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Refugee Crisis and Labor Market Outcomes in Brazil

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Refugee Crisis and Labor Market Outcomes in Brazil*

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Abstract

Refugee influx is a contentious and sensitive topic for politicians, policy-makers and general public alike. An often neglected factor is the increase in the demand for goods and services that refugees create in the local economy which can drive up the income of the host country population. We use difference-in-differences on administrative data of the universe of formal sector workers to investigate the effects of the Venezuelan refugee crisis in Brazil. We isolate Roraima as the treatment state where the vast majority of refugees in Brazil went to, and use three other northern states as controls. We found a positive overall effects in wages of Brazilians in Roraima. These results are robust when we use the an instrumental variable approach. We use an instrument that is a function of foreigner share of the population in a municipality in 2012 and the road distance between a municipality and the Venezuela-Brazil border. We also disaggregate the effects at the economic sector level and consider three sectors with highest share of Venezuelans post-treatment. We find negative effects on wages in restaurants sector that was highly penetrated by Venezuelans. However, construction sector experienced higher wages due to the increased housing demands. We also perform our analysis using synthetic control method with a household survey data, however, the results are not robust to placebo tests.

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

JEL Codes: J30, J40, J61

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1 Introduction

The impact of refugees on the labor market of a host country is a topic of immense policy concern. Refugees form a subset of immigrants who are distinct from the others due to their more vulnerable position. There are conflicting findings on the effects of such refugees on labor market outcomes, mostly due to the differences in methodology but also the sociopolitical context of the host country. While refugees increase demand for products and services, thus improving local incomes, the labor supply shock that they create may also affect wages and unemployment among the natives. If the refugees disproportionately enter the informal labor market where the economically poor are mostly involved in, it may further exacerbate the preexisting socioeconomic inequalities.

To understand the labor market impacts of refugees in an emerging economy, we use the Venezuelan refugee crisis in Brazil. The crisis started due to the global oil price drop in 2014. This led to a convoluted series of sociopolitical and economic changes in Venezuela that forced millions away from the country. This exodus primarily began in 2015, with much larger waves in later years. UNHCR (2021) estimates that as of December 2021, more than four million Venezuelans are living as refugees. Out of them, around 260,000 are currently living in Brazil, mostly concentrated in the border state of Roraima.

This paper studies the impacts of the Venezuelan refugee influx on labor market outcomes of Brazilian citizens. Labor market outcomes we analyze include wages, employment, firm hiring, and entrepreneurship. We use three datasets, the Annual Social Information Report (RAIS) from the Federal Government of Brazil's Ministry of Labor and Employment (MTE) ¹, the Continuous National Household Sample Survey (PNAD-C) conducted by the Brazilian Institute of Geography and Statistics (IBGE), and the refugee application data collected by the National Committee for Refugees (CONARE).

We first use a two-way fixed effects (TWFE) event study approach on a balanced version of the RAIS data. Since most of the refugees in Brazil are concentrated in the state of Roraima which is geographically isolated from the rest of the country, we take Roraima as the treatment unit. We

¹After 2018's presidential election, the Ministry has been combined with the Ministry of Economy

thus focus on the labor market impacts in Roraima with comparison to three control states that are demographically and geographically similar to Roraima – Acre, Amapa, and Rondonia. Using TWFE models, we find that the refugee influx increased the wages of Brazilian citizens in Roraima in the years following 2015. There is a positive trend in the effect going from 2014 to 2017 by between 2.72 percent in 2015 to 12.26 percent in 2017. The direction of effect is robust to both individual fixed effects and municipality fixed effects. We also analyze the labor market impacts in the three economic sectors with the highest concentration of Venezuelan refugees as per the RAIS data – wholesale and retail commerce, construction, and restaurants. We find that construction sector saw an increase in the wages of Brazilian citizens in Roraima. Journalistic evidence suggests that there was a boom in the construction sector in Roraima that could be driven by the increase in the demand for housing due to the increased population.

We also use instrumental variable approach using the RAIS and CONARE data. In order to remove the endogeneity bias when regressing labor market outcomes on the number of refugees in the municipality, we use two separate instruments: (1) the road distance between a municipality and the Brazil-Venezuela border and (2) a ratio of the share of foreigners in a municipality in 2012 and the road distance between the municipality and the Brazil-Venezuela border. Both of these IV approaches suggest a positive increase in the wage of Brazilian citizens. Estimates using the second instrument show that on average, the increase of a thousand Venezuelans in a municipality increased wages by around 11 percent. Disaggregating the results by economic sector, we see a negative effect on the wages of Brazilian citizens involved in the restaurant sector, the sector with the highest share of Venezuelans working, which confirms that while the overall economy prospers from the refugee influx, those in the economic sector with the highest penetration of refugees face an adverse effect as a result of the labor supply shock.

Similarly, using synthetic control method (SCM) on PNAD-C data, we find weak results implying an increase in employment, decrease in formal and informal wages and a decrease labor force participation. However, the results fail, with lower mean squared prediction error ratio when compared to placebo counterparts.

There is considerable literature on the impacts of immigration on labor markets. Peri (2016) has a comprehensive review of the literature. However, refugees are a distinct category of immigrants who are forcibly displaced from their home country. The literature on the labor market impacts of such displacement in the host country is small but growing.

Card (1990)'s paper on the 1980 Mariel boatlift from Cuba found no significant effects on the labor market in Miami. With the use of different econometric strategies, the result is further confirmed by Clemens and Hunt (2017) and Peri and Yasenov (2019), but Borjas (2017) found slightly negative results. These weak results may be driven by the city's ability to incorporate these individuals into the already developed labor market.

A few papers have explored this question in the context of developing countries. Maystadt and Verwimp (2014) found slightly negative impacts of Rwandan and Burundian refugees on Tanzanian agricultural labor market. Ruiz and Vargas-Silva (2016), however, found that Tanzanians adjusted to the refugee influx by changing economic activities in the long run. Conversely, Alix-Garcia et al. (2018) found that natives living near refugee camps benefit from new employment and favorable price changes.

There is also a series of recent studies examining the labor market effects of the Syrian refugee crisis in the neighboring countries. While Fallah, Krafft, and Wahba (2019) finds no significant effects of the crisis in the Jordanian labor market, Tumen (2016) found that there is a small but significant impact of Syrian refugee influx in Turkey in terms of informal employment losses among natives. Cengiz and Tekgüç (2022) in their study on Syrian refugees in Turkey argue that refugees bring capital and purchasing power to local economies and shift the labor demand to offset any negative labor supply effects.

There is also a small number of studies on the labor market impacts of Venezuelan refugees. Bahar, Ibáñez, and Rozo (2021) study the labor market impacts of a large migratory amnesty program that granted work permits to nearly half a million undocumented Venezuelan migrants in Colombia in 2018. Their analysis indicates no significant impact of the program on hours worked, wages, or labor force participation of Colombian workers, but finds that there were

negligible negative effects on formal employment for female and highly educated Colombian workers. Bonilla-Mejía et al. (2020) found no significant effect on non-immigrants' unemployment in Colombia following the Venezuelan refugee inflow. Similarly, Santamaria et al. (2020) using Google search data to locate refugees across Colombia finds negligible changes in wages after the migration induced supply shocks.

To the best of our knowledge, Ryu and Paudel (2022) is the only paper that addresses the crisis from the Brazilian perspective. They use synthetic control method (SCM) to study the labor market impacts of Brazilian refugees in Roraima using PNAD-C, the Brazilian quarterly household survey. The studied period ranges from 2014 to mid-2018. Using 2016 as when the treatment started, they find the crisis lowered labor force participation and employment rate in Roraima but had no significant impact on hourly wages. The paper also finds that the labor force participation among less educated individuals decreased by a larger magnitude.

Our contribution is the use of the Annual Report of Social Information (RAIS), an administrative dataset that provides the universe of formal workers in Brazil, where we can observe wages, social features, and nationality at the individual level. Therefore we point out when the influx of immigrants started happening with more precision. We also use refugee status request data from the National Committee for Refugees (CONARE) that gives a much better view of the situation at the municipality level. We propose expanding the experiment periods by going from 2012 to 2017, first to make sure we get periods not affected yet by the refugee crisis and also to avoid 2018 as the situation changed in Roraima due to the federal intervention in December 2018. Most importantly we changed our treatment period to 2015, where the presence of Venezuelans becomes more evident in the data.

The paper also contributes to the existing literature by providing empirical evidence on the labor market impacts of a refugee crisis in an emerging economy context. Most of the prior studies use contexts in which refugees form a negligible part of the local population. Just like in the case of Fallah et al. (2019) on Syrians in Jordan, Venezuelans form a big chunk of the total population of the host state of Roraima. Therefore, the impacts could be very different from cases like that of

the Mariel boatlift refugees, in which the local Miami economy was large enough to adjust to the shock of incoming Cubans.

The remainder of the paper is organized as follows. Section 2 explains the background of the crisis, the geographical setting, and the Brazilian labor market. Section 3 describes the data. Section 4 explains the empirical strategy. Section 5 discusses the results before Section 6 concludes.

2 Background

2.1 The Venezuelan crisis

Venezuela has the largest proven oil reserves in the world. The commodity boom of the 2000s provided the country with funds not seen since the country struggle in 1980s. Hugo Chavez, the then president, introduced social and economic policies viewed as populist that ultimately led to a large dependency on oil exportation. Its sales make up more than 95% of exports. However, by 2014 the price went from more than US\$100 in 2014 to US\$40 per barrel by 2016.

This phenomenon coupled with a series of government mismanagement created an unprecedented humanitarian crisis. Hyperinflation, shortage of goods and services, and an upsurge in crime provoked an exodus of Venezuelans. The United Nation Humanitarian Crisis Report estimates that as of December 2021, more than 5 million Venezuelans are living as refugees. The top destinations are countries such as Colombia, Peru and Ecuador, with a significant number moving to Brazil. Due to geographical conditions we will explore later, most of the refugees in Brazil are concentrated in the state of Roraima. The numbers reported vary, but it suffices to say more than half a million of Venezuelans entered Brazil since 2015. While a fraction of them used Brazil as a transit to enter other countries, Roraima absorbed most of these immigrants. By the time we wrote this article, around 15% of Roraima's population was composed by Venezuelans.

2.2 Brazilian job market

Mercosul is an economic block formed by a majority of South American countries including Venezuela and Brazil. As a result, Venezuelans enjoy not only free entry to Brazil, but refugee or residency status following their request to the Brazilian government. It allows an individual to have a home and a job in the formal sector. For that, a refugee must apply to the government the necessary documentation to work in the formal labor market, which usually takes months to be finalized. In the data section, we dissect the characteristics of the Venezuelan formal workers present in RAIS.

In theory, for a firm to be allowed to operate in Brazil it must have a National Registry of Legal Person number (CNPJ). A Legal Person in Brazil is an entity made by one or more Physical Persons (a company or NGO, for example). To be registered means the owners must declare the objective of the entity and their intended activity to the government. When the owner does not register the firm, it becomes informal. In summary, what defines the formal and the informal market in Brazil is the existence of a Legal Person registry for a given firm. The cost of registry for a company is usually high, so informality is common in poor regions of the country.

There are some interesting particularities regarding the formal market. A firm as a Legal Person must hire only formal workers. Being under the National Registry means employers and employees have the right to social security and workers have several rights the firm owner must guarantee by law. Being a Legal Person also effectively separates the responsibilities of the company from the individuals inside it.

In general, workers under the formal market (also known as CLT workers) earn more due to the benefits when compared to their informal counterparts. This can be shown using the household survey data (compare the wage trends of formal and informal using PNAD-C in Figure 7).

The government uses PNAD-C as the official dataset to calculate employment, formal/informal labor force participation, fertility, and other social indicators. The bureau responsible for the data collection and measurements is the Brazilian Institute of Geography and Statistics (IBGE). We follow IBGE's method of categorizing individuals into formal and informal economies. In the

formal economy, we include private or public sector employees with a formal contract, and domestic workers with a formal contract. In contrast, for the informal economy, we include employees in the private or public sector without a formal contract, and domestic workers without a formal contract. Labor force participation additionally includes individuals looking for jobs, divided by individuals above 14 years old.

For RAIS, the universe of formal workers is observed. We can count the unique social identification numbers to calculate the participation in the labor market or employment. We also count unique firm identification numbers.

2.3 Geographical Setting

The geographical setting is crucial to our identification strategy. In principle, Venezuela borders the Brazilian states of Amazonas and Roraima, as illustrated in Figure B1. However, it is impossible to cross the Amazonas frontier by land. It is entirely covered by the Amazon Rainforest, mountains and rivers, creating an unlikely path for refugees to cross. Venezuelans enjoy free entry, so there is no reason to undertake such a journey. On the other hand, Roraima is connect by the BR-174 Highway. This is the only land transportation path connecting the two countries, as shown in Figure B2. The vertical red line represents the highway while the horizontal blue line is the geographical division between the two countries. If someone would like to reach Manaus, the capital of Amazonas, by land, it is mandatory to cross Roraima first.

Roraima is therefore isolated from the rest of Brazil, creating a high concentration of refugees who crossed the borders through the land route and stopped there. We will show in our data section that Roraima concentrates virtually all Venezuelan formal workers.

This setting provides a natural experiment where Roraima acts as a treated unit post-2015. Instead of employing most of the country as our counterfactual, we use the other frontier states of Brazil in the north: Acre, Rondônia and Amapá, that not only share similar demographic, socioeconomic, and geographical statistics but they are also border states. Acre borders Peru and Bolivia, Rondônia borders only Bolivia, and Amapá borders Suriname and France.

3 Data

We primarily use two datasets: Annual Social Information Report (RAIS) and Continuous National Household Sample Survey (PNAD-C). We also use the data on the number of refugee application by municipality and year from the National Committee for Refugees (CONARE). Table A1 shows the comparison between the RAIS and PNAD-C datasets.

3.1 Annual Report of Social Information (RAIS)

Our primary dataset is the RAIS, which is an annual administrative dataset that covers the universe of Brazilian formal labor workers. It is comprised of extensive information on firms and employees, including information on occupation, contract type, earnings, economic activity, and individual characteristics like gender, age, education, and nationality, among others. We use RAIS data from 2012 to 2017. We allow the first pre-treatment period to be 2012 to avoid it being too far from the crisis. For the post-treatment, we stop at 2017 due to several particularities of 2018.²

The total sample size of this dataset is over 6 million observations after keeping the four states. When we filter only social identifiers present in both pre and post treatment periods we obtain around 5 million observations. The panel nature of this dataset allows us to use individual fixed effects to remove the effects of time-invariant unobserved characteristics.

Table 1 presents the summary statistics comparing the demographic characteristics of Brazilian citizens in Roraima and the three control states before and after the crisis. There is no notable age variation between pre and post-treatment, among controls and Roraima. Formal workers in the region are, on average, 35 years old with approximately 11 years of standard deviation. For the second part of the table, we divided wage earnings into three cohorts. The first cohort has earnings below the 25th percentile. The second, between 25th and 75th, and the third above the 75th percentile. Low and Middle income cohorts have approximately the same range of income,

²The local government was a target of corruption scandal and a financial crisis during the year. The treasury declared no funds and no payment to public officers, including law enforcement agents. This led to widespread prison break and rebellions across the state. In the end of 2018, the situation was irreversible and the federal government intervened by December of that year. To avoid confounding results, we stop at 2017 in our analysis.

around BR\$1,000-BR\$2,000. High income, on the other hand, has an average of approximately BR\$6,000, however, with a much higher distance from the mean, revealing a large inequality among wages in the population. In terms of variation across groups, Roraima has a small positive difference in average among high earners.

Race composition is a self-declared variable that sometimes are omitted. This can be seen in the table. More than half of Roraima's observations are other or race not declared. The second most declared value for race is mixed and white is a minority.

Roraima, when compared to the control states, has a slighter balanced sex ratio in the labor force, with around 0.9 female to male ratio. On the other hand, the control states have an approximate ratio of 0.72.

Table 1: Summary statistics for Brazilian in control states and Roraima (RAIS)

		Control States				Roraima			
		Pre-Treatment		Post-Treatment		Pre-Treatment		Post-Treatment	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
	Age	34.46	11.31	35.94	11.63	34.95	11.17	35.86	11.34
Wage	Low Income	1220.86	195.81	1204.48	185.40	1202.74	182.37	1172.70	161.33
	Middle Income	1867.18	281.18	1872.66	280.64	1845.66	288.55	1874.16	290.13
	High Income	5800.02	5467.99	5898.28	5432.33	6468.84	5944.31	6407.86	5745.85
	Total	2964.02	3737.33	2990.26	3760.48	3285.44	4322.60	3051.39	4044.93
		Percent	N	Percent	N	Percent	N	Percent	N
Race	White	16.27	444,386	13.70	342,816	8.50	32,762	7.27	28,065
	Mixed	43.66	1,192,566	39.87	997,599	38.65	148,950	36.12	139,509
	Other or Not Declared	40.07	1,094,632	46.43	1,161,829	52.84	203,632	56.62	218,697
Sex	Female	40.49	1,105,909	43.72	1,094,016	47.96	184,792	47.81	184,657
	Male	59.51	1,625,675	56.28	1,408,228	52.04	200,552	52.19	201,614
Education	No High School	30.28	827,187	22.63	566,219	21.78	83,928	18.42	71,145
	High School	56.35	1,539,379	56.29	1,408,436	56.49	217,668	55.62	214,854
	College Degree	13.36	365,018	21.08	527,589	21.73	83,748	25.96	100,272
	Total		2,731,584		2,502,244		385,344		386,271

Table 2 presents the summary statistics comparing the demographic characteristics of foreigners in the labor market of Roraima and the three control states, pre and post comparison. There are far less foreign workers in Roraima in the pre period than anywhere else in the data. Race composition is similar with Brazilians for every period, including control and treatment. However, female

and male ratio is much lower, with 80% and 76% of males for control in pre and post-treatment states respectively, and 64% and 71% of males for Roraima, pre and post respectively. In terms of income, Middle and Low cohort does not have any notable difference from Brazilians, but High income cohort earns around BR\$3,000 more than a Brazilian high income earner. However, bear in mind the standard deviation for the high income cohort is relatively large in magnitude. Also, foreigners are slightly more educated in comparison, with around 26% and 30% having a college degree for control states.

We should also take note on how suddenly Roraima received, after 2015, foreigners. While control states actually had a decrease of a little bit more than a thousand observations, Roraima from pre-treatment increased from 625 to 3,298, five times more. The vast majority of these are high school degree individuals.

Table 2: Summary statistics for foreigners in control states and Roraima (RAIS)

		Control States				Roraima			
		Pre-Treatment		Post-Treatment		Pre-Treatment		Post-Treatment	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
	Age	37.63	11.89	39.35	12.45	38.75	12.68	33.15	10.43
Wage	Low Income	1253.19	188.00	1249.14	182.52	1244.81	134.11	1170.30	160.26
	Middle Income	1901.22	300.52	1950.28	302.38	1780.23	258.96	1907.37	303.72
	High Income	9352.05	7667.40	9216.35	8712.18	8422.22	6473.32	9233.36	6872.21
	Total	4471.23	5970.51	4714.14	6661.38	2219.19	3178.34	4736.52	5900.83
		Percent	N	Percent	N	Percent	N	Percent	N
Race	White	11.99	799	10.41	571	14.24	89	7.97	263
	Mixed	28.80	1919	30.98	1700	35.04	219	48.15	1588
	Other or Not Declared	59.21	3945	58.61	3216	50.72	317	43.88	1447
Sex	Female	19.23	1281	23.73	1302	35.04	219	28.32	934
	Male	80.77	5382	76.27	4185	64.96	406	71.68	2364
Education	No High School	40.82	2720	32.35	1775	15.84	99	15.77	520
	High School	32.91	2193	37.27	2045	48.16	301	65.71	2167
	College Degree	26.26	1750	30.38	1667	36.00	225	18.53	611
Total			6663		5487		625		3,298

In RAIS, we also observe firm based economic activity which is essentially a code provided by the IBGE. Called the National Registry of Economic Activities, it is a seven digit code that identifies in great detail what type of activity a firm performs, called “exercise”. Although a firm

can have more than one code, what matters for our study is the primary exercise, provided in RAIS. Every firm must have a code designated in the registry alongside their national identification to perform in the formal sector. This is done by the firm owner and usually requires accountants to understand the firm activity and report it to the government. Failure to do so has severe implications to the Brazilian Internal Revenue.

Each digit in the coding system represents an additional level of detail. For example, 01 stands for Agriculture, Livestock, Forestry and Aquaculture. 01.5 stands for Livestock. If we go even further, we have 01.51-2, which represents bovine livestock. 01.51-2/02 is the highest level of detail, for companies having bovine livestock for milk production. For this paper, we extract the first two digits of the code. Details are shown in Table 3.

Table 4 and 5 expose the distribution of workers, Brazilians and Foreigners respectively, in pre-treatment periods. For Brazilians, the observations are more evenly distributed, with Roraima and Control states having Public as the largest economic activity presence. In second place, we have Commerce, followed by Construction and Services.

Statistics are different for foreigners in terms of their involvement in a particular economic sector. Most of the foreigners are involved in construction, while in Roraima, they are mostly involved in education and health. There was, relatively speaking, no significant foreign presence in construction, and restaurants in Roraima.

Looking at the overall amount, we can say foreign presence in the formal labor market is almost negligible in Roraima before 2015, when we compare it to the local population. In the next subsection, we will explore the nationalities before and after the crisis, and how this distribution changed.

3.1.1 Foreigners in the formal market

Here we explore the characteristics of the foreigners present in RAIS. A first glance at Figure 1 reveals that Haitians have the most common non-Brazilian presence in the northern states before 2015. The reason is that in the 2000s, Brazil led a United Nations peace keeping mission in Haiti.

Table 3: Categorization of CNAE's code.

Category name	First 2-digit code	IBGE definition
Agriculture	01...03	Agriculture, livestock, hunting, fishing and etc.
Industry	04...33	Transformation, manufacture, mining and extraction in general.
Construction	35...43	Infrastructure and construction. Building. Water, sewage and electricity.
Transportation	49...53	Transportation.
Restaurants	55...56	Restaurants and hotels.
Services	58...82	The extensive list can be found at IBGE's website .
Public	84	Everything related to public administration.
Education and Health	85...88	Schools and hospitals.
Culture	90...93	Culture.
Domestic	97	Domestic labor.
Other		Anything else not covered by the categories.

Table 4: Distribution of formal Brazilian workers by economic activity, pre-2015 (RAIS)

		Control States		Roraima	
		N	Pct.	N	Pct.
Economic Activity	Agriculture	63095	2.9	4829	1.5
	Commerce	537777	24.4	69740	21.9
	Construction	216400	9.8	20924	6.6
	Culture	4734	0.2	804	0.3
	Domestic	441	0.0	24	0.0
	Education and Health	126207	5.7	20604	6.5
	Restaurants	63558	2.9	10331	3.3
	Industry	185032	8.4	10150	3.2
	Other	39445	1.8	3756	1.2
	Public	697439	31.7	138281	43.5
	Services	199281	9.0	32620	10.3
	Transportation	68833	3.1	5764	1.8

The increased Brazilian presence in their country strengthened their relations, while many Haitians decided to move to Brazil to seek new opportunities. As expected, Latin Americans and Latin Europeans such as Portugal, Spain and France, are the top presence next to the Haitians, Bolivians being the second.

If we analyse unique observations from after 2015, the situation changes dramatically. Figure 2 shows that by far, the top nationality that entered RAIS after treatment was Venezuela, followed by Haitians and other Latin American nationalities.

One important issue is the presence of Haitians. Before proceeding with our study, we must make sure Haitians are not a growing population, but a population that is carried from past years

Table 5: Distribution of formal Foreign workers by economic activity, pre-2015 (RAIS)

Economic Activity	Control States		Roraima	
	N	Pct.	N	Pct.
Agriculture	67	1.6	10	2.1
Commerce	489	11.6	101	21.3
Construction	1252	29.8	38	8.0
Culture	9	0.2	5	1.1
Domestic	0	0.0	0	0.0
Education and Health	439	10.5	125	26.4
Restaurants	157	3.7	43	9.1
Industry	375	8.9	9	1.9
Other	70	1.7	13	2.7
Public	1071	25.5	84	17.7
Services	203	4.8	43	9.1
Transportation	66	1.6	3	0.6

Figure 1: Unique foreign observations (pre-2015 RAIS)

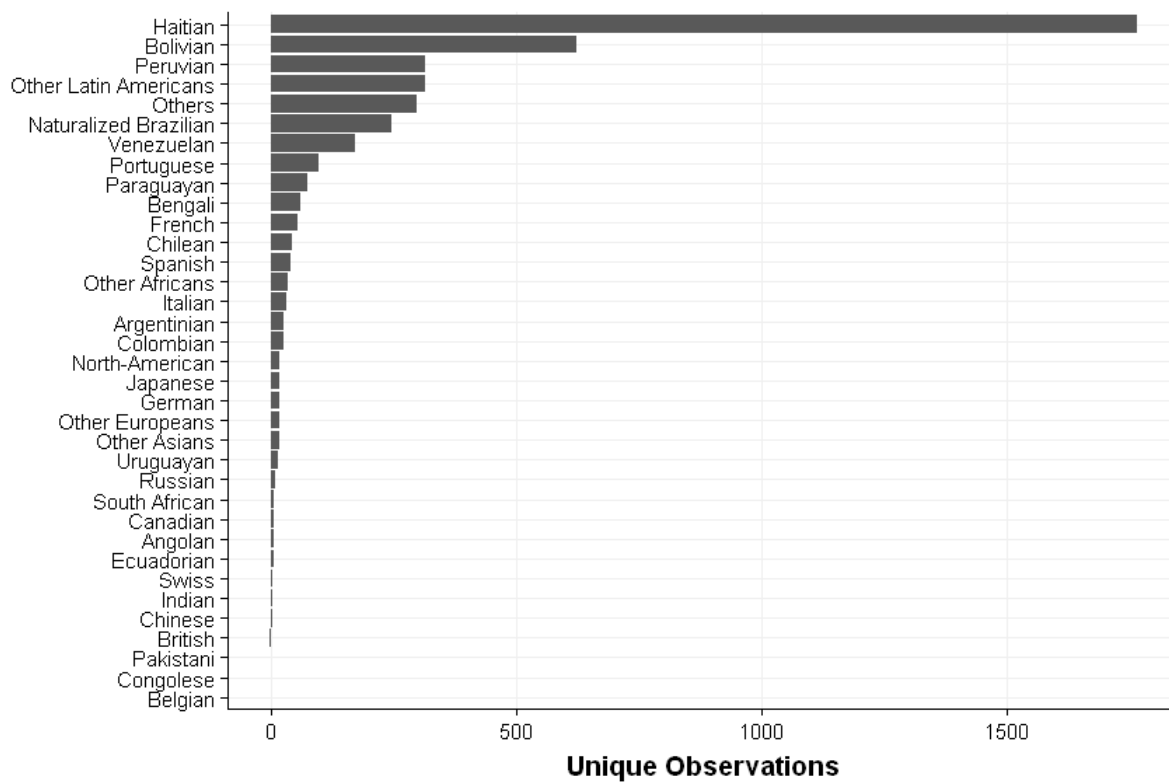
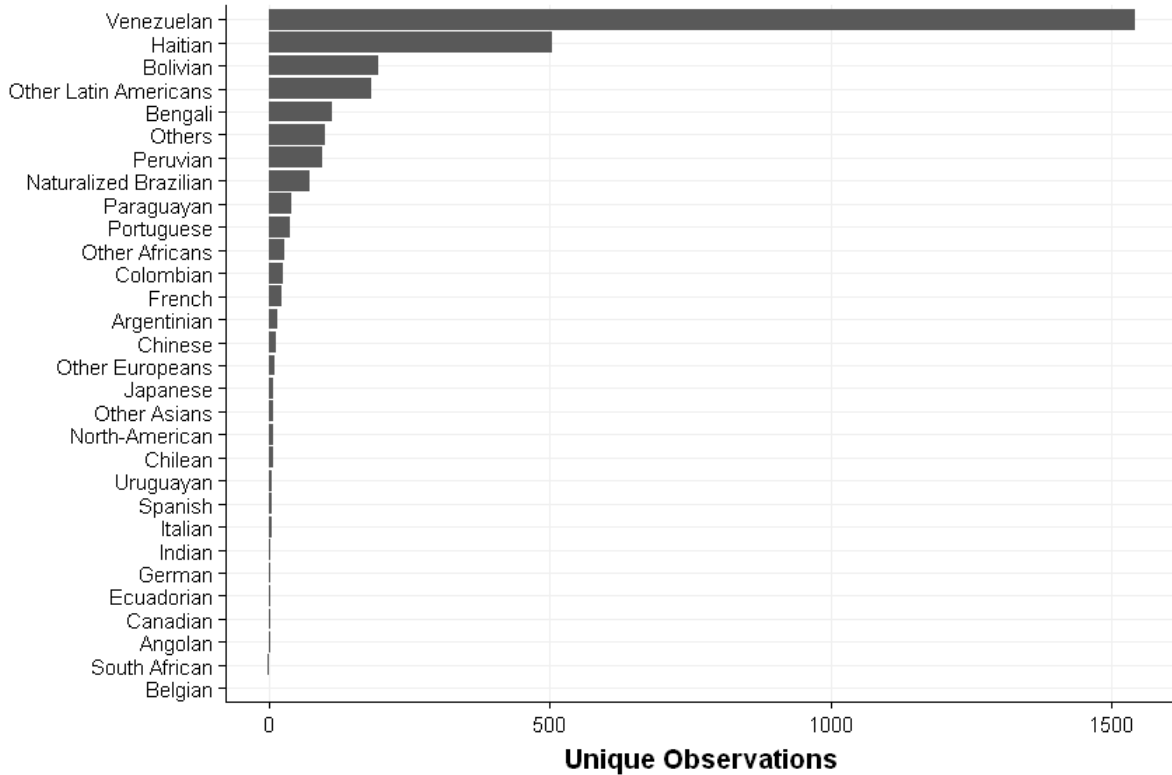


Figure 2: Unique foreign observations (post-2015 RAIS)



that still remain. In other words, we want to make sure their effects were absorbed in the long run or their presence is irrelevant and too small to the local population. Therefore we must observe where the foreigners are allocated by state and how the population evolves.

Figure 3 shows the evolution of foreign population in RAIS. We divided into two groups, Venezuelans and non-Venezuelans. The first row of graphs is made of unique observations only. Roraima concentrates almost the totality of Venezuelan observations and it is the only state that has a clear increase in unique non-Venezuelan observations. Moreover, the other states present a steady decrease (or negligible) new foreign presence. Second row shows the cumulative numbers, with Venezuelan observations being carried over the years. The notable difference in the second column is Rondônia, where not only they have a higher foreign population but also a large fluctuation of values. We must be careful to assume this fluctuation does not affect Rondônia, as we include it in

our analysis. The third graph shows the foreign observation per total population. The first figure shows how Venezuelans became more than one percent of the formal job market in Roraima. The second figure reveals that due to Rondônia having a large population, the fluctuations are virtually absorbed. More than that, in terms of foreigners per capita, Roraima became the number one state by 2016. We also assume the increase in other foreigners is due to non-Venezuelans residing in Venezuela also crossing the border to Brazil.

If we combine Figure 3 third row measurements, Roraima remarkably becomes from negligible to heavily concentrated by 2015, even surpassing the heavily populated Rondônia. No other nationality increased as the Venezuelans, which in 2017, became 1.25% of Roraima's total observations in RAIS.

The new Venezuelans were not randomly assigned to a certain economic activity. We can see this in Figure 4. By far, restaurants and hotels seem to be the preferred workplace of Venezuelans. 8 out of 100 workers in 2017 were Venezuelans in Roraima's restaurant sector. Mazzolari and Neumark (2012) shows that there is an increase in diversity of restaurants when the sector is exposed to the presence of immigrants.

Commerce and Construction are the only other sectors where the ratio is above 1. However, as shown previously in Figure 4, Commerce, when excluding the Public sector, is by far the largest sector in Roraima, seven times higher than Restaurant in terms of workforce. We will exploit this situation to investigate the effect of these allocations on labor outcomes. Specifically, what happens when there is such high concentration of foreigners in a relatively small sector in contrast to a larger sector, where the vast majority of Brazilians are working in the state. For the given reasons, we focus on Commerce, Construction, and Restaurant sector for our analysis.

Figure 3: Line plots of foreigners per year by state

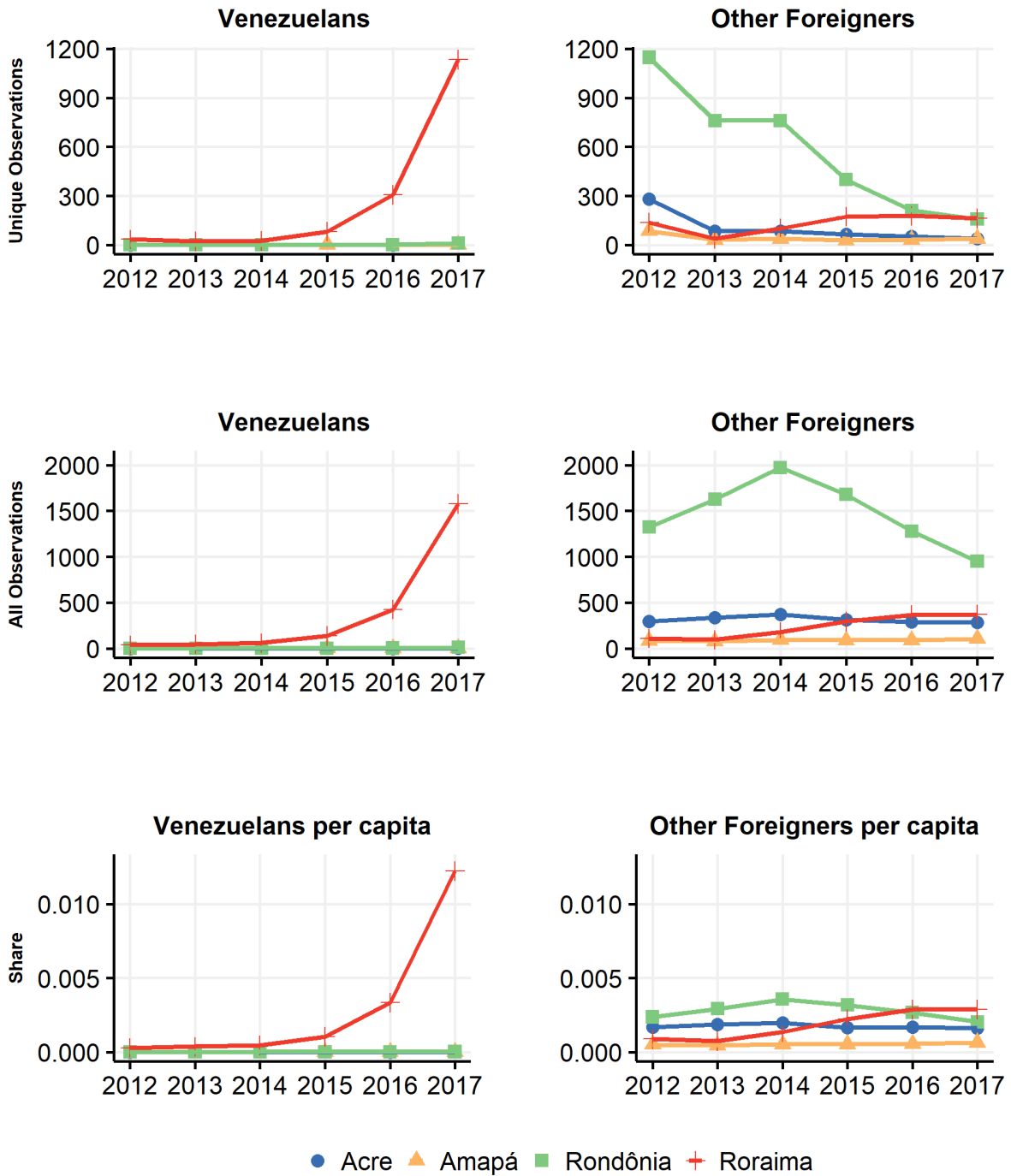
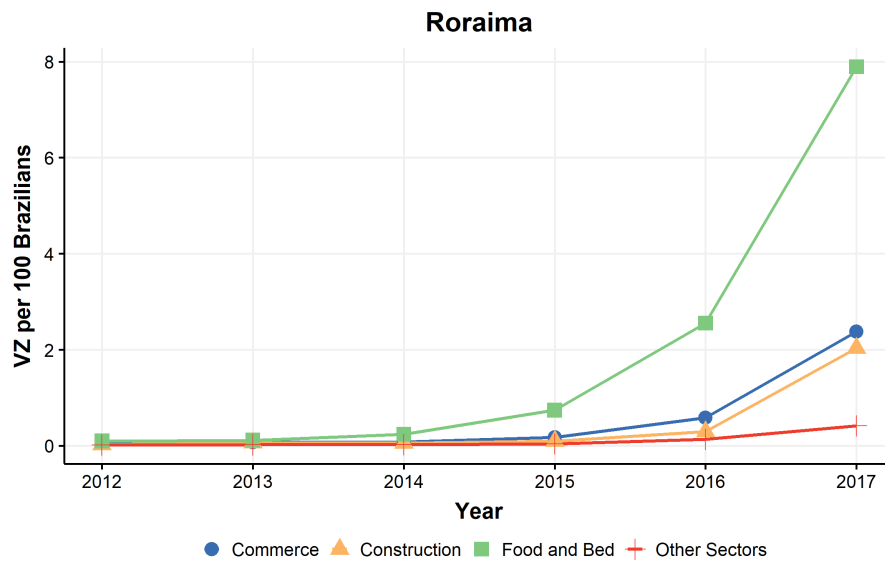


Figure 4: Venezuelan Allocation by Economic Activity Sector



3.2 Continuous National Household Sample Survey (PNAD-C)

Similarly, the Continuous National Household Sample Survey (PNAD-C) is a representative household survey conducted by the Brazilian Institute of Geography and Statistics (IBGE) every quarter. It contains various socioeconomic and demographic information, and includes information on household composition, education, labor, income, migration, and fertility, among others. It is a repeated cross-sectional data. Unlike RAIS, PNAD-C includes both formal and informal economic sectors. However, it does not include information on the respondents' nationality nor we can identify the individuals based on their social identifier. This precludes us from analyzing the impacts specifically on Brazilian citizens and the inclusion of Venezuelans in the sample may bias the results. Furthermore, the repeated cross-section nature of the data does not allow us to observe real counterfactual of an individual pre- and post-treatment.

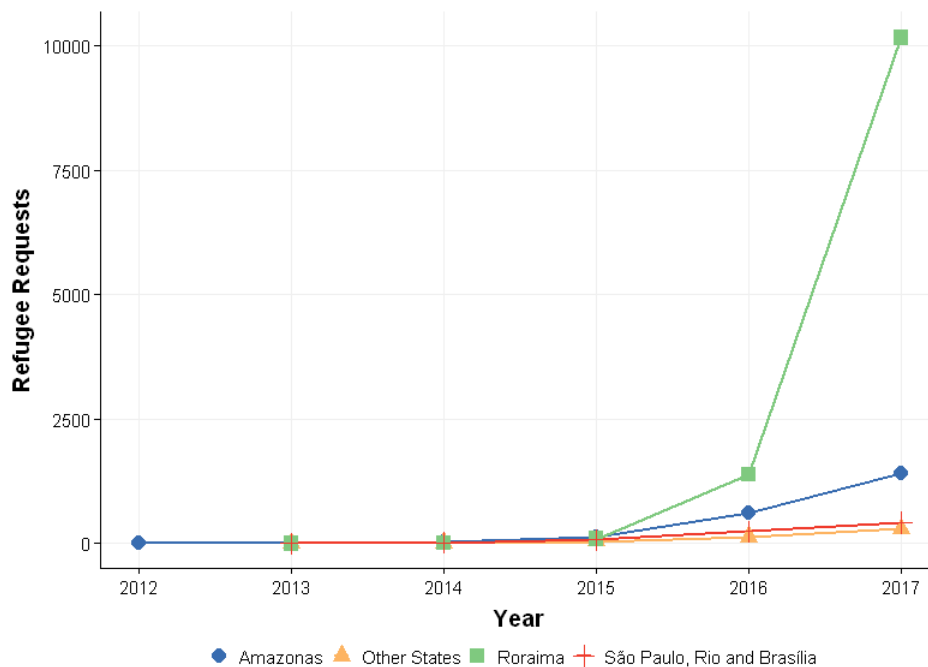
Our analysis with the PNAD-C differs from that with RAIS. First, we cannot perform a two-way fixed effects analysis at the individual nor municipality level but at the state level. Keeping only four states for each quarter, we would be reducing any number of observations to only 96, which is not desirable. We also would have to avoid including the other, non-northern states for the two-way fixed effects, based on the assumption that not only Venezuelans are going to Rio de Janeiro or São Paulo, but these states are drastically different from Roraima, not only in terms of demographics but also economic development.

Our solution is to apply the Synthetic Control Method, following Ryu and Paudel (2022), with some care. We use PNAD-C data from 2012 to 2017 and exclude 2018. We also avoid using states for control where there was a spike in refugee applications in our auxiliary dataset. For all these reasons, we exclude Rio de Janeiro, São Paulo, the capital, and Amazonas. Finally, we have $23 \times 4 \times 6$, or a total of 552 observations in the prepared panel data.

3.3 Refugee Application Data (CONARE)

The third data we use is the refugee application data from the National Committee for Refugees (CONARE). Refugees in Brazil can be registered as a refugee to get benefits such as obtaining the

Figure 5: Refugee requests per year (2012-17 CONARE)



individual taxpayer registration number (CPF), accessing health and education services, and other social benefits, and requesting the opening of a bank account, among others.

An individual submits a request for the recognition of refugee status (via Sisconare and document insurance by the federal police). The applications are then analyzed by CONARE. The committee then decides whether an individual is recognized as refugee or not. If they are not recognized as refugee, then they can appeal for the refugee status again.

The data provided by CONARE includes 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 the decision was made by CONARE. The process to receive refugee status for Venezuelans was made much faster and easier due to their proximity to Brazil and their exceptional case of humanitarian crisis.

Table 6 shows the number of refugee applications by state and year. There were 76,794 Venezuelans in the data who submitted the refugee status request. Overall, 75 percent of the applications were in Roraima, followed by 18 percent in Amazonas, São Paulo (2.3 percent),

Brasília (1.3 percent), and Rio de Janeiro (0.7 percent). Very few applications were submitted to other northern states besides Roraima and Amazonas. Within Roraima, only 2.9 percent of all applications by Venezuelans were submitted before 2015. Figure 5 shows the trend of refugee applications from 2012 to 2017 between Roraima, Amazonas, the three big metropolitan areas (São Paulo, Rio de Janeiro, and Brasília), and other states. It is evident that Roraima had a big increase in the number of refugee applications after the crisis started compared to other states.

We use the CONARE refugee status request application to calculate the proxy for the total number of refugees per municipality that we use for the instrumental variable approach as we will explain in the following sections. Although the number of refugee applications can be lower than the actual number of refugees, the underestimation is assumed to not systematically differ between regions.

Table 6: Top 10 states by refugee applications (2009-20 CONARE)

	N	Percentage
Roraima	56,984	74.20
Amazonas	14,337	18.67
São Paulo	1,802	2.35
Brasília	1,040	1.35
Rio de Janeiro	551	0.72
Rondônia	484	0.63
Paraná	419	0.55
Santa Catarina	227	0.30
Acre	164	0.21

4 Empirical Strategy

4.1 Difference-in-differences: Labor income analysis using RAIS

For the case of classic difference-in-differences, we use Roraima as the treated unit and the bordering states of the north (Acre, Amapá, and Rondônia) as controls. Since there is only one treatment unit, this can be designed as a two-way fixed effect regression (Goodman-Bacon 2021).

$$\log(wage)_{imst} = \gamma_t + \lambda_c + X_{ims} + \sum_{\substack{t=2012 \\ t \neq 2014}}^{2017} \beta_t D_{st} + \epsilon_{imst} \quad (1)$$

Where $\log wage_{imst}$ is the logarithmic wage of individual i in year t in municipality m and state s . γ_t is the time fixed effect, and λ_c is the unit fixed effect. We test for c being individual and municipal aggregations. X_{ims} is a matrix of covariates for the individual, including race, age, education, and gender.

To increase the robustness of our results we must take into account the fuzziness of the treatment, given every year refugees arrive exponentially in Roraima. Most importantly, it is desirable to have during pre-treatment years a parallel trend between control and treated unit. To address these assumptions, we use an event study design, where β_t is the parameter of interest for every period. D_{st} is an indicator function that values 1 when $s = \text{Roraima}$ and a given year t . ϵ_{ist} is the error term clustered at firm identifier level.

4.2 Difference-in-differences: Firm analysis using RAIS

(1) no. of brazilian workers in a firm (firm level analysis) (2) no. of firms per municipality (municipality level) (3) worker-to-firm ratio at the municipality level

We also examine the effects of the crisis on other variables from firms' perspective including firms' Brazilian workforce, number of firms, and worker-to-firm ratio, the last two at the municipality level.

For the first outcome variable, we aggregated the number of workers in RAIS by firms, municipality and year. The objective is to investigate any changes in the average total Brazilian workforce in a given firm and year due to the crisis. We keep clustering at firm identifier level. We also use year and firm fixed effects.

For the second outcome variable, we analyze the total number of firms in a municipality in a given year. We want to investigate any effect of the crisis on firm openings. Azoulay et al. (2022) identify a relationship between immigration and entrepreneurship in the United States. We cluster

at municipality level and use year and municipality fixed effects.

For the third outcome variable, we study the effects on firm concentration in Roraima after the Venezuelan influx. This is at the municipality level, with municipality level clustering and fixed effects, and year fixed effects.

$$y_{cst} = \gamma_t + \lambda_c + X_{cs} + \sum_{\substack{t=2012 \\ t \neq 2014}}^{2017} \beta_t D_{cst} + \epsilon_{cst} \quad (2)$$

Where y_{cst} is our outcome variable in state s and in year t , c being either firm or municipality, depending on which outcome we want to measure. γ_t is the time fixed-effect, and λ_c is the firm identifier or municipality fixed effect. Because we are using a higher level of aggregation in our data, we change the covariates slightly. X_{cs} is a matrix of covariates for the firm or municipality representing share of white, average age of workers, average education level, and gender ratio, in given state s .

We perform an event study where our parameter of interest is β_t interacted with indicator function D_{cst} that values one when a firm or municipality belongs to Roraima in a given year t . ϵ_{cst} is the error term clustered at firm or municipality level, depending on the outcome variable regressed.

4.3 Instrumental variable approach using RAIS and refugee status request application data

The TWFE approach identifies Roraima as a treatment state and the other three northern states as control states. The method assumes that refugee influx was the only change that happened in Roraima. Another way to assess the impact of refugees *per se* in specific would be to incorporate the number of refugees into the econometric model that allows us to estimate the association between the intensity of the local refugee crisis and the labor market outcomes. Equation 3 illustrates this, where $Refugees_{st}$ is the number of refugees living in municipality m in state s in time t .

$$y_{imst} = \lambda_c + \gamma_t + X_{imst} + \beta Refugees_{mst} + \epsilon_{imst} \quad (3)$$

However, this approach suffers from potential endogeneity problem since refugees are drawn to a particular region based on numerous factors that can also affect labor market outcomes. We therefore employ an instrumental variable approach to curb this issue.

First, we employ road distance between a municipality and the Brazil-Venezuela border at the starting point of the BR-174 highway as the instrument. The road distances are calculated using Google Maps. This measurement is negatively associated with the number refugees residing in a particular municipality but is not directly associated with labor market. There is a concern however, that labor market situation of a region closer to a border is characteristically different from those away from the border due to the trade between the region and the neighboring country.

In order to deal with this issue, we use a second instrument, which is a modified form of instrument by Del Carpio and Wagner (2015) as illustrated in equation 4, where $F_{m,2012}$ is the proportion of population of municipality m that is foreign or non-Brazilian in year 2012, before the crisis started, and D_m is the road distance between the Brazil-Venezuela border and the municipality m . $F_{m,2012}$ is calculated using the RAIS data that includes a universe of formal labor market workers in Brazil, and therefore, is a proxy for the actual proportion of foreigners in a particular municipality. Similarly, as stated, D_m is calculated using Google Maps³.

$$IV_m = \frac{F_{m,2012}}{D_m} \quad (4)$$

We argue that the instrument satisfies the exclusion restriction. First, the foreign population in a particular municipality in 2012, before the crisis started, draws Venezuelan immigrants towards the municipality due to the presence of past network of Venezuelans but also due to the presence of other Spanish-speaking communities. Therefore, there is a positive relationship between $F_{m,2012}$ and the number of Venezuelan migrants in the municipality. Second, the distance between the

³Since there is no land connection between Pacaraima and the state of Amapá, we calculate the approximate distance of the Amazon river connecting the two regions.

Brazil-Venezuela border and a municipality is inversely proportional to one another. The farther away a municipality, the less likely a refugee is going to travel there on road. Since we are restricting our instrumental variable analysis to northern Brazilian states only, this rules out Venezuelans who flew to one of the metropolitan areas in Coastal Brazil. Furthermore, since the Pacaraima border through the BR-174 highway is the only land route to the northern states, the distance between a municipality from the border is a more suitable measurement of distance as opposed to the distance from the center of Venezuela.

For the number of refugees per municipality, we use the refugee status request application data from CONARE that contains the number of refugee applications received by the Brazilian government each year at the municipality level. We calculate the number of refugees as stated in equation 5 where $Refugees_{m,j}$ is the number of refugees in municipality m and year j , which is a sum of refugee status applications, $Apps_{m,i}$ submitted in that municipality since 2010 up to that particular year. Since the number of applications is assumed to be below the actual refugee numbers, which is thus underestimating the refugees at the municipality level, our results will only be conservative estimates of the actual impact. Moreover, we assume that there is no systematic regional difference in between the actual number of Venezuelans in a municipality and the number of refugee status request applications, thus allowing us to use the latter as a proxy for the former.

$$Refugees_{m,j} = \sum_{i=2010}^j Apps_{m,i} \quad (5)$$

The first and the second stage regressions are shown below in equations 6 and 7 respectively. In 6, $\delta_{2,i}$ is the individual fixed effects, $\delta_{3,t}$ is the year fixed effects, and X_i is a vector of individual characteristics. IV_m is the instrument and is not time-variant. Similarly, the second-stage regression in 6 uses the fitted values calculated from the first-stage regression and gives us β , the coefficient of interest.

$$\frac{Refugees_{mt}}{1000} = \delta_1 + \delta_{2,i} + \delta_{3,t} + X_i + \gamma IV_m + u_{ist} \quad (6)$$

$$y_{imt} = \delta_1 + \delta_{2,c} + \delta_{3,t} + \hat{X}_i + \beta \frac{\widehat{Refugees}_{mt}}{1000} + \hat{\epsilon}_{ist} \quad (7)$$

4.4 Synthetic Control Method using PNAD-C

Ryu and Paudel (2022) uses synthetic control to investigate the impacts of the Venezuelan refugee crisis on the Roraima labor market outcomes. We propose a slightly different approach in terms of two aspects. First, we expand the time period to coincide with the TWFE regressions and to be more consistent with our data analysis. Additionally, it is advisable to have a larger pre-treatment period (Abadie, Diamond, and Hainmueller 2010). We also change the treatment period from 2016 to 2015. For the sake of comparability, we use similar variables and covariates to generate the SCM weights. They are share of white individuals, literate people, young and old population, and the proper outcome variable of each period except the first one, adapted to our case.

Moreover, there are other crucial differences beyond treatment period. Based on RAIS and CONARE, first we assume that some states will suffer from spillover effects. We decided to remove São Paulo and Rio de Janeiro because of their high concentration of foreigners, high population, and their level of economic development. We assume these key characteristics are too distinct when compared to Roraima.

We also remove Distrito Federal, the capital district of Brazil, to avoid putting an outlier in the donor pool. Amazonas was also removed because not only the existence of Manaus, the capital of the state, which is a metropolitan region with more than two million individuals and a hub of northern Brazil, but also because of Venezuelan refugee spillover. CONARE data confirms that Venezuelans also appear Amazonas although in lower numbers.

We can proceed briefly explaining the Synthetic Control Method. Consider $J + 1$ states, where the treated state is $j = 1$. Hence, J represents the number of control states. Formally, we need to solve the following optimization problem:

$$\begin{aligned}
(\hat{V}, \hat{W}) &= \arg \min_{WV} (X_1 - X_0W)'V(X_1 - X_0W) \\
\text{s.t.} \quad &\sum_{j=2}^{J+1} w_j = 1, w_j \geq 0
\end{aligned} \tag{8}$$

X_1 is a vector representing the pre-treatment period variables for the treatment unit, while X_0 is a matrix representing the same but for donors. We want to find the vector of weights \hat{W} that minimizes the differences of variables between treatment and donors. In SCM, the weights are non-negative and add to one. V is a diagonal matrix that is also optimized. It gives the importance of each pre-period variable. Ultimately the optimal parameter will yield the synthetic Roraima constructed by the donor control states.

To understand the second step of the SCM optimization, let us go back to the two-way fixed effect model, where we want to minimize the error term such that:

$$\hat{\phi} = \arg \min_{\phi} \sum_{s=1}^{S+1} \sum_{t=2012}^{2017} (y_{ict} - \alpha - \lambda_c - \gamma_t - X_i - \sum_{\substack{t=2012 \\ t \neq 2014}}^{2017} \beta_t D_{st})^2 \tag{9}$$

Where ϕ is a vector of the regression parameters α , λ_s , γ_t , covariate parameters X_t , and β_t .

The two-way fixed effect model relies on the parallel trend that sometimes does not hold. A researcher must rely on covariates or select appropriate time periods based on assumptions (Callaway and Sant'Anna 2021). On the other hand, SCM in theory does not require such assumptions since the weights provide sufficiently approximation between proper and synthetic. Slightly different, it minimizes the error term such that:

$$\hat{\phi} = \arg \min_{\phi} \sum_{s=1}^{S+1} \sum_{t=2012}^{2018} (y_{ist} - \alpha - \gamma_t - \beta_t D_{ts})^2 \hat{w}_i^{sc} \tag{10}$$

We introduce in Equation 10 the weights of donors and remove the individual fixed-effect .

In theory, optimizing the weights beforehand allows for SCM to absorb unit fixed effects and the necessity for covariates. However, in practice the synthetic version of the treated unit is only approximately equal. Because RAIS is a balanced panel at the individual level, we can test

with precision using a difference-in-differences model at different aggregation levels. We do not have the same luxury in PNAD-C, given it is a repeated cross-sectional data where we do not identify individuals nor their nationality. Also, we can consider only one treated unit and several potential donors across the country. Hence, for the case of Roraima and the Venezuelan crisis using PNAD-C, synthetic control seems indeed to be more adequate as a model (Abadie, Diamond, and Hainmueller 2015, 2010). Increasing the number of controls may weaken the parallel trend assumption in a TWFE model.

5 Results

5.1 Results: Two-way fixed effects event study

Our two-way fixed-effects model uses from 2012 until 2017 with 2015 as the treatment period thus using 2014 as the reference year for comparison. Our treatment unit is the state of Roraima, while the other border states in the north, Acre, Amapá, and Rondônia, serve as control units.

Table 7 shows the association between the treatment and logged wages of Brazilian citizens in Roraima using the two-way fixed effects event study regression illustrated in equation 1. We balanced the panel data by only keeping the individuals who appear both before and after 2015. This helps to create a counterfactual for comparison for all individuals in the sample as well as it allows us to take benefits of the individual-level fixed effects.

For unit fixed effects, column (1) and column (2) use individual and municipality fixed effects respectively. Both regressions use year fixed effects. The standard errors are clustered at the firm level⁴.

Results using individual fixed effects in column (1) show that there is an increasing effect of the treatment on wages of Brazilian citizens in Roraima, which is consistent for all three years following the treatment start period and has an increasing trend. For instance, compared to the year

⁴Firm IDs help to capture geographical as well as sectoral variations. The treatment, in our case the intensity of refugee penetration, varies at both of these dimensions.

2014, the average wage of Brazilian citizens in Roraima increased by 2.72 percent more compared to the control states in 2015. This only increased to almost 6 percent in 2016 and to 12 percent in 2017. All of these estimates are significant at 5 percent level.

Similarly, our results using municipality fixed effects in column (2) reflect the same direction of effects. Compared to the year 2014, the average wage of Brazilian citizens in Roraima increased by 2.23 percent more compared to the control states in 2015. This only increased to 8 percent in 2016 and to 17 percent in 2017. All of these estimates are also significant at 5 percent level.

The fact that neither of the estimates in the two pre-treatment periods (2012 and 2013) are statistically significant confirms that the parallel trend assumption that is essential for the event study, is fulfilled. Figure 6 plots the estimates from these two event studies.

Table 8 disaggregates these estimates at the sector level. We show results for the three economic sectors with the highest concentration of Venezuelans, using both individual fixed effects and municipality fixed effects. All regressions also use year fixed effects.

The results show that construction industry saw a positive increase in wages for the Brazilian citizens. Journalistic evidence suggests that there was a boom in the construction sector in Roraima that could be driven by the increase in the demand for housing due to the increased population.

5.2 Results: Instrumental variable approach

We also use instrumental variable approach to estimate the association between the intensity of the refugee crisis at the municipality level and the labor market outcomes. Simply regressing labor outcomes on the number of refugees per municipality would create endogeneity bias since there could be a multitude of factors drawing refugees to a particular region that can also influence labor market conditions. We therefore make use of two separate variables as instruments.

Table 9 shows results from the IV regressions using equation 7. We first use the road distance between the Brazil-Venezuela border near the town of Pacaraima to a municipality as an instrument, followed by using the instrument illustrated in equation 4 that incorporates the share of foreigners in 2012 in a particular municipality and the distance from the border.

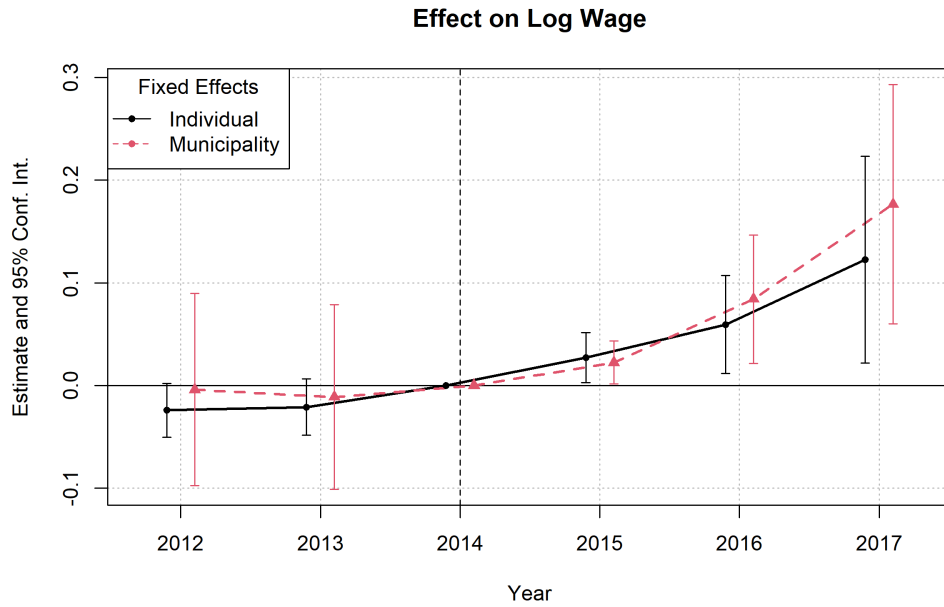


Figure 6: CPF fixed effects and Municipality SE cluster event study

Table 7: Event study: Effects on logged wages

	Log Wage	
	(1)	(2)
Pre Treatment		
Roraima x 2012	-0.0240 (0.0134)	-0.0040 (0.0477)
Roraima x 2013	-0.0210 (0.0139)	-0.0112 (0.0458)
Post Treatment		
Roraima x 2015	0.0272* (0.0124)	0.0223* (0.0107)
Roraima x 2016	0.0594* (0.0243)	0.0842* (0.0319)
Roraima x 2017	0.1226* (0.0514)	0.1764* (0.0594)
N	4 967 872	4 967 872
Year fixed effects	X	X
Individual fixed effects	X	
Municipality fixed effects		X

¹ Standard-errors are clustered by firm identifiers.

² Covariates are white, age, male, and education level.

³ * $p < .05$

Table 8: Event study: Effects on logged wages by sector

	Log Wage							
	Commerce		Construction		Restaurants		All sectors	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Pre Treatment								
Roraima x 2012	0.0169*	0.0148	-0.0157	0.0749	0.0038	0.0114	-0.0240	-0.0040
	(0.0078)	(0.0080)	(0.0249)	(0.0401)	(0.0189)	(0.0161)	(0.0134)	(0.0477)
Roraima x 2013	0.0033	0.0007	-0.0101	0.0437	-0.0045	0.0012	-0.0210	-0.0112
	(0.0080)	(0.0087)	(0.0172)	(0.0367)	(0.0128)	(0.0137)	(0.0139)	(0.0458)
Post Treatment								
Roraima x 2015	-0.0066	-0.0025	0.0243	0.0435	0.0142	0.0372*	0.0272*	0.0223*
	(0.0070)	(0.0071)	(0.0191)	(0.0284)	(0.0088)	(0.0171)	(0.0124)	(0.0107)
Roraima x 2016	0.0086	0.0126	0.0664*	0.1454*	0.0067	0.0327	0.0594*	0.0842*
	(0.0069)	(0.0076)	(0.0184)	(0.0423)	(0.0102)	(0.0181)	(0.0243)	(0.0319)
Roraima x 2017	0.0231*	0.0381*	0.1038*	0.2080*	-0.0015	0.0228	0.1226*	0.1764*
	(0.0082)	(0.0089)	(0.0440)	(0.0528)	(0.0128)	(0.0196)	(0.0514)	(0.0594)
N	1 176 038	1 176 038	417 172	417 172	143 916	143 916	4 967 872	4 967 872
Year fixed effects	X	X	X	X	X	X	X	X
Individual fixed effects	X		X		X		X	
Municipality fixed effects		X		X		X		X

¹ Standard-errors are clustered by firm identifiers.

² Covariates are white, age, male, and education level.

³ * p < .05

Table 9: IV regression

	Log Wage							
	2SLS: Distance				2SLS: Foreigner Share and Distance Relation			
	Commerce	Construction	Restaurants	All Sectors	Commerce	Construction	Restaurants	All Sectors
Fitted Thousands of Refugees	-0.0262	-0.1546	-0.0329	0.2207*	0.0353	0.4841	-0.0837*	0.1098*
	(0.0235)	(0.0838)	(0.0464)	(0.0839)	(0.0332)	(0.8590)	(0.0326)	(0.0300)
N	1 176 038	417 172	143 916	4 967 872	1 176 038	417 172	143 916	4 967 872
Year fixed effects	X	X	X	X	X	X	X	X
Individual fixed effects	X	X	X	X	X	X	X	X
First Stage Wald Test	51.776	24.812	6.976	51.459	15.989	0.329	55.534	32.746

¹ Standard-errors are clustered by firm identifiers.

² Covariates are white, age, male, and education level.

³ * p < .05

The second-stage regression using distance as the instrument, which is in column (4), shows that on average the increase of a thousand Venezuelan refugees in a municipality increases the wage of Brazilian citizens by 22 percent. Similarly, the second-stage regression using ?? as an instrument, which is in column (8), shows that on average the increase of a thousand Venezuelan refugees in a municipality increases the wage of Brazilian citizens by 11 percent. Both of these estimates are significant at 5 percent level.

Disaggregating by sectors, as shown in columns (1)-(3) and (4)-(6), we see that an increase of 1,000 Venezuelans in a municipality negatively affects the wages of Brazilian citizens involved in restaurant sector. This is because restaurants have the highest concentration of Venezuelan refugees following the treatment period. Therefore, with a higher change in labor supply compared to the change in labor demand led to a negative overall drop in wages of Brazilians working in the sector. This result is significant at 5 percent level when using the second instrument.

5.3 Firm level analysis results

Table 10: Event study: Workforce analysis

	(1) Employment	(2) New Firms	(3) Worker-Firm Ratio
Pre Treatment			
Roraima x 2012	-1.4054 (1.1890)	11.6971 (30.0096)	-4.9032 (2.4737)
Roraima x 2013	0.5081 (0.7488)	-0.6095 (15.8609)	1.0561 (2.3826)
Post Treatment			
Roraima x 2015	1.4503 (0.8356)	5.7914 (11.5151)	-0.6827 (1.9415)
Roraima x 2016	0.7190 (0.9341)	19.9941 (19.3736)	2.3403 (3.0840)
Roraima x 2017	1.1904 (1.0901)	19.9757 (17.9087)	3.2898 (1.9034)
N	245 726	630	630
Year fixed effects	X	X	X
Municipality fixed effects		X	X
Firm fixed effects	X		

¹ Standard-errors are clustered at firm identifier level for column (1) and by municipality level for columns (2) and (3).

² Covariates for (1) are fraction of white and male, average age and education level by firm.

³ Covariates for (2) and (3) are fraction of white and male, average age and education level by municipality.

⁴ * $p < .05$

Table 10 shows the results of the effects on firms' Brazilian workforce, no. of firms, and worker-to-firm ratio. Column (1) shows the effects of the crisis on the number of Brazilian citizens working

in a firm, taking Roraima as the treated state. The analysis is at the firm level and thus uses firm fixed effects alongside year fixed effects. Results show that there is a positive effect on the number of Brazilian citizens hired in a firm after the crisis started although it is not consistently statistically significant throughout the following years.

Table 11 disaggregates the effects by economic sectors. There is a positive effect on the number of Brazilian workers hired by construction firms, which are significant at least at 10 percent level. In 2015, construction firms in Roraima, on average, hired 15 more workers when compared to the previous year, which increased to hiring 12 more workers in 2016 and 2017 each, again compared with the previous year. We do not see consistent effect on other economic sector.

Azoulay et al. (2022) finds a causal relationship between immigration and entrepreneurship. We follow this evidence to investigate the number of firms that were registered after the treatment started. Column (2) of Table 12 shows the results for the event study regression analyzing the effects on entrepreneurship, taking the number of firms registered in a municipality as the outcome variable. The analysis is at the municipality and thus uses municipality fixed effects alongside year fixed effects. The results do not show any effects on the number of firms registered. This could be due to a series of reasons. First, the high cost of opening a formal business in Brazil (Cavalcanti, Magalhães, and Tavares 2008). Second, the demographics of the new population, who are largely poor. Third, Brazil as a country was struggling economically during the period with stagnant economic growth. We may infer that most of the entrepreneurship went to the informal sector, but due to the data limitation, we cannot observe this. Table 12 has the same analysis but disaggregated at the economic sector level. We do not see any significant increases in the number of firms in Roraima for any of the three top economic sectors by the share of Venezuelan refugees.

Similarly, column (3) of Table 12 shows the results for the effects on the worker-to-firm ratio. This analysis is at the municipality level and thus uses municipality fixed effects alongside year fixed effects. The results do not show any evidence on the impacts of the treatment on the outcome variable. Table 13 shows that the results are not significant for most of the three economic sectors, with the exception of civil construction, in accordance to our previous workforce analysis.

Table 11: Event study: Effects on employment by sector

	Workforce			
	Commerce	Construction	Restaurants	All Sectors
Pre Treatment				
Roraima x 2012	-1.5881* (0.4589)	-20.7718 (21.4171)	-1.0134 (1.1731)	-1.4054 (1.1890)
Roraima x 2013	-0.8790* (0.2844)	-0.0575 (11.6383)	-0.2646 (1.0847)	0.5081 (0.7488)
Post Treatment				
Roraima x 2015	0.7211* (0.3347)	14.8697* (5.6276)	-0.5952 (1.7867)	1.4503 (0.8356)
Roraima x 2016	0.5395 (0.4986)	26.8387* (9.6530)	-1.0921 (1.9930)	0.7190 (0.9341)
Roraima x 2017	0.4538 (0.5999)	39.2350* (13.1138)	-0.7260 (2.2517)	1.1904 (1.0901)
N	108 020	10 073	13 354	245 726
Year fixed effects	X	X	X	X
Firm fixed effects	X	X	X	X

¹ Standard-errors are clustered by firm identifiers.

² Covariates are fraction of white and male, average age and education level by firm.

³ * p < .05

5.4 Results: Synthetic Control Method

Our results for synthetic control are shown in Figure 7. Robustness figures, such as placebo plots, MSPE ratio ranking and the donor weights list, are in the appendix.

We provide in tag A and B figures the synthetic control results for wages of formal and informal workers respectively. We use for this variable the amount of cash the individual received for a month worth of work, aggregated at the state level for the synthetic algorithm. In both cases, after 2015 there was a decrease in average monthly payment. Although the results seem to provide evidence of a decrease in wages, the results barely passes the placebo tests, with a high mean squared predicted error for formal and an average for informal. However, for formal, the placebo state of Pernambuco had a better score. We also must be conservative in our assumptions due to the fact PNAD-C is a cross-section data repeated quarterly. Individuals are not identified. That being the case, the survey pool may be capturing individuals that appears in the labor force after

Table 12: Event study: Effects on entrepreneurship by sector

	Number of Firms			
	Commerce	Construction	Restaurants	All Sectors
Pre Treatment				
Roraima x 2012	1.9805 (10.8903)	1.5561 (3.0647)	-1.2350 (5.7268)	11.6971 (30.0096)
Roraima x 2013	-1.6779 (5.0089)	-2.1123 (4.0504)	-2.9473 (4.3313)	-0.6095 (15.8609)
Post Treatment				
Roraima x 2015	4.2265 (4.8317)	-1.1853 (1.7764)	3.8786 (4.9562)	5.7914 (11.5151)
Roraima x 2016	10.0632 (5.6140)	1.0745 (1.9378)	6.1122 (7.2601)	19.9941 (19.3736)
Roraima x 2017	7.9649* (3.6973)	4.2403 (2.2558)	7.0439 (8.0214)	19.9757 (17.9087)
N	627	502	523	630
Year fixed effects	X	X	X	X
Municipality fixed effects	X	X	X	X

¹ Standard-errors are clustered by municipality.

² Covariates are fraction of white and male, average age and education level by municipality.

³ * p < .05

2015. Including non-Brazilians such as Venezuelans present in Roraima.

For labor force participation we aggregated the individuals seeking for a job and the ones already occupied. This includes the formal and informal sector, and also own accounts and employers. We removed statutory and military workers. Tag C figure shows the results of the synthetic control method for labor force participation in PNAD-C. There is a sudden drop in LFP beginning 2016 in Roraima when compared to its synthetic counterpart. As we showed in Figure 5, there is an exponential trend of Venezuelan arrivals in Roraima during this period. This could be reflected in a drop of labor force participation due to this new population. However, we do not have a counterfactual for individuals in PNAD-C, hence, we cannot say the labor force participation decreasing is due to Brazilians leaving the labor market or Venezuelans entering the dataset. Additionally, we cannot guarantee the causal relationship due to weak MSPE results, when compared to placebo tests.

Tag D figure shows the results of synthetic employment. This variable is the ratio between

Table 13: Event study: Effects on worker-to-firm ratio by sector

	Worker-Firm Ratio			
	Commerce	Construction	Restaurants	All Sectors
Pre Treatment				
Roraima x 2012	-0.1942 (0.5036)	21.6586 (21.0230)	-2.2228 (6.6854)	-4.9032 (2.4737)
Roraima x 2013	-0.4578 (0.2382)	19.6891 (12.0861)	-5.7276 (5.3462)	1.0561 (2.3826)
Post Treatment				
Roraima x 2015	0.0741 (0.2425)	13.4817 (7.7128)	-5.0283 (5.2592)	-0.6827 (1.9415)
Roraima x 2016	0.3146 (0.2867)	33.2887* (15.0641)	-4.1513 (5.2816)	2.3403 (3.0840)
Roraima x 2017	0.2150 (0.2921)	16.9482 (13.6132)	-3.1490 (4.3448)	3.2898 (1.9034)
N	627	502	523	630
Year fixed effects	X	X	X	X
Municipality fixed effects	X	X	X	X

¹ Standard-errors are clustered by municipality.

² Covariates are fraction of white and male, average age and education level by municipality.

³ * $p < .05$

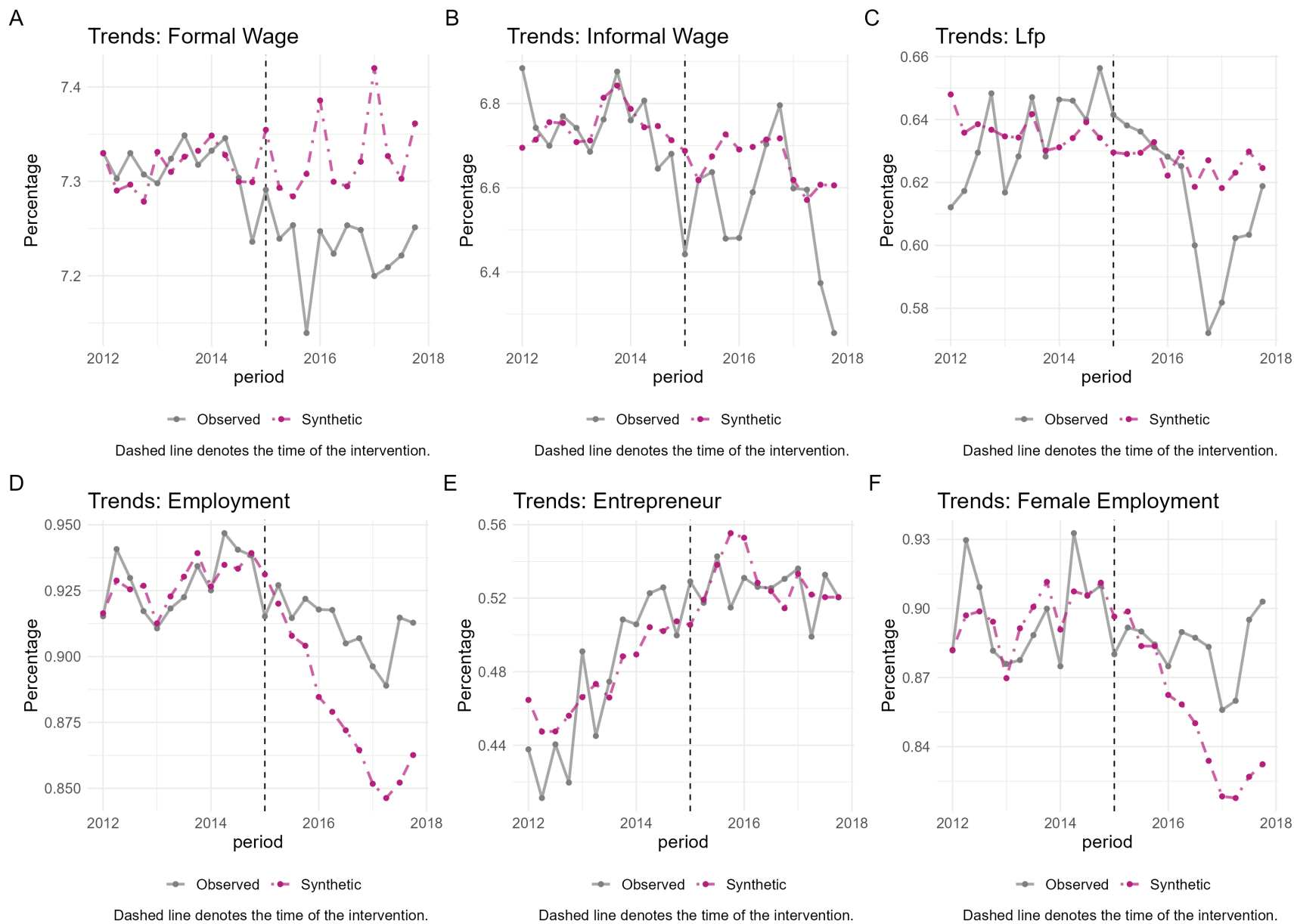
occupied individuals and labor force participation. There was a clear distinction between synthetic and treated groups after the treatment period. In Roraima, employment remained steady while in the donor states, there was a drop after 2015. The results are weakly robust when compared to the majority of the placebos.

We also tested for what we call entrepreneurship. People not living from wages but from profit. These are labeled in PNAD-C “employers” and “own account” individuals. Unfortunately, we cannot observe the nature of their firm before 2015. Only after this date we can see if their activity is formal or informal. We do not find any evidence of change in the fraction of the population who is risk taker. Results are shown in Tag E figure.

While we cannot separate nationality nor formality for risk takers in PNAD-C, specially before 2015, we can separate by gender. We perform a synthetic control analysis using only women who are firm owners. The last figure shows that there was a slight increase in women being entrepreneurs, although the result does not survive placebo tests. Again, our analysis suffers from the fact formality

becomes an unobservable variable for non-wage earners.

Figure 7: Synthetic Control Results: Trends



6 Conclusion

Immigration in general and refugees in specific is a contentious as well as a sensitive topic for politicians, policy-makers and general public alike, owing much to the assumption that the immigrants lower wages and increase unemployment among the local population. However, an often neglected factor is the increase in the demand for goods and services that they create in the local economy which can drive up the income of the native. In this paper, we analyze the effects of the Venezuelan refugee influx in the Brazilian labor market, specifically in the border state of Roraima.

We first use two-way fixed effects event study shows that earnings in the formal economy increases following the crisis due to the increase in demand for goods and services. We take Roraima as the treatment state and three other northern Brazilian states, Amapá, Acre, and Rondônia, that are similar to Roraima in terms of geographical, demographic, and socioeconomic characteristics, as control states. Using the balanced version of the RAIS data, we find that refugee influx increased wages of Brazilian citizens by between 2.72 percent in 2015 to 12 percent in 2017. There was an upward trend of the wages following the treatment, in Roraima compared to the control states. We also analyze this effect in three economic sectors with the highest concentration of Venezuelans as per the RAIS data – commerce, construction, and restaurants. We see positive effects on the wages of Brazilians who are involved in construction.

The aggregate result is confirmed when using the instrumental variable approach in which we use two instruments: (1) the road distance between a municipality and the Brazil-Venezuela border and (2) a ratio of the share of foreigners in a municipality in 2012 and the road distance between the municipality and the Brazil-Venezuela border. Both measures show a positive increase in wage of Brazilians. The method using the second instrument, using the share of refugees and the distance from the border, estimates that an increase of a thousand Venezuelan refugees lead to around 11 percent increase in wages of Brazilians in the formal market. However, when disaggregating by economic sector, we see a negative effect on the wages of Brazilians involved in the restaurant sector, which is the sector with the highest share of Venezuelans following the crisis.

Our results infer that the net overall effect of Venezuelan refugees in Roraima is positive

which is driven mostly by the increase in the demand of products and services due to the increased population. However, in relatively small economic sectors with a high share of immigrants, in this case the restaurant sector, the penetration of the sector by Venezuelans increased the labor supply by a higher degree as compared to the service demand, and which, therefore, led to a drop in the wages of Brazilians in the sector.

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Appendix A. Tables

Table A1: Datasets Overview

	RAIS	PNAD
Data type	Panel	Repeated cross-section
Time interval	Annual/Monthly	Annual/Quarterly
Individual level	Yes	Yes
Labor Relation	Formal	Formal/Informal/Non-Labor
Administrative	Yes	No
Nationality	Present	Not Present

*After restricting the sample to working-age individuals.

*Only includes Roraima, Rondônia, Amapá and Acre.

Appendix B. Figures

Figure B1: Overview of Venezuela's neighbors

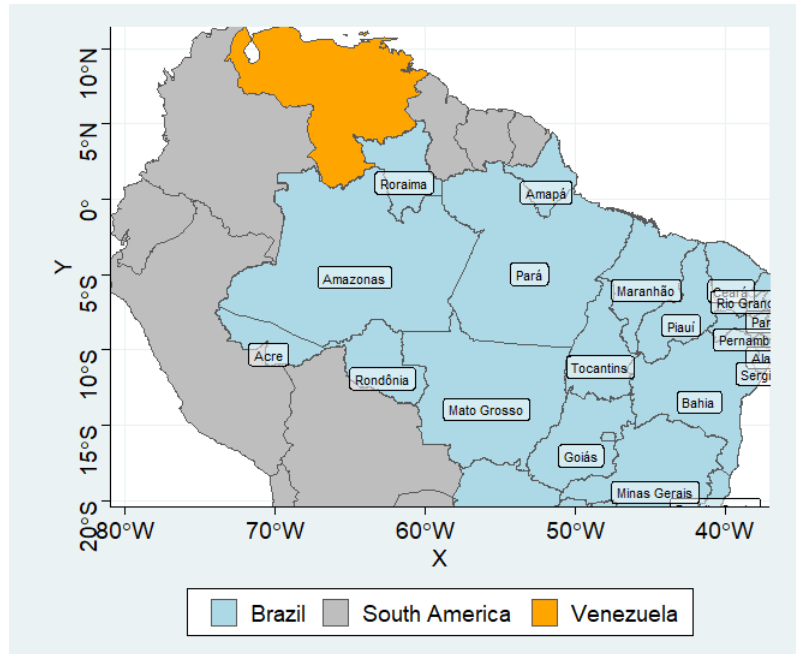


Figure B2: Venezuela, Roraima, and the BR-174 Highway

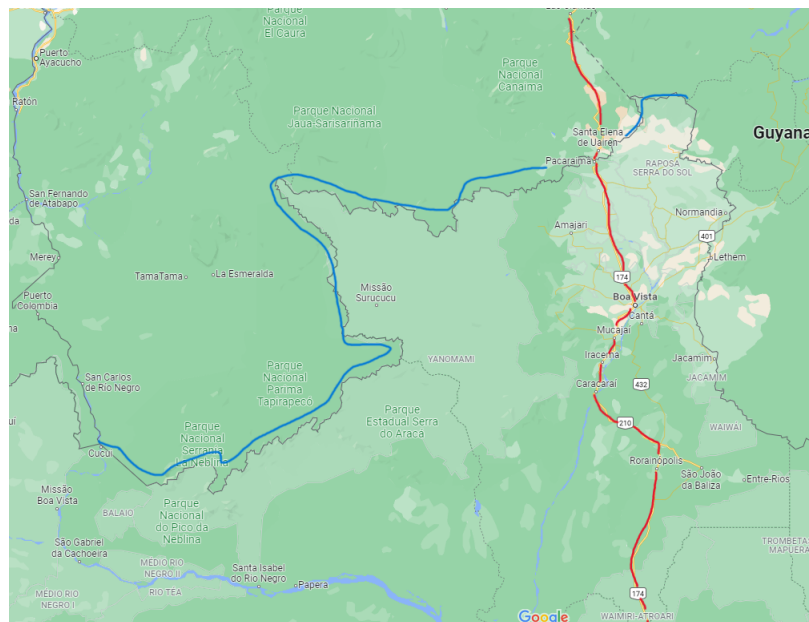


Figure B3: Synthetic Control Results: Placebos



Figure B4: Synthetic Control Results: MSPE Ranking

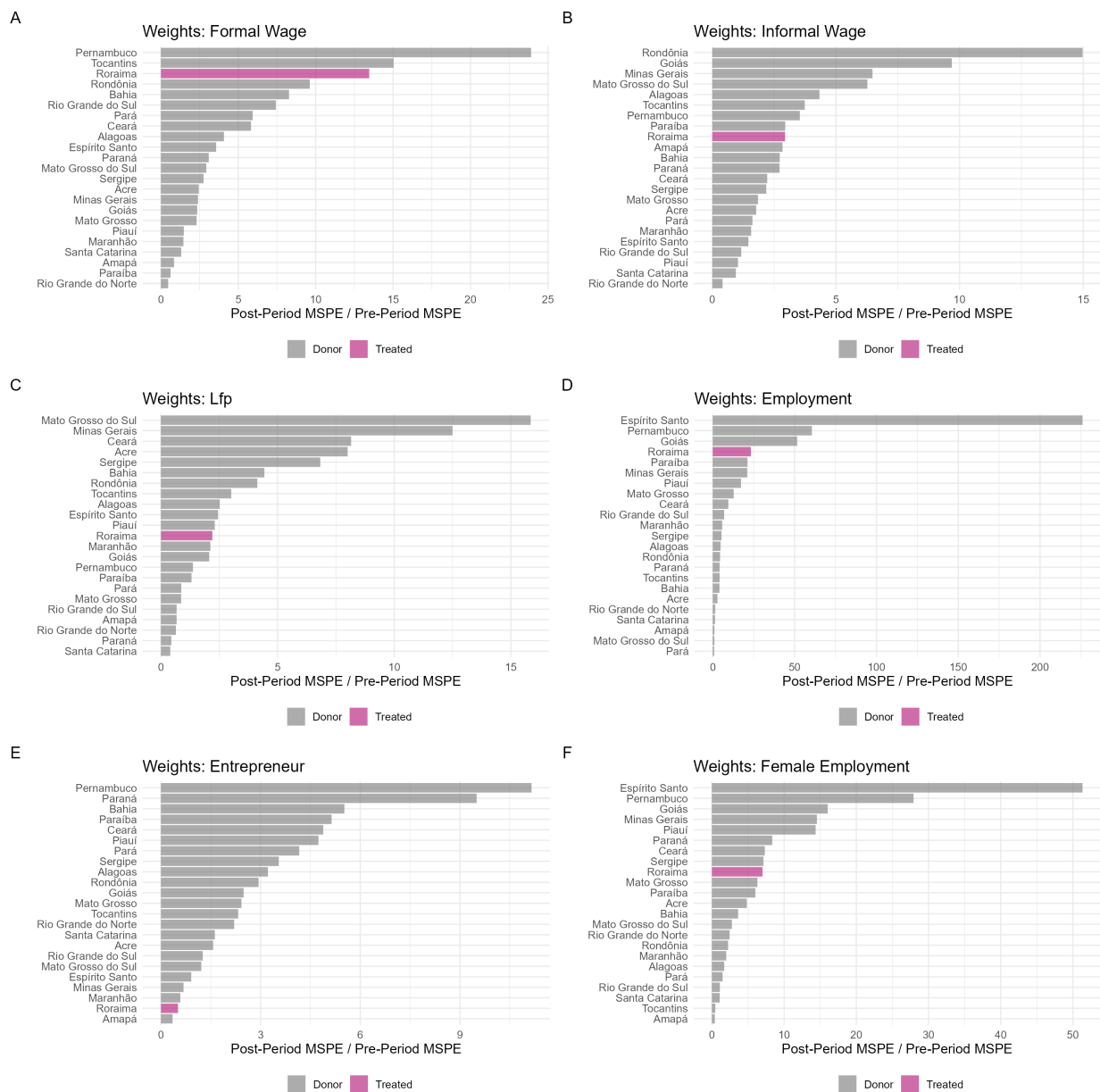


Figure B5: Synthetic Control Results: Weights of Donors and Variables

