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Employment Local Multipliers in Mexico*

Multiplicadores locales de empleo en México

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Abstract

In this paper we estimate the local multiplier of employment in the tradable sector on employment in the non-tradable sector in Mexico, over the 2000-2010 period. Instrumental variables estimations indicate that an exogenous change of one unit in employment in the tradable sector generates from 1.8 to 2.6 additional jobs in the non-tradable sector. Out of these, from 1 to 1.5 jobs correspond to the formal sector. Our results imply an opportunity for policy markers pursuing development strategies as the prevalence of a highly informal economy is often considered as an impediment for economic growth. Our study implies that creating jobs in the tradable sector represents a possible strategy for increasing formal employment in the non-tradable sector. Our analysis also reveals that increases in employment are twice as large for workers with nine and more years of education than for those with less than nine years of schooling.

Keywords: employment multipliers; shift-share; Mexico

JEL: J21, J23, R11, R23

Resumen

En este artículo estimamos el multiplicador local del empleo en el sector comerciable sobre el empleo en el sector no comerciable en México, para el periodo 2000-2010. Usando un estimador de variables instrumentales, nuestros resultados indican que un cambio exógeno de una unidad en el empleo en el sector comerciable genera entre 1.8 y 2.6 empleos adicionales en el sector no comerciable. De estos, entre 1 y 1.5 corresponden al sector formal. Nuestros resultados implican una oportunidad para los hacedores de política que persiguen estrategias de desarrollo, pues la prevalencia de una economía altamente informal se considera frecuentemente un impedimento para el desarrollo económico. Nuestro estudio señala que la creación de empleos en el sector comerciable es una posible estrategia para incrementar el empleo formal en el sector no comerciable. Nuestro análisis también revela que el incremento en el empleo para trabajadores con más de nueve años de educación es dos veces más grande que para aquéllos con menos de nueve años de educación.

Palabras clave: multiplicadores de empleo; shift-share; México

JEL: J21, J23, R11, R23

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Introduction

The magnitude of the local multipliers is a critical issue for regional economic development policies (Moretti, 2010; Moretti & Thulin, 2013; Van Dijk, 2016). Governments at the national and subnational levels spend considerable amounts of public money on policies aimed to attract new investments, reducing taxes and providing monetary and non-monetary incentives to firms, under the assumption that these policies will incentivize local employment at the end. A complete assessment on the effectiveness of such policies involves not only the direct effect on labor demand, but also the so called multiplier effects: the effects that an exogenous increase in employment in a city's given sector has on the rest of employment in other sectors in the same city.

The empirical literature of local multipliers initiated by Moretti (2010) looks at the multiplier effect that occurs when one job is created in the tradable sector (which's prices are set at the national level) and that produces additional demand for goods and services. Van Dijk (2018) studies subsequent work – building on Moretti's (2010) empirical strategy – and the robustness of his results to alternative assumptions. Certainly, most work grounded in Moretti (2010) focused on the US and other developed countries.

In Mexico, the 1994 North American Free Trade Agreement (NAFTA) inaugurated a period of economic change oriented to the deregulation of the economy and trade and financial openness. Since then, policy efforts have included measures such as subsidies and tax exemptions, diverse programs to promote exports, sector-specific programs to attract investment in key industries – for example, the automobile and the electronics industries –, among many others (see a characterization of Mexican industrial policy – and the lack of it – in the post-NAFTA period in Moreno-Brid, 2013 and Moreno-Brid et al., 2005). Local employment multipliers are thus an important dimension of economic policy as they represent the externalities that occur at the local labor markets due to the generation of new employment in a sector or subsector of the economy.

In this paper we estimate the local employment multiplier in the tradable sector in Mexican cities. We also assess the quality of this indirect job creation, as informality is a widely observed phenomenon that may be the source of economic sluggishness (see a debate in Levy, 2018). We use employment data for 369 Mexican cities from the 2000 and 2010 Population and Housing Census of Mexico. Following Moretti (2010), we use an instrumental variable approach to solve the endogeneity issue that emerges when unobserved shocks affect both, the employment in the tradable and the non-tradable sectors in the local economy. Our instrument is the shift-share of tradable employment, which exploits the differences in local manufacturing structure across cities to isolate the impacts of nationwide changes in employment demand. Our identifying assumption is that the shares of the subsectors that contribute the most to the shift-share are not correlated to changes in demand in the non-tradable sector.

Several findings emerge from our research. First, we quantify an economic and statistically significant multiplier effect of tradable employment on non-tradable employment. An additional new job in the tradable sector generates from 1.8 to 2.6 (depending on the specification) additional jobs in the non-tradable sector. The magnitude of the multiplier is in line with the estimated multipliers in other countries. In his seminal paper, Moretti (2010) estimated an employment multiplier of 2.6 for the U.S., while Van Dijk (2018) uses alternative specifications and finds a multiplier in the range of 1.17 and 1.93; for Sweden, Moretti and Thulin (2013) estimate a local multiplier in the range of 0.4–0.8. Furthermore, we also find a multiplier effect of 1.2-1.6 on the same tradable sector, which is indicative of agglomeration economies and productive linkages at the local level.

Regarding the characterization of the additional non-tradable employment generated by the initial shock, we find that most of the increase (1 to 1.6 extra jobs) is concentrated in the formal sector. Thus, the structure of the labor market can be eventually modified by increasing the amount of jobs in the tradable. This represents an opportunity for policy design given the precarity of informal work in Mexico, as these workers are not protected by the labor legislation and have no access to health services through their employer. We find that the employment multiplier favors skilled versus unskilled labor, which is consistent with the constant increase in the qualification of the Mexican labor force.

Our paper proceeds as follows. In section 1 we review the empirical evidence on employment multipliers, mostly coming from developed countries. We describe the empirical strategy we follow for estimating the local multipliers in section 2. In section 3 we present the results of the paper. Section 4 discusses our findings. Finally, section 5 concludes.

1. Estimating employment multipliers

Moretti's (2010) seminal paper presents a spatial equilibrium framework to estimate the long-term employment multiplier at the local level. A positive employment shock to a tradable industry has a positive effect on employment, both in the non-tradable sector and in other tradable industries. In order to interpret our findings, we consider the conceptual framework in Moretti and Thulin (2013).

We assume that each metropolitan area is a competitive economy that uses labor to produce a vector of nationally traded goods and a vector of non-traded goods. The price of the traded goods is set at the national market and therefore does not reflect local economic conditions, whereas the price of non-traded goods is determined locally. Labor is perfectly mobile across sectors within a city so, in the long run, the marginal product of labor and wages are equalized within a city. Workers have preferences over the income they can make from working– net of costs – and from living at a particular location, generating an upward sloping local labor supply. The stronger the specific-location preferences, the lower the mobility across cities. The supply of housing is upward sloping too, and amenities and public goods are assumed to be equal across locations.

A permanent increase in the demand for local labor in a tradable industry has a direct effect on employment in the tradable sector. But an often-neglected consequence is the indirect effect, which includes changes both in local employment in the rest of the tradable sector and in the non-tradable sector. Since we assume upward slopping curves for labor supply and housing, the shock to the labor market also generates general equilibrium effects increasing wages and housing prices. The effect on the local non-tradable sector is always positive because the city's aggregate income increases, expanding the local demand for non-tradables. The new jobs are split between existing residents and new residents, depending on the degree of geographical mobility (Moretti & Thulin, 2013).

Estimating job multipliers is challenging due to feedback effects across sectors. If there are unobserved shocks to non-tradable employment that also affect tradable employment, ordinary least squares (OLS) estimators become inconsistent. Moretti's (2010) approach addresses the endogeneity problem using a shift-share as an instrumental variable. The intuition behind this instrument is that nationwide changes in employment have differentiated effects across cities because of differences in the local industry mix and, thus, the instrument isolates changes that do not reflect local economic conditions.

Using data from the U.S. Census of Population and Housing, Moretti (2010) found that for each additional job in the tradable sector in each city, 1.6 jobs are created in the non-tradable sector in the same city. Using the same data, Van Dijk (2014) estimated a multiplier of only 1.02 by removing from the analysis industries that are not observed in every period and by not treating mining and agriculture as non-tradable industries. Accordingly, in this paper we use Moretti's (2010) empirical strategy and show the robustness of our results to the Van Dijk (2014) critique.

Magrini and Girolimetto (2011) implemented a nonparametric procedure that allows spatial effects to estimate the local multipliers for 363 Metropolitan Areas in the U.S., between 2001 and 2008. These authors find a U-shaped relationship between tradable and non-tradable, instead of a linear effect: the additional effect on non-tradable employment is extremely small (less than 0.2) for low initial employment levels and reaches approximately the value of one for an employment size of about 350,000, and the subsequent decline cannot be considered a significant feature.

Subsequent papers have adopted Moretti's approach to estimate the multiplier effect, mainly in developed countries. Moretti and Thulin (2013) estimate a multiplier in the range of 0.4–0.8 jobs in Sweden for the period 1995-2007. Notably, the multiplier effect was significantly larger for jobs with high level of human capital and for high-technology industries. Adding a tertiary education job to the tradable sector of a local economy results in the creation of 3 additional jobs in the non-tradable sector in the long run. On the same line, Faggio and Overman (2014) analyzed the impact of public sector employment on local labor markets using English data for 2003–2007. These authors find that the positive multiplier on tradable employment is offset by the crowding out in manufacturing jobs, yielding an almost-zero net effect. While for Japan, Kazekami (2017) estimates an elasticity of 1.2 of tradable employment to changes in the manufacturing employment.

Most of the work on the magnitudes and characteristics of local multipliers comes from developed countries, while there is scarce evidence from developing countries and, particularly, for Latin America. Macedo and Monasterio (2016) estimated employment multipliers between the industrial and services sectors of around 7 using data from Brazilian mesoregions between 2000 and 2010, which is very far from any other estimate in the literature we are aware of. For the case of Mexico, Pereira and Soloaga (2013) estimate a local multiplier of 3.

In this paper, we contribute with a study for Mexico considering a larger set of 369 cities from the National Urban System. We test the sensitivity of the estimated multiplier to the classification of industries, as Van Dijk (2014). We also assess the quality of this indirect job creation, as informality is a widely observed phenomenon that may be the source of economic sluggishness. Moreover, we contribute to the understanding of the identification assumptions behind the estimation of employment multipliers based on isolating local national shocks to industry subsectors from the variation due to the local productive structure.

2. Empirical strategy

We adopt the same methodology as Moretti and Thulin (2013) and model the new employment in the non-tradable sector as a function of the new employment in the manufacturing sector. Thus, we estimate the following equation:

$$E_{c,t}^{NT} - E_{c,t-1}^{NT} = \alpha + \beta_1 E_{c,t-1}^{NT} + \beta_2 \left(E_{c,t-1}^{NT}\right)^2 + \gamma\left(E_{c,t}^{T} - E_{c,t-1}^{T}\right) + \varepsilon_{c,t} \qquad (1)$$

where $E_{c,t}^{k}$ is the employment level in sector $k = \{T\,(\text{tradable}),\ NT\,(\text{non-tradable})\}$, at time t in city c. The parameter γ is the local multiplier. We control for convergence effects using the initial level of employment in the non-tradable sector. When estimating the employment multiplier at different subgroups, the left-hand-side sums only over the relevant type of work.

To estimate the multiplier effect on the tradable sector we randomly divide the tradable sector of city c and calculate the employment change $\left(E_{c,t}^{T1} - E_{c,t-1}^{T1}\right)$. Then, we estimate the multiplier resulting from a change in the remaining part $\left(E_{c,t}^{T-T1} - E_{c,t-1}^{T-T1}\right)$. In practice, we estimate the following equation:

$$E_{c,t}^{T1} - E_{c,t-1}^{T1} = \hat{\alpha} + \hat{\beta}_1 E_{c,t-1}^{T1} + \hat{\beta}_2 \left(E_{c,t-1}^{T1}\right)^2 + \hat{\gamma}\left(E_{c,t}^{T-T1} - E_{c,t-1}^{T-T1}\right) + \epsilon\varepsilon_{c,t} \qquad (2)$$

where $E_{c,t}^{T1}$ stands for a randomly selected subsample of the tradable sector. It is expected that $\gamma > \hat{\gamma}$ due to the increase in labor costs because of the demand shock (Moretti, 2010). The effect on the non-tradable sector is always positive since the income effect induces a higher demand for personal services, food, transportation, among other locally provided services and products. But the increases in costs affects the competitiveness of the tradable industry, which's prices are set nationally, so in the long run some work moves out to more competitive cities. A positive multiplier on the tradable industry can occur if there are agglomeration economies and if production chains involve several intermediate goods produced in the same city.

2.1 Addressing endogeneity of employment shocks

Estimating equation 1 via OLS leads to inconsistent estimates of the parameter vector if the error term is correlated with the right-hand-side variables. This is likely to occur in the presence of unobservable shocks that affect contemporaneously the tradable and non-tradable sectors. For example, changes in infrastructure, taxes and incentives, improvements in the quality of the labor force, among many others. To address this problem, we follow an instrumental variables (IV) strategy, using the variation in the local productive structure which isolates the variation coming from aggregate changes in employment. These subsector-specific changes affect cities differently because of the differentiated productive structure. This instrument is known in the economics literature as a *shift-share* and was first used by Moretti (2010) to study employment multipliers.

For each city c, we construct a shift-share instrument that considers nationwide demand shifts over the period 2000-2010 in sector j, excluding changes that occur at city c. These changes are then weighted by the importance of sector in the total employment of city c. In practice, this instrument is calculated using 22 three-digits industries of the North American Industry Classification System (NAICS), as follows:

$$z_c = \sum_j^{J=22} E_{c,j,t-1}^T \left(\ln\left(E_{j,t}^T - E_{c,j,t}^T \right) - \ln\left(E_{j,t-1}^T - E_{c,j,t-1}^T \right) \right) \qquad (3)$$

The shift-share instrument was introduced by Bartik (1991) and Blanchard and Katz (1992) and has been used extensively afterwards in applications on trade, immigration literature, crime, parental investment, among many others. Jaeger et al. (2018) list over 60 economic studies in the last 20 years that hinge on the exogenous variation at the local level coming from changes at the national level. In our study, this assumption means that national shocks on individual industries of the tradable sector affect the local economies proportionally to the employment shares of those industries in the total employment and that the national shocks and the lagged industry shares are exogenous to local labor markets changes in employment over time (De Blasio & Menon, 2011).

2.2 On the validity of the shift-share instrument[1]

The shift-share instrument (also known as the Bartik instrument) is based on a decomposition of local employment growth in the tradable sector into three effects. Consider the tradable employment change in Equation 1 $E^T_{c,\Delta} = \left(E^T_{c,t} - E^T_{c,t-1}\right)$, and define $s_{j,c,t-1} = \frac{E^T_{c,j,t-1}}{\sum_j E^T_{c,j,t-1}}$, the share of employment in subsector j in the total tradable employment in city c. We can then decompose tradable employment change in city c as the weighted sum of the changes in all tradable subsectors in city c, $E^T_{j,c,\Delta}$, where weights are given by the subsectors' tradable employment share:

$$E^T_{c\Delta} = \sum_{j=1}^{J} s_{c,j,t-1} E^T_{c,j\Delta} \qquad (4)$$

Equation 4 shows that a change in tradable employment can be decomposed into the sum of structural effect $s_{j,c,t-1}$ weighted by location-subsector specific grow rates $E^T_{c,j\Delta}$. But the term $E^T_{j,c,\Delta}$ can be further decomposed into a nationwide change in subsector j and an idiosyncratic city-subsector change:

$$E^T_{c,j,\Delta} = E^T_{j,\Delta} + \tilde{E}^T_{c,j,\Delta}$$

Thus, the shift-share in equation 3 can be rewritten as:

$$z_c^{'} = \sum_{j=1}^{J} s_{c,j,t-1} E^T_{j,\Delta} \qquad (5)$$

which is the inner product of the subsector-location shares (the *share*) and the subsector national employment changes (the *shift*), and can be interpreted as the expected employment change in city c, based on the period $t-1$ subsectors

[1] We thank an anonymous referee for suggesting the inclusion of this discussion.

composition. Moreover, Goldsmith-Pinkham et al. (2020) demonstrate that the shift-share estimator is numerically equivalent to estimating an overidentified model with each individual share as an instrument, and where the shifts contribute only to the weighting matrix in the GMM estimation. In other words, this result indicates that are the shares and not the shifts the source of identifying variation. A consequence of this result is that the multiplier effect estimated using the shift-share requires the exogeneity of the shares, and not the shifts, for consistency.

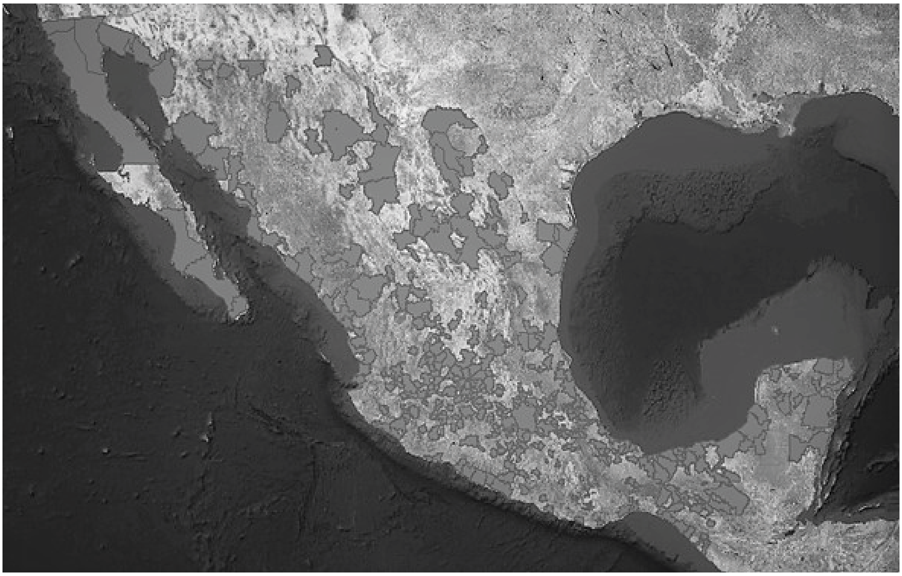
Our identification strategy thus relies on the differentiated expansion of Mexican manufacturing subsectors during the 2000 decade. These changes affected cities demand for tradable employment differently, depending on the industry mix of each city. In the results section we show how the performance of subsectors was very heterogeneous in the aggregate. Furthermore, we perform an analysis as suggested in Goldsmith-Pinkham et al. (2020) to uncover which subsectors account for the largest variation in the shift-share instrument. And finally, we show that the shares in 2000 were not systematically correlated to observable characteristics of the cities' population, supporting our claim of exogeneity.

3. Data and descriptive statistics

The employment data used in this paper comes from the 2000 and 2010 Mexican Population and Housing Census. This information includes demographic and employment characteristics of the Mexican population. We use the data on the industry of employment to characterize the sector of employment. We restrict our analysis to workers aged 18-66 who live in one of the 369 cities identified by the Mexican National Urban System 2012 (SUN), which areas are plotted in Figure 1.[2]

[2] The 2010 SUN classification includes 384 cities that coincide with one or more municipalities. Nevertheless, few municipalities include more than one city. In such cases, 14 cities were redefined as a conglomerate of two or, in one case, original cities from the catalogue.

Figure 1. Cities in the Urban National System (SUN)



Source: Author's elaboration with information from INEGI/CONAPO.

Taking into consideration Mexico's educational structure, skilled workers in the sample are defined as those individuals with nine or more years of schooling. This is a conventional definition of skilled in the case of Mexico. For example, it is one of the definitions used by Cortez (2001) in his analysis of wage inequality and by Pereira and Soloaga (2013) in their analysis of local multipliers and informal employment.

The two-digit NAICS sectors were classified in two sectors mutually exclusive categories -tradable and non-tradable- according to the traditional or, as called by Moretti and Thulin (2013), *assumption methodology*, which regards mainly the manufacturing sector as tradable and the services sector as non-tradable. Following Dijk (2014) we exclude natural resource-dependent sectors (agriculture and mining). We also construct a more comprehensive industry classification which includes the agricultural sector. Total tradable employment thus includes the employment in the manufacturing sector plus the *tradable part* of agricultural employment. To determine the tradable agricultural employment, we exclude family workers without payment -considering them as employment for self-consumption- and include them as part of non-tradable sector. We call this the *alternative methodology*. In the appendix Table A1 we list the sectors classification using both methodologies.

Using the information on the access to health services from the census and based on ILO´s statistical manual (2012) and INEGI (2012), we define workers in the informal sector as those with no access to social security (medical services), independent workers and non-paid family work[3]. Workers affiliated only to Seguro Popular are considered as informal workers. The complement is defined as workers in the formal sector.

Table 1 presents descriptive statistics of the variables used in our analysis. Workers in the 369 cities used in this paper represent up to 91% of the total labor force aged 18-66 in the country. Over the 10-years period of analysis, the employment in these cities increased by 32%. This growth was highly concentrated in the non-tradable sector, which increased by 41%. On the other hand, tradable employment grew only 2%.

The share of informal employment in both tradable and non-tradable sectors is very high (57% and 40% in 2010, respectively) and remained relatively stable over the 2000-2010 period. This is an important characteristic of the Mexican labor force that impedes a more dynamic economic growth. For the same period, the overall schooling level of the labor force has increased considerably. The share of workers with more than secondary education increased by 10 percentage points in the non-tradable sector and by 12 percentage points in the tradable industry.

4. Results

4.1 On the shift-share identifying assumptions

Our empirical strategy for identifying the effects of changes in employment in the tradable sector on changes in employment in the non-tradable sector uses as an instrument the shift-share of employment in 22 subsectors of the Mexican manufacturing sector, defined as the sum of aggregate sectorial shocks, weighted by the relative importance of local productive structure. In subsection 2.2. we highlighted the contribution in Goldsmith-Pinkham et al. (2020) showing that the shift-share instrument consistency relies on the exogeneity of the shares.

Table 1. Descriptive statistics

Period	2000	2010	2000-2010 change
Total national employment	25,687,687	34,046,293	33%
Tradable employment	23%	18%	3%
Non-tradable employment	77%	82%	41%
Total employment in the 369 cities in the SUN	23,444,872	30,959,715	32%
% of total national employment	91%	91%	
Tradable employment	23%	18%	2%
Non-tradable employment	77%	82%	41%
	For the 369 cities in the SUN:		
% formal, non-tradables	44%	43%	
% informal, non-tradables	56%	57%	
% formal, tradables	64%	60%	
% informal, tradables	36%	40%	
% skilled, non-tradables	63%	73%	
% unskilled, non-tradables	37%	27%	
% skilled, tradables	59%	71%	
% unskilled, tradables	41%	29%	

Source: Author's elaboration.

Thus, we first motivate the use of our instrument showing four key facts about the components of our shift-share instrument.

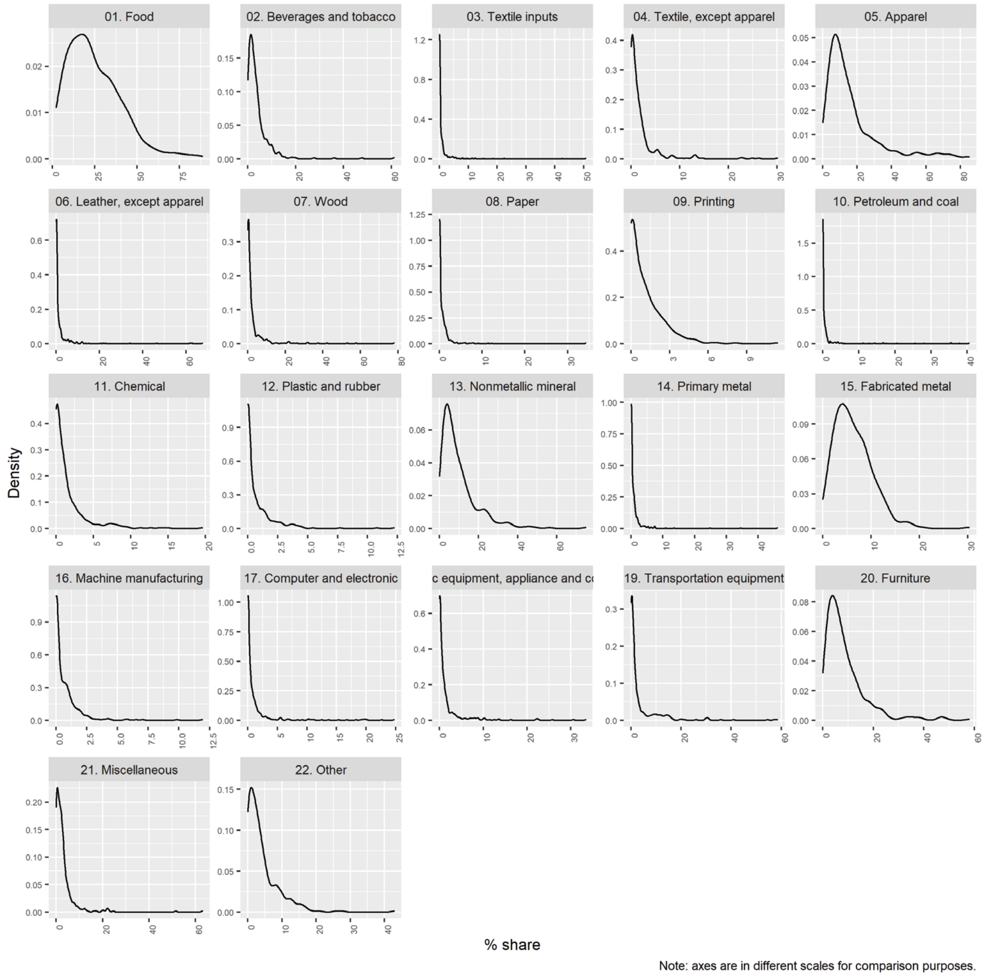
The first key fact is the differentiated performance of subsectors in the Mexican manufacture over the period analyzed in this paper. Employment in the manufacturing sector grew by 2% in the analyzed period. At the same time, as it is evident in Figure 2, there was a heterogeneous performance across subsectors at the national level. This fact means that cities were affected very differently by aggregate shocks, depending on the local productive structure. Figure 3 helps making this argument clearer by showing the density across cities of the employment share by subsector. Visibly, there is a lot of heterogeneity in the relative importance of subsectors: for many of these subsectors, employment shares are small in most cities, but for others, such as the food subsector (01), there is a good amount of cities with over 25% of their employment depending on a given productive activity.

In Figure 3 we plot the densities of the subsectors shares across cities. Consider again the food subsector, where employment grew in over 223,000 jobs. The corresponding panel for this subsector in Figure 3 makes clear how to interpret equation 5. Our shift-share instrument will exploit the interaction of a large positive aggregate shock, but that will affect cities in different ways. On the other hand, consider the panel corresponding to the apparel subsector in Figure 3, which lost about 147,000 jobs. Here, a large negative shock will affect a smaller number of cities.

Figure 2. National employment growth by manufacturing subsector 200-2010

Source: Author's elaboration.

Figure 3. Employment shares by sector



Source: Author's elaboration.

One of the main results in Goldsmith-Pinkham et al. (2020) is that the shift-share instrumental variables estimator is equivalent to a GMM estimator for an overidentified model in which the shares of a single subsector is used as an instrument, and in which the weighting matrix is given by the aggregate shifts. Thus, the shift-share estimator can be decomposed into a weighted sum of just-identified IV coefficients, weighted by the contribution of each individual share to the shift-share instrument:

$$\hat{\beta}_{shift-share} = \sum_j \alpha_j \beta_j \qquad (6)$$

where α_j can be positive or negative and represents the contribution of the share in subsector *j* to the shift-share instrument. By implementing the procedure proposed in Goldsmith-Pinkham et al. (2020), the second key fact in our application is that the five subsectors with the greatest weight represent 98% of the variation in the shift-share instrument: 01. Food (78%); 15. Fabricated metal (9%); 05. Apparel (8%); 07. Wood (2%); and 03. Textile inputs (1%). Thus, the exogeneity of the shift-share relies on the exogeneity of the shares in these five subsectors.

Although it is not possible to directly test for exogeneity, we analyze how the subsectors shares are correlated to cities' characteristics that might be correlated to the dependent variable in the structural equation, the employment growth in the non-tradable sector. Specifically, we run the following OLS regression for each subsector:

$$\begin{aligned} share_{j,2000} = {} & \alpha + \beta_1 fmale_{j,2000} + \beta_2 flocal_{j,2000} + \beta_3 funiversity_{j,2000} \\ & + \beta_4 onlyprimary_{j,2000} + \beta_5 schooling_{j,2000} + \beta_6 findigenous_{j,2000} \\ & + \beta_1 householdsize_{j,2000} + \beta_8 femalepart_{j,2000} \\ & + \beta_9 childmortality_{j,2000} + \varepsilon_{j,2000}, \\ & j = \{1, \ldots, 22\} \end{aligned} \qquad (7)$$

where *fmale* is the fraction of males in city *j*'s population, *flocal* is the fraction of the population that was born in the same state as *j*, *funiversity* is the fraction of the population older than 18 with a university degree in city *j*, *onlyprimary* is the share of the population older than 18 with only basic primary education, *schooling* is the average years of schooling of the population older than 15 in city *j*, *findigenous* is the share of indigenous population in city *j*, household size is the average household size in city *j*, *femalepart* is the percentage of women older than 12 that work, and *childmortality* is the child mortality for children older than 1 year of age per thousand children in city *j*. These characteristics come from the 2000 Population Census and from the National Population Council (CONAPO).

Table 2 reports the R-squared of each of these regressions. There is mild correlation between the observable cities' characteristics in 2000 and the subsectors' shares. The largest R-squared is 0.17 for the food subsector, meaning that the observable characteristics explain only 17% of the variation in the share of the food subsector across cities. The R-squared in the other four subsectors contributing the most to the shift-share are also below 0.16.

Table 2. R-squared statistics from OLS correlations of sector shares and cities' characteristics

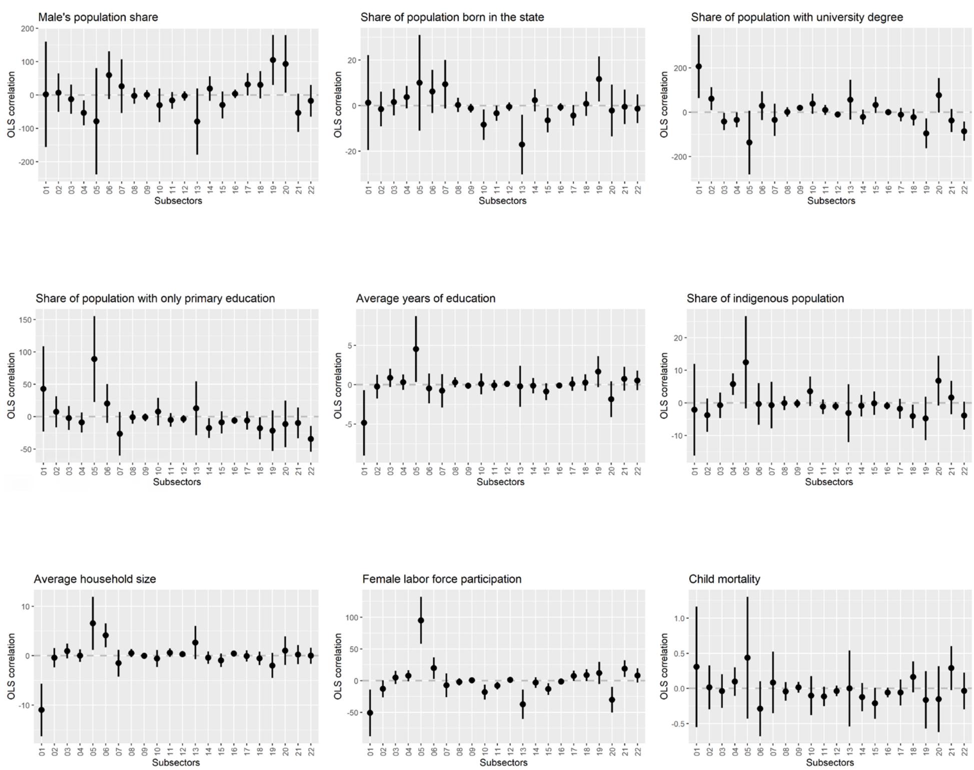
Subsector	R squared	Subsector	R squared
01. Food	0.16	12. Plastic and rubber	0.07
02. Beverages and tobacco	0.04	13. Nonmetallic mineral	0.06
03. Textile inputs	0.03	14. Primary metal	0.07
04. Textile, except apparel	0.10	15. Fabricated metal	0.09
05. Apparel	0.16	16. Machine manufacturing	0.10
06. Leather, except apparel	0.07	17. Computer and electronic	0.15
07. Wood	0.03	18. Electric equipment, appliance and component	0.10
08. Paper	0.03	19. Transportation equipment	0.17
09. Printing	0.09	20. Furniture	0.07
10. Petroleum and coal	0.05	21. Miscellaneous	0.05
11. Chemical	0.07	22. Other	0.16

Note: R-squared statistics for individual regressions in which the dependent variable es is cities' share of employment in a given subsector, and the regressors are described in equation 4.1. A high R-statistic can be interpreted as evidence that the observable characteristics predict subsector shares.
Source: Author's elaboration.

In Figure 4 we plot the corresponding coefficient for each regressor that results when estimating equation 7 for each of the 22 subsectors' shares. For two of the subsectors that contribute the most to the shift-share (food and apparel), shares across cities are correlated to educational outcomes and to the share of females participating in the labor market. The other three subsectors contributing the most to the instrument are not correlated to observable characteristics of cities in 2000. This reveals the precise assumption needed for identification:

the change in non-tradable employment must be uncorrelated to educational differences across cities and to the extent in which female labor force participation differs across locations. Of course, we cannot test exhaustively for all possible characteristics and the fact that there are characteristics correlated to the shares that contribute the most to the instrument means there might be some other factors, observable and non-observable, also correlated to the instrument. A final piece of evidence comes from the geographic concentration of economic activity.

Figure 4. OLS correlation coefficients on cities' demographic characteristics in 2000 from a regression



Note: this figure shows the coefficient on each characteristic across 22 OLS regressions correlating cities' employment growth in a given sector from 2000 to 2010 with five observable characteristics at the city level.
Source: Author's elaboration.

Table 3. Top-5 subsectors shares geographic concentration across cities

01. Food (13.52% of total manufacturing employment)		**05. Apparel** (13.11% of total manufacturing employment)		**19. Transportation Equipment** (7.71% of total manufacturing employment)		**22. Other** (7.68% of total manufacturing employment)		**20. Furniture** (6.59% of total manufacturing employment)	
Top-5 cities' share:		Top-5 cities' share:		Top-5 cities' share:		Top-5 cities' share:		Top-5 cities' share:	
Valle de México	22%	Valle de México	26%	Juárez	16%	Valle de México	23%	Valle de México	28%
Guadalajara	6%	La Laguna	6%	Valle de México	14%	Juárez	9%	Guadalajara	8%
Monterrey	5%	Puebla-Tlaxcala	5%	Monterrey	8%	Monterrey	9%	Monterrey	5%
Puebla-Tlaxcala	3%	Guadalajara	4%	Puebla-Tlaxcala	8%	Tijuana	6%	Tijuana	4%
Toluca	2%	Tehuacán	3%	Saltillo	6%	Guadalajara	6%	Puebla-Tlaxcala	4%

Note: each column corresponds to each of the top-5 subsectors with the largest national wide employment subsector share. For each sector shown, the rows represent the percentage of employment in the top-5 cities with the largest shares.
Source: Author's elaboration.

In Table 3 we report, for each of five the most important subsectors in terms of employment, the top-five cities' shares. For example, the transportation and equipment subsector accounts for 7.71% of the total manufacturing employment. Out of the total employment in this subsector, 16% is employed at Ciudad Juárez, 14% at Valle de México, and 8% at Monterrey. A similar pattern emerges for other subsectors. Thus, there might be a concern that production in certain subsectors is highly concentrated in some locations because of some unobserved factors. To reduce these concerns, the shift-shares expressed in equation 3 are computed as *leave-out* sums, that is, dropping the own-city subsector shares from the sum.

4.2 First-stage regressions

Once we have stated our identifying assumption in terms of the exogeneity of the shares, we motivate the validity of the shift-share in the first-stage regression, where the dependent variable is the employment change in the tradable sector between 2010 and 2010.

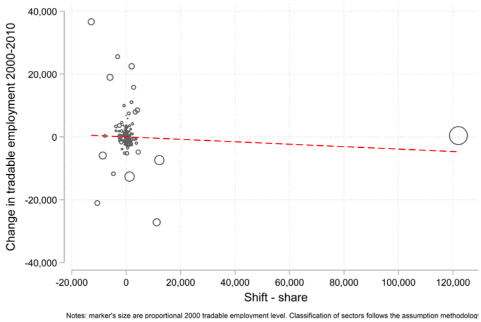
First, we show in Figure 5 the correlation between the (residual) growth in employment in tradables and the shift-share. Since we use the employment in the non-tradable sector in 2000 and its squared as controls in all specifications, we first *purge* the endogenous variable and plot the correlation between the instrument and the variation that is left in the endogenous variable after controlling for the baseline values of the dependent variable. As shown in Panel A, there is a negative relationship between the residuals of the endogenous regressor and the instrument, which is a first indication that our first stage estimations are valid.

In Panel B of Figure 5 we drop Valle de Mexico, which includes Mexico City and its metropolitan area, and which is clearly the largest value in the instrument and the largest and most important city in the country. The negative relationship still holds. In Panel C we drop Valle de Mexico and the second and third largest cities in the country, Guadalajara and Monterrey, resulting in the same pattern of negative correlation. Finally, in Panel D, we drop observations at the top 5% and at the bottom 5% of the distribution of tradable employment changes and the conclusion on the negative relationship between the residuals and the instrument does not change. Clearly, the inclusion of Valle de Mexico means the inclusion of an atypical observation, not only in terms of the share of labor, but also in the changes in tradable employment, which are captured by the shift-share. Throughout our analysis, we discard Valle de Mexico, so we believe our results are more representative for the average city in the country.

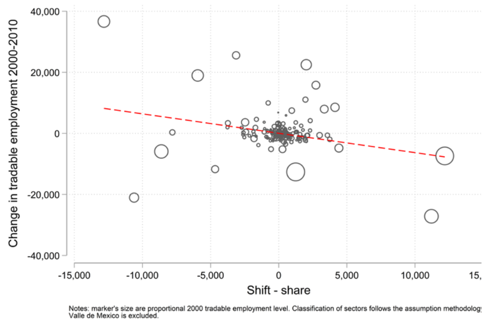
More formally, in Table 4, column (1) reports the first-stage using the *assumption methodology*. The coefficient on the shift-share instrumental variable is negative and statistically significant at the 99% level of confidence. The Angrist-Pischke F statistic is well above the rule of thumb of 10 for an IV first-stage with a single instrument, meaning that the instrument is relevant. An endogeneity test rejects the null hypothesis of the manufacture employment to be exogenous to the structural equation. Finally, two weak identification tests reject the null hypothesis of the first stage to be weakly identified. This evidence supports the use of the shift-share as instrumental variable of the employment growth in the tradable sector. In column (2) we include regional dummies, yielding almost identical results. For this purpose, we group the states into seven geographic regions: Capital, Center, Center-North, North, Gulf, Pacific and South. In column (3) we use the alternative classification methodology for subsectors, where we impute

Figure 5. Correlation between the (residual) growth in tradable employment and the shift-share instrument

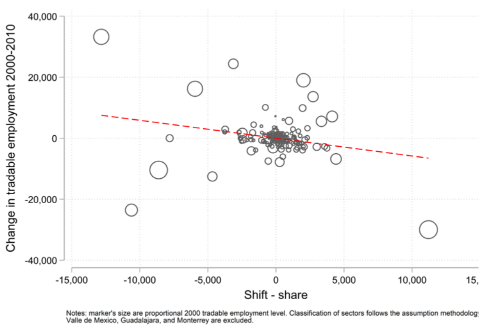
Panel A. All cities



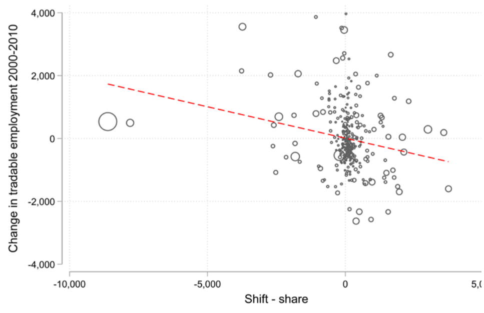
Panel B. Excluding Valle de Mexico



Panel C. Excluding Valle de Mexico, Guadalajara and Monterrey



Panel D. Excluding top and bottom 5% observations according to employment change 2000-2010



Note: residual growth in the tradable employment is the residual from a regression of tradable employment on level of non-tradable employment in 2000 $\left(E_{c,t-1}^{NT}\right)$ and its squared, which are used as controls in all specifications.
Source: Author's elaboration.

the non-paid labor in agriculture in the non-tradable sector[4]. Once again, alternative results are very similar to our baseline set of results. Finally, in column (4) we present the results adding regional dummy variables to the specification in column (3). The inclusion of region dummies barely modifies the magnitudes and significance in the first stage.

Table 4. First-stage results

	Dependent variable is change in tradable employment			
	(1)	**(2)**	**(3)**	**(4)**
Shift-share	-0.365***	-0.383***	-0.490***	-0.488***
	(0.102)	(0.103)	(0.116)	(0.115)
Non-tradable employment in 2000	0.040***	0.040***	0.041***	0.040***
	(0.005)	(0.005)	(0.006)	(0.006)
Non-tradable employment in 2000 (squared)	-0.000***	-0.000***	-0.000**	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-7.101	1646.787	620.535**	2136.475*
	(233.541)	(1146.611)	(269.150)	(1279.936)
N	368	368	368	368
Angrist-Pischke F statistic	12.75	13.68	17.74	17.92
Anderson-Rubin Wald test (p-value)	0.000	0.000	0.000	0.000
Stock-Wright LM S (p-value)	0.000	0.000	0.000	0.000
Anderson LM (p-value)	0.000	0.000	0.000	0.000
Tradables classification methodology	Assumption	Assumption	Alternative	Alternative
Region dummies	No	Yes	No	Yes

Notes: significance codes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors in parenthesis.
Source: Author's elaboration.

[4] We consider the family workers without payment as proxy of the employment for self-consumption in agriculture sector, and therefore we exclude them of the tradable employment.

4.3 Local multiplier estimates

In the first column of Table 5 we present the OLS estimates of the relationship between the change in the tradable sector employment and that in the non-tradable sector. The estimated correlation is positive and statistically significant. Nevertheless, this estimate is likely to be inconsistent for the reasons we have previously argued. Adding region dummies does not alter much this correlation, as shown in column (2).

Table 5. IV employment multiplier estimates on the non-tradable sector

	Dependent variable is change in non-tradable employment					
	OLS	**OLS**	**IV**	**IV**	**IV**	**IV**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Change in tradable employment 2000-2010	1.587***	1.188***	2.612*	2.519**	1.764*	1.832*
	(0.394)	(0.320)	(1.363)	(1.280)	(1.011)	(1.106)
Non-tradable employment in 2000	0.430***	0.441***	0.395***	0.401***	0.423***	0.424***
	(0.027)	(0.028)	(0.039)	(0.038)	(0.037)	(0.039)
Non-tradable employment in 2000 (squared)	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-132.840	-947.595	-118.446	-105.135	-1210.585	-168.953
	(509.968)	(578.518)	(584.940)	(2826.654)	(815.232)	(2490.599)
N	368	368	368	368	368	368
Tradables classification methodology	Assumption	Alternative	Assumption	Assumption	Alternative	Alternative
Region dummies	No	No	No	Yes	No	Yes

Notes: significance codes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors clustered at the state level in parenthesis
Source: Author's elaboration.

An IV strategy using the shift-share instrument motivated in section 2.1 is utilized to solve the endogeneity problem. In columns (3) through (6) we report these results. All errors are clustered at the state level. We estimate that a new job in the manufacture sector has a multiplier effect of 1.8 – 2.6 new jobs in the non-tradable sector.

In column (3) we use the assumption methodology to classify subsectors, with an estimated coefficient of 2.6. In column (4) we add regional dummies, and the result is practically unchanged. Columns (5) and (6) show our results when we re-estimate the same models but using the alternative methodology to classify subsectors. The estimated multiplier decreases to 1.8. Our results show an estimated multiplier of smaller magnitude than the one found by Pereira and Soloaga (2013) using a sample of the 58 largest Mexican metropolitan areas. Our sample includes their sample of cities plus many other smaller urban centers, so the multiplier effects are likely to be attenuated. Our results are in line with estimates from more developed economies, as discussed in section 1.

A second indirect effect of creating one job in the tradable sector is a multiplier effect in the same tradable sector. To estimate this, we randomly divide the sample of cities into two and estimate equation (2.2) following a similar IV strategy. The original employment increase means an increase in wages and housing for all workers in the city. This traduces into an increase in production costs, making the city less competitive. At the same time, the employment shock might stimulate the demand for intermediate goods linked to the production in the industry that received the shock, increasing labor demand. Then the sign and magnitude of the multiplier effect on the tradable sector is expected to be quantitatively smaller than the multiplier on the non-tradable sector or even negative. Our empirical results are reported in Table 6. The simple OLS correlation is estimated using the two different classification methodologies in columns (1) and (2) and is about 1.1 When we estimate the multiplier impact following the IV strategy, a multiplier between 1.2 and 1.6 is estimated. This is somehow different to the results in countries such as the U.S. or Sweden, where the estimated multiplier is, respectively, statistically non-significant or very small (0.33-0.41).

Table 6. IV employment multiplier estimates on the tradable sector

	Dependent variable is change in tradable employment			
	OLS	**OLS**	**IV**	**IV**
	(1)	**(2)**	**(3)**	**(4)**
Change in tradable employment 2000-2010	1.009***	1.002***	1.199***	1.592***
	(0.084)	(0.075)	(0.316)	(0.254)
Non-tradable employment in 2000	-0.006	-0.001	-0.029	-0.055
	(0.019)	(0.018)	(0.042)	(0.046)
Constant	316.716**	302.811*	201.118	-130.467
	(117.574)	(168.506)	(205.248)	(206.552)
N	368	368	368	368
Tradables classification methodology	Assumption	Alternative	Assumption	Alternative

Notes: significance codes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors clustered at the state level in parenthesis.
Source: Author's elaboration.

One potential drawback in our empirical strategy is the limited number of clusters, which could lead to a high over-rejection rate (Cameron & Miller, 2015). In Appendix tables A2 through A4 we report our multiplier estimates using jackknife standard errors clustered at the state level. The standard errors in most of our specifications considerably increase, making most of our estimates imprecise.[5]

[5] The question of whether researchers should or should not cluster their standard errors in practice remains open. For example, Abadie et al. (2017) argue that there are two reasons for clustering standard errors. A first one is if the data comes from a clustered sampling scheme designed to extrapolate conclusions to a population. A second reason is treatment clustering in experimental analysis. None of these reasons can be applied to our data. We also performed the main analysis using only robust standard errors (without clustering). The results from this analysis are very similar to those presented in the main text and are available on request.

Employment multiplier by subgroups

An important guide for policy is to characterize the employment multiplier in terms of the subgroups that are likely to be affected indirectly by an additional job in the tradable sector. In Table 7 we report the estimated employment multiplier for groups of workers in terms of formality and qualification. We show the robustness of each estimate to the two different classifications of tradables used in this paper.

Table 7. Estimated employment multiplier by subgroups

Dependent variable is:	Formal employment		Informal employment	
	0.951*	1.557***	0.965	0.843
	(0.510)	(0.409)	(0.730)	(0.844)
Dependent variable is:	Skilled employment		Unskilled employment	
	1.436***	1.667***	0.691**	0.843*
	(0.389)	(0.455)	(0.292)	(0.456)
Tradables classification	Assumption	Alternative	Assumption	Alternative

Notes: significance codes: * p<0.05, ** p<0.01, *** p<0.001. Standard errors clustered at the state level in parenthesis.
Source: Author's elaboration.

First, when estimating the employment multiplier among formal and informal workers, the estimated coefficient is 1 when using the assumption methodology and 1.6 when using the alternative methodology. The impact on the informal employment is of 0.8 to 1, varying across specifications, but only imprecisely estimated. This means that the shock to the local economy due to the addition of a new job in the tradable sector seems to favor the formal employment. This is likely to occur because the new tradable jobs required more sophisticated goods and services produced locally. This finding is relevant given the high prevalence of informality in the non-tradable sector (up to 57% in 2010), so the creation of tradable jobs has also the benefit of accelerating the transition toward a more formal economy.

Secondly, we estimate the employment multiplier by type of skills. As we cannot observe from the census the precise activities workers perform in their jobs, we consider schooling as a proxy for qualification. We classify workers with less than 9 years of schooling (less than secondary education) as unskilled, while workers with 9 years of schooling and more are classified as skilled. We find that the additional job in the tradables sector favors skilled new employment in non-tradables. For each additional unskilled job that is created, about two skilled jobs emerge. This reflects the improvements in the qualification of the overall labor force: from 2000 to 2010, skilled employment in the non-tradable sector increased by 10 percentage points. Together with the previous result on formality, this means that the creation of employment in the tradable sector also benefits the growth of employment of those with more skills.

5. Conclusion

In this paper, we estimate the multiplier effect of an exogenous change in the size of the tradable employment on the number of new employees in the non-tradable sector and on the number of new employees in the tradable sector itself. We use employment data from the 2000 and 2010 Population and Housing Census of Mexico in 368 cities and follow an IV strategy to solve the endogeneity issue that emerges when unobserved shocks affect both, the employment in the tradable and the non-tradable sectors in the local economy. We estimate that one additional new job in the tradable sector generates from 1.8 to 2.6 additional jobs in the non-tradable sector. There is also a multiplier effect on the same tradable sector, which is indicative of agglomeration economies and productive linkages at the local level.

Regarding the characterization of the additional non-tradable employment generated by the initial shock, we find that most of the increase (1 to 1.6 extra jobs) is concentrated in the formal sector. Thus, the structure of the labor market can be eventually modified by increasing the amount of jobs in the tradable. This represents an opportunity for policy design given the precarity of informal work in Mexico as informal workers are not protected by the labor legislation and have no access to health services via their employer. We find that the employment multiplier favors skilled versus unskilled labor, which is consistent with the constant increase in the qualification of the Mexican labor force.

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Appendix

Table A1. Tradable and non-tradable classification using the assumption methodology

Classification methodology	Assumption		Alternative	
	2000	2010	2000	2010
Total national employment	23,444,872	30,968,766	25,685,430	33,342,212
Classified as tradable:				
Manufacturing	22.9%	17.8%	20.9%	16.5%
Agriculture, Forestry, Fishing and Hunting (excluding unpaid family work)	-	-	7.6%	6.4%
Classified as non-tradable:				
Agriculture, Forestry, Fishing and Hunting (unpaid family work)	-	-	1.1%	0.7%
Utilities	0.6%	0.6%	0.5%	0.5%
Construction	8.9%	9.0%	8.1%	8.4%
Wholesale trade	1.5%	2.8%	1.4%	2.6%
Retail trade	19.1%	19.5%	17.4%	18.1%
Transportation and Warehousing	5.5%	5.4%	5.0%	5.1%
Information	1.2%	1.2%	1.1%	1.1%
Finance and Insurance	1.2%	1.3%	1.1%	1.2%
Real Estate and Rental and Leasing	0.5%	0.7%	0.5%	0.6%
Professional, Scientific, and Technical Services	2.8%	3.5%	2.6%	3.3%
Management of Companies and Enterprises	0.0%	0.0%	0.0%	0.0%
Admin. and Support and Waste Management and Remediation Services	2.3%	3.6%	2.1%	3.3%
Educational Services	6.9%	6.8%	6.3%	6.3%
Health Care and Social Assistance	4.0%	4.1%	3.7%	3.8%
Arts, Entertainment, and Recreation	1.0%	1.0%	0.9%	1.0%
Accommodation and Food Services	5.8%	6.9%	5.3%	6.4%
Other Services (except Public Administration)	10.6%	10.3%	9.7%	9.6%
Public Administration	5.1%	5.4%	4.6%	5.1%

Note: own calculation using data from the Population and Housing Census 2000 and 2010. The sample includes individual workers aged 18 and 66 years. The assumption methodology follows Moretti and Thulin (2013).
The alternative methodology imputes in the non-tradable sector the fraction of unpaid family work in primary activities.

Table A2. IV employment multiplier estimates on the non-tradable sector using *jackknife* standard errors

	Dependent variable is change in non-tradable employment					
	OLS	**OLS**	**IV**	**IV**	**IV**	**IV**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Change in tradable employment 2000-2010	1.587***	1.580***	2.612	2.519	1.764	1.832
	(0.483)	(0.458)	(2.300)	(2.231)	(1.509)	(1.558)
Non-tradable employment in 2000	0.430***	0.433***	0.395***	0.401***	0.423***	0.424***
	(0.034)	(0.032)	(0.083)	(0.079)	(0.051)	(0.053)
Non-tradable employment in 2000 (squared)	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-132.840	1532.504	-118.446	-105.135	-1210.585	-168.953
	(624.983)	(1325.816)	(566.380)	(4008.638)	(1012.675)	(3338.816)
N	368	368	368	368	368	368
Tradables classification methodology	Assumption	Alternative	Assumption	Assumption	Alternative	Alternative
Region dummies	No	No	No	Yes	No	Yes

Notes: significance codes: * p<0.05, ** p<0.01, *** p<0.001. *Jackknife* standard errors clustered at the state level in parenthesis.

Table A3. IV employment multiplier estimates on the tradable sector using *jackknife* standard errors

	Dependent variable is change in tradable employment			
	OLS	**OLS**	**IV**	**IV**
	(1)	**(2)**	**(3)**	**(4)**
Change in tradable employment 2000-2010	1.009***	1.002***	1.199**	1.592
	(0.108)	(0.093)	(0.476)	(1.116)
Non-tradable employment in 2000	-0.006	-0.001	-0.029	-0.055
	(0.027)	(0.022)	(0.064)	(0.095)
Constant	316.716**	302.811	201.118	-130.467
	(142.409)	(199.639)	(284.712)	(963.347)
N	368	368	368	368
Tradables classification methodology	Assumption	Alternative	Assumption	Alternative

Notes: significance codes: * p<0.05, ** p<0.01, *** p<0.001. *Jackknife* standard errors clustered at the state level in parenthesis.

Table A4. Estimated employment multiplier by subgroups using *jackknife* standard errors

Dependent variable is:	**Formal employment**		**Informal employment**	
	0.951	1.557	0.965	0.843
	(1.090)	(1.815)	(1.212)	(1.470)
Dependent variable is:	Skilled employment		Unskilled employment	
	1.436***	1.667***	0.691	0.843*
	(0.369)	(0.509)	(0.918)	(0.452)
Tradables classification	Assumption	Alternative	Assumption	Alternative

Notes: significance codes: * p<0.05, ** p<0.01, *** p<0.001. *Jackknife* standard errors clustered at the state level in parenthesis.