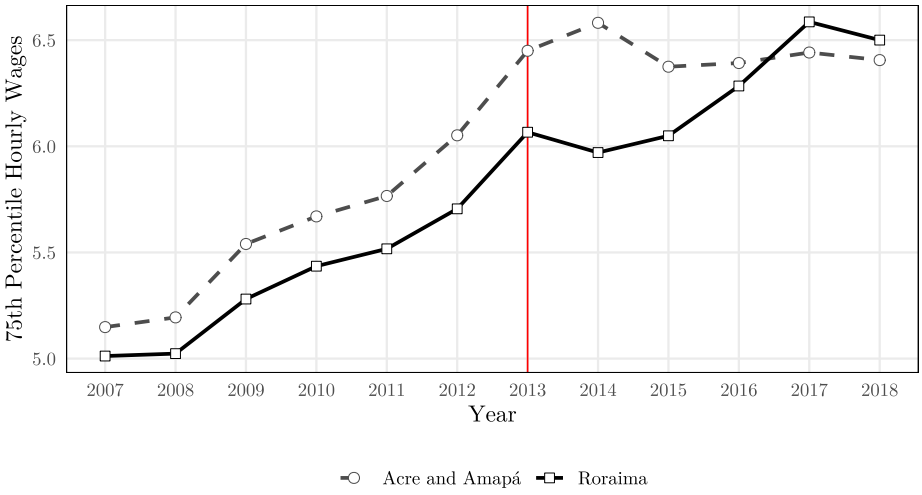


Figure C.1: Median Hourly Wage Trends for Treatment and Control States

Notes: Median hourly wage values for Roraima and the control states are from RAIS (covering Brazilian formal sector workers in these states). If an individual holds multiple jobs in the data, we use the job with the longest tenure; in cases where multiple jobs have the same tenure, we select the higher-paying job. The wages are expressed in 2010 Brazilian Reais, assuming a 40-hour work week and four weeks of work per month. Original hourly wages are calculated by dividing nominal contractual wages by contractual work hours. The baseline year, 2013, is highlighted with a vertical red line.



(a) 25th Percentile Hourly Wage Trends for Treatment and Control States.



(b) 75th Percentile Hourly Wage Trends for Treatment and Control States.

Figure C.2: Percentile Hourly Wage Trends for Roraima and the control states.

Notes: 25th and 75th percentile hourly wage values for Roraima and the control states are from RAIS (covering Brazilian formal sector workers in these states). If an individual holds multiple jobs in the data, we use the job with the longest tenure; in cases where multiple jobs have the same tenure, we select the higher-paying job. The wages are expressed in 2010 Brazilian Reais, assuming a 40-hour work week and four weeks of work per month. Original hourly wages are calculated by dividing nominal contractual wages by contractual work hours. The baseline year, 2013, is highlighted with a vertical red line.

C.2 Profile of Brazilians and Venezuelans in 2018

Table C.1 compares key characteristics of Brazilian and Venezuelan formal sector workers in Roraima in 2018, the peak year of Venezuelan presence in the state. Since most Venezuelans in RAIS are first observed in 2018, for comparability purpose, we show statistics for new entrants for both groups.[18] This comparison provides a basis for evaluating potential substitution behaviors in the local labor market.

Panel A reports general demographic and wage-related statistics. Venezuelan formal sector workers in 2018 tended to be slightly older (32 versus 27 years on average), more likely to be male (77 versus 56%), and somewhat less educated at the college level, though they had a higher share with completed high school. Mean log hourly wages were lower among Venezuelans (1.43 vs. 1.57; corresponding to 667 and 768 in 2010 Brazilian Reais respectively). The wage distribution was more compressed, with a variance of 0.11 compared to 0.24 for Brazilians.

Panel B displays the top five formal sector occupations employing the largest shares of Venezuelan workers, alongside their Brazilian counterparts. Both groups are heavily represented in low-wage service occupations such as building maintenance and retail sales. However, Venezuelans are especially concentrated in food service, construction support roles, and food manufacturing, whereas Brazilians are more evenly distributed across occupations.

Panel C presents, using the same logic as Panel B, the distribution of workers across economic sectors in the formal labor market. Both groups are heavily concentrated in retail trade, but Venezuelans are more likely to work in restaurants and civil construction, while the shares are relatively comparable between the two groups in wholesale trade and agriculture. These patterns suggest substantial overlap across sectors and occupations, which could imply potential substitution effects for both existing workers and new entrants.

[18] This includes those individuals who appear for the first time in the dataset.

Table C.1: Descriptive Statistics: Brazilians and Venezuelans in the Formal Sector in Roraima (2018)

	Brazilian	Venezuelan
Panel A: Demographics		
Distinct firms	2,257	805
Workers	7,629	2,228
Mean log wage	1.57	1.43
Variance of log wage	0.24	0.11
Mean age (years)	27.2	31.8
Male workers (%)	56.1	76.6
White workers (%)	9.1	6.1
College education (%)	11.1	7.1
High school education (%)	66.3	75.2
No high school education (%)	22.7	17.7
Panel B: Occupation Distribution (%)		
Building Maintenance Workers	7.10	17.00
Retail Salespersons	18.50	14.70
Food Service Workers	7.10	14.50
Auxiliary Construction Workers	2.90	8.20
Food Manufacturing Workers	2.00	5.20
Panel C: Sectorial Distribution (%)		
Retail Trade	35.30	39.70
Restaurants	5.80	13.70
Civil Construction	4.90	7.10
Wholesale Trade	6.10	5.50
Agriculture	3.60	4.10

Notes: Data from RAIS 2018 on new entrants to the formal labor market (individuals appearing for the first time in the dataset). Most Venezuelans in RAIS are first observed in 2018; for comparability, we show statistics for Brazilian new entrants. Occupations are defined by the first three digits of the Brazilian Code of Occupations, and sectors by the first two digits of the National Code of Economic Activities. The table reports the top five occupations and sectors for Venezuelans, with the corresponding Brazilian formal labor market share in each category.

D Foreign Presence Outside RAIS

Even though RAIS provides a good picture of Venezuelans entering Brazil and exclusively staying in Roraima, it only counts Venezuelans in the formal labor market. Venezuelans may be crossing the border and going through, staying in other states outside the formal labor market, in refugee camps, or working informally. The Federal Police data shows that around 41 thousand individuals crossed Roraima and did not return to Venezuela. However, we do not observe either in RAIS or the Federal Police data whether they stayed in Roraima or moved around.

It would jeopardize our identification strategy if the control states hosted many Venezuelan refugees outside the formal labor market. To show that it is not the case, we rely on the refugee application data from the Brazilian National Committee for Refugees (CONARE).

Foreigners in Brazil can be registered as refugees to get benefits such as obtaining the individual taxpayer registration number (CPF), accessing health and education services, and opening a bank account, among others. A potential refugee must submit its recognition to, and then analyzed by, CONARE. The committee then decides whether they are recognized as a refugee. If rejected, they can appeal. Since refugee applications only exist conditional on the presence of a forcibly displaced population, we believe the data is an adequate proxy for Venezuelans not observed in the formal labor market.

Variables included in CONARE are the nationality of the applicants, the reason for leaving their country, the date when the application was submitted, the municipality and the state where the application was submitted, and the date when CONARE made the decision.

Figure D.1 shows the number of refugee applications by treatment groups (Roraima, Amapá and Acre) between 2007 and 2018. There were approximately 40 thousand refugee requests in Roraima in these years, with the first wave of applications appearing in 2015. We found virtually zero applications in control states. If immigrants are moving across treated and control states, the likelihood of a Venezuelan applying for refugee status in another location rather than Roraima would significantly increase. Accordingly, we do not see this

behavior in the data.

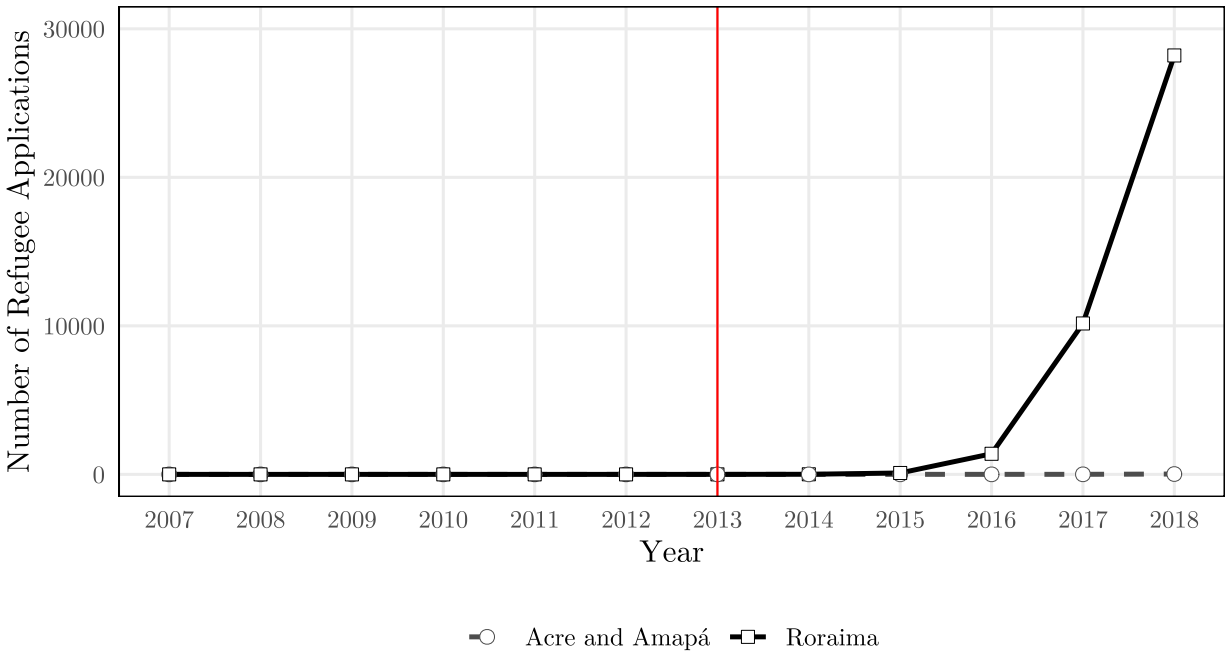


Figure D.1: Refugee Status Requests in Roraima and Control States

Notes: Data collected from the Brazilian National Committee for Refugees (CONARE). The red vertical intercept represents our baseline year for the event study.

Another relevant consideration is that only a small share of refugee applicants entered the formal labor market. Based on RAIS data for 2018, we estimate that approximately 10% of individuals who applied for refugee status secured formal employment, primarily in the commerce sector (see Table C.1). Given that the act of applying for refugee status often signals an intent to regularize one's legal status and seek employment, it is reasonable to infer that a substantial portion of Venezuelan migrants were actively looking for work. However, many may have done so outside the boundaries of the formal labor market, likely accepting positions in informal sectors where entry barriers are lower.

E Construction of Shift-Share Labor Demand Control

In the preferred specification of our regressions, we include a municipality-level shift-share-style variable, r_{mt}, often referred to as a 'Bartik-style control' (Bartik, 1992; Goldsmith-Pinkham, Sorkin, and Swift, 2020) to account for changes in local economic conditions and labor demand shocks that may influence wage dynamics independently of the refugee inflow. This variable predicts local labor demand by combining the municipality's baseline industry composition with subsequent national growth trends in those industries. Specifically, it captures how much of the wage variation in a given municipality and year can be attributed to broader structural shifts in the national economy, rather than local events.

Specifically, the variable is constructed as:

$$r_{mt} = \sum_{k} (s_{ik0} \times g_{kt}) \tag{4}$$

where s_{ik0} is the share of employment in industry k within municipality m in the baseline year (2007), and g_{kt} is the national growth index or growth factor of industry k in year t, measured as the ratio of national employment in that industry in year t to its level in 2007. That is,

$$g_{kt} = \frac{Emp_{kt}}{Emp_{k0}} \tag{5}$$

where Emp_{kt} is total national employment in industry k in year t, and Emp_{k0} is the baseline level in 2007.

This control variable is constructed using employee counts from the RAIS dataset. Because it relies only on pre-treatment local industrial composition and nationally exogenous industry-level trends, it serves as a plausibly exogenous proxy for local labor demand shocks. Including this variable is particularly important in our setting, as Brazil experienced a nationwide economic downturn starting in 2014, which may have had differential impacts across municipalities depending on their industrial makeup.

Although shift-share measures like this one are commonly used as instruments in IV

frameworks, several recent papers use it as a regression control variable (Beerli, et al., 2021; East, et al., 2023) for isolating exogenous variation in local labor demand. By including this Bartik-style control, we aim to better isolate the causal effect of the refugee influx on labor market outcomes and improve the precision of our estimates.

F Doubly-Robust Estimator

To strengthen the robustness of our baseline model, we use a doubly robust estimation strategy that combines inverse propensity score weighting (IPW) with our difference-in-differences strategy.

We apply as regression weights the inverted propensity scores when performing the fixed effects analysis. To generate the scores, we use a logistic regression framework:

$$p(X_i) = Pr(D_i = 1|X_i) = F(X_i'\theta) = \frac{e^{X_i\theta'}}{1 + e^{X_i'\theta}} \tag{6}$$

where D_i equals one if individual i resides in Roraima (the treatment group), and zero otherwise. The vector X_i includes demographic characteristics observed before the Venezuelan influx, and the parameter vector θ captures how these covariates influence the probability of being in Roraima.

Once propensity scores are estimated, each observation in our main specification is weighted by the inverse propensity score. Specifically, observations from the treated region receive weights proportional to the inverse of their probability of being treated, and control observations receive weights proportional to the inverse of their probability of not being treated. This weighting scheme balances the distribution of observable characteristics across the treated and control groups, mitigating biases arising from systematic differences.

Formally:

$$w_i = \begin{cases} \frac{1}{1-p(X_i)}, & \text{if } Z_i = 0 \\ \frac{1}{p(X_i)}, & \text{if } Z_i = 1 \end{cases} \tag{7}$$

where $p(X_i)$ is the propensity score provided by Equation (6). If fundamental demographic or economic differences exist between Roraima and control states, the inverse propensity score weighting accounts for this heterogeneity by assigning higher weights to control observations that closely resemble those in the treated region and *vice-versa*. A key advantage of doubly

robust specifications is that it yields consistent estimates even if one of the propensity score model or the difference-in-differences model is misspecified (Uysal, 2015; Sant'Anna and Zhao, 2020).

We also impose trimming rules to avoid propensity score values that are too extreme, avoiding weights above the 99.75% quantile (Lechner and Strittmatter, 2019). The final step minimizes the weighted sum of squares in the fixed effects framework:

$$\hat{\beta} = \arg\min_{\beta} \sum_{i=1}^{N} w_i (y_{imt} - \hat{y}_{imt})^2 \tag{8}$$

where w_i is calculated using Equation (7), y_{imt} is the outcome variable of interest, β represents the parameter of interest, and $\hat{y}_{imt}$ is the predicted outcome given the difference-in-differences specification.

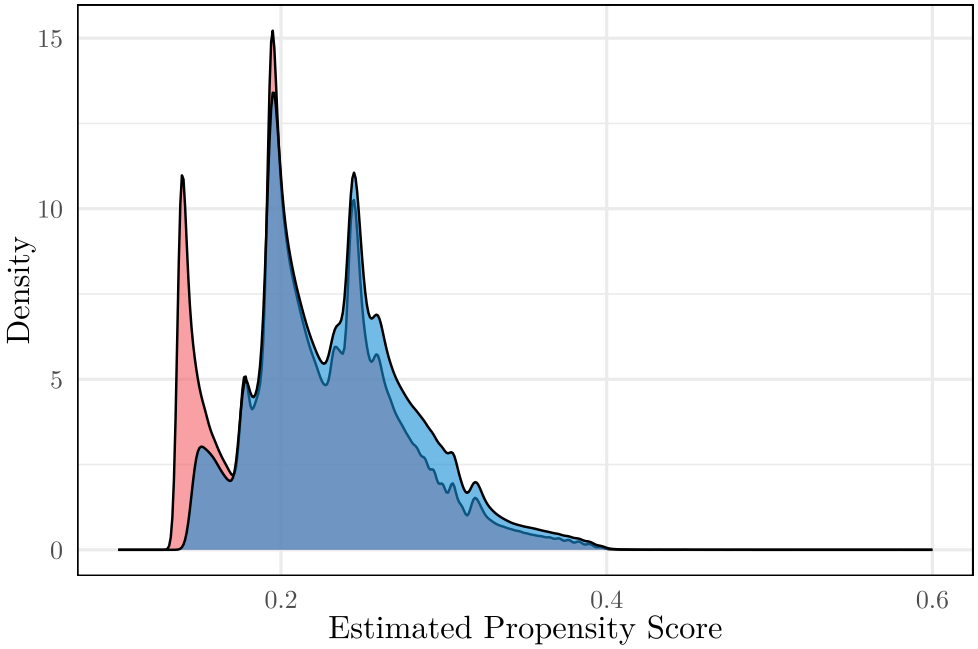
Propensity Score Density and Covariate Balance The covariates used to estimate the propensity score are time-invariant worker characteristics plausibly correlated with wages. Specifically, we include a binary indicator for race (white vs. non-white), gender, age and its quadratic term to capture nonlinear effects, and a set of educational attainment dummies distinguishing individuals with incomplete high school, completed high school, and completed college.

Figure F.1a shows the distribution of estimated propensity scores for the treatment group (blue) and the control group (red). While the control group is more concentrated at lower propensity scores, there is substantial overlap between the two distributions. This overlap ensures adequate common support, allowing for the construction of valid counterfactuals and the reliable application of inverse propensity score weighting.

Figure F.1b presents the standardized mean differences for each covariate between the control and treatment groups. The horizontal axis represents the magnitude of imbalance, with the vertical axis listing covariates. A commonly used threshold of 0.1 indicates acceptable balance. All covariates fall below this threshold, suggesting strong balance on observables

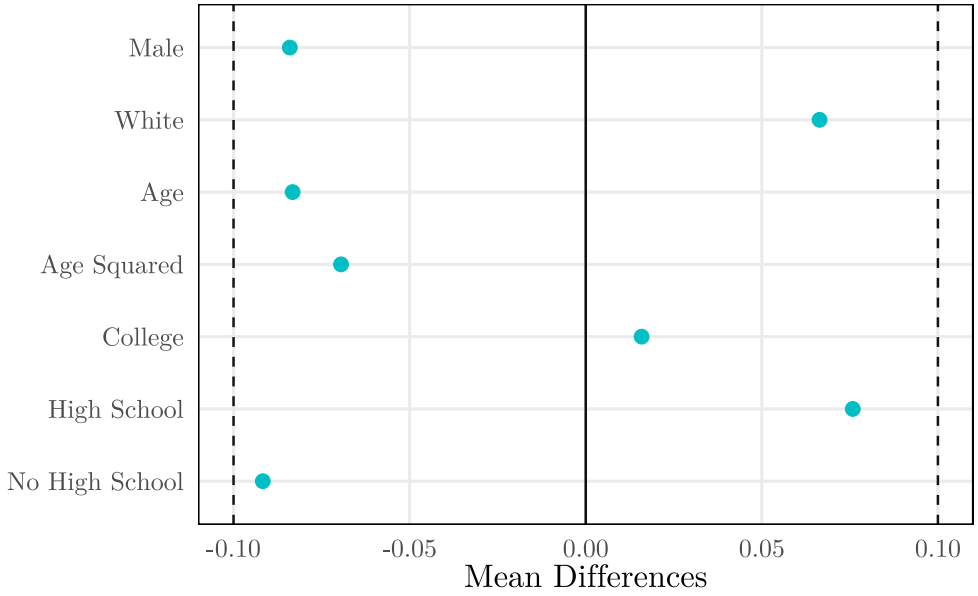
and reinforcing the credibility of our identification strategy.

As a supplementary analysis focused on the informal market, we also implement a doubly robust approach, where both the propensity score distribution and covariate balance are satisfactorily achieved in Figure F.2.



(a) Control and treatment group density of propensity scores.

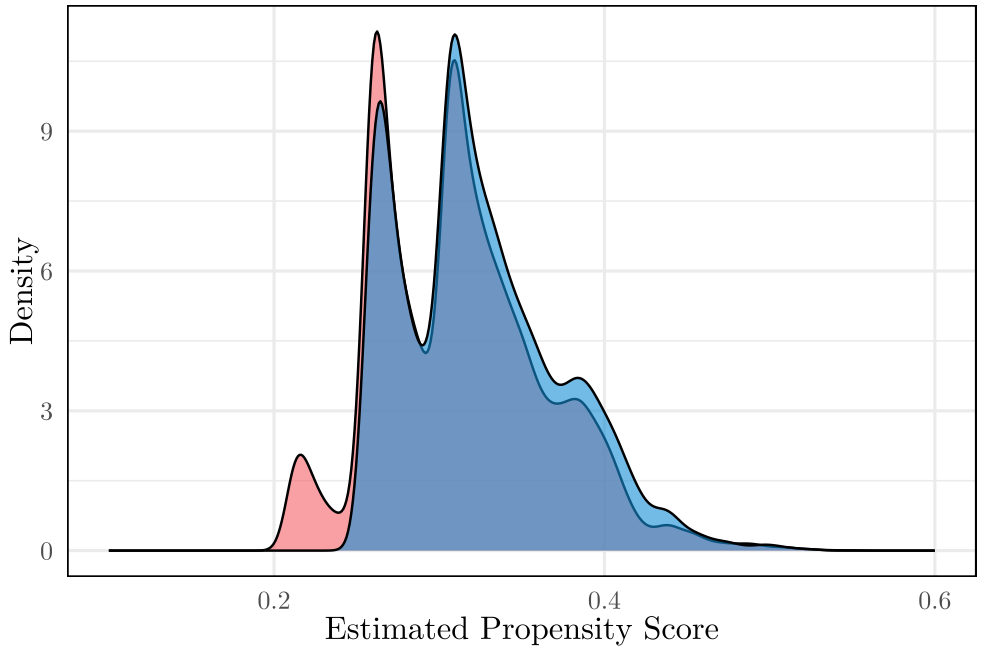
Note: Control group (Acre and Amapá) represented as the red distribution, treatment group (Roraima) represented as the blue distribution.



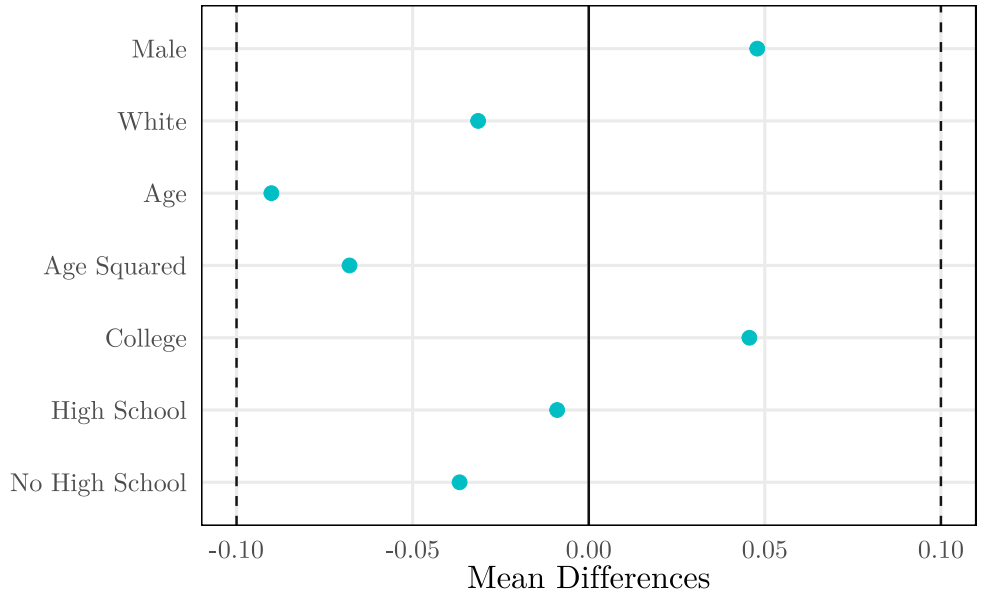
(b) Covariate balance (Love Plot) by standardized differences after weighting.

Figure F.1: Propensity Score Density Plot and Covariate Balance for the RAIS dataset.

Note: Points represent the standardized difference between the control and treated group average covariate values.



(a) Control and treatment group density of propensity scores.



(b) Covariate balance (Love Plot) by standardized differences after weighting.

Figure F.2: Propensity Score Density Plot and Covariate Balance for the PNAD-C Informal Sample

Note: Points represent the standardized difference between the control and treated group average covariate values.

G Wage Effects for New Entrants

Because our individual fixed effects models rely on within-person variation over time, they do not capture the outcomes of Brazilian workers who enter the formal labor market after the refugee crisis. These new entrants may face different wage dynamics than incumbent workers, particularly if they entered sectors more directly affected by the inflow of Venezuelan refugees. To examine this, we conduct an analysis using a subsample of new entrants, the workers who are first observed in the dataset during or after the treatment period.[19]

Table G.1 presents the results from this analysis using Equation (1), with the only modification being the exclusion of individual fixed effects, since each worker appears only once in the sample. However, we include municipality fixed effects to account for time-invariant differences across municipalities that may be correlated with both refugee inflows and wage outcomes.

The results in column (3) using our preferred specification show that new entrants experienced a 2.5% increase in wages, on average, in the post-treatment years compared to control states. This finding provides additional support for the positive labor market effects of the refugee crisis, suggesting that even workers entering the formal sector during the years of the refugee crisis benefited from improved wage outcomes.

[19]We thank the anonymous reviewer for suggesting this analysis.

Table G.1: DID Estimates of Venezuelan Immigration on Log Wages on New Entrants

	(1)	(2)	(3)
RR × Post	−0.004	0.023***	0.025***
	(0.007)	(0.006)	(0.006)
Year FE	X	X	X
Municipality FE	X	X	X
Demographic Controls		X	X
Shift-Share Labor Demand Control			X
R^2 Adj.	0.035	0.268	0.268
RMSE	0.534	0.465	0.465
Num.Obs.	675.509	675.509	675.509
No. of Clusters	53	53	53

Notes: All regressions use 2007–18 data on the sample of first entrant formal market workers from the Brazilian states of Roraima, Acre, and Amapá. All regressions present estimates from the difference-in-differences regression model specified in equation (1). Treat variable equals 1 if a worker is from Roraima from year 2014 or later. Column (1) regression includes municipality and year fixed effects. Column (2) additionally controls for demographic characteristics, including age, age-squared, and tenure. Column (3) additionally includes municipality fixed effects. Column (4) also controls for shift-share measure of local economic conditions to control for 2014–16 recession. All specifications use the IPW weights generated using a logistic regression that includes race, age, age-squared, education level, and gender as predictors. Standard errors in parentheses are clustered at the municipality level. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

H Wage Effects in the Informal Sector

The main analysis in the paper focuses on formal sector labor market outcomes using linked administrative data, RAIS, which allows us to precisely track individual workers over time, identify their sector and occupation, and distinguish between Brazilian citizens and foreign-born individuals. However, as noted in the main text, a significant share of the labor force in Roraima, at approximately 45%, is employed informally, and many Venezuelan refugees are likely to participate in this segment of the labor market. To provide a more complete picture of the refugee crisis's labor market impacts, we conduct a complementary analysis using data on informal workers.

We use the 2012-18 data from the National Household Sample Survey (PNAD-Continuous or PNAD-C) collected by the Brazilian Institute of Geography and Statistics (IBGE).[20] The PNAD-C is a nationally representative quarterly rotating panel survey that includes detailed information on respondents' labor market status, earnings, education, demographic characteristics, and other household attributes. Crucially, it also allows us to distinguish formal from informal workers based on whether the worker has a signed employment contract (carteira assinada), receives social security benefits, or contributes to a pension plan through their employment. We restrict our wage analysis to individuals who are classified as informally employed.[21]

This analysis complements our RAIS-based estimates by providing insights into labor market dynamics among workers not covered in administrative data, especially lower-educated individuals, new entrants, and foreign-born workers without legal work authorization, who are more likely to be employed informally.

While the PNAD-C provides rich data on informality and a broader segment of the labor

[20]PNAD-C officially began in January 2012. It was initially launched experimentally in October 2011 and then expanded to cover the entire Brazilian territory from January 2012 onward. This explains the difference in our PNAD-C sample years (2012-18) from our RAIS sample years (2007-18).

[21]We define informal workers as those in one of the following occupation and employment categories: private-sector employees without a formal contract, domestic workers without a formal contract, and unpaid family workers.

force, it has several limitations relative to RAIS. First, PNAD-C does not include unique personal identifiers, so we cannot construct a true panel or estimate individual fixed effects.

Second, it does not report respondents' nationality or migration status, meaning we cannot directly distinguish Venezuelan refugees from Brazilian citizens. This likely biases our estimates downward, as newly arrived refugees, many of whom are unemployed or earn very low wages, are included in the sample, potentially depressing average observed wages in the post-treatment period.

Third, in northern states like Roraima, the PNAD-C sample is heavily concentrated in the state capital (Boa Vista), which may not fully represent rural or smaller urban labor markets. In light of this, we restrict all shift-share instruments and location-specific controls (e.g., shift-share local labor demand shocks) to the state capital municipality to maintain internal consistency.

H.1 Summary Statistics

Table H.1 presents descriptive statistics comparing workers in Roraima to those in control states in 2015. On average, workers in Roraima earned higher log hourly wages (1.73 vs. 1.55), were more likely to have completed college (13.3% vs. 9.0%), and were slightly younger. The occupational distribution indicates that Roraima had a smaller share of workers in low-skill occupations such as elementary occupations (28.6% vs. 41.4%) and a larger share in public administration, administrative support, and managerial roles. Similarly, the sectoral distribution shows that domestic work was less prevalent in Roraima (16.8% vs. 29.3%), while employment in public administration, education, and health was more common. These patterns suggest that Roraima had a somewhat more educated and formal labor force, with greater public sector presence and a lower concentration in the most precarious job categories compared to the rest of the country.

H.2 Empirical Specification

To estimate the impact of the Venezuelan refugee crisis on informal wages, we adopt a difference-in-differences design that compares informal workers in Roraima before and after the onset of the crisis (post-2014) to a set of control states—specifically Acre and Amapá—that are demographically and geographically similar but did not experience comparable refugee inflows. We estimate regressions of the form:

$$y_{it} = \beta D_{it} + x'_{it}\alpha + r'_{st}\lambda + \chi_s + \omega_q + \alpha_t + \varepsilon_{it} \tag{9}$$

Equation 9 estimates the impact of the Venezuelan refugee crisis on log hourly earnings y_{it} for informal worker i in quarter t. The treatment variable D_{it} is an indicator equal to 1 for individuals in Roraima observed in 2014 or later. The vector x_{it} includes demographic controls: age, age squared, education, sex, and race. The term r_{st} represents the shift-share control for local labor demand shocks, constructed using baseline sectoral shares and national growth rates from RAIS data, and restricted to the state capital. The model includes state fixed effects χ_s, quarter fixed effects ω_q, and year fixed effects α_t. All specifications apply inverse probability weights (IPW), estimated from a logistic regression on observable characteristics to ensure covariate balance between treated and control groups. Standard errors are clustered at the municipality $\times$ quarter $\times$ year level.

While we interpret results from the informal sector with caution given the aforementioned data limitations, the PNAD-C estimates provide useful evidence on the extent to which informal sector wages may have been affected by the refugee crisis and whether labor market pressures differ by sector (e.g., commerce vs. services) or demographic group (e.g., education level). The results are presented in Tables H.2, H.3, and H.4 below.

H.3 Results

Across all model specifications in Table H.2, we find that the Venezuelan refugee crisis had a statistically significant negative effect on informal hourly wages in Roraima. The baseline specification in Column (1) shows a 10.2% decline in wages, which decreases to approximately 6.8–6.9% after adjusting for observable worker characteristics and local labor demand shocks. In sectoral analyses (Table H.3), we observe that the negative wage effects are concentrated outside the commerce sector, as the interaction term for commerce is small and statistically insignificant. In contrast, results by education group (Table H.4) indicate that less-educated informal workers may have experienced larger wage declines, although interaction terms by education level are not statistically significant. These results suggest that the refugee inflow may have exerted downward wage pressure on the informal labor market, with heterogeneous impacts across sectors and education levels. However, given that we cannot identify Venezuelan refugees in the PNAD-C data, the observed wage declines may partly reflect the inclusion of low-earning Venezuelan workers in the post-treatment sample; these findings should therefore be interpreted with caution.

Table H.1: Descriptive Statistics: Roraima vs. Other Brazilian States (2012 and 2013)

Measure	Roraima	Other States
Panel A: Regional Summary Statistics		
Total observations	4415	9450
Mean log hourly wage	1.73	1.55
SD of log hourly wage	0.80	0.75
Male workers (%)	53.9	48.0
White workers (%)	14.2	18.8
Mean age (years)	31.7	33.0
College education (%)	13.3	9.0
High school education (%)	26.6	27.2
No high school education (%)	60.1	63.9
Panel B: Occupation Distribution (%)		
Elementary occupations	28.60	41.40
Grocery and supermarket service workers	17.60	17.00
Construction helpers	9.20	9.20
Scientific workers	9.00	7.90
High school technicians	8.40	6.60
Administrative assistant	9.80	5.60
Machine operators	5.00	4.70
Managers	5.30	2.80
Rural workers	4.60	2.20
Not declared	2.40	2.50
Panel C: Economic Activity Distribution (%)		
Domestic workers	16.80	29.30
Commerce, retail, and wholesale	14.90	15.20
Public administration	18.10	13.10
Education and health	11.70	8.00
Rural sector	9.20	8.40
Service and administration	5.50	5.60
Hospitality	5.80	5.10
Construction	5.40	5.10
Manufacturing	6.00	4.30
Other services	4.60	4.00
Transport, logistics, and post office	1.90	1.80

Notes: Based on 2012-13 PNAD-C data from Brazil's Ministry of Labor.

Table H.2: DID Estimates on the Effects of Venezuelan Immigration on Informal Sector Log Wages

	(1)	(2)	(3)
RR × Post	−0.102***	−0.069***	−0.068***
	(0.021)	(0.018)	(0.018)
Year FE	X	X	X
Quarter FE	X	X	X
Municipality FE	X	X	X
Demographic Controls		X	X
Shift-Share Labor Demand Control			X
R^2 Adj.	0.010	0.159	0.159
RMSE	0.753	0.694	0.694
Num.Obs.	52,658	52,658	52,658
Num.Clusters	84	84	84

Notes: This table reports difference-in-differences estimates of the impact of the Venezuelan refugee crisis on log hourly wages in the informal labor market, using data from the PNAD-Continuous (PNAD-C) household survey from 2012 to 2017. The treatment group consists of individuals residing in Roraima during the post-2014 period. Column (1) includes municipality, quarter, and year fixed effects. Column (2) adds demographic controls: age, age squared, sex, education, and race. Column (3) incorporates a shift-share control for local labor demand shocks, constructed using baseline sectoral composition at the state level and national sectoral growth rates. This control variable is derived from RAIS data and is restricted to the state capital, as PNAD-C primarily samples the capital municipality in northern Brazilian states. All specifications apply inverse probability weights (IPW), estimated from a logistic regression on age, age squared, sex, education, and race, to ensure covariate balance. Standard errors, clustered at the municipality × quarter × year level, are reported in parentheses. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

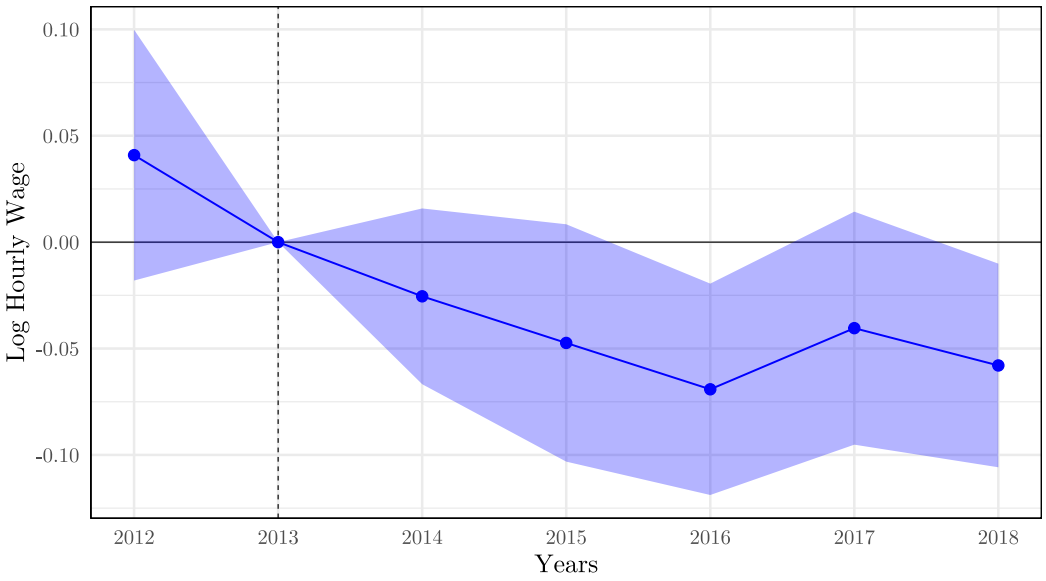


Figure H.1: Event Study: Effects of the Venezuelan Refugee Crisis on Brazilian Workers' Wages in the Informal Sector

Notes: This figure plots the event study coefficients with log hourly wages as the outcome variable. The baseline year for comparison is 2013, the year preceding the onset of the Venezuelan refugee crisis. The blue shaded region represents the 95% confidence interval.

Table H.3: DID Estimates on the Effects of Venezuelan Immigration on Informal Sector Log Wages (Heterogeneity by Sector)

	(1)	(2)	(3)
RR × Post	−0.098***	−0.063***	−0.063***
	(0.022)	(0.018)	(0.018)
RR × Post × Commerce	−0.009	−0.020	−0.020
	(0.026)	(0.020)	(0.020)
Commerce	−0.263***	−0.196***	−0.196***
	(0.010)	(0.010)	(0.010)
Year FE	X	X	X
Quarter FE	X	X	X
Municipality FE	X	X	X
Demographic Controls		X	X
Shift-Share Labor Demand Control			X
R^2 Adj.	0.028	0.168	0.168
RMSE	0.747	0.690	0.690
Num.Obs.	52 658	52 658	52 658
Num.Clusters	84	84	84

Notes: This table reports difference-in-differences estimates of the impact of the Venezuelan refugee crisis on log hourly wages in the informal commerce sector, using data from the PNAD-Continuous (PNAD-C) household survey from 2012 to 2017. The treatment group consists of individuals residing in Roraima during the post-2014 period. Commerce is a binary indicator equal to one for individuals employed in the commerce sector. Column (1) includes municipality, quarter, and year fixed effects. Column (2) adds demographic controls: age, age squared, sex, education, and race. Column (3) incorporates a shift-share control for local labor demand shocks, constructed using baseline sectoral composition at the state level and national sectoral growth rates. This control variable is derived from RAIS data and is restricted to the state capital, as PNAD-C primarily samples the capital municipality in northern Brazilian states. All specifications apply inverse probability weights (IPW), estimated from a logistic regression on age, age squared, sex, education, and race, to ensure covariate balance. Standard errors, clustered at the municipality × quarter × year level, are reported in parentheses. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

Table H.4: DID Estimates on the Effects of Venezuelan Immigration on Informal Sector Log Wages (Heterogeneity by Education)

	(1)	(2)	(3)
RR × Post	−0.076***	−0.078***	−0.077***
	(0.020)	(0.020)	(0.019)
High School	0.106***	0.120***	0.121***
	(0.012)	(0.013)	(0.013)
College	1.110***	1.032***	1.032***
	(0.021)	(0.024)	(0.024)
RR × Post × High School	0.015	−0.009	−0.012
	(0.032)	(0.031)	(0.031)
RR × Post × College	−0.039	−0.065**	−0.066**
	(0.034)	(0.030)	(0.030)
Year FE	X	X	X
Quarter FE	X	X	X
Municipality FE	X	X	X
Demographic Controls		X	X
Shift-Share Labor Demand Control			X
R^2 Adj.	0.113	0.149	0.149
RMSE	0.713	0.698	0.698
Num.Obs.	52 658	52 658	52 658
Num.Clusters	84	84	84

Notes: This table reports difference-in-differences estimates of the impact of the Venezuelan refugee crisis on log hourly wages in the informal education sector, using data from the PNAD-Continuous (PNAD-C) household survey from 2012 to 2017. The treatment group includes individuals residing in Roraima during the post-2014 period. High School and College are binary indicators of a worker's education level. Column (1) includes municipality, quarter, and year fixed effects. Column (2) adds demographic controls: age, age squared, sex, education, and race. Column (3) incorporates a shift-share control for local labor demand shocks, constructed using baseline sectoral composition at the state level and national sectoral growth rates. This control variable is derived from RAIS data and is restricted to the state capital, as PNAD-C primarily samples the capital municipality in northern Brazilian states. All specifications apply inverse probability weights (IPW), estimated from a logistic regression on age, age squared, sex, education, and race, to ensure covariate balance. Standard errors, clustered at the municipality × quarter × year level, are reported in parentheses. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.