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## ABSTRACT

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# The Labor Market Impacts of Venezuelan Refugees and Migrants in Brazil

As more and more Venezuelans leave their country, fleeing the economic and social crisis, the number of Venezuelans in Brazil has risen steadily since 2016, constituting about 18.6 percent of Brazil's 1.4 million refugee and migrant population as of October 2020. Past research finds that the impacts of forced displacement on the labor market outcomes of host community are mixed and tend to depend on country characteristics. This paper extends the previous literature by exploring the economic impact of Venezuelan influx on Roraima, the state bordering the República Bolivariana de Venezuela at the north and the main gateway of the Venezuelan refugees and migrants entering Brazil, and focusing on the formal sector employment of the host community. Using survey and administrative data and regression discontinuity frameworks, this paper finds that in the short-run, the Venezuelan influx led to an overall increase in unemployment and a decrease in informal sector employment, specially among the female workers in Roraima. Focusing on the host community, the findings suggest that Venezuelan influx led to increase in formal sector employment among the Brazilians, while the effect on both overall and native wages are heterogenous, suggesting distribution impacts and need for gender targeted policies.

**JEL Classification:** J21, J31, J61, F22, F15, O15, R23, H20, H50

**Keywords:** labor market impacts, Venezuelan refugees and migrants, host community, forced displacement

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# 1 Introduction

In a world, where 82.4 million of its 7.9 billion people are forcibly displaced due to persecution, conflicts, violence and human rights violations ([UNHCR, 2021](#)), the impact of forcibly displaced population<sup>1</sup> on the host communities is an issue of great significance and past research have found heterogenous effects of forced displacement on the labor market. This paper contributes to the literature by studying the impact of the influx of Venezuelan refugees and migrants on the overall labor market outcomes in Roraima, the state bordering the Republica Bolivariana de Venezuela at the north and the main gateway of the Venezuelan refugees and migrants entering Brazil, with a focus on the formal labor market outcomes of host Brazilians.

Since 2013, Venezuela, once one of the richest countries in Latin America, has been plunging in to one of the worst economic and social crises of modern day due to questionable investment and macroeconomic policies. Economic activity has been contracting with real GDP shrinking by about 82% since 2013 according to IMF (International Monetary Fund). Inflation rate hit 929,797% in 2019 ([IMF, 2019](#)), while 89% of the population has been estimated to be living in poverty. Health conditions have worsened with an average Venezuelan losing 10 kilos of body weight in 2017 and infant mortality rising to 26 per 1000 live births in 2016 from 14.6 per 1000 live births in 2010. An average of 89 homicides were reported per 100,000 inhabitants in 2019, which is almost three times that of countries that are at war ([World Bank, 2019](#)).

This worsening economic condition and rise in violence generated an unprece-

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<sup>1</sup>Forced displacement population include refugees, returnees, expellees, escapees and internally displaced person. This paper uses forcibly displaced and refugees and migrants interchangeably.

mented exodus of about 5.6 million<sup>2</sup> Venezuelans in search of better future and ability to avail basic human rights. Colombia and Peru have been the most significant hosts followed by Chile, Ecuador, United States and Brazil. As of January 31, 2021, Colombia has about 1.7 millions of the Venezuelan refugees and migrants, which is after about 60,000 to 100,000 Venezuelans returning back to reunite with families during the COVID-19 pandemic (Mazza, 2020). Peru stands second with about 1 million refugees and migrants, while Chile and Ecuador are the third and fourth significant hosts with about 0.47 million and 0.41 million Venezuelan refugees and migrants respectively.

This paper focuses on Brazil as host country for Venezuelans. Brazil is hosting about 0.26 million Venezuelans (18% of all its total migrant and refugee population) as of the fourth quarter of 2020, seventy-six times the number of Venezuelan refugees and migrants in 2015, with the majority of the Venezuelan influx, more than 30%, being concentrated in the smallest border state of Roraima, which resulted in a federal decree number 9.285 of February 2018, recognising the situation as a humanitarian crisis.<sup>3</sup>

Although leaders of the other Latin American countries, including Brazil, have been accommodative in welcoming and granting legal status to Venezuelan refugees and migrants (Selee and Bolter, 2020), the sheer size of the Venezuelan refugees and migrants means that addressing the humanitarian crisis and the population shock may affect the labor market outcomes and public resources of the respective countries. Research on Colombia (Bonilla-Mejia et al. (2020), Caruso et al. (2019) and Penaloza (2019)) find short-term negative effect of the Venezuelan influx on informal wages and employment. However, the impact on

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<sup>2</sup>Dashboard of R4V as of 5th May 2021

<sup>3</sup><http://www.planalto.gov.br/ccivil03/ato2015-2018/2018/decreto/D9285.htm>

the host communities depends on the rules governing the labor market and relative socio-economic characteristics of both the refugees and the host communities (Verme and Schuettler (2021)) and Brazil is one of the few countries in Latin America that has universal access to education, healthcare and social protection irrespective of documentation status and prohibit any kind of discrimination at work (Selee and Bolter, 2020) and consequently it serves as a case study to see whether different legal constraints can lead to differential observed outcomes.

An inflow of about 117,347 Venezuelans in Brazil in 2018, with majority entering through the small state of Roraima, which had a population of only 576,568 and working age population of 383,000 in 2018, makes it interesting to explore the labor market impact of migrants and refugee exodus on a small community in a developing country. This paper focuses on investigating the impact of Venezuelan influx on the overall labor market in Roraima, with a focus on the impact of host community in the formal sector, which comprises of about 62% of the total employed in Roraima. It also presents results on the other areas of Brazil for comparison, where the size of the Venezuelan community is much smaller.

This paper uses a regression discontinuity methodology to study the impact on the labor market of Roraima, exploiting the 2% (11,000) increase in the working age population in Roraima in the first quarter of 2018. For the rest of Brazil, this paper uses a difference-in-difference IV methodology to assess the impact of the Venezuelan migrants and refugees, who migrated to the other provinces. The findings suggests that 2% increase in working age population in Roraima led to an increase in unemployment among females living in the state by about 26%, and informal employment among females decreased by about 6%,

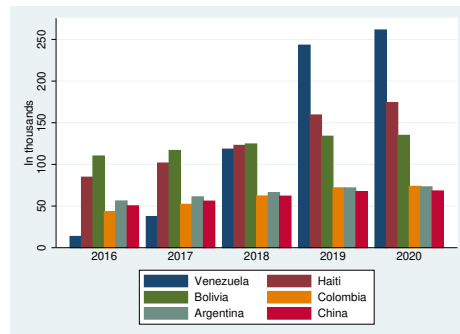
suggesting that females are suffering disproportionately more from the displacement crisis as Roraima tries to absorb the excess supply in the short-run. The labor participation rate did not change significantly suggesting that the increase in unemployment may be coming from both new people entering the labor force and decrease in informal employment. However, Roraima experienced a 20% increase in formal employment among the host Brazilians, with the low-skilled and female Brazilians experiencing a slight decrease in their wage, suggesting there might be some movement of native workers from the informal sector to the formal sector. Further findings include that a 1 percentage point increase in Venezuelan share of the population led to about 0.17% increase in Brazilian formal employment in the northern provinces from the difference-in-difference IV estimates. The effect on Brazilian wages in the northern provinces are not statistical significant but there seems to be a shift in employment from agriculture to more industrial and commercial works. Overall the results suggest that although the Venezuelan influx created formal employment for the natives, female workers are being left behind, and the effects on wages are heterogenous across different groups and municipalities.

This paper is divided into six sections. Section 2 gives a description of the migration trend in Brazil, focusing on the influx of Venezuelan refugees and migrants and a discussion on the overall formal labor market of Brazil. Section 3 provides a brief survey of the past literature, while section 4 discusses the time-series data and the main variables used. Section 5 discusses the methodology and Section 6 presents the results along with the robustness checks. Section 7 concludes with some policy implications and discusses venue for further research.

## 2 Venezuelan Migration in Brazil and the Formal Labor Market of Brazil

The diaspora population in Brazil has been increasing rapidly from 2016 and total migrants and asylum seeker population increased from about 0.7 million in 2016 to about 1.4 million in July 2020. From being one of the lowest diaspora population in 2016, among the Latin American countries, Venezuelans in Brazil (shown in blue in Figure 1) quickly became the largest migrant population by 2019. Brazil also has diaspora<sup>4</sup> from Bolivia and Haiti, followed by Colombia, Argentina and China as the figure shows. During the period of July 2017 to October 2020, Brazil received about 126,256 migrants and 30,000 asylum seekers from Haiti, 38,232 migrants from Colombia, 9,063 asylum seekers from Cuba and 3,986 refugees from Syria.

Figure 1: Migration Trend in Brazil



Source: Author's calculation from SISMIGRA and STIMAR.

Although the number of Venezuelans increased quickly from about 1100 in 2017 to 118,000 by the end of 2018 to about 265,000 in the first quarter of 2020, the stock started dwindling down after the onset of COVID-19 pandemic.

<sup>4</sup>Regular migrants and asylum seekers



Half of the Venezuelans, who entered Brazil, exited Brazil either to go back to Venezuela or to remigrate to other countries. When the pandemic hit, the movement across borders was restricted and more Venezuelans were leaving than coming in and as a result the total number started falling. The Federal Police database reveals that half of the Venezuelan migrants and asylum seekers entered Brazil with regular visa, while the other half registered as asylum seekers. 95% of the migrant population have temporary visas. As of October 2020, there were 145,462 Venezuelan migrants, 96,556 Venezuelan asylum seekers and 46,647 Venezuelans refugees, who had migrated to Brazil since July 2017.

In Brazil, estimate suggests that most Venezuelan migrants and asylum seekers enter through the municipalities of Pacaraima, Bonfim and Boa Vista in Roraima, which is not surprising given the proximity of these municipalities to Venezuela at the north (FGVDAPP, 2020). The population of Roraima in 2017 was about 0.5 million, the lowest among the states in Brazil and contributing only about 0.2% of the Brazilian GDP. Consequently, after the massive Venezuelan inflow, the Venezuelan migrants and asylum seekers quickly comprised of about 12%<sup>5</sup> of the population of Roraima and the state received help from the federal government, UNHCR, the Catholic church and civil society partners to manage its response to the influx and provide humanitarian assistance. The initiative is called “*Operação Acolhida*” (Operation Welcome) and has three main programmes: border control and documentation; provision of humanitarian assistance including shelter; and “Interiorization” which involves the voluntary relocation of Venezuelans from Roraima to other cities. The voluntary relocation program has relocated about 50,400<sup>6</sup> Venezuelans from Roraima to other Brazilian cities, where there are more opportunities for social and economic integration.

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<sup>5</sup>Estimated

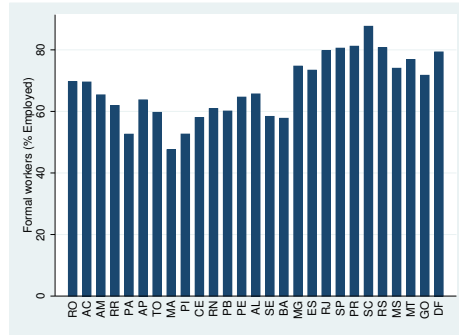
<sup>6</sup>This number represents those relocated by April 2021.

Available data managed by the Federal Police shows that the Venezuelan population in Brazil has a balanced gender distribution, contrary to the other population movements that are observed in other parts of the world, where men form the dominant movers. Of the Venezuelan migrant population, 49% are women while 51% are men, and 45% of the asylum seekers are women while 54% are men. This Venezuelan balanced gender distribution is observed in other Latin American countries like Colombia and Peru suggesting that this gender equality may be specific to the Venezuelan migration process. Venezuelan refugees and migrants are young, and many are single parents. Of the Venezuelan migrants, 75% are below 50 years old and 50% of the refugees and migrants are between the age of 20 and 40 years old. The presence of about 20% children below the age of 20 years points to the fact that a key component of the Venezuelan migrants and asylum seekers is that there has been substantial family migration. However, about 72% of Venezuelan asylum seekers and 84% of asylum seekers above the age of 25 years report their civic status as single, signifying that most of those families consist of single parents. There is no significant difference in proportion of single parents between men and women.

Like most other Latin American countries, Brazil's labor market is segmented into informal and formal sectors, with about 32% (38% in Roraima) of the country's total employed (formal and informal) working in the informal sector, that is in a job unregulated by the government. Although in most countries, refugees's access to the labor market is limited to the informal sector ([Clemens et al., 2018](#)), in Brazil, refugees also have access to the formal labor market, which in theory should allow Venezuelans to be more integrated and contribute positively to the economy. Figure 2 shows the formal sector as a fraction of total

employed across the different parts of Brazil and it is evident that Roraima has a substantial formal sector, although not the largest in Brazil.

Figure 2: Formal sector of Brazil across provinces and time



Source: Author's calculation from IBGE PNADC.

### 3 Past Research

This paper contributes to the literature on forced displacement, and economic and social impacts of refugees and migrants on the host communities and aims to extend the literature by being the first to explore the short-term formal labour market effects of the Venezuelan influx on the host community in Brazil. This paper also extends the literature by utilizing the sudden influx of Venezuelan in 2018 in Brazil and their concentration in Roraima to identify the impact of the Venezuelan forced displacement on the labor market outcomes.

Past literature on the effect of forced displacement on host country has found mixed results. For example, [Verme and Schuettler \(2021\)](#) finds that 6 in 10 results of studies on employment and wage are non-significant, but when they are significant, the results are more likely to point to decreases in employment and wages than increases. The negative effects on employment and wages are

likelier for informal, young, low-skilled and female workers and are prevalent in the short-run. There is also some evidence that low income countries benefit with an increase in employment among host workers as compared to high-income countries. Research on the Syrian displacement crisis ([Del Carpio and Wagner \(2016\)](#) and [Aksu et al. \(2018\)](#)) find that the Syrian influx displaced natives in the informal sector but led to increase in formal employment among the Turkish, while there is some evidence that formal wages among men increased ([Aksu et al. \(2018\)](#)).

[Ryu and Paudel \(2021\)](#) looks into the overall labour market effect of the Venezuelan exodus in Roraima and find that overall employment fell, with vulnerable groups like the unskilled and female suffering greater losses using a synthetic cohort matching method and PNADC (Continuous National Household Sample Survey) data from 2014 to third quarter of 2018. It should be noted here that the sample period and methodology of this paper is different from [Ryu and Paudel \(2021\)](#). In addition, this paper explores the formal sector impact on host community.

[Bonilla-Mejia et al. \(2020\)](#), [Caruso et al. \(2019\)](#) and [Penaloza \(2019\)](#) focus on the impact of the influx of Venezuelans on the labor market in Colombia and find that it reduces wages, especially for male workers in the informal sector. [Caruso et al. \(2019\)](#) finds that a percentage point increase in displaced Venezuelans reduces informal sector wages by ten percentage points in urban areas. [Bahar et al. \(2021\)](#) provides evidences of asymmetrical effects of a large scale amnesty program that granted work permits to undocumented Venezuelans in Colombia that helped labor market outcomes of Venezuelan at the cost of Colombian workers. [Morales and Pierola \(2020\)](#) also finds heterogeneity in the impacts of

Venezuelan refugees and migrants on native labor market outcomes in Peru with increasing likelihood of tertiary educated workers being employed in non-service sector and decreasing wage for secondary educated workers working in service sector.

Although this paper looks in to the overall labor market in Roraima, it focuses on the formal sector because data on the informal sector (PNADC) is not available by nationality. The large concentration of Venezuelans in Roraima and their sudden surge in the formal sector in the beginning of 2018 allows this paper to utilize regression discontinuity design and to identify the impact of the Venezuelan forced displacement on the labor market outcomes in Roraima. Following past literature on other countries, this paper complements the regression discontinuity methods with a difference-in-difference methodology that uses the variation in the ratio of migrants to populations across the different municipalities in Brazil over time to identify to effect on the formal labor market on the country as a whole. However, the supply shocks across the municipalities may not be random and consequently this paper uses an instrumental variable approach, which employs a variant of the distance instrument used in many studies including [Del Carpio and Wagner \(2016\)](#) and [Aksu et al. \(2018\)](#).

## 4 Data

The data for the regression discontinuity estimates on the overall labor market consequences of the Venezuelan influx in Roraima come from the quarterly data of PNADC (Continuous National Household Sample Survey) for the period 2012 to 2019. The survey sample of PNAD is representative of the states and the federal level of Brazil and aims to monitor dynamism in the labor force.

Unfortunately, it does not collect information on nationality or immigration status and as a result, this part of the analysis focuses on the overall labor market variables and not solely on the impact on native community.

Table 1 shows the summary statistics of the overall labor market variables by pre-2018 and 2018 and after groups using the quarterly data of PNADC. Across Brazil, both total employment and unemployment increased after 2017, but while formal employment decreased in other provinces, it increased in Amazonas and Roraima. Another point to note is that the two-third of the increase in working age population is coming from Roraima and Amazonas. The increase in college educated in Roraima is substantially higher than across Brazil, suggesting that Venezuelans coming in are on average more educated than the natives. The gender ratio does not change significantly in Roraima and Amazonas, pointing to the balanced gender ratio of the Venezuelan exodus.

Table 1: Summary Statistics of the overall labor market by years and provinces in Brazil

Variables	All Provinces		Roraima & Amazonas	
	2018 and After	Before 2018	2018 and After	Before 2018
Working Age Population	6,673,175 (7,722,091)	6,498,186* (7,548,153)	1,687,808 (1,336,273)	1,572,036 (1,243,727)
Employment	3,627,078 (4,494,772)	3,557,765+ (4,341,299)	901,520 (710,401)	853,566 (666,828)
Unemployment	495,639 (669,772)	435,556* (594,195)	145,656 (116,131)	122,590 (111,805)
Underemployment	266,262 (291,543)	203,758* (227,914)	62,341 (50,235)	41,288 (34,569)
Own Account Worker	926,074 (1,004,182)	873,071+ (892,443)	294,759 (244,513)	272,823 (224,627)
Employee	2,446,902 (3,208,749)	2,439,315 (3,206,893)	503,331 (373,496)	480,603 (353,266)
Employer	174,097 (247,862)	159,545* (229,536)	27,014 (18,595)	26,344 (19,766)
Formal	1,305,160 (2,023,931)	1,357,239* (2,105,652)	205,790 (167,477)	197,440 (155,221)
Informal	446,261 (497,799)	402,464* (424,187)	99,807 (77,208)	95,206 (72,779)
Industry	467,126 (711,699)	473,804 (722,444)	94,908 (87,249)	91,740 (81,410)
Construction	263,013 (318,709)	282,816* (327,555)	53,448 (36,870)	58,212 (42,617)
Trade	689,824 (803,377)	683,699 (784,866)	169,092 (129,334)	161,973 (122,697)
Agriculture	327,234 (284,341)	347,982+ (297,187)	149,103 (135,637)	157,225 (142,654)
Hours Worked	37.161 (1.697)	37.573 (1.762)	36.338 (1.121)	37.51 (.857)
Wage	891 (382)	782* (329)	771 (159)	746 (151)
College	.146 (.044)	.127* (.043)	.154 (.021)	.129* (.022)
Gender Ratio	1.065 (.039)	1.057* (.037)	1.003 (.013)	.991 (.012)
Age	34.525 (2.19)	33.481* (2.403)	29.869 (.48)	28.852 (.269)
Children	.079 (.009)	.080* (.011)	.101 (.005)	.109* (.003)
Household size	3.726 (.343)	3.822* (.358)	4.604 (.157)	4.661 (.197)

All standard deviations are given in the brackets and the asterisks show the significance of the differences. +  $p < 0.10$ , \*  $p < 0.05$ . The data is at province level.

The formal sector analysis in the paper comes from the identified RAIS dataset of the period 2015 to 2019, which is an administrative data managed by the Ministry of Economy. It covers all formally employed wage earners, either public or private, and is collected annually, including data on demographics, income, occupation, nationalities, new hires and terminations during the year. In 2019, it contains information about 28,910 Venezuelans with about 19,746 employed in the formal sector as of December 31, 2019. The identified RAIS individual level data is then merged with the identified Caged data, which is a monthly administrative register of employment in Brazil and also contains most of the variables in RAIS, except nationality and is managed by the Ministry of Economy. Due to the very large data size, this analysis focuses at the municipality level so the merged dataset is then collapsed by municipalities and years for the difference-in-difference IV methodology and is collapsed by provinces and months for the regression discontinuity estimates that focuses on Roraima.

Table 2 shows the descriptive statistics of the formal labor market before 2018 and 2018 onwards. Although total formal sector employment among host community fell across Brazil, the fall in Roraima and Amazonas seem to be statistically insignificant at 10 percent level of significance. Real monthly earnings of Brazilian formal workers on average seem to have increased by a larger magnitude in Roraima and Amazonas than in Brazil overall.



Table 2: Summary Statistics of the formal sector by years and provinces in Brazil

Variables	All Provinces		Roraima & Amazonas	
	2018 and After	Before 2018	2018 and After	Before 2018
<b>Formal Employment:</b>				
Brazilian	3,108 (20,002)	3,487* (23,077)	3,986 (22,721)	4,503 (26,790)
Low-skilled Brazilian	2,523 (16,271)	2,850* (19,118)	3,389 (19,788)	3,850 (23,628)
Brazilian Female	1,494 (9,724)	1,678* (11,169)	1,855 (10,225)	2,157 (12,615)
Brazilian in Agriculture	143 (389)	161* (403)	48 (196)	52 (206)
Brazilian in Industrial	686 (3,234)	823* (4,035)	761 (5,343)	962 (6,948)
Brazilian in Commerce	701 (5,342)	772* (6,137)	958 (5,335)	1,001 (5,856)
Venezuelan	.897 (11.898)	.049* (.996)	50.052 (302.102)	6.524 (59.629)
Low-skilled Venezuelan	.698 (9.97)	.034* (.758)	44.143 (266.429)	5.571 (51.362)
Venezuelan female	.300 (4.232)	.021* (.474)	11.734 (71.278)	1.788 (16.166)
<b>Formal Wage:</b>				
Brazilian wage	2,830 (771)	2,727* (1,210)	3,462 (2,646)	2,948* (1,534)
Brazilian female wage	2,927 (856)	2,814* (1,469)	3,499 (2,581)	2,959* (1,653)
Brazilian skilled wage	3,335 (1,524)	3,501* (2,393)	3,919 (3,795)	3,861 (3,554)
Brazilian low-skilled wage	2,760 (761)	2,629* (1,109)	3,372 (2,579)	2,797* (1,385)
Brazilian wage in industry	2,631 (909)	2,529* (881)	3,456 (3,835)	2,731 (1,455)
Brazilian wage in agriculture	2,577 (1509)	2,385* (951)	2,809 (1,592)	2,425 (402)
Brazilian wage in commerce	2,763 (759)	2,648* (1,133)	3,152 (2,339)	2,645* (1,534)
Venezuelan wage	2,996 (2,393)	3,313 (2,540)	2,627 (1,621)	2,544 (317)
Venezuelan skilled wage	3,660 (4,767)	4,617 (5,038)	3,028 (1,723)	2,842 (1,069)
Venezuelan unskilled wage	2,957 (2,888)	2,686 (695)	2,648 (1,745)	2,517 (347)
Venezuelan female wage	3,100 (2,033)	3,895 (4,330)	2,564 (525)	2,376 (177)
<b>Fraction and Index:</b>				
Population Shock	.094 (6.631)	.021 (2.243)	.909 (6.397)	.022 (.147)
Instrument	.913 (5.374)	.196* (1.374)	1.664 (3.285)	.358 (.859)

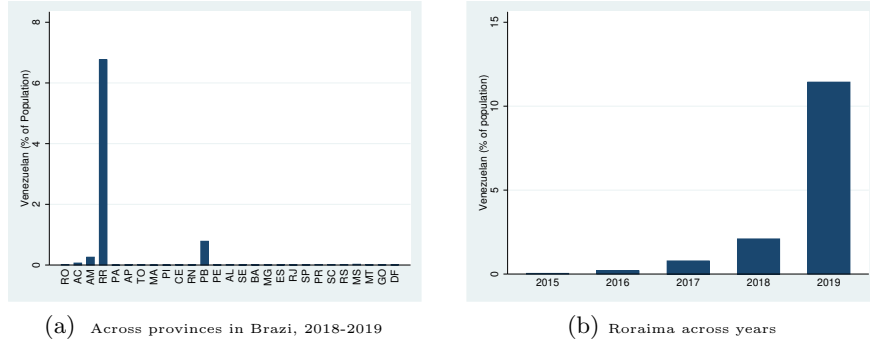
All standard deviations are given in the brackets and the asterisks show the statistical significance of the differences (+  $p < 0.10$ , \*  $p < 0.05$ ). All numbers are at municipality level. Population shock is number of Venezuelan refugee and migrants divided by the population of the municipality. The instrument used is a variant of distance based instrument in [Del Carpio and Wagner \(2016\)](#).

In line with the past literature (Del Carpio and Wagner (2016)), we use the number of Venezuelans in the municipality over the population to identify the effect of the Venezuelan influx for the difference-in-difference method. The population data comes from IBGE (Brazilian Institute of Geography and Statistics Foundation) and the total migrants data come from SISMIGRA (National Migration Registry System), which is the administrative record, maintained by the Federal Police, of migrants and refugees, who applied for residence permits and contains information on age, sex, country of birth and municipality of residence. The data is quite comprehensive and used by the government to measure the size of the diaspora community. Access to social protection programs, education and formal labor cards are all based on this registration and hence it is unlikely that migrants and refugees will self-exclude from registering in the database. Figure 3 shows that although Venezuelans started flowing into Brazil from 2017, the stock did not get substantial till 2018. Another feature of the data shows that population shock is concentrated in the north part of Brazil, especially Roraima, where it constituted on average about 7% of the population in the period 2018-2019. This concentration of Venezuelans in Roraima allows this paper to utilize the regression discontinuity method to identify the Venezuelan influx on the labor market.

## 5 Conceptual Framework & Econometric Specification

The influx of displaced Venezuelans mainly through Roraima theoretically should create two types of shock - a population shock with a sudden increase in population of the state and an expenditure shock with host government or

Figure 3: Venezuelans as % of total population



international community providing for housing, education and social assistance to the forcibly displaced. The effect on the labor market depends not only on the degree of substitutability between the local and the displaced workers but also on the labor market structure of the host country. Only if the displaced workers are substitute to local workers, local employment may fall leading to a rise in unemployment and(or) a fall in wage. This detrimental effect may well be negated and even exceeded by the humanitarian agencies and the government recruiting local workers to provide and accommodate for the influx of forcibly displaced and the increase in consumer demand which generates a multiplier effect generating new employment opportunities across the economy.

In a country like Brazil, where informal sector is substantial and there is no legal barrier for migrants and refugees to work in the formal sector, sectoral effect of the exodus is ambiguous. Venezuelans can be either substitute (complement) in both the formal and informal sectors or be substitute in one and complement in the other and a priori their effects on the labor market are not clear. For example, with different language skill and education that is not being recognized, the Venezuelan migrants may be more likely to work in the informal sector, acting as substitute to the host workers, which may lower wages and employment of

natives in the informal sector depending on the elasticity of supply and demand. In the formal labor market, occupationally downgraded Venezuelans may act as complement to the native workforce, increasing productivity and labor demand, which then leads to increase in native employment and wages. The magnitude of the impact depends on the elasticity of labor supply. The formal sector may also get a boost from the increase in government and international community spending, which leads to more employment and higher wages. With both positive labor supply and demand shock, the equilibrium effect on employment is clear but the effect on wages are not.

## 5.1 Regression Discontinuity on Roraima

This paper tries to evaluate the effect of the forcibly displaced by using the discontinuity that is observed in the population data, mainly the working age population, in the first quarter of 2018, in a regression discontinuity (RD) design to evaluate the labor market effects.<sup>7</sup> In the RD design, this paper uses a transformed variable ( $X$ ) of the time quarters as the running or score variable.  $X$  is the distance between any time in quarter and the first quarter of 2018. Since the PNADC data is from 2012-2019, there are 32 observations for  $X$ , with  $X$  being equal to zero in the first quarter of 2018, which is defined as the cutoff. The treatment is defined as when  $X \geq 0$  and is denoted by  $D_i = I(X_i > 0)$ , where  $I(\cdot)$  is the indicator function. Since the CAGED data is monthly from the period 2015-2019,  $X$  becomes the distance from the first month of 2018 for the analysis focusing on the formal sector. Consequently, there are 60 observations for  $X$  in the formal sector, with  $X$  being equal to zero in January of 2018, which is defined as the cutoff. It should be noted here that assigning to the treatment

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<sup>7</sup>It should be noted here that a bigger jump in total population is observed in the annual data series published by IBGE, but due to limited observations, the jump cannot be estimated by RD.

condition does not mean receiving the treatment. For example, in this case, the Venezuelan refugees and migrants started coming in to Brazil in 2017, but the net influx did not become substantial till the first quarter of 2018, which witnessed a net inflow of about 20,000 that is 50% of the total Venezuelan influx in Brazil at that point in time, which translated into 11000 increase in working age population that is observed in Figure 4. The sharp rise in the working age population in Roraima in 2018 (Figure 4) add evidence for a sharp RD design, where it is assumed that the treatment condition assigned is identical to the treatment condition received. The results of the fuzzy RD design<sup>8</sup>, where there is noncompliance, or where the treatment condition assigned is not equal to treatment condition received is also estimated for robustness checks and the results are given in the appendix

Just like the fundamental problem in any causal inference, in RD design, one only observes the outcome under control,  $Y_i(0)$  for those units or quarters whose running variable or score is below the cutoff and the outcome under treatment,  $Y_i(1)$ , for those units or quarters whose score is above the cutoff. The average potential outcome given the score,  $E[Y_i|X_i]$  is observed for only  $E[Y_i(1)|X_i \geq c]$  for values where  $c$  is the cutoff and for  $E[Y_i(0)|X_i < c]$ .  $E[Y_i(1)|X_i < c]$  and  $E[Y_i(0)|X_i > c]$  are unobserved. Consequently, the sharp RD design exhibits an extreme case of lack of common support, as units in the control ( $D_i = I(X_i \geq c) = 0$ ) and treatment ( $D_i = I(X_i \geq c) = 1$ ) groups cannot have the same value of the running variable ( $X_i$ ). Thus, RD performs a local extrapolation in order to compare the control and the treatment units.

The average treatment effect at a score is the vertical distance between the

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<sup>8</sup>The fuzzy RD involves a two stage estimation, where the first stage estimates the probability of treatment, while the second stage uses this estimated probability to find its effect on the outcome variable.

two regression curves at the value. This distance cannot be directly estimated because one never observes both curves for the same value of X. Thus the treatment effect is defined as:

$$\pi_{SRD} = [Y_i(1) - Y_i(0)|X_i = c] = \lim_{x \downarrow c} [Y_i|X_i = x] - \lim_{x \uparrow c} [Y_i|X_i = x] \quad (1)$$

where the parameter captures the reduced form treatment effect for units with score values equal to  $c$ . It shows the average outcome change for units at the cutoff if their status is switched from control to treated. This treatment effect is local in nature and without further assumptions can not be used to deduce the treatment effects at the other levels of the running variable. A fundamental assumption of the above equation is the comparability of the units with very similar values of the running variable but on opposite sides of the cutoff, which is reflected as a continuity assumption in the above equation. Continuity means that as the score  $X_i$  gets closer and closer to the cutoff  $c$ , the average potential outcome function  $E[Y_i(0)|X_i = x]$  and  $E[Y_i(1)|X_i = x]$  get closer and closer to its value at the cutoff,  $E[Y_i(0)|X_i = c]$  and  $E[Y_i(1)|X_i = c]$  respectively. Thus, continuity gives a formal justification for estimating the Sharp RD effect by focusing on observations above and below the cutoff in a very small neighborhood around it. By virtue of being very close to the cutoff, the observations in this neighbourhood will have very similar score values; and by virtue of continuity, their average potential outcomes will also be similar.

This suggests that in order to conduct RD, this paper needs to estimate  $E[Y_i(0)|X_i = x]$  and  $E[Y_i(1)|X_i = x]$  and this requires choosing the functional form of these regression functions and the neighbourhood of the score that will be used for estimation. [Cattaneo et al. \(2019\)](#) and [Gelman and Imbens \(2017\)](#) suggest using a local linear approximations as higher order polynomial leads

to overfitting problems. Thus, this paper focuses on the local linear regression for all estimations. The estimations are conducted using uniform kernel and triangular kernel to test sensitivity as suggested by [Cattaneo et al. \(2019\)](#). For the neighbourhood estimations, which is formally called the bandwidth, this paper uses the robust biased corrected bandwidth suggested by [Calonico et al. \(2014\)](#). The optimum bandwidth seeks to minimize the mean square error of the local linear RD point estimator, while the robust biased corrected bandwidth includes a regularization term in the bandwidth to control for small sample size ([Calonico et al., 2014](#)). [Cattaneo et al. \(2019\)](#) also suggests adjusting the RD estimate and the standard errors for the biases caused by small sample and as a result, this paper estimates three estimates using the bandwidths suggested by [Calonico et al. \(2020\)](#), the conventional estimate suggested by the equation above, and the bias-corrected estimate which accounts for the bias in the estimate and the robust estimate which controls for the bias in the estimate and the standard error. However, the results section only include the robust estimates. The standard errors are clustered at the score value as prescribed by [Cattaneo et al. \(2021\)](#).

The covariates include fixed effects for each month (quarter) to control for seasonality in the time series data as advocated by [Hausman and Rapson \(2018\)](#). [Hausman and Rapson \(2018\)](#) also suggested using the lag of the dependent variable as a covariate to see the robustness of result. So, the  $\pi_{SRD}$  estimated are interpreted as the reduced form RD effect or the reduced form local average treatment effect on the treated months (quarters). The assumptions that are needed for the identification are that the score variable can not be caused or influenced by the treatment, cutoff is exogenous and that nothing other than the treatment is discontinuous at the cutoff. In the result section, this paper presents support for the assumptions along with the falsification analysis and

robustness of the results to fuzzy RD.

## 5.2 Difference-in-Difference using all Provinces

To study the effect of forced displacement on the labor market outcomes, most papers use a difference-in-difference with multiple time periods model. In line with the past literature, this paper estimates the following model:

$$\text{Ln}(Y_{jt}) = \alpha + \beta V_{jt} + \gamma X_{jt} + \theta_t + \theta_j + \pi_{jt} \quad (2)$$

where  $Y_{jt}$  denote the labor market outcome for municipality  $j$  at time  $t$  and  $V_{jt}$  is the percentage of the population in the municipality that are Venezuelan in municipality  $j$  at time  $t$ .  $\beta$  is the key parameter of interest, which shows the effect of increasing Venezuelan percentage of the population on the labor market outcome.  $X_{jt}$  refers to controls while  $\theta_t$  and  $\theta_j$  refer to time and municipality fixed effects. The outcome variables this paper looks at include total number of Brazilians in the formal sector, total number of Brazilian female, total number of unskilled Brazilian, total number of Brazilian in agriculture, total number of Brazilian in industry, total number of Brazilian in commerce, average Brazilian formal sector wage, average Brazilian female formal sector wage, average Brazilian unskilled formal sector wage, and average Brazilian formal wage in agriculture, industry and commerce respectively, The covariates that are included are gender ratio, log of natural number of population, average age, fraction of the labor force who are white, fraction of people who are college educated and the volume of trade in the province that the municipality is in. This specification makes the common-trend assumption across the municipalities and this paper conducts a test for it by including the interaction of the dummies with year fixed effect as suggested by [Pischke \(2005\)](#).



There exists a limitation in identifying the causal impact in this way because of the potential endogeneity arising from the sorting of forcibly displaced to areas with certain characteristics and other time varying factors, such as public expenditure, that may lead to spurious correlation. Most studies try to address these endogeneity issues by using instrument variable methods (Verme and Schuettler, 2021). The instrumenting strategy used in the literature, is based on the idea that travel distance from the source country to the host community is a key determinant of forcibly displaced location decision. Thus, this paper borrows from Del Carpio and Wagner (2016) to use the instrument of the form below:

$$IV_{jt} = \frac{R_t * \pi_j}{T_{jv}} \quad (3)$$

where  $R_t$  is the total number of Venezuelan refugees and migrants who left Venezuelan in year  $t$  and  $\pi_j$  is the number of total immigrants in Brazil in the municipality in year 2014 that is before the Venezuelan influx started and  $T_{jv}$  is the distance between Caracas, the capital of Venezuela and the different municipalities in Brazil calculated using the longitudes and latitudes of the different municipalities, provided by IBGE, and the haversine formula. Since this paper includes region and time fixed effects, the instrument depends on the distance between the five thousand municipalities and the capital of Venezuela for identification. This instrument differs from the instrument in Del Carpio and Wagner (2016) by not disaggregating the distribution of Venezuelans in Brazil from the source regions in Venezuela as data is not available. The identifying assumption of the instrument, once fixed effects are included, is that the location of Venezuelans in refugees and migrants depends on the distance from Venezuela, while other systematic trends including the direct impact of the Venezuelan

on economic activity in Brazil does not depend on distance from Venezuela. Although Roraima and Amazonas, the two provinces bordering Venezuela, are the closest in distance, they are certainly not the poorest in terms of GDP per capita, but the provinces in the South do have a higher GDP per capita than the north in Brazil and as a result, the instrument may become debatable.

## 6 Results and Discussion

### 6.1 Regression Discontinuity Results

Looking only on the formal sector leaves out a lot of dynamism in the Brazilian labor market as the informal sector consists of about 32% of the total employed. Typically, PNADC (Continuous National Household Sample Survey) is used to study the informal sector, but unfortunately it does not collect information on nationality or immigration status. Thus, this paper first concentrates on the overall labor market of Roraima and then goes on to explore the formal labor market impacts on Brazilians using the CAGED data.

#### 6.1.1 Overall Labor Market - Roraima

The overall labor market effect is the effect on the labor market and cannot be discerned by nationality due to unavailability of data. Figure 4 shows that the working age population, defined as those above the age of 14 years, increased from 372,000 in last quarter of 2017 to 383,000 in the first quarter of 2018, which is about a 3% increase, suggesting a labor supply shock in Roraima due to forcibly displaced Venezuelans. This shock in working age population of this magnitude in the first quarter of 2018 is only being witnessed in Roraima as

Figure A1 reveals and most of the other northern states see a slight decline in the population in 2018, adding evidence that the influx of forcibly displaced Venezuelans are responsible for the population jump up in Roraima. It further shows a jump up in total number of unemployed from about 22,000 to about 25,000 in the first quarter of 2018 to about 27,000 in the second quarter to about 33,000 in the third quarter of 2018. Underemployment increased from 10,500 to about 12,400 in the first quarter of 2018 to about 15,000 in the second quarter to 18,000 in the third quarter of 2018, suggesting that in the short-term, the labor market in Roraima is finding it hard to cope leading to higher unemployment and underemployment. Total employment also shows a downward trend for most of 2018 decreasing from 214,000 to about 213,000 in the second quarter to about 212,000 in the third quarter of 2018. The diagram also shows that pre 2018 while unemployment and underemployment was almost constant, employment was rising, suggesting that the labor market experienced a shock in 2018 that lead to a change in trend.

Figure 4: Overall labor market scenario in Roraima.



Note: The y-axis is in thousand and the x-axis the distance in quarters from the first quarter of 2018. The data comes from PNADC and solid line shows the local linear fit while the dashed lines show the 95% confidence interval.

Formal employment and informal employment both seem to suggest an ambiguous trend (Figure 5), but both the series became more volatile after first quarter of 2018. Among the formally employed, there was a small declining trend for the number of employees, while the number of employer showed an increasing trend. Own-account workers showed an uptick in the first quarter of 2018 and so did gross income. Both the number of own-account workers and gross income fell for the rest of 2018.

Figure 5: Different types of employment and income in Roraima.



Note: The y-axis is in thousand and the x-axis the distance in quarters from the first quarter of 2018. The data comes from PNADC and solid line shows the local linear fit while the dashed lines show the 95% confidence interval. The monthly gross income is in real Brazilian reais and is adjusted for inflation by IPCA.

Table 3 reports the reduced form sharp RD estimates of the impact of forcibly displaced Venezuelans on the overall labor market in Roraima. The tables in this section use a triangular kernel and the bandwidth suggested by Calonico et al. (2020), with the rows displaying the difference in regression function, controlling for the bias in the estimates in the conventional method as in Calonico et al. (2014)<sup>9</sup>. All standard errors are clustered at the score variable and the covariates that are controlled for in the estimations include dummies for each quarter to control for seasonality and previous quarter's outcome variable to control for unit root as in Hausman and Rapson (2018). The robust estimates controlling for seasonality and unit root are in the third columns and suggest that working age population increased by about 2.3% increase from its value in the last quarter of 2017, while employment decreased by about 3.4% and unemployment increased

<sup>9</sup>The results from the conventional method are available on request

by about 11.2% in the first quarter of 2018.

It should be noted here that the impact is on the overall labor market and the data does not allow to disentangle the impact on the host community. So, it is possible that the displaced Venezuelans are contributing to the increase in unemployment and underemployment, but the fall in employment does support the fact that the small economy of Roraima is finding it difficult to absorb the excess labor supply. The overall fall in employment happens despite the 8% increase in public employment, which is restricted to the native workers, suggesting that although government is hiring more, private sector employment for both natives and Venezuelans may be going down. However, the effect on employment in formal and informal sector, and on monthly earnings are statistically insignificant. There is some evidence that number of employers fell by about 27% and the number of own account workers fell by about 2.7%, but these results are not robust across all specifications.

Table 3: Regression discontinuity estimates of the impact on labor market participation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Working Age Population			Employed			Unemployed		
Venezuelan Influx	0.019*	0.029*	0.023*	-0.034*	-0.010	-0.034*	0.142*	0.144*	0.112
	(0.006)	(0.003)	(0.004)	(0.005)	(0.008)	(0.005)	(0.072)	(0.072)	(0.075)
<i>N</i>	32	32	31	32	32	31	32	32	31
	Underemployed			Hours Worked			Public Employment		
Venezuelan Influx	0.232*	0.236*	0.282*	-0.003	0.012*	0.014*	0.026	0.076*	0.078*
	(0.078)	(0.040)	(0.077)	(0.007)	(0.005)	(0.004)	(0.019)	(0.014)	(0.019)
<i>N</i>	32	32	31	32	32	31	32	32	31
	Formal			Informal			Employer		
Venezuelan Influx	-0.028	-0.027	-0.079	-0.127*	-0.030	-0.067	-0.102	-0.245*	-0.270*
	(0.023)	(0.024)	(0.158)	(0.059)	(0.048)	(0.045)	(0.088)	(0.085)	(0.044)
<i>N</i>	32	32	31	32	32	31	32	32	31
	Employed			Own-account			Monthly Income		
Venezuelan Influx	-0.003*	0.002*	0.001	0.002	0.005	-0.027*	0.009	0.001	-0.004
	(0.001)	(0.001)	(0.001)	(0.007)	(0.007)	(0.004)	(0.010)	(0.004)	(0.002)
<i>N</i>	32	32	31	32	32	31	32	32	31
	Agriculture			Industry			Construction		
Venezuelan Influx	0.066	-0.004	-0.001	-0.182*	-0.019	-0.139*	-0.216*	-0.178*	-0.031
	(0.057)	(0.027)	(0.023)	(0.033)	(0.039)	(0.016)	(0.048)	(0.027)	(0.045)
<i>N</i>	32	32	31	32	32	31	32	32	31
	Trade			Transport			Hospitality		
Venezuelan Influx	-0.047*	-0.159*	-0.108*	0.066	0.074	0.093	0.144 <sup>+</sup>	0.099	-0.085
	(0.017)	(0.039)	(0.034)	(0.061)	(0.073)	(0.074)	(0.077)	(0.086)	(0.058)
<i>N</i>	32	32	31	32	32	31	32	32	31
Quarterly Dummies	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Lag Outcome	No	No	Yes	No	No	Yes	No	No	Yes

The standard errors are given in parentheses. <sup>+</sup>  $p < 0.10$ , \*  $p < 0.05$ . The bandwidths and the estimates are calculated using the regression discontinuity model proposed by [Calonico et al. \(2020\)](#) and [Calonico et al. \(2014\)](#). All standard errors are clustered at the score variable level ( $x$ ) and all the outcomes are in log of natural numbers. The covariates used are quarter dummies and past quarter's value of the outcomes.

Table 3 also shows the effect on employment by sector and offers some evidence suggesting that employment in industry and trade fell. It suggests controlling for seasonality and unit root, employment in industry fell by about 14%, while trade fell by about 10%. These results are sensitive to the bandwidth and kernel used and using uniform kernel and different bandwidths, most of the

results are statistically insignificant or changes sign.<sup>10</sup>

Table A1 shows the fuzzy RD estimates of the labor market outcomes which is reported in the appendix to show robustness of the results found under the sharp RD design. The estimates in Table A1 take into account that there might be some non-compliance and the four quarters in 2017 might have also experienced some population shock impacting the labor market outcome. The results that are robust include the rise in unemployment and fall in employment, together with the fall in employment in trade and industry.

The estimates on the overall labor market suggest that the influx of Venezuelan refugee and migrants lead to an increase in overall unemployment in the short run, suggesting that the small state of Roraima found it difficult to absorb the population shock that it experienced due to Venezuelan influx. There may also be some heterogenous effect by socio-economic characteristics of the Venezuelan and native workers and so next this paper explores the heterogeneity on the outcomes by gender and education.

Table 4 shows the effect on the overall labor market by education level and shows that although the working age population increased proportionately between those with college education (skilled) and those without, the rise in unemployment seems to be concentrated on the college educated, while underemployment increased among the unskilled. Employment of skilled workers went down in informal sector and this fall is consistent across the different categories of workers, that is as employer, employee and as own-account workers. Monthly income declines for both skilled and unskilled workers but the decline in unskilled wage is higher than that of the skilled.

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<sup>10</sup>Results available on request



Table 4: The effect on labor market outcomes in Roraima by education level

	College	Below	College	Below	College	Below	College	Below	College	Below
	Working Age	Population	Employed	Unemployed	Unemployed	Underemployed	Underemployed	Hours	Worked	Worked
Venezuelan Influx	0.025*	0.027*	- 0.052 <sup>+</sup>	-0.014	0.181 <sup>+</sup>	0.072	0.039	0.277*	-0.267 <sup>+</sup>	0.875*
	(0.002)	(0.004)	(0.029)	(0.009)	(0.103)	(0.054)	(0.067)	(0.043)	(0.158)	(0.203)
<i>N</i>	31	31	31	31	31	31	31	31	31	31
	Formal		Informal		Employer		Employee		Own-Account	
Venezuelan Influx	-0.211	-0.002	-0.134*	-0.016	-0.447*	-0.105	-0.851*	0.006	-0.234*	-0.032 <sup>+</sup>
	(0.175)	(0.024)	(0.027)	(0.020)	(0.108)	(0.084)	(0.000)	(0.008)	(0.053)	(0.017)
<i>N</i>	31	31	31	31	31	31	31	31	31	31
	Agriculture		Industry		Construction		Trade		Income	
Venezuelan Influx	-0.028	0.007	-0.116	0.144*	1.607*	0.022	-0.600*	-0.162*	-0.005*	-0.007*
	(0.407)	(0.045)	(0.107)	(0.039)	(0.000)	(0.031)	(0.084)	(0.019)	(0.000)	(0.003)
<i>N</i>	31	31	31	31	31	31	31	31	31	31

The standard errors are given in parentheses. <sup>+</sup>  $p < 0.10$ , \*  $p < 0.05$ . Below refers to those without college degree. The bandwidths and the estimates are calculated using the regression discontinuity model proposed by [Calonico et al. \(2020\)](#) and [Calonico et al. \(2014\)](#). All variables are clustered at the score variable level ( $x$ ) and all the outcomes are in log of natural numbers. The covariates used are quarter dummies and past quarter's value of the outcomes.

Table 5 shows that in the short-run the women are facing the adverse effect of the excess supply in the labor market. The increase in unemployment and the decrease in employment are concentrated among female workers while the effects on the male workers are smaller and insignificant. Female employment went down by about 3% as the female working age population increased by about 2.6%. Female unemployment jumped up by about 26% while the change in male unemployment is insignificant. While underemployment and hours worked among male have jumped up by about 27% and 4%, respectively, among female, underemployment increased by 32% and hours worked decreased by 1.5%, suggesting that while the impact on female workers is at both the extensive and intensive margin, the impact on male workers is more at the intensive margin. While formal employment fell among men, informal employment fell among women. The number of female employers and own-account workers also declined.

Table 5: The effect on labor market outcomes in Roraima by gender

	Male Working Age Population	Female Working Age Population	Male Employed	Female Employed	Male Unemployed	Female Unemployed	Male Underemployed	Female Underemployed	Male Hours Worked	Female Hours Worked
Venezuelan Influx	0.031*	0.026*	-0.021*	-0.030*	0.068	0.260*	0.275*	0.317*	0.040*	-0.015*
	(0.003)	(0.005)	(0.002)	(0.014)	(0.075)	(0.085)	(0.051)	(0.142)	(0.007)	(0.006)
<i>N</i>	31	31	31	31	31	31	31	31	31	31
	Formal		Informal		Employer		Employee		Own-Account	
Venezuelan Influx	-0.083*	0.004	-0.029	-0.062 <sup>+</sup>	-0.017	-0.236*	0.215*	0.039*	-0.067*	-0.228*
	(0.029)	(0.024)	(0.033)	(0.037)	(0.054)	(0.078)	(0.000)	(0.005)	(0.003)	(0.038)
<i>N</i>	31	31	31	31	31	31	31	31	31	31
	Agriculture		Industry		Construction		Trade		Income	
Venezuelan Influx	-0.012	0.189*	-0.035	-0.558*	0.028	0.471	-0.186*	-0.172*	0.003	0.005
	(0.040)	(0.025)	(0.070)	(0.002)	(0.040)	(0.377)	(0.046)	(0.035)	(0.028)	(0.021)
<i>N</i>	31	31	31	31	31	31	31	31	31	31

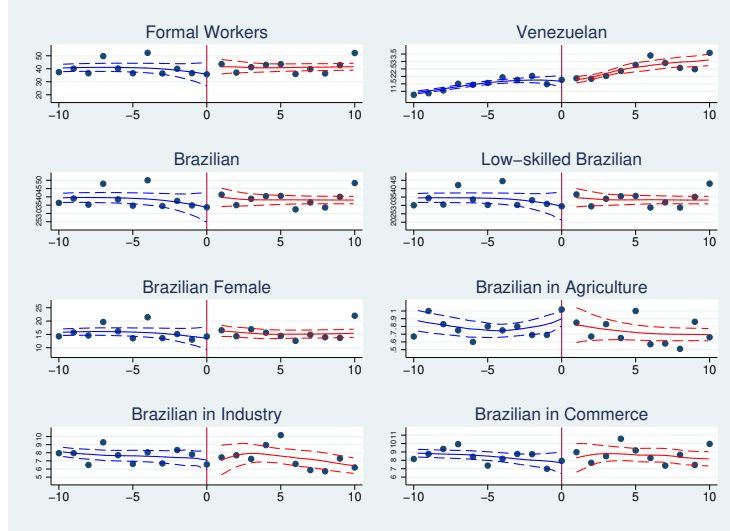
The standard errors are given in parentheses. <sup>+</sup>  $p < 0.10$ , \*  $p < 0.05$ . The bandwidths and the estimates are calculated using the regression discontinuity model proposed by [Calonico et al. \(2020\)](#) and [Calonico et al. \(2014\)](#). All variables are clustered at the score variable level ( $x$ ) and all the outcomes are in log of natural numbers. The covariates used are quarter dummies and past quarter's value of the outcomes.

### 6.1.2 Formal Labor Market Effects for Brazilians - Roraima

Looking into the Brazilian formal labor market conditions in Roraima, figure 6 reveals that the 2.6% working age population shock in Roraima translated in to a 15 percentage increase in Venezuelans in the formal labor market from December 2017 to January 2018. Brazilian formal employment increased jumped up too. Female Brazilians and low skilled Brazilians (those with an education below college degree) in the formal sector both shared some of the increase in employment. Among the different sectors, there seems to be a movement away from agriculture towards industry and commerce.

Figure 7 shows wages among the Brazilian formal workers and shows that the average Brazilian wage slightly dipped down but Brazilian female wage and unskilled skilled jumped down substantially between December 2017 to January 2018. Industrial wage among Brazilians seemed to increase in the same period

Figure 6: Formal employment level in Roraima across time and subgroups

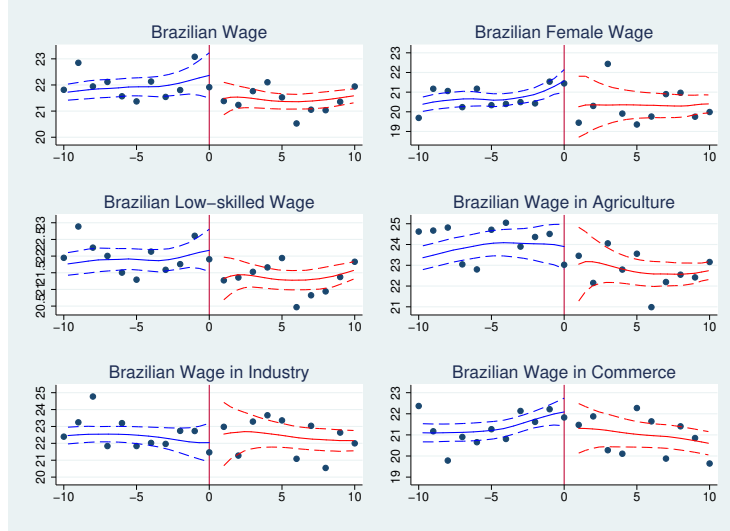


The y-axis is in log of natural numbers and the x-axis is the distance in months from the first month of 2018. The data comes from merged CAGED and RAIS and solid line shows the local linear fit while the dashed lines show the 95% confidence interval.

but the effect on agricultural and commercial wage seem to be not significant. It should be mentioned here that the figures are not seasonally adjusted and as a result can lead to misleading conclusions [Hausman and Rapson \(2018\)](#).

Next, the analysis focuses on the RD estimates Brazilian formal sector in Roraima. The analysis is conducted at the province level using monthly data and the cutoff takes the value of 0 at January 2018. This cutoff is based on the jump in the number of Venezuelan in the formal labor force that we observe in [Figure 6](#). [Table 6](#) reports the reduced form sharp RD estimates of the impact of forcibly displaced Venezuelans on the formal labor market in Roraima. The estimation uses triangular kernel with the optimum bandwidth suggested by [Calonico et al. \(2020\)](#). The first column does not have any control and the second column includes dummies for each month to control for seasonal variation and the third column includes both the seasonal adjustment and lag of the outcome

Figure 7: Brazilian wage level in Roraima across time and subgroups



The y-axis is in numbers and the x-axis is the distance in months from the first month of 2018. The formal workers refer to all workers in the formal sector irrespective of nationality. The data comes from merged CAGED and RAIS and solid line shows the local linear fit while the dashed lines show the 95% confidence interval. The wages are in Reais and adjusted for inflation by IPCA

variable. The results depict that formal employment among Brazilian in Roraima rose by about 19% to 20%, while employment among low-skilled Brazilian went up from about 18% to 29%. There seems to be no significant effect on female Brazilian employment. It is difficult to compare Roraima with other Brazilian state, so this paper employs a synthetic cohort matching technique, suggested by [Abadie et al. \(2010\)](#). The weights are given in the appendix (Table A2) and the the difference in Roraima's and the synthetic cohort's outcome is then used to estimate how the gap between the two changed at the cutoff. Panel B shows that difference also had a positive jump, adding credence to the result that the Venezuelan influx in Roraima improved the formal employment opportunities among Brazilians in Roraima.

Table 6: Regression discontinuity estimates of the impact on Brazilian formal market outcome in Roraima

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Brazilian	Brazilian	Brazilian	Unskilled	Unskilled	Unskilled	Female	Female	Female
<b>Employment:</b>									
	Panel A: Roraima								
Venezuelan Influx	0.197*	0.208*	0.200*	0.183*	0.292*	0.194*	0.209*	-0.011	-0.032
	(0.068)	(0.019)	(0.030)	(0.082)	(0.020)	(0.031)	(0.085)	(0.050)	(0.049)
	Panel B: Roraima over Synthetic Cohort								
Venezuelan Influx	0.008	0.011*	0.026*	0.004	0.008 <sup>+</sup>	0.010*	0.005	0.017*	0.014*
	(0.010)	(0.005)	(0.009)	(0.009)	(0.005)	(0.004)	(0.012)	(0.006)	(0.005)
<b>Wage:</b>									
	Panel C: Roraima								
Venezuelan Influx	-0.039*	-0.044*	-0.097*	-0.031*	-0.051*	-0.067*	-0.054	-0.064*	-0.076*
	(0.013)	(0.011)	(0.002)	(0.013)	(0.007)	(0.007)	(0.033)	(0.000)	(0.000)
	Panel D: Roraima over Synthetic Cohort								
Venezuelan Influx	0.000	-0.000	0.006	0.018	0.019	-0.024	0.021	-0.081	-0.026
	(0.018)	(0.028)	(0.027)	(0.015)	(0.033)	(0.021)	(0.049)	(0.099)	(0.059)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Agriculture	Agriculture	Agriculture	Industry	Industry	Industry	Commerce	Commerce	Commerce
<b>Employment:</b>									
	Panel E: Roraima								
Venezuelan Influx	-0.041	-0.086	-0.389*	0.142 <sup>+</sup>	0.156*	0.448*	0.121 <sup>+</sup>	0.061 <sup>+</sup>	0.104*
	(0.162)	(0.059)	(0.032)	(0.085)	(0.045)	(0.009)	(0.069)	(0.033)	(0.029)
	Panel F: Roraima Over Synthetic Cohort								
Venezuelan Influx	0.455*	7.688*	0.496*	0.057	-0.029	0.113*	0.152	1.099*	3.020*
	(0.230)	(0.106)	(0.089)	(0.195)	(0.245)	(0.056)	(0.110)	(0.048)	(0.317)
<b>Wage:</b>									
	Panel G: Roraima								
Venezuelan Influx	-0.019	-0.099*	-0.101*	0.031	-0.007	-0.019	-0.039 <sup>+</sup>	-0.014	-0.038*
	(0.034)	(0.012)	(0.012)	(0.027)	(0.016)	(0.013)	(0.020)	(0.013)	(0.009)
	Panel H: Roraima Over Synthetic Cohort								
Venezuelan Influx	-0.043*	-0.160*	-0.092*	-0.020	-0.026	-0.033	0.064*	-0.012	-0.143*
	(0.016)	(0.017)	(0.017)	(0.051)	(0.018)	(0.023)	(0.029)	(0.024)	(0.023)
Month-effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Lagged	No	No	Yes	No	No	Yes	No	No	Yes
<i>N</i>	59	59	58	59	59	58	59	59	58

The standard error is in parentheses. <sup>+</sup>  $p < 0.10$ , \*  $p < 0.05$ . The bandwidths are estimated using the methodology proposed by [Calonico et al. \(2020\)](#) while the estimates use the methodology developed in [Calonico et al. \(2014\)](#). All variables are clustered at the score variable level and all numbers in log of natural numbers. The synthetic control matching advocated by [Abadie et al. \(2010\)](#) is used to calculate the synthetic values of control variables based on the weights given in the appendix. The ratio of the treated (Roraima) over the synthetic control variable then is used to estimate the Roraima over synthetic cohort estimates. All wages are adjusted for inflation by IPCA.

However, employment increased at the cost of lower wages. Panel C of Table 6 shows that wages decreased in average and also among the low skilled and female Brazilians. Robust estimates suggest that unskilled Brazilian saw their wage going down by about 7 percentage, while female Brazilians experienced a dip of about 8 percentage. The results seem to suggest that as Venezuelan migrants and refugees flow into Roraima, it suffers two shocks, a population shock and an expenditure shock, shifting both the labor supply and labor demand curve of the formal labor market to the right, but the population shock is higher leading to a fall in earnings and a rise in employment among the native population.

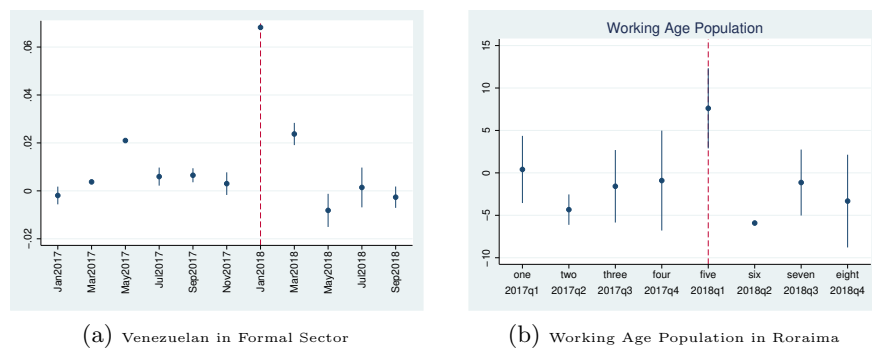
Panel C and D of Table 6 show the impacts on host population by sectors. Brazilian employment in agriculture fell while employment in commerce and industry increased in Roraima. Real wages in all sectors declined.

### **6.1.3 Robustness Check on Regression Discontinuity Design**

Since this section focuses on the sharp RD design, empirical evidence supporting the validity of the design is warranted. The continuity of the score density at the cutoff is assumed in estimating the sharp RD effects and so this section starts by examining whether in a local neighborhood near the cutoff, the number of observations below the cutoff is significantly different from the number of observations above it. By the structure of the setup of the estimation method, there is only one observation per month (quarter) or per score variable and consequently units do not have the ability to precisely manipulate the value of the score that they receive. The McCrary(2006) density test is conducted and the discontinuity takes the value of 0.42 (0.28) with a standard error of 0.34 (1.56) and is non-significant, suggesting no evidence of sorting around the cutoff.

Since the choice of cutoff at January, 2018 (first quarter of 2018) is by observing the Venezuelan population jump in Roraima and some Venezuelan refugees and migrants have entered Roraima in 2017, albeit in smaller number, the next validity test tries to examine whether there was any significant increase in Venezuelan formal employment (working age population) in Roraima in 2017. The cutoff at the January 2018 is replaced by each of the months of 2017 for the number of Venezuelans in the formal sector. Figure 8a shows that the positive Venezuelan shock in the former sector happens in January, 2018 and dwarfs the other positive shock by a large magnitude. The changes in the fraction of Venezuelan formal workers in the artificial cutoff are mostly positive but non-significant and small in magnitude, which provides evidence for the appropriateness of using January 2018 as the cutoff to estimate the population shock and its subsequent impact on the formal labor market variables. Figure 8b shows that the positive working age population shock only happens in the first quarter of 2018. The changes in the working age population in the artificial cutoff are mostly negative and non-significant.

Figure 8: Testing with alternate cutoffs



Next, this paper tries to validate that the population shock that is observed in

Roraima in the first quarter of 2018 is in fact a result of the influx of Venezuelans. In absence of perfect control state for Roraima, this paper estimates placebo effect on the working age population of all the states in the north of Brazil, as Roraima is in the north and the northern region lags behind many socio-economic indicators in Brazil. Table 8 shows that the only two states that experienced a significant increase in working age population are Roraima and Amazonas, the two states bordering Venezuela at the north. While Roraima sees a 2.27% increase working age population, Amazonas sees a mere 0.12% increase in the working age population in the first quarter of 2018, providing evidence that it is indeed the influx of Venezuelans which led to the population shock that may affect the labor market and the fiscal outcomes of Roraima.

Table 7: Testing for placebo outcome

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Acre	Amapa	Amazonas	Para	Rondonia	Roraima	Tocantis
Venezuelan Influx	0.041 (1.94)	-0.030 (0.087)	0.001* (0.000)	-0.003* (0.000)	-0.094* (0.001)	0.023* (0.004)	-0.002 (-0.003)
<i>N</i>	32	32	32	32	32	32	32

The standard errors are given in parentheses. +  $p < 0.10$ , \*  $p < 0.05$ . All estimations use the bandwidths proposed by Cattaneo et al. (2021) and assuming uniform kernel. Covariates include dummies for each quarter and value of the outcome variables in the previous quarter.

To test the robustness of the results, this paper also estimates the impact on the formal labor market outcomes among Brazilian using fuzzy regression discontinuity methods. The results of the fuzzy RD design<sup>11</sup>, where there is noncompliance, or where the treatment condition assigned is not equal to treatment condition received is also estimated for robustness checks and the results are given in the appendix. Table A4 reveals the results of the fuzzy RD and all the results are consistent with the sharp RD results. The additional results

<sup>11</sup>The fuzzy RD involves a two stage estimation, where the first stage estimates the probability of treatment, while the second stage uses this estimated probability to find its effect on the outcome variable.



that shows up is that female Brazilian employment falls in Roraima, which is consistent with the finding of [Ryu and Paudel \(2021\)](#), who find that overall female workers are negatively impacted by the influx of Venezuelans.

In absence of perfect control state for Roraima, this paper estimates placebo effect on the formal labor market in the synthetic cohort. [Table 8](#) shows the impact on the synthetic cohort was exactly the opposite as in Roraima, providing evidence that it is indeed the influx of Venezuelans, which led to the changes in the formal labor market in Roraima.

Table 8: Placebo Effect on the Synthetic Cohort

	(1) Synthetic Cohort
Employment	
Brazilian	-0.280* (0.001)
Female	-0.038* (0.005)
Low-skilled	-0.214* (0.001)
Agriculture	-5.216 (0.087)
Industry	-2.584* (0.019)
Commerce	-0.010 (0.111)
<b>Wage</b>	
Wage - Brazilian	-1.046* (0.009)
Wage - Female	-0.003 (0.008)
Wage - Low-skilled	3.295 * (0.000)
Wage - Agriculture	0.05* (0.009)
Wage - Industry	0.006 (0.053)
Wage - Commerce	0.656* (0.009)

The standard errors are given in parentheses.  
<sup>+</sup>  $p < 0.10$ , \*  $p < 0.05$ . All estimations use the bandwidths proposed by Cattaneo et al. (2021) and assuming triangular kernel. Covariates include dummies for each month and value of the outcome variables in the previous month.

To test that the jumps in the labor market outcomes are due to the discontinuity observed in population and not the other covariates, Table A5 reveals the sharp RD estimates on the covariates used in the estimations like trade and IPCA (Price Index) of Roraima. All the estimates are small in magnitude and insignificant suggesting that there is no discontinuity in these covariates.

Another confounding variable that can explain the discontinuity observed is extreme weather. Roraima is prone to flooding due to heavy rainfall and rising river level. However, floods in Roraima usually occur in the second and third quarter and not in January, where the discontinuity is observed. There is also no indication of major catastrophic flood reported in Roraima in 2018.

## 6.2 Difference-in-Difference Results

Table 9 presents the OLS and IV results of the impact of the Venezuelan exodus on the Brazilians in the formal sector across all Brazil. It shows the results for total Brazilian formal sector workers, Brazilian low-skilled formal workers and Brazilian formal female workers. The table reports only the coefficients on the percentage of population consisting of Venezuelans, which is call the population shock. This paper focuses on the north part of Brazil separately because Roraima and Amazonas, the two states bordering Venezuelan and receiving higher number of Venezuelan refugees and migrants are in the north part of Brazil. By North Provinces, we refer to all the provinces in north of Brazil, that includes Roraima, Amazonas, Rondonia, Acre, Amapa, Para and Tocantis.

In the northern provinces, the results suggest that the the share of Venezuelans in the population have a positive effect on the Brazilian employment in the formal sector. An one percentage point increase in Venezuelans in the population led to a 0.17% increase in Brazilian employment in the northern provinces on average. The results also reveal that Brazilian unskilled employment increased by about 0.17% and female Brazilian employment in the formal sector increased by about 0.2%. Across all the provinces, however, the OLS results reveal a negative

correlation between Venezuelan influx and the Brazilian formal employment. The IV estimates are all statistically insignificant, suggesting in the provinces outside the North, the number of Venezuelan may be too low to have substantial effect. The F-stat for the first stage of all the IV estimations are above 10, suggesting the relevance of the instrument.

Table 9: Effect of population shock on employment level of host community

	North Provinces					
	Brazilian		Low-skilled Brazilian		Female Brazilian	
	OLS	IV	OLS	IV	OLS	IV
% of Venezuelans in Population	0.007	0.173*	0.020	0.168*	0.008	0.198*
	(0.039)	(0.040)	(0.037)	(0.042)	(0.058)	(0.045)
<i>N</i>	2250	2250	2250	2250	2250	2250
<i>R</i> <sup>2</sup>	0.922	0.255	0.916	0.215	0.900	0.400
	All Provinces					
% of Venezuelans in Population	-0.016 <sup>+</sup>	-0.000	-0.023*	-0.009	-0.009	0.012
	(0.008)	(0.021)	(0.007)	(0.019)	(0.009)	(0.024)
<i>N</i>	24624	24624	24624	24624	24624	24624
<i>R</i> <sup>2</sup>	0.983	0.521	0.983	0.518	0.982	0.462

The standard errors are given in parentheses and are clustered at the municipality level. <sup>+</sup>  $p < 0.10$ , \*  $p < 0.05$ . Venezuelan present refers to a dummy which equals 1 if at least 1 Venezuelans are present in the municipality and 0 otherwise. Population shock is number of Venezuelans divided by the population in the municipality. Other covariates included in the estimations include time and municipalities fixed effects, college attainment ratio, gender ratio, average age, log of population, fraction of population who are whites and fraction who work in temporary jobs. The instrument used is a variant of the distance based measure in [Del Carpio and Wagner \(2016\)](#).

Table 10 shows the results on the effect of the Venezuelan influx on wages of Brazilian, female Brazilian, skilled Brazilian and low-skilled Brazilian formal workers. The effects on wages in the northern provinces seem to be statistically insignificant but the results on the other provinces suggest that average Brazilian wage went down by about 0.07% for a percentage point increase in Venezuelans in the population. Female Brazilian wage across all provinces on average went down by about 0.09% for a percentage point increase in Venezuelans in the population, while unskilled Brazilian experienced a 0.07% drop in wage. Skilled Brazilian wage in the formal sector also seems to be going down, although the

causal estimate is not statistically significant.

Table 10: Effect of population shock on wage level of host community

	North Provinces								
	Brazilian		Female Brazilian		Skilled Brazilian		Low-skilled Brazilian		
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	
% of Venezuelans in Population	-0.004	-0.001	-0.001	0.006	0.016	-0.013	-0.008	0.0020	
	(0.015)	(0.011)	(0.016)	(0.009)	(0.026)	(0.043)	(0.013)	(0.010)	
$N$	2250	2250	2250	2250	2250	2250	2250	2250	
$R^2$	0.518	0.461	0.518	0.472	0.490	0.520	0.490	0.469	
	All Provinces								
	% of Venezuelans in Population	-0.066*	-0.069*	-0.087*	-0.099*	-0.019*	-0.001	-0.071*	-0.075*
		(0.004)	(0.006)	(0.005)	(0.006)	(0.007)	(0.019)	(0.003)	(0.006)
$N$	24624	24624	24624	24624	24620	24624	24620	24624	
$R^2$	0.586	0.420	0.588	0.428	0.603	0.198	0.589	0.444	

The standard errors are given in parentheses and are clustered at the municipality level. +  $p < 0.10$ , \*  $p < 0.05$ . Venezuelan present refers to a dummy which equals 1 if at least 1 Venezuelans are present in the municipality and 0 otherwise. Population shock is number of Venezuelans divided by the population in the municipality. Other covariates included in the estimations include time and municipalities fixed effects, college attainment ratio, gender ratio, average age, log of population, fraction of population who are whites and fraction who work in temporary jobs. The instrument used is a variant of the distance based measure in [Del Carpio and Wagner \(2016\)](#).

These results point to the fact that the effects of Venezuelans influx on the formal labor market varies according to the geography of Brazil. The results seem to suggest that in the northern part of Brazil, labor supply curve is more elastic than the other parts and consequently the effect on wages is much more in the other provinces than in the north.

Looking in to employment by sector, Brazilian formal employment seem to increase in all sectors except agriculture in the northern provinces, with a percentage point increase in Venezuelans in the population leading to about 0.08% increase in Brazilian working in industry and 0.07% increase in Brazilian working in administration as [Table 11](#) shows. [Table 12](#) shows that the effect on Brazilian wages by sectors in the north is not statistically significant, but wages on average in all provinces went down across all sectors, except industry.

Table 11: Effect of population shock on employment level of host community by sector

	North Provinces									
	Agriculture		Industry		Commerce		Admin		Personal	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
% of Venezuelans in Population	-0.047	-0.070	0.020	0.761*	0.033	0.271*	0.134	0.664*	-0.029	0.130*
	(0.192)	(0.098)	(0.269)	(0.102)	(0.105)	(0.110)	(0.162)	(0.104)	(0.035)	(0.026)
<i>N</i>	2023	2023	2023	2023	2235	2023	2235	2023	2246	2023
<i>R</i> <sup>2</sup>	0.948	0.158	0.948	0.279	0.921	0.385	0.858	0.528	0.927	0.243
All Provinces										
% of Venezuelans in Population	-0.005	-0.021	0.003	0.022	-0.009	0.026	0.027	-0.015	-0.027*	-0.004
	(0.009)	(0.025)	(0.020)	(0.041)	(0.014)	(0.023)	(0.025)	(0.043)	(0.006)	(0.014)
<i>N</i>	22901	22901	22901	22901	24566	24566	24566	24566	24604	24604
<i>R</i> <sup>2</sup>	0.973	0.113	0.973	0.262	0.973	0.369	0.973	0.529	0.968	0.262

The standard errors are given in parentheses and are clustered at the municipality level. <sup>+</sup>  $p < 0.10$ , \*  $p < 0.05$ . Venezuelan present refers to a dummy which equals 1 if at least 1 Venezuelans are present in the municipality and 0 otherwise. Population shock is number of Venezuelans divided by the population in the municipality. Other covariates included in the estimations include time and municipalities fixed effects, college attainment ratio, gender ratio, average age, log of population, fraction of population who are whites and fraction who work in temporary jobs. The instrument used is a variant of the distance based measure in [Del Carpio and Wagner \(2016\)](#).

Overall, the results from the difference-in-difference methodology suggests that the effect of the Venezuelan influx is heterogeneous across Brazil, with the northern provinces enjoying an increase in Brazilian formal employment, which may be coming from a boost in international aid in the region, while the rest of Brazil finds that higher labour supply with the advent of Venezuelans lead to fall in the wage rate.

Table 12: Effect of population shock on wage level of host community by sector

	North Provinces					
	Industrial		Agriculture		Commerce	
	OLS	IV	OLS	IV	OLS	IV
% of Venezuelans in Population	-0.016 (0.052)	0.048 <sup>+</sup> (0.025)	0.024 <sup>+</sup> (0.014)	0.024 (0.018)	-0.016 (0.025)	-0.002 (0.017)
<i>N</i>	2241	2241	2241	2241	2095	2095
<i>R</i> <sup>2</sup>	0.471	0.266	0.470	0.346	0.492	0.495
	All Provinces					
	Industrial		Agriculture		Commerce	
	OLS	IV	OLS	IV	OLS	IV
% of Venezuelans in Population	-0.003 (0.006)	0.021* (0.010)	-0.269* (0.013)	-0.313* (0.019)	-0.023* (0.003)	-0.039* (0.006)
<i>N</i>	24557	24557	24557	24557	22828	22828
<i>R</i> <sup>2</sup>	0.524	0.218	0.539	0.242	0.563	0.466

The standard errors are given in parentheses and are clustered at the municipality level. <sup>+</sup>  $p < 0.10$ , \*  $p < 0.05$ . Venezuelan present refers to a dummy which equals 1 if at least 1 Venezuelans are present in the municipality and 0 otherwise. Population shock is number of Venezuelans divided by the population in the municipality. Other covariates included in the estimations include time and municipalities fixed effects, college attainment ratio, gender ratio, average age, log of population, fraction of population who are whites and fraction who work in temporary jobs. The instrument used is a variant of the distance based measure in [Del Carpio and Wagner \(2016\)](#).

The key assumption used in the analysis is that all the municipalities would have the same employment trends in absence of the Venezuelan influx. [Table A7](#) shows the interaction of the time dummies with the percentage of the Venezuelan in the population, as used in the seminal work of [Autor \(2003\)](#), followed by many others. The interaction with 2015 is the omitted category and the interaction with 2016 is statistical insignificant suggesting that our results do not suffer from common trend violation. The other threat to our econometric strategy comes from migration. Brazilians may be moving out from some regions as Venezuelans flow in or Venezuelans may return back to home country after being registered in a Brazilian municipality. The available data does not allow to measure internal migration in Brazil or return migration of Venezuelans, which can bias the estimates, but internal migration in Brazil consists mainly of moving away from the northern parts to the Southern parts, which should not be increasing the Brazilian formal employment in the northern provinces, providing some support that the results are due the Venezuelan influx in the northern part of Brazil.

### 6.2.1 Sensitivity to Operation Welcome

Since mid 2018, Brazil has been implementing Operation Welcome, which relocate Venezuelan migrants and refugees from the border province to other regions in Brazil that have more opportunities. This movement can also potentially influence the formal labor market outcome of Brazilians. In order to identify the impact of Venezuelan influx without Operation Welcome, this paper restricts the sample size to the period 2015 to 2017, or to the period without Operation Welcome and Table 13 and 14 show the main results. They reveal that even before Operation Welcome was initiated, Brazilian employment in the northern provinces increased by about 0.9% for each percentage point increase in the percentage of Venezuelan in the population. Low-skilled Brazilian and female Brazilian employment increased too with female Brazilian seeing an increase of 1% in formal employment. The results on wages suggest that the north of Brazil experienced an increase in average wage among Brazilians, with skilled Brazilian workers seeing an increase of about 4% in their earnings. These results seem to point out that in the very short-run, Venezuelans may be complementing Brazilians and increasing their productivity.



Table 13: Effect of population shock on employment level of host community before Operation Welcome

	North Provinces					
	Brazilian		Low-skilled Brazilian		Female Brazilian	
	OLS	IV	OLS	IV	OLS	IV
% of Venezuelans in Population	-0.257	0.956*	-0.163	0.791*	-0.346	1.140*
	(0.479)	(0.420)	(0.574)	(0.393)	(0.598)	(0.488)
<i>N</i>	1350	1350	1350	1350	1350	1350
<i>R</i> <sup>2</sup>	0.944	0.802	0.944	0.795	0.937	0.847
	All Provinces					
% of Venezuelans in Population	-0.042*	-0.015	-0.044*	-0.027	-0.032*	0.009
	(0.007)	(0.021)	(0.008)	(0.022)	(0.007)	(0.021)
<i>N</i>	14774	14771	14774	14771	14771	14771
<i>R</i> <sup>2</sup>	0.987	0.660	0.986	0.650	0.986	0.652

The standard errors are given in parentheses and are clustered at the municipality level. +  $p < 0.10$ , \*  $p < 0.05$ . The sample is restricted till 2017. Venezuelan present refers to a dummy which equals 1 if at least 1 Venezuelans are present in the municipality and 0 otherwise. Population shock is number of Venezuelans divided by the population in the municipality. Other covariates included in the estimations include time and municipalities fixed effects, college attainment ratio, gender ratio, average age, log of population, fraction of population who are whites and fraction who work in temporary jobs. The instrument used is a variant of the distance based measure in [Del Carpio and Wagner \(2016\)](#).

Overall, the results suggest that the Venezuelan influx led to both a labor supply shock and a labor demand shock in the Brazilian formal labor market, leading to an overall increase in formal employment and ambiguous effect on native formal sector earnings.

Table 14: Effect of population shock on wage level of host community before Operation Welcome

	North Provinces							
	Brazilian		Female Brazilian	Skilled Brazilian		Low-skilled Brazilian		
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
% of Venezuelans in Population	0.180	0.728 <sup>+</sup>	0.275	0.923*	0.596	4.460*	0.124	0.367
	(0.190)	(0.407)	(0.249)	(0.447)	(0.497)	(2.190)	(0.161)	(0.287)
<i>N</i>	1350	1350	1350	1350	1350	1350	1350	1350
<i>R</i> <sup>2</sup>	0.625	0.506	0.576	0.579	0.617	0.224	0.646	0.754
	All Provinces							
% of Venezuelans in Population	-0.116*	-0.214*	-0.196*	-0.296*	-0.087*	-0.004	-0.114*	-0.244*
	(0.003)	(0.013)	(0.004)	(0.015)	(0.005)	(0.031)	(0.003)	(0.014)
<i>N</i>	14774	14774	14774	14774	14774	14774	14774	14774
<i>R</i> <sup>2</sup>	0.739	0.480	0.720	0.495	0.710	0.095	0.751	0.484

The standard errors are given in parentheses and are clustered at the municipality level. <sup>+</sup>  $p < 0.10$ , \*  $p < 0.05$ . The sample is restricted till 2017. Venezuelan present refers to a dummy which equals 1 if at least 1 Venezuelans are present in the municipality and 0 otherwise. Population shock is number of Venezuelans divided by the population in the municipality. Other covariates included in the estimations include time and municipalities fixed effects, college attainment ratio, gender ratio, average age, log of population, fraction of population who are whites and fraction who work in temporary jobs. The instrument used is a variant of the distance based measure in [Del Carpio and Wagner \(2016\)](#).

## 7 Conclusion

The inflow of forcibly displaced Venezuelans into Brazil is a humanitarian crisis and has created a development challenge and with Brazil's diversity in job opportunities and structure of the labor markets across different regions, the impact of the Venezuelan influx on the Brazilian host community has been heterogenous.

In the northern regions, that include Roraima, the main gateway of Venezuelan refugee and migrants in Brazil, the population shock along with expenditure shock resulted in more Brazilians being employed in the formal labor market, suggesting there was no displacement of local worker in the formal sector.

The economy of Roraima is small and is mainly dependent on the public

sector and although it is relatively easy for forcibly displaced Venezuelans in Brazil to get labor cards and work in the private sector, jobs in the public sector are out of their bounds. As a result, Roraima seems to have found it hard to absorb the excess supply of labor and unemployment increase, specially among women. The Venezuelan influx seems to have displaced disproportionately a higher number of females in the informal sector; some of these women might have found jobs in the formal sector, but others remained unemployed. The increase in women unemployment could also be partially coming from Venezuelan women staying behind at home or shelter. The data at hand is not suited to study these different channels through which Venezuelan influx is affecting the labor market. The effect on male unemployment is statistically insignificant, but there is some evidence that while unemployment among the skilled increased more than the unskilled, unskilled are also penalized at the intensive margin.

In municipalities outside the northern part of Brazil, however, the impacts was felt more on Brazilian wages as wages decreased across all sectors. These heterogenous impacts have been reported in many studies ([Verme and Schuetler, 2021](#)) along with the positive impact on formal employment among native workers ([Del Carpio and Wagner \(2016\)](#) and [Aksu et al. \(2018\)](#)).

The findings in the paper emphasize the need to understand the different impacts that refugee influx can have on the labor market depending on the structure of the market. It highlights that there are winners and losers in the impact of forced displacement on host community and while formulating policies, government should consider both. It should be noted here that this paper focuses on the short-term formal labor market impacts and future research should focus on the impact on host community in the informal sector and the longer term

impact of forced displacement.

## 8 Appendix

### 8.1 Regression Discontinuity Appendix

Figure A1: Placebo Effect on Working Age Population in other Northern States

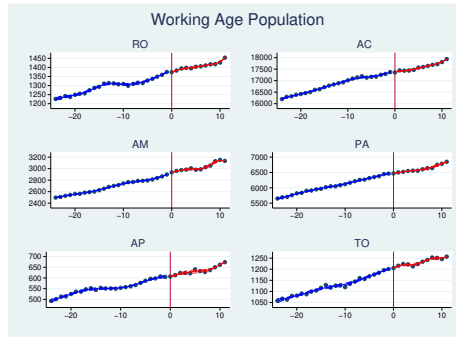


Table A1: Fuzzy Regression discontinuity estimates of the overall labor market variables in Roraima

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Working Age	Employed	Unemployed	Underemployed	Hours Worked	Public	Wage
Venezuelan Influx	0.023	-0.212*	0.189*	0.212*	0.041*	-3.068	0.000*
	(0.0499)	(0.0449)	(0.0231)	(0.0784)	(0.0108)	(9.450)	(0.000)
<i>N</i>	31	31	31	31	31	31	31
	Formal	Informal	Agriculture	Industry	Construction	Trade	Hospitality
Venezuelan Influx	-0.042*	-0.086*	0.120*	-0.132*	0.251*	-0.193*	0.141*
	(0.0135)	(0.0397)	(0.0455)	(0.0154)	(0.00346)	(0.0239)	(0.0543)
<i>N</i>	31	31	31	31	31	31	31

The standard errors are given in parentheses.  $+ p < 0.10$ ,  $* p < 0.05$ . All estimations use the bandwidths proposed by Cattaneo et al. (2021) assuming that the inflow of Venezuelans started in 2017 rather than 2018. All standard errors are clustered at score variable. Covariates include dummies for each quarter and value of the outcome variables in the previous quarter. All variables are in thousands. Monthly Income is adjusted for inflation by national IPCA.

Table A2: Weights used for synthetic cohort matching

Variables	Provinces					
	RO	AC	AM	PA	AP	TO
Brazilian	0.069	0.115			0.816	
Low-skilled	0.072	0.094			0.834	
Female	0.09	0.003			0.907	
Agriculture	0.241	0.225			0.503	
Industry	0.087	0.014			0.9	
Commerce	0.057	0.293			0.65	
Administration	0.095	0.109			0.796	
Personal	0.102				0.898	
Brazilian Wage	0.091	0.217	0.224		0.468	
Female Wage	0.2	0.373	0.029		0.397	
Low-skilled Wage	0.076	0.321	0.165		0.438	
Industry Wage	0.097		0.268		0.635	
Agriculture Wage	0.433				0.533	0.033
Commerce Wage	0.0235	0.278	0.06		0.427	

Table A3: Difference-in-difference estimates of labor market variables in Roraima using synthetic cohort matching

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Working Age	Employed	Unemployed	Employee	Employer	Own Account	Formal	Informal	Wage
Venezuelan Influx	0.073*	0.044*	0.441*	0.062*	0.319*	0.032	0.027	0.074*	0.131*
	(0.007)	(0.016)	(0.059)	(0.014)	(0.075)	(0.035)	(0.029)	(0.035)	(0.017)
<i>N</i>	32	32	32	32	32	32	32	32	32
States	Weights								
RO	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AC	0.000	0.000	0.819	0.000	0.375	0.226	0.667	0.314	0.832
AM	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PA	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AP	1.000	1.000	0.181	1.000	0.625	0.774	0.333	0.686	0.168
TO	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
RMSPE	218.92	103.74	18.93	59.655	1.742	38.806	24.181	6.883	847.928

The standard errors are given in parentheses. +  $p < 0.10$ , \*  $p < 0.05$ . DID refers to the difference-in-difference estimates assuming 2018 and after as the treatment period and using the other northern states (RO, AC, AM, PA, AP and TO) to create the synthetic control unit. The weight that each state receives is given in the table. All standard errors are clustered at the time variable and the methodology used to create the synthetic cohort is the one explained in [Abadie et al. \(2010\)](#). Covariates include gender ratio, young age dependency, fraction college educated, household size, fraction white. Monthly income is in Brazilian reais and adjusted for inflation using IPCA. All variables in thousands.

Table A4: Impact on the formal labor market outcomes among Brazilians using Fuzzy RD methods

	(1)	(2)	(3)	(4)	(5)	(6)
	Brazilian	Unskilled	Female	Brazilian wage	Unskilled wage	Female Wage
Venezuelan Influx	0.014*	0.061*	-0.002*	-0.048*	-0.065*	-0.112*
	(11.02)	(9.40)	(-10.23)	(-73.62)	(-49.30)	(-2.60)
<i>N</i>	59	59	59	59	59	59
	Agriculture	Industry	Commerce	Agricultural wage	Industrial wage	Commercial wage
Venezuelan Influx	-0.077*	0.005*	0.031*	-0.042*	-0.009	0.301*
	(-23.84)	(4.83)	(8.19)	(-19.68)	(-1.43)	(67.75)
<i>N</i>	58	58	58	58	58	58

*t* statistics in parentheses. +  $p < 0.10$ , \*  $p < 0.05$ . The standard errors are clustered by the assignment variable. The bandwidths are estimated using the methodology proposed by [Calonico et al. \(2020\)](#) while the estimates use the methodology developed in [Calonico et al. \(2014\)](#). Covariates include monthly dummies and lag of outcome variables.

Table A5: Testing for placebo effect on covariates

	(1)	(2)
	IPCA	Trade Index
Venezuelan Influx	-43.029	2.9559
	(99.235)	(12.778)
<i>N</i>	59	59

The standard errors are given in parentheses. +  $p < 0.10$ , \*  $p < 0.05$ . All estimations use the bandwidths proposed by [Cattaneo et al. \(2021\)](#) and assuming triangular kernel. Covariates include dummies for each month and value of the outcome variables in the previous month. Data is from IBGE.

## 8.2 Difference-in Difference Appendix

Table A6: Test of common-trend assumptions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Brazilian	Unskilled	Female	Agriculture	Industrial	Commerce	Admin	Personal	BWage	FWage	UWage	IWage	AWage	CWage
2016	-0.017 (0.173)	0.008 (0.149)	-0.022 (0.169)	0.280 (0.190)	-0.354 (0.461)	-0.166 (0.345)	-0.111 (0.267)	-0.028 (0.138)	0.041 (0.039)	0.032 (0.038)	0.051 (0.039)	-0.227* (0.108)	0.091 (0.094)	0.006 (0.053)
2017	0.018 (0.018)	-0.008 (0.021)	-0.020 (0.019)	-0.022 (0.044)	-0.016 (0.035)	-0.056* (0.019)	0.029 (0.032)	-0.001 (0.029)	0.015 (0.009)	0.023+ (0.013)	0.016+ (0.009)	0.002 (0.017)	0.012 (0.011)	0.004 (0.014)
2018	0.002 (0.002)	-0.002 (0.002)	-0.002 (0.002)	-0.002 (0.004)	-0.006 (0.009)	-0.001 (0.004)	0.001 (0.005)	-0.002 (0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	-0.000 (0.003)	0.003* (0.001)	0.001 (0.001)
2019	0.008* (0.003)	0.003 (0.004)	0.011* (0.003)	0.013* (0.004)	0.011 (0.009)	0.005 (0.004)	0.018* (0.006)	0.004 (0.004)	0.003 (0.002)	0.004 (0.003)	0.003 (0.002)	0.001 (0.004)	0.009* (0.001)	0.003 (0.002)
<i>N</i>	2250	2250	2250	2250	2250	2250	2250	2249	2250	2250	2250	2250	2250	2250
$\hat{R}^2$	0.961	0.959	0.959	0.971	0.958	0.940	0.917	0.959	0.496	0.472	0.492	0.472	0.434	0.467

BWage refers to Brazilian wage, FWage refers to female Brazilian wage and so on. All standard errors are clustered at the municipality level. The sample is restricted to northern provinces. The years refer to the interaction between population shock and the indicator variable for the respective years. Population shock is number of Venezuelans divided by the population in the municipality. Other covariates included in the estimations include time and municipalities fixed effects, college attainment ratio, gender ratio, average age, log of population, fraction of population who are whites and fraction who work in temporary jobs.



Table A7: First-stage regression for IV method

	All Provinces	North Provinces
Instrument	-0.557 <sup>+</sup> (0.310)	-0.112 <sup>+</sup> (0.055)
Ln(population)	-0.221* (0.110)	-0.0536 (0.666)
College	-2.828 (4.123)	-4.324 (11.85)
Age	0.106 (0.282)	0.662 (0.950)
White	-4.491 (6.043)	-60.97 (38.27)
Mismatched	-0.370 (5.194)	27.94 <sup>+</sup> (16.53)
Temporary	-15.53 (40.12)	-4.464 (964.7)
Agriculture	0.231 (11.36)	2.757 (31.40)
Industry	-3.824 (5.433)	-20.25 (20.18)
Commerce	-0.0691 (5.504)	-38.11 <sup>+</sup> (22.04)
Female	-0.515 (1.256)	-3.209 (22.09)

All standard errors are clustered at the municipality level. The dependent variable is a dummy if Venezuelans are present in the municipality. The instruments for the Heckman selection used is the distance based instrument in [Del Carpio and Wagner \(2016\)](#). The variables college, age, white, mismatched, temporary refer to the difference between the fractions between Brazilian and Venezuelan of the variables respectively. Agriculture, industry and commerce refer to the fraction of Brazilian involved in the respective sector.

## **9 Declarations**

### **9.1 Availability of data and material**

The datasets analysed during the current study are available from the corresponding author on reasonable request.

### **9.2 Competing Interests**

The authors declare that they have no competing interests.

### **9.3 Funding**

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#### **9.4 Authors' contributions**

All authors read and approved the final manuscript. PA and RS provided the identified RAIS and CAGED data, suggested the research methods, contributed to writing the paper and provided overall guidance. MS performed the statistical analysis and wrote the manuscript. JF and NP provided overall guidance and contributed to writing the manuscript.

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