The Gains from Foreign Investment in an Economy with Distortions*

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This paper investigates the local labor market and aggregate effects of foreign direct investment (FDI) in an economy where distortions affect the allocation of resources. Our empirical application is Mexico. We divide our analysis into three parts. In the first part, we build a rich establishment-level panel tracking between 1994 and 2019, the near-universe of three types of establishments in Mexico: domestically-owned establishments (labeled domestic) separated into formal or informal, and foreign-owned (labeled FDI). We also put together a comprehensive database with measures of distortions varying across establishment types, industries, and space. We measure distortions such as crime, labor taxes, subsidies, markups, and credit constraints. We show that the Mexican economy faces significant distortions that generate resource misallocation within and across space. In the second part, we study the reallocation effects within a local labor market of the employment growth in FDI establishments. Following the migration literature, we use the spatial clustering of FDI establishments by origin country to build an instrument for the endogenous component of the FDI expansion. We find that increases in FDI employment in a labor market lead to increases in the size of the local

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domestic economy. This effect comes from a larger size of the formal sector in the domestic economy, with the net effect on the size of the informal sector being not statistically different from zero. In the third and last part, we build on Baqaee and Farhi (2022) and use a first-order approximation to calculate in GE the aggregate and distributional effects of the FDI shock. We decompose the impact on each labor market between technological changes, reallocation effects or changes in the distortion revenue. We simulate productivity shocks matching the evolution of FDI employment in Mexico to study the impact of FDI on Mexico's welfare and use an inference-matching procedure to estimate the key elasticities of the model.

JEL Codes: F23, F14, F16, D61, O17, J46, E26

1 Introduction

Developing countries are often characterized by market imperfections or distortions that can misallocate resources and hinder economic development. At the same time, most of these countries have pursued a development strategy focused on attracting foreign direct investment (FDI) – with its appeal of embodying technology and know-how in addition to the capital often scarce in these countries. Against this backdrop, we know relatively little about whether FDI amplifies or attenuates the (mis)allocative consequences of domestic distortions and, therefore, whether pursuing FDI as a development strategy is more or less desirable in contexts with severe distortions. In this paper, we aim to fill this gap by studying both the average effects of FDI on the domestic economy and its reallocative effects across differentially distorted parts of the domestic economy. We also look into the impacts of FDI on aggregate TFP and welfare in a context with extensive distortions.

We study this question in Mexico, which presents several empirical advantages for an inquiry into the relationship between FDI and development in a country plagued by distortions. At the beginning of our study period, 1994, Mexico's future seemed bright. In 1994, Mexico joined the OECD and liberalized FDI and trade once NAFTA came into force. In the following twenty-five years, Mexico became the tenth-largest recipient of annual FDI inflows and the twelfth main exporting economy. However, over the same period, the growth in the aggregate total factor productivity (TFP) of Mexico has been disappointingly low (Iacovone et al., 2022). We inquire whether the many distortions prevalent in the Mexican economy (Hsieh and Klenow, 2014; Levy, 2018; Bloom et al., 2022) have hampered or amplified the gains from opening to FDI.[1] To the extent that distortions in Mexico resemble those in other underdeveloped economies, our findings shed light on the potential of FDI to improve TFP and welfare in distorted economies.

Mexico also presented us with the opportunity to build a rich combination of microdata necessary to study the effects of FDI in a setting with distortions. One of the two data pillars is the establishment-level Economic Census data, which tracks over a long period of interest (1994 to 2019) the outcomes of three types of establishments: domestically-owned establishments (labeled domestic henceforth) separated

[1] This conjecture was also put forward in a *Journal of Economic Literature* article by Gordon Hanson ("Why Isn't Mexico Rich?," Hanson, 2010): "Over the last three decades, Mexico has aggressively reformed its economy, opening to foreign trade and investment, achieving fiscal discipline, and privatizing state-owned enterprises. Despite these efforts, the country's economic growth has been lackluster, trailing that of many other developing nations. [. . .] The most prominent [arguments] suggest that some combination of poorly functioning credit markets, distortions in the supply of nontraded inputs, and perverse incentives for informality creates a drag on productivity growth. [. . .] Even a cursory examination of Mexico's economic structure suggests the country is deep in the world of the second best, meaning that models based on a single distortion may be a poor guide to how future reform would change economic outcomes in the country."

into formal or informal, and foreign-owned (labeled FDI henceforth). We define an establishment as informal if it does not comply with the legal requirement of paying Social Security contributions for its workers. In part of our analysis, we use the informal dummy as a proxy for whether an establishment faces high or low distortions.[2] Moreover, in the Economic Census, we observe whether establishments have foreign ownership and the country of foreign ownership (which is crucial for our instrumental variable strategy). The second data pillar is a database that we build and that measures various distortions salient not only in Mexico but across most developing countries (such as crime, corruption, subsidies, markups, labor taxes and credit constraints).

The analysis proceeds in three steps. In the first step, we produce a set of facts about FDI and distortions in Mexico. We first show that, since 1994, FDI has become more important in the Mexican economy, with FDI establishments representing 12% of employment, 17% of sales, 26% of the wage bill and 12% of assets in 2019. There is significant spatial variation in the extent to which FDI employment has grown, with states such as Nuevo León and Quintana Roo experiencing larger increases in FDI employment. We also show that the composition of FDI by country of origin has become more diversified away from the initial dominance of the U.S. Second, we look into both the average level of distortions in Mexico and their distribution across establishment types, industries and commuting zones (our definition of a labor market, abbreviated CZ henceforth). While distortions in Mexico are severe overall, we also find a large variation in how taxing distortions are. For instance, we find that formal domestic establishments face a disproportionately higher cost (as a share of sales) of dealing with bureaucracy and regulations compared to informal and FDI establishments. We also find that while informal establishments face lower tax and regulatory burdens, they incur higher costs due to other distortions, such as crime. Overall, informal establishments experience lower total output and input distortions than formal domestic and FDI establishments.

In the second step, we study the reallocation effects of FDI in Mexico exploiting variation in FDI employment growth across time and space. We are interested in both the overall size of the domestic sector but also how resources shift within this sector between differentially-distorted types of establishments. In particular, we study the reallocation between formal and informal domestic establishments, where the informal status tags (on average) less distorted establishments. We conduct our analysis at both the CZ and establishment levels for two main reasons. First, by comparing the two sets of estimates, we can tease out the role of the extensive (establishment entry and

[2]Overall, the literature has found that the informal sector faces lower distortions than the formal sector. For example, Atkin and Khandelwal (2020) calibrate distortions for the entire world, finding larger distortions in the formal sector, and Levy (2008); Busso et al. (2013) show that the formal sector is more distorted in Mexico.

exit) vs. intensive (within establishment) margin in driving the effects of FDI on the domestic sector. Second, while CZ-level estimates will be directly used in our model-based estimate of the welfare effects of FDI, the establishment-level regressions allow for additional controls that tighten the reduced-form design.

The explanatory variable of interest measures the change in the employment in FDI establishments in a CZ between two consecutive Economic Censuses (i.e., between $t-5$ and t, as Economic Censuses occur every five years), normalized by the overall employment in that CZ in the earlier Census year ($t-5$). We want to estimate the effect of this FDI employment growth on the domestic sector in the same CZ (measured as the difference in log outcomes for domestic establishments between the two consecutive Economic Censuses, e.g., the difference in log employment between $t-5$ and t). An OLS estimation presents two main concerns: that there might be (i) omitted variables correlated with both the future performance of domestic establishments in a CZ and FDI inflows in that CZ (e.g., a new government commitment to invest in productive infrastructure); or (ii) measurement error in the explanatory variable.

To address these concerns, we use an instrumental variable (IV) approach. Namely, to build an IV for the growth in FDI employment from a given country of origin in a given CZ, we leverage (i) the past spatial clustering of FDI employment from that country of origin and (ii) the growth of FDI employment from that country of origin in all Mexican CZs *except* the CZ of interest.[3] The final formula for the IV sums across countries of origin to capture the supply-push component of all FDI inflows in a CZ. This IV was recently used by Setzler and Tintelnot (2021) to study the effects of FDI in the U.S. As the first-stage F-statistics tend to be above 30, this IV is a statistically significant predictor for FDI employment growth. The IV satisfies the exclusion restriction if it does not affect the outcomes of a specific CZ other than through its effect on the change in the employment in FDI establishments in that CZ. To help in this direction, the IV does not use CZ-level specific information on the change in market conditions in that CZ. Moreover, to address remaining threats to identification, we include a rich set of CZ-level controls in the regressions.[4]

Using the IV strategy just described, we estimate that a 1 percentage point in-

[3]The rationale of this IV is analogous to that of a classic IV from the migration literature, which instruments the immigrant inflows from a given source country to a location by using the historical settlement patterns of immigrants from that source country and the total number of newly-arriving immigrants from that country (Card, 2001).

[4]We include (i) CZ indicators (controlling for time-invariant differences in growth rates across CZs); (ii) economic region-year indicators (controlling for shocks common across CZs in an economic region); (iii) time-varying CZ-specific controls (such as urban concentration rates, employment rates, the importance of manufacturing in employment, the prevalence of a secondary education or routine occupations, in addition to demographic characteristics such as the share of indigenous or foreign-born individuals); and (iv) controls for changes in CZ-level exposure to the "China shock" (both via import competition and competition in Mexico's historical export markets) and to rising imports from the U.S. into Mexico (following Autor et al., 2013; Blyde et al., 2020).

crease in the share of FDI employment in a CZ increases the overall local domestic employment by 0.28%, sales by 0.95%, value added by 1.49% and wage bill by 0.86% (all statistically significant at the 1 or 5% significance level). The local number of domestic establishments also increases by 0.29%. Then, at the establishment level, we estimate that the same FDI shock leads to a statistically significant growth in the size of continuing domestic establishments. Namely, their employment grows by 0.30%, sales by 1.07%, value added by 1.35%, and the wage bill by 0.52%.

Next, we explore the effects of FDI employment growth on the reallocation of economic activity in the domestic sector between formal and informal establishments. We first aggregate the outcomes of domestic formal and informal establishments at the CZ-year level to jointly capture the extensive and intensive margin adjustments to the FDI shock. Using the IV, we find that a 1 percentage point increase in the share of FDI employment in a CZ leads to an unambiguous expansion of the domestic formal economy. Specifically, the number of domestic formal establishments grows by 0.52%, overall employment by 0.64%, sales by 1.21%, value added by 1.50% and the wage bill by 1.13%. Relative to the domestic formal sector, the domestic informal sector experiences a mirroring decrease in size. On net, the size of the domestic informal sector appears mostly unchanged (at least on variables such as employment and the wage bill). In the within-establishment analysis, we find that continuing domestic formal establishments thrive due to positive local FDI shocks. In contrast, the effects on domestic informal establishments are more mixed.

In work-in-progress, we separate FDI into maquila and non-maquila FDI, as the two types of FDI have plausibly distinct effects on the domestic economy and the reallocation of factors across segments of the domestic economy. The maquila status of an FDI establishment is associated with duty-free and tariff-free operations. These establishments tend to take raw materials and assemble, manufacture, or process them and export the finished products. We show that in the Mexican context, maquila FDI tends to be more (less) labor (capital) intensive, more reliant on foreign inputs and more export-oriented (hence, interacting less with the local economy in both input and output markets). Moreover, we will study the effects of local FDI exposure on the employment and wage bills of high and low-skill workers separately.

In the third and last step, we introduce the theoretical framework for our general equilibrium analysis. We build on the models from Baqaee and Farhi (2022) and Atkin and Donaldson (2022) to understand the aggregate and distributional effects across space of the FDI shock at the CZ and aggregate levels. The model allows for the FDI shock to potentially affect total TFP and welfare through three channels: technological changes, reallocation effects, and changes in distortion revenue.[5] The model includes

[5]For now, we do not allow FDI also to change the magnitude of the distortions themselves (e.g., we do not allow for FDI to change markups or institutions). We are considering relaxing this assumption.

multiple locations and industries, three types of firms (FDI, domestic formal and domestic informal), and three factors of production (capital and two types of workers: low- and high-skilled).

One advantage of this framework is its relative generality – in the sense that we do not need to impose parametric assumptions about the primitives of the model. For instance, the utility and production functions only need to be homogeneous of degree one. However, to calculate the reallocation effects due to distortions, we need to calculate the Allen-Uzawa elasticities that measure how producers and final consumers (entities) substitute goods and inputs. We assume a nested CES structure for consumers and producers.[6]

For the case of the representative consumer in each commuting zone, we assume that they have preferences for formal vs. informal varieties; then, within the formal sector, there is a lower nest that includes FDI and formal domestic varieties. Furthermore, we assume that it is easier to substitute varieties in the formal sector than between formal and informal varieties. This assumption captures the intuitive notion that there is more competition between formal domestic and FDI firms than with respect to informal firms.

In the case of the production functions, we also assume a nested structure. In the case of informal firms, they only produce using domestic inputs: labor and capital. Meanwhile, formal firms (including FDI and formal domestic firms) use different intermediate inputs from several locations that they combine with the three factors of production. In particular, FDI firms source some of their inputs from formal domestic firms. In that sense, these assumptions imply that changes in the labor demand of FDI firms can generate a positive or a negative reallocation effect toward formal domestic firms. On the one hand, if there is more competition between FDI and formal domestic firms (since these products are easier to substitute), domestic formal firms are hurt by the change in FDI employment; on the other hand, if domestic formal domestic firms supply more inputs to FDI firms, formal firms benefit from the growth in FDI employment. The sign of this effect comes directly from our reduced-form estimates.

To calibrate the model, we plan to use an inference-matching procedure. First, following Caliendo et al. (2019) and Rodriguez-Clare et al. (2022), we plan to match the change in FDI employment that we observe in the data for each location to changes in the TFP of FDI firms in that location (since this replicates a change in local labor demand from FDI firms). Second, we plan to replicate our reduced-form regressions using the data coming directly from simulating the FDI shock in the model. We will simulate the model for different values of our key elasticities. In particular, we will run our simulations changing the demand elasticity that captures the competition between

[6] Baqaee and Farhi (2022) also assume a nested structure but do not include different types of firms. In our case, the reallocation effects across the different types of firms are captured by these elasticities.

formal domestic and FDI firms, and the elasticity of substitution between domestic factors and intermediates for FDI firms. These two parameters capture the negative and positive impacts of FDI shocks on formal employment. We recover these parameters by matching the reduced-form coefficients with the simulated data.

We plan to extend the Baqaee and Farhi (2022) framework to include three additional features that become necessary when studying the impact of FDI firms. First, empirical evidence suggests that the entry and expansion of FDI firms generate positive spillovers on the TFP of domestic firms. We want to incorporate these spillovers as external economies of scale in which, as the size of the FDI sector increases, the TFP of domestic firms also rises. Since these effects are positive externalities and correspond to a market failure, we plan to extend the framework from Baqaee and Farhi (2022) to add these elements into the model. In particular, we derive an additional term in the change in welfare that captures the role of external economies of scale in the domestic economy (given that the price index changes due to shifts in TFP). The second feature to incorporate corresponds to a Roy model with frictions to reallocate across sectors or firm types. Recent evidence suggests that workers face frictions when moving across sectors (Caliendo et al., 2019; Galle et al., 2020) and that these frictions impact how the gains from trade are distributed across the economy. In that sense, the baseline model from Baqaee and Farhi (2022) assumes free mobility across sectors. We plan to extend the model to capture that in the same way that certain products are easier to substitute for final consumers, there are certain types of jobs that are easier to substitute across for workers. Specifically, we will assume a nested structure in which workers are more likely to substitute jobs within the formal sector (FDI vs. formal domestic) than between the formal and informal sectors. The third and last feature that we want to include in the model is the reallocation of workers across regions (migration). Classic trade models (Armington, 1969; Eaton and Kortum, 2002) assume that workers do not move out of their country/region. Since we are studying the effects of the FDI shock within a country over a long time horizon (twenty-five years), we need to allow for the reallocation of workers across space; workers can move from more distorted toward less distorted locations or vice versa, and such worker movements can affect aggregate welfare. We will include migration decisions based on a migration elasticity meant to capture how workers reallocate across regions within Mexico and whether workers move towards more distorted or less distorted locations. These decisions depend on the change in welfare in each region.

Related literature This article relates and contributes to two main literatures. First, the accumulation of capital and its relationship to workers' welfare (particularly those in the informal subsistence sector) have been at the core of established theories of economic development of classics such as Adam Smith, David Ricardo, and Joan Robinson. Lewis (1954) noted that most countries start growing a capitalist class (necessary for economic development) by "importing their capitalists from abroad." However, Lewis (1954) pointed out that labor in capital-importing countries may not see real wage increases (if foreign capital only increases productivity in export-oriented industries); adding to his stylized model the many distortions prevalent in developing economies may further nuance the impact of foreign capital on welfare.[7]

The longstanding interest in the development potential of FDI has spurred a large empirical literature estimating the effects of FDI on receiving economies.[8] Most of this literature has focused on knowledge spillovers from FDI to domestic firms as the market failure of interest in relation to FDI.[9] More recent exceptions study the effects of FDI in contexts with product (Asturias et al., 2022) or labor market power (Alfaro-Ureña et al., 2021; Setzler and Tintelnot, 2021; Méndez and Van Patten, 2022) or distorted access to capital (Bau and Matray, 2022).

We contribute to this literature by exploring the interaction – both in reduced form and in general equilibrium – between FDI and a wide set of distortions prominent in developing economies. For now, we assume that the distortions themselves remain fixed as local economies within Mexico receive more FDI and focus on the allocative efficiency of FDI tilting the local activity towards more or less distorted establishments.[10] We also study explicitly the impact of FDI on informal establishments (which, we find, tend to face lower distortions). To our knowledge, almost all research on FDI uses data that excludes the informal sector, even in contexts plagued with informality.[11] Moreover, Mexico is a particularly valuable case to study given the puzzle of its history of plausibly growth-enhancing policies (e.g., massive liberalization of trade and FDI), yet disappointing subsequent productivity growth.[12]

Second, a vast literature has studied the prevalence of distortions in developing countries and their implications for both firm-level and aggregate TFP (Hsieh and Klenow, 2009; Hopenhayn, 2014; Restuccia and Rogerson, 2017; Baqaee and Farhi,

[7] Banerjee and Duflo (2005) argue that market imperfections (such as government failures, credit constraints, externalities) can explain why capital may be misallocated within poor countries.

[8] There is a smaller but complementary literature interested in the welfare gains from multinational production, in which Northern multinationals with superior technologies benefit the Southern countries that receive their affiliates and their accompanying technologies (Ramondo and Rodríguez-Clare, 2013; Tintelnot, 2017; Arkolakis et al., 2018).

[9] Prior research has either produced evidence in favor of knowledge spillovers (Javorcik, 2004; Poole, 2013; Alfaro-Ureña et al., 2022; Abebe et al., 2022) or has assumed them as the reason behind productivity growth among domestic firms in proximity to FDI firms (Setzler and Tintelnot, 2021).

[10] The closest exercise to ours is performed by Alfaro and Chen (2018), who provide cross-country evidence that FDI leads to the reallocation of workers and revenues away from the less productive establishments.

[11] Sharma and Cardenas (2018) and Cao (2020) are notable exceptions, studying the cases of Mexico and Vietnam.

[12] Prior research on FDI in Mexico has focused on the link between the maquiladora sector (where a large share of FDI is concentrated), the skill-premium and incentives to acquire education (Feenstra and Hanson, 1997; Verhoogen, 2008; Atkin, 2016). Atkin et al. (2018) find gains from FDI in retail, mainly driven by a lower cost of living.

2020). In particular, Mexico has already been documented as a country with high distortions, which have been presented as the plausible culprit behind the low firm-level and aggregate TFP of the country (Hanson, 2010; Kehoe and Ruhl, 2010; Hsieh and Klenow, 2014; Levy, 2018; Bloom et al., 2022).

Related to this literature is a recent set of papers that study the effects of international trade in developing countries characterized by weak institutions, market failures and firm distortions (for recent summaries, see Atkin and Khandelwal, 2020; Atkin et al., 2022). The distortions most studied have been those associated with informality – with informal firms paying little or no taxes and not complying with regulations (particularly those applying to labor).[13] On the one hand, papers such as Dix-Carneiro and Kovak (2019); Blyde et al. (2020); Ulyssea and Ponczek (2022); Cisneros-Acevedo (2022) show that exposure to foreign competition has increased informality among low-skill workers in Brazil, Mexico and Peru, with informality acting as a buffer against unemployment. On the other hand, Aleman-Castilla (2006) and McCaig and Pavcnik (2018) show that greater access to foreign markets in Mexico and Vietnam has led to the reallocation of workers away from informal firms to more productive formal firms. In contrast, we study the effect of a different form of globalization (FDI) on informality.

More broadly, Atkin and Donaldson (2022) develop a framework that draws on Baqaee and Farhi (2022) to study how international trade interacts with economic development, acknowledging the prevalence in developing countries of not only informality but also a plethora of other distortions. In the same spirit, we build a database that measures the size of several distortions on both the output and input side across establishment types (including FDI), industries and locations within Mexico. On the theory side, we build on these frameworks, adjusting them to our shock of interest (the FDI shock, which we model as a productivity shock instead of a trade cost shock) and the within-country analysis in this paper. We are also working on several extensions, such as incorporating external increasing returns to scale, two worker types, and internal migration which are particularly relevant when wanting to study the effects of foreign investment over a longer time horizon.

The remainder of the paper proceeds as follows. Section 2 presents the theoretical framework we use to study the welfare implications of FDI in an economy with distortions and the steps we take to map the theory to the data. Section 3 describes the data. Section 4 provides context on FDI and distortions in Mexico. Section 5 presents the empirical evidence on the effects of the higher exposure FDI within a commuting zone on domestic establishments. Section 6 presents the model estimation and calibration procedure. Section 7 presents our counterfactual exercises. Most importantly, we study what would have happened to Mexico in the absence of FDI and the effect of

[13] Exceptions include Asturias et al. (2019); Arkolakis et al. (2019); Bai et al. (2021); Lanteri et al. (2022).

FDI in the absence of distortions. Section 8 concludes.

2 Model

We now describe the theoretical framework for our analysis. The main goal of the paper is to understand the welfare and output implications of foreign investment in an economy in which market failures distort the allocation of resources. We use the model from Baqaee and Farhi (2022) and Atkin and Donaldson (2022) to understand the effects of foreign investment shocks at the commuting zone level and for the Mexican economy in the aggregate. The model decomposes the effect in different mechanisms that explain the change in total output and welfare: technological changes, reallocation effects, and changes in total revenue. In the last part of this section, we also describe how we apply the theoretical results to the empirical context of FDI in Mexico.

2.1 Model environment

There is a set of locations $\mathcal{C}$, a set of producers $\mathcal{N}$ producing different goods that operate in the formal or informal sector, and a set of factors of production $\mathcal{F}$. The set of producers in each location is denoted by $\mathcal{N}_c$ and the set of factors by $\mathcal{F}_c$. We assume that there is a representative consumer in each location c that consumes the different goods and is the owner of the production factors in that particular location.

Producers: Each good $i \in N$ is produced in some location c using a constant-returns to scale technology that uses the different production factors and intermediate inputs. The production function is:

$$y_i = A_i f_i \left(\{x_{ik}\}_{k \in N}, \{l_{if}\}_{f \in \mathcal{F}_c} \right),$$

where y_i is the total quantity that is produced of good i, x_{ik} is an intermediate input, and l_{if} is a production factor. The parameter A_i is a Hicks neutral exogenous productivity shifter. Producer i chooses the inputs to minimize costs and charge a price to entity j that is equal to the marginal cost times a wedge, $p_{ji} = \mu_{ji} mc_i$. For example, if $\mu_{ji} > 1$, we can interpret the wedge as a markup or a tax, and if $\mu_{ji} < 1$, the wedge can be a markdown or a subsidy.

Production factors: Agents in each location c own the different production factors with an ownership matrix $\Phi_{f(c)}$ that corresponds to the share of factor's f income in total value-added. Households obtain income from the primary factors and revenue from the distortions.

Prices of goods:

Households: Since the utility function is homogeneous of degree 1. The indirect utility function of the representative consumer in location c is:

$$W_c = \frac{X_c}{P_c}, \quad X_c = \sum_{f \in \mathcal{F}_c} \Phi_{f(c)} \sum_s w_{f(c),s(c)} L_{f(c),s(c)} + R_c + D_c$$

where P_c denotes the ideal price index of location c, $\Phi_{f(c)}$ corresponds to the ownership matrix of production factors, $w_{f(c),s(c)} L_{f(c),s(c)}$ to the total factor income of factor f in firm type s in location c, R_c to the revenue from the distortions that obtain households in c, and D_c to the initial trade deficits that we assume that are exogenous. The total change in welfare for a representative consumer due to a perturbation in the economy is given by:

$$d\log W_c = \underbrace{\sum_{ij \in B_c} \tilde{\Psi}^{W_c}_{ij} d\log A_j}_{\text{Technological change}} \tag{1a}$$

$$+ \underbrace{\sum_{f \in F_c, i \in \mathcal{N}_c} \left(\Lambda^c_{f,i} - \tilde{\Psi}^{W_c}_{f,i} \right) [d\log w_{f,i} + d\log L_{f,i}]}_{\text{Change in local factor income}} \tag{1b}$$

$$- \underbrace{\sum_{f \notin \mathcal{F}_c, i \notin \mathcal{N}_c} \left(\tilde{\Psi}^{W_c}_{f,i} \right) [d\log w_{f,i} + d\log L_{f,i}]}_{\text{Changes in factor income abroad}} \tag{1c}$$

$$+ \underbrace{\Lambda^c_R d\log R_c}_{\text{Revenue from distortions}} \tag{1d}$$

$$- \underbrace{\sum_{ij \in B_c} \tilde{\Psi}^{W_c}_{ij} d\log \mu_{ij}}_{\text{Change in the wedges}}, \tag{1e}$$

where $\Lambda^c_f = \Phi_{f(c)} \sum_s w_{f(c),s(c)} L_{f(c),sc} / X_c$ corresponds to the share of factor's f income in total expenditure from location c, and similarly $\Lambda^c_R = R_c / X_c$ corresponds to the share of the revenue from distortions in the total expenditure from location c. As in AD and BF, we can decompose the effect of a perturbation in the productivity into four different components: a technological change, a change in the factoral terms of trade, a change in the total revenue from distortions, and a change in the wedges.[14]

The first term captures technological changes.

[14]Look that we are assuming that transfers D_c are constant and do not change since they are exogenous.

2.2 Nested structure

To compute the Allen-Uzawa elasticities, we assume a nested CES structure for both the demand and production functions. We use the following notation, M corresponds to foreign firm that are not in the maquila program, D to formal domestic firms, P to firms that are in the maquila program, F to the formal sector, and I to the informal sector that only includes the informal domestic firms. This notation corresponds to the four types of firms that we use in the model.

2.2.1 Final consumer demand

Following BF, we assume that the demand of final consumers for different varieties take a CES form. The utility of each commuting zone or country c is:

$$U_c = \left(\alpha_{c,F} C_{c,F}^{\frac{\xi-1}{\xi}} + \alpha_{c,\mathrm{I}} C_{c,\mathrm{I}}^{\frac{\xi-1}{\xi}} \right)^{\frac{\xi}{\xi-1}}, \tag{2}$$

where α_{cF} and $\alpha_{c\mathrm{I}}$ are taste shifters for formal and informal varieties, C_{cF} is a composite good of formal varieties, $C_{c\mathrm{I}}$ is a composite good for informal varieties, and ξ is the elasticity of substitution between formal and informal varieties. The formal composite good is composed by varieties from foreign and formal domestic firms:

$$C_{cF} = \left(\alpha_{cM} C_{cM}^{\frac{\epsilon-1}{\epsilon}} + \alpha_{cD} C_{cD}^{\frac{\epsilon-1}{\epsilon}} \right)^{\frac{\epsilon}{\epsilon-1}}, \tag{3}$$

where α_{cM} and α_{cD} are also taste shifters for foreign and formal domestic firms, and ϵ is the elasticity of substitution between foreign and formal domestic varieties. To capture that there is more competition between formal domestic firms and foreign firms for final consumers we assume that $\epsilon \geq \xi$. This assumption implies that an increase in foreign employment due to productivity shocks have a bigger impact on the formal domestic firms than on the informal ones due to higher competition in the final consumer markets.

Finally, we assume that each one of the composite good is composed by varieties from each one of the commuting zones and the rest of the world with a trade elasticity σ_s. In particular,

$$C_{cs} = \left(\sum_{c' \in C} \alpha_{cc's} c_{cc's}^{\frac{\sigma_s-1}{\sigma_s}} \right)^{\frac{\sigma_s}{\sigma_s-1}}, \tag{4}$$

where $1 - \sigma_s$ corresponds to the trade elasticity, and $c_{cc's}$ is the total level of consumption of location c from location c' in sector s. We assume that for the informal sector, the good is only consumed locally, then $c_{cc'\mathrm{I}} = 0$ for all $c \neq c'$.

2.2.2 Production Functions

For the production function we will denote a producer as $s(c)$, where s corresponds to the type of producer and c to the location of the producer. Following the assumptions that we use to construct the matrix X_{ij}, we assume that formal firms use inputs from other firms and that informal firms only consume locally.
The production function of firm type $s(c)$ is:

$$Y_{s(c)} = \left(\beta_{s(c),F} Q_{s(c),F}^{\frac{\zeta-1}{\zeta}} + \beta_{s(c),VA} VA_{s(c)}^{\frac{\zeta-1}{\zeta}} \right)^{\frac{\zeta}{\zeta-1}}, \tag{5}$$

where ζ is the elasticity of substitution between intermediate inputs and value-added. This elasticity measures how important are intermediate inputs in the production function of formal firms, and the parameters β represent the relative efficiency terms. Since these terms are fixed, we do not need to know their exact value. Similar to the case of consumers, $Q_{s(c),F}$ is a composite input of formal varieties that is composed by foreign and formal domestic varieties:

$$Q_{s(c),F} = \left(\beta_{s(c),M} Q_{s(c),M}^{\frac{\epsilon-1}{\epsilon}} + \beta_{s(c),D} Q_{s(c),D}^{\frac{\epsilon-1}{\epsilon}} \right)^{\frac{\epsilon}{\epsilon-1}},$$

where ϵ corresponds to the same elasticity of substitution within the formal sector that captures the competition between formal domestic and foreign varieties. And each composite input is composed by varieties from the different locations with the same trade elasticity that in the consumer case. On the other hand, the value-added input is composed by labor and capital

$$VA_{s(c)} = \left(\beta_{s(c),N} N_{s(c)}^{\frac{\iota-1}{\iota}} + \beta_{s(c),K} K_{s(c)}^{\frac{\iota-1}{\iota}} \right)^{\frac{\iota}{\iota-1}},$$

where $N_{s(c)}$ represents a labor composite input, $K_{s(c)}$ corresponds to the capital stock, and ι is the EoS between labor and capital. The labor composite input is also a CES aggregator composed by low and high-skilled workers:

$$N_{s(c)} = \left(\beta_{s(c),L} L_{s(c)}^{\frac{\sigma_L-1}{\sigma_L}} + \beta_{s(c)} H_{s(c)}^{\frac{\sigma_L-1}{\sigma_L}} \right)^{\frac{\sigma_L-1}{\sigma_L}},$$

where $L_{s(c)}$ and $H_{s(c)}$ corrrespond to the efficiency units of low and high-skilled workers, and σ_L to the elasticitiy of substitution between groups of workers.

2.2.3 Roy model

In a similar fashion that there is higher competition in the final consumption market, we also assume that there are frictions in the labor market from worker-specific idiosyncratic shocks and that there is higher substitutability between formal domestic and foreign firms than between informal and other types of firms. Following recent papers in the trade and labor literature, we assume that wages vary by type of firm .[15] In that sense, following the notation from Galle et al. (2020) workers draw idiosyncratic productivity shocks to work in each type of firm. Then, the share of earnings of workers g in location c from working in firm type F and type I is:

$$\lambda_{cFg} = \frac{B_{cFg} w_{cFg}^{\kappa}}{B_{cFg} w_{cFg}^{\kappa} + B_{c\mathrm{I}g} w_{c\mathrm{I}g}^{\kappa}}, \quad \lambda_{c\mathrm{I}g} = \frac{B_{c\mathrm{I}g} w_{c\mathrm{I}g}^{\kappa}}{B_{cFg} w_{cFg}^{\kappa} + B_{c\mathrm{I}g} w_{c\mathrm{I}g}^{\kappa}}, \tag{6}$$

where κ corresponds to the dispersion parameter of the Fréchet distribution and captures how easy is for workers from group g substitute jobs between the informal and the formal sector. We assume that in a lower nest, workers choose between foreign and formal domestic firms. In particular the share of workers that decide to work in foreign firms is:

$$\lambda_{cMg} = \frac{B_{cMg} w_{cMg}^{\theta}}{B_{cFg} w_{cMg}^{\theta} + B_{cDg} w_{cDg}^{\theta}}, \tag{7}$$

where θ corresponds to the labor supply elasticity and captures how easy is for workers to substitute jobs between foreign and formal domestic firms. We assume that $\theta \geq \kappa$ implying that foreign and formal domestic jobs are higher substitutes.

2.3 Mapping the theory to the data

In order to bring the theory described above to the data, we need five sets of inputs: (a) local FDI spillover elasticities; (b) TFP shocks to the FDI sector experienced by CZs in Mexico; (c) the Allen-Uzawa demand and supply elasticities; (d) the measures of distortions μ_{ij} affecting payments from j to i ; and (e) revenue expenditures / trade flows (X_{ij}) between all entities (consumer, firm, or factor) j in a commuting zone in Mexico or in RoW to any other entity i.

The tension here is that we haven't yet described the data in this organization (model as Section 2), so it's strange to describe what we do given that the reader does not know what data we use.

(a) Local FDI spillover elasticities Explain where we take these from, how they relate to the reduced-form estimates in Section 5.

(b) TFP shocks to the FDI sector Explain briefly how we go from changes in employment in FDI establishments in a given CZ to changes in TFP of the FDI sector in

[15] This is an extension that Baqaee and Farhi (2022) include in their paper, but they do not calibrate it.

that same location across the same time span (now 5 years). We should be using the predicted FDI employment growth (the IV), not the actual growth.

(c) Allen-Uzawa demand and supply elasticities Explain which papers we take our elasticities for consumption and production from. Moreover, explain which elasticities we hope to estimate directly, if any.

(d) Measures of distortions We postpone the discussion of the output and input distortions that we consider and measure in the Mexican context to Section 3.2. In Section 4.2, we describe the level and heterogeneity of distortions in Mexico across CZs and establishment types.

(e) Revenue expenditures / trade flows between all entities Explain briefly what we do then point to the appendix.

3 Data

3.1 Establishment-level data

The primary data source on establishments is the Economic Census collected by the "National Institute of Statistics and Geography" (INEGI in Spanish) every five years since 1994. The Economic Census is an almost complete enumeration of fixed establishments in Mexico.[16]

Critically for our analysis, the Economic Census includes establishments that are not registered or, even if registered, are not compliant with government regulation. Our baseline definition of an informal establishment labels as informal any establishment that does not comply with the legal requirement of paying social security contributions for its workers (as in Levy, 2008; Ulyssea, 2020), irrespective of whether the establishment is registered or not.

The Economic Census microdata allows us to build an unbalanced panel of all establishments in Mexico between 1994 and 2019.[17] This panel tracks typical balance sheet variables such as total sales, number of workers, wage bill, value added and assets (our proxy for capital). We also observe the municipality of each establishment, which we then map to a commuting zone – abbreviated CZ hereafter. Mexico will

[16]For manufacturing, commerce and non-financial services, the Economic Census has a reduced coverage in more isolated rural locations. Businesses that do not have a permanent location and without fixed installations – such as street vendors – are not covered by the Economic Census (irrespective of their industry).

[17]The Economic Census gathers data about the previous calendar year. We follow the convention of referring to years by the Economic Census year (e.g., 1994) but note that the data corresponds to the prior calendar year (e.g., 1993).

therefore be divide into 781 CZs. The Economic Census also records the industry classification of each establishment; we will focus in our main analysis on two-digit NAICS industries.

Last and crucially for this paper, we also observe the establishments that are at least partially foreign-owned. We refer to an establishment as an FDI establishment if it is at least 10% foreign-owned. Additionally, we track the country of origin of an establishment's foreign capital (which is a key input for our leading instrumental variable). In the rare instances where we observe more than one country of origin, we keep the country with the largest share of ownership. Appendix A describes in detail the Economic Census data construction.

3.2 Distortions in Mexico

One of our key contributions is to build a comprehensive dataset that estimates the level of a broad set of output and input distortions for the initial year (1994) across establishment types, industries and CZs. The source data for all these distortions is Mexico-specific and draws either from the Economic Census directly or from national surveys.

Explain the difference between the direct and indirect approach of measuring the distortions. The benefits of the direct approach, the benefits of the indirect approach. Direct approach has the benefit that is closer to policy, more informative, it allows us to shed light on the most costly distortions. Arguments in favor of endogeneizing distortions: Gupta (2020).

For those distortions measured directly in the Economic Census, we observe a value for each establishment in the Census. For those distortions measured via national surveys covering a sample of establishments, we project survey responses on establishment-level observables and use those projections to generate values for all establishments in the Census based on their observables. We assume that the projection coefficients are time-invariant (e.g., that the predictive role of establishment size for a given distortion is the same in 2018 and 1994).

Appendix B provides a detailed account of these data sources, variables used and the imputation procedure.

3.2.1 Sales distortions

Regulation The data source for the distortion associated with the excessive burden of regulation is the "National Survey on Productivity and Competitiveness of Micro, Small and Medium Enterprises" (ENAPROCE in Spanish, collected in 2015 and 2018). ENAPROCE allows us to estimate (i) the value of time spent by senior employees to address government requirements and (ii) any additional payments to the government due to regulation (other than taxes).

Crime and corruption We use the National Survey of Business Victimization (ENVE in Spanish, collected in 2012, 2014, 2016, 2018, 2020) to obtain estimates for the cost of crime and corruption to establishments in Mexico. For crime, we measure both the cost of prevention measures and those of actual damages cause by crimes. For corruption, we look into the bribes paid by establishments to public servants or third parties. Cite literature showing this is an important distortion.

Taxes and subsidies The Economic Census tracks establishment-specific (i) taxes paid for supplying goods and services to firms and final consumers and (ii) subsidies granted by the government to establishments associated with their programs. Does this include any benefits associated with the maquiladora program? What about differences in effective corporate income tax rates (due to tax credits, exemptions, etc.)?

Tariffs We use the World Integrated Trade Solution (WITS) data on product-level import tariffs for Mexico for the years 1995, 1998, 2003, 2008, 2013, and 2018. We then build industry-level average tariffs (based on the weighted importance of products for each industry) for each Economic Census year. Whenever we know which establishments are part of the maquiladora program, update their establishment-specific tariffs.

Markups We use the goods and services output elasticities on labor computed by Alfaro-Ureña et al. (2022) following De Loecker and Warzynski (2012). We take the expenditure share in labor directly from the Economic Census. We transform the establishment-specific markup estimates into "pure markups" by removing other output and input distortions (otherwise, they would be confounded with markups).

3.2.2 Input distortions

Capital input distortions To build our measure of capital input distortions, we draw on a rich set of questions from the "National Business Financing Survey" (ENAFIN in Spanish, collected in 2015 and 2018). We use the predicted base rate for loans evaluated at the mean percentage of collateral required (115%) and loan duration (1.85 years).

Labor input distortions We use the Economic Census to calculate the contributions to social security on behalf of workers and other labor-related contributions that each establishment made in a given year as a share of its wage bill.

3.3 Other data

Appendix D describes the construction of our CZ-level controls based on data from the "Integrated Public Use Microdata Series" (IPUMS) and Comtrade. We also describe our concordance efforts for changing commuting zones and industry classifications across time.[18]

4 FDI and distortions in Mexico

4.1 FDI into Mexico

Differences between FDI and domestic establishments Table A1 presents summary statistics on the sample of establishments in our analysis, separated into three groups: FDI, domestic formal, and domestic informal. Table A1 shows the average establishment characteristics by establishment type at the beginning and end of our sample period (1994 and 2019). Specifically, we look into the total number of workers, wage bill per worker, sales, capital, imports, and exports. Across all characteristics, informal domestic establishments perform about an order of magnitude more poorly than formal domestic establishments, which in turn perform about an order of magnitude more poorly than FDI establishments. For instance, in 2019, informal domestic establishments employed, on average, 2.7 workers, formal domestic establishments employed 20.8 workers, while FDI establishments employed 291.6 workers.

Table A2 shows the importance of each establishment type as a share of the economy-wide totals, again in 1994 and 2019. While in 2019, FDI establishments represent only 0.2% of the number of establishments, they account for 11.81% of employment, 22.13% of sales, 27.25% of the wage bill, 20.40% of assets, XX% of exports and XX% of imports. Meanwhile, in 2019, informal domestic establishments account for a sizable share of employment (45.91%), sales (30.11%), wage bill (26.4%), and assets (20.40%). Moreover, we learn that both informal and FDI establishments have grown in importance at the national level between 1994 and 2019. Appendix A includes further details on the data, sample build, and summary statistics.

FDI and the maquiladora program Provide some summary statistics over the extent to which FDI establishments are also part of the maquiladora program (vs. the domestic establishments that might also be part of this program). Is the overlap between FDI status and the maquiladora status larger for particular industries (e.g., manufacturing) or countries of origin (e.g., the U.S.)?

[18] Between 1994 and 2019, Mexico both created new municipalities and merged some municipalities, making it necessary to create time-consistent CZs. Moreover, the 1994 Economic Census industry classification differs from the NAICS classification used in the subsequent Censuses.

Verhoogen (2013):

Distribution of FDI across space and industries Figure A1 (Appendix A) presents the percentage of CZ-level employment in FDI establishments in our initial (1994) and last year of analysis (2019). While the proximity to the U.S. border remains a good predictor of the importance of FDI in CZ-level employment, between 1994 and 2019, we notice an intensification of FDI also in Central and parts of Southern Mexico. Include maps with $\widehat{FDI}_{cz,1994-2019}$, as defined in equation (8). Include also a table showing the mean, median, p25, p75 of $\widehat{FDI}_{cz,t}$ between two consecutive censuses, given our main regressions will use the short-differences. Include tables with the share of FDI in 1994 and 2019 across broad industry groups (plus change between 1994 and 2019).

Spatial distribution and clustering of FDI by country of origin We now turn our interest to the country of origin of FDI into Mexico. Figure A2 (Appendix A) shows the changing composition between 1994 and 2019 of employment in FDI establishments by the country of origin of the foreign capital. While FDI from the U.S. remains dominant, Mexico has also been able to increasingly diversify the origin countries for FDI.

Figure 1 showcases the spatial clustering by country of origin of FDI, measured as the employment in FDI establishments from a given origin country (region) in a given CZ as a share of the total employment in FDI establishments in that CZ. FDI for Canada is more likely to favor Northern Mexico, with particular preferences for Baja California Sur and Coahuila. While FDI from Japan rarely targets East, Southeast and Southwest Mexico, FDI from Western Europe is particularly well represented in those regions. While FDI from the U.S. is prevalent across Mexico, it is particularly dominant in areas such as the Yucatán Peninsula and Chiapas. We will leverage this spatial clustering by country of origin in our identification strategy for the effects of FDI on the domestic economy.

4.2 Distortions in Mexico

Appendix B.4 includes tables providing summary statistics on the magnitudes of distortions in 1994 across establishment types (FDI, domestic formal, domestic informal), economic areas, and two-digit industries. The maps focus on average distortions in 1994 by commuting zone (averaging across establishment types and industries). To be updated with the correct shares, new cleaning rules, etc.

4.3 FDI growth and pre-existing distortions

Show relationship between underlying distortions in 1994 and FDI growth from 1994 to 2019. This relationship could be at the commuting zone level, industry level, or commuting zone-industry level. We can do the analysis distortion by distortion or using an overall "index".

5 The effects of exposure to FDI on domestic establishments

We want to estimate the effect of changes in the importance of foreign direct investment (FDI) in a commuting zone (CZ) on domestically-owned (domestic, henceforth) establishments. We study both the effects at the CZ and establishment level on all domestic establishments but also separately for formal and informal domestic establishments. Before describing the empirical strategy, it is helpful to discuss the channels by which an increased presence of FDI (maquila FDI or not) in a CZ can affect (formal and informal) domestic establishments.

First, the growth of the FDI sector in a CZ can affect local input markets. The effects are a priori ambiguous. On the one hand, FDI establishments increase demand for non- or less-tradable inputs such as land and labor, raising their prices and hurting domestic establishments. On the other hand, FDI firms can increase the set of input varieties available to domestic buyers (Rodriguez-Clare, 1996) or improve the quality of existing inputs (e.g., by transferring knowledge to workers and workers moving to domestic firms, as in Poole, 2013). Among FDI establishments, those focused on maquila activities tend to import most of their inputs and are less likely to trigger the positive effects just mentioned. For informal establishments, an increase in FDI employment will likely toughen the competition for domestic factors (particularly low-skill workers).

Second, FDI establishments can also affect domestic establishments via interactions in the output market. Again, the sign of this effect is ambiguous. On the one hand, FDI establishments tend to be more productive and their expansion can make domestic establishments shrink or even exit (e.g., as was the case with retail FDI in Mexico, see Atkin et al., 2018). On the other hand, the increased competition from FDI establishments incentivises domestic establishments to innovate or imitate (Brambilla et al., 2009). Maquila FDI is less likely to affect domestic establishments through these channels as maquilas export most of their output. Informal domestic establishments are less likely to both be hurt and benefit from this channel as informal varieties are less substitutable with FDI varieties.

Third, FDI establishments can also impact the performance of domestic establishments whenever they enter supply-chain linkages (as either buyers or suppliers). There is consistent evidence that suppliers to FDI firms experience gains in productivity (Javorcik, 2004; Alfaro-Ureña et al., 2022). Again, maquilas are less likely to benefit domestic establishments through this channel as they tend to import most of their inputs and export most of their output. Informal domestic establishments are less likely to benefit from FDI through this channel, as FDI establishments are less likely to source from them and themselves are less likely to source from FDI establishments.

Fourth and last, an increase in FDI employment can lead to positive demand effects on domestic establishments in the nontradables sector (Moretti, 2010). This channel is plausibly relevant for both formal and informal establishments.

Measure of FDI exposure Formally, we define the change in the importance of FDI in a commuting zone *cz* between two Economic Census years $(t-5)$ and t as the change between those years in the number of workers employed by FDI establishments divided by all employment of that CZ in $(t-5)$:

$$\widehat{FDI}_{cz,t} \equiv \frac{L^{FDI}_{cz,t} - L^{FDI}_{cz,t-5}}{L^{FDI}_{cz,t-5} + L^{dom}_{cz,t-5}} \tag{8}$$

where $L^{FDI}_{cz,t-5}$ and $L^{dom}_{cz,t-5}$ are the total number of workers employed at FDI and domestic establishments, respectively, in CZ *cz* in year $(t-5)$.

We first estimate the effects of changes in the CZ-level exposure to FDI on the overall CZ-level size of the domestically-owned economy. The CZ-level outcomes capture both the intensive (within-establishment) and extensive (across-establishments) margin. We then estimate the establishment-level effects of changes in the CZ-level exposure to FDI, which capture the intensive-margin effects among continuing establishments between $(t-5)$ and t.

5.1 Commuting-zone-level effects of FDI on domestic establishments

We start by studying the effects of FDI on domestic establishments aggregated at the commuting zone (CZ) level. We study these effects in the aggregate across all domestic establishments and separately by subgroups of domestic establishments (e.g., formal and informal establishments, or high- and low-distortion establishments). We use the simpler case of the average effects on all domestic establishments to motivate our empirical strategy.

5.1.1 Average effects on the domestic economy

OLS specification We start with the following regression equation:

$$\log y_{cz,t} - \log y_{cz,t-5} = \beta \widehat{FDI}_{cz,t} + \theta' K_{cz,t} + \Delta\epsilon_{cz,t}, \tag{9}$$

where cz indexes commuting zones in Mexico and t indexes Economic Census years (i.e., 1994, 1999, 2004, 2009, 2014, 2019). $y_{cz,t}$ is the outcome associated to domestic establishments in CZ cz in Economic Census year t; our main outcomes are the total sales, number of workers, wage bill, and capital of all domestic establishments in CZ cz. All observations are weighted by the number of workers in domestic establishments in 1994. We cluster standard errors at the CZ-year level.

Potential endogeneity concerns We want a consistent estimate of β measuring the effect of employment growth at FDI establishments on the CZ-level outcomes of domestic establishments. However, the OLS estimate presents two main potential concerns. First, there is the classic omitted variables concern. The OLS estimate might overestimate the effects of FDI employment growth if FDI tends to flow into CZs set to grow (e.g. because FDI parent firms learn about a new government commitment to invest in productive infrastructure). Conversely, the OLS estimate might underestimate the effects of FDI if FDI tends to flow into CZs experiencing a decline (e.g., in reaction to falling wages or local government incentives). Second, there might be measurement error in the growth of the employment share of FDI establishments in a CZ (for instance, if an establishment misreports its foreign ownership).

Instrumental variable (IV) approach Before introducing the instrument, it is first helpful to denote $L_{cz,t}^{FDI,o}$ as the employment of FDI establishments from origin country o in CZ cz in year t and rewrite the expression of $\widehat{FDI}_{cz,t}$ as follows:

$$\widehat{FDI}_{cz,t} \equiv \frac{L_{cz,t}^{FDI} - L_{cz,t-5}^{FDI}}{L_{cz,t-5}^{FDI}} \times \frac{L_{cz,t-5}^{FDI}}{L_{cz,t-5}^{FDI} + L_{cz,t-5}^{dom}} = \left(\sum_{o} \frac{L_{cz,t}^{FDI,o} - L_{cz,t-5}^{FDI,o}}{L_{cz,t-5}^{FDI,o}} \times \frac{L_{cz,t-5}^{FDI,o}}{L_{cz,t-5}^{FDI}} \right) \times \frac{L_{cz,t-5}^{FDI}}{L_{cz,t-5}^{FDI} + L_{cz,t-5}^{dom}}.$$

The expression above spells out the fact that the overall growth in FDI employment in a CZ cz between $(t-5)$ and t is a weighted sum across origin countries o of the growth experienced by FDI establishments from each origin country (where the weights are the $(t-5)$ share of employment from that origin in all FDI employment in that CZ and year). Consider two hypothetical CZs with the same share of FDI employment in overall employment in $(t-5)$, $\left(L_{cz,t-5}^{FDI} / (L_{cz,t-5}^{FDI} + L_{cz,t-5}^{dom})\right)$ but with different compositions of that FDI employment across countries of origin $\left(L_{cz,t-5}^{FDI,o} / L_{cz,t-5}^{FDI}\right)$. Whenever Mexico receives more FDI from origin o (for reasons unrelated to cz-specific shocks), cz would benefit from those FDI inflows from o proportional to the original importance of origin country o for that CZ. The instrument takes advantage of this past composition of FDI inflows in a CZ to predict its growth in FDI.

Below is an alternative rewriting of $\widehat{FDI}_{cz,t}$ also useful to understand the IV:

$$\widehat{FDI}_{cz,t} \equiv \frac{L^{FDI}_{cz,t} - L^{FDI}_{cz,t-5}}{L^{FDI}_{cz,t-5} + L^{dom}_{cz,t-5}} = \sum_{o} \frac{L^{FDI,o}_{cz,t} - L^{FDI_o}_{cz,t-5}}{L^{FDI,o}_{cz,t-5}} \times S^{o}_{cz,t-5} = \frac{1}{L^{FDI}_{cz,t-5} + L^{dom}_{cz,t-5}} \sum_{o} \left(L^{FDI,o}_{cz,t} - L^{FDI,o}_{cz,t-5} \right)$$

The instrument will predict the increase in FDI employment from origin country o in cz $\left(L^{FDI,o}_{cz,t} - L^{FDI,o}_{cz,t-5} \right)$ by leveraging the insight that new inflows of FDI into Mexico from origin country o will disproportionately head towards CZs where that country of origin clustered in the past. Let's construct the instrument $\widehat{Z}^{FDI}_{cz,t}$ as follows:

$$\begin{aligned} \widehat{Z}^{FDI}_{cz,t} \equiv & \sum_{o} \frac{\sum_{cz' \neq cz} \left(L^{FDI,o}_{cz',t} - L^{FDI,o}_{cz',t-5} \right)}{\sum_{cz'} L^{FDI,o}_{cz',t-5}} \times \frac{L^{FDI,o}_{cz,t-5}}{L^{FDI}_{cz,t-5} + L^{dom}_{cz,t-5}} = \sum_{o} \frac{\sum_{cz' \neq cz} \left(L^{FDI,o}_{cz',t} - L^{FDI_o}_{cz',t-5} \right)}{\sum_{cz'} L^{FDI,o}_{cz',t-5}} \times S^{o}_{cz,t-5} \\ = & \frac{1}{L^{FDI}_{cz,t-5} + L^{dom}_{cz,t-5}} \sum_{o} \left(\sum_{cz' \neq cz} L^{FDI,o}_{cz',t} - L^{FDI,o}_{cz',t-5} \right) \times \frac{L^{FDI,o}_{cz,t-5}}{\sum_{cz'} L^{FDI_o}_{cz',t-5}} \end{aligned} \tag{10}$$

Each term in the last summation is the prediction for $\left(L^{FDI,o}_{cz,t} - L^{FDI,o}_{cz,t-5} \right)$, which uses the prediction for the overall change in employment in Mexico in FDI establishments from origin o (i.e., the overall change in FDI employment in Mexico from that origin *excluding* the change in the CZ of interest) and apportions it to cz based on the previous clustering of FDI from o in cz. For instance, if 30% of the employment in Mexico of FDI establishments from Germany was clustered in $(t-5)$ in a CZ in Puebla, that CZ is predicted to receive 30% of any new increase between $(t-5)$ and t of employment in Mexico in FDI establishments from Germany.

The rationale of this IV is analogous to that of a classic IV from the migration literature, which instruments the immigrant inflows from a given source country to a particular location by using the historical settlement patterns of immigrants from that source country and the total number of newly-arriving immigrants from that country (Card, 2001). Several studies have documented herding patterns in MNC entry decisions for parent firms from the same origin country. For example, Head et al. (1995) find that Japanese firms tend to locate affiliates in U.S. states that already host many other Japanese-owned firms, Barry et al. (2003) find co-localization patterns for U.S.-owned affiliates in Ireland, while Bernard and Thomas (2019) bring similar evidence for MNC entry in Eastern Europe. A variant of this instrument was recently used by Setzler and Tintelnot (2021) to study the effects of FDI in the U.S. Discuss Figure A3 in Appendix A.3.

The relevance of this IV requires that the growth of FDI employment from an origin country o in a CZ and its growth in all other CZs in Mexico are correlated. This is the case whenever both growth rates are affected by improvements in the overall appeal of Mexico as an investment destination for parent firms from origin country o[19] or exogenous shocks to the performance of these parent firms that lead to increased investments worldwide. Moreover, the relevance of the instrument requires that the past clustering patterns of FDI by country of origin is indeed a good predictor of the spatial split of future FDI flows from that country. Update and discuss Figure A4 in Appendix A.3. Check the first stage without the shares.

The exclusion restriction requires that the unexplained determinant of growth of the domestic economy in cz and the instrument are orthogonal (conditional on the potential determinants of growth already controlled for through $K_{cz,t}$). Formally, the exclusion restriction is:

$$E(\Delta\epsilon_{cz,t}\widehat{Z}^{FDI}_{cz,t}|K_{cz,t}) = 0$$

While the exclusion restriction is not testable, it is not unreasonable to expect it to be satisfied. First, $\widehat{Z}^{FDI}_{cz,t}$ is not a function of cz-specific changes in input or output market between $(t-5)$ and t. Moreover, prior papers on the spatial clustering of FDI by origin country argue that differences across locations in endowments of natural resources, labor and infrastructure do not seem to explain this pattern of localization choice (Head et al., 1995; Barry et al., 2003; Bernard and Thomas, 2019). Instead, this pattern suggests stronger agglomeration and demonstration effects among firms from the same origin country.

The third way of writing the IV in equation (10) highlights that this IV has a shift-share or "Bartik" structure. Identification in our shift-share IV regressions follows from the assumption that the assignment of the shocks $\left(\Delta L^{FDI,o}_{-cz,t}\right)$ is quasi-random, whereas the exposure shares $\left(S^{o}_{cz,t-5}\right)$ are allowed to be endogenous (as in Borusyak et al., 2022). In the same paper, Borusyak et al. (2022) recommend to control for the "missing share", which in our case is $\frac{L^{dom}_{cz,t-5}}{L^{FDI}_{cz,t-5}+L^{dom}_{cz,t-5}}$. We add this control to all our regressions so as to avoid to compare CZs with too different levels of importance of FDI in their overall employment.

To address remaining threats to identification, we include in the control vector $K_{cz,t}$ a conservative set of CZ-level controls. First, we include CZ indicators to control for time-invariant differences in growth rates across CZs. Second, we also include economic region-year indicators to control for shocks common across commuting zones in an economic region.[20] Third, we include time-varying controls for commuting-zone-specific urban concentration rates, employment rates, the importance of manufactur-

[19] For instance, after each revision of the "Global Agreement" between Mexico and the EU (which first came into force in 2000), Mexico became a more attractive destination for FDI from countries o in the European Union (EU).

[20] Mexico is split into 8 economic regions: East, North, Northeast, Northwest, South, Southeast, Southwest, and West.

ing in employment, the prevalence of secondary education or routine occupations, and demographic characteristics such as the share of indigenous or foreign-born individuals. Last, we include controls for CZ-level shocks in import and export markets. Namely, we control for the "China shock" using two variables: one capturing the rising importance of imports from China into Mexico and another capturing the increasing competition from China in the main export markets of Mexico in 1994 (in the spirit of Autor et al., 2013; Blyde et al., 2020). We also include a control for the rising importance of imports from the U.S. into Mexico. Appendix D provides additional details on these controls.

Results Discuss OLS first. Then first stage, reduced form and IV estimates. Compare OLS and IV estimates. Propose an explanation of how the estimates compare.

Mention the IV estimates for all IV estimates. Interpret their magnitude. Is there a story emerging overall?

5.1.2 Effects by formality status

To study the reallocation effects between the formal and informal segments of the domestic economy, we use the following augmented specification:

$$\log y_{i,cz,t} - \log y_{i,cz,t-5} = \beta_1 \widehat{FDI}_{cz,t} + \beta_2 \widehat{FDI}_{cz,t} \times Inf_{i,cz,t-5} + \beta_3 Inf_{i,cz,t-5} + \theta' K_{cz,t} + \Delta\epsilon_{i,cz,t} \tag{11}$$

where i stands for either the formal or informal segment of the domestic economy in CZ cz. For example, assume that i refers to the formal domestic segment. Then, the value of an outcome (e.g., number of workers) for i in CZ cz and year t is the summation of that variable across all formal domestic establishments in that CZ cz and year t. For each measure of size, CZ and year, there are two stacked observations: one capturing the size of the formal domestic economy and another capturing the size of the informal domestic economy.

5.1.3 Effects by severity of distortions

5.2 Establishment-level effects of FDI on domestic establishments

Average effects on domestic establishments We adjust the specification used in the CZ-level analysis in the following way:

$$\log y_{i,cz,t} - \log y_{i,cz,t-5} = \beta \widehat{FDI}_{cz(i),t} + \theta' K_{cz(i),t} + \Delta\epsilon_{i,cz,t} \tag{12}$$

where $y_{i,cz,t}$ is the outcome of domestic establishment i in CZ cz in year t. The notation $cz(i)$ designates the CZ where establishment i is located. In the baseline version of this regression, for comparability reasons, we use the same CZ-level controls used in the regression in equation (9). In a robustness check, we add two-digit industry by year fixed effects to control for nationwide trends in the industry of the domestic establishments. Observations are weighted by the initial establishment-level employment (where the initial year is defined as the earliest year when an establishment appears in the Economic Census).

Effects by the establishment-level formality status

Effects by severity of establishment-level distortions

5.3 Discussion

Compare the CZ and establishment level regressions. Reconcile the sign and magnitudes of the coefficients. Discuss future analysis on transitions for establishments between formal and informal status.

6 Model estimation

7 Counterfactuals

8 Conclusion

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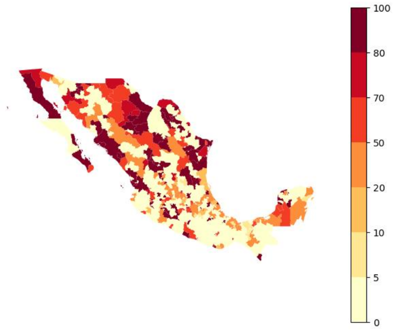
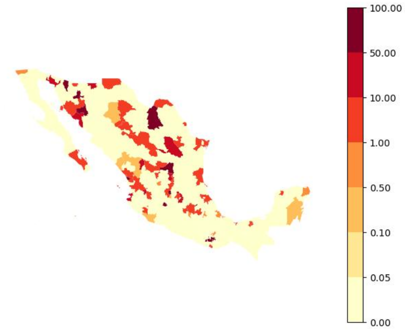
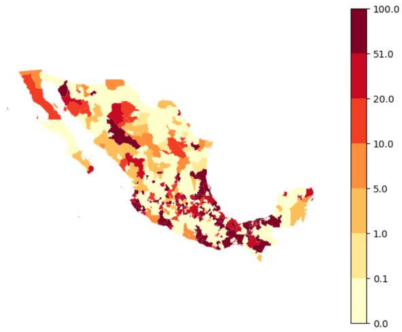
Figure 1: Spatial concentration of FDI into Mexico by country (region) of ownership (2019)



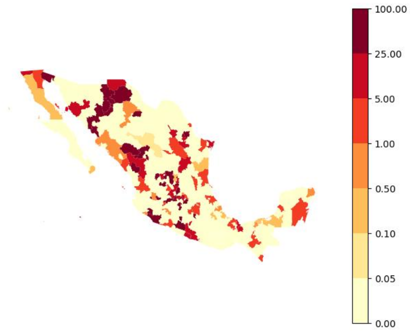
(a) United States



(b) Canada



(c) Western Europe



(d) Japan

Notes: Figure 1 displays the spatial variation in the importance of employment at FDI establishments across commuting zones in Mexico in our end-year 2019. Namely, we plot the share of employment in FDI establishments from a given country (region) of origin as a share of the total employment in FDI establishments in a commuting zone. Panel A focuses on FDI into Mexico from the United States, Panel B on FDI from Canada, Panel C on FDI from Western Europe and Panel D on FDI from Japan. Most FDI from Western Europe comes from Germany, Netherlands, Great Britain, France, and Switzerland (sorted in descending order based on overall employment in 2019).

The Gains from Foreign Investment in an Economy with Distortions

Isabela Manelici, Jose P. Vasquez, and Román D. Zárate

Appendices for online publication

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Appendix A Establishment-level microdata: Economic Census

Appendix A.1 Data construction

Unit of observation The Economic Census is a complete enumeration of establishments in Mexico with the following characteristics: economic units in a single physical location, settled in a permanent place and delimited by constructions or fixed installations, that combine activities and resources under the control of a single owner or controlling entity to carry out activities of production of goods, purchase and sale of merchandise or provision of services; whether for profit or not (INEGI, 2021).

Coverage The activities subject to the Economic Censuses are divided into two large groups: (i) those for which information is collected throughout the entire Mexican territory: fishing and aquaculture; mining; electricity, water and gas; construction; transport, mail and storage, as well as financial and insurance services; and (ii) manufacturing, commerce and non-financial services, whose information is collected through a complete survey in the largest and most economically-important geographical areas in Mexico and, through a sample in rural areas, where the economic activity in these industries is unimportant (INEGI, 2021).

Data We build an unbalanced panel of establishment-level data uniting six consecutive Economic Censuses from 1994, 1999, 2004, 2009, 2014, and 2019. This panel tracks typical balance sheet variables such as total sales, number of workers, wage bill and assets (our proxy for capital). Be more precise on the variables.

Crucially, we also observe the establishments that are at least partially foreign-owned. We refer to an establishment as an FDI establishment if it is at least 10% foreign-owned. Additionally, we track the country of origin of an establishment's foreign capital (which is a key input for our leading instrumental variable). In the rare instances where we observe more than one country of origin, we keep the country with the largest share of ownership.

We also observe the municipality of each establishment, which we then map to a commuting zone – abbreviated CZ (out of 781 CZs). The Economic Census also records the industry classification of each establishment at the 4-digit level.

Cleaning rules Describe briefly the cleaning rules: what do we do with establishments switching formality status, missing / zero/ negative values, winsorizing top 99.9% of values or not.

Challenges Tracking establishments across time. Describe what share we are able to track, whether we think those not linked have entered/exited or without ID.

Appendix A.2 Summary statistics

Table A1: Summary statistics by establishment type

	1994			2019		
	Domestic		FDI	Domestic		FDI
	Informal	Formal		Informal	Formal	
Number of estab.	1,733,699	429,164	6,549	3,997,350	549,347	9,660
Employment	1.7	13.2	153.9	2.8	19.6	304.0
Sales	24.9	895.5	13,754.3	102.5	1,261.5	24,133.0
Assets	3.7	267.5	3,382.6	45.3	445.7	6,269.1

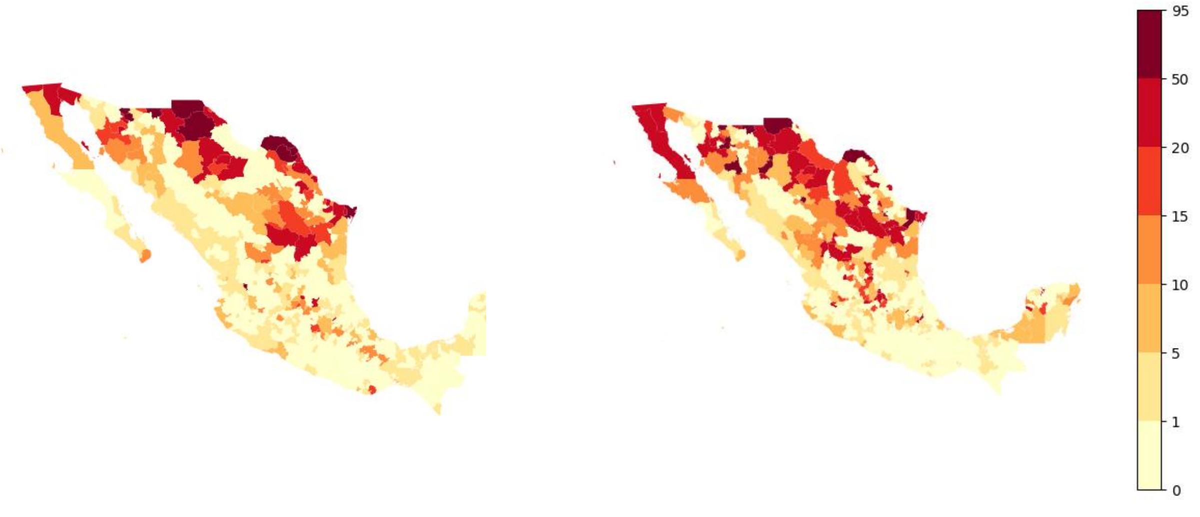
Notes: Table A1 presents summary statistics on the sample of establishments in our analysis, separated into three groups (FDI, domestic formal, and domestic informal). Namely, Table A1 shows the averages across all CZs (weighted by the number of establishments) at the beginning and end of our sample period (1994 and 2019). We measure size as total sales, number of workers, capital, imports, and exports. Values for sales and capital are expressed in 2019 CPI-deflated thousands of U.S. dollars. Wages are reported as annual earnings per worker in 2019 CPI-deflated U.S. dollars.

Table A2: Importance in the Mexican economy of domestic informal and FDI establishments

	1994		2019	
	Informal	FDI	Informal	FDI
Workers	30.81	10.41	44.63	11.88
Sales	8.33	17.41	30.67	17.45
Wagebill	2.00	19.79	9.00	25.72
Assets	4.50	15.45	37.24	12.45

Notes: Table A2 shows the importance of domestic informal establishments and FDI establishments as a share of the economy-wide totals of the number of workers, sales, wage bill, assets, imports, and exports, in 1994 and 2019. Values are reported as percentages. Formal domestic establishments are the complement to 100%.

Figure A1: Percentage of CZ-level employment in FDI establishments

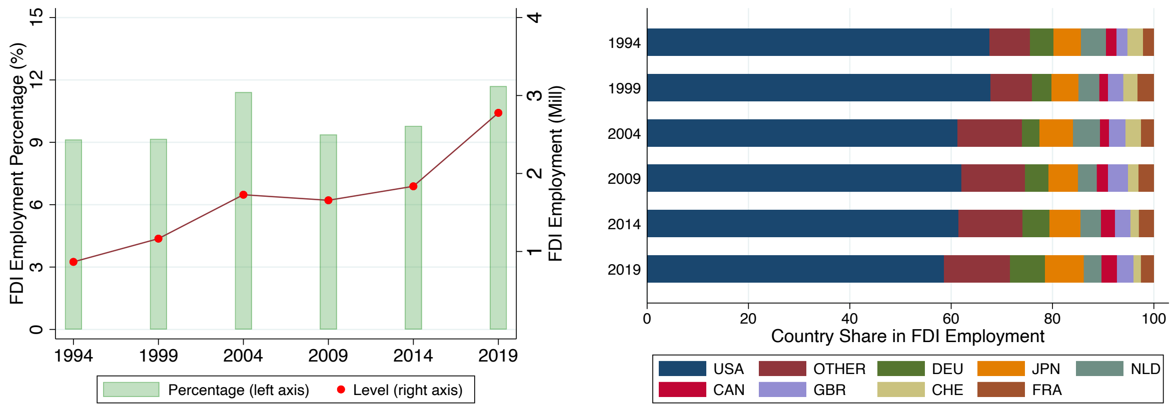


(a) 1994

(b) 2019

Notes: Figure A1 presents the percentage of CZ-level employment in FDI establishments in our initial (1994) and last year of analysis (2019).

Figure A2: Evolution of employment in FDI establishments



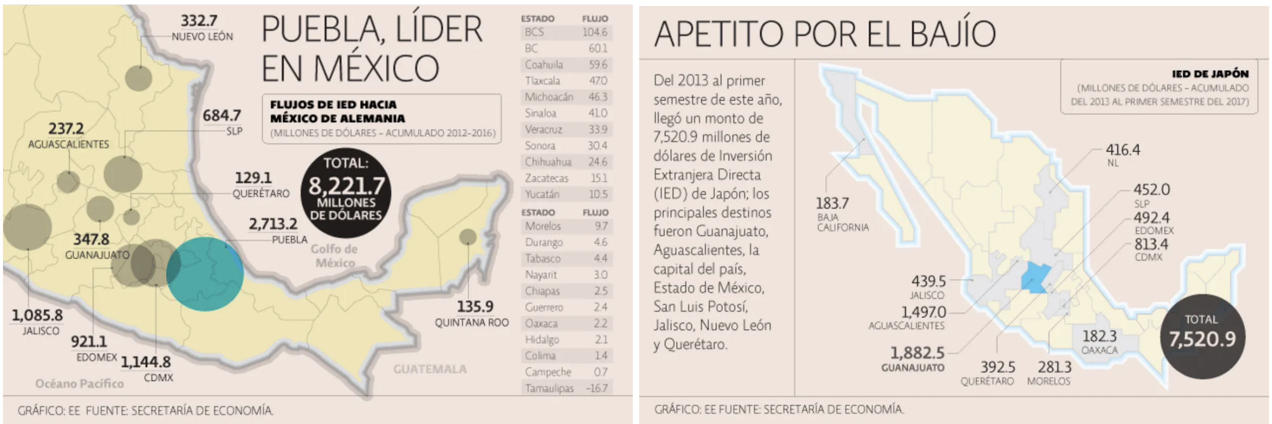
(a) FDI employment in Mexico

(b) FDI share by country of origin

Notes: Panel (a) in Figure A2 plots the evolution of employment in FDI establishments in Mexico between 1994 and 2019 (both as a share of overall employment on the left-hand-side axis and in absolute numbers, on the right-hand-side axis). Panel (b) in Figure A2 shows the composition of employment in FDI establishments by the country of origin of the foreign capital.

Appendix A.3 Supportive evidence for the IV

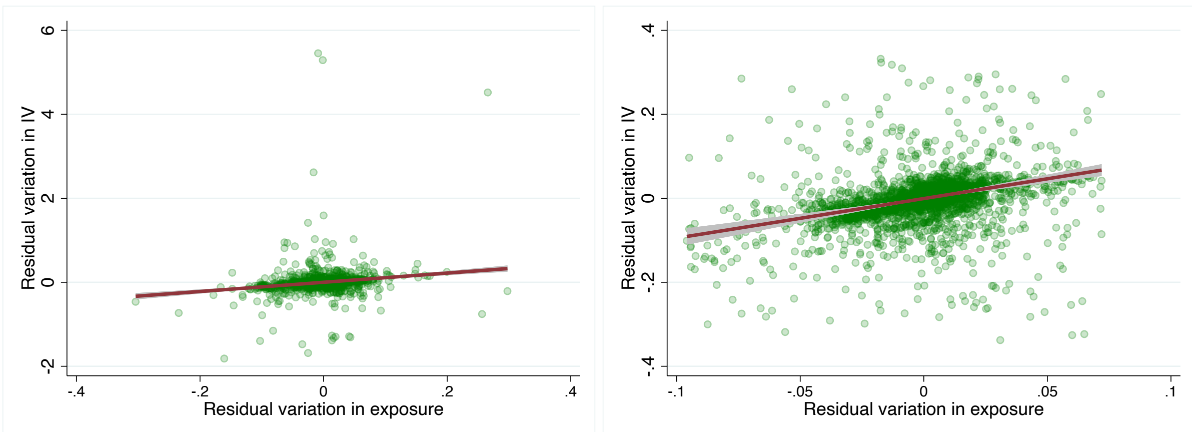
Figure A3: Spatial concentration of FDI from Germany and Japan into Mexico



(a) German FDI clusters in Puebla (2012-2016) (b) Japanese FDI clusters in Guanajuato (2017)

Notes: The maps in Panels (a) and (b) come from two articles in the Mexican newspaper *El Economista* (see here and here). The message of these maps and the articles more broadly is twofold: (i) FDI from specific origin countries (Germany and Japan in these particular examples) tends to be spatially concentrated (e.g., Germany keeps investing in Puebla, whereas Japan keeps investing in Bajío) and (ii) different origin countries have different spatial clustering patterns (even when the countries are similar in GDP per capita and invest in similar industries).

Figure A4: First stage of the instrument



(a) $\widehat{Z}^{FDI}_{cz,t}$ vs. $\widehat{FDI}_{cz,t}$. Full sample (b) $\widehat{Z}^{FDI}_{cz,t}$ vs. $\widehat{FDI}_{cz,t}$. Trimming top/bottom 1%

Notes: In both panels, the X-axis presents the residualized FDI exposure measure ($\widehat{FDI}_{cz,t}$) and the Y-axis presents its residualized instrument ($\widehat{Z}^{FDI}_{cz,t}$). Both variables are residualized by controlling for the vector of FE and other controls $K_{cz,t}$. Clustering happens at the CZ-year level. The coefficients (standard errors) are 1.09 (0.13) for Panel (a) and 0.94 (0.10) for Panel (b).

Appendix B Establishment-level distortions

We rely on Atkin and Donaldson (2022) as an organizing framework for the construction of establishment-level distortions data.

Appendix B.1 Sales distortions

Appendix B.1.1 Regulation

Data ENAPROCE 2015, 2018. This survey reports data from 2014, 2016 and 2017. Panel available: ID to link 2015 with 2018, should the establishment exist.

Sources of distortion

1. Time spent (labor factor) used to address government requirements.
2. Additional payments to the government **due to regulation** (other than taxes).

Variables Total sales (even if the Economic Census was not collected that year). FDI vs domestic (cannot distinguish between formal and informal). This survey could be standalone if necessary, making an assumption for the domestic sectors.

1. Time spent (labor factor) used to address government requirements

$$\frac{\overbrace{\frac{\text{Wage bill}^{\text{monthly}}_{\text{senior}}}{N_{\text{senior}}}}^{\text{Average monthly senior wage}} \times \overbrace{\frac{\text{Hours}^{\text{monthly}}_{\text{bureaucracy}}}{4.34 \cdot \text{Hours}^{\text{weekly}}_{\text{worked}}}}^{\text{Monthly time share in regulation}} \times \text{Months worked}}{\text{Sales}^{\text{annual}}}$$

Superscripts denote the frequency of the variable (weekly, monthly or annual).

We assume that senior employees perform these tasks — there is no information on wages available for other positions.

Variables and questions from the surveys

1. Wages of senior executives:
   (a) 2014 PYMES: $P14\_1$
   (b) 2014 Micro: $M14B$ (Total wages, not only seniors)
   (c) 2017 PYMES: $P15\_1B$
   (d) 2017 Micro: $M15B$ (Total wages, not only seniors)
2. Average number of senior executives:
   (a) 2014 PYMES: $P12\_1A$ (Total senior employees, not average)

   (b) 2014 Micro: $M10\_0A$ (Average employees, not only seniors)
   (c) 2017 PYMES: $P13\_1C$
   (d) 2017 Micro: $M12\_0B$ (Average employees, not only seniors)

3. Hours dedicated to administrative requirements (Bureaucracy):
   (a) 2014 PYMES: $P82$ (Missing values present)
   (b) 2014 Micro: $M64$
   (c) 2017 PYMES: $P84$
   (d) 2017 Micro: $M67$

4. Average hours worked per month:
   (a) 2014 PYMES: $P10$
   (b) 2014 Micro: $M12$
   (c) 2017 PYMES: $P11B$
   (d) 2017 Micro: $M14B$

5. Months worked by year:
   (a) 2014 PYMES: $P9$
   (b) 2014 Micro: $M13$
   (c) 2017 PYMES: $P10B$
   (d) 2017 Micro: $M13B$

6. Annual sales:
   (a) 2014 PYMES: $P2\_0A$
   (b) 2014 Micro: $M2\_0A$
   (c) 2017 PYMES: $P2\_0A$
   (d) 2017 Micro: $M2\_0A$

7. Factor weights: FAC_EXPA

8. ID: ID_UELM

9. Sector:
   (a) 2014 PYMES: $P1\_1C\_2$
   (b) 2014 Micro: $M1\_1C\_2$
   (c) 2017 PYMES: $P1\_1B$
   (d) 2017 Micro: $M1\_1B$

10. CZ: Census
11. Size:
    (a) 2014 PYMES: $P11\_0$
    (b) 2014 Micro: $M10\_0A$
    (c) 2017 PYMES: $P12\_0B$
    (d) 2017 Micro: $M12\_0B$

Imputation algorithm The main variable of interest is the only one with missing values. We ignore the observations in the micro-enterprises reported in 2014 and predict the distortion shares as explained in the next section.

2. Additional payments to the government due to regulation (other than taxes)

$$\text{Additional payments markup} = \frac{\text{Additional payments} \cdot \text{Months worked}}{\text{Sales}}$$

Variables and questions from the surveys

1. Additional payments:
    (a) 2014 PYMES: $P81$
    (b) 2014 Micro: $M63$
    (c) 2017 PYMES: $P83$
    (d) 2017 Micro: $M66$
2. Months worked by year:
    (a) 2014 PYMES: $P9$
    (b) 2014 Micro: $M13$
    (c) 2017 PYMES: $P10B$
    (d) 2017 Micro: $M13B$
3. Annual sales:
    (a) 2014 PYMES: $P2\_0A$
    (b) 2014 Micro: $M2\_0A$
    (c) 2017 PYMES: $P2\_0A$
    (d) 2017 Micro: $M2\_0A$
4. Factor weights: FAC_EXPA
5. ID: ID_UELM

6. Sector:
   (a) 2014 PYMES: $P1\_1C\_2$
   (b) 2014 Micro: $M1\_1C\_2$
   (c) 2017 PYMES: $P1\_1B$
   (d) 2017 Micro: $M1\_1B$
7. CZ: Census
8. Size:
   (a) 2014 PYMES: $P11\_0$
   (b) 2014 Micro: $M10\_0A$
   (c) 2017 PYMES: $P12\_0B$
   (d) 2017 Micro: $M12\_0B$

Imputation algorithm There is no variable that needs an imputation.

Extrapolating to other establishments, matching to Economic Census and obtaining the sales denominator This is a standalone survey; therefore, we can take the sales reported in this survey. We have to match these observations with the Economic Census using different years and project the distortion share to other establishments. The distortions reported in 2014 should be matched with those in the Census 2014, where the reported year is 2013.

The linear regression approach is more transparent than performing the mean imputation; also, the unobserved heterogeneity captured by the fixed effects will improve the estimation. Let the distortion share μ_{fiszt} of the establishment f in the commuting zone i of the sector s in year t, which is explained by:

$$\mu_{fist} = \beta \log(\text{Size}_{ft}) + \alpha_f + \gamma_i + \delta_s + \theta_t + \varepsilon_{fist} \tag{B1}$$

where α_f, γ_i, δ_s, θ_t are the fixed effects of the establishment, location, sector, and time, respectively, and the observations weighted by the expansion factor. **From here on, assume all the regressions are weighted by the expansion factor.**

Regarding the selection of variables, Atkin and Donaldson (2022) strongly emphasize size as the main predictor, and my understanding is that it is correlated with the type; hence, I would prefer to use the establishment size, measured by the number of employees.

Román: This sounds like a good idea. I wonder if we should also include a formal and informal dummy variable from the census? JI: In this case, we have to choose since these independent variables are correlated, therefore, the regression would suffer from collinearity. We can see if the type dummies are better predictors than the establishment size measured by employees.

As discussed with JP, we will start by considering the CZs and our grouped sectors. The ENAPROCE will provide us with a great panel to estimate this linear regression as best we can to project the distortions in the Economic Census. However, due to the sample size in these surveys, there is a great chance that we will encounter collinearity among the dummies. Hence, we have to take a stance on the order in which we will relax the fixed effects. Note that we cannot use REGHDFE since we will rely on the "fixed effects" (dummies should be preserved rather than residualized) to predict the result. Román: But you can calculate the fixed effects with the reghdfe. It corresponds to the mean of each group relative to the average mean when you demean the variable. JI: My idea is not to save the averages, but rather use the Least Squares Dummy Estimator, my prior is that it's easier to save the coefficients of the linear regression than adding means to other predictions. Let me know if you have a clear idea to predict out of sample using REGHDFE considering the FEs. The other option is to residualize the FEs and just consider the continuous variables. For this task, we will use a well-known variance decomposition to obtain the Shapley values for each predictor. These values tell us how much each group of variables explains — it is decomposing R^2. Another aspect we have not considered is that predicting with dummy variables is usually computationally costly; hence, even if the data allow us to compute the perfect regression, it might not be computationally feasible. We will require the *rego* package. This survey is optimal to decide the order, also, it will show us if the variables are correlated — my expectation is that there will not be.

Appendix B.1.2 Crime

Data ENVE 2012, 2014, 2016, 2018, 2020. Sometimes, they ask questions related to the year they were interviewed. No panel is available.

Sources of distortion

1. Prevention measures.

2. Actual damages caused by crimes.

Entity variables No sales were reported. ID, sector, state, factor weight, establishment's start year.

1. Prevention measures

$$\text{Prevention share} = \frac{\text{Prevention}}{\text{Sales}}$$

1. **Prevention:** Amount, interval or doesn't know.

2. Enough heterogeneity to impute values.

3. Sales should come from Economic Census.

Variables and questions from the surveys

1. Prevention expenditure (Interval): $P13$

2. Prevention expenditure (Exact value): $P14$

3. Criminal events in surrounding areas (heard or known). Create dummy variables: 0 to 4 ticks, 5 to 9 ticks or 10+ ticks. Specific events, i.e., alcohol consumption, vandalism, criminal gangs, etc. Drop 1 dummy.

   (a) 2014: $P8\_1$-$P8\_14$. Compute $\mathbb{1}[0 \leq \sum_{i=1}^{14} \mathbb{1}(P8\_i = 1) < 5]$, $\mathbb{1}[5 \leq \sum_{i=1}^{14} \mathbb{1}(P8\_i = 1) < 10]$, and $\mathbb{1}[\sum_{i=1}^{14} \mathbb{1}(P8\_i = 1) \geq 10]$.

   (b) 2017: $P8\_1$-$P8\_15$. $\mathbb{1}[0 \leq \sum_{i=1}^{15} \mathbb{1}(P8\_i = 1) < 5]$, $\mathbb{1}[5 \leq \sum_{i=1}^{15} \mathbb{1}(P8\_i = 1) < 10]$, and $\mathbb{1}[\sum_{i=1}^{15} \mathbb{1}(P8\_i = 1) \geq 10]$.

4. Perception of crime incidence in the geographical area: $P11\_2$. Increased (1), stayed the same (2), decreased (3), doesn't know or answer (9). Compute dummy variables $\mathbb{1}(P11\_2 = 1)$, $\mathbb{1}(P11\_2 = 2 \vee P11\_2 = 9)$ and $\mathbb{1}(P11\_2 = 3)$. Drop 1 dummy.

5. Prevention measures: $P12\_1$-$P12\_13$. Create dummy variables: $\{\mathbb{1}(P12\_i = 1) : i \in \{1, \ldots, 13\}\}$. Drop 1 dummy.

6. Annual sales:

   (a) 2013: Census

   (b) 2017: Census. Adjust 2018 sales for inflation and growth. Look at Section 2.4 and the tasks in Section 14.

7. Factor weights: FAC_EXPA

8. ID: ID_UELM

9. Sector: Census

10. CZ: Census

11. Size: Census. For 2017 use the same number of workers as in 2018.

Imputation algorithm We need to get the point estimate. I suggest two procedures and I have questions about which sample to use.

Fixed effects estimator **Decision 1:** Do we include exactly known values in the sample in addition to the midpoints of the intervals or just the former? Román: I think that we need to check the missing values. If the exact values do not have many missing values, I will go with the exact values.

Decision 2: Do we pool the sample using 2012-2020 or just 2014 and 2018 to estimate the model? Román: Mmm I think that to keep it simple, let's just use the 2014 and 2018 sample.

Decision 3: Do we use establishment and time FEs? I think if we used the 2012-2020 sample, there would be some overlap. However, there is the chance that STATA drops observations (singletons).

Let the prevention expenditure be explained by

$$
\begin{aligned}
\log(\text{Prevention expenditure})_{fist} = {} & \left(\sum_{k=1}^{5} \psi_k \mathbb{1}(P13 = k+1)\right) (\sum_{k=0}^{11} \beta_k \mathbb{1}(P12\_(k+2) = 1) \\
& + \beta_{12} \mathbb{1}[5 \leq \sum_{i=1}^{14} \mathbb{1}(P8\_i = 1) < 10] \\
& + \beta_{13} \mathbb{1}[\sum_{i=1}^{14} \mathbb{1}(P8\_i = 1) \geq 10] \\
& + \beta_{14} \mathbb{1}(P11\_2 = 1) + \beta_{15} \mathbb{1}(P11\_2 = 3) + \nu \log(\text{Size}_{ft}) \\
& + \alpha_f + \gamma_i + \delta_s + \theta_t) + \varepsilon_{fist}
\end{aligned}
$$

where α_f, γ_i, δ_s, and θ_t are fixed effects of establishment, location, sector, and time, respectively. Note that we pooled the observations across different intervals, using the midpoints or just the known values, and set different slopes and intercepts for each one. The other options are to run the pooled regression just adding the dummies for the interval, or run separate regressions for each interval.

Interval regression Even though you don't like this option, I will leave it for the worst-case scenario. It has several advantages over the FE estimator. For instance, you can report the boundaries of the interval and the exactly known values together, and also, you do not lose efficiency by setting up all those dummies. Finally, you can run the regression with FEs in a joint sample. Furthermore, the predicted values are $\mathbb{E}(\log(\text{Prevention expenditure})^*_{fist}) = \max(a, \min(\log(\text{Prevention expenditure})_{fist}, b))$ where $a \leq \log(\text{Prevention expenditure})^*_{fist} \leq b$. See intreg, intreg postestimation, and xtintreg.

2. Actual damages caused by crimes **Source:** Additional module of ENVE with events by crime type and establishment. Let c be the type of crime.

$$
\text{Damages share} = \frac{\sum_c \text{Damages}_c}{\text{Sales}}
$$

Rich dataset: Characteristics by establishment and type of crime to predict missing values.

Variables and questions from the surveys

1. Economic costs caused by crime (Interval): $M1\_30$
2. Economic costs caused by crime (Exact value): $M1\_31$
3. Annual sales:
   (a) 2013: Census
   (b) 2017: Census. Adjust 2018 sales for inflation and growth. Look at Section 2.4 and the tasks in Section 14.

4. Crime type: *id_delito*

5. ID: Match *cve_unica* to ENVE, then *ID_UELM* to Census.

6. Factor weights: *FAC_EXPA*

7. Factor weights (crimes): *FAC_DEL*

8. Sector: *Sector*

9. CZ: Census

10. Size: Census. For 2017 use the same number of workers as in 2018.

Imputation algorithm The variable should be the sum of the individual crimes reported. However, sometimes only the interval is known or a missing value is reported for a subset of the total crimes committed against a establishment; therefore, we must impute these values. We run separate regressions for each type of crime.

Let the damage costs caused by the crime c

$$\log(\text{Crime costs})_{cfist} = \left(\sum_{k=1}^{5} \psi_k \mathbb{1}(M1\_30 = k+1)\right)(\nu \log(\text{Size}_{ft}) + \alpha_f + \gamma_i + \delta_s + \theta_t) + \varepsilon_{cfist}$$

Then, we predict the crime costs for each event reported for a establishment with a missing value. Finally, we compute the sum of the damage costs and divide them by the total sales. Note that this regression faces the same problems reported in Section 2.2.2. Consider these issues in the regression again and provide answers to the decisions. Román: I think that we should check the missing values, but using the midpoints seems fine.

Extrapolating to other establishments, matching to Economic Census and obtaining the denominator Match with the years where the Economic Census was not collected. Román: I put my RA to do this, but it was thanksgiving, this seems simple, so I will code it tomorrow.

1. Using the Economic Census, calculate the 5-year growth rate for a establishment in a particular entity (even better if we have the exact establishment).

$$g_{f(i),t+4} = \frac{\text{Sales}_{f(i),t+4}}{\text{Sales}_{f(i),t}}, t \in \{1999, 2004, 2009, 2014\}$$

2. Annualize this rate, then multiply to compute new sales. We have information on the start year, therefore, we know the EC we have to use and if we have to de/inflate their sales.

$$\text{Sales}_{f(i),t+k} = \text{Sales}_{f(i),t} \cdot g_{f(i),t+k}^{\frac{k}{5}}, t \in \{1999, 2004, 2009, 2014\}, k \in \{-1, 2, 0, 1, 2\}$$

Also, read Section 1.3.3 for instructions on how to impute the distortion share related to damage costs for every establishment in the EC.

Appendix B.1.3 Corruption

Data ENVE.

Sources for distortion Bribes.

$$\text{Bribes share} = \frac{\text{Bribes}}{\text{Sales}}$$

Difficult to impute data: only event counts and perceptions.

Variables and questions from the surveys

1. Bribes (Interval): $P34$
2. Bribes (Exact value): $P35\_1$
3. # government employee asked for benefit: $P29\_1X$
4. # government employee direct bribes: $P30\_1X$
5. # smuggler bribes: $P31\_1X$
6. Annual sales:
   (a) 2013: Census
   (b) 2017: Census. Adjust 2018 sales for inflation and growth. Look at Section 2.4 and the tasks in Section 14.
7. ID: ID_UELM.
8. Factor weights: FAC_EXPA
9. Sector: *Sector*
10. CZ: Census
11. Size: Census. For 2017 use the same number of workers as in 2018.

Imputation algorithm We don't have as much information as in previous distortions. The best we can do is compute the average bribe per event conditional on observables, then multiply by the reported number of events. Remember, this is just in case where they don't report anything at all. Again, the decisions from Section 2.2.2. should be considered here too.

Let the average bribe per event be

$$\text{Avg bribe} = \frac{\text{Bribes}}{P29\_1X + P30\_1X + P31\_1X},$$

then, we predict the average bribe per event by

$$\log(\text{Avg bribe})_{fist} = \left(\sum_{k=1}^{5} \psi_k \mathbb{1}(P34 = k+1)\right) (\nu \log(\text{Size}_{ft}) + \alpha_f + \gamma_i + \delta_s + \theta_t) + \varepsilon_{fist}$$

Then,

$$\text{Bribes}_{fist} = (P29\_1X + P30\_1X + P31\_1X) \cdot \exp(\widehat{\log(\text{Avg bribe})}_{fist})$$

Appendix B.1.4 Taxes

$$\text{Taxes share} = \frac{\text{Sales VAT} - \text{Inputs VAT}}{\text{Sales}}$$

We can't decompose the remaining taxes from the interest and others. Here, the informal establishments have a markdown rather than a markup, these establishments we'll be subsidized in a sense concerning the others. The other option is simply to use the sales VAT. My understanding is that when you have VAT, you can deduct the taxes you already paid from the ones you owe, at least that's how "créditos fiscales" work in Costa Rica.

Variables and questions from the surveys

1. Sales: $m000a$
2. Sales VAT: $m001a$
3. Inputs VAT: $k001a$
4. Income tax + special taxes + interest on loans + donations + FX arbitrage losses, etc.: $l000a$
5. Manufacture survey:
   (a) Income tax + donations + transfers: $l210$
   (b) Special taxes: $l220$
   (c) **2019:** Income tax donations + FX arbitrage losses, etc.: $l999a$

Imputation algorithm No imputations are needed, nor extrapolation to other establishments.

Appendix B.1.5 Subsidies

$$\text{Subsidies share} = -\frac{\text{Subsidies}}{\text{Sales}}$$

We have the same problems about the decomposing the subsidies in the basic surveys, however, I think it's a great quick and dirty way to obtain it for the presentation.

Variables and questions from the surveys

1. Sales: $n000a$
2. Subsidies + financial interests from loans establishments extended + donations: $m001a$
3. Inputs VAT: $k001a$
4. Income tax + special taxes + interest on loans + donations + FX arbitrage losses, etc.: $l000a$
5. Manufacture survey:
   (a) Subsidies: $n200a$

Imputation algorithm No imputations are needed, nor extrapolation to other establishments.

Appendix B.1.6 Tariffs

Obtain a weighted average of the WITS tariffs by sector. We need to retake this after the presentation.

Appendix B.1.7 Markups

Missing

Appendix B.2 Input distortions

Appendix B.2.1 Capital input distortions

Capital distortions can act as a markdown or markup relative to the market equilibrium: it is the difference between the predicted and the actual interest paid by establishments, conditional on their collateral, duration, currency, and other factors. Atkin and Donaldson (2022) compute a predicted rate for 3.5 years. However, for simplicity, we look at the net expenditure on interest on loans.

$$\text{Capital distortions share} = \frac{\text{Due interests on loans} - \text{Received interest on loans}}{\text{Sales}}$$

$$\text{Capital distortions share} = \frac{\text{Net payment of interests on loans}}{\text{Sales}}$$

In this way, we can achieve the markup/markdown ambiguity, also, this accounts for establishments' arbitrage. We still have the problem of decomposing the variables in the basic survey at the cost of no imputations.

Variables and questions from the surveys

1. Sales: $n000a$
2. Subsidies + financial interests from loans establishments extended + donations: $m001a$
3. Income tax + special taxes + interest on loans + donations + FX arbitrage losses, etc.: $l000a$
4. Manufacture:
   (a) Financial interests from loans establishment extended: $n100a$
   (b) Financial interests due to loans: $l100a$

Imputation algorithm No imputations are needed, nor extrapolation to other establishment.

Appendix B.2.2 Labor input distortions

The distortions related to labor input will be captured through contributions to social security and additional required payments to the government or employees by law.

$$\text{Labor distortion share} = \frac{\text{Social security}}{\text{Sales}}$$

Variables and questions from the surveys

1. Sales: $n000a$
2. Social security 1: $j300$
3. Social security 2: $j400$

Imputation algorithm No imputations are needed, nor extrapolation to other establishment.

Appendix B.3 Questions and tasks

Questions Atkin and Donaldson sometimes predict the distortion as a share rather than inputting their values. I think we have enough data to predict the costs instead of the share; however, we have it as a plan B following AD. Jose: I agree this is a good plan B. We will first start with inputting values then we will move to predicting costs whenever this is better. We should re-take this idea after the presentation.

We focus on the distortions of entities located in Mexico; however, we have not discussed the distortions affecting entities from the rest of the world. For instance, see my suggestions on crime, corruption, and tariffs. Jose: Good point. For now we will assume they are the sames as for Mexico as a whole. After the presentation we will need to reconsider this. The most apparent path would be to follow AD constructing the data for several countries and then collapse that data to a RoW.

I understand that we would want to extrapolate to every establishment available in the Economic Census; however, these are samples. I think you would want to impute the distortion share to the remaining establishments. My prior is that the set of establishments with all the distortions available would be very small or even null. We have to take a stance on how to adapt the share from years in between Census collection, i.e., ENAPROCE has info for 2014, then, do we assign that share to 2013? Also, think about 2016 or 2017 to 2018. In this line, Atkin and Donaldson sometimes predict distortions based on establishment size. I would predict the distortion share rather than the amounts when the establishments are not present in a particular survey.

In ENAPROCE we have panel data; do we take advantage of it or not? The FEs are not identified for establishments present in only one year; therefore, STATA will drop these observations. The second option is to run separate regressions for the year. The third option is to run the pooled sample from both years. (If we decide on the third, do we do the same for the other distortions?)

Tasks

1. For each distortion share, sales are needed by knowing the exact value or an estimate. In particular,

   (a) Create a panel data set of establishments present in the Economic Census. We assume that all the establishments are present in the data set; hence, should one of them disappear, we would assume that it closed. establishments do not appear or disappear on and off in between Censuses.

   (b) Compute the growth rate between Economic Census years (5-year rate). Use the INEGI identifier as the establishment ID.

   (c) Annualize the growth rate according to the formula in Section 2.4.

   (d) Record the last Census in which the establishment appeared, also locate the variable that indicates

   (e) There will probably be establishments where we cannot estimate their growth rate given data constraints; therefore, we will use the CZ-sector-establishment size growth rate. We will compute it as the sales-weighted average of the growth rates of the available at this point. Only impute the establishments with missing values.

   (f) Expand the data set to incorporate every year in the period 1993-2018. (Remember that the Economic Census collects information from the previous year; you will see it reported as a year after, that is, 2003 is labeled as 2004.)

   (g) Compute sales using the formula in Section 2.4 after obtaining the 5-year growth rate.

   (h) Please keep only the years for each establishment from the reported start year (take literal value from the survey + 1) and the last Census it was reported (use the Census year). [You can do it the other way, the important thing is to keep the periods straight considering the misalignment of the Census]

2. For the interval variables, we need to recode the observations from numbers or labels into actual values. Specifically,

   (a) Take the list of variables in each section reported as an interval and look for them in the Census questionnaires or the FD files.

   (b) Create three additional variables from the original one:

      i. Upper bound of the interval.

      ii. Lower bound of the interval.

      iii. Midpoint of the interval.

   Also, be careful with missing values. INEGI uses 9 for missing values. Only focus on the interval; the cases with the exact amounts will be handled by José Ignacio. The primary focus should be on having the intervals coded correctly according to the surveys.

3. JI has WITS and UN COMTRADE accounts provided by Bob at the WB. However, the tariffs are only available at WITS for people connected directly to the WB's network. Then we need to download these tariffs at the sector level for the period 1994-2019 for every country. It is unlikely that we can map the products reported in the Economic Census to actual products at WITS, then, we will use the industry-level information.

Appendix B.4 Summary statistics of distortions in Mexico

Table B1: Distortions as a share of sales by census division, manufacturing, and firm type (percentages): 1994

Economic Regions	Mfg	Firm Type	Security	Bribes	Crime	Bureau.	Regul.	Markup	VAT	Lab. Tax	Capital
East	No	Informal	8.83	5.71	7.69	44.53	12.76	.	12.00	1.06	14.02
		Formal	3.31	3.96	3.00	39.32	27.15	.	12.19	17.14	14.51
		FDI	2.48	0.51	3.22	24.64	35.91	.	14.97	21.87	8.84
	Yes	Informal	7.94	3.91	6.64	57.91	18.77	.	16.49	0.57	12.13
		Formal	1.20	3.51	0.99	59.35	33.69	.	8.12	21.14	13.89
		FDI	0.36	0.51	1.04	13.76	10.38	.	14.76	22.73	8.84
North	No	Informal	7.59	4.56	6.88	10.97	4.44	.	9.98	0.59	13.11
		Formal	2.25	2.87	2.12	25.07	23.11	.	11.96	16.75	13.18
		FDI	0.90	0.51	1.66	8.16	23.44	.	15.00	20.08	8.84
	Yes	Informal	5.99	3.23	5.02	20.48	10.36	.	8.01	0.77	13.11
		Formal	0.52	1.75	0.60	43.02	30.64	.	8.74	19.56	12.56
		FDI	0.56	0.51	1.52	7.97	23.56	.	12.59	24.97	8.84
Northeast	No	Informal	9.06	5.01	7.27	8.05	8.49	.	10.53	0.98	11.35
		Formal	3.08	3.61	1.88	19.83	23.89	.	12.34	18.06	11.80
		FDI	2.38	0.51	2.09	12.87	28.91	.	15.00	17.07	8.66
	Yes	Informal	7.51	2.52	5.75	16.08	10.26	.	8.39	0.67	11.18
		Formal	0.96	0.87	0.84	31.20	28.78	.	11.33	22.40	11.20
		FDI	0.60	0.51	0.99	12.47	17.25	.	13.70	28.04	8.66
Northwest	No	Informal	8.59	6.15	6.76	10.60	8.85	.	9.71	1.02	11.69
		Formal	2.97	4.52	1.84	23.70	24.43	.	12.71	17.10	12.35
		FDI	0.86	0.51	1.25	21.11	22.18	.	14.99	21.56	8.66
	Yes	Informal	6.77	5.51	5.06	24.90	12.68	.	7.89	1.95	11.94
		Formal	0.86	2.62	0.74	40.23	30.07	.	10.07	20.32	11.70
		FDI	0.44	0.51	0.49	24.37	24.24	.	13.81	27.80	8.66
South	No	Informal	7.16	6.96	6.81	6.56	7.81	.	6.23	0.64	13.88
		Formal	1.78	3.88	1.34	31.74	26.66	.	12.26	18.07	13.66
		FDI	1.29	0.51	1.47	23.12	28.45	.	14.70	15.94	8.97
	Yes	Informal	5.93	5.06	5.42	25.96	12.58	.	4.12	0.78	13.60
		Formal	0.45	2.36	1.01	46.34	31.65	.	10.70	19.69	13.70
		FDI	0.88	0.51	3.30	7.98	22.55	.	12.15	23.76	9.07
Southeast	No	Informal	9.20	4.87	7.10	12.04	5.22	.	10.24	0.64	15.78
		Formal	3.36	5.96	1.97	33.00	23.26	.	13.06	17.67	15.23
		FDI	0.53	0.51	2.38	60.47	26.33	.	15.00	25.16	8.84
	Yes	Informal	8.86	3.73	4.96	33.27	10.89	.	44.14	0.94	12.96
		Formal	2.23	3.90	1.07	46.54	25.40	.	8.68	19.42	12.56
		FDI	1.25	0.51	0.13	60.47	26.60	.	15.00	18.57	8.84
Southwest	No	Informal	7.66	5.13	6.81	13.95	3.20	.	9.53	0.60	15.23
		Formal	2.22	2.71	2.01	19.98	19.55	.	13.05	16.81	15.21
		FDI	0.04	0.51	0.38	17.37	25.44	.	15.00	22.28	8.84
	Yes	Informal	7.48	4.79	5.78	15.95	6.85	.	19.55	0.48	17.00
		Formal	1.35	2.15	1.30	30.52	23.74	.	7.88	18.23	12.66
West	No	Informal	7.33	4.36	7.04	5.95	5.40	.	8.88	0.75	14.22
		Formal	2.20	4.03	1.90	24.72	23.29	.	12.36	17.78	14.13
		FDI	0.62	0.51	0.84	62.28	29.93	.	14.99	18.12	9.07
	Yes	Informal	6.45	2.94	5.98	20.27	9.12	.	9.33	0.95	11.64
		Formal	0.67	0.68	0.95	43.59	30.23	.	9.19	19.92	13.85
		FDI	0.62	0.51	0.47	38.20	13.58	.	12.73	23.33	8.94
All	No	Informal	7.90	5.70	7.02	13.76	7.50	.	8.95	0.77	13.65
		Formal	2.43	3.94	1.80	27.79	24.87	.	12.40	17.63	13.43
		FDI	1.28	0.51	1.51	24.90	28.15	.	14.79	17.21	8.91
	Yes	Informal	6.96	4.09	5.69	29.43	12.09	.	13.15	0.83	13.06
		Formal	0.75	2.07	0.90	43.61	30.63	.	9.95	20.29	12.91
		FDI	0.61	0.51	1.44	16.43	21.13	.	13.28	26.25	8.79

Note: Table reports the weighted average by number of establishments of each distortion. Security, bribes, crime, bureaucracy time, regulation payments, markups, and VAT distortions are shares of total annual sales. Labor tax are reported as a share of wagebill. Capital distortion is reported as interest rates. All values are presented as percentages.

Table B2: Distortions as a share of sales by sector (percentages): 1994

2-digit sector	Security	Bribes	Crime	Bureau.	Regulation	VAT	Labor Tax	Capital
Agriculture/Mining	0.80	0.02	3.25	0.68	4.66	2.20	20.54	12.67
Energy/Maintenance	0.61	0.02	4.11	0.23	1.75	7.77	37.11	11.09
Construction/Rentals	1.92	0.04	4.56	0.44	4.66	7.56	11.42	12.61
Foods/Textile	1.38	0.03	4.28	0.44	2.12	2.54	16.64	12.04
Chemical/Paper/Non-metallic	1.31	0.03	4.14	0.52	3.58	5.32	18.04	12.17
Metallic/Machinery/Equipment	1.05	0.02	3.55	0.55	3.30	3.30	22.68	10.73
Wholesale Trade	1.18	0.03	4.71	0.64	4.57	7.69	15.24	12.93
Retail Trade	2.57	0.04	3.06	0.44	5.53	4.49	6.59	14.23
Transport	1.01	0.03	4.04	0.52	2.57	6.67	15.63	11.59
Postal and Storage	1.59	0.02	3.31	1.12	7.62	10.69	26.84	14.04
Media	1.98	0.04	4.75	0.49	4.26	8.10	12.36	11.72
Professional Services	1.73	0.04	5.14	0.70	4.34	6.66	13.75	13.58
Healthcare/Education/Social Assistance	1.87	0.04	4.72	0.59	4.93	1.42	12.48	12.87
Other Services	2.69	0.04	3.99	0.42	5.74	1.94	6.04	11.07
Accomodation Services	2.17	0.04	4.13	0.47	4.13	3.06	10.01	14.71

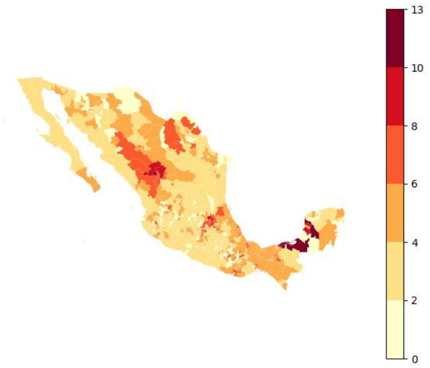
Note: Table reports the weighted average by number of establishments of each distortion. Security, bribes, crime, bureaucracy time, regulation payments, markups, and VAT distortions are shares of total annual sales. Labor tax are reported as a share of wagebill. Capital distortion is reported as interest rates. All values are presented as percentages.

Table B3: Output and input distortions (%)

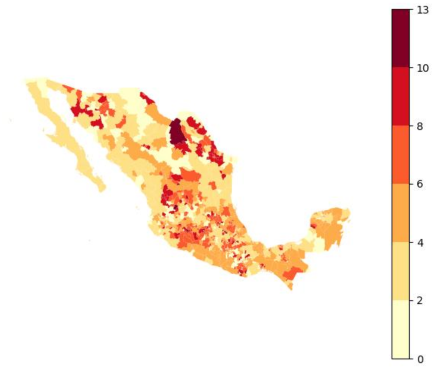
Mfg	Establishment Type	Output distortions			Input distortions	
		Bureaucracy & Regulation	Crime, Security & Bribes	VAT	Interest Rates	Labor Tax
No	Informal	4.76	7.67	5.16	11.91	0.00
	Formal	6.59	3.66	7.41	12.67	16.22
	FDI	3.37	1.61	9.26	8.40	17.06
Yes	Informal	3.15	7.41	3.95	11.02	0.00
	Formal	4.49	2.50	5.13	13.05	17.85
	FDI	4.16	0.95	3.38	4.37	20.55

Note: Table reports the weighted average by number of workers of each distortion for the full period. Security, bribes, crime, bureaucracy time, regulation payments, and VAT distortions are shares of total annual sales. Labor taxes are reported as a share of wage bill. The capital distortion is reported as interest rates. All values are presented as percentages.

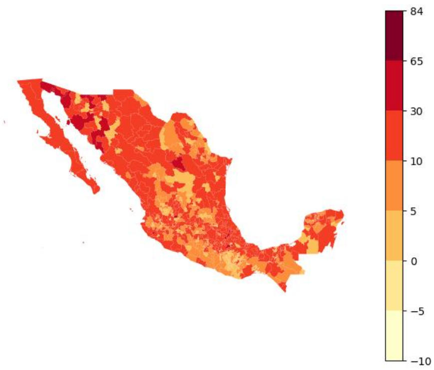
Figure B1: Spatial distribution of sales distortions by commuting zone



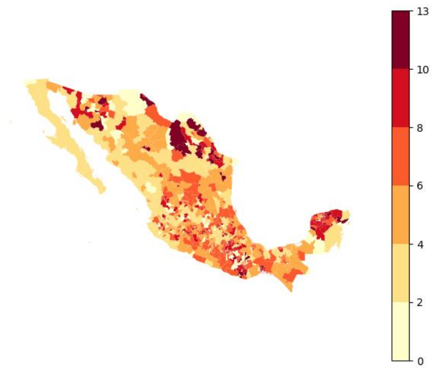
(a) Bribes



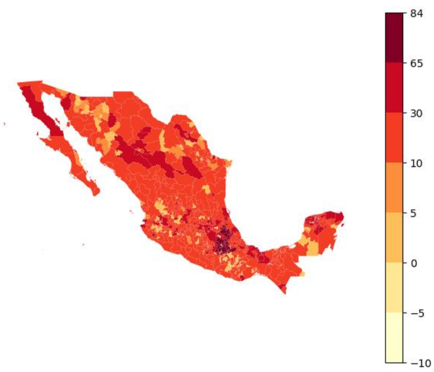
(b) Crime damages



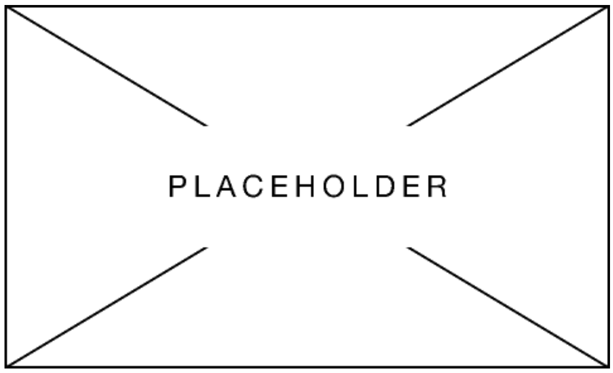
(c) Extra payments to government



(d) Security expenses



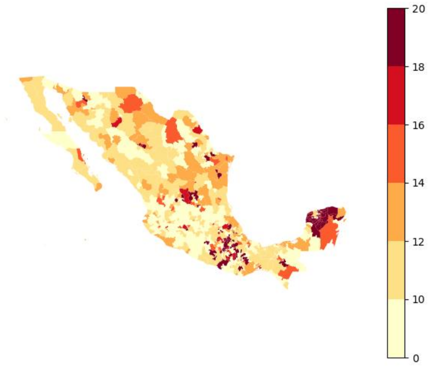
(e) Bureaucracy time



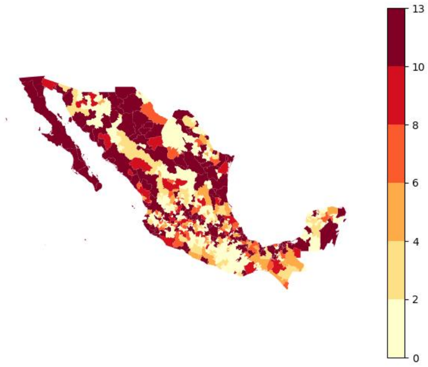
(f) Markup

Notes: Figure shows the sales-weighted average of sales distortions within each CZ as shares of annual sales for our initial year 1994. Namely, we plot the expenditure of firms on bribes, crime, extra payments to government, security, bureaucracy time and sales markups for each CZ within Mexico.

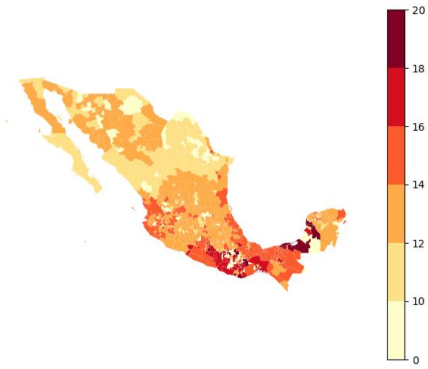
Figure B2: Spatial distribution of tax and capital costs distortions



(a) VAT



(b) Labor tax



(c) Capital distortion

Notes: Figure shows the tax and capital distortions within each CZ for our initial year 1994. Namely, we plot the average expenditure on VAT taxes, labor taxes and costs of access to capital as shares of their respective input costs for each CZ within Mexico.

Appendix C Trade flows data

Appendix C.1 List of sectors and locations

We consider an economy with 789 commuting zones (CZ) and the Rest of the World (RoW), 16 sectors classified according to the North American Industry Classification System (NAICS) revised by Mexico (MX) in 2013, and three types of establishments (formal, informal, and FDI). The National Institute of Statistics and Geography (INEGI) grouped a subset of municipalities (second-level administrative divisions) into 59 metropolitan statistical areas. Then, Blyde et al. (2020) provide a methodology to group the remaining municipalities, resulting in 789 independent commuting zones (CZs) total, and we borrow their CZ aggregation as the set of locations in addition to the Rest of the World (RoW).

We group the economic activities into the following sectors: **1)** Agriculture, Forestry, Fishing, Hunting and Mining (NAICS 11-21); **2)** Utilities, Administrative and Support, Waste Management and Remediation Services (NAICS 22, 56); **3)** Construction, Real Estate, Rental and Leasing (NAICS 23, 53); **4)** Food, Beverage, Tobacco, Textile, Apparel and Leather Manufacturing (NAICS 31); **5)** Wood, Paper, Printing, Petroleum, Coal, Chemical, Plastics, Rubber and Non-Metallic Manufacturing (NAICS 32); **6)** Primary and Fabricated Metal, Machinery, Computer, Electronic, Electrical Equipment, Appliance, Component, Transportation Equipment, Furniture and Other Manufacturing (NAICS 33); **7)** Wholesale Trade (NAICS 43); **8)** Retail Trade (NAICS 46); **9)** Transportation (NAICS 48); **10)** Postal Service, Couriers, Messengers, Warehousing and Storage (NAICS 49); **11)** Information (NAICS 51); **12)** Finance and Insurance (NAICS 52); **13)** Professional, Scientific, and Technical Services (NAICS 54); **14)** Educational Services, Health Care and Social Assistance (NAICS 61-62); **15)** Arts, Entertainment, Recreation, and Other Services (except Public Administration) (NAICS 71, 81); and **16)** Accommodation and Food Services (NAICS 72).

We exclude the government and self-consumption sectors to focus on the profit-maximizing sectors. Our selection of the number of sectors and countries was guided by the maximum level of disaggregation at which we were able to collect the production and trade data needed to compute our matrix Ω_{ij}. In addition, we aggregated three sectors to reduce computational complexity (sectors 1-3). We adapt two INEGI classifications to define our three types of establishments. First, we define informal establishments in the data as those that do not report contributions to social security. Second, the remaining establishments are split into two categories: domestic formal and foreign-owned. Foreign-owned establishments have more than 50% foreign capital participation and domestic formal establishments are the remaining.

Appendix C.2 Definitions

Let $X_{isu,jkv}$ be the sales of an entity of type $u \in \{\text{formal, informal}, MNC\} = \mathcal{U}$ in sector $s \in \{1, 2, \ldots, S\} = \mathcal{S}$ located in region $i \in \{1, 2, \ldots, L\} = \mathcal{L}$ to an entity of type v in sector k located in region j. We will denote the six-dimensional tensor of $X_{isu,jkv}$ as $\mathbb{X}$.

In the last step, we unfold $\mathbb{X}$ as a matrix. This matrix will have dimension $(N+F) \times (N+F)$, where $N = |\mathcal{S}| \times |\mathcal{L}| \times |\mathcal{U}|$ and F are factors of production, with $F = G \times L$, where G is the number of factors, which can range from simply labor and capital or disaggregate to low-skilled and high-skilled by type of establishment. We will also implement additional assumptions, such as workers from one location not getting any flows from establishments in other locations and that workers do not spend anything on other workers.

Next, let $X_{isu,jC}$ be the sales of the establishment type u in the sector s of the location i to the final consumer in the location j; $C_{jsu} \equiv \sum_i X_{isu,jC}$ as the total final consumption in the location j of the goods sent by the establishments of the type u, in the sector s; and $C_{js} \equiv \sum_u C_{jsu}$ as the total final consumption of the goods of the sector s in the location j. Also, define $X_{isu,j} \equiv \sum_k \sum_v X_{isu,jkv} + X_{isu,jC}$ as the total sales of type u, in location i, sector s to location j. As additional definitions, take $R_{isu} \equiv \sum_j X_{isu,j}$ as the total revenue of establishments of type u in the region i in sector s, and $E_{jsu} \equiv \sum_i X_{isu,j}$ as the total expenditure of location j, buying the good of sector s produced by establishments of type u. Let $MX \subseteq \mathcal{L}$ be the set of locations that contain the Mexican CZs. We refer to a region i as a Mexican CZ (country) using the notation $i \in MX$ ($i \notin MX$).

Appendix C.3 Bilateral flows, value-added, final use and consumption

The 2016 World Input-Output Database (WIOD) provides bilateral trade flows in 56 sectors and 43 countries and RoW, from 2000 to 2014, $X^{\text{WIOD}}_{is,jk,t}$, where the sector s in country i sells to the sector k in country j in year t; value-added $X^{\text{WIOD}}_{iVA,jk,t}$; final use $X^{\text{WIOD}}_{is,jF,t}$; and consumption $X^{\text{WIOD}}_{is,jC,t}$. WIOD classifies economic activities following ISIC revision 4. We apply the negative inventories correction proposed by Costinot and Rodríguez-Clare (2014). Table C1 provides a concordance table between WIOD and our sector classification.

Household consumption in Mexican municipalities comes from the National Survey of Household Income and Expenditure (ENIGH) by the municipality. We provide a concordance table in the replication package that maps each expenditure to one of our sectors. We exclude self-consumption and most of the consumption paid with credit cards or gifted to other households following the profit-maximizing logic. Furthermore, these codes are difficult to classify because the disaggregation provided by INEGI could be matched to at least three of our sectors. The MX NAICS assigns consumption to the tertiary sectors, which are closer to the final consumer.

Appendix C.4 Distances

Appendix C.4.1 Commuting zones (CZs)

We compute the distances between the CZs by calculating the distance matrix between every MX municipality. Specifically, we calculate the Haversine distance in kilometers between the centroids of each municipality r in CZ i and the municipality s in CZ j (d_{rs}), and define the

Table C1: Concordance table INEGI-WIOD

Sector	WIOD sector	Description
1	c1-c4	Crop and animal production, hunting and related service activities; Forestry and logging; Fishing and aquaculture; Mining and quarrying
2	c24-c26	Electricity, gas, steam and air conditioning supply; Water collection, treatment and supply; Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services
3	c27, c44	Construction; Real estate activities
4	c5-c6	Manufacture of food products, beverages and tobacco products, textiles, wearing apparel and leather products
5	c7-c14	Manufacture of wood and cork (except furniture), articles of straw and plaiting materials, paper and paper products, coke and refined petroleum products, chemicals and chemical products, basic pharmaceutical products and pharmaceutical preparations, rubber and plastic products, other non-metallic mineral products; Printing and reproduction of recorded media
6	c15-c22	Manufacture of basic metals, fabricated metal products, machinery and equipment, computer, electronic and optical products, electrical equipment, motor vehicles, trailers and semi-trailers; other transport equipment; furniture; other manufacturing
7	c28-c29	Wholesale trade; Wholesale and retail trade and repair of motor vehicles and motorcycles
8	c30	Retail trade, except of motor vehicles and motorcycles
9	c31-c33	Land transport and transport via pipelines; Water transport; Air transport
10	c34-c35	Warehousing and support activities for transportation; Postal and courier activities
11	c37-c39	Publishing activities; Motion picture, video and television programme production, sound recording and music publishing activities; programming and broadcasting activities; Telecommunications
12	c41-c43	Financial service activities; Insurance, reinsurance and pension funding; and their auxiliar activities
13	c40, c45-c50	Computer programming, consultancy and related activities; information service activities; Legal and accounting activities; activities of head offices; management consultancy activities; Architectural and engineering activities; technical testing and analysis; Scientific research and development; Advertising and market research; Other professional, scientific and technical activities; veterinary activities; Administrative and support service activities
14	c52-c53	Education; Human health and social work activities
15	c23, c54	Repair and installation of machinery and equipment; Other service activities
16	c36	Accommodation and food service activities

aggregate distance at the CZ level dist_{ij} following Head and Mayer (2002):

$$\text{dist}_{ij} = \left(\sum_{r \in i} \sum_{s \in j} \left(\frac{\text{pop}_r}{\text{pop}_i} \right) \left(\frac{\text{pop}_s}{\text{pop}_j} \right) d_{rs}^{\theta} \right)^{\frac{1}{\theta}} \tag{C2}$$

where $r \in i$ means all municipalities r in the CZ i and pop_i is the population of the place i with $\theta = -1$. We obtain the 2010 population by the municipality from the Census of Population and Housing (CPV). Finally, we calculate the MX to RoW distance with a weighted average of the distances from MX to other countries present in Rodríguez-Clare et al. (2020) by the destination countries GDP calculated using WIOD 2013.

Appendix C.4.2 Countries

We borrow the Rodríguez-Clare et al. (2020) distance matrix, where they compute the Haversine distance between cities with more than 300,000 inhabitants; then, they aggregate them at the country pair level with equation (C2). Additionally, we calculate the RoW to RoW distance by averaging the previous distances using 2011 GDP in WIOD version 2013 by country as weights.

Appendix C.5 Revenues

We obtain aggregate revenues from establishments surveyed in the 2014 Economic Census conducted by INEGI. In particular, we accessed the Economic Census microdata from INEGI's lab to acquire the sum of establishment revenues R_{isu}. We applied our CZ and sector concordance tables to aggregate them. Regarding the revenues from the Rest of the World, we take the sum of the bilateral flows from $R^*_{RoWs} \equiv \sum_{i \notin MX} \sum_j X^{\text{WIOD}}_{is,j}$.

Appendix C.6 Input and value-added shares

We need the share of inputs $\phi_{is,k}$ that sector s uses from sector k in region i and the value-added share $\phi_{i,k}$ for every CZ. We calculate these shares at the country level for Mexico and assume that $\phi_{is,k} = \phi_{Ms,k}$ and $\phi_{i,k} = \phi_{M,k}$ for every CZ i and sector s and k, furthermore, the equalities

$$\phi_{i,k} + \sum_s \phi_{i,sk} = 1 \quad \forall i, k$$

should hold. Finally, let

$$\phi_{Ms,k} \equiv \frac{X^{\text{WIOD}}_{Ms,Mk,2013}}{X^{\text{WIOD}}_{MVA,Mk,2013} + \sum_s X^{\text{WIOD}}_{Ms,Mk,2013}} \quad \forall s, k$$

and

$$\phi_{M,k} \equiv \frac{X^{\text{WIOD}}_{MVA,Mk,2013}}{X^{\text{WIOD}}_{MVA,Mk,2013} + \sum_s X^{\text{WIOD}}_{Ms,Mk,2013}} \quad \forall k.$$

Appendix C.7 Share of production and expenditures by type of establishment

We determine the share of production α_{isu} and the share of expenditures μ_{jsu} of locations i, j, sector s, and type u. We don't need to compute $\alpha_{jsu} \forall j \in M$.

Appendix C.7.1 Mexican CZs

We obtain the 2013 Extended Supply and Use Tables (COUE) from INEGI that report $X_{Ms,Mkv}$. We need the share of expenditure μ_{jsu} that establishments in location j use from the type u companies that produce in the sector s. We calculate these shares at the country level for Mexico and assume $\mu_{jsu} = \mu_{Mkv}$ for every CZ j, sector $s = k, \ \forall s, k$ and types $u = v, \ \forall u, v$. Define

$$\mu_{Mkv} \equiv \frac{\sum_s X_{Ms,Mkv}}{\sum_s \sum_v X_{Ms,Mkv}}.$$

Appendix C.7.2 RoW

FDI First, we acquire $X^{\text{OECD}}_{isu,jkv,t}$ and $X^{\text{WIOD}}_{isu,jF,t}$ for $u, v \in \{\text{formal}, \text{FDI}\}$ from the Analytical Activities of MNEs (AMNE) database provided by the OECD to calculate the share of FDI establishments $\alpha_{RoWs\text{FDI}}$ in total RoW production and share of production $\mu_{RoWs\text{FDI}}$ for each sector s. AMNE reports bilateral flows for 59 countries (mainly OECD members) and 34 industrial sectors based on ISIC revision 4 (see Table C2 for the correspondence table for our sectors to OECD). We apply the negative inventories correction proposed by Costinot and Rodríguez-Clare (2014).

Let

$$\alpha_{RoWs\text{FDI}} \equiv \frac{\sum_{i \notin M} \sum_j \sum_k \sum_{v \in \{F,\text{FDI}\}} X^{OECD}_{isFDI,jkv,2013}}{\sum_{i \notin M} \sum_{u \in \{F,\text{FDI}\}} \sum_j \sum_k \sum_{v \in \{F,\text{FDI}\}} X^{OECD}_{isu,jkv,2013}},$$

and

$$\mu_{RoWs\text{FDI}} \equiv \frac{\sum_i \sum_s \sum_{u \in \{F,\text{FDI}\}} \sum_{j \notin M} X^{OECD}_{isu,jkFDI,2013}}{\sum_i \sum_s \sum_{u \in \{F,\text{FDI}\}} \sum_{j \notin M} \sum_{v \in \{F,\text{FDI}\}} X^{OECD}_{isu,jkv,2013}}.$$

Informal We borrow the informal production share estimates (computed with a Dynamic General Equilibrium model) from Elgin et al. (2021) for every country except Mexico in year 2013. We estimate the RoW's share of informal production as a weighted average of each country's estimate. Let ω_i be the share of GDP of country i with respect to the global GDP excluding Mexico. We use countries' GDPs reported by the World Bank. Furthermore, data constraints will force us to assume $\alpha_{RoWsI} = \alpha_{RoWI}$ for all sectors s, also, we will assume that the share of expenditure $\mu_{RoWsI} = \alpha_{RoWsI}$, then,

$$\alpha_{RoWI} \equiv \sum_{i \notin M} \omega_i \alpha_{iI}, \text{ with } \sum_{i \notin M} \omega_i = 1.$$

Table C2: Concordance table INEGI-OECD

Sector	ISIC code
1	A-B
2	D-E
3	F, L
4	C10-C15
5	C16-C23
6	C24-C33
7	G
8	G
9	H
10	H
11	J58-J61
12	K
13	J62-J63, M-N
14	P-Q
15	R-S
16	I

Formal Finally, we calculate the formal shares residually. Let

$$\alpha_{RoWsF} = 1 - \alpha_{RoWsI} - \alpha_{RoWsFDI},$$

and

$$\mu_{RoWsF} = 1 - \mu_{RoWsI} - \mu_{RoWsFDI}.$$

Appendix C.8 Share of consumption by type of establishment

We define the share of consumption λ_{jsu} by agents in location j from establishments in sector s and type u sequentially as:

$$\lambda_{js\text{FDI}} \equiv \begin{cases} \frac{\sum_{j \notin M} \sum_i X^{\text{OECD}}_{is\text{FDI},jC,2013}}{\sum_{j \notin M} \sum_{u \in \{F,\text{FDI}\}} \sum_i X^{\text{OECD}}_{isu,jC,2013}} & \text{if } j \notin M \\ \frac{\sum_i X^{\text{OECD}}_{is\text{FDI},MC,2013}}{\sum_{u \in \{F,\text{FDI}\}} \sum_i X^{\text{OECD}}_{isu,MC,2013}} & \text{otherwise} \end{cases},$$

then, we divide the remaining proportion between the formal and informal sector proportional to their expenditure shares:

$$\lambda_{jsF} \equiv (1 - \lambda_{jsFDI}) \left(\frac{\mu_{jsF}}{\mu_{jsF} + \mu_{jsI}} \right),$$
$$\lambda_{jsI} \equiv (1 - \lambda_{jsFDI}) \left(\frac{\mu_{jsI}}{\mu_{jsF} + \mu_{jsI}} \right).$$

Appendix C.9 Gravity system

Appendix C.9.1 Setup

We start with the standard gravity equation.

$$X_{isu,j} = \left(\frac{w_{isu}\tau_{isu,j}}{P_{jsu}}\right)^{-\varepsilon} E_{jsu}, \qquad P_{jsu}^{-\varepsilon} = \sum_i \left(w_{isu}\tau_{isu,j}\right)^{-\varepsilon}$$

where P_{jsu} is the price index, w_{isu} are wages in establishment-sector-location i, s, u, $\tau_{isu,j}$ are iceberg costs, and ε is the trade elasticity. We know that $\sum_j X_{isu,j} = R_{isu}$ and hence $\sum_j \left(\frac{w_{isu}\tau_{isu,j}}{P_{jsu}}\right)^{-\varepsilon} E_{jsu} = R_{isu}$. This implies $w_{isu}^{-\varepsilon}\Pi_{isu}^{-\varepsilon} = R_{isu}$, where $\Pi_{isu}^{-\varepsilon} = \sum_j \tau_{isu,j}^{-\varepsilon} P_{jsu}^{\varepsilon} E_{jsu}$. Let $\tilde{P}_{jsu} \equiv P_{jsu}^{-\varepsilon}$ and $\tilde{\Pi}_{isu} \equiv \Pi_{isu}^{-\varepsilon}$, and $\tilde{\tau}_{isu,j} \equiv \tau_{isu,j}^{-\varepsilon}$. Given $\left\{E_{jsu}\right\}, \left\{R_{isu}\right\}$, and $\left\{\tilde{\tau}_{isu,j}\right\}$, we can get $\left\{\tilde{P}_{jsu}\right\}$ and $\left\{\tilde{\Pi}_{isu}\right\}$ for all i, s, u from the following system:

$$\begin{aligned} \tilde{P}_{jsu} &= \sum_i \tilde{\tau}_{isu,j}\tilde{\Pi}_{isu}^{-1} R_{isu} \\ \tilde{\Pi}_{isu} &= \sum_j \tilde{\tau}_{isu,j}\tilde{P}_{jsu}^{-1} E_{jsu} \end{aligned} \tag{C3}$$

Note that we can write the previous system as $|\mathcal{S}| \times |\mathcal{U}|$ independent systems of equations, each of them with $2 \times |\mathcal{L}|$ variables and $2 \times |\mathcal{L}|$ unknowns. The solution for $\left\{\tilde{P}_{jsu}, \tilde{\Pi}_{isu}\right\}$ is unique up to a constant; therefore, we have to normalize $\tilde{P}_{1su}$ $\forall s, u$ by imposing $\tilde{P}_{1su} = 100$ on each of the systems. Then we can compute our outcome of interest $\left\{X_{isu,j}\right\}$ from

$$X_{isu,j} = \tilde{\tau}_{isu,j}\tilde{\Pi}_{isu}^{-1}\tilde{P}_{jsu}^{-1} R_{isu} E_{jsu}. \tag{C4}$$

We now need to construct $\left\{E_{jsu}\right\}, \left\{R_{isu}\right\}$, and $\left\{\tilde{\tau}_{isu,j}\right\}$ for each sector-region before solving the system of equations in (C3). Once we solve the system, we can then compute $X_{isu,j}$ according to (C4).

Appendix C.9.2 Distance and own-sector elasticities

To solve the gravity system, we must first compute the iceberg cost $\tilde{\tau}_{isu,j}$ for the establishments of type u in every sector s that sends products from location i to the location j. We will estimate $\tilde{\tau}_{is,j}$ defined as the trade cost of sending sector s goods from location i to location j and assume (1) trade costs are the same for MNCs and formal establishments in the same sector; (2) informal establishments do not trade (face infinite trade costs) outside of their location; (3) within the same location, informal establishments face the same trade cost as MNCs and formal establishments to compute $\tilde{\tau}_{isu,j}$. We summarize Assumption (1) as follows:

$$\tilde{\tau}_{isu,j} \equiv \tilde{\tau}_{is,j} \ \forall u \in \{\text{MNC, Formal}\}; \forall s; \forall i, j$$

Then, Assumptions (2) and (3) are equivalent to:

$$X_{isI,j} = \begin{cases} R_{isI} & \text{if } i = j \\ 0 & \text{otherwise} \end{cases}$$

We then get $\{\tilde{\tau}_{is,j}\}$. First, we impose the following functional form:

$$\tilde{\tau}_{is,j} = \left(\text{dist}_{ij}^{\delta_s} \alpha_s^{\iota_{ij}}\right) \exp\left(\xi_{is,j}\right) \quad \forall i, s, j \tag{C5}$$

where ι_{ij} is an indicator variable equal to 1 if region $i = j$, and $\xi_{is,j}$ is an idiosyncratic error term. In addition, δ_s captures the standard distance elasticity, which varies by the sending sector, and α_s captures the additional inverse resistance to trading with others compared to oneself.

We estimate $\{\delta_s, \alpha_s\}_{s \in \mathcal{S}}$ running separate regressions by sector using the functional form:

$$X_{is,j} = \left(\text{dist}_{ij}^{\delta_s} \alpha_s^{\iota_{ij}}\right) \exp\left(\xi_{is,j}\right) \tilde{\Pi}_{is}^{-1} \tilde{P}_{js}^{-1} R_{is} E_{js},$$

where $X_{is,j}$ is total sales of location i and sector s to location j (in all sectors in location j). We can rewrite the previous equation as follows:

$$X_{is,j,t}^{\text{WIOD}} = \exp(\lambda_{is,t} + \lambda_{js,t} + \delta_s \ln \text{dist}_{ij} + \tilde{\alpha}_s \iota_{ij} + \xi_{is,j,t}) \tag{C6}$$

where $\tilde{\alpha}_s = \ln \alpha_s$, $\lambda_{is,t}$ are year-by-origin fixed effects and $\lambda_{js,t}$ are year-by-destination fixed effects for each regression. We estimate equation (C6) using the panel of bilateral trade flows between WIOD countries using the pseudo-Poisson maximum likelihood function to obtain structural gravity (Fally, 2015). Table C3 presents the estimation results for the parameters.

Table C3: Gravity Regressions

Dependent Variable:	Bilateral flow $X^{\text{WIOD}}_{is,j,t}$															
Sector:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
$\log(\text{dist}_{ij})$	-1.148***	-0.8146***	-0.7127***	-0.8113***	-0.9358***	-0.8929***	-0.7397***	-1.058***	-0.5406***	-0.6916***	-0.6478***	-0.7487***	-0.6722***	-0.7822***	-0.4038***	-0.6835***
	(0.0425)	(0.0298)	(0.0417)	(0.0220)	(0.0254)	(0.0249)	(0.0263)	(0.0495)	(0.0240)	(0.0330)	(0.0242)	(0.0461)	(0.0319)	(0.0295)	(0.0366)	(0.0364)
ι_{ij}	3.058***	5.209***	7.649***	2.931***	2.448***	1.584***	4.533***	5.495***	4.209***	4.788***	5.074***	5.403***	4.403***	6.934***	5.838***	4.865***
	(0.1354)	(0.0933)	(0.1262)	(0.0900)	(0.0774)	(0.0797)	(0.0844)	(0.1244)	(0.0739)	(0.0905)	(0.0774)	(0.1512)	(0.1284)	(0.1962)	(0.1367)	(0.2218)
Fixed-effects																
Origin × Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Destination × Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics																
Observations	21,660	21,660	21,660	21,660	21,660	21,660	21,660	21,660	21,660	21,660	21,660	21,660	21,660	21,660	21,660	21,660
Pseudo R^2	0.93777	0.98102	0.99761	0.96376	0.94941	0.93772	0.96794	0.98249	0.95296	0.97026	0.98316	0.97539	0.95844	0.99607	0.97771	0.95559

Clustered (Origin × Year & Destination × Year) standard-errors in parentheses
Signif. Codes: ***: 0.01, **: 0.05, *: 0.1

We take the estimates $\left\{\hat{\delta}_s,\hat{\alpha}_s\right\}_{s=1}^{S}$ to compute $\left\{\hat{\delta}_s,\hat{\alpha}_s\right\}_{s=1}^{S}$ and construct the bilateral $\tilde{\tau}_{isu,j}$ for Mexico as:

$$\tilde{\tau}_{isu,j} = \text{dist}_{ij}^{\hat{\delta}_s}\hat{\alpha}_s^{\iota_{ij}} \ \forall u \in \{\text{MNC, Formal}\}\,; \forall s; \forall i, j$$

Appendix C.9.3 Consumption by sector

We need to normalize consumption C_{js} because we assume that the total consumption should sum up to WIOD. In addition, it should respect the spatial and sectoral allocation provided by ENIGH. We comply with these assumptions by normalizing the consumptions as follows:

$$C_j^* = \frac{\sum_s C_{js}}{\sum_{j\in M}\sum_s C_{js}} C_M^{WIOD}$$

$$C_{js}^* = \frac{C_{js}}{\sum_s C_{js}} C_j^*$$

Appendix C.9.4 Expenditures and revenues by type

For RoW We will first compute E_{RoWs}^* in year 2013 from WIOD. This should be straightforward as the $E_{RoWs}^*\& \equiv \sum_{i\notin M} X_{is,j}^{\text{WIOD}}$.

Next, we go from R_{RoWs}^* to R_{RoWsu}^* and from E_{RoWs}^* to E_{RoWsu}^*. We will assume $R_{RoWsu}^* = \alpha_{RoWsu} R_{RoWs}^*$, where α_{isu} is the share of production done by establishments of type u defined in Section Appendix C.7. Analogously, assume $E_{RoWsu}^* = \alpha_{RoWsu} E_{RoWs}^*$.

For Mexican CZs Note that the total expenditure $E_{j,k}$ of region j in sector k could be written as

$$E_{jsu}^* = \mu_{jsu} \sum_k \phi_{js,k}(1-\phi_{j,k}) R_{jku}^* + \lambda_{jsu} C_{js}^*, \tag{C7}$$

where $\phi_{j,sk}$ is the share of inputs in sector s coming from sector k in location j, and and $\phi_{j,s}$ is the share of value added in gross production s in location j. Finally, we construct E_{jsu} using $E_{jsu}^* = \alpha_{jsu} E_{js}^*$. From now on we will use $\left\{R_{is}^*, E_{jsu}^*\right\}$ as the new $\left\{R_{isu}, E_{jsu}\right\}$.

Appendix C.9.5 Solving the system

Fix some combination of s and u. For each s and u we will solve a system of equations for the location pairs. Let CZ be the cardinality of $|M|$ (i.e., number of commuting zones in Mexico). Let $P_{su} \equiv (\tilde{P}_{1su}, \tilde{P}_{2su}..., \tilde{P}_{CZsu}, \tilde{P}_{ROWsu})'$, $\Pi_{su} \equiv (\tilde{\Pi}_{1su}, \tilde{\Pi}_{2su}..., \tilde{\Pi}_{CZsu}, \tilde{\Pi}_{ROWsu})'$. To solve each system, we follow this algorithm:

1. Guess an initial vector of prices $P_s u^0$ in each pair of locations i, j.

2. Given a vector $\vec{P_{su}}$:

- Solve for the production price index $\tilde{P}i_{su}$.

$$\tilde{\Pi}_{isu} = \sum_j \tilde{\tau}_{isu,j} \tilde{P}_{jsu}^{-1} E_{jsu}$$

- Solve for the consumer price index $\tilde{P}i_{su}$.

$$\tilde{P}_{jsu} = \sum_i \tilde{\tau}_{isu,j} \tilde{\Pi}_{isu}^{-1} R_{isu}$$

- Normalize $\tilde{P}_{su} = 100$.

Finally, the algorithm stops when $||\tilde{P}_{su}^{n+1} - \tilde{P}_{su}^{n}||_\infty < \varepsilon$ for a fixed ϵ, $||\cdot||_\infty$ is the supreme norm.

Appendix C.10 The final bilateral flows between locations, sectors and types

The gravity procedure explained above helps us to get $\{X_{isu,j}\}$. Now, we need to assign the flows that go to the location j among the types of establishments and the receiving sectors at that location. These receiving sectors could use the good from sector s as an intermediate input.

1. Let $\phi_{js,k}$ be the share of inputs in sector k that come from sector s, in location j according to the IO matrix in j. We will assume it is the same for all establishment types given a location-sector. Let ϕ_{jkv} be the share of value added to the gross production of establishments v in sector k in the location j. We will compute this as the share of the wage bill in the total sales for each j, k, v. We will then normalize $\phi_{jkv} + \sum_p \phi_{j,pk} = 1; \forall j, k, v$.

2. Let $\gamma_{ku,v}$ be the share inputs of good k produced by establishments of type u that establishments of type v purchase (among all purchases of input k by establishments v). This means that $\sum_w \gamma_{kw,v} = 1; \forall k, \forall v$. Note that the total expenditure of the region j of goods sent by establishments of type u in sector s (E_{jsu}) could be written as $E_{jsu} = C_{jsu} + \sum_w \sum_p \tilde{\phi}_{j,pu,sw} R_{jpw}$, where $\tilde{\phi}_{j,ku,sv} = \gamma_{ku,v} \times \phi_{j,sk} \times (1 - \phi_{jkv})$. This is to say that the total expenditure is a sum of the total final consumption plus total expenditure in intermediates of all establishment-types (that is why it sums across u) and all sectors since all sectors potentially use sector s and an input (that's why we sum across k). The expenditure in intermediates for each establishment-type, in each sector, depends on how the sectors are connected through the IO matrix $\phi_{j,sk}$, how large the purchasing sector is R_{jkv}, how much the sectors uses intermediate goods $1 - \phi_{jkv}$, and how likely are establishments of a certain type to buy from another type $\gamma_{ku,v}$.

   Important:

- We need to take a stance on $\gamma_{ku,v}$. How? We are likely to assume that $\gamma_{ku,v} = 0$ when u is informal and v is MNC (MNCs do not supply from informal establishments).[21] But what about the rest? In the worst case scenario we can assume

$$\gamma_{ku,v} = \begin{cases} 0 & \text{if } u \text{ or } v \text{ are informal or MNC} \\ \frac{\sum_{l\in MX} E_{lku}}{\sum_{w\in\{MNC,formal\}}\sum_{l\in MX} E_{lkw}} & \text{if } u \text{ is formal or MNC and } v \text{ is MNC} \\ \frac{\sum_{l\in MX} E_{lku}}{\sum_{w}\sum_{l\in MX} E_{lkw}} & \text{otherwise} \end{cases}$$

1. Let's assume that $X_{isu,jC} = \lambda_{isu,j} C_{jsu}$ with $\lambda_{isu,j} \equiv \frac{X_{isu,j}}{\sum_l X_{lsu,j}}$, and $C_{jsu} = \lambda_{jsu} C_{js}$.

1. Finally, we can define:

$$X_{isu,jkv} = \frac{\tilde{\phi}_{j,ku,sv} R_{jkv}}{\sum_w \sum_p \tilde{\phi}_{j,pw,sv} R_{jpw}} \cdot \left[X_{isu,j} - X_{isu,jC}\right].$$

Note (and check) that:

$$X_{ist,j} \equiv X_{ist,jC} + \sum_p \sum_w X_{isu,jpw}$$

which is correct. Proof $X_{isu,jC} + \sum_p \sum_w X_{isu,jpw} = X_{isu,jC} + \sum_w \sum_p \frac{\tilde{\phi}_{j,pu,sw} R_{jpw}}{\sum_w \sum_p \tilde{\phi}_{j,pu,sw} R_{jpw}} \cdot \left[X_{isu,j} - X_{isu,jC}\right] = X_{isu,jC} + \left[X_{isu,j} - X_{isu,jC}\right] = X_{isu,j}$

Appendix C.11 Imposing additional restriction to the gravity system

This is something we will do at the end. We want the aggregates to add up to WIOD. This is, we want

1. Exports of Mexico (country) by sector to coincide with the exports of Mexico by sector in WIOD
2. Imports of Mexico (country) by sector to coincide with the imports of Mexico by sector in WIOD
3. Sales from Mexico to Mexico as a whole (by sector) to coincide with WIOD
4. Sales from the RoW to the RoW as a whole (by sector) to coincide with WIOD

This is, we will end up using some $X^*_{isu,jkv}$ such that:

$$\sum_{i\in M}\sum_{j\notin M}\sum_k\sum_u\sum_v X^*_{isu,jkv} = X^{WIOD}_{M,RoW,s}$$

[21] Would MNCs be interested in trading with informal establishments at all? We're restricting one way, but, I'd think it should be two way. The other way (informal to MNC) is easily justifiable because of RS policies. Both ways should be restricted because of legal policies and the impossibility of contract enforcement. (We know related literature like Boehm and Oberfield). JP: good point. I am happy to assume $\gamma_{ku,v} = 0$ when v is informal and u is MNC as well. Can you fix the formula then?

$$
\begin{aligned}
\sum_{i \notin M} \sum_{j \in M} \sum_{k} \sum_{u} \sum_{v} X^{*}_{isu,jkv} &= X^{WIOD}_{RoW,M,s} \\
\sum_{i \in M} \sum_{j \in M} \sum_{k} \sum_{u} \sum_{v} X^{*}_{isu,jkv} &= X^{WIOD}_{M,M,s} \\
\sum_{i \notin M} \sum_{j \notin M} \sum_{k} \sum_{u} \sum_{v} X^{*}_{isu,jkv} &= X^{WIOD}_{RoW,RoW,s}
\end{aligned}
\tag{C8}
$$

This means that once we get the $\{X_{isu,jkv}\}$, we will define $\forall s,k \in \mathcal{S}; \forall u,v \in \mathcal{U}$:

$$
X^{*}_{isu,jkv} = \begin{cases}
\frac{X_{isu,jkv}}{\sum_{i \in M} \sum_{j \notin M} \sum_k \sum_u \sum_v X_{isu,jkv}} X^{WIOD}_{M,RoW,s} & \text{if } i \in M \text{ and } j \notin M \\
\frac{X_{isu,jkv}}{\sum_{i \notin M} \sum_{j \in M} \sum_k \sum_u \sum_v X_{isu,jkv}} X^{WIOD}_{RoW,M,s} & \text{if } i \notin M \text{ and } j \in M \\
\frac{X_{isu,jkv}}{\sum_{i \in M} \sum_{j \in M} \sum_k \sum_u \sum_v X_{isu,jkv}} X^{WIOD}_{M,M,s} & \text{if } i \in M \text{ and } j \in M \\
\frac{X_{isu,jkv}}{\sum_{i \notin M} \sum_{j \notin M} \sum_k \sum_u \sum_v X_{isu,jkv}} X^{WIOD}_{RoW,RoW,s} & \text{if } i \notin M \text{ and } j \notin M
\end{cases}
$$

Note that by construction, the previous definition satisfies equations (C8) but this should be something to check in the code.

Appendix D Other data

Time-consistent commuting zones Between 1994 and 2019, Mexico both created new municipalities and merged some municipalities, making it necessary to create time-consistent commuting zones (CZs). We began with an initial mapping of municipalities to CZs for 2019, which became our reference for the CZ definitions. In 2019, there were 781 CZs in Mexico. Then, to keep track of changes in municipality codes, new municipalities, and municipalities that split or merged, we used the "Catálogo Único de Claves de Áreas Geoestadísticas Estatales, Municipales y Localidades" from INEGI for the 2000-2020 period. For the 1994-2000 period, we used INEGI's census reports of new municipalities.

In 1994, CZs had a mean of 12,196 workers per CZ, a median of 980, a minimum of 4 workers, and a maximum of 2,535,464 workers. In 2019, CZs had a mean of 30,379 workers and a median of 3,081, whereas the minimum and maximum of total workers were 9 and 4,872,287, respectively. CZs have an average area of 2,460.2 km^2 and a median of 666.4 km^2. The smallest CZ has 4.3 km^2, and the biggest has an area of 52,982 km^2.

Concordance between industry classifications The industry classification used in the 1994 Economic Census differs from the NAICS classification used in the subsequent Economics Censuses (1999-2019). In the 1994 Economic Census, INEGI used the "Mexican Classification of Activities and Products" (CMAP in Spanish). CMAP comprises nine sectors that disaggregate into sub-sectors, branches, and classes. We created a manual mapping between the 30 CMAP sub-sectors (used in 1994) and the 21 NAICS two-digit codes (used between 1999 and 2019) to a set of 16 broad sectors. Table D1 shows the concordance between these 16 broad sectors and each industry classification.

Table D1: Concordance table INEGI-NAICS

Sector	CMAP (1994)	NAICS (1999-2019)
Agriculture/Mining	11, 21, 22, 23, 29	11, 21
Energy/Maintenance	41, 42	22, 56
Construction/Rentals	50, 82, 83	23, 53
Foods/Textile	31, 32	31
Chemical/Paper/Non-metallic	33-36	32
Metallic/Machinery/Equipment	37-39	33
Wholesale Trade	61	43
Retail Trade	62	46
Transport	71	48
Postal and Storage	72	49
Media	94	51
Finance and Insurance	81	52
Professional Services	95, 97	54
Healthcare/Education/Social Assistance	92	61-62
Other Services	96	71, 81
Accommodation Services	93	72

Commuting-zone level controls Data for part of our commuting zone-level controls comes from the "Integrated Public Use Microdata Series" (IPUMS) for Mexico. The Mexico IPUMS data is based on the General Population and Housing Census taking place every ten years. We use beginning-of-decade General Population and Housing Census data for the two years we observe each decade in the Economic Census. Namely, we use the 1990 values for 1994 and 1999, the 2000 values for 2004 and 2009, and the 2010 values for 2014 and 2019. From IPUMS, we use the following commuting-zone level controls: (i) the share of individuals living in a place designated as urban; (ii) the share of individuals working in manufacturing; (iii) the share of individuals with a completed secondary degree; (iv) the share of individuals who are employed; (v) the share of individuals in routine occupations; (vi) the share of indigenous individuals; and (vii) the share of foreign-born individuals.

We also use Comtrade data to build three measures of CZ-level exposure to imports of Mexico from the U.S. and China and to the growing exports of China to Mexico's main export markets from 1994. These measures adapt to the Mexican setting the exposure measures proposed by Autor et al. (2013). We use two-digit HS import data from Comtrade and map these HS codes to ISIC4 two-digit industry codes using the R package concordance by Liao et al. (2020).

The first two measures aim to control for changes in the import patterns of Mexico from two important global trade partners, China and the U.S. China's becoming a member of the WTO in 2001 is an event with plausible repercussions for Mexican labor markets. The U.S. gained preferential access to the Mexican market after NAFTA came into force in 1994. Instead of directly using the change in imports of Mexico from these two countries (which might reflect endogenous responses to demand or supply shocks in Mexico), we leverage the changes in the imports of countries Ω from the U.S. and China, respectively. Namely, Ω includes Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Guyana, Jamaica, Nicaragua, Panama, Peru, Paraguay, Uruguay, and Venezuela (as in Blyde et al., 2020). Changes in imports of countries Ω from China and the U.S. capture the supply-driven component in Mexico's imports from China and the U.S., in addition to changes in demand from China from countries at comparable levels of development as Mexico and distance to China. In addition, for the U.S.-specific measure, we add Canada to the set Ω, as NAFTA has plausibly affected Canada's imports from the U.S. similarly to how it has affected Mexico's imports.

To build CZ-level measures of exposure to the imports from the U.S. and China, we apportion the "shock" (the change in imports of countries Ω from the U.S. and China) to CZs based on their 1994 employment in the relevant industry j and CZ cz. The measure is then translated into a per-worker measure by dividing it by the CZ cz overall employment in 1994. Namely, we build the following CZ-level measure of exposure to changes in imports from the U.S. and China as follows:

$$\Delta IPW_{o,cz,t} = \frac{1}{L_{cz,1994}} \sum_{j} \frac{L_{cz,j,1994}}{L_{j,1994}} \Delta M_{jt}^{H\to\Omega} \tag{D9}$$

where cz indexes CZs in Mexico, j is a broad sector category, $H \in \{U.S., China\}$, and L is employment. $\Delta M_{jt}^{H\rightarrow RoW}$ represents the change in exports from either the U.S. or China to the set of countries Ω between $(t-5)$ and t.

Second, we build a CZ-level measure of Mexico's competition with China in the markets to which Mexico traditionally exported. Namely, we build the changes in the exports of China to the main importing partners of Mexico in 1994, i.e., the exports of China to the U.S., Canada, Japan, Spain, and France (who jointly account for about 90% of Mexico's export that year).

The measure of exposure to competition with China is given by equation (D10), where $k \in$ {Japan, Spain, France, U.S., Canada}. We aggregate across countries k the changes in exports of China to each country k, weighted by the importance of imports from Mexico for that specific country. For a CZ cz and industry j, we weigh the export competition shock by the importance of industry j in the employment of that CZ cz in 1994.

$$Exp_{cz,t} = \frac{1}{L_{cz,1994}} \sum_j \frac{L_{cz,j,1994}}{L_{j,1994}} \left[\sum_k \frac{M_{j,1994}^{MX\rightarrow k}}{M_{j,1994}^{k}} \Delta M_{jt}^{China\rightarrow k} \right] \tag{D10}$$

where cz indexes CZs in Mexico, j is a broad sector category, L is employment, $\frac{M_{j,1994}^{MX\rightarrow k}}{M_{j,1994}^{k}}$ is the share of imports of country k from Mexico out the total imports of country k in 1994, and $\Delta M_{jt}^{China\rightarrow k}$ denotes the change of imports of country k from China between $(t-5)$ and t.

Appendix E Additional model derivations

Appendix E.1 Allen-Uzawa Demand Elasticities

In this section, we derive the AU elasticities based on the first order approximation. We divide the section into three different blocks, how final consumers substitute products, how producers substitute inputs for factors and other inputs, and how producers substitute factors for factors and other inputs.

Appendix E.1.1 Final consumers

Let's assume that entity c corresponds to final consumers in the respective commuting zone, and that j corresponds to an entity of any of the firm types. Recall that we normalize global GDP, then the total consumption from entity c in goods produced by entity j is:

$$X_{cj} = \tilde{\Omega}_{cj}\lambda_c. \tag{E11}$$

Then we have that we can decompose the change in the expenditure in goods j between the change in the expenditure share and the change in income:

$$d\ln X_{cj} = d\ln \tilde{\Omega}_{cj} + d\ln \lambda_c.$$

We will first focus on the change of $\tilde{\Omega}$ and then compute the change in the income from location c, λ_c

Change for FDI varieties Let's start assuming that $j \in \mathcal{M}$, this means that j is a variety of foreign firms. Then, the expenditure share in goods j of consumer c is given by:

$$\tilde{\Omega}_{cj} = \left(\frac{\alpha_{cj} p_{cj}^{1-\sigma_M}}{\sum_h \alpha_{ch} p_{ch}^{1-\sigma_M}} \right) \left(\frac{\alpha_{cM} P_{cM}^{1-\epsilon}}{P_{cF}^{1-\epsilon}} \right) \left(\frac{\alpha_{cF} P_{cF}^{1-\xi}}{P_c^{1-\xi}} \right)$$

Taking the derivative with respect to the change of all prices, the change in the expenditure from consumer c in goods produced by entity j is:

$$\begin{aligned} d \ln \tilde{\Omega}_{cj} = (1 - \sigma_M) & \left[d \ln p_{cj} - \sum_{h \in \mathcal{M}} \tilde{\Omega}_{ch|cM} d \ln p_{ch} \right] \\ & + (1 - \epsilon) \left[d \ln P_{cM} - \tilde{\Omega}_{cM|cF} d \ln P_{cM} - \tilde{\Omega}_{cD|cF} d \ln P_{cD} \right] \\ & + (1 - \xi) \left[d \ln P_{cF} - \tilde{\Omega}_{cF} d \ln P_{cF} - \tilde{\Omega}_{c\mathrm{I}} d \ln P_{c\mathrm{I}} \right] \end{aligned}$$

where $\tilde{\Omega}_{ch|cM}$ means the normalized expenditure share of producer h within the FDI varieties, and the same logic applies for the formal domestic varieties, and the formal and informal sectors. Deriving each one of the price index we get:

$$\begin{aligned} d \ln P_{cM} &= \sum_{h \in \mathcal{M}} \tilde{\Omega}_{ch|cM} d \ln p_{ch} \\ d \ln P_{cD} &= \sum_{i \in \mathcal{D}} \tilde{\Omega}_{ci|cD} d \ln p_{ci} \\ d \ln P_{c\mathrm{I}} &= \sum_{r \in \mathcal{I}} \tilde{\Omega}_{cr|c\mathrm{I}} d \ln p_{cr} \\ d \ln P_{cF} &= \tilde{\Omega}_{cM|cF} d \ln P_{cM} + \tilde{\Omega}_{cD|cF} d \ln P_{cD} \\ d \ln P_c &= \tilde{\Omega}_{cF} d \ln P_{cF} + \tilde{\Omega}_{c\mathrm{I}} d \ln P_{c\mathrm{I}} \end{aligned}$$

Recall that the system of equations we are solving is:

$$d \ln \tilde{\Omega}_{cj} = \delta_c(j,j) d \ln p_{cj} + \sum_k \tilde{\Omega}_{ck} \theta_c(j,k) d \ln p_{ck},$$

where $\theta_c(j,k)$ is how consumer c substitutes the good k for good j, and $\delta_c(j,j)$ is the own elasticity.[22] We can solve for the EoS for the different cases of k. The easiest case is when $k \in \mathcal{I}$, this is if k is an informal variety, then we get that:

$$\theta_c(j,k) = (\xi - 1).$$

In the case in which $k \in \mathcal{D}$, and if we consider only the partial change in $d \ln p_{ck}$, we get that:

[22] For example, in the CES case $\delta_c(j,j)$ is just $1 - \sigma$.

$$d\ln\tilde{\Omega}_{cj} = \left[(\epsilon-1)(\tilde{\Omega}_{cD|cF}\tilde{\Omega}_{ck|cD}) + (\xi-1)(\tilde{\Omega}_{cF}\tilde{\Omega}_{cD|cF}\tilde{\Omega}_{ck|cD} - \tilde{\Omega}_{cD|cF}\tilde{\Omega}_{ck|cD})\right] d\ln p_{ck}.$$

Note that $\tilde{\Omega}_{cF|c}\tilde{\Omega}_{cD|cF}\tilde{\Omega}_{ck|cD} = \tilde{\Omega}_{ck}$, then:

$$d\ln\tilde{\Omega}_{cj} = \tilde{\Omega}_{ck} \underbrace{\left[(\epsilon-1)\left(\frac{1}{\tilde{\Omega}_{cF}}\right) + (\xi-1)\left(1-\frac{1}{\tilde{\Omega}_{cF}}\right)\right]}_{\theta_c(j,k)} d\ln p_{ck}.$$

The third case to study in this block is when $k \in \mathcal{M}$. In this case and considering only the partial change of $d\ln p_{ck}$ we get that:

$$\begin{aligned} d\ln\tilde{\Omega}_{cj} = &\Big[(\sigma_M-1)\tilde{\Omega}_{ck|cM} \\ &+ (\epsilon-1)(\tilde{\Omega}_{cM|cF}\tilde{\Omega}_{ck|cM} - \tilde{\Omega}_{ck|cM}) \\ &+ (\xi-1)(\tilde{\Omega}_{cF}\tilde{\Omega}_{cM|cF}\tilde{\Omega}_{ck|cM} - \tilde{\Omega}_{cM|cF}\tilde{\Omega}_{ck|cM})\Big] \\ &\times d\ln p_{ck} \end{aligned}$$

Recall that $\tilde{\Omega}_{ck} = \tilde{\Omega}_{cF}\tilde{\Omega}_{cM|cF}\tilde{\Omega}_{ck|cM}$. Then, we get that:

$$d\ln\tilde{\Omega}_{cj} = \tilde{\Omega}_{ck} \underbrace{\left[(\sigma_M-1)\left(\frac{1}{\tilde{\Omega}_{cM|cF}\tilde{\Omega}_{cF}}\right) + (\epsilon-1)\left(\frac{1}{\tilde{\Omega}_{cF}} - \frac{1}{\tilde{\Omega}_{cF}\tilde{\Omega}_{cM|cF}}\right) + (\xi-1)\left(1-\frac{1}{\tilde{\Omega}_{cF}}\right)\right]}_{1-\theta_c(j,k)} d\ln p_{ck}$$

Then, the only parameter that we are missing to calculate is $\delta_c(j,j)$, in this case, this is just $1-1-\sigma_M$

Change for formal domestic varieties Now let's assume that $j \in \mathcal{D}$, by symmetry we then can compute the AU elasticities:

- If $k \in \mathcal{I}$:

$$\theta_c(j,k) = \xi - 1$$

- If $k \in \mathcal{M}$:

$$\theta_c(j,k) = \left[(\epsilon-1)\left(\frac{1}{\tilde{\Omega}_{cF}}\right) + (\xi-1)\left(1-\frac{1}{\tilde{\Omega}_{cF}}\right)\right]$$

- If $k \in \mathcal{D}$:

$$\theta_c(j,k) = \left[(\sigma_D-1)\left(\frac{1}{\tilde{\Omega}_{cD|cF}\tilde{\Omega}_{cF}}\right) + (\epsilon-1)\left(\frac{1}{\tilde{\Omega}_{cF}} - \frac{1}{\tilde{\Omega}_{cF}\tilde{\Omega}_{cD|cF}}\right) + (\xi-1)\left(1-\frac{1}{\tilde{\Omega}_{cF}}\right)\right]$$

- And finally the own elasticity δ is:

$$\delta_c(j,j) = 1 - \sigma_D$$

Change for informal domestic varieties The change for informal domestic varieties is easy as there is only one type of variety in the nest, let's assume that $j \in \mathcal{I}$. Then, we will get the following AU elasticities:

- If $k \in \mathcal{M}$ or $k \in \mathcal{D}$:

$$\theta_c(j,k) = \xi - 1$$

- If $k \in \mathcal{I}$:

$$\theta_c(j,k) = 1 - \left[(\sigma_{\mathrm{I}} - 1) \left(\frac{1}{\tilde{\Omega}_{c\mathrm{I}}} \right) + (\xi - 1) \left(\frac{1}{\tilde{\Omega}_{c\mathrm{I}}} \right) \right]$$

- And finally the own elasticity δ is:

$$\delta_c(j,j) = 1 - \sigma_{\mathrm{I}}$$

Appendix E.1.2 Foreign producers

In this section, we derive the Allen-Uzawa elasticities for the foreign producers. Recall that a producer can substitute an intermediate input for an intermediate input, an intermediate input for a production factor or vice-versa, and a production factor for another production factor.

Foreign producers use a nested CES technology to produce output (see equation 5). In this first section, we will look at the EoS for intermediate inputs. Let's start assuming that $j \in \mathcal{M}$, which means that the intermediate input is a foreign variety. The expenditure share in varieties M from location c' is:

$$\tilde{\Omega}_{M(c),M(c')} = \left(\frac{\beta_{M(c),M(c')} p^{1-\sigma_M}_{M(c),M(c')}}{\sum_h \beta_{M(c),M(h)} p^{1-\sigma_M}_{M(c),M(h)}} \right) \left(\frac{\beta_{M(c),M} P^{1-\epsilon}_{M(c),M}}{P^{1-\epsilon}_{M(c),F}} \right) \left(\frac{\beta_{M(c),F} P^{1-\zeta}_{M(c),F}}{P^{1-\zeta}_{M(c)}} \right)$$

Then, we get the following EoS:

- If k is a factor of production then:

$$\theta_{M(c)}(j,k) = \zeta - 1$$

- If k is an intermediate input of formal domestic varieties then

$$\theta_{M(c)}(j,k) = \left[(\epsilon - 1) \left(\frac{1}{\tilde{\Omega}_{M(c),F}} \right) + (\zeta - 1) \left(1 - \frac{1}{\tilde{\Omega}_{M(c),F}} \right) \right]$$

- If k is an intermediate input of foreign varieties then

$$\theta_{M(c)}(j,k) = \left[(\sigma_M - 1)\left(\frac{1}{\tilde{\Omega}_{M(c),M}}\right) + (\epsilon - 1)\left(\frac{1}{\tilde{\Omega}_{M(c),F}} - \frac{1}{\tilde{\Omega}_{M(c),M}}\right) + (\zeta - 1)\left(1 - \frac{1}{\tilde{\Omega}_{M(c),F}}\right)\right]$$

- Finally, foreign producers do not use informal varieties, which means that if k is an informal variety then:

$$\theta_{M(c)}(j,k) = 0$$

By symmetry, we get a similar result, if $j \in \mathcal{D}$. In particular:

- If k is a factor of production, then:

$$\theta_{M(c)}(j,k) = \zeta - 1$$

- If k is an intermediate input of foreign varieties:

$$\theta_{M(c)}(j,k) = \left[(\epsilon - 1)\left(\frac{1}{\tilde{\Omega}_{M(c),F}}\right) + (\zeta - 1)\left(1 - \frac{1}{\tilde{\Omega}_{M(c),F}}\right)\right]$$

- If k is an intermediate input of formal domestic varieties:

$$\theta_{M(c)}(j,k) = \left[(\sigma_D - 1)\left(\frac{1}{\tilde{\Omega}_{M(c),D}}\right) + (\epsilon - 1)\left(\frac{1}{\tilde{\Omega}_{M(c),F}} - \frac{1}{\tilde{\Omega}_{M(c),D}}\right) + (\zeta - 1)\left(1 - \frac{1}{\tilde{\Omega}_{M(c),F}}\right)\right]$$

- Finally, since foreign producers do not use informal varieties, if k is an informal variety then:

$$\theta_{M(c)}(j,k) = 0$$

We now turn to the factors of production:

Appendix E.2 Industries

So far, we have assumed a nested structure with three nests:

1. Formal vs. Informal
2. Within the formal sector: Formal domestic vs. FDI
3. Within each type of firm: a trade elasticity given by $\sigma_s - 1$

However, we are still missing the industry part and we need to be consistent with the assumptions that we use to construct the trade flow matrix X_{ij}. We have three different options:

1. Assume that the industry doesn't matter only the firm type, so even if there are two firms of the same type, but in different industries, the elasticity of substitution is $\sigma_s - 1$

2. Another option would be to assume that the third layer is only within the firm type and industry, then even if there are firms of the same type but in different industries the elasticity of substitution is $\epsilon - 1$

3. The final option is to assume a fourth nest in which there is more substuitability between firms of the same type within the industry and in this case we will need to add a new parameter $\zeta - 1$ in which in principle ζ can vary across industries.

Appendices References

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