# The Impact of Chinese Competition on Mexican Labor Outcomes*


Juan Blyde♦ IDB

Matias Busso• IDB

Valeria Faggioni IDB

Dario Romero IDB


This version: April, 2017


**ABSTRACT**

In this study, we examine the impact of Chinese import competition on Mexican labor outcomes between 1998 and 2013. We found that the adjustment in the labor market took two forms: a decline in the number of paid employees and a substitution of some paid employees by contract workers. We find that the shrinkage in the level of employment was met by an increase in the population that exit the labor force. Among the paid employees, we found that the negative impact was 3 times more severe on production workers than on non-production workers, indicating that workers with lower skills were affected more severely. This is confirmed with additional findings indicating that noncollege manufacturing workers experienced the main negative effects. Overall, the impact of Chinese competition on Mexican labor outcomes at the national level were relatively moderate, but the effects were heterogenous across regions and across different types of labor. The latter suggests that the design of any trade assistance policy should consider such heterogeneity issues carefully.



JEL No. F14, F16, J23

Key words: import competition, labor markets, employment


---


* We would like to thank Santiago Levy, Antoni Estevadeordal, Mauricio Mesquita Moreira, Christian Volpe, Danielken Molina, Denisse Pierola, Marisol Rodriguez, Filipe Lage De Sousa and Dennis Sanchez for helpful comments and suggestions on an earlier version of this paper. The views and interpretations in this study are strictly those of the authors and should not be attributed to the Inter-American Development Bank, its Board of Directors, or any of its member countries



♦ Correspondence address: Juan Blyde. Inter-American Development Bank, 1300 New York Ave., NW, Washington DC, 20755, U.S. Phone: (202) 623-3517, E-mail: juanbl@iadb

• Correspondence address: Matias Busso. Inter-American Development Bank, 1300 New York Ave., NW, Washington DC, 20755, U.S. Phone: (202) 623-2303, E-mail: mbusso@iadb

# 1 Introduction

The trade liberalization episodes of the early nineties triggered a period of product and labor markets adjustments in most countries that lowered their trade barriers. More recently, many countries have been facing a second trade shock, the rise of China as a manufacturing powerhouse. Propelled by the sheer size of its labor market and its notable low wages, China's exports of manufacturing products have increased by more than 6 times since the country joined the WTO in 2001. Accordingly, many nations have been facing a relentless increase in the competition from Chinese manufacturing products.

Importantly, the impact of China is likely to be heterogeneous within countries. For instance, Autor, Dorn and Hanson (2013) find that localities in the US that specialize in producing manufactured goods that are exported by China experienced the largest declines in employment while localities where the employment is concentrated in industries not competing with China were not affected by this shock. Therefore, like other trade shocks, even if there are net overall welfare gains from China's increased competition, the effects might be unevenly distributed across regions and across segments of the population within a country. Understanding these impacts might be important, for example, for policies that seek to compensate the losers of a trade shock.

In this paper, we examine the impact of the rising exposure to Chinese import competition across Mexican local labor markets. A local labor market is viewed as a place where employers and workers interact. They can be defined by commuting zones because these labor interactions normally exist in a space determined geographically by the boundaries of work and residence (Tolbert and Sizer, 1996). Importantly, local labor markets differ in their mix of industries that hire employment and thus the exposure to import competition tends to differ across locations. Such heterogeneity can be used to identify the impact of China's import competition on labor outcomes.

Autor, Dorn and Hanson (2013), for example, exploit variation in import exposure across US local labor markets and find that the increased competition from China between 1990 and 2007 explained about 21% of the decline in the US manufacturing employment during this period, or an equivalent of about 1.53 million workers. In this paper, we employ a similar methodology to examine the impact of Chinese import competition on Mexican labor outcomes. The methodology essentially relates the change in a labor market outcome of a region with the change in exposure to Chinese competition of that region, after controlling for a number of regional characteristics.

Mexico's pattern of specialization has been traditionally more biased towards the production of manufacturing goods than its peers in the Latin American region. This makes the analysis about Mexico particularly interesting. Figure 1 provides an illustration of how Chinese products have been increasingly penetrating the Mexican market. China's share in Mexican manufacturing imports went from a mere 1.3% in 1998 to more than 16% in 2014. It is important to note that China's import penetration also increased substantially in the US, Mexico's main export market. Figure 2 shows that China surpasses Mexico's share of US imports in the year 2002. Since the US is by far the main destination market of Mexican manufacturing exports (around 90% in 2000), the increase of Chinese competition in the US might have not come unnoticed in Mexico. In this study, we analyze how Mexican local labor markets were affected by Chinese import competition in Mexico but also in the US.

We studied the impact of China on Mexican labor outcomes over the years 1998 and 2013. We found that the increased exposure to Chinese imports affected Mexican manufacturing jobs negatively. We found that the adjustment in the labor force took two forms: a decline in the number of paid employees and a substitution of some paid employees by contract workers. We find that the shrinkage in the level of employment was met by an increase in the population that exit the labor force. Among the paid employees, we found that the negative impact was 3 times more severe on production workers than on non-production workers, indicating that workers with lower skills were affected more severely. This is confirmed with additional findings indicating that noncollege manufacturing workers experienced the main negative effects. We also provide evidence that the largest impacts took place during the first part of the 15-year period that we analyzed, suggesting that the largest adjustments might be behind. Finally, we found that the full impact on employment at the national level was relatively moderate. Had import penetration from China remained unchanged between 1998 and 2013, employment in the manufacturing sector would have been about 4.2% higher in 2013. At the local level, however, some of the job losses were important.

Our study is related to a growing body of analyses that examine the impact of the rising competition from China in other countries. One strand of the literature identifies the effects by exploiting variation in Chinese import competition at the industry level (Bernard, Jensen and Schott, 2006 and Mion and Zhu, 2013), an approach that has been applied to Latin American countries in Alvarez and Claro (2008), Iacovone, Rauch and Winters (2013) and Caamal-Olvera and Rangel-Gonzalez (2015). Another strand of the literature examines the impact of the Chinese competition by exploiting variation in import exposure across local labor markets (Autor, et al., 2013; Acemoglu, et al., 2015; Feler and Senses, 2016; Rothwell, 2017), with applications to Latin America in Costa et al., (2016), Mendez (2015) and Chiquiar, Covarrubias and Salcedo (2017). Our study is particularly related to Mendez (2015) who also examines the impact of China on Mexican local labor markets. Nevertheless, our study differs from Mendez (2015) in several respects: we cover a relatively longer period of time (15 years versus 10), we analyze the impacts across different types of workers, and we examine the adjustment of Mexican labor market to Chinese competition not only in

Mexico but also in the US. Similarly, our paper is also related to Chiquiar, Covarrubias and Salcedo (2017), but these authors only analyze the impact in Mexico from the Chinese competition that emanates through the US. Our study also differs from this paper in that we cover a longer period of time and examine heterogeneous effects across different classes of employment.

The rest of the paper is divided as follows. Section 2 introduces the empirical methodology that we employ. This section also describes the dataset and provides a first look at its most salient features. Section 3 discusses the results while section 4 provides some concluding remarks.

## 2 Empirical methodology and data description

The empirical strategy in this paper follows closely the methodology described in Autor, Dorn and Hanson (2013, ADH hereafter). These authors relate changes in labor-market outcomes across US local labor markets to changes in exposure to Chinese import competition. More specifically, they relate the change in a labor market outcome of region *i* with the change in exposure to Chinese competition of that region. The latter is calculated as the weighted average of the import exposure faced by the industries that manufacture goods in that region, using employment as the weight. The particular expression for the import exposure is the following:

$$\Delta IPW_{it} = \frac{1}{L_{it}} \sum_j \frac{L_{ijt}}{L_{jt}} \Delta M_{cjt} \qquad (1)$$

where $L_{ijt}/L_{jt}$ is the share of region *i* in industry *j's* employment; $L_{it}$ is the total employment in region *i* and $\Delta M_{cjt}$ is the change of imports from China in industry *j*. This expression is derived from a trade model with monopolistic competition in which each region is treated as a small open economy.[1] The intuition is nevertheless straightforward: if region *i* concentrates employment in industries that manufacture goods that compete directly with the imports from China, the import exposure of that region –measured as imports per worker- will be high.

We employ a similar measure of local labor market exposure to Chinese competition in this paper. Also, similar to ADH we construct an instrument to address a potential endogeneity between the import exposure and the labor-market variables. The intuition is that the observed changes in the import penetration measure might not be entirely driven by China but instead might be partly the outcome of internal shocks in the Mexican industries that affect Mexican import demand. We are interested only in the supply-driven component of Mexican imports from China. Therefore, similarly to ADH, we construct the instrument by

[1] For a complete derivation, see Autor et al., (2013)

substituting the change in the imports from China in expression (1) with the change in the imports of other countries:

$$\Delta IPWO_{it} = \frac{1}{L_{it-1}} \sum_j \frac{L_{ijt-1}}{L_{jt-1}} \Delta M_{ojt} \qquad (2)$$

where $\Delta M_{ojt}$ is the change in the imports of other countries from China. The identifying assumption is that the change in the imports of other countries from China is uncorrelated with potential shocks to Mexican industries that affect Mexican import demand. In this study, the group of other countries consists of 17 Latin American economies.[2]

Besides using imports from other countries as the basis of the instrument, ADH also use 10-year lag values of the employment variables that are used as weights in expression (2). This is done to address a second concern, that the start-of-period employment might be potentially affected by an anticipation of the China shock. We follow the same approach and use 10-year lag values of employment in expression (2).

In order to estimate the effect of the import exposure on employment at the commuting zone level we follow ADH in using the specification given below:

$$\Delta L_{it}^m = \beta_1 \Delta IPW_{it} + X_{it}' \beta_2 + e_{it} \qquad (3)$$

where $\Delta L_{it}^m$ is the change in manufacturing employment share of working-age population in commuting zone *i* and $X_{it}'$ is a vector of controls at the commuting zone level (we elaborate more about these controls below).[3] [4] While the baseline model is estimated for a 15-year change (between 1998 and 2013) in employment and in the import exposure variables, we also present results for alternative sub-periods. Being a cross-section, the model does not require a time-fixed effect, but other fixed effects (like broad regions) are included in some specifications (more details below).

[2] For the case of the US, Autor et al., (2013) substitute the change of US imports from China with the change of imports from China of eight high-income countries. In this paper, the 17 countries from Latin America are: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Guyana, Jamaica, Nicaragua, Panama, Peru, Paraguay, Uruguay and Venezuela.

[3] Manufacturing employment in a region might change for demographic reasons: old workers might retire while young workers enter the labor market. Accordingly, the level of manufacturing employment is likely to depend on the region's working-age population and the latter might evolve differently across regions for reasons not related to the China shock. Therefore, to assess the impact of China on the level of employment at the CZ level we want to control for these differences. One possibility is to include the working-age population as an additional regressor. An alternative solution is to divide the dependent variable by the region's working-age population, the strategy employed in ADH. We follow the same strategy of ADH in this paper.

[4] Working-age population is defined as persons between 15 and 64 years of age

## Data Description

Data on international trade are from the UN Comtrade Database. These data are converted from six-digit HS to five-digit NAICS (version 2002) using the concordance in Pierce and Schott (2012). This results in 168 manufacturing industries.

As shown in expression (1) the trade data by industry is combined with employment data by industry and region to construct a measure of exposure to Chinese imports at the regional level. As in ADH, a region or local labor market is defined by the commuting zone (CZ's). Mexico already has 59 metropolitan zones assigned by the Mexican statistics agency, the *Instituto Nacional de Estadística y Geografía* (INEGI). Each zone consists on a group of municipalities that exhibit a high degree of socioeconomic interactions. The 59 zones do not cover the entire country; therefore, we created the additional commuting zones using the rest of the municipalities. The procedure follows a similar set of criteria used by INEGI which includes, among others, interactions due to the commuting between the residence and the work place. Details of this procedure are described in Appendix A. The final number of commuting zones is 789. Table 1 shows some basic statistics for these local labor markets. The average CZ has 125 thousand people and an area of 2,521 $Km^2$. There is a large variation among the CZ's with some representing large metropolises while others small towns.

The main source of data on labor outcomes is the Mexican Economic Census, from which we extract information on employment and payroll by municipality and industry. The Census is conducted every 5 years. In this analysis, we use the censuses for the years 1998, 2003, 2008 and 2013. The industry classification in the census is 6-digit NAICS which we aggregate to 5-digits to match the trade data.[5] The information at the municipality level is then aggregated at the CZ level.

We supplement the data from the Economic Census with information from the Population Census, which provides data by municipality on working-age population. We also extract from this census information on certain population characteristics (like educational level) that we use as controls. The years of the Economic Census and Population Census do not overlap exactly; however, the gap of two years is very small. Accordingly, the data from the Mexican Economic Census for the years 1998, 2003, 2008 and 2013 are matched with the data from the Population Census for the years 2000, 2005, 2010 and 2015, respectively.

Table 2 presents descriptive statistics of the measure of exposure to Chinese imports at the CZ level. The import exposure increased substantially during the 15-year period. For example, as shown in the table, in

[5] The various economic censuses are originally reported in different versions of the NAICS classifications (2002, 2007 and 2012). We employed concordance tables, provided by INEGI, to express all of them in the NAICS classification version 2002.

1998 the imports per worker from China were about 52$ (0.052*1000) on average across all the CZ's. In 2013 this value increased to 805$ (0.805*1000). Thus, in 15 years the import exposure increased by 753$.[6] Note, however, that this is an average across all CZ's. There is a significant heterogeneity across the CZ's. For example, in the CZ that corresponds to the 90th percentile of the change in exposure, the imports per worker grew by 1,390$ while in the CZ that corresponds to the 25th percentile the imports grew by only 24$. This reflects the geographic variation in industry specialization across CZ's, with CZ's relatively more or less specialized in industries that compete directly with the imports from China. Figure 3 complements Table 2 by providing a similar information in a map. The figure presents the 15-year change in import exposure by CZ. In general, the CZ's located in the north and in the center of the country experienced the largest increases in import exposure due to their relative specialization in industries that compete more directly with the imports from China.

Table 3 presents descriptive statistics for our main dependent variable, the change in the manufacturing employment share of working-age population. Once again, there is a significant heterogeneity across CZ's. On average, the share of working-age population employed in manufacturing declined by 0.69 percentage points across all CZ's over 15 years. The change of this variable in the CZ's associated with the 90th and 25th percentiles were 1.16 and -1.00 percentage points, respectively. Figure 4 illustrates the situation for all the CZ's. The figure shows the high degree of heterogeneity across the CZ's.

Comparing Figures 3 and 4, it is possible to note a pattern in which the CZ's at the north and at the center of the country experience some of the largest increases in import exposure as well as some of the largest decreases (or smallest increases) in manufacturing employment. However, the pattern is not perfect: many CZ's exhibit larger than average rises in import exposure but smaller than average decreases in employment while others experience smaller than average rises in exposure and larger than average decreases in employment. Ultimately, the issue is about the sensitivity of the CZ's employment to the China shock. To this end, we employ regression analysis in the next section.

# 3 Estimation Results

We start this section by running a simple OLS regression of equation 3 without controls. Since the model is estimated in first differences, this is equivalent to a fixed effects regression. Similar to ADH, the standard errors are clustered at the state level to account for potential spatial correlations across CZ's. Column 1 of Table 4 presents the results. The coefficient on the import exposure is negative and significant at conventional levels, suggesting that the competition from China has a detrimental effect on total

[6] All dollar values are expressed in constant terms of 1998

manufacturing employment. Column 2 presents the results of the 2SLS estimation. The coefficient on the import exposure is once again negative and significant and larger (in absolute value) than the coefficient in the OLS regression. The value of -0.342 indicates that a $1,000 rise in a CZ's import exposure per worker induces a reduction of its manufacturing employment per working-age population of 0.34 percentage points. The F statistic of 19.3 suggests that the specification does not seem to suffer from a weak instrument problem.

We now proceed to include covariates in the regression to control for various labor force and demographic factors. The first control is related to trends in manufacturing employment not associated with China. In the US, for example, the share of manufacturing employment in working-age population has experienced an overall trend decline since the late 1980s -well before the China shock- which many attribute to skilled-biased technical progress. Therefore, not controlling for this trend might lead to attribute entirely to China a decline in manufacturing employment that partly depends on factors that pre-date the China shock. In Mexico, the share of manufacture in working-age population has remained more stable that in the US during a similar period. As shown in Figure 5, for example, between 1988 and 1998 the share of manufacturing in working-age population increased from 5.1% to 6.8%, and then it hovered at around 5.5%-6% between 2003 and 2013.[7] While the share of manufacturing employment in working-age population did not decline in Mexico prior to the China shock, we still follow ADH in controlling for the evolution of manufacturing employment before to the start of the period. In particular, we add a pre-trend control for the change in manufacturing employment as a share of working-age population from 1988 to 1998. Column 3 shows the result. The coefficient for the pre-trend control is not statistically significant while the coefficient for the import exposure does not significantly change.

Our second control addresses demographic factors. The evolution of employment in manufacturing might be driven in part by the skills of the population in the CZ. Therefore, we follow ADH and include in column 4 the start-of-period share of the CZ's population that has secondary education. The coefficient is negative and significant at conventional levels, while the coefficient for the import penetration variable declines (in absolute values) by 0.13 percentage points. The estimate, however, is still significant at the 5% level. A $1,000 rise in a CZ's import exposure per worker induces a reduction of its manufacturing employment per working-age population by 0.197 percentage points.

In column 5 we add the import exposure in Mexico from the rest of the world (ROW). The idea is that the increased import exposure to China might be just a reflection of a more general overall import exposure

[7] These numbers are slightly different from those in table 2 because the numbers in table 2 refer to simple means across CZ's. Recalculating table 2 using weighted averages (with CZ population as a weight) instead of simple means give shares closer to 6%

and not only to China. That is, it could be that Mexico's import exposure to many other countries is increasing as well. If this is the case, the import variable from China might be capturing the exposure to other countries as well, possibly overstating its effect. We construct the import exposure to the ROW as in expression (1), where the change of imports from China is replaced for the change in imports to the ROW. Similarly, we construct an IV for this variable based on expression (2), in particular using the imports of Latin American countries from ROW. The results in column 5 show that the import exposure from the ROW is not statistically significant, while the coefficient for the import exposure to China does not significantly change. In column 6 we also add geographic dummies for 8 regions to control for region-specific trends in employment.[8] The coefficient of the import exposure from China increases in absolute value. The result implies that the share of manufacturing employees in working-age population of a CZ at the $75^{th}$ percentile of import exposure declined by 0.158 percentage points more than in a CZ at the $25^{th}$ percentile between 1998 and 2013.[9]

Finally, as a robustness test, we employ in column 7 an alternative set of countries for the instrumental variables in expression (2). Note that until now we have used Latin American countries to construct the instruments because a shock in Mexico is likely to be uncorrelated with the import demand of Latin American countries from China due to the relatively limited trade linkages between Mexico and Latin America. Now we employ an alternative group of countries based on similarities with Mexico in terms of economic development. In particular, we use Argentina, Brazil, Colombia, Costa Rica, Malaysia, Peru, Poland and Romania.[10] The idea is that because of similarities in economic structure and levels of development, these countries and Mexico are similarly exposed to growth in imports from China. The results are shown in column 7. Changing the countries used to construct the instruments does not alter the results in any significant way.

As mentioned before, the empirical strategy used in this study follows closely that in ADH, which facilitates comparing our results with theirs. Nevertheless, we also experimented with an alternative import exposure measure for an alternative robustness test. In particular, Appendix B presents a set of regressions similar to those in Table 4 but in which the Chinese import exposure is expressed in terms of the imports from China to Mexican apparent consumption instead of imports per worker. In general, all the results are qualitatively similar.

[8] Mexico's 32 states are grouped in 8 regions according to cultural, economic and geographical similarities

[9] Table 2 shows that the import exposure for CZ's at the $75^{th}$ and $25^{th}$ percentile were 0.613 and 0.024, respectively. Therefore, the predicted differential impact between the CZ's at the $75^{th}$ and $25^{th}$ percentile is (0.613 – 0.024) x -0.268 = -0.158

[10] The similarities are based on a World Bank algorithm that compares countries on a 5-dimensional space (GDP per capita, physical capital, human capital, population and export basket composition)

## Effects by type of workers

The evidence in Table 4 indicates that the competition from China impacted manufacturing jobs negatively. In this section, we look at whether the effects are heterogeneous across different types of workers. One conjecture is that while firms can lay off workers (or shut down entire plants) they can also reduce their labor costs by relying relatively more on informal workers.

Unfortunately, we do not observe informal workers or the self-employed. We only observed formal employees working under the roof of an established firm. Nevertheless, even within this group of employees, there is an important distinction between what is called paid employees and contract workers. In general, paid employees earn a predetermined amount of money while contract workers are paid hourly. More importantly, the regulations for paid labor in Mexico establish certain rights for these employees, like the right to a severance payment when fired or the right to form a union. Contract workers do not have these rights. Also, firms that hire paid employees have certain obligations that do not apply to contract workers, like enrolling them in the Mexican Social Security Institute, pay a social security tax and pay the employees at least the minimum wage. These obligations do not apply to contract workers. In general, contract workers are not considered by law to be the firm's employees and thus they are not covered by the labor regulations that paid employees enjoy. Since the work arrangements and the commitments of the firm for paid employees and contract workers differ, it is possible that the impact of the China shock might also differ across these two groups.

Note that all the results presented in Table 4 examined the impact of China on manufacturing employment using the sum of all the employees, paid employees and contract workers. Now we estimate separate effects for each group.[11] The results are reported in Table 5.[12] For comparison, the first column repeats the result for all the employees (also reported in column 6 of Table 4). The effect on paid employees is shown in column 2, which in turn can be separated between production workers (column 3) and non-production workers (column 4). The results on paid employees in column 2 show an impact that is even larger than for all workers with a point estimate of -0.44. Column 5 shows the effect for contract workers. In line with our priors, the effect on contract workers is positive.[13] The message from columns 1, 2 and 5 is the following: the China shock induced a sharp decline on paid employees and part of this decline was met by an increase in contract workers. The increase in contract workers, however, was not enough to upset the decline in paid

[11] In 1998, paid employees represented about 90% of the total labor force in manufacture

[12] According to the Economic Census, the owners and the family members working for the firm are also non-paid employees. To simplify matters, we have excluded the persons in this group from the entire analysis because it is likely that they behave different than the contract workers

[13] The sum of the coefficients for production and non-production workers is equal to the coefficient for paid employees. Likewise, the sum of the coefficients for paid employees and contract workers is equal to the coefficient for all workers.

employees and this is the reason why the coefficient for “all employees” is negative and significant. In short, the adjustment in the labor force took two forms: some shrinkage in the level of paid employees and some substitution of paid employees by contract workers. Another interesting finding from the table is that among the paid employees, the impact was three times larger for production workers (column 3) than for non-production workers (column 4). This suggests that workers with lower skills were more severely affected.

One can also separate the group of paid employees in a different way: those that are hired legally and those that are hired illegally. This has to do with the fact that even though a firm is required to pay social security taxes for its paid employees, in practice the “compliance” to this obligation is not always perfect. In other words, some firms may hire paid employees but do not pay social security taxes for them. We call these workers, illegal paid employees. Given this situation, one can conjecture that faced with a negative trade shock, one potential adjustment is that firms might stop paying social security taxes on some of their paid employees effectively switching them from legally-hired to illegally-hired paid employees. We now test this hypothesis by separating the paid employees into these two groups -legal and illegal- an examine the effects.

Total social security taxes on paid employees in Mexico are approximately 32% of the wage. However, because the census data excludes some contributions (like the housing fund or sub-national taxes), a firm that fully complies with the components of salaried regulations included in the census would pay 18% of wages as social security taxes. Busso, Fazio and Levy (2012) use this ratio of total social security taxes paid to total wages pages paid to define firms that hire paid employees legally or not. In particular, they define three groups: legal (the ratio is 18%), semi-legal (the ratio is greater than 0% and lower than 18%) and illegal (the ratio is equal to 0%). For simplicity, we create only two groups, illegal and the rest (which we call legal). In particular, we take all the firms in the CZ for which the ratio of total social security taxes paid to total wages paid is equal to zero and we add all their (paid) employees. These are the illegal paid employees. All the other workers are the legal paid employees. Measured in this way, about 93% of all the paid employees in the manufacturing industry in Mexico are classified as legal. Table 6 shows the results after running separate regressions for legal and illegal paid employees. Only the coefficient for the legal employees is negative and statistically significant. The coefficient for illegal employees is positive but not significant. Therefore, we do not find evidence that firms switch from legal to illegal employees to adjust to the China shock. The decline in paid employees is the result of a decline in the legal paid employees of a similar magnitude with no substitution from legal to illegal employees.

**Effects by components of the working-age population**

Going back to Table 5, we already mentioned that the increase in the import exposure from China induced a decline in the paid employees that was partly mitigated by an increase in contract workers. The increase in contract workers, however, was not enough to fully upset the decline in the paid employees, so there was effectively a shrinkage of employment in the manufacturing sector. The question that we would like to answer now is what happened with these employees? There could be various possibilities. If the working-age population does not move away from the CZ, then the net decline of employment in the manufacturing sector must be met by a corresponding increase in nonmanufacturing employment, an increased in the unemployed, an increase in the population not in the labor force (NILF), or some combination of the above. We consider first the impact of the China shock on the *share* of working-age population in each of these four categories: employment in manufacturing, employment in non-manufacturing, unemployed and population not in the labor force. A decline in the population share in one category must yield equivalent gains in other categories.

In order to perform this exercise, we rely solely on the Population Census. Note that until now, our dependent variable, the share of manufacturing employment in working-age population, has been constructed using two sources: data on manufacturing employment from the Economic Census and data on working-age population from the Population Census. The advantage of using the Economic Census dataset is that it allowed us to further decomposed manufacturing employment into the various classes that we have already examined (paid employees versus contract workers, production versus non-production workers, and legal versus illegal employees). But the Economic Census does not have information on the population unemployed or the population NILF. For this reason, we now use only the Population Census to calculate the share of manufacturing employment in working-age population, as well as the shares of working-age population in non-manufacturing, the unemployed and the population NILF. This means that the share of manufacturing employment in working-age population measured solely with data from the Population Census differs slightly from our previous version when we measured it using employment data from the Economic Census. There are at least two reasons for this difference. First, the Population Census includes employees not necessarily working under the roof of a formal firm (like the self-employed). These workers are not included in the Economic Census. Second, the assignment of whether the employee works in the manufacturing sector is decided according to the sector of the firm in the Economic Census while it is left to the decision of the worker in the Population Census. Given these differences in the way the share of manufacturing employment in working-age population is measured, the impact of the China shock on this variable might not be exactly the same as in the previous regressions.

Table 7 reports the results. The first row shows regressions when all the education levels are considered. The impact of the exposure to China on the share of manufacturing employment is somewhat smaller (in absolute value) than in the corresponding regression when we use the Economic Census (see Column 1 of Table 5). But the impact is nevertheless in a similar order of magnitude. Importantly, the decline in the share of manufacturing employment is met exclusively by an increase in the share of the population NILF. The decline in the share of manufacturing employment does not lead to increases in the share of non-manufacturing employment or in the share of the unemployed, only an increase in the share of the population NILF. In other words, the reduction in manufacturing employment mainly induces workers out of the labor force.

The next two rows of the table show that noncollege manufacturing workers experience the main negative impacts. The coefficients for college manufacturing workers are not statistically significant. Instead, a $1,000 per worker increase in a CZ's import exposure reduces its share of noncollege manufacturing employment in working-age population by 0.175 percentage points and it increases the share of noncollege population that exit the labor force by 0.261 percentage points.

We can gain further insights by reporting the impact on the log change in the number of persons in each of the four categories as well as in the working-age population itself. These results are reported in Table 8. Once again, the first row reports the results for all education levels. Interestingly, the coefficient on the working-age population is positive and significant. That is, the increase of Chinese import competition induces an increase in the level of working-age population. While this result is contrary to what one should expect, it is worth mentioning that the largest metropolitan centers in Mexico, like Mexico City, traditionally attract population from other regions for various socioeconomic reasons. At the same time, these large centers are the ones that tend to exhibit some of the largest increases in import exposure from China.[14] This explains the positive effect that we observe in the working-age population. Another interesting finding from the table is the lack of effect on the growth rate of employment (manufacturing or non-manufacturing) and the positive impact on the growth rates of the unemployed and the population NILF. Therefore, a more nuanced explanation of the results reported earlier in Table 7 is that while the working-age population have been increasing during the last 15 years, particularly in the CZ's most exposed to the China shock, employment in manufacturing has not grown proportionally. This leads to a negative impact on the *share* of manufacturing employment in working-age population, as reported in all the previous

[14] For instance, while the average 15-year change in import exposure for all CZ's is 0.753 (kUS$), the average change in import exposure for the 20 largest CZ's is 3.614 (kUS$)

regressions. The last two rows of the table confirm that the negative effects apply in particular to the population without college education.

### Effects by sub-periods

So far, we have presented results of the impact of Chinese competition on manufacturing labor for the 15-year period that goes from 1998 to 2013. We now present results for the short and medium term. This exercise would give us a sense of whether the labor impacts from China have been increasing or decreasing over time. For a clean comparison, we hold constant the start-of-period analysis, 1998 and only change the end-of-period to 2003 (5 years), 2008 (10 years) and 2013 (15 years). This allows us to employ the same start-of-period labor weights in the import exposure measures (1998 for $\Delta IPW_{it}$ and 1988 for $\Delta IPWO_{it}$), thereby minimizing the possibility that these weights are influenced by the China shock.

Table 9 presents the findings for all the employees, the paid employees and the contract workers. The short-run 5-year impacts are reported in row (a), and the 10-year impacts are reported in row (b). For comparison purposes, row (c) shows the 15-year impacts which correspond to the results already presented in Table 5. The point estimates for "all employees" indicate that the largest impact took place within the first 5-year sub-period. A similar result is found with respect to the paid employees for which the magnitude of the impact also declines overtime. Finally, for contract workers we observe a positive impact only in the 15-year period with positive but not statistically significant effects in the other sup-periods. This last result implies that the substitution of paid employees for contract workers that we reported earlier took place in the long-run. In the short and medium run, the trade shock from China only generated a shrinkage of the manufacturing employment.

For comparison purposes, it would have been optimal to do a similar exercise for the four components of the working-age population presented in Table 7. Unfortunately, the Mexican statistics agency, INEGI, did not conduct a full Population Census in 2005, which precludes us to examine the short-run impact of the China shock on non-manufacturing employment, the unemployed and the population NILF.

Overall, the results of this section suggest that the largest negative impacts of the China shock on manufacturing employment took place during the first part of the 15-year period that we analyzed with the effects progressively declining overtime.[15]

[15] A more formal way to see that the effects decline overtime is through the following annual comparison: the first 5-year change in import exposure was 0.111 (kUS$). This implies that the China trade shock induced a decline in the share of paid employees on working-age population of 0.199 percentage points during these 5 years (0.111*1.788 = 0.199) or a decline of 0.04 percentage points annually (0.199/5 = 0.04). Comparatively, the 10-year change in import exposure was 0.431 (kUS$). This implies that the

## Effects through third markets

Until now we have examined the various impacts through the direct competition of China in the Mexican market. But as we already mentioned in the introduction, the rising Chinese import penetration in other countries, and particularly in the US, may have also impacted employment in Mexico. Before adding the effects of China through third markets, it is worth calculating what has been the number of jobs lost by the Chinese competition directly in Mexico. This would allow us to compare later the overall job losses once we add the effects through the US market.

To perform this exercise, we follow Author, Dorn and Hanson (2013) and construct a counterfactual. In particular, we calculate how much manufacturing employment would have grown between 1998 and 2013 if the import exposure from China would have remained at the 1998 levels and then compare the resulting number of jobs with the actual figures. We do this separately for paid employees (who experienced a negative impact) and for contract workers (who experienced a positive impact). In particular, we take the estimations from columns 2 and 5 of Table 5 for paid employees and contract workers, respectively.

Had import exposure from China remained unchanged between 1998 and 2013, paid manufacturing employment would have been larger by 259 thousand jobs in 2013. That is, paid manufacturing employment would have been 7.6% higher than what it was in 2013. Additionally, there would have been 101 thousand fewer contract workers in the economy; that is, contract manufacturing labor would have been 10% smaller.[16]

Now we are ready to add the impact of China in Mexico through third markets. Given that most Mexican manufacturing exports go to the US, it is rational to focus on the impact that China exerts on Mexico through its increased competition in the US market.[17] Our measure of Chinese import exposure through the US market is given by expression (4):

China trade shock induced a decline in the share of paid employees on working-age population of 0.391 percentage points during 10 years (0.431*0.901 = 0.391) or 0.039 percentage points annually (0.391/10 = 0.039). Finally, the 15-year change in import exposure was 0.753 (kUS$). This implies that the trade shock induced a decline in the share of paid employees on working-age population of 0.331 percentage points during 15 years (0.753*0.440 = 0.331) or 0.022 percentage points annually (0.331/15 = 0.022).

[16] The 15-year change of import exposure in Mexico is 0.753 (kUS$). Given the point estimate for paid employees of -0.44, the share of paid employees per working-age population would have increased by 0.33 percentage points more than what it did (0.753 x 0.44 = 0.33). The working-age population is 78.2 million people. Therefore, the estimates imply a reduction in paid manufacturing employment of approximately 259 thousand workers due to the import exposure in Mexico (78,241,016 x 0.0033 = 259,228). Equivalent, the point estimate for contract workers is 0.1716. Accordingly, the share of contract workers per working-age population would have increased by 0.129 percentage points less than what it did (0.753 x 0.1716 = 0.129). Therefore, the estimates imply an increase in contract manufacturing employment of approximately 101 thousand workers due to the import exposure in Mexico (78,241,016 x 0.00129 = 101,099)

[17] The US receives around 90% of Mexican manufacturing exports

$$\Delta IPWUS_{it} = \frac{1}{L_{it}} \sum_j \left(\frac{L_{ijt}}{L_{jt}}\right) \cdot \left(\frac{M_{jt}^{usamex}}{M_{jt}^{usa}}\right) \cdot \Delta M_{jt}^{usachi} \quad (4)$$

where $M_{jt}^{usa}$, $M_{jt}^{usamex}$ and $\Delta M_{jt}^{usachi}$ are the US total imports in industry *j*, the US imports from Mexico in industry *j* and the change in the US imports from China in industry *j*, respectively, while the labor weights are the same as in expression (1). This expression mirrors the import exposure used by Author, Dorn and Hanson (2013) when these authors analyze the impact of China in the US through third markets.

Expression (4) specifically captures the growth in the US imports from China ($\Delta M_{jt}^{usachi}$) weighted by the initial share of US spending on Mexican goods ($M_{jt}^{usamex}/M_{jt}^{usa}$). Accordingly, the Mexican exposure to Chinese competition through the US market will be larger the larger is the share of US expenditures directed toward Mexican products.[18]

One econometric problem of adding the import exposure (4) in equation (3) is the high level of correlation between $\Delta IPW$ and $\Delta IPWUS$, which is equal to 0.74. This is not surprising, as the labor weights used in both expressions are the same. With a variance-inflation factor (VIF) of 10.4, we suspect that there is a severe case of multicollinearity between the two covariates. The problem with multicollinearity is that it makes it very difficult to disentangle the individual effects of each import exposure on the dependent variable. Accordingly, we follow ADH and include only one measure of import exposure that consists on the sum of the domestic plus the international exposure to Chinese exports. In particular, our overall import exposure variable is given by the sum of $\Delta IPW$ and $\Delta IPWUS$:

$$\Delta IPW'_{it} = \frac{1}{L_{it}} \sum_j \left(\frac{L_{ijt}}{L_{jt}}\right) \cdot \Delta M_{cjt} + \frac{1}{L_{it}} \sum_j \left(\frac{L_{ijt}}{L_{jt}}\right) \cdot \left(\frac{M_{jt}^{usamex}}{M_{jt}^{usa}}\right) \cdot \Delta M_{jt}^{usachi} \quad (5)$$

By adding the import exposure in the domestic market with the import exposure through the US market, the mean change of the import exposure increases. For instance, while the 15-year mean change of $\Delta IPW$ was 0.753 (kUS$) (see Table 2), the mean change of $\Delta IPW'$ is now 1.254 (kUS$), an increase of 67%.

The first row in Table 10 presents the results after running the regressions with this new import exposure $\Delta IPW'$.[19] For comparison purposes, row (b) shows the results when we employ $\Delta IPW$, as reported in Table

[18] One way to think about this expression is to consider an extreme case: suppose that Mexican region *i* is highly specialized in producing goods in industry *j* ($L_{ijt}/L_{jt}$ is large), but the country does not export any good in industry *j* to the US ($M_{jt}^{usamex}/M_{jt}^{usa} = 0$), then the increase in US imports from China in industry *j* does not entail an increase in import exposure to region *i* through the US market

[19] We try different instruments for $\Delta IPW'$. The first instrument is the same instrument as for $\Delta IPW$. The second instrument is an adjustment of the instrument for $\Delta IPW$ that include the second part of expression (5). In both cases, we are implicitly assuming that no instrument is needed for the part of the import penetration of China in the US because Mexico is too small to exert any

5. The results are qualitatively similar to our baseline estimations. Note that on the one hand, the coefficients are smaller in absolute values, but on the other hand the mean change of the new import exposure is larger, as mentioned above. The net effect is a slight increase in the negative impact on paid employees and a similar positive impact on contract workers. This becomes more obvious when we re-calculate our counterfactual exercise using this new import exposure and the new estimates. Again, we do this separately for paid employees and for contract workers. In particular, we take the estimations from columns 2 and 3 of row (a) in Table 10.

Had import exposure from China in Mexico and the US remained unchanged between 1998 and 2013, paid manufacturing employment would have been larger by 280 thousand jobs in 2013. Therefore, the import exposure through the US induces an additional job loss of 21,182 paid employees, relative to our previous counterfactual. At the same time, there would have been 99 thousand fewer contract workers in the economy (which is very similar to the previous counterfactual).[20] The overall job loss in the manufacturing sector, measured as the change in paid employees plus the change in contract workers, is 182 thousand workers (280,410 - 98,899 = 181,511). In other words, had import exposure from China in Mexico and the US remained unchanged between 1998 and 2013, the number of total workers in the manufacturing sector would have been larger by 182 thousand. It is important to put this number within the context of the level of employment in the manufacturing sector by 2013, which was around 4.4 million employees: had import penetration from China remained unchanged between 1998 and 2013, employment in the manufacturing sector would have been only about 4.2% higher in 2013.[21] Therefore, when we look at the job figures at the national level, the impact was not necessarily dire.

This, of course, is not to diminish the importance of such a reduction in employment for some CZ's. Some of the job losses have been significant at the local level. For example, the 15-year increase in overall import exposure in the CZ of Mexicali (at the northern border of Mexico) was equal to 15.29 (kUS$), compared to the national average of 1.25 (kUS$). Had import penetration from China remained unchanged between 1998 and 2013, manufacturing employment in Mexicali would have been 27% higher in 2013. This

significant change in the overall US demand for imports. Results are essentially the same with any of the instruments. Table 10 reports results when we employ the second instrument

[20] The 15-year change of import exposure in Mexico and the US is 1.254 (kUS$). Given the point estimate for paid employees of -0.286, the share of paid employees per working-age population would have increased by 0.358 percentage points more than what it did (1.254 x 0.286 = 0.358). The working-age population is 78.2 million people. Therefore, the estimates imply a reduction in paid manufacturing employment of approximately 280 thousand workers due to the import exposure in Mexico (78,241,016 x 0.00358 = 280,410). Equivalent, the point estimate for contract workers is 0.1008. Accordingly, the share of contract workers per working-age population would have increased by 0.126 percentage points less than what it did (1.254 x 0.1008 = 0.126). Therefore, the estimates imply an increase in contract manufacturing employment of approximately 99 thousand workers due to the import exposure in Mexico (78,241,016 x 0.00126 = 98,899)

[21] The 4.4 million workers in the manufacturing sector for the year 2013 refers to figures from the Economic Census. Note that we have excluded from the analysis the owners and the family members working for the firm (see footnote 12). In 2013, this group represented around 700 thousand people

illustrates that in the context of local labor markets, job losses in some CZ's were important. Overall, however, the national long-run impact of the trade shock from China on Mexico's manufacturing employment seems to have been relatively moderate.

### Effects on wages

Finally, we evaluate the impact on wages. We combine information on the annual wage bill and the number of paid employees to obtain a measure of the average wage at the CZ.[22] It is worth noting that because we do not see individual wages, we cannot say whether the observed changes in the average wage are due to changes in wages for individual workers or the result of changes in the composition of workers. Not being able to keep the composition of workers constant might introduce a bias in the estimation.[23] Accordingly, the results should be viewed with some caution. Table 11 presents the findings. The dependent variable is expressed as the log change of wages. To examine the existence of heterogenous effects across different types of paid employees, we run separate regressions for production and non-production workers, as well as for legal and illegal employees. The results in Table 11 shows some negative impacts on wages, although the magnitudes are modest. For instance, when we calculate the impact on the earning of production versus non-production workers, only the latter appears to be negatively affected: a $1,000 per worker increase in a CZ's exposure to Chinese imports reduce the annual wage of non-production workers by 0.03 log points. With respect of the earnings of the legal versus the illegal employees, we also found some small negative effect on the wages of the legal employees: a $1,000 per worker increase in a CZ's exposure to Chinese imports reduce the annual wage of legal workers by 0.028 log points.

[22] We express wages in constant terms by using the GDP deflator

[23] As mentioned in ADH, if workers with lower wages are more likely to lose employment, then the observed changes in the average wage will understate the change in wages relative to the case when the composition is kept constant

# 4 Concluding Remarks

In this study, we examine the impact of China's emergence as a manufacturing powerhouse on Mexican manufacturing employment. We exploit the heterogeneity that exists across local labor markets in terms of industry specialization and exposure to import competition to identify the effects of this trade shock on various labor outcomes.

We found that the adjustment in the labor market took two forms: a decline in the number of paid employees and a substitution of some paid employees by contract workers. We find that the shrinkage in the level of employment was met by an increase in the population that exit the labor force. Among the paid employees, we found that the negative impact was 3 times more severe among production workers than among non-production workers, indicating that workers with lower skills were affected more severely. This is confirmed with additional findings indicating that noncollege manufacturing workers experienced the main negative effects. We found that the trade shock from China had a labor impact in Mexico through the increased import exposure in the domestic market but also through the US market, although the effect through the domestic market was found to be much larger. We provide evidence that the largest impacts took place during the first part of the 15-year period that we analyzed, indicating that the magnitude of the impacts has been declining overtime.

When we review the negative effects within the context of manufacturing employment at the national level, the impact seems to have been relatively moderate. Had import penetration from China remained unchanged between 1998 and 2013, employment in the manufacturing sector would have been about 4.2% higher in 2013. But the size of the effects differs across CZ's with some locations experiencing more significant impacts than others. The overall analysis in this paper indicates that the costs of the adjustment from China are not spread evenly across regions and across different types of labor. This suggests that the design of any trade assistance policy should consider such heterogeneity issues carefully.

## References


Acemoglu, Daron, David Autor, David Dorn, Gordon Hanson, and Brendan Price, 2015, "Import Competition and the Great US Employment Sag of the 2000s," Journal of Labor Economics, Vol 34, No S1

Alvarez, Roberto and Sebastian Claro, 2008, "David versus Goliath: The Impact of Chinse Competition on Developing Countries," Working Paper No.478, Central Bank of Chile

Autor, David, David Dorn and Gordon Hanson, 2013, "The China Syndrome: Local Labor Market Effects of Import Competition in the United States," American Economic Review, 103(6)

Bernard, Andrew, J. Bradford Jensen and Peter K. Schott, 2006, "Survival of the best fit: Exposure to low-wage countries and the (uneven) growth of U.S. manufacturing plants," Journal of International Economics, 68

Busso, Matías, María Victoria Fazio and Santiago Levy, 2012, "(In)Formal and (Un)Productive: The Productivity Costs of Excessive Informality in Mexico," IDB Working Paper Series No. IDB-WO-341, Inter-American Development Bank, Washington DC

Caamal-Olvera, Cinthya and Erick Rangel-Gonzalez, 2015, "Measuring the impact of the Chinese competition on the Mexican labor market: 1990-2013," North American Journal of Economics and Finance, 34.

Chiquiar, Daniel, Enrique Covarrubias and Alejandrina Salcedo, 2017, "Labor Market consequences of trade openness and competition in foreign markets," Working paper No. 2017-01, Central Bank of Mexico

Costa, Francisco, Jason Garred and Joao Paulo Pessoa, 2016, "Winners and Losers from a Commodities-for-Manufactures Trade Boom," Journal of International Economics, 102.

Feler, Leo and Mine Senses, 2016, "Trade Shocks and the Provision of Local Public Goods," unpublished document.

Iacovone, Leonardo, Ferdinand Rauch and L. Alan Winters, 2013, "Trade as an engine of creative destruction: Mexican experience with Chinese competition," Journal of International Economics, 89.

Mendez, Oscar, 2015, "The effect of Chinese import competition on Mexican local labor markets," North American Journal of Economic and Finance, Vol 34.

Mion, Giordano and Linke Zhu, 2013, “Import competition from and offshoring to China: A curse or blessing from firms?,” Journal of International Economics, 89.

Paz, Lorenço S, 2016, “The China Shock Impact on Brazil’s Manufacturing Labor Market,” unpublished document.

Rothwell, Jonathan T., 2017, “Cutting the Losses: Reassessing the Costs of Import Competition to Workers and Communities,” SSRN Working Paper

Tolbert, Charles and Molly Sizer, 1996, “US Commuting Zones and Labor Market Areas: A 1990 Update,” Economic Research Service Staff Paper 9614

**Figure 1: China's Share of Mexican manufacturing imports**

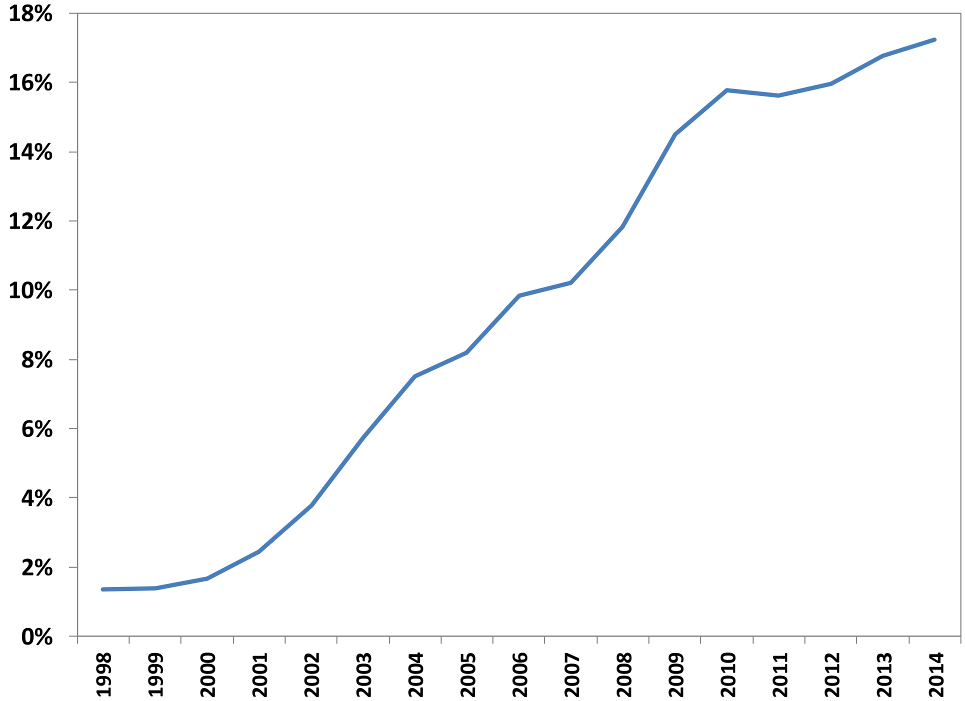


**Figure 2: Shares of China and Mexico in US manufacturing imports**

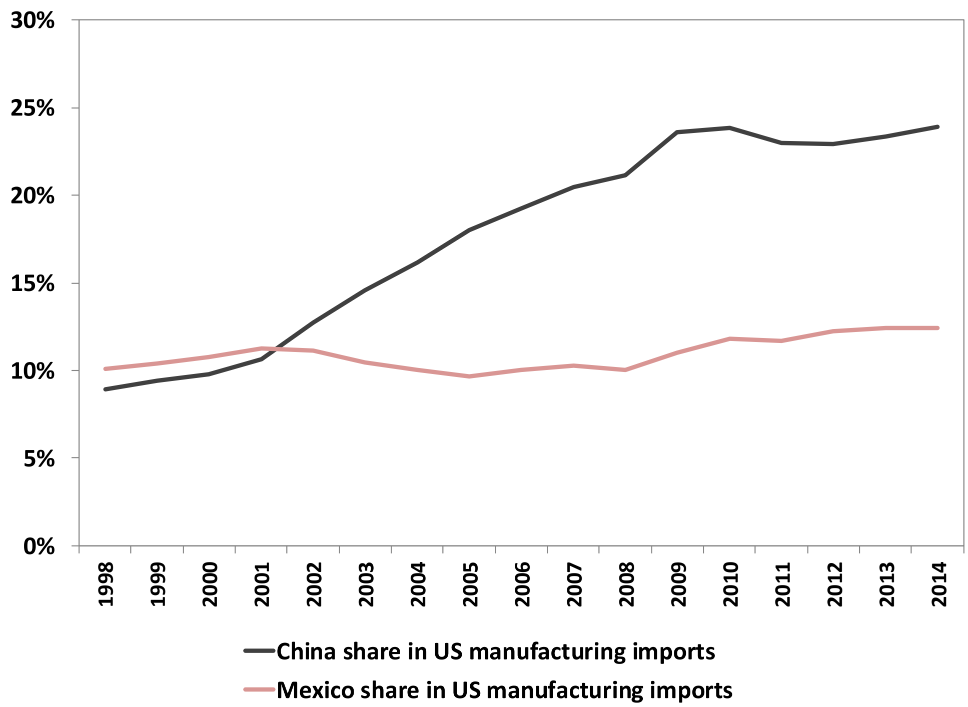

**Figure 3: Change in imports from China to Mexico per worker by CZ, 1998-20013**

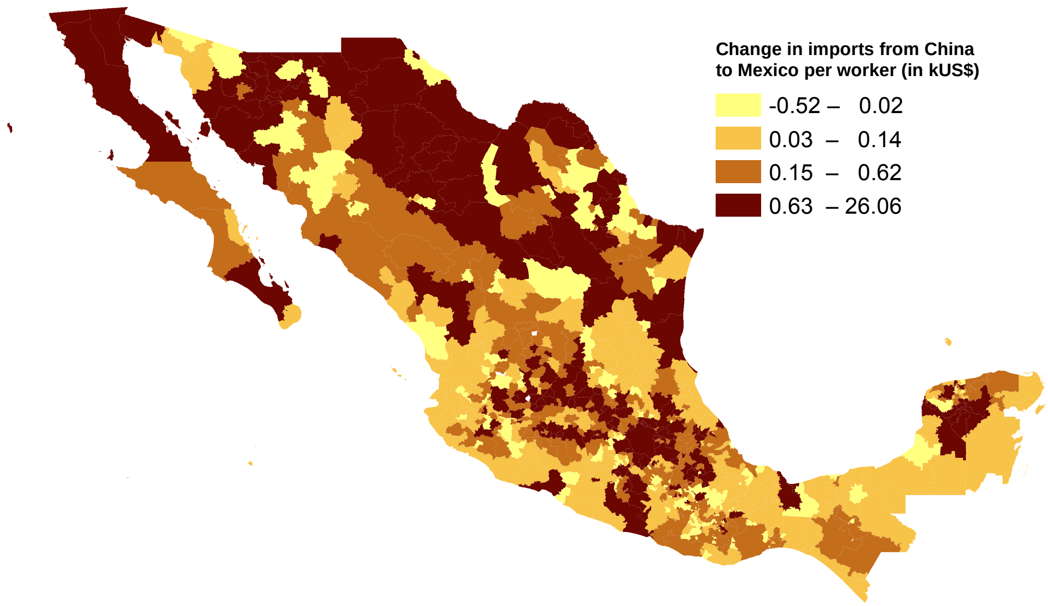


**Figure 4: Change in manufacturing employment share of working-age population by CZ, 1998-2013**

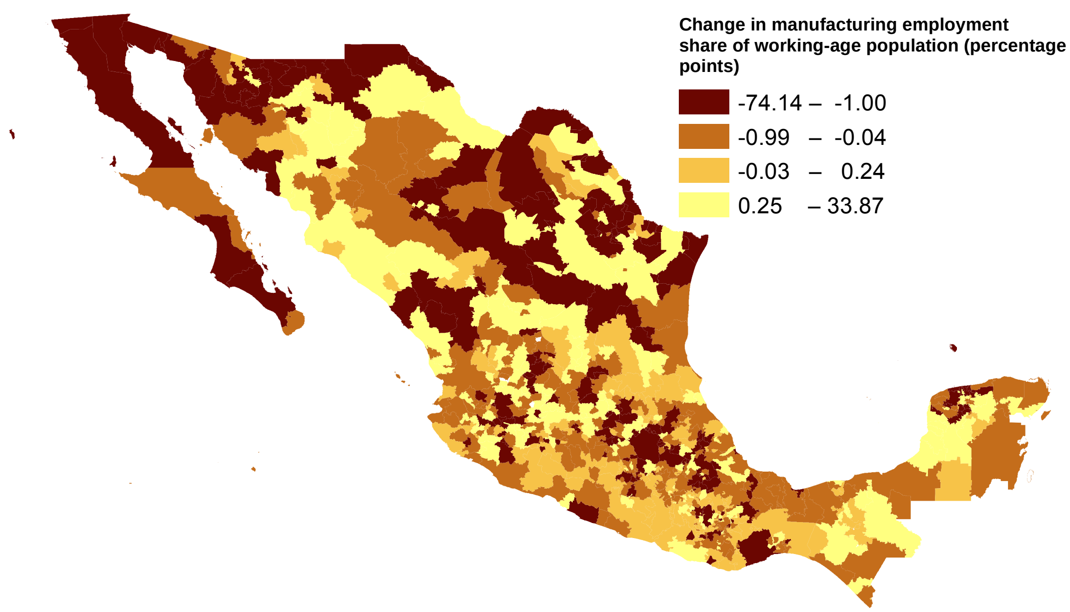

**Figure 5: Percentage of working-age population employed in manufacturing**

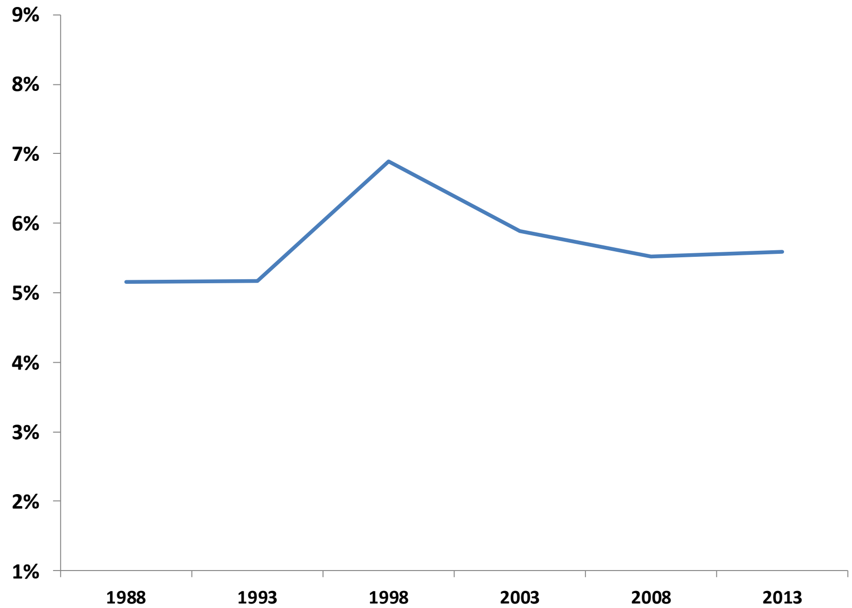

**Table 1: CZ's basic statistics**

| | |
|---|---|
| Population (in Thousands) | 124.8<br>(708.6) |
| Area (Km2) | 2,521<br>(5,303) |

**Table 2: Summary Statistics of Import Exposure Variable**

| | 1998 | 2013 | 15 Year Change |
|---|---|---|---|
| (Imports from China to Mexico)/(workers in 1998) (in kUS$) | 0.052<br>(0.103) | 0.805<br>(2.429) | 0.753<br>(2.361) |
| *Percentiles* | | | **15 Year Change** |
| 90th percentile | | | 1.390 |
| 75th percentile | | | 0.615 |
| 50th percentile | | | 0.141 |
| 25th percentile | | | 0.024 |
| 10th percentile | | | 0.000 |

**Table 3: Summary Statistics of Employment Variable**

| | 1998 | 2013 | 15 Year Change |
|---|---|---|---|
| Percentage of working-age population | 3.41 | 2.71 | -0.69 |
| employed in manufacturing | (5.83) | (4.58) | (4.50) |
| *Percentiles* | | | **15 Year Change** |
| 90th percentile | | | 1.16 |
| 75th percentile | | | 0.24 |
| 50th percentile | | | -0.04 |
| 25th percentile | | | -1.00 |
| 10th percentile | | | -3.17 |

**Table 4: Change in manufacturing employment in CZs, 1998-2013**

| | OLS | 2SLS | 2SLS | 2SLS | 2SLS | 2SLS | 2SLS |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| **Change in imports from China to Mexico/worker** | -0.2639*** | -0.3417*** | -0.3241*** | -0.1965** | -0.2047** | -0.2684** | -0.2688*** |
| | (0.0684) | (0.1141) | (0.0911) | (0.0865) | (0.0879) | (0.0994) | (0.0872) |
| **Percentage of employment in manufacturing pre-trend (88-98)** | | | 0.0140 | -0.0105 | -0.0069 | -0.0235 | -0.0235 |
| | | | (0.0269) | (0.0177) | (0.0196) | (0.0171) | (0.0172) |
| **Percentage of population with secondary education** | | | | -0.2045*** | -0.2079*** | -0.1595*** | -0.1593*** |
| | | | | (0.0639) | (0.0642) | (0.0529) | (0.0566) |
| **Change in imports from ROW to Mexico/worker** | | | | | 0.0117 | 0.0091 | 0.0091 |
| | | | | | (0.0137) | (0.0145) | (0.0142) |
| **Region fixed effect** | no | no | no | no | no | yes | yes |
| **$R^2$** | 0.134 | 0.123 | 0.131 | 0.184 | 0.186 | 0.247 | 0.247 |
| **Number of observations** | 780 | 780 | 780 | 780 | 780 | 780 | 780 |
| | | 2SLS first stage estimates | | | | | |
| **Change in imports from China to LAC/worker** | | 0.2401*** | 0.2675*** | 0.2509*** | 0.0923** | 0.0756** | |
| | | (0.0547) | (0.0581) | (0.0562) | (0.0374) | (0.0380) | |
| **Change in imports from China to Other/worker** | | | | | | | 0.0622** |
| | | | | | | | (0.0309) |
| **Weak identification test F statistic** | | 19.3 | 21.2 | 19.9 | 10.5 | 8.1 | 10.6 |

Notes: Each column reports results from regressions over the period 1998-2013. The dependent variable is the change in manufacturing employment over working-age population in CZ, in percentage points. The main explanatory variable is the change in imports from China to Mexico per worker, in kUS$. The instrument is the change in imports from China to LAC per worker (2-6) or the change in imports from China to a selected group of countries per worker (7). The control variables are the share of manufacture in the country's total employment (3-7), the percentage of population with secondary education (4-7) and the change in imports from the ROW to Mexico per worker, in kUS$ (5-7). Additional control in columns 6-7 is a region fixed effect. Observations are weighted by start of period CZ share of national population. Robust standard errors in parentheses are clustered by the state. The weak identification test is the Kleibergen-Paap Wald F statistic

*** ; ** ; * significant at the 1%, 5% and 10% level

## Table 5: Change in manufacturing employment in CZs, by labor type

| | All employees | Paid employees | Production workers | Non-production workers | Contract workers |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| **Change in imports from China to Mexico/worker** | -0.2684** | -0.4400*** | -0.3338*** | -0.1062** | 0.1716* |
| | (0.0994) | (0.1548) | (0.1409) | (0.0285) | (0.0941) |
| **Percentage of employment in manufacturing pre-trend (88-98)** | -0.0235 | -0.0045 | -0.0116 | 0.0071** | -0.0190* |
| | (0.0171) | (0.0174) | (0.0149) | (0.0034) | (0.0099) |
| **Percentage of population with secondary education** | -0.1595*** | -0.1975*** | -0.1267** | -0.0708*** | 0.0380 |
| | (0.0529) | (0.0608) | (0.0511) | (0.0151) | (0.0465) |
| **Change in imports from ROW to Mexico/worker** | 0.0091 | 0.0113 | 0.0072 | 0.0041 | -0.0022 |
| | (0.0145) | (0.0117) | (0.0094) | (0.0029) | (0.0086) |
| **$R^2$** | 0.247 | 0.362 | 0.301 | 0.492 | 0.143 |
| **Number of observations** | 780 | 780 | 780 | 780 | 780 |

Notes: Each column reports results from regressions over the period 1998-2013. The dependent variable is the change in manufacturing employment over working-age population in CZ, for all employees (1), for paid employees (2), for production workers (3), for non-production workers (4) and for contract workers (5). The main explanatory variable is the change in imports from China to Mexico per worker, in kUS$. The instrument is the change in imports from China to LAC per worker. The control variables are the share of manufacture in the country's total employment, the percentage of population with secondary education and the change in imports from the ROW to Mexico per worker, in kUS$. All the regressions also include a region fixed effect. Observations are weighted by start of period CZ share of national population. Robust standard errors in parentheses are clustered by the state

*** ; ** ; * significant at the 1%, 5% and 10% level respectively

## Table 6: Change in salaried employment in CZs

| | Paid employees | Legal employees | Illegal employees |
|---|---|---|---|
| | **(1)** | **(2)** | **(3)** |
| **Change in imports from China to Mexico/worker** | -0.4400*** | -0.4491*** | 0.0091 |
| | (0.1548) | (0.1589) | (0.0094) |
| **Percentage of employment in manufacturing pre-trend (88-98)** | -0.0045 | -0.0058 | 0.0013 |
| | (0.0174) | (0.0170) | (0.0031) |
| **Percentage of population with secondary education** | -0.1975*** | -0.2012*** | 0.0037 |
| | (0.0608) | (0.0612) | (0.0103) |
| **Change in imports from ROW to Mexico/worker** | 0.0113 | 0.0231 | -0.0118 |
| | (0.0117) | (0.0169) | (0.0165) |
| **$R^2$** | 0.362 | 0.364 | 0.066 |
| **Number of observations** | 780 | 780 | 780 |

Notes: Each column reports results from regressions over the period 1998-2013. The dependent variable is the change in manufacturing employment over working-age population in CZ, for paid employees (1), for legal employees (2), and for ilegal employees (3). The main explanatory variable is the change in imports from China to Mexico per worker, in kUS$. The instrument is the change in imports from China to LAC per worker. The control variables are the share of manufacture in the country's total employment, the percentage of population with secondary education and the change in imports from the ROW to Mexico per worker, in kUS$. All the regressions also include a region fixed effect. Observations are weighted by start of period CZ share of national population. Robust standard errors in parentheses are clustered by the state

*** ; ** ; * significant at the 1%, 5% and 10% level respectively

## Table 7: Change in working-age population shares, by employment categories

| | Mfg emp | Non-mfg emp | Unemployed | NILF |
|---|---|---|---|---|
| | **(1)** | **(2)** | **(3)** | **(4)** |
| ***All education levels*** | | | | |
| **Change in imports from China to Mexico/worker** | -0.1857** | -0.1289 | 0.0188 | 0.2959*** |
| | (0.0690) | (0.0940) | (0.0214) | (0.0285) |
| ***College education*** | | | | |
| **Change in imports from China to Mexico/worker** | -0.0912 | 0.0238 | -0.0171 | 0.0845 |
| | (0.0567) | (0.1387) | (0.0185) | (0.1100) |
| ***No college education*** | | | | |
| **Change in imports from China to Mexico/worker** | -0.1750** | -0.1135 | 0.0269 | 0.2616*** |
| | (0.0690) | (0.0879) | (0.0222) | (0.0956) |

Notes: Each cell in the table reports the result from a regression over the period 2000-2015. The dependent variable is the change in the manufacturing employment share of working-age population (1), the change in the non-manufacturing employment share of working-age population (2), the change in the unemployed sahre of working-age population (3) and the change in the population that is not in the labor force (NILF) share of working-age population (4). The main explanatory variable is the change in imports from China to Mexico per worker, in kUS$. The instrument is the change in imports from China to LAC per worker. All the regressions include the full set of control variables from table 5. Observations are weighted by start of period CZ share of national population. Robust standard errors in parentheses are clustered by the state

*** ; ** ; * significant at the 1%, 5% and 10% level respectively

## Table 8: Change in working-age population counts, by employment categories

| | Working-age population | Mfg emp | Non-mfg emp | Unemployed | NILF |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| ***All education levels*** | | | | | |
| **Change in imports from China to Mexico/worker** | 0.6898* | 0.4895 | 0.4133 | 2.867** | 1.3498*** |
| | (0.3492) | (0.5728) | (0.4679) | (1.1165) | (0.3771) |
| ***College education*** | | | | | |
| **Change in imports from China to Mexico/worker** | 0.2938 | 1.2211 | 0.2775 | -0.7390 | 0.6449 |
| | (0.6584) | (0.8981) | (0.7286) | (2.2997) | (0.7840) |
| ***No college education*** | | | | | |
| **Change in imports from China to Mexico/worker** | 0.9111** | 0.5661 | 0.6140 | 3.5736*** | 1.4826*** |
| | (0.3447) | (0.5801) | (0.4367) | (1.1321) | (0.3788) |

Notes: Each cell in the table reports the result from a regression over the period 2000-2015. The dependent variable is the log change in the number of working-age population (1), the log change in the number of working-age population employed in manufacturing (2), the log change in the number of working-age population employed in non-manufacturing (3), the log change in the number of the working-age population that is unemployed (4) and the log change in the number of the working-age population that is not in the labor force (NILF) (5). The main explanatory variable is the change in imports from China to Mexico per worker, in kUS$. The instrument is the change in imports from China to LAC per worker. All the regressions include the full set of control variables from table 5. Observations are weighted by start of period CZ share of national population. Robust standard errors in parentheses are clustered by the state

*** ; ** ; * significant at the 1%, 5% and 10% level respectively

## Table 9: Change in manufacturing employment in CZs, by sub-periods

| | All employees | Paid employees | Contract workers |
|---|---|---|---|
| | (1) | (2) | (3) |
| **Change in imports from China to Mexico/worker:** | | | |
| **(a) Period 1998-2003** | -1.6317** | -1.7888** | 0.1571 |
| | (0.7476) | (0.7197) | (0.0981) |
| **(b) Period 1998-2008** | -0.7633** | -0.9077** | 0.1368 |
| | (0.3677) | (0.1439) | (0.0960) |
| **(c) Period 1998-2013** | -0.2684** | -0.4400*** | 0.1716* |
| | (0.0994) | (0.1548) | (0.0941) |

Notes: Each column reports results from regressions over the periods 1998-2003 (a), 1998-2008 (b) and 1998-2013 (c). The dependent variable is the change in manufacturing employment over working-age population in CZ, for all employees (1), for paid employees (2) and for contract workers (3). The main explanatory variable is the change in imports from China to Mexico per worker, in kUS$. The instrument is the change in imports from China to LAC per worker. All the regressions include the full set of control variables from table 5. Observations are weighted by start of period CZ share of national population. Robust standard errors in parentheses are clustered by the state

*** ; ** ; * significant at the 1%, 5% and 10% level respectively

## Table 10: Import exposure through third markets

| | All employees | Paid employees | Contract workers |
|---|---|---|---|
| | **(1)** | **(2)** | **(3)** |
| **(a) Exposure to Chinese exports in Mexico and USA** | -0.1850*** | -0.2858*** | 0.1008** |
| | (0.0576) | (0.0869) | (0.0480) |
| **(b) Exposure to Chinese exports in Mexico (baseline)** | -0.2684** | -0.4400*** | 0.1716* |
| | (0.0994) | (0.1548) | (0.0941) |

Notes: Each column reports results from regressions over the period 1998-2013. The dependent variable is the change in manufacturing employment over working-age population in CZ, for all employees (1), for paid employees (2) and for contract workers (3). The main explanatory variable is the change in imports from China to Mexico and USA per worker, in kUS$ (a), and the change in imports from China to Mexico per worker, in kUS$ (b). See the text. All the regressions include the full set of control variables from table 5. Observations are weighted by start of period CZ share of national population. Robust standard errors in parentheses are clustered by the state

*** ; ** ; * significant at the 1%, 5% and 10% level respectively

## Table 11: Effects on wages

| | Paid employees | | | |
|---|---|---|---|---|
| | Production workers | Non-production workers | Legal employees | Illegal employees |
| | (1) | (2) | (3) | (4) |
| **Change in imports from China to Mexico/worker** | -0.0138<br>(0.0124) | -0.0344**<br>(0.0143) | -0.0279*<br>(0.0154) | -0.0017<br>(0.0159) |
| **$R^2$** | 0.134 | 0.246 | 0.171 | 0.193 |
| **Number of observations** | 780 | 780 | 780 | 780 |

Notes: Each column reports results from regressions over the period 1998-2013. The dependent variable is the log change in wages for production workers (1), non-production workers (2), for legal employees (3) and for ilegal employees (4). The main explanatory variable is the change in imports from China to Mexico per worker, in kUS$. The instrument is the change in imports from China to LAC per worker. The control variables are the share of manufacture in the country's total employment, the percentage of population with secondary education and the change in imports from the ROW to Mexico per worker, in kUS$. All the regressions also include a region fixed effect. Observations are weighted by start of period CZ share of national population. Robust standard errors in parentheses are clustered by the state

*** ; ** ; * significant at the 1%, 5% and 10% level respectively

## Appendix A: Construction of commuting zones

In this Appendix, we describe the algorithm used to group Mexico's municipalities in commuting zones (CZ's). Mexico already had 59 metropolitan zones assigned by INEGI where a zone consists on a group of municipalities that exhibit a high degree of socioeconomic interactions. The 59 zones do not cover the entire country; therefore, we created the additional commuting zones with the rest of the municipalities following a procedure similar to the one employed by INEGI.

First, we created an index of urbanity to identity central localities that are the core of labor relations amongst municipalities. The central localities are municipalities that attract population from other municipalities for employment reasons and these are the places where economic activity tends to be concentrated. The index is composed by the following variables: municipality population, percent of urban population; urban density, percent of population working in non-primary activities and number of municipalities with which the main municipality has labor relations. We classified a municipality as central if the municipality has an urban index score above the 25th percentile among the municipalities already used by INEGI to create the original 59 CZ's. The process identities 599 central municipalities around which the remainder municipalities (60%) were added to identified the commuting structure.

We assign a non-allocated municipality to a CZ (original CZ and new central municipalities) following three criteria: if the average distance between the two municipalities urban areas is lower than 100 km[24], some people from the non-allocated municipality work in the central municipality and there is a positive correlation between the urban employment rates amongst them.

*Correlation:*

We created the following measure of employment correlation between municipalities M and N:

$$\alpha_{M,N} = \frac{L'PW_L}{L'PL}$$

where: $L_{mx1}$ is the vector of employment rate for municipality M subareas. This measure is standardized by the state average and standard deviation. $W_{mxn}$ is the special weight matrix for each municipality M and N's sub-areas. This is defined as the inverse of the distance of each subarea and the sum of all the values in each row weight is equal to 1. $W_L = W * L^n$ is the vector of the weighted average employment rate of

[24] Two municipalities were too large so that they did not have a neighbor municipality near below the 100km threshold. We treated these municipalities as independent CZ's. A latitude grade was approximately 111km.

municipality N's sub area. P is a diagonal matrix that weights by the share of population of each M municipality subarea of municipality M.

If one municipality was a neighbor of two or more central municipalities we created and index that took into account the three criteria of assignment described above. We assigned the municipality with the greatest index value. We repeated this procedure until no more municipalities could be assigned. This procedure assigned 1068 municipalities to CZ's after seven rounds (73% of remainder municipalities). Finally, to assign the residual municipalities we lifted the restriction about having a positive correlation amongst employment rates and after five new rounds 291 more municipalities were assigned. At the end, there was a small residual of 92 municipalities that were not assigned with this process. On average these were very rural[25] and small[26] municipalities so we treated them as independent CZ's. This algorithm assigned the whole universe of Mexican municipalities into 789 CZ's.

[25] On average 72% of population in these municipalities work on primary activities, the urban area is less than 19% and most of them (77) are located in Oaxaca

[26] The population of these municipalities is always lower than 19,000 inhabitants

## Appendix B: Alternative import exposure variable

In this Appendix, we present results when we employ an alternative measure of import exposure. In particular, the Chinese import exposure is expressed in terms of the imports from China to Mexican apparent consumption instead of imports per worker. The construction of this import exposure at the CZ level follows the work in Acemoglu et al., (2015) and is given by the following expression:

$$\Delta IPW_{it} = \sum_j \frac{L_{ijt}}{L_{it}} \left( \frac{\Delta M_{cjt}}{Y_{jt} + M_{jt} - E_{jt}} \right)$$

where $Y_{jt}$ , $M_{jt}$ and $E_{jt}$ refer to industry $j$'s total output, imports and exports, respectively, while the rest of the variables are defined as before. Also, following a strategy similar to Acemoglu et al., (2015) the instrument for this variable is constructed by substituting in the numerator the change of the Mexican imports from China by the change in the imports of other countries from China, where the group of other countries consists of 17 Latin American economies. Table B1 presents a set of regressions similar to those in Table 4 but when this alternative import exposure variable is employed.

## Table B1: Change in manufacturing employment in CZ's, 1998-2013

| | 2SLS | 2SLS | 2SLS | 2SLS | 2SLS |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| **Change in imports from China** | -0.0958*** | -0.1025*** | -0.0784** | -0.0944** | -0.1086** |
| **to Mexico/worker** | (0.0323) | (0.0326) | (0.0361) | (0.0423) | (0.0425) |
| **Percentage of employment in** | | 0.0214 | -0.0005 | 0.0039 | -0.0123 |
| **manufacturing pre-trend (88-98)** | | (0.0258) | (0.0150) | (0.0148) | (0.0119) |
| **Percentage of population with** | | | -0.1800** | 0.1892** | -0.1385** |
| **secondary education** | | | (0.0779) | (0.0746) | (0.0634) |
| **Change in imports from ROW** | | | | 0.0215 | 0.0149 |
| **to Mexico/worker** | | | | (0.0318) | (0.0271) |
| **Region fixed effect** | no | no | no | no | yes |
| **$R^2$** | 0.093 | 0.096 | 0.149 | 0.153 | 0.209 |
| **Number of observations** | 780 | 780 | 780 | 780 | 780 |
| | 2SLS first stage estimates | | | | |
| **Change in imports from China** | 0.5970*** | 0.6064*** | 0.5961*** | 0.5057*** | 0.5036*** |
| **to LAC/worker** | (0.0526) | (0.0500) | (0.0528) | (0.0422) | (0.0398) |
| **Weak identification test F statistic** | 129.0 | 147.1 | 127.6 | 143.3 | 160.0 |

Notes: Each column reports results from regressions over the period 1998-2013. The dependent variable is the change in manufacturing employment over working-age population in CZ, in percentage points. The main explanatory variable is the change in imports from China to Mexico over Mexico's apparent consumption, in percentage points. The instrument is the change in imports from China to LAC over Mexico's apparent consumption. The control variables are the share of manufacture in the country's total employment (2-5), the percentage of population with secondary education (3-5) and the change in imports from the ROW to Mexico over Mexico's apparent consumption (4-5). Additional control in column 5 is a region fixed effect. Observations are weighted by start of period CZ share of national population. Robust standard errors in parentheses are clustered by the state. The weak identification test is the Kleibergen-Paap Wald F statistic

*** ; ** ; * significant at the 1%, 5% and 10% level respectively