Industrial Place-Based Policies and Informality: Evidence from Colombia*

Laura Contreras†

Preliminary and incomplete - Do not circulate

Abstract

This paper examines the local economic impact of Colombia's Free Economic Zones (FEZs) program, implemented between 2005 and 2018. Using a novel dataset that integrates georeferenced data on FEZs, municipalities, household characteristics, and firms, I analyze the spatial effects of these zones on labor markets and firm dynamics, with a particular focus on informality. The findings reveal that FEZs significantly increase informality, with spillover effects on nearby regions but minimal impact on overall employment and earnings. While they create formal job opportunities for skilled workers and women, low-skilled workers face rising informality and wage losses. To explain these patterns, I develop a spatial structural model incorporating informality, firm sorting, and internal trade. I show both theoretically and empirically that FEZs make high-productivity formal firms more profitable, enabling them to raise wages and expand their workforce. However, this also increases labor costs, forcing low-productivity formal firms to exit and raising the productivity threshold for new formal firm entry—ultimately leading to higher informality. These dynamics spill over into neighboring regions, where lower price indices and a greater variety of products boost revenues but further reshape the local labor market.

Keywords: Place-Based Policies, Local Labor Markets, Informality
JEL CLassification: H25, J61, R11, R12

*This work is supported by the French National Research Agency Grant ANR-17-EURE-0020 and by the Excellence Initiative of Aix-Marseille University - A*MIDEX.

†Aix-Marseille University, CNRS, EHESS, Centrale Marseille, AMSE, France. Email:laura.contreras-portela@univ-amu.fr. Website: https://lauradcontreras.github.io

1 Introduction

The distribution of economic activity across space is remarkably uneven. The location choices of economic agents play a crucial role in shaping these spatial disparities: some areas thrive, fueled by the presence of large, productive firms, while others struggle to attract any significant economic activity. In response to this, governments implement different policies designed to attract firms to specific regions. Recent research examines the aggregate gains from place-based policies, assuming perfectly efficient economies. However, experiences in perfectly competitive setups may fail to capture key features of developing economies, where labor market frictions and other economic distortions are salient. In this paper, I study the economic effects of place-based policies, considering the indirect impacts arising from labor market distortions and input misallocation.

I focus on a key economic inefficiency in developing countries: informality. The informal sector is a direct consequence of imperfectly enforced and inefficient regulations, both firms and workers evade burdensome taxes and labor market regulations. Informal firms avoid paying taxes and do not contribute to social security for their workers, creating gaps in the marginal product of labor and other inputs, which might reduce total factor productivity (Hsieh and Klenow, 2009). Particularly, formal firms face higher distortions than informal ones, resulting in a higher marginal revenue product of inputs relative to informal establishments, thereby creating misallocation. This is particularly important in the presence of agglomeration externalities, which can exacerbate resource allocation inefficiencies between the formal and informal sectors. The differing composition of these sectors further amplifies these inefficiencies, as the informal sector is less responsive to the productivity-enhancing effects of agglomeration. As a result, market forces often lead to an excessively large informal sector relative to the socially optimal allocation. These intersectoral distortions and differences in agglomeration forces suggest that any policy or shock affecting informality can have significant welfare implications through allocative efficiency. For instance, place-based industrial policies can significantly impact informality by enabling firms' and workers' reallocation across regions and sectors in response to localized economic incentives. These policies may either mitigate or exacerbate informality, depending on their influence on the relative costs and benefits of formal versus informal economic activities and the extent to which they address underlying market distortions.

I study this question in the context of Colombia, which serves as a pertinent and illustrative case study for several reasons. First, Colombia exhibits a highly concentrated and uneven distribution of economic activity across regions. Second, labor and firm informality are widespread in the economy, with over 50% of the urban labor force and 60% of establishments operating informally. This pattern, common in developing countries, leads to significant resource misallocation (Busso et al., 2012; Levy, 2018; Fernandez, 2021). Furthermore, Colombia's economic growth and development levels are comparable to those of other low- and middle-income countries. Most importantly, the Free Economic Zones ("Zonas Francas") regime—a place-based industrial policy that incentivizes firms to locate, invest, and engage in international trade—offers a unique and valuable context for analysis.

The first part of this paper empirically examines the impact of a major industrial place-based policy program, the Free Economic Zones (FEZs), on local labor markets in Colombia. I leverage labor market data from the National Household Survey (GEIH), the micro-business survey (EMICRON), and the structural surveys of manufacturing, retail, and services (EAM, EAC, and EAS). Additionally, I identify the location and operational start dates of all FEZs using official statistics from the Ministry of Industry and Commerce and link them to their respective municipalities through the National Geostatistical Framework. Using this novel dataset that integrates georeferenced data on FEZs, municipalities, firms, and worker characteristics, I measure the labor market

effects of these zones, with a particular focus on sector composition (formal vs. informal)[1]. Exploiting the staggered rollout of these zones across regions, I estimate their causal effects by matching municipalities with FEZs and their firms and workers to comparable counterparts in areas without such zones. The key identification assumption is that the opening dates of zones were unrelated to other local demand- or supply-side shocks that affected locations. I address this concern in two ways: First, I test for differential outcome pre-trends between FEZ-treated municipalities and reference municipalities in the years directly leading up to treatment; and second, I use region-specific disaster risk as an instrumental variable to determine the placement of the zones. The findings reveal a significant and lasting increase in informality rates following the implementation of FEZs. However, the effects on earnings and overall employment are negligible, as many workers reallocated from formal to new informal sector jobs. Furthermore, these place-based policies generate spatial spillover effects: informality, employment, and earnings rise in neighboring municipalities but diminish with increasing distance. These spillovers complicate the reduced-form analysis of equilibrium outcomes.

The results suggest that place-based industrial policies can lead to welfare effects that diverge from those traditionally emphasized in the literature, especially when informality is taken into account. To investigate and identify the underlying mechanisms, I develop a spatial structural general equilibrium model with informality and firm sorting. In the model, zones are represented as locations characterized by: (a) lower formalization costs, as they provide firms with streamlined access to tax authority procedures, such as company registration and licensing; (b) exemptions from VAT and tariffs for consumers of zone-produced goods, reducing input costs; and (c) higher profitability due to reduced corporate tax rates for firms operating within these zones. Consequently, these changes impact firms' decisions to operate formally or informally and their sorting patterns, affecting their entry and exit. Similar to Melitz 2003 and Dix-Carneiro et al. 2024, these changes lead to higher-paying formal firms becoming more profitable, allowing them to raise wages and expand their workforce. However, this raises labor costs, causing low-productivity formal firms to exit due to unsustainable costs and increasing the productivity threshold for new formal firm entry, leading to more informality. These dynamics spread to nearby regions through lower price indices and a greater variety of products, boosting revenues.

I then empirically investigate the underlying mechanisms driving the effects of these zones on informality. Using firm-level data, I observe an increase in both the workforce and revenues of formal manufacturing firms. However, when examining firm dynamics, I find a rise in the exit of formal firms, presumably the least productive ones. [2]

Related literature. I contribute to multiple strands of economic literature. The first is the economic geography and urban economics literature, which analyzes both the microeconomic and macroeconomic impacts of place-based policies. The second is the labor and development literature, which investigates the primary causes of informality and its responses to labor market policies. The third is the macro-development literature, which examines the determinants of allocative efficiency and its implications for total factor productivity (TFP). This final strand overlaps with the international economics literature, which studies how trade shocks affect allocative efficiency in the context of domestic distortions.

First, my paper relates mainly to the sizable literature on the effects of place-based policies (PBPs). While existing studies have predominantly focused on developed economies, analyzing

[1]The term "sector" here refers to firms operating either informally or formally, as both types coexist within the same industries.

[2]The model does not currently account for worker migration; however, I plan to extend it to test this mechanism. This addition is essential for disentangling whether the observed effects stem from FEZ-induced economic activity or the sorting of specific types of households into or out of FEZ municipalities.

outcomes such as investment, productivity, employment, and firm creation (e.g. Freedman, Khanna, and Neumark 2023; Gobillon, Magnac, and Selod 2012; Kline and Moretti 2013; Mayer, Mayneris, and Py 2015; Neumark and Kolko 2010), little attention has been paid to the effect on less-developed countries. For example, some of the literature estimates the impact of PBPs on local economic growth through agglomeration economies and finds a positive effect of the Chinese Special Economic Zones (SEZs) program on capital investment, employment, output, productivity, and wages, and the entry of firms in designated areas Alder, Shao, and Zilibotti 2016, with limited spillover effects to surrounding areas Lu, Wang, and Zhu 2019; Wang 2013. However, these studies have largely focused on firms in the formal sector, while the effects of place-based policies on informal businesses remain largely unexplored.

The little evidence of informal activity is mixed. For instance, **?** identify the impact of SEZs on local employment in manufacturing and services in India, showing that smaller, informal entities respond strongly to SEZs establishment and contribute to the aggregate creation of non-agricultural jobs. They link SEZ establishment to sectoral shifts from agricultural to manufacturing through the increase in the informal sector. However, in an earlier work by **?**, they find that place-based policies only affecting industrial firms lead to a decline in the number of firms in the targeted areas, resulting from a decrease in the number of informal firms. They argue that this reduction may be driven by informal firms becoming formal, potentially to benefit from the policy, or exiting, potentially because the policy's benefits obtained by formal firms make informal firms relatively less competitive. In line with these results, McCaig et al. 2024 find that industrial zones in Vietnam increase formal employment and the number of firms. This is particularly true for employment in foreign and manufacturing firms. I contribute to this literature in two key ways. First, I estimate the impact of place-based policies on the informal sector in Colombia, explicitly accounting for spatial spillovers. Second, I incorporate general equilibrium effects by developing a spatial general equilibrium framework that integrates both the formal and informal sectors alongside firm location decisions. [3]

The second strand is the development literature studying the main causes of informality. Part of the literature identifies potential determinants such as entry costs, labor and tax regulations, corruption, and institutional quality (see Ulyssea 2020 for an extensive review). Interventions targeting the reduction of formalization costs have shown significant impacts on formalization rates, particularly in lowering entry costs De Soto 2002; Djankov et al. 2010; Ulyssea 2018. However, the empirical evidence supporting the effectiveness of such reforms remains limited La Porta and Shleifer 2014. Similarly, the impact of reducing the tax burden on entrepreneurs' decisions to formalize or start new formal businesses lacks empirical support Kaplan, Piedra, and Seira 2011. Yet, studies such as **?** demonstrate a transitory increase in formal firms resulting from large-scale formalization programs. Additionally, some literature emphasizes the role of the tax structure, particularly value-added tax (VAT), in transmitting informality, proposing mechanisms for informal transmission based on production chain informality De Paula and Scheinkman 2010; Ulyssea 2020. In this paper, I contribute to the literature by examining how reductions in costs faced by formal firms in specific locations influence the prevalence and spatial distribution of informal labor practices. It particularly relates to **?** who test whether infrastructure projects facilitating transit within a city improve allocative efficiency by reallocating workers from informal establishments to formal establishments in a spatial setting.

Finally, this paper relates to a large literature in international economics that has estimated the

[3] To reconcile the findings in the literature with my results, I conduct a counterfactual exercise in which the central planner chooses the location of these place-based policies optimally. This is particularly relevant in the Colombian context, where zones are established after the initiative of a private investor, leaving the national government with limited influence over their placement. This contrasts, for instance, with the Vietnamese context.

effects of trade reforms on allocative efficiency in the presence of domestic distortions, especially on informality which could induce reallocation of firms and workers between sectors. This literature empirically shows that the informal sector constitutes an important margin of adjustment to trade shocks Dix-Carneiro and Kovak 2017; McCaig and Pavcnik 2018; Ponczek and Ulyssea 2021. This literature has mostly relied on reduced-form empirical methods, resorting to difference-in-differences identification strategies, while often overlooking broader general equilibrium effects. An exception is **?**, who develop and estimate a trade model incorporating firm dynamics and heterogeneity, formal and informal sectors, labor market frictions, and a detailed institutional framework. Their findings indicate that reductions in trade costs result in a significant decline in informality within manufacturing, though the overall effect on informality remains modest. While this body of work primarily examines trade reforms influencing labor demand, my paper focuses on the impact of place-based policies on aggregate productivity and informality.

I extend recent work on quantitative spatial economic models and classic models of informality. The model builds on **?** and Gaubert 2018. It closely relates to Zárate 2022, who develops a quantitative urban spatial model with distortions, factor misallocation, and an endogenous decision for firms and workers to operate in the informal sector. [4] My model extends this framework by distinguishing two margins of informality: (i) whether firms register and pay entry fees to achieve formal status, the extensive margin; and (ii) whether firms that are formal in the first sense hire workers "off the books," the intensive margin.

The paper is organized as follows. Section 2 introduces the setting of my study in Colombia and describes the institutional context of the zones. Section 3 provides reduced-form evidence on how this place-based policy affects informality. Section 4 provides the results. Section 5 presents the robustness checks. Section 6 introduces the quantitative spatial model, highlighting the mechanisms that drive the empirical results. Finally, Section 7 concludes.

2 Institutional Context

Special Economic Zones (SEZs) are widely used place-based policy instruments in developing countries, designed to promote economic development, enhance competitiveness, attract foreign direct investment (FDI), and generate employment. Globally, the total number of SEZs increased from 500 in 1995 to 5,400 in 2018, driven by globalization, trade liberalization, and integration programs (Facility for Investment Climate Advisory Services 2008; World Bank Group 2017; 2019). While their specific designs may vary, SEZs share the common characteristic of being established within clearly defined geographic areas, where firms located within the zone benefit from reduced tax and tariff rates or streamlined bureaucratic procedures Akinci, Crittle, and Bank 2008.

In the 1950s, Colombia established its first Free Economic Zone (FEZ), becoming the first country in Latin America to adopt such a model. Initially, these zones were public initiatives aimed at supporting import substitution in a closed economy, with ten zones established by the central government. In the late 1990s, globalization prompted a shift, allowing private sector management of existing zones and aligning policies with WTO regulations to promote a competitive export environment. In line with the globalization trend, the Colombian government implemented the Free Economic Zones Act in 2005, allowing for private investments in FEZs and a much more flexible environment than the precedent framework in which all zones were owned and managed exclusively by the central government. In 2007, the legislation introduced three distinct categories of FEZs: (i) "Permanent" zones, hosting industrial parks and offshore entities, (ii) "Special" zones,

[4] One limitation of his model is the strict duality between the informal and formal sectors.

dedicated to single-firm operations, and (iii) "Transitory" zones, designated for temporary activities like fairs and exhibitions.

The Act 1004 of 2005 established four main objectives: (i) to promote employment and attract capital investments, (ii) to serve as a development hub fostering regional competitiveness, (iii) to enable the development of highly productive industrial processes through economies of scale, and (iv) to simplify international trade procedures. To achieve these goals, the FEZs Act provided a uniform legal framework for developing and doing business in these specially designated areas. Firms operating in FEZs benefit from a range of fiscal, international trade, and administrative incentives. On the fiscal side, they enjoy (a) a reduced flat income tax rate of 20%, compared to 35% elsewhere in the domestic tariff area, and (b) exemptions from value-added taxes (VAT) on raw materials, supplies, goods exchanged within or between zones, and imported goods. In terms of international trade and customs, firms are granted tariff-free imports and can retain foreign-origin goods indefinitely within the zones. Lastly, on the administrative side, licensed operations are exempt from customs declarations, significantly simplifying trade processes.

Applications for establishing a FEZ in Colombia are assessed by the Intersectoral Commission of Free Economic Zones and the Ministry of Industry and Commerce. Proposals must meet general guidelines, including alignment with the municipality's development plan to ensure local economic impact, compliance with environmental regulations to prevent negative externalities, and provision of a contiguous area of at least 20 hectares, except for special zones. Additionally, zone-specific requirements vary; for example, permanent zones must host at least five firms within five years, while special zones must employ at least 150 workers within three years. Once these requirements are fulfilled, the Ministry of Industry and Commerce formally declares the designated area as an FEZ.

Once a zone is declared, firms can operate within the FEZ as "users," categorized as industrial goods users, industrial services users, or commercial operators. Industrial users benefit from both tax and customs incentives, while commercial operators are limited to customs exemptions due to their lack of value-added activities. To access these incentives, firms pay rent to the FEZ in exchange for essential infrastructure, such as offices, warehouses, and production facilities. In contrast, all firms must adhere to the exclusivity principle, restricting their production activities to the FEZ, thereby reinforcing its role as a place-based economic policy tool.

Since 2005, the number of FEZs in Colombia has grown exponentially, reaching 124 zones by 2023, positioning the country as the South American leader in FEZs. These zones, categorized into 42 "Permanent" and 82 "Special," are located in municipalities that contribute to more than half of Colombia's added value Cámara de Usuarios de Zonas Francas, ANDI 2019. FEZs support diverse sectors, including industry (60 zones), services (47 zones), and agroindustry (17 zones). Additionally, FEZs are pivotal for international trade, with their imports and exports accounting for 8% of the national GDP. In terms of the composition of the firms, 87% are small and medium-sized enterprises Cámara de Usuarios de Zonas Francas, ANDI 2019.

Although FEZs aim to stimulate investment, employment, and industrial development, ongoing debates question their broader economic impact. Concerns focus on taxation inequality, high fiscal costs, and their alignment with competitive economic regimes. Moreover, limited attention has been paid to their effectiveness in fostering employment through indirect mechanisms, such as production networks and spillover effects, as well as their impact on informality. The coexistence of formal and informal activities within and around FEZs raises questions about whether these zones effectively reduce informality or inadvertently reinforce it through indirect linkages.

3 Empirical Analysis

In this section, I present the data, the variation from the FEZs construction, the main variables used in the empirical analysis, the descriptive statistics, and the empirical strategy.

3.1 Data and descriptive statistics

The basis of the empirical work of this paper is the geographical location of the Free Economic Zone, the administrative data from municipalities in Colombia, and its labor market information. The analysis covers the period from 2000 to 2018, from the period before the change in the law to the period before the COVID-19 pandemic. My primary unit of observation for the baseline analysis is the municipality as it is the most disaggregated geographic unit in the data.[5][6]

The data used in this paper come from multiple sources. The data on the characteristics of municipalities has been provided by the Center for Studies on Economic Development (CEDE by its acronym in Spanish), at the Universidad de los Andes. This dataset offers a comprehensive overview of a variety of variables at the municipality level from the 1990s to the present day. CEDE primarily collects data from government agencies. For the information on the FEZs, I use data on the declaration and operation of the zones by the Ministry of Industry and Commerce of Colombia. I georeference the exact location of the zones, identifying the municipalities hosting at least one of them. I restrict the sample of FEZs to operated areas, excluding offshore or transitory zones, as they do not account for spatial or lasting employment effects.

The data on labor market outcomes come from the Households National Surveys administered by the National Statistics Office of Colombia (DANE, by its acronym in Spanish). They cover approximately 240,000 households annually and are the national survey with the most detailed sample coverage. These cross-section surveys gather information about the employment condition of people (whether they work, whether they are part of the informal sector, what they do, how much they earn, whether they have social security for health care, or whether they are looking for a job), as well as about the general characteristics of the population, such as sex, age, marital status, educational level, sources of income and expenses.

To measure economic development, I use as a proxy nighttime light intensity from two sources (the Defense Meteorological Satellite Program (DMSP), and the Visible Infrared Imaging Radiometer Suite (VIIRS)) combined, cleaned, and harmonized to create a single panel dataset by Li et al. (2020). Additionally, I consider total tax revenues as a measure of state capacity that can reflect the taxation benefits from the FEZs. The data comes from the National Planning Department (DNP, by its acronym in Spanish). It includes property tax, industry and commerce tax, and gasoline tax, among others.

3.1.1 Definition of informality and key stylized facts

Informality can be an elusive concept, given the wide variety of definitions, measurements, and rationales. Following Busso et al. (2012) and Levy(2010), I use three measures: (i) the number of workers in a firm; (ii) contributions to social security, and (iii) employment contract (see Appendix A for a detailed description). The first two definitions are the most related to the legalistic definition, while the latter definition is more restrictive and refers to workers in the worst labor conditions. These definitions cover the two margins of informality: (a) Extensive, based on whether the firms

[5] For clarification purposes, municipalities are second-level administration divisions, and each FEZ belongs to only one municipality.

[6] As part of the robustness checks, I consider the metropolitan areas when existing as they are a closer definition of Local Labor Markets.

register and pay entry fees to achieve the formal status related to the employment size, and (b) Intensive: based on whether formal firms hire workers without a formal contract.

I construct the variable I_{it} that defines the informality rate in a municipality i at time t, defined by the ratio of the total number of informal workers to the total number of workers in municipality i for the year t (E_{it}).

There are some well-established facts in the literature about the informal sector in different countries (Brazil in Ulyssea 2018; La Porta and Shleifer 2014). These facts are also present in the Colombian data:

Fact (1). *The probability that a firm is informal declines sharply with its employment size.*

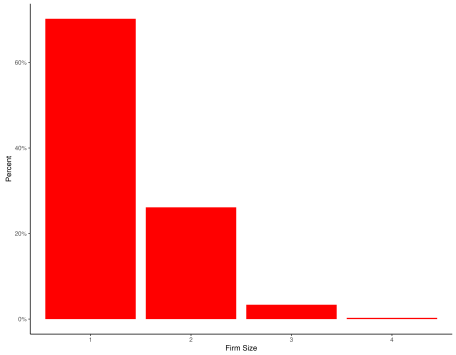


Figure 1: Informality and firm size

Note: category 1 refers to 1-2 workers, 2 refers to 3-5, 4 to 5-10, and 4 to more than 10.

Figure 1 shows the negative relationship between informality and firm size. Ulyssea 2018 argue that one possible rationale behind this fact is that larger firms are too visible to the government and thus more likely to be audited. This is important since it suggests that there is an employment threshold so that firms formalize.

Fact (2). *Informal firms are, on average, less productive than formal firms. Therefore, informal sector jobs are widely considered as low quality.*

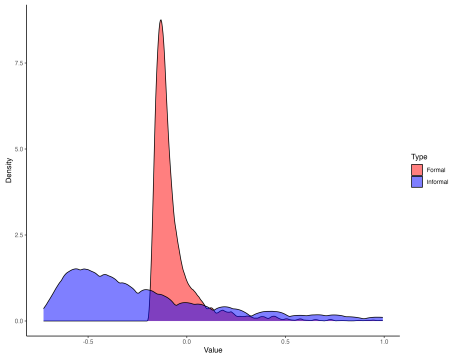


Figure 2: Productivity distribution by type

Using surveys for different countries, La Porta and Shleifer 2014 show that observing differences in employees, revenues, and profits between formal and informal firms reflect substantial differences in average productivity. Using manufacturing census data (Encuesta Anual de Manufactura in

Spanish) and microbusiness data (Encuesta de Microestablecimientos), I compute value-added per worker as a proxy for productivity for formal and informal firms, following Ulyssea (2018). Figure 2 shows that the productivity distribution in the formal sector is substantially shifted to the right, suggesting that formal firms are on average more productive than informal.

Fact (3). *The average informal worker is paid lower wages than the average formal worker, even without benefits.*

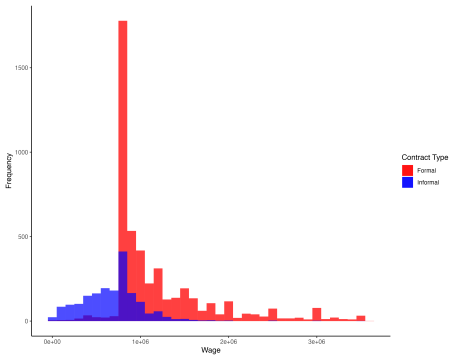


Figure 3: Wage distribution by type

Figure 3 shows the wage differences between formal and informal workers. It suggests that formal firms are subject to payroll and value-added taxes, firing costs, and minimum wage regulation.

3.1.2 Descriptive statistics

This subsection reports summary statistics for the main outcome variables.

In Colombia, nearly half of the total labor force is employed in the informal sector (48% by 2023). Since the early 2000s, the informality rate has steadily increased (see Figure 4). Although there was a 3% decrease in 2005, it subsequently rose more sharply. Furthermore, Figures 5 and 6 illustrate the trends over time for the logarithm of total employment and the average nominal wages, respectively. There was a decline in employment in the early 2000s, followed by an upturn after 2005. Over the past few years, employment has remained constant. In contrast, while nominal and real wages have been increasing over time, the increase in real wages has been of a lesser magnitude. This suggests that although wages are rising, the purchasing power of these wages is not growing as rapidly, likely due to inflation or rising living costs.

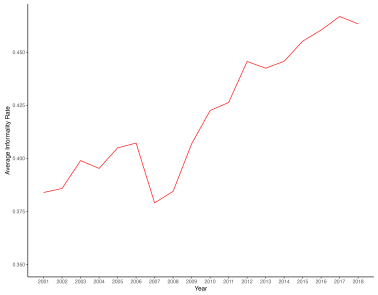


Figure 4: Informality rate

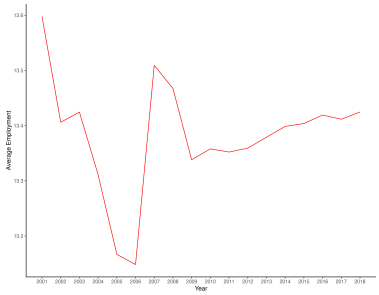


Figure 5: Employment

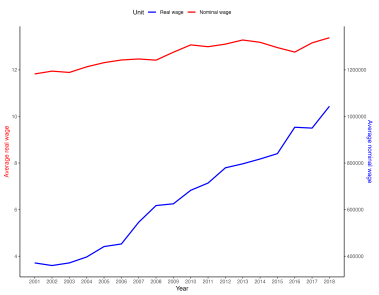


Figure 6: Wages

Table 1 shows descriptive statistics for municipalities with and without FEZs. In terms of observable characteristics, municipalities with FEZs have a higher informality rate, better labor market outcomes (employment and wages), better economic indicators (population density, rurality, and night-time light), and higher state capacity (tax revenues). On average, these municipalities are closer to the capital cities of their respective departments, and the capital of Colombia, Bogotá.[7] In addition, municipalities with FEZs are smaller and less prone to natural disasters than non-FEZ municipalities.

Table 1: Descriptive Statistics

Variable	*Mean T=1*	*Mean T=0*
Informality rate	0.46	0.42
Total Employment	14.23	13.19
Wages	13.52	13.29
Population density	0.86	-0.97
Gov. tax revenue	11.02	9.10
Gov tax property revenue	8.36	5.27
Night-time light int.	19.98	4.54
Distance Capital	61.75	82.31
Distance Bogota	319.34	321.53
Rurality index	0.28	0.59
Size (km2)	898.74	1020.24
Public health coverage	0.87	0.92
Area exposed to risk	0.33	0.50
Average precipitation	78.22	78.22

[7]This can also be associated with a higher state capacity since political power and control are concentrated in these capitals.

3.2 Empirical strategy

To identify the causal effect of FEZs across space on municipalities, the primary analysis exploits a spatial difference-in-difference (DID) framework that compares changes in the economic outcomes in municipalities where FEZs were established with municipalities without zones. Similar to Gallé et al. (2022), I group municipalities in "i"km-distance rings around their closest FEZs up to 50km.[8] Table 2 describes the different treatment groups.

Table 2: Different treatment groups

Nomenclature	*Description*
z	Municipality hosting a FEZ
z_b	The bordering municipalities
z_{10}	Municipalities at less than 10 km
z_{25}	Municipalities at less than 25 km
$z_{37.5}$	Municipalities at less than 35 km

I estimate the following event-study regression which allows me to measure the average treatment effects with elapsed treatment time and to investigate how the effect of participating in the treatment varies with the length of exposure to the treatment.[9]

$$Y_{it} = \sum_{j=-5}^{10} \beta_j D_{it}^{j} + \mu_i + \lambda_t + \epsilon_{it} \tag{1}$$

where Y_{it} are the outcomes of interest of municipality i at time t. The D_{it} terms are dummies for leads and lags of the treatment [10] – e.g., D_{it}^{-4} is a dummy equal to 1 if the municipality i is treated 4 years later. The terms μ_i and λ_t are municipality and year-fixed effects, and ϵ_{it} is the error term. I thus exploit differences across municipalities (treated vs. non-treated) and differences across years t (before vs. after the construction).

Given the nature of the policy intervention, Free Economic Zones (FEZs) were phased in at different times, with varying effects across municipalities and years. Then, as highlighted by Sun and Abraham 2021, the fully dynamic version of the TWFE model estimated using OLS provides consistent estimates, but only under the strong assumption of treatment effect homogeneity. To allow for heterogeneity in treatment effects across time and treated units, I also present the event-study figures generated by a set of recently proposed estimators that are robust to treatment effect heterogeneity (De Chaisemartin and D'Haultfoeuille 2020; Callaway and Sant'Anna 2021, and Sun and Abraham 2021) are also presented.

Complementary, to account for possible non-linearities in the treatment across space, I also regress the outcome variables (Y_{it}) on the dummies for whether a municipality belongs to a radius of 10, 25, 37.5 from the municipalities treated, the time, and individual fixed effects.

$$Y_{it} = \sum_{r}^{37.5km} \beta_r z_{rit} + \gamma_i + \delta_t + \epsilon_{it} \tag{2}$$

[8] The selection of the reference category is arbitrary and serves as a basis for interpreting the coefficient estimates that reflect the influence of the FEZs on the economic development of municipalities within a radius of d relative to the reference municipalities.

[9] I compare the results to the dynamic event study estimated by TWFE.

[10] I also consider a continuous treatment analysis. The reasoning behind this is that the scope of the treatment is unknown, but it decreases on distance. For instance, if a free economic zone can supply from a remote municipality, then the effect might be omitted when considering only the relatively close municipalities. In this continuous analysis, every municipality is exposed to FEZs with a different intensity at different points in time.

Threat to identification. The main empirical identification concern is that FEZs are not randomly allocated in space, but that their location systematically correlates with the economic trajectories before FEZ-establishment. I address this concern in two ways: First, I test for differential outcome pre-trends between FEZ-treated municipalities and reference municipalities in the years directly leading up to treatment.[11]

Second, as part of the robustness check, I use region-specific disaster risk as an instrumental variable to determine the placement of Free Economic Zones (FEZs). Multinational firms tend to invest in areas with lower disaster risk to safeguard their supply chains. Since FEZs aim to attract investment and promote economic development, they are typically constructed in less disaster-prone areas. Any disruptions in these zones could jeopardize the efficiency and profitability of businesses operating within them, affecting their investors.

4 Baseline results

In this section, I present estimation results from specification (1) and (2).

4.1 Main outcomes

Figure 9 provides the estimates from specification (1). The first finding is that pre-trends for informality are not statistically significant for all the estimation methods. More importantly, I find a positive and statistically significant effect of the roll-out of the zones on the informality rate. Figure 9 shows the staggered differences in differences are positive after the treatment was put in place, it also demonstrates that the longer the exposure, the more important the effect. The dots indicate the estimated parameters. The FEZs seem to have a positive and permanent effect on informality that lasts for years.

Figure 8 demonstrates that parallel trends for wages and employment are maintained before the treatment event, validating the difference-in-differences approach. Post-treatment, there is no statistically significant effect on employment, suggesting overall employment levels remain stable in municipalities hosting an FEZ. However, the increase in informality indicates a shift of workers from the formal to the informal sector in the treated municipalities. For wages, there is a significant negative impact in the period immediately following the treatment, but this effect diminishes and becomes insignificant over time.

To recover the overall effect of the FEZs on the main outcomes, I use the aggregation method proposed by Callaway and Sant'Anna Callaway and Sant'Anna 2021 to aggregate group-time average treatment effects. The estimate is a weighted average of each $ATT(g,t)$ weighted by the group sizes. This combination rules out troubling issues due to negative weights, providing an unbiased estimate. Table 3 shows the results.

On average and in the aggregate, informality increases by 6.58 percentage points in municipalities hosting the free economic zones. Similar to the results highlighted with the event-study design, the effect on total employment is statistically insignificant. In contrast, for wages, the effect is negative and statistically significant at 10%. This indicates that hosting municipalities experience a decrease of 7% in wages.[12]

[11] The previous research on place-based policies has used identification strategies to compare locations that are targeted by a particular policy with locations that were considered but ultimately not selected for treatment. In this case, most FEZ applications are approved and finally constructed. Another strategy used in previous literature is to compare treated municipalities with municipalities treated in the future. I take the latter into account when estimating the staggered DiD.

[12] This result appears counterintuitive when examining Figure 8. However, the aggregate ATT is a weighted

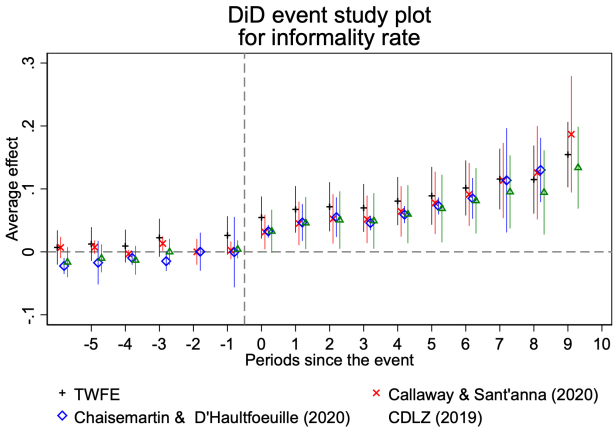
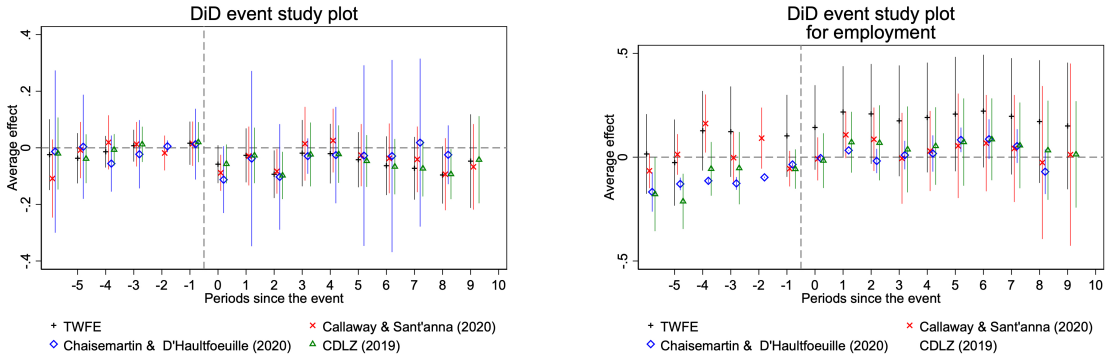


Figure 7: Informality rate

Note: The dots indicate the estimated parameters $\hat{\beta}_j$. Each subscript j refers to the leads and lags. The bars represent 95% confidence intervals with SEs clustered at the department level. This figure overlays the event-study plots constructed using four different estimators: a dynamic version of the TWFE model (2), estimated using OLS; Callaway and Sant'Anna (2021) (cross markers); De Chaisemartin and D'Haultfoeuille (2021); and Cengiz et. al (2019). The time variable is the year of the declaration, and the treatment group is defined by municipalities hosting a FEZ. The omitted category is the year before treatment.



(a) Log of Wages

(b) Log of Employment

Figure 8: Event-study results

Note: The dots indicate the estimated parameters $\hat{\beta}_j$. Each subscript j refers to the leads and lags. The bars represent 95% confidence intervals with SEs clustered at the department level. This figure overlays the event-study plots constructed using four different estimators: a dynamic version of the TWFE model (2), estimated using OLS; Callaway and Sant'Anna (2021) (cross markers); De Chaisemartin and D'Haultfoeuille (2021); and Cengiz et. al (2019). The time variable is the year of the declaration, and the treatment group is defined by municipalities hosting a FEZ. The omitted category is the year before treatment.

Table 3: Aggregated ATT for z

Outcome	Informality rate	Employment	Wages
Estimate	0.0658***	0.00454	-0.0719*
	(0.02)	(0.0761)	(0.0378)

Notes: This table explores the effect of the Free Economic Zones on informality rate, wages, and employment. Specifically, it presents aggregate estimates β from the aggregation procedure by Callaway and Sant'Anna 2021. I use as a control group the not-yet-treated units. Controls include specific-municipality trend fixed effects. The unit of analysis is at the municipality level for this table. Standard errors are reported in parenthesis and are clustered at the department level. Signif. Codes: ***: 0.01, **: 0.05, *: 0.1

To capture the spatial spillover effects of the policy, first, I run the same specification with a different treatment group: the bordering municipalities. Second, I run the specification 2 to capture the non-linearities in the treatment.

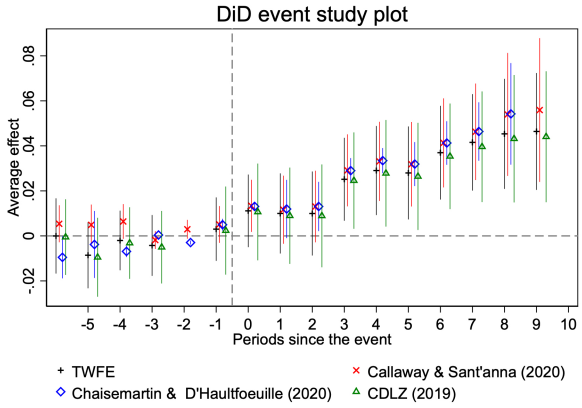
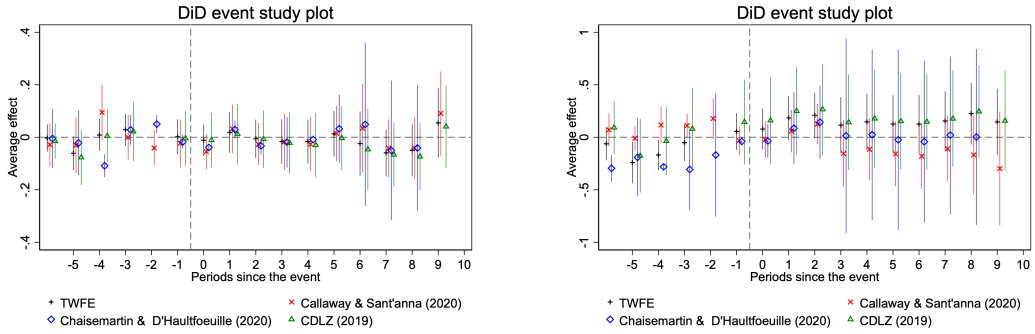


Figure 9: Informality rate in z_b

Note: The dots indicate the estimated parameters $\hat{\beta}_j$. Each subscript j refers to the leads and lags. The bars represent 95% confidence intervals with SEs clustered at the department level. This figure overlays the event-study plots constructed using four different estimators: a dynamic version of the TWFE model (2), estimated using OLS; Callaway and Sant'Anna (2021) (cross markers); De Chaisemartin and D'Haultfoeuille (2021); and Cengiz et. al (2019). The time variable is the year of the declaration, and the treatment group is defined by municipalities bordering a municipality with a FEZ. The omitted category is the year before treatment.

For the bordering municipalities, I observe positive but relatively lower effects on informality, compared to the hosting zones. This effect becomes noticeable in the mid-run, starting approximately three years after the treatment. This effect can be attributed to the fact that young businesses, like those located in the FEZs, in Colombia exhibit an "up or out" dynamic, that is, they face a high probability of exit but conditional on survival, they have higher net growth rates than their more mature counterparts by their fourth year of age (Eslava et. al 2022). By the third year, as these firms grow and the local labor market adjusts, employment opportunities may

average that depends on the size of each treatment-year group. Since the weight is larger for the groups that have experienced a negative effect on wages, the aggregate effect reflects these negative impacts more prominently.



(a) Log of Wages

(b) Log of Employment

Figure 10: Event-study results for z_b

Note: The dots indicate the estimated parameters $\hat{\beta}_j$. Each subscript j refers to the leads and lags. The bars represent 95% confidence intervals with SEs clustered at the department level. This figure overlays the event-study plots constructed using four different estimators: a dynamic version of the TWFE model (2), estimated using OLS; Callaway and Sant'Anna (2021) (cross markers); De Chaisemartin and D'Haultfoeuille (2021); and Cengiz et. al (2019). The time variable is the year of the declaration, and the treatment group is defined by municipalities bordering a municipality with a FEZ. The omitted category is the year before treatment.

expand to the nearby municipalities. Nevertheless, the employment opportunities do not translate into increases in overall employment or changes in wages (see Figure (10)).

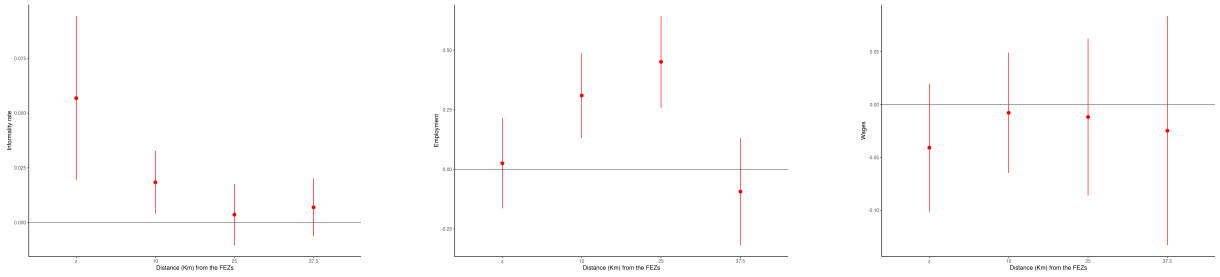
Table 4: Aggregated ATT for z_b

Outcome	Informality rate	Employment	Wages
Estimate	0.0332***	-0.157	-0.0337
	(0.00847)	(0.177)	(0.0473)

Notes: This table explores the effect of the Free Economic Zones on informality rate, wages, and employment. Specifically, it presents aggregate estimates β from the aggregation procedure by Callaway and Sant'Anna 2021. I use as a control group the not-yet-treated units. Controls include specific-municipality trend fixed effects. The unit of analysis is at the municipality level for this table. Standard errors are reported in parenthesis and are clustered at the department level. Signif. Codes: ***: 0.01, **: 0.05, *: 0.1

Table 4 reports the aggregate estimates for the main outcomes when considering z_b as the treatment. On average, informality increases by 3 percentage points in nearby areas. While for employment and wages, the effect is statistically insignificant.

Figure 11 presents the results for the specification (2). The graph shows that the informality rate increases with distances until 25 kilometers, then the effect vanishes. It suggests that informality increases by 2 pp in municipalities less than 10km from a FEZ. For employment and wages, I find a positive impact on total employment that decreases with distance. Specifically, municipalities located 10 kilometers away from FEZs exhibit a 20% increase in employment, while those 25 kilometers away experience an increase of 40%. Furthermore, the findings indicate that municipalities located 25 kilometers away witness a surge in formal employment, which primarily propels the overall rise in total employment. Conversely, in municipalities positioned 10 kilometers away



(a) Informality rate (b) Log of Employment (c) Log of Wages

Figure 11: Non-linear effects of distance

Note: The dots indicate the estimated parameters $\hat{\beta}_r$. Each subscript d refers to a distance on the horizontal axis, e.g. the coefficient at 0km refers to z. The lines indicate 95% confidence intervals.

from FEZs, the simultaneous increase in employment and informality may suggest the emergence of informal enterprises in nearby markets, rather than a direct reallocation between formal and informal sectors. For wages, the effect remains statistically insignificant.

4.2 Other economic indicators

The results from the previous subsection suggest that the FEZs increased informality in the nearby municipalities to a zone and have persisted over time. In this subsection, I evaluate whether the creation of the FEZs translated into advances in different economic indicators. To do so, I use the same difference-in-difference strategy as in Section 4.1.

First, I use official estimates of population density by municipality from the National Statistical Office (DANE). Second, following the recent literature on new measures of economic activity (see for example, Donaldson and Storeygard 2016; Henderson, Storeygard, and Weil 2012; Henderson et al. 2017), I use nighttime light intensity as a proxy for economic development. For comparability, I standardize this measure for each year. Additionally, I consider total tax revenues, and total property tax revenue as a measure of state capacity that can reflect the taxation benefits from the FEZs, since more firms will be paying more taxes if they are located in these or nearby locations.

Figure 12 - 15 show the estimates for the municipalities nearby FEZs.[13] Parallel trends holds for most of the outcomes except for population density. For the night-time light intensity, there is a positive effect in the first period after treatment, after it remains constant. Similarly, for total tax revenue, there is a positive effect in the first two periods, but this effect vanishes subsequently. In contrast, total property tax revenue shows an increasing effect over time, particularly after the third year following treatment. This increase could be attributed to a rise in the mass of economic agents in these municipalities, including both firms and individuals, leading to greater occupation of floor space.

Additionally, in Table 5, I report the estimates of the aggregation method by Callaway and Sant'Anna 2021, to recover the overall effects of the FEZs. The results using the different proxies of economic development are consistent: they suggest that the FEZs regime improved economic indicators in nearby areas to the zones. For instance, based on the data for nighttime illumination intensity, there is a 0.98 standard deviation (SD) increase in light intensity. Similarly, the state capacity indicators also show positive results. For example, the findings reveal that total government

[13]The results for the hosting municipalities are reported in Appendix B.

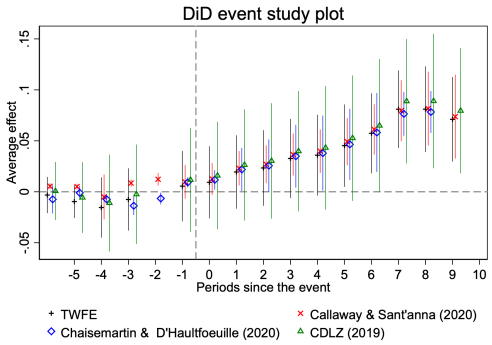


Figure 12: Population density

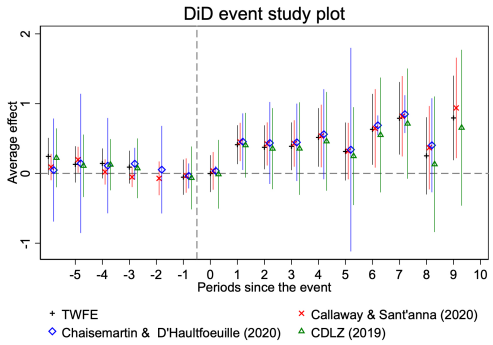


Figure 13: Night-time light

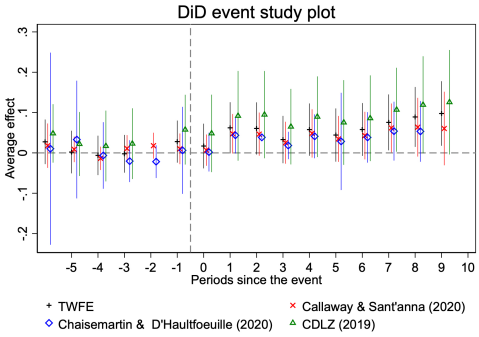


Figure 14: Total tax revenue

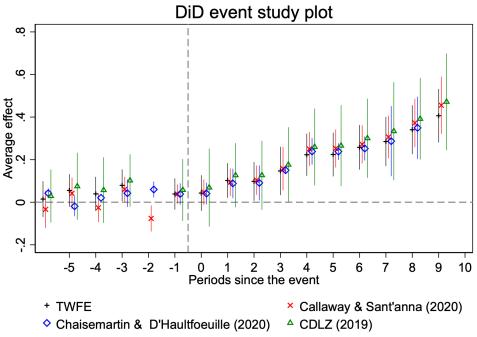


Figure 15: Total property tax revenue

Note: The dots indicate the estimated parameters $\hat{\beta}_j$. Each subscript j refers to the leads and lags. The bars represent 95% confidence intervals with SEs clustered at the department level. This figure overlays the event-study plots constructed using four different estimators: a dynamic version of the TWFE model (2), estimated using OLS; Callaway and Sant'Anna (2021) (cross markers); De Chaisemartin and D'Haultfoeuille (2021); and Cengiz et. al (2019). The time variable is the year of the declaration, and the treatment group is defined by municipalities bordering a municipality with an FEZ. The omitted category is the year before treatment.

Table 5: Aggregated ATT for z_b

Outcome	Population density	Night-light intensity	Total tax revenues	Total property tax
Estimate	0.0799***	0.988***	0.0946**	0.255***
Std. Error	(0.022)	(0.309)	(0.0375)	(0.049)

Notes: This table explores the effect of the Free Economic Zones on different measures of economic activity. Specifically, it presents aggregate estimates β from the aggregation procedure by Callaway and Sant'Anna 2021. Controls include specific-municipality trend fixed effects. The unit of analysis is at the municipality level for this table. Standard errors are reported in brackets and are clustered at the department level. Signif. Codes: ***: 0.01, **: 0.05, *: 0.1

revenues increased by 9% in the municipalities near FEZs, and total property tax revenues rose by 25%. This implies the existence of positive spatial spillover effects in the other economic activity measures. However, they do not materialize into improvements in the labor market.

4.3 Heterogenous effects

In this subsection, I shed light on heterogeneous treatment effects by zone characteristics. Zones in Colombia differ in two key dimensions: First, there is heterogeneity in their main industry domination, including manufacturing, agroindustrial, and services. Second, zones in Colombia are developed and run by either a single or multiple firms. I assess how these characteristics shape the impact of FEZs on local economic activity.

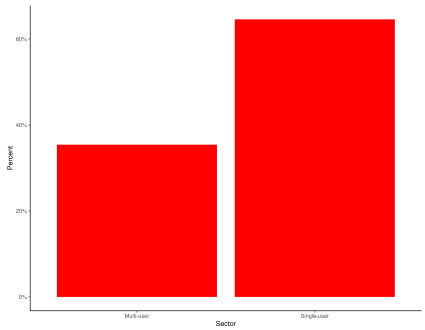


Figure 16: FEZs by type

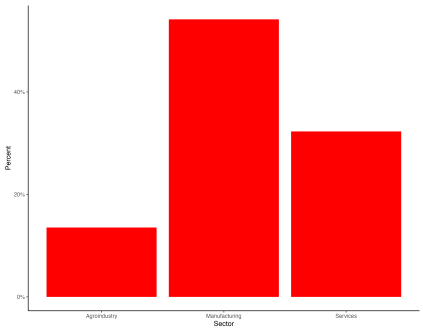


Figure 17: FEZs by sector

Single vs multiple user. As illustrated in Figure 16, over 60% of Colombia's zones are operated by a single firm. One reason to suspect that the local employment effects of single and multi-user FEZs could diverge is the potential for industrial parks to have a more pronounced impact on local economies due to their typically larger size and higher employment capacity. In contrast, single-firm FEZs often prioritize profit maximization through tax exemptions, which may result in a different emphasis on employment generation compared to multi-user zones.

To test for the effect heterogeneity along these lines, I estimate the following model:

$$Y_{it} = \beta_h FEZ_{it} \times \text{type} + \gamma_i + \delta_t + \epsilon_{it} \tag{3}$$

where "type" is a dummy variable indicating whether the FEZ in municipality i is developed by a single firm or by different. I include municipality and time-fixed effects.

Table 6: Heterogeneous effects by type of zone

Dependent Variables:	Informality rate		Employment		Wages	
	Multi-user	Solo-user	Multi-user	Solo-user	Multi-user	Solo-user
Model:	(1)	(2)	(3)	(4)	(5)	(6)
Variables						
Estimate	0.0427 *	0.0769 ***	0.0236	-0.0619	-0.0645	-0.0724 *
Std. error	(0.0242)	(0.0268)	(0.0876)	(0.0876)	(0.044)	(0.0399)

Notes: This table explores the effect of the different types of Free Economic Zones on the main outcomes: Informality rate, employment, and wages. Specifically, it presents aggregate estimates β from the aggregation procedure by Callaway and Sant'Anna 2021. Controls include specific-municipality trend fixed effects. The unit of analysis is at the municipality level for this table. Standard errors are reported in brackets and are clustered at the department level. Signif. Codes: ***: 0.01, **: 0.05, *: 0.1

In Table 6, I present the impacts of FEZs on informality rate, employment, and wages for municipalities hosting single-firm and multi-firm zones separately. The findings indicate that the effect on informality varies depending on the zone type. In particular, in municipalities with a solo-user zone, informality rises significantly, by 7 percentage points. For employment, the results do not exhibit systematic differences between multi-user and single-user FEZs, in both cases, the effect is statistically insignificant. Conversely, regarding wages, municipalities hosting single-firm zones experience an average decrease of 7%.

Sector-specific effects. The influence of Free Economic Zones (FEZs) on local economic activity may also depend on the specific industries they accommodate. In this case, I characterize three main macro-sectors: agroindustry, manufacturing, and services. [14] These sectors account for 17%, 48%, and 35% of the FEZs' activities, respectively (Figure 17).

One potential reason to investigate heterogeneity by sector is that each sector may have distinct characteristics, which could lead to varying impacts on local economies. For instance, agroindustry zones, characterized by their seasonal labor demands and reliance on agricultural inputs, may exert unique effects on local labor markets compared to manufacturing or service-oriented zones. Additionally, manufacturing zones may play a pivotal role in enhancing local value-added production, while service-oriented zones may drive employment growth and foster skill development.

Table 7: Heterogeneous effects by type of sector

Dependent Variables:	Informality rate			Employment			Wages		
	Industrial	Agroindustrial	Services	Industrial	Agroindustrial	Services	Industrial	Agroindustrial	Services
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables									
Estimate	0.0647**	0.1192***	0.0263***	0.0484	-0.5853**	0.2077***	-0.0438	0.0225	-0.0846**
Std. error	(0.0261)	(0.0549)	(0.00827)	(0.0809)	(0.1299)	(0.0725)	(0.0406)	(0.0544)	(0.0365)

Notes: This table explores the effect of the different sectors of Free Economic Zones on the main outcomes: Informality rate, employment, and wages. Specifically, it presents aggregate estimates β from the aggregation procedure by Callaway and Sant'Anna 2021. Controls include specific-municipality trend fixed effects. The unit of analysis is at the municipality level for this table. Standard errors are reported in brackets and are clustered at the department level. Signif. Codes: ***: 0.01, **: 0.05, *: 0.1

Table 7 presents the results from the heterogeneity analysis by sector, revealing notable variations in the impacts of FEZs by industrial, agroindustrial, and service sectors. Notably, municipalities hosting FEZs exhibit statistically significant effects on informality rates across all sectors. However, the effect is particularly pronounced in municipalities with agroindustrial zones, where informality increases by 11 percentage points. This substantial increase might be explained by the fact that agroindustry zones may experience a prevalence of informal labor arrangements, potentially attributed to seasonal fluctuations in labor demand.

Similarly for employment, while municipalities hosting industrial FEZs show non-significant effects, the results uncover significant variations in the impacts of the agroindustrial and services FEZs municipalities. For instance, municipalities hosting agroindustrial zones experience a decrease of 58% in their employment. This significant reduction in employment suggests that agro-industrial zones may have negative effects on local employment opportunities. Possible explanations for this finding include the mechanization of agricultural processes, leading to a decreased demand for manual labor. Together with the results for informality, these findings imply a reallocation of labor from the formal to the informal sector in these municipalities. In contrast, the employment effects on municipalities hosting services FEZs are positive. They translate into an increase of 20%. This suggests that services-focused FEZs may contribute to job creation and employment growth in

[14] The agroindustry includes all the activities that convert raw agricultural materials into value-added products, such as the food industry, etc.

the hosting municipalities. These results align with the "jobless industrialization" phenomenon highlighted by Alfaro et al. 2023. There is a divorce pattern between value-added and employment in late industrialized, which is accounted for by "jobless" large manufacturing firms, primarily formal, whose contribution to manufacturing value-added grows over their life cycle but not their contribution to employment.

Finally, while the impacts on wages are not statistically significant for the industrial and agroindustrial sectors, a significant negative effect is observed for the service sector. This suggests that, on average, wages decrease by 8% in municipalities hosting services FEZs. The decline in wages within service-oriented FEZs highlights potential challenges faced by workers in these areas, such as downward pressure on wages. This can occur due to an oversupply of (informal) labor relative to available job opportunities, allowing employers to offer lower wages to attract workers.

5 Robustness checks

In this section, I conduct a series of robustness checks to assess the reliability and robustness of my main findings regarding the impacts of Free Economic Zones (FEZs) on local economic outcomes. These checks aim to test the sensitivity of our results to different unit of analysis, such as municipality-level versus local labor markets, and to address potential endogeneity issues that may arise from reverse causality.

5.1 IV: Risk disaster

As discussed in Section 3.2, the main empirical identification concern is that FEZs are not randomly allocated in space, but that their location systematically correlates with the economic trajectories before FEZ-establishment. Therefore, I employ a Difference-in-Differences with Instrumental Variables (DiD-IV) approach for identification. This strategy utilizes an instrumental variable based on investment location decisions, specifically considering region-specific disaster risk. The rationale behind this is to mitigate potential endogeneity issues arising from the systematic correlation between FEZ locations and pre-existing economic conditions.

I construct a shift-share instrument, with the shares as the percentage of area at natural disaster risk and the shift as the average precipitation by municipality and year. I argue that the only way the index of risk disaster affects labor market conditions is through investment decisions, particularly of the free economic zones. The literature on global supply chains has shown that multinational firms consider the local costs and region-specific disaster risks when selecting locations for production, implying that investments tend to flow into less-disaster regions to avoid possible disruption risks (Friedt & Toner-Rodgers, 2022). Given the nature of the legislation, FEZs are investment decisions made by private investors. As FEZs aim to promote economic development and attract foreign direct investment, their success is contingent upon mitigating risks and ensuring the continuity of supply chains. Then, I argue that FEZs are constructed and less-prone disaster areas. Otherwise, any possible disruptions can hinder the efficiency and profitability of businesses operating within these zones, affecting their investors.

For this analysis, I consider the risk of hydro-meteorological disasters. According to the National Planning Department of Colombia (DNP, by its acronym in Spanish), 88% of occurred catastrophes are of hydro-meteorological origin, comprising floods, landslides, and torrential flows. Unfortunately, the country is significantly prone to these types of natural hazards because it ranks first with the highest precipitation rate in the world (World Bank, 2020). I use the Municipality Index of Risk Disaster created by the which aggregates data on regions vulnerable to three types of hazards: slow-onset flood regions (valleys and flat areas with stream sources), mass movement

areas (mountains), and torrential flows (natural stream channels on mountains or areas with high slope). This index helps identify the most threatened regions and computes the proportion of the municipality's area at risk. Since this variable remains constant over time, I create a shift-share instrument, using the percentage of area at risk as the share component and the average precipitation per municipality per year as the shift component.

The main concern is the validity of the instrument. One can argue that this index affects labor market conditions and population density because people might live in safer places. However, because of the particular geography of Colombia, 61% of individuals at risk live in urban agglomerations, where the labor market characteristics might be better. Another argument, it's that the people live there because the government might be taking away their risk by providing insurance. Nevertheless, it is not credible because the National Disaster Risk Management Plan is still under construction, so there are no clear rules on mitigating and attenuating the impact of a natural disaster. I argue that the index of disaster risk impacts labor market conditions primarily through investment decisions, particularly those concerning the establishment of free economic zones.

Table 8: IV results

	Dependent variable:		
	Informality	Log Employment	z
	IV	IV	First Stage
z	0.065^{***}	0.112^{***}	
	(0.005)	(0.007)	
Shift-Share IV			-0.0002^{**}
			(0.0001)
Observations	2,370	2,370	2,370
Municipality FE	X	X	
Year FE	X	X	
F Statistic	169.225^{***}	241.578^{***}	4.348^{**}

Notes: This table explores the effect of the Free Economic Zones on the main outcomes accounting for the IV. Specifically, it presents estimates of coefficient β from the DiD-IV. Controls include specific-municipality trend fixed effects. The unit of analysis is at the municipality level for this table. Standard errors are reported in brackets and are clustered at the department level. $^{***}p < 0.01$.

Table 8 contains the results of the DiD-IV. I highlight the negative relationship between the index of risk disaster adjusted by rainfall and the treatment adoption, which implies that investors might tend to consider the risk when deciding where to invest (Friedt and Toner-Rodgers 2022). Consistent with previous specifications, I also find a positive and statistically significant effect on the informality rate. Specifically, informality increases by 6 percentage points in municipalities hosting at least one FEZ. Moreover, the results for employment, for instance, show an increase of 11%, aligning with the estimates from previous analyses.

5.2 Local labor markets

One potential shortcoming of the analysis is the suitability of the comparison group. [15] To address this, I transform the municipality variable into a more standard definition of local labor markets or commuting zones, using the methodology of Sanchez-Serra (2016). I build a smaller sample of functional urban areas (FUAs) in Colombia. This sample consists of the 53 biggest urban areas in the country defined from population grid data, municipal boundaries, and inter-municipal commuting flows.

To capture this, I estimate the following regression:

$$Y_{itl} = \beta_h FEZ_{itl} + \gamma_i + \delta_t + \varphi_l + \epsilon_{it} \tag{4}$$

where Y_{itl} corresponds to the outcome in municipality i at time t, belonging to the local labor market l. FEZ is a dummy indicating if the municipality has an active FEZ at time t. I control for the municipality, local labor market, and time-fixed effects. In this case, the control group is the municipalities in local labor markets that are not treated.

Table 9: Regression results: LLM

Dependent Variables:	Informality rate	Total Employment	Wages	Population density	Night-light intensity	Total gov. revenue	Property tax gov. revenue
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables							
z	0.0563**	0.7680*	0.0343	0.8287***	6.298	1.577***	1.985***
	(0.0258)	(0.3922)	(0.0593)	(0.2994)	(4.020)	(0.3721)	(0.5189)
Fixed-effects							
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Local labor market	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Municipality	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics							
Observations	1,092	1,092	1,092	2,322	2,322	2,297	2,293
R^2	0.43421	0.34651	0.71176	0.49107	0.53797	0.50483	0.52609

Notes: This table explores the effect of the Free Economic Zones on the main outcomes controlling for Local Labor Markets fixed effects. Specifically, it presents estimates of coefficient β. I estimate this equation by restricting the sample to all the municipalities being part of at least one of the 53 local labor markets (FUAS). Controls include specific-municipality trend fixed effects. The unit of analysis is at the municipality level for this table. Standard errors are reported in brackets and are clustered at the department level. $^{***}p < 0.01$.

The regression results in Table 9 shed light on the impact of Free Economic Zones (FEZs) within Local Labor Markets (LLMs) on various outcome variables. For informality, the effect is positive. It implies that informality increases by 5 percentage points. However, they significantly boost total employment by approximately 76.80% at a 10% significance level. Additionally, FEZs substantially increase population density by about 82.87%, suggesting they attract more residents. Furthermore, FEZs significantly enhance total government revenue and property tax revenue, highlighting their positive fiscal impact on the local labor markets.

6 A simple model

There are several channels through which the construction of free economic zones can impact informality, pushing the response to changes in the roll-out of the policy program in different directions. I consider the following two. The first mechanism linking this policy program and informality is the entry channel mechanism, which operates through the formalization of entrant firms to the zones because only formalized firms can benefit from the zone, which might decrease informality. Second, I consider the "demand-type" mechanism. The construction of an FEZ can

[15] In the previous section, I compared treated with not-treated municipalities, comparing Bogotá, the Capital of Colombia, with other less economically important cities in Colombia.

be interpreted as a positive demand and income shock, encouraging the exit of the least productive formal firms. They are replaced by informal firms, which tends to increase informality.

In this section, I present a simple spatial structural equilibrium model with heterogeneous firms that choose to operate in the formal or the informal sector. The model highlights the key mechanism that can explain the empirical facts. It incorporates firm heterogeneity (Melitz, 2003; Ulyssea, 2018) driven by differences in the local productivity distribution into a Helpman (1998) framework with labor mobility (Bakker et. al, 2024). In the model, locations differ in their exogenous firm productivity distribution and amount of housing. Informal and formal market entry of firms and labor mobility across locations give rise to the equilibrium distribution of economic activity.

6.1 Setup

I consider an economy featuring N symmetric locations. Each location is endowed with an exogenous stock of local land T, and labor L is the sole production factor. Regions trade with each other at a symmetric iceberg trade cost ($d_{ni} > 1, d_{nn} = 1$), implying that d_{ni} must be shipped from region n for one unite to arrive in i. Workers are assumed to be perfectly mobile across locations.

For simplicity, I abstract from differences in amenities to focus on the role of differences in productivity distribution across locations. I also disregard labor market distortions, so I define informality as firms with a level of employment (and productivity) below a certain threshold. [16] This goes in line with the Fact 1 (3.1.1).

Preferences. Workers are homogeneous; they decide where to locate and consume a bundle of goods and housing while earning the local wage w_i in location i. Worker preferences are given by:

$$U_i = c_i^{\beta} h_i^{1-\beta} \tag{5}$$

where h_i denotes (individual) housing consumption in location i, and c_i is a CES composite of the consumption of tradable varieties:

$$c_i = \left[\int c_i(x)^{\frac{\sigma-1}{\sigma}} dx \right]^{\frac{\sigma}{\sigma-1}} \tag{6}$$

which yields consumption of each variety by the representative consumer at each location n from location i

$$c_{ni} = p_{ni}^{-\sigma} P_i^{\sigma-1} w_i L_i \tag{7}$$

Since h is a non-tradeable and exogenously given local resource, we refer to it as "housing", following Helpman (1998). In each location, housing is produced in perfect competition. The stock of housing in each region is constant. Therefore, given expenditure shares, the equilibrium price of h is given by:

$$p_i^h = \frac{(1-\beta)}{\beta} \frac{w_i L_i}{H_i} \tag{8}$$

Production. In each location, there is an unlimited supply of potential entrants. Each firm produces a differentiated tradable variety using local labor. Once they've paid the entry cost F_e in units of local labor, firms draw their productivity ψ from the location-specific productivity distribution $g_i(\psi)$. In each location, productivity is distributed Pareto with a common scale parameter

[16] This definition highlights a well-documented fact that the share of informal firms declines as firms grow large. It reflects an opportunity cost of operating in the informal sector, such as accessing credit or issuing buyer tax receipts (Ulyssea, 2020).

set to value 1 and a location-specific shape parameter α_i. [17] The production technology is given by:

$$l(q, \psi) = c_i \frac{q}{\psi} \tag{9}$$

where $l(q, \psi)$ denotes the local labor input required to produce a quantity of output q for a firm of productivity ψ. Depending on their productivity and employment level, firms choose to exit immediately, serve the market informally paying fixed cost F_u (in units of local labor), or serve the market formally (paying an additional fixed cost F_f to formalize). Additionally, I consider an additional marginal cost, denoted by $c_i = \frac{1}{c}$[18] In equilibrium, there are three types of firms:

1. Unbounded informal firms. All firms entering the market with lower productivity and a level of employment lower than the regulation threshold $\bar{l}$.

$$l_u = F_u + c_i \frac{q}{\psi}$$

The entry of these firms depends upon an entry cutoff (ψ_u^*), implying that initially, all firms entering the market need productivity above the threshold. This definition reflects two main views of informality in the literature. The first suggests that informal firms are a reservoir of potentially productive entrepreneurs unable to enter the formal sector due to high entry costs (De Soto 2002). The second implies that some firms view informality as a survival strategy for low-skill individuals who are too unproductive to become formal. [19]

2. Bounded informal firms. Informal firms with binding employment so that they exhaust their labor but gain from higher productivity ψ_b^*. Even though these firms do not consider productivity in their cost function, they consider a higher level of productivity in their revenues. Therefore, the entry to this type of firm is given by the "bounded informal" cutoff, ψ_b^c.

$$l_b = \bar{l}$$

This definition refers to the view that sees informal firms as parasite firms, which are productive enough to survive in the formal sector but choose to remain informal to earn higher profits from the cost advantages of not complying with taxes and regulations (Levy 2010; Ulyssea 2020; La Porta and Shleifer 2014).

3. Formal firms. Firms that produce with levels of employment and productivity above the thresholds, $\bar{l}$ and ψ_f^*, respectively.

$$l_f = F_f + c \frac{q}{\psi}$$

I adopt the standard simplifying assumption that all firms can trade, paying a symmetric iceberg trade cost d_{ni}.

[17] As in Bakker et al. (2024), I allow the shape parameter to vary across locations to account for locations with more productive firms featuring stronger labor demand for a given wage hence stronger selection effects.

[18] In line with Melitz (2003), I impose the parametric restriction that $F_f > F_u$, which ensures that formal firms are on average more productive than informal firms (Fact 3.1.1)

[19] For the former, reducing the fixed cost associated with registration could have a significant impact on formalization. In the latter case, reducing the cost of formality might not be effective enough.

Firms engage in monopolistic competition. Given CES demand, this implies that prices are set at a constant markup over marginal cost:

$$p_{ni}(\psi) = \frac{\sigma}{\sigma - 1} d_{ni} c \frac{w_i}{\psi} \tag{10}$$

Operational profits derived from serving each sector are given by:

$$\pi_i^u(\psi^u) = \frac{r_i^u(\psi^u)}{\sigma} - w_i F_u \tag{11}$$

$$\pi_i^b(\psi^b) = \frac{r_i^b(\psi^b)}{\sigma} - w_i \bar{l} \tag{12}$$

$$\pi_i^f(\psi^f) = \frac{r_i^f(\psi^f)}{\sigma} - w_i F_f \tag{13}$$

where π_i^u, π_i^b, and π_i^f denote profits from the unbounded informal, bounded, and formal firms, respectively. While $r_i^u(\psi)$, $r_i^b(\psi)$, and $r_i^f(\psi)$ denote the revenue from serving the market informally and formally, respectively. Total firm revenue and profit (across destinations) are $r_i^j(\psi) = \sum_n r_{ni}^j(\psi)$ and $\pi_i^j(\psi) = \sum_n \pi_{ni}^j(\psi)$, j represents the type of firm.

As in Melitz (2003), the industry equilibrium (in this case, for each location) can be characterized using the zero-profit cutoff conditions (14) that yield expressions for the minimum productivity threshold for successful entry into the informal segment of the market (as a unbounded $\psi_i^{u^*}$ or bounded informal $\psi_i^{b^*}$ firm) and for successful entry into the formal segment $\left(\psi_i^{f*}\right)$, as well as a free entry condition (15). The latter states that the expected operational profits of market entry $\bar{\pi}_i$ are equal to the fixed cost of market entry (in terms of local labor). [20]

$$\pi_i^d\left(\psi_i^{d^*}\right) = 0, \quad \pi_i^d\left(\psi_i^{t^*}\right) = \pi_i^t\left(\psi_i^{t^*}\right), \text{ and } \pi_i^t\left(\psi_i^{f*}\right) = \pi_i^f\left(\psi_i^{f*}\right) \tag{14}$$

$$\bar{\pi}_i = \int_{\psi_i^{d^*}}^{\psi_i^{t^*}} \pi_i^d(\psi) g_i(\psi) d\psi + \int_{\psi_i^{t^*}}^{\psi_i^{f^*}} \pi_i^t(\psi) g_i(\psi) d\psi + \int_{\psi_i^{f*}}^{\infty} \pi_i^x(\psi) g_i(\psi) d\psi = \frac{\delta w_i F_e}{1 - G_i(\psi_d^*)} \tag{15}$$

where $1 - G_i(\psi_d^*)$ denotes the probability of entering the market. Firms face an exogenous constant exit probability denoted by δ. Similarly to Melitz (2003) and Ulyssea (2020), there is endogenous entry but exogenous exit, as there are no actual dynamics after entry occurs.

Using the free entry condition at each location allows us to solve for the measure of entrants (M_i^e) in each location:

$$M_i^e = \frac{R_i}{\bar{r}_i} \tag{16}$$

where $\bar{r}_i$ is the average revenue of a firm that enters at location i and is given by equation (A.10), and R_i denotes the aggregate revenues of the tradable sector in each location.

From the total mass of producing firms, I get each type of firm's mass in equilibrium by multiplying M by their conditional probability to exist. Then,

[20] Before entry, firms are identical. To enter, firms must first make an initial investment, modeled as a fixed entry cost $f_e > 0$ (measured in labor units), which is after that sunk. The expectation of positive profits is the only reason firms consider sinking the investment costs required for entry.

$$M_i = \underbrace{\chi_i^u M_i^e}_{\text{Mass of informal}} + \underbrace{\chi_b^t M_i^e}_{\text{Mass of bounded informal}} + \underbrace{\chi_i^f M_i^e}_{\text{Mass of formal}} \tag{17}$$

where $\chi_i^u = \frac{G_i(\psi_i^{b*}) - G_i(\psi_i^{u*})}{1 - G_i(\psi_i^{u*})}$, $\chi_i^b = \frac{G_i(\psi_i^{f*}) - G_i(\psi_i^{b*})}{1 - G_i(\psi_i^{u*})}$ and $\chi_i^f = \frac{1 - G_i(\psi_i^{f*})}{1 - G_i(\psi_i^{u*})}$ represent the conditional probability of being unbounded informal, bounded and formal, respectively.

Residential choice in spatial equilibrium. In spatial equilibrium, utility is equal across all locations and given by:

$$U_i = \frac{v_i}{(P_i)^{1-\beta} \left(p_i^h\right)^{\beta}} = \bar{U} \quad \forall i \tag{18}$$

where v_i denotes total income per worker, p_i^h is the price of housing at location i, and P_i is the price index of the tradable good. Total income in location i is given by labor income plus expenditure on housing:

$$v_i L_i = w_i L_i + (1 - \beta) v_i L_i = \frac{w_i L_i}{\beta} \tag{19}$$

General equilibrium. The general equilibrium of the model is represented by a measure of workers L_i, a set of entry thresholds for producing informally and formally ($\psi_i^{u^*}$, $\psi_i^{b^*}$ and ψ_i^{f*}, respectively), a set of firm entrants M_i^e, wages w_i and price indices P_i for each location, as well as the level of utility in the economy $\bar{U}$, that satisfy the following system of equations:

1. The industry equilibrium consisting of the zero profit cut-off conditions and the free entry condition (equations 14 and 15)

2. Labor markets clear at each location i

$$M_i^e = \frac{R_i}{\bar{r}_i} = \frac{w_i L_i}{\bar{r}_i} \tag{20}$$

3. The price index at each location

$$P_i^{1-\sigma} = \underbrace{\sum_{k \in N} \chi_k^u M_k \left(\frac{w_k d_{ik}}{\rho}\right)^{1-\sigma} \tilde{\psi}_k^{u\sigma-1}}_{\text{Unbounded Informal}} + \underbrace{\sum_{k \in N} \chi_k^b M_k \left(\frac{w_k d_{ik}}{\rho}\right)^{1-\sigma} \tilde{\psi}_k^{b\sigma-1}}_{\text{Bounded formal}} \tag{21}$$

$$+ \underbrace{\sum_{k \in N} \chi_k^f M_k \left(\frac{w_k d_{ik}}{\rho}\right)^{1-\sigma} \tilde{\psi}_k^{f\sigma-1}}_{\text{Formal}} \tag{22}$$

   where χ_k^u, χ_k^b and χ_k^f correspond to the probability that a firm in location $k \in N$ enters the informal and the formal sector, respectively. I define $\rho \equiv \frac{\sigma-1}{\sigma}$. [21]

4. Good markets clear at each location i

   In equilibrium, total expenditure equals the value of domestic production (total labor payments) in each location i by type of firm:

[21] The aggregate productivities for location i and sector j are denoted by $\tilde{\psi}_i^j$, these are detailed in equations A.13, A.14, A.15. Detailed derivation in equation (A.18).

$$w_i L_i = \sum_{n \in N} \pi_{ni} W_n L_n \tag{23}$$

where π_{ni} denotes the expenditure share of goods sourced from i in the overall expenditure of location n. These expenditure shares comprise a combination of domestic and external, and formal and informal consumption.

5. Spatial equilibrium for workers among all locations

$$U_i = \bar{U} \quad \forall i \tag{20}$$

6. National labor markets clear

$$\sum_i L_i = L \tag{21}$$

6.2 Comparative statics

I study the quantitative implications of my model for the relationship between the creation of free economic zones and informality across space. I embed the zones into my model by assuming two channels. First, a reduction in the cost of formalization as firms entering the zones may benefit from streamlined access to tax authority procedures.[22] Second, cheaper inputs, which rationales the fact that consumers of products from the zones are exempt from paying VAT. As this simple model does not consider the intermediates for production, I assume the latter effect through a decrease in the marginal cost ($c_i = \frac{1}{c}$, with $c \in (0, 1]$).

I consider three comparative statics involving only three regions to show the spatial spillover effects of the policy: one region hosting a municipality, another closer region, and a further one.

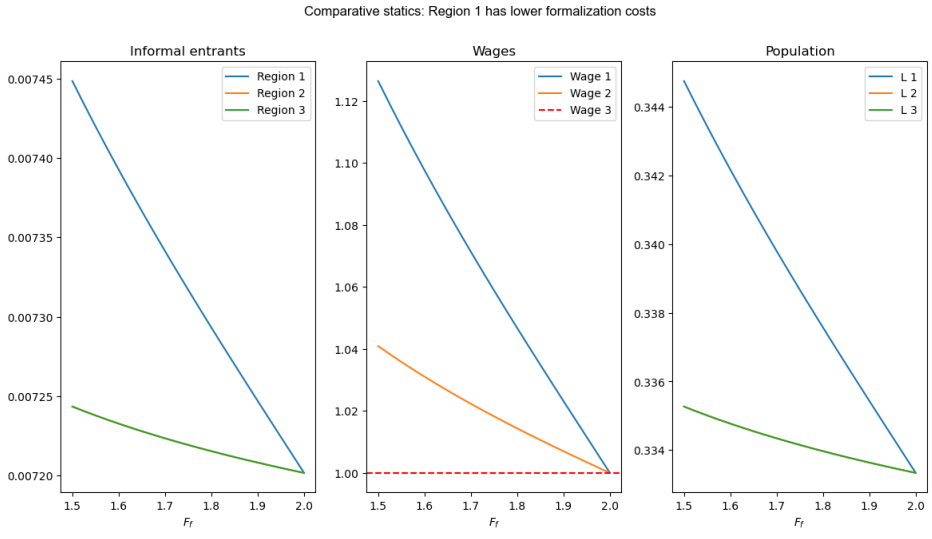


Figure 18: Comparative statics: formalization cost

[22] By simplifying these processes, FEZs lower the barriers to formalizing business operations, which can include registering the company, obtaining necessary licenses, and complying with tax regulations

First, I analyze how changes in the formalization cost affect the spatial equilibrium. I assume three equidistant regions and changes in F_f for Region 1. Figure 18 illustrates that downward changes in the fixed cost of formalization lead to a higher mass of informal entrants in the economy, thereby increasing informality. The effect on wages and population is similar, that is when there are lower formalization costs, wages and population are higher in Region 1 than in Region 2.

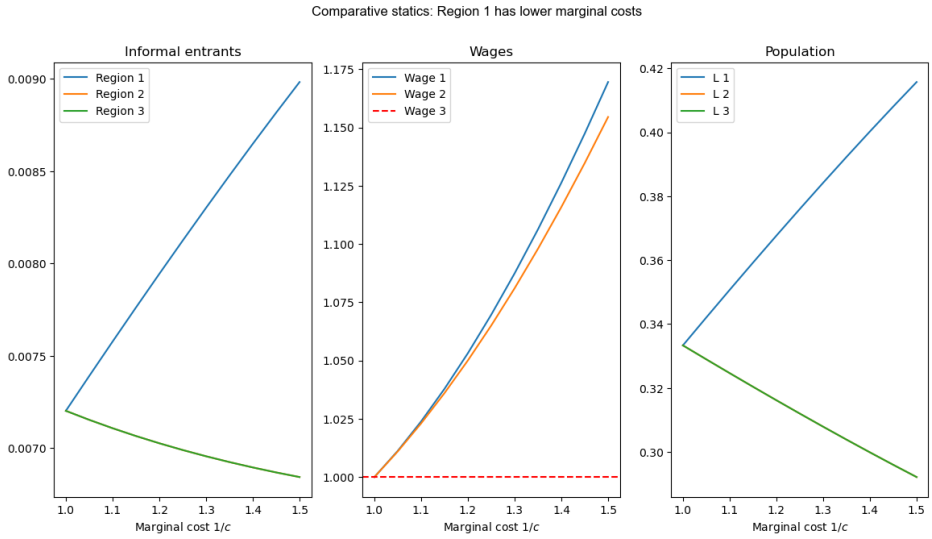


Figure 19: Comparative statics: marginal cost

In addition, I analyze how changes in the marginal cost affect the spatial equilibrium. Figure 19 illustrates upward changes in c for Region 1, representing a lower marginal cost of production $c_i = \frac{1}{c}$. It shows a negative relationship between informality and the marginal cost in Region 1. The results are similar for wages and population.

Finally, I analyze how changes in the marginal cost in Region 1 and other closer regions (Region 2) affect the spatial equilibrium. Figure 20 illustrates changes in c, representing a lower marginal cost in Region 1, but Region 2 is closer. In this case, informality increases in the region hosting the FEZs and to a lesser extent in Region 2, illustrating how informality spills over across space. In addition, wages and population also increase in Region 1 and 2.

In theory, a change in the formalization cost and the marginal directly affects the decisions of firms to enter, exit, and produce formally or informally. Consequently, initially higher-paying formal firms experience greater profitability, prompting them to further raise wages and expand their workforce. However, the higher labor costs prompt low-productivity formal firms to exit the formal segment of firms due to an inability to meet the costs, and the productivity threshold for new firm entry to produce as a formal form is raised, which leads to an increase in informality. These effects are transmitted similarly to closer regions through lower price indices and more varieties, increasing revenues.

7 Conclusion

In conclusion, this study explores the impact of Free Economic Zones (FEZs) on labor market outcomes in Colombia, a country facing significant regional disparities in economic development. While place-based policies are globally implemented to address regional inequalities, much of the

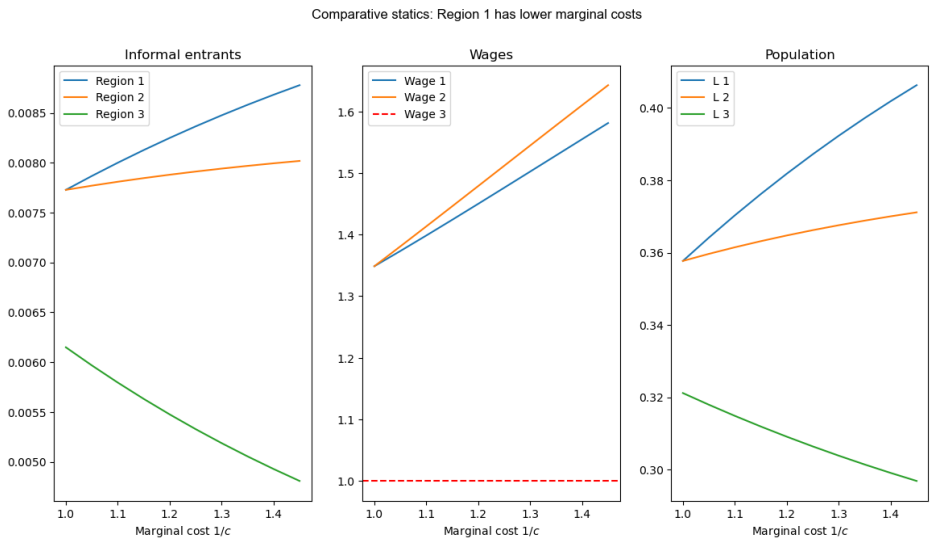


Figure 20: Comparative statics: Region 1 and 2 closer

research has focused on developed economies, leaving a gap in understanding their efficacy in less-developed contexts.

The findings underscore the significant influence of FEZs on Colombia's labor market dynamics. The establishment of FEZs is correlated with a persistent increase in informality rates, primarily driven by a shift from the formal to the informal sector. There is also evidence of a spillover effect on neighboring municipalities, though this effect is less pronounced. Despite these shifts, the overall impact on wages and total employment remains insignificant, highlighting the complex interplay between policy interventions and labor market dynamics. These results align with the "jobless industrialization" phenomenon highlighted by Alfaro et al. (2023), which describes a disconnect between value-added and employment in late industrialized economies. This phenomenon is characterized by large, primarily formal manufacturing firms that increase their contribution to manufacturing value-added over their life cycle without a corresponding increase in employment.

The study also highlights the positive effects of FEZs on economic indicators, evidenced by improvements in nighttime illumination intensity and state capacity indicators. Notably, FEZs contribute to increased government revenue, bolstering municipal tax revenues and potentially enhancing local fiscal capacities.

These findings have important policy implications for economic growth and regional disparities. While FEZs are often part of broader strategies to foster economic growth and reduce regional inequalities, policymakers must consider their unintended consequences on informality. Balancing the economic benefits of FEZs with measures to mitigate informal employment is crucial for promoting inclusive and sustainable development across regions.

References

Abeberese, Ama Baafra and Ritam Chaurey (Mar. 2019). "An unintended consequence of place-based policies: a fall in informality". In: Economics Letters 176, pp. 23–27. DOI: 10.1016/j.econlet.2018.12.004. URL: https://doi.org/10.1016/j.econlet.2018.12.004.

Akinci, Gokhan, James Crittle, and World Bank (Apr. 2008). "Special economic zone : performance, lessons learned, and implication for zone development". In: World Bank WP, pp. 1–83.

Alder, Simon, Lin Shao, and Fabrizio Zilibotti (May 2016). "Economic reforms and industrial policy in a panel of Chinese cities". In: Journal of Economic Growth 21.4, pp. 305–349. DOI: 10.1007/s10887-016-9131-x. URL: https://doi.org/10.1007/s10887-016-9131-x.

Alfaro, Laura et al. (2023). "Jobless industralization". In.

Bakker, Jan David et al. (Apr. 2024). Cities, Heterogeneous Firms, and Trade. Tech. rep. DOI: 10.3386/w32377. URL: https://www.nber.org/papers/w32377.

Busso, Matías, María Victoria Fazio, and Santiago Levy Algazi (Jan. 2012). "(In)Formal and (Un)Productive: The Productivity Costs of Excessive Informality in Mexico". In: Social Science Research Netwo DOI: 10.2139/ssrn.2207240. URL: https://doi.org/10.2139/ssrn.2207240.

Callaway, Brantly and Pedro H. C. Sant'Anna (Dec. 2021). "Difference-in-Differences with multiple time periods". In: Journal of Econometrics 225.2, pp. 200–230. DOI: 10.1016/j.jeconom.2020.12.001. URL: https://doi.org/10.1016/j.jeconom.2020.12.001.

Cámara de Usuarios de Zonas Francas, ANDI (2019). Estudio de impacto, jurídico, económico y fiscal de las Zonas Tech. rep. URL: http://www.andi.com.co/Uploads/ESTUDIO%20DE%20IMPACTO%20JUR%C3%8DDICO%20ECON%C3%93MICO%20Y%20FISCAL%20DE%20LAS%20ZONAS%20FRANCAS%20-%20Consorcio%20Ara%C3%BAjo%20Ibarra%20Ibarra%20Abogados%20HJ%20G%C3%B3mez.pdf.

De Chaisemartin, Clément and Xavier D'Haultfoeuille (Sept. 2020). "Two-Way Fixed Effects Estimators with Heterogeneous Treatment Effects". In: The American Economic Review 110.9, pp. 2964–2996. DOI: 10.1257/aer.20181169. URL: https://doi.org/10.1257/aer.20181169.

De Paula, Áureo and José A. Scheinkman (Oct. 2010). "Value-Added taxes, chain effects, and informality". In: American Economic Journal: Macroeconomics 2.4, pp. 195–221. DOI: 10.1257/mac.2.4.195. URL: https://doi.org/10.1257/mac.2.4.195.

De Soto, Hernando (Sept. 2002). The other path: the economic answer to terrorism. URL: http://ci.nii.ac.jp/ncid/BA67506804.

Dix-Carneiro, Rafael and Brian K. Kovak (Sept. 2017). "Trade liberalization and regional dynamics". In: American Economic Review 107.10, pp. 2908–2946. DOI: 10.1257/aer.20161214. URL: https://doi.org/10.1257/aer.20161214.

Dix-Carneiro, Rafael et al. (Feb. 2024). TRADE AND DOMESTIC DISTORTIONS. Tech. rep. DOI: 10.3386/w28391. URL: https://doi.org/10.3386/w28391.

Djankov, Simeon et al. (July 2010). "The effect of corporate taxes on investment and entrepreneurship". In: American Economic Journal: Macroeconomics 2.3, pp. 31–64. DOI: 10.1257/mac.2.3.31. URL: https://doi.org/10.1257/mac.2.3.31.

Donaldson, Dave and Adam Storeygard (Nov. 2016). "The View from Above: Applications of Satellite Data in Economics". In: The journal of economic perspectives/The Journal of economic perspectives 30.4, pp. 171–198. DOI: 10.1257/jep.30.4.171. URL: https://doi.org/10.1257/jep.30.4.171.

Eslava, Marcela, John Haltiwanger, and Álvaro Pinzón (Mar. 2022). "Job Creation in Colombia Versus the USA: 'Up-or-out Dynamics' Meet 'The Life Cycle of Plants'". In: Economica 89.355, pp. 511–539. DOI: 10.1111/ecca.12418. URL: https://doi.org/10.1111/ecca.12418.

Facility for Investment Climate Advisory Services (2008). Special Economic Zone: Performance, Lessons Learned, a Tech. rep. URL: https://documents1.worldbank.org/curated/en/343901468330977533/pdf/458690WP0Box331s0April200801PUBLIC1.pdf.

Freedman, Matthew L., Shantanu Khanna, and David Neumark (Jan. 2023). "JUE Insight: The Impacts of Opportunity Zones on Zone Residents". In: Journal of Urban Economics 133, p. 103407. DOI: 10.1016/j.jue.2021.103407. URL: https://doi.org/10.1016/j.jue.2021.103407.

Friedt, Felix L. and Aidan Toner-Rodgers (June 2022). "Natural disasters, intra-national FDI spillovers, and economic divergence: Evidence from India". In: Journal of development economics 157, p. 102872. DOI: 10.1016/j.jdeveco.2022.102872. URL: https://doi.org/10.1016/j.jdeveco.2022.102872.

Gallé, Johannes et al. (Jan. 2022). "Place-Based policies and Structural change: evidence from India's special economic zones". In: Social Science Research Network. DOI: 10.2139/ssrn.4210059. URL: https://doi.org/10.2139/ssrn.4210059.

Gaubert, Cecile (Oct. 2018). "Firm sorting and agglomeration". In: American Economic Review 108.11, pp. 3117–3153. DOI: 10.1257/aer.20150361. URL: https://doi.org/10.1257/aer.20150361.

Gobillon, Laurent, Thierry Magnac, and Harris Selod (Oct. 2012). "Do unemployed workers benefit from enterprise zones? The French experience". In: Journal of Public Economics 96.9-10, pp. 881–892. DOI: 10.1016/j.jpubeco.2012.06.003. URL: https://doi.org/10.1016/j.jpubeco.2012.06.003.

Henderson, J. Vernon, Adam Storeygard, and David N Weil (Apr. 2012). "Measuring Economic Growth from Outer Space". In: The American economic review 102.2, pp. 994–1028. DOI: 10.1257/aer.102.2.994. URL: https://doi.org/10.1257/aer.102.2.994.

Henderson, J Vernon et al. (Sept. 2017). "The Global Distribution of Economic Activity: Nature, History, and the Role of Trade1". In: The Quarterly journal of economics 133.1, pp. 357–406. DOI: 10.1093/qje/qjx030. URL: https://doi.org/10.1093/qje/qjx030.

Kaplan, David S., Eduardo Piedra, and Enrique Seira (Dec. 2011). "Entry regulation and business start-ups: Evidence from Mexico". In: Journal of Public Economics 95.11-12, pp. 1501–1515. DOI: 10.1016/j.jpubeco.2011.03.007. URL: https://doi.org/10.1016/j.jpubeco.2011.03.007.

Kline, Patrick and Enrico Moretti (Nov. 2013). "Local economic development, agglomeration economies, and the Big Push: 100 years of Evidence from the Tennessee Valley Authority *". In: The Quarterly Journal of E 129.1, pp. 275–331. DOI: 10.1093/qje/qjt034. URL: https://doi.org/10.1093/qje/qjt034.

La Porta, Rafael and Andrei Shleifer (Aug. 2014). "Informality and development". In: Journal of Economic Perspect 28.3, pp. 109–126. DOI: 10.1257/jep.28.3.109. URL: https://doi.org/10.1257/jep.28.3.109.

Levy, Santiago (Jan. 2010). Good intentions, bad outcomes. Rowman Littlefield.

Li, Xuecao et al. (June 2020). "A harmonized global nighttime light dataset 1992–2018". In: Scientific data 7.1. DOI: 10.1038/s41597-020-0510-y. URL: https://doi.org/10.1038/s41597-020-0510-y.

Lu, Yi, Jin Wang, and Lianming Zhu (Aug. 2019). "Place-Based Policies, creation, and Agglomeration Economies: Evidence from China's Economic Zone Program". In: American Economic Journal: Economic P 11.3, pp. 325–360. DOI: 10.1257/pol.20160272. URL: https://doi.org/10.1257/pol.20160272.

Mayer, Thierry, Florian Mayneris, and Loriane Py (2015). "The impact of Urban Enterprise Zones on establishment location decisions and labor market outcomes: evidence from France". In: Journal of Economic Geography 17.4, pp. 709–752. DOI: 10.1093/jeg/lbv035.

McCaig, Brian and Nina Pavcnik (July 2018). "Export markets and labor allocation in a Low-Income country". In: The American Economic Review 108.7, pp. 1899–1941. DOI: 10.1257/aer.20141096. URL: https://doi.org/10.1257/aer.20141096.

McCaig, Brian et al. (2024). Industrial Zones and Private Formal Sector Job Creation in Vietnam. Working Paper.

Melitz, Marc J. (Nov. 2003). "The impact of trade on Intra-Industry reallocations and aggregate industry productivity". In: Econometrica 71.6, pp. 1695–1725. DOI: 10.1111/1468-0262.00467. URL: https://doi.org/10.1111/1468-0262.00467.

Neumark, David and Jed Kolko (2010). "Do enterprise zones create jobs? Evidence from California's enterprise zone program". In: Journal of Urban Economics 68.1, pp. 1–19. DOI: 10.1016/j.jue.2010.01.002.

Ponczek, Vladimir and Gabriel Ulyssea (June 2021). "Enforcement of Labour Regulation and the Labour Market Effects of Trade: Evidence from Brazil". In: The Economic Journal 132.641, pp. 361–390. DOI: 10.1093/ej/ueab052. URL: https://doi.org/10.1093/ej/ueab052.

Rocha, Rodney García, Gabriel Ulyssea, and Laísa Rachter (Sept. 2018). "Do lower taxes reduce informality? Evidence from Brazil". In: Journal of Development Economics 134, pp. 28–49. DOI: 10.1016/j.jdeveco.2018.04.003. URL: https://doi.org/10.1016/j.jdeveco.2018.04.003.

Sun, Liyang and Sarah Abraham (Dec. 2021). "Estimating dynamic treatment effects in event studies with heterogeneous treatment effects". In: Journal of Econometrics 225.2, pp. 175–199. DOI: 10.1016/j.jeconom.2020.09.006. URL: https://doi.org/10.1016/j.jeconom.2020.09.006.

Sánchez-Serra, Daniel (Nov. 2016). "Functional Urban Areas in Colombia". In: OECD regional development workin DOI: 10.1787/5jln4pn1zqq5-en. URL: https://www.oecd-ilibrary.org/urban-rural-and-regional-development/functional-urban-areas-in-colombia_5jln4pn1zqq5-en.

Ulyssea, Gabriel (Aug. 2018). "Firms, Informality, and Development: Theory and Evidence from Brazil". In: The American Economic Review 108.8, pp. 2015–2047. DOI: 10.1257/aer.20141745.

— (Aug. 2020). "Informality: Causes and Consequences for development". In: Annual Review of Economics 12.1, pp. 525–546. DOI: 10.1146/annurev-economics-082119-121914. URL: https://doi.org/10.1146/annurev-economics-082119-121914.

UNCTAD Annual Report (2019). URL: https://unctad.org/annualreport/2019/Pages/index.html.

Wang, Jin (Mar. 2013). "The economic impact of special economic Zones: evidence from Chinese municipalities". In: Journal of Development Economics 101, pp. 133–147. DOI: 10.1016/j.jdeveco.2012.10.009. URL: https://doi.org/10.1016/j.jdeveco.2012.10.009.

World Bank Group (2017). Special Economic Zones : An Operational Review of Their Impacts. Tech. rep. URL: https://openknowledge.worldbank.org/handle/10986/29054.

Zárate, Román D. (Mar. 2022). "Spatial Misallocation, Informality, and Transit Improvements: Evidence from Mexico City". In: World Bank policy research working paper. DOI: 10.1596/1813-9450-9990. URL: https://doi.org/10.1596/1813-9450-9990.

Appendices

A Definition of informality

Table 10 outlines the three criteria used to define informality. These criteria are based on self-reported measures from household surveys. Workers are asked to report the number of employees in the firm where they work, whether they or their employer contribute to social security and the type of contract they hold.

These definitions are crucial as they capture two key aspects of informality: workers in small and unproductive firms, and workers experiencing the worst labor market conditions.

Table 10: Definitions of Informality

Definition	*Description*
No. of workers	- A worker that is part of a firm with no more than 5 or 10 workers. - A firm that has no more than 5 or 10 workers.
Social security	- A worker who does not contribute to social security (either health or pension) - A firm that does not pay for the social security of its workers.
Employment contract	- A worker that does not have a written employment contract. - A firm that does not provide its workers with written employment contracts.

I use these to calculate the informality rate of municipality i at time t. An important data limitation is that I observe the place of residence rather than the workplace. Therefore, this could lead to a bias.

B Other economic outcomes

Figure 21 - 24 show the estimates for the municipalities hosting FEZs. Parallel trends don't hold for most of the outcomes. Therefore, I cannot infer anything from these results. This lack of parallel trends suggests that FEZs were predominantly established in areas that were already experiencing development before their implementation.

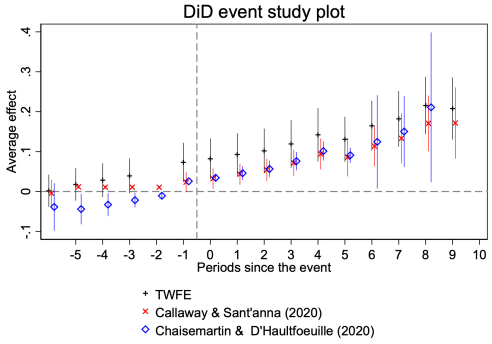


Figure 21: Population density

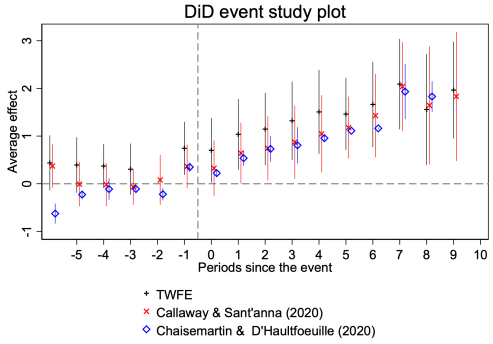


Figure 22: Night-time light

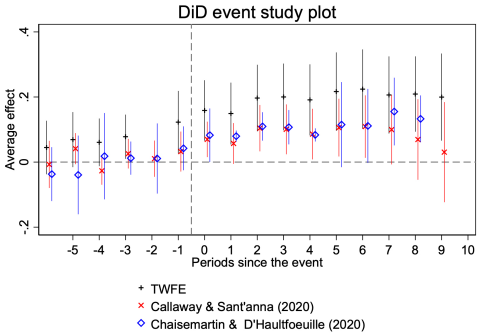


Figure 23: Total tax revenue

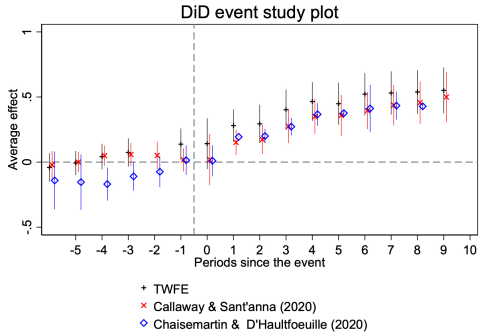


Figure 24: Total property tax revenue

Note: The dots indicate the estimated parameters $\hat{\beta}_j$. Each subscript j refers to the leads and lags. The bars represent 95% confidence intervals with SEs clustered at the department level. This figure overlays the event-study plots constructed using four different estimators: a dynamic version of the TWFE model (2), estimated using OLS; Callaway and Sant'Anna (2021) (cross markers); De Chaisemartin and D'Haultfoeuille (2021); and Cengiz et. al (2019). The time variable is the year of the declaration, and the treatment group is defined by municipalities with an FEZ. The omitted category is the year before treatment.

C Detailed derivation of the simple model

Consumer problem. To solve the simple model, I begin with the optimization problem of workers/consumers:

$$c_i(x) = \left(\frac{p_i(x)}{P_i}\right)^{-\sigma} c_i$$

Since trade is costly between locations, P_i represents the price index of the tradable good in location i.

Consumer expenditure on housing and the consumption composite is given by

$$\begin{aligned} c_i &= \beta v_i \\ h_i &= (1-\beta)\tfrac{v_i}{p_i^h} \end{aligned} \tag{A.2}$$

where v_i is defined in equation (19).

Firm Problem and Firm Entry. Given that the firm problem is symmetric for all firms of a given productivity ψ_i^j at each location i of type j, I perform a change of notation and write the demand faced by a firm of productivity ψ_i^j at location i as

$$q_i^j(\psi_i^j) = p_i^j(\psi_i^j)^{-\sigma} P_i^{1-\sigma} \beta v_i \tag{A.3}$$

While firm-level revenues are given by

$$r_{ni}^j(\psi_i^j) = p_{ni}^j(\psi_i^j) q_i^j(\psi_i^j) = p_{ni}^j(\psi_i^j)^{1-\sigma} P_i^{1-\sigma} \beta v_i \tag{A.4}$$

For the informal and formal firms aim to maximize profits given by

$$\max \pi_{ni}^j = p_{ni}^j q_{ni}^j(\psi_i^j) - w_i l_i(\psi_i^j) = p_{ni}^j q_{ni}^j(\psi_i^j) - w_i \left(F_j + \frac{q_i(\psi_i^j)}{\psi_i^j}\right) \tag{A.5}$$

Plugging (A.9) into (A.11) and taking the FOC with respect to prices yields the familiar optimality condition that profit maximization involves setting prices at a constant mark-up over marginal costs in the case of monopolistically competitive firms and CES demand:

$$p_{ni}^j(\psi_i^j) = d_{ni} \frac{\sigma}{\sigma - 1} \frac{w_i}{\psi_i^j} = \frac{d_{ni} w_i}{\psi_i^j \rho} \tag{A.6}$$

Instead, the bounded informal firms have to scale back production and adjust their prices to satisfy their residual demand and maximize their profits, hiring up to $\bar{l}$ workers.

Plugging optimal prices into the formulas for firm-level revenues (equation (A.4)) yields:

$$r_{ni}^j(\psi) = \left(\frac{\psi_i^j \rho}{w_i d_{ni}}\right)^{\sigma-1} P_i^{1-\sigma} \beta v_i \tag{A.8}$$

Plugging the pricing rule into the formula for profits (A.5) leads to the expressions in equation (11).

As in Melitz (2003), in the presence of firm heterogeneity, fixed costs, and free entry there are three general equilibrium objects for each location i that play a key role in the characterization of equilibrium: $\psi_i^{u^*}$ - the productivity threshold for a firm in location i to serve the informal sector, $\psi_i^{b^*}$ - the productivity threshold for a bounded informal firm in location i to serve the informal sector, $\psi_i^{f^*}$ - the productivity threshold for a firm at location i to serve the formal sector, and M_i^e - the mass of firms entering (i.e. paying F_e) at each location. The cutoffs are pinned down by the zero profit conditions outlined in equation (14), while the latter is pinned down by the labor market clearing condition:

$$M_i^e * \bar{l}_i = M_i^e \frac{\bar{r}_i}{w_i} = L_i \tag{A.9}$$

where $\bar{r}_i$ is the average revenue of a firm that enters at location i and is given by

$$\bar{r}_i = \left(\int_{\psi_i^{u^*}}^{\psi_i^{b^*}} r_i^u(\psi) g_i(\psi) d\psi + \int_{\psi_i^{b^*}}^{\psi_i^{f^*}} r_i^b(\psi) g_i(\psi) d\psi \int_{\psi_i^{f*}}^{\infty} r_i^f(\psi) g_i(\psi) d\psi \right) \tag{A.10}$$

To understand the intuition of equation (A.9) it is important to note that, because of free entry expected profits are zero, such that firms' revenues are equal to total payments to labor, accounting for both fixed and variable input costs.

I obtain the thresholds of bounded informal and formal firms using the relative revenue equation and the no-arbitrage conditions (zero profit conditions). [23] Both thresholds are functions of the entry cutoff.

In line with Melitz (2003) it will be useful to define a notion of average productivity among different types of firms:

$$\tilde{\psi}_i^u(\psi_i^{u*}) = \left[\frac{1}{G_i(\psi_i^{b*}) - G_i(\psi_i^{u*})} \int_{\psi_i^{u*}}^{\psi_i^{b*}} \psi^{\sigma-1} g_i(\psi) d\psi \right]^{\frac{1}{\sigma-1}} \tag{A.13}$$

$$\tilde{\psi}_i^t(\psi_i^{d*}) = \left[\frac{1}{G_i(\psi_i^{f*}) - G_i(\psi_i^{t*})} \int_{\psi_i^{t*}}^{\psi_i^{f*}} \psi^{\sigma-1} g_i(\psi) d\psi \right]^{\frac{1}{\sigma-1}} \tag{A.14}$$

$$\tilde{\psi}_i^f(\psi_i^{d*}) = \left[\frac{1}{1 - G_i(\psi_i^{f^*})} \int_{\psi_i^{f*}} \psi^{\sigma-1} g_i(\psi) d\psi \right]^{\frac{1}{\sigma-1}} \tag{A.15}$$

Noting that the assumed productivity distributions are standard Pareto with shape parameters α_i, I can derive closed-form expressions for the average productivities of the different types of functions as a function of the entry cutoffs.

[23] The ratios of revenues of two firms producing in the same region only depend on their productivity levels, so that $\frac{r_i^j(\psi^j)}{r_i^{j'}(\psi^{j'})} = \frac{\psi^j}{\psi^{j'}}^{(\sigma-1)} \rightarrow \quad r_i^j(\psi^j) = \frac{\psi^j}{\psi^{j'}}^{(\sigma-1)} r(\psi^{j'})$

With the above definitions in place, I can rewrite the free entry condition (equation (15)) and the expression for average revenues (equation (A.10)) as

$$\bar{\pi}_i = \chi_i^d \pi_i^d\left(\tilde{\psi}_i^d\right) + \chi_i^t \pi_i^t\left(\tilde{\psi}_i^t\right) + \chi_i^f \pi_i^f\left(\tilde{\psi}_i^f\right) = \frac{\delta w_i F_e}{1 - G_i(\psi_i^{d*})} \tag{A.16}$$

$$\bar{r}_i = \chi_i^d r_i^d\left(\tilde{\psi}_i^d\right) + \chi_i^t r_i^t\left(\tilde{\psi}_i^t\right) + \chi_i^f r_i^f\left(\tilde{\psi}_i^f\right) \tag{A.17}$$

where $\chi_i^d = \frac{G_i(\psi_i^{t*}) - G_i(\psi_i^{d*})}{1 - G_i(\psi_i^{d*})}$, $\chi_i^t = \frac{G_i(\psi_i^{f*}) - G_i(\psi_i^{t*})}{1 - G_i(\psi_i^{d*})}$ and $\chi_i^f = \frac{1 - G_i(\psi_i^{f*})}{1 - G_i(\psi_i^{d*})}$ represent the conditional probability of being unbounded informal, bounded informal and formal, respectively.

Price index. The price index P_i (21) in that destination is the CES aggregate of the prices of all the tradable varieties sold in location i by the different types of firms. Therefore, this aggregates two margins: (i) type of firm and (ii) location.[24]

I can rewrite equation (21) in terms of both the domestic and external prices.

$$P_i^{1-\sigma} = \underbrace{\chi_i^u M_i \left(\frac{w_i}{\rho}\right)^{1-\sigma} \tilde{\psi}_i^{u\sigma-1} + \chi_i^b M_i \left(\frac{w_i}{\rho}\right)^{1-\sigma} \tilde{\psi}_i^{b\sigma-1} + \chi_i^f M_i \left(\frac{w_i}{\rho}\right)^{1-\sigma} \tilde{\psi}_i^{f\sigma-1}}_{\text{Domestic}} + \tag{A.18}$$

$$\underbrace{\sum_{k \in N} \chi_k^u M_k \left(\frac{w_k d_{ik}}{\rho}\right)^{1-\sigma} \tilde{\psi}_k^{u\sigma-1} + \sum_{k \in N} \chi_k^b M_k \left(\frac{w_k d_{ik}}{\rho}\right)^{1-\sigma} \tilde{\psi}_k^{b\sigma-1} + \sum_{k \in N} \chi_k^f M_k \left(\frac{w_k d_{ik}}{\rho}\right)^{1-\sigma} \tilde{\psi}_k^{f\sigma-1}}_{\text{External}}$$

[24] This price index is analogous to the one in a hypothetical monopolistic competition equilibrium with M representative firms sharing a common productivity $\tilde{\psi}$.