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Labor market consequences of trade openness and competition in foreign markets*

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Abstract: We analyze the labor market consequences of international trade, using the evidence provided by the behavior of Mexican labor markets after the introduction of NAFTA in the nineties and the accession of China to the WTO in 2001. Following an approach close to that proposed by Autor, Dorn and Hanson (2013), we use the local market variation on exposure to international markets to identify the effects of these events. We show that NAFTA integration reduced unemployment, and boosted employment and wages. Chinese competition tended to have the opposite effect. Additionally, we find that the labor market responses to international trade are heterogeneous across regions in the country, being significantly stronger in the regions closer to the U.S. border.
Keywords: International trade and labor markets, local labor markets, Mexico, NAFTA, Chinese competition.
JEL Classification: E24, F14, F16

Resumen: Se analizan las consecuencias del comercio internacional sobre el mercado laboral utilizando la evidencia ofrecida por el comportamiento del mercado laboral mexicano después de la entrada en vigor del TLCAN en los noventa y de la entrada de China a la OMC en 2001. Siguiendo un enfoque cercano al propuesto por Autor, Dorn y Hanson (2013), se utiliza la variación en el grado de exposición al comercio internacional de los mercados laborales locales para identificar los efectos de estos eventos. Se muestra que la integración al TLCAN redujo el desempleo e incrementó el empleo y los salarios. La mayor competencia con China parecería haber tenido el efecto contrario. Adicionalmente, se encuentra que la respuesta del mercado laboral al comercio internacional es heterogénea entre las diferentes regiones del país, con efectos significativamente más pronunciados en regiones cercanas a la frontera con Estados Unidos.
Palabras Clave: Comercio internacional y mercado laboral, mercados laborales locales, México, TLCAN, Competencia de China.

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1. Introduction

Particularly after the trade liberalization process of many developing countries during the last decades of the twentieth century, a large strand of the literature has focused on the labor market consequences of international trade. As a result, a fruitful debate has evolved concerning the causes that may have led to the labor market outcomes that have been observed across the world and of the particular role that trade integration may have had in these outcomes. For the case of developed countries, a large part of the research has tried to identify to what extent the rising skill premium has been a result of enhanced trade with unskilled labor-abundant countries or of other factors, such as migration or skill-biased technological change (see e.g. Katz and Autor, 1999; Krugman, 2000 and 2008; Feenstra, 2010). In contrast, much of the literature focusing in developing countries has studied whether the response of their labor markets has been consistent with the predictions of standard models of international trade or not. Indeed, some papers argued that a rising skill premium was observed in these markets, suggesting either that other forces were dominating the behavior of the labor markets in these economies (such as skill-biased technological change), or that an important departure from the predictions of standard trade models was taking place (e.g. Cragg and Epelbaum, 1996; Harrison and Hanson, 1999). This last point led to the development of alternative trade models that could explain the rising skill premium in both developing and developed countries in response to trade liberalization (Feenstra and Hanson, 1997; Markusen and Zahniser, 1999).

Other papers have shown theoretically that the consequences of trade liberalization may be regionally heterogeneous across a country, and that the main predictions of traditional trade models may only be observed in a subset of regions (Venables and Limão, 2002). Taking this into account, several papers focusing on the experience of developing countries have provided evidence that the labor market consequences of trade were stronger in regions more exposed to trade, and that it is within these regions where the predictions of traditional trade models were observed (Hanson, 2004; Chiquiar, 2008). Recently, Autor, Dorn and Hanson (2013) have provided evidence of local heterogeneity of the labor market consequences of trade for the case of the U.S. They have shown that the consequences of import competition from China were stronger in those local labor markets that were initially more specialized in the kinds of goods whose imports from China increased more after this country's trade liberalization. However, they did not find a clear pattern at a regional scale. Indeed, they found a considerable variation in the degree of exposure to Chinese imports of the metropolitan areas located within even relatively narrowly defined regions in the U.S., such as the state of California, for instance.

In this paper, we contribute further to the strand of the literature that focuses on regionally heterogeneous responses to international trade. In contrast with most of the previous research, which only analyzes the consequences of trade integration between developing and developed countries, we study the labor market consequences for a developing economy of both trade integration with a developed country and of increased competition from another developing country. In particular, we apply the approach taken by Autor, Dorn and Hanson (2013) to the case of Mexico, to study the effects on its labor markets of both the introduction of the North American Free Trade Agreement (NAFTA) in 1994 and of China's entry into the World Trade Organization (WTO) at the end of 2001. Using their methodology to construct measures of exposure of local labor markets to foreign markets we can simultaneously study the effects of trade liberalization *vis-à-vis* a developed country on one hand, and of the consequences of a developing country's insertion into world trade on the other.

Our results suggest that the increase in market access to the U.S. after NAFTA led to a decrease in unemployment, to increases in the number of unskilled workers employed in manufacturing, and to higher real wages in Mexico. In contrast, the increase in U.S. imports from China, which tended to affect Mexican exports to the U.S., seems to have induced higher unemployment, a decrease in manufacturing employment and a decrease in non-manufacturing wages in Mexico. We provide evidence suggesting that these effects were regionally heterogeneous and, in particular, were stronger in local labor markets that were more exposed to international markets and foreign competition, which in general correspond to those located closer to the U.S. border. Thus, in contrast with the case of the U.S. described in Autor, Dorn and Hanson (2013), for the case of Mexico we *do* find a clear regional pattern in the degree of exposure to trade and in the labor market consequences of trade-related shocks. This supports the idea that, at least for the case of Mexico, in order to study the consequences of trade, the regional dimension should be taken into account.

The rest of the paper is organized as follows. Section 2 presents a brief background related to the trade-related shocks that the Mexican labor markets have suffered in the last decades. Section 3 describes the methodology and data sources used to estimate the measures of local market exposure to international trade that we use afterwards. Section 4 illustrates the correlation between these exposure measures and some labor market outcomes in Mexico. These relationships are formally examined with an econometric approach in Section 5. Finally, Section 6 summarizes the main findings and concludes.

2. Background

As mentioned before, in this paper we study the labor market consequences in Mexico of: (i) the introduction of NAFTA, which significantly increased Mexican manufacturing exports to the U.S. after 1994, and (ii) the accession of China to the WTO in 2001, which increased Chinese exports to the U.S., notoriously substituting Mexican products in this market. We make particular emphasis on the differential effects across regions. Given this purpose, it is relevant to discuss briefly why these shocks may have had important consequences on Mexico's labor markets, and why these consequences may have been heterogeneous across regions.

Given its initial comparative advantages, Mexico responded to NAFTA integration mostly by specializing in unskilled labor-intensive processes. Indeed, NAFTA boosted the formation of regional production-sharing arrangements, such as maquiladoras, in which Mexico specialized in assembly processes, importing components and re-exporting finished goods to the U.S. (Hanson, 1996; Graham and Wada, 2000; Robertson, 2007). The literature has argued that this process altered the optimal location choice of manufacturing firms in Mexico by increasing the market potential of plants located closer to the U.S., and thus leading to a movement of manufacturing employment towards the border with the U.S. and to an increase in the border wage premium (Krugman and Livas Elizondo, 1996; Hanson, 1996, 1997, 1998). Furthermore, previous research has shown that the predictions of traditional trade models and, specifically, of the Stolper-Samuelson Theorem, were only observed precisely in the regions closer to the U.S. (Chiquiar, 2008).

Unwittingly, during this process the enhanced market access to the U.S. provided by NAFTA induced Mexico to specialize in industries and activities in which, in some cases, China would eventually exhibit a comparative advantage. Thus, once China entered more actively in international manufacturing export markets, especially after its accession to the WTO by the end of 2001, Mexico started facing a stronger competition in its main export markets, especially in the U.S. Indeed, a large overlap exists in the kind of products that both Mexico and China have specialized in, and therefore their export mixes to the U.S. became very similar when China increased its manufacturing export capacity (Chiquiar, Fragoso and Ramos-Francia, 2007; Hanson and Robertson, 2010; Amoroso, Chiquiar and Ramos-Francia, 2011). The increase in China's role in manufacturing export markets was apparently due to factors such as enhanced productivity derived from its transition to a market economy, its greater access to foreign technologies, capital goods and intermediate inputs, and its comparative advantage in unskilled labor-intensive sectors (Autor, Dorn and Hanson, 2013). Those factors were exploited more fully by China when it joined the WTO in the category of "most favored nation". In this regard, the increase in Chinese exports to the U.S. had a negative effect on Mexico's market share in U.S. imports (see Figure 1) and could have affected adversely labor demand in Mexico's labor markets, particularly in those regions where the industries now competing with China were previously established. Evidence pointing to the importance of Chinese increased export capacity has already been shown for the case of the U.S. (Autor, Dorn and Hanson, 2013; Caliendo et al., 2015). It is therefore natural to think that some disruption in Mexican labor markets may have taken place, given the strong trade relationship between Mexico and the U.S. Indeed, Mendez (2015), also using the methodology proposed by Autor, Dorn and Hanson (2013), finds a negative impact on employment in Mexico. However, contrary to the findings of this paper, no effect on wages is found, which could probably be explained by the more limited coverage of the information on wages in that paper.[1]

[1] It is possible that Mendez (2005) is not able to identify the effects on wages because of at least two reasons. First, it is possible that it is confounding the regional heterogeneous effects of Chinese competition with the regional effects of the global financial crisis of 2009 because his analysis focuses on the period 2000 to 2010.

In sum, these arguments seem to suggest that Mexican labor markets could have faced a positive labor demand shock after NAFTA, while increased Chinese competition could have induced a negative demand shock after 2001. These shocks may have been disproportionately large in the case of manufacturing unskilled labor, and their effects may have been regionally heterogeneous, being possibly stronger in the regions where the largest share of export-oriented manufacturing plants were established at the time NAFTA was enacted. Thus, it seems to be natural, as will indeed be done in the following sections, to exploit the regional variation in exposure to international markets and competition, to identify the labor market consequences of these trade shocks in Mexico.

3. Regional exposure to trade integration and competition

3.1. Description of exposure measures

In this section we describe the construction of two measures of exposure to trade in Mexican local labor markets. With this purpose, we follow the approach proposed by Autor, Dorn and Hanson (2013), who estimate the effect that the increase in U.S. imports from China had on U.S. metro zones by exploiting the variation in the degree of exposure of different local U.S. labor markets to the increase in those imports. In particular, they assume that labor markets in those subeconomies that were initially more specialized in the production of goods that experienced the largest increase in imports from China may have been more affected than other regions of the country through Chinese import competition.

Following this approach, we will assume that Mexico's local labor markets were also differentially affected from the increase in U.S. imports from China to the extent that they differed in the degree to which they were previously specialized in producing the kind of goods that exhibited the largest export increases from China to the U.S. We will also apply this approach to study the initial impact that NAFTA had on Mexico's labor markets. In

Second, the information on wages is limited to a subset of the labor force. In particular, in Mexico more than half of the workers are informal and the rest are formal. The data source used in the paper only covers formal firms. The data sources we use allow us to overcome these two concerns. Moreover, we also include in the analysis the effect of NAFTA integration to estimate the effects of exposure to international markets on local labor markets.

particular, to identify the labor market impact of NAFTA, we assume that those local labor markets within Mexico that were previously specialized in producing goods that were later on increasingly exported to the U.S. as a consequence of increased market access due to NAFTA integration, may have exhibited a larger response than the rest of the country.

Thus, we will compute two measures of local exposure to international trade: (i) exposure to Chinese competition in U.S. markets, and (ii) exposure to NAFTA trade integration. We formalize the notion of "local exposure" as Autor, Dorn and Hanson (2013) do. In particular, if we index Mexican local labor markets by *i* and different sectors by *j*, and we let ΔM_j^{USChi} be the dollar-valued change in U.S. imports from China of goods produced in sector *j* from 2000 to 2008, we compute the Index per Worker (ΔIPW_i^{US}) of local labor market exposure of metropolitan area *i* to the increase of Chinese exports to the U.S. as:

$$\Delta IPW_i^{US} = \sum_j \frac{E_{ij}}{E_j} \frac{\Delta M_j^{USChi}}{E_i} \qquad (1)$$

where E_{ij} is the start-of-period number of workers in industry *j* in metro area *i*, E_i is the total number of workers in metro area *i* in that same starting year, and E_j is the start-of-period number of workers at the national level in industry *j*. The intuition behind this index is as follows. If, say, 30 per cent of the Mexican employment in industry *j* was located in metro area *i* at the start of the period, then we apportion 30 per cent of the increase of U.S. imports from China of goods from sector *j* observed in the following years to this metropolitan area. This process is repeated for each industry, and then we sum over all industries to obtain $\sum_j \frac{E_{ij}}{E_j} \Delta M_j^{USChi}$, a measure of the total exposure of the labor market in metro area *i* to Chinese competition in the U.S. Finally, we divide by the total initial number of workers in metro area *i* (E_i) to obtain a per-worker measure of local exposure to Chinese competition as $\frac{1}{E_i} \sum_j \frac{E_{ij}}{E_j} \Delta M_j^{USChi}$. Intuitively, a local labor market *i* would be more exposed to Chinese competition and, thus, have a larger value for this index, to the extent that its labor force was initially more concentrated in sectors producing goods where exports from China to the U.S. increased the most from 2000 to 2008.[2]

Note that we are assuming that the main mechanism through which Chinese export capacity may have affected Mexico's labor markets was through the negative effects that Chinese exports to the U.S. may have had on Mexican exports to that market, rather than directly through an increase in Mexican imports from China. This may be a reasonable assumption to the extent that the U.S. market is significantly larger than Mexico's local market and a large share of manufacturing production in Mexico is directed to the U.S. Furthermore, if we take into account that a large share of Mexican manufacturing exports to the U.S. are related to production-sharing arrangements in which Mexico specializes in unskilled labor intensive processes, and imports components from the U.S. to later export assembled goods, it is reasonable to treat Mexico's regions as another group of regions that contribute jointly with U.S.'s local labor markets to the overall North American production chain (which has the U.S. as its main final output market; see Chiquiar, Fragoso and Ramos-Francia, 2007). Thus, Mexico's local labor markets may have been affected in a similar way as U.S. local markets by the increase of Chinese exports to the U.S., so extending the analysis made by Autor, Dorn and Hanson (2013) to include Mexico's labor markets is reasonable. In any case, we acknowledge that increased competition from China may have also directly affected the Mexican labor market through the increase in Mexican imports from China. Although in this paper we only report the effects on local labor markets derived from the enhanced competition of Chinese products in the U.S., we obtained qualitatively similar results in analyses in which we included the increase of Chinese exports to both the U.S. and Mexico or only Chinese exports to Mexico in our exposure measure.

Analogously, we also construct a measure of local market Openness per Worker (ΔOPW_i^{US}) or exposure to trade integration due to NAFTA as:

$$\Delta OPW_i^{US} = \sum_j \frac{E_{ij}}{E_j} \frac{\Delta X_j^{MxUS}}{E_i} \tag{2}$$

[2] We do not include in the analysis trade data from 2009 on, to avoid the results from being affected by the consequences that the global financial crisis had on international trade flows.

where ΔX_j^{MxUS} is the dollar-valued increase from 1993 to 2000 of Mexican exports to the U.S. of goods produced in sector j, E_{ij} is the initial number of workers in industry *j* in metro area *i*, E_i is the total initial number of workers in area *i*, and E_j is the initial number of workers at the national level in industry j. Again, the intuition behind this index is that the labor market in metro area *i* was more exposed to market expansion due to NAFTA integration to the extent that its labor force was initially more concentrated in producing goods that later on exhibited larger export increases to the U.S. market.

3.2. Estimating the exposure measures

To construct the described indexes we use the following data. First, we use the UN Comtrade database using the Standard International Trade Classification (SITCrev3) at group level (3 digits) to compute the change in Mexican export to the U.S. from 1993 to 2000 (ΔX_j^{MxUS}) and the change in U.S. imports from China from 2000 to 2008 (ΔM_j^{USChi}). Second, employment data (E_{ij}) by industry *j* for each municipality in Mexico was obtained from the Economic Censuses and was aggregated to the level of metropolitan area *i*. Note that an Economic Census is conducted by Mexico's National Statistics Institute INEGI (Instituto Nacional de Estadística y Geografía) every five years. In this study we use data from the 1994 Census to compute the NAFTA exposure measure and from the 1999 Census to compute the measure associated to increased competition from China. In both cases employment data is taken at class level (6 digits), but in the 1994 Census it was arranged by a domestic classification (CMAP), whereas the Mexican NAICS classification was first implemented in the 1999 Census.[3] As can be noted, the pieces of information required to estimate the exposure measures use different industry classifications. Moreover, the NAICS classification of Mexican employment data in the Economic Censuses has changed over time since its implementation in 1997 and even the standardized NAICS classification differs between Mexico and the U.S. at the class disaggregation level discussed in this paper.

[3] CMAP stands for Clasificación Mexicana de Actividades y Productos. NAICS is the North American Industry Classification System created against the background of the NAFTA to provide common definitions of the industrial structure of the three countries, however the sixth digit (class level) is used to designate only national industries. For the purposes of this study, that means that the Mexican and U.S. NAICS categories are not equivalent at the analyzed class level.

Therefore, to address these concerns, we applied several correspondence tables in order to convert data into a comparable base.

For the analysis of the effect of NAFTA on local labor markets, we compute the previously defined indexes for each of the 37 metropolitan areas identified in the Mexican National Urban Employment Survey (ENEU, Encuesta Nacional de Empleo Urbano) for 1993. According to ENEU, in 1993 these 37 metropolitan areas together included 161 municipalities, and covered a total population of 26.8 million people (30% of the total population of the country in that year). An important aspect in the analysis below is that we will distinguish between metropolitan areas in border states and those in non-border states, where we will consider metropolitan areas in border states as those whose full set of municipalities are located within a state that has a border with the U.S. (Figure 2). With respect to the metropolitan zones used for the analysis of the exposure to Chinese competition, we consider 56 zones defined by INEGI (2005). According to INEGI, in that year these metropolitan zones represented 345 municipalities, with a total population of 57.9 million people (60% of the working population of the country). Again, metropolitan areas in border and non-border states are distinguished (Figure 3). Limitations from the data source did not allow us to have a perfect match in terms of the metropolitan zones defined for each of the two analyses we conduct, although 29 metropolitan zones appear in both samples.

Figures 4 and 5 show that, as expected, metropolitan areas located in border states are generally more exposed to trade integration and to Chinese competition than those in non-border states. This is consistent with the fact that Mexico’s trade liberalization tended to cause a re-location of manufacturing employment and export activity towards the border region of the country (Hanson, 1996). Furthermore, as discussed before, NAFTA integration led border regions of the country to become increasingly specialized in goods for which later on Mexico would compete directly with China in the U.S. market. This reflects the fact that Mexico and China tended to share a similar pattern of comparative advantages (see Chiquiar, Fragoso and Ramos-Francia, 2007; Amoroso, Chiquiar and Ramos-Francia, 2011).

Indeed, Figure 4 shows that the highest levels of the NAFTA exposure measure ΔOPW_i^{US} are in most cases attained in metropolitan areas in border states. A similar pattern is observed in Figure 5, where metropolitan areas are sorted according to their ΔIPW_i^{US} level. Again, the highest exposure to Chinese competition in the U.S. markets is observed on metropolitan areas close to the Mexico-U.S. border. Note that some non-border states metropolitan areas also attain high levels of the NAFTA exposure index. Most of these correspond to cities relatively specialized in the automotive industry, which in Mexico is a highly export-oriented sector. [4] In contrast, the degree of concentration on the auto industry does not seem to be a relevant driver of the degree of exposure to Chinese competition. This reflects the fact that China does not seem to be currently a relevant competitor for Mexico in the U.S. automotive market (see Chiquiar, Fragoso and Ramos-Francia, 2007).

To formalize the idea that the metropolitan areas located in border states are generally more exposed to Chinese competition than those in non-border states, we show that the production patterns of the metropolitan areas in border states are relatively similar to China's pattern of comparative advantages and, in contrast, the production patterns in the non-border regions were negatively correlated with China's comparative advantages. In particular, we calculate the Spearman rank correlation coefficient between China's Revealed Comparative Advantage patterns (RCA, see Balassa, 1965) and a similarly defined Sectorial Specialization Index (SSI) for the metropolitan areas in Mexico in 1999.[5] To do this, we first identify the pattern of China's comparative advantages by computing a *RCA* index for each sector $j = 1 \ldots n$, given by

$$RCA_j^{China} = \left[\frac{X_j^{China} \Big/ \sum_{j=1}^{n} X_j^{China}}{X_j^{World} \Big/ \sum_{j=1}^{n} X_j^{World}} \right] \tag{3}$$

where ${RCA_j}^{China}$ is China's Revealed Comparative Advantage index in sector j, ${X_j}^{China}$ is the value of China's exports to the U.S. in sector j, and ${X_j}^{World}$ is the value of world exports to the U.S. of sector j. The interpretation of this index is straightforward. The numerator indicates the share of sector j in total Chinese exports to the U.S., while the denominator

[4] We assume the metro areas specialized in the automotive industry are those for which this industry represents at least 29% of the value of its exposure index to NAFTA.

[5] We use 1999 as the benchmark period, prior to the accession of China to the WTO, because it is the Economic Census year from which we take the employment data used to compute the Chinese exposure measure described here.

represents the share of this same sector *j* in world's exports to the U.S. If this index is greater than 1, it implies that China is exporting a relatively larger share of sector *j* to the U.S. than the rest of the world, suggesting a revealed comparative advantage in that sector. The computation of Mexico's regional patterns of specialization is based on a similar index, although two comments are in order. First, since we wish to show that metropolitan areas in border states were "more similar" to China in their specialization patterns than metropolitan areas in non-border states, all the areas will be grouped into two: "border" and "non-border". The second comment is that, since there is no data available regarding exports at the metropolitan area level, the indices we compute in this case are based on the regional-specific distribution of employment across sectors. In particular, we use a sectorial specialization index (SSI), similar to the RCA index, for the metro areas in border states:

$$SSI_j^{Border} = \frac{E_j^{Border} \Big/ \sum_{j=1}^{n} E_j^{Border}}{E_j^{Mex} \Big/ \sum_{j=1}^{n} E_j^{Mex}} \tag{4}$$

where E_j^{Border} is the number of workers in sector j in border states and E_j^{Mex} is the total number of workers in sector *j* in Mexico. The *SSI* for metropolitan areas in non-border states is calculated using the same formula, but with the data corresponding to non-border states. Note that, by construction, the border areas specialization patterns and those of non-border areas will simply be mirror images of one another and, in particular, the rank correlation between China's RCA and SSI_j^{Border} will be identical with the one with $SSI_j^{No-Border}$, with its sign interchanged. [6]

Figure 6 illustrates the correlation between China's RCA in the U.S. market and the SSI for the Mexican regions in 1999. As can be seen, there is a positive and statistically significant relationship between the comparative advantage pattern of China and the sectorial specialization index of the metropolitan zones located in Mexican border states. This implies a negative, statistically significant and equally-valued (in absolute terms) correlation coefficient with non-border states' metropolitan zones. Thus, indeed we find that

[6] As previously specified, we will report Spearman's rank correlations coefficients, which assess the degree of ordinal association between two series.

metropolitan areas in border states were on average more exposed to Chinese competition in U.S. markets than their counterparts in non-border states.

4. Relationship between exposure measures and labor market outcomes

In this section we analyze the apparent links between both exposure indexes and the labor market outcome variables that we analyze in the paper. The labor market variables we evaluate are unemployment, employment and wages. The relations presented are summarized in dispersion diagrams that include the corresponding correlation coefficient. One, two or three asterisks are added when such correlation is statistically significant at a 10%, 5% or 1% level, respectively. It is worth mentioning that we only present here a preliminary analysis based on the correlations between variables. We leave the full econometric analysis for the next section.

Data for the labor market outcome variables comes from different employment surveys conducted by the Mexican Statistics Agency, INEGI, in representative samples of Mexican households. In particular, the NAFTA effect is analyzed using data from the ENEU survey for the years 1993 and 2000. The analysis uses the change in the variables between those two years. The Chinese competition effect is analyzed using data from ENE for the year 2000 and ENOE for 2008. Again, the analysis uses the change in the variables between those two years.[7]

[7] ENEU (Encuesta Nacional de Empleo Urbano) was conducted during 1983-2004 and ENE (Encuesta Nacional de Empleo) was conducted during 1991-2004. In 2005 both surveys were replaced by ENOE (Encuesta Nacional de Ocupación y Empleo), the current survey to date. The purpose of these surveys is to collect data on the employment situation of Mexicans 12 years of age or older, as well as additional information on demographic and economic variables that allows a better appreciation of Mexican labor market characteristics. For the analysis of the effect of NAFTA, the information for both 1993 and 2000 was computed by using the average of the four quarters of each year. For the China effect, the average of the second and third quarters of 2000 and of 2008 were used. The reasons for this last choice are twofold: i) a methodological change in the labor market survey used to compute these data makes the survey from the first quarter of 2000 incomparable to the following surveys; and ii) to avoid the consequences of the global financial crisis on Mexico's manufacturing labor market, which started to be felt in the last quarter of 2008.

4.1. Exposure to NAFTA openness (ΔOPW_i^{US}) and labor market outcomes

We begin by presenting the observed correlations between the initial degree of exposure to NAFTA integration of each metro zone and the labor market outcomes. As can be seen in Figure 7, there is a negative and statistically significant correlation between the initial exposure to NAFTA integration (ΔOPW^{US}) and the change in unemployment from 1993 to year 2000. This result is observed both for changes in unemployment measured as the logarithmic differences in unemployed population or as the change in unemployment rates from 1993 to 2000. Similarly, Figure 8 shows some evidence of a positive and statistically significant relationship between the initial exposure to NAFTA and the change in employment levels. This positive correlation seems to be explained fully by the positive and statistically significant relationship between NAFTA integration and the change in manufacturing employment levels, since the correlation with the changes in non-manufacturing employment is not statistically significant. Finally, Figure 9 shows a positive and statistically significant relationship between the initial exposure to NAFTA and the change in local real wages. This result is observed both for manufacturing and for non-manufacturing sector wages. Thus, the correlations depicted in this section suggest that metropolitan zones that were most exposed to NAFTA integration exhibited a larger increase in manufacturing employment and in real wages in the years following NAFTA integration, relative to the rest of the country.

4.2. Exposure to Chinese competition (ΔIPW_i^{US}) and labor market outcomes

Focusing now on the correlation between the levels of initial exposure to Chinese competition and the posterior local labor market indicators, we may note in Figure 10 that there is a positive correlation between exposure to Chinese competition and the change in unemployment levels and rates in the 2000-2008 period. However, this correlation turned out to be statistically significant only when unemployment is measured as a proportion of the labor force. Furthermore, while Figure 11 shows a negative correlation between the exposure to Chinese competition and the change in manufacturing employment levels, the correlation coefficient is relatively small and not statistically significant. Furthermore, the correlation of the exposure to Chinese competition and the change of non-manufacturing employment levels turned out to be negligible, so that basically no correlation is found between Chinese competition and total employment variations. In contrast, in Figure 12 we do find a negative and statistically significant relationship between the degree of exposure to Chinese competition and the change in real wages from 2000 to 2008. However, this negative correlation seems to be driven exclusively by the behavior of wages in the non-manufacturing sector, since the correlation between the degree of exposure to Chinese competition and the behavior of manufacturing wages does not appear to be significant.

Thus, the results seem to suggest that most of the adjustment to the Chinese competition shock, which could initially lead to lower manufacturing employment levels, may have been absorbed fundamentally through wage adjustments. Indeed, this shock seems to have caused some downward pressure on labor demand in the manufacturing sector. However, the ensuing effective increase in the labor supply faced by the non-manufacturing sector seems to have driven down the wages paid by that sector in the process, so that large reductions in employment levels were not observed. It is relevant to note that these results mirror the findings of Autor, Dorn and Hanson (2013), who show that in the case of the U.S. metropolitan zones, the increase in Chinese imports exposure led to reduced manufacturing employment, had no significant effect on manufacturing wages, but decreased non-manufacturing wages too.

5. Econometric analysis

While the correlation analysis presented in the previous section seems to lead to some relevant preliminary findings, it is necessary to pursue a more structured econometric approach. This will allow us to identify more fully the causal effects that the NAFTA and Chinese competition shocks may have had on labor market outcomes, by including additional controls and accounting for possible endogeneity biases, and will also allow us to distinguish the size and significance of the effects these shocks had in different regions of the country. In particular, to assess the labor market consequences of NAFTA integration, we estimate equations of the form:

$$\Delta y_i = \alpha + \beta \Delta OPW_i^{US} + \gamma X_i + e_i \quad (5)$$

where Δy_i is the change from 1993 to 2000 in the labor market variable of interest (unemployment, employment and wage indicators) in metro area i; ΔOPW_i^{US} is the measure of exposure of metro area *i* to NAFTA integration; and X_i denotes a vector of other metropolitan zone specific controls: the proportion of working women, the proportion of the population with high school education and a measure of state-level historical migration rates to the U.S. The first two controls correspond to the information at the beginning of the period (1993) and are based on information from ENEU. For the migration variable see Woodruff and Zenteno (2007).[8]

Similarly, the regression equation to estimate the effects of Chinese competition in the U.S. market on Mexico's local labor markets is:

$$\Delta y_i = \alpha + \beta \Delta IPW_i^{US} + \gamma X_i + e_i \quad (6)$$

where Δy_i is again the change in the labor market variable of interest in metro area i from 2000 to 2008, ΔIPW_i^{US} is our measure of exposure of metro area *i* to Chinese competition in the U.S. market, and X_i is the same vector of additional controls as in the previous model. In this case, demographics are based on the 2000 Population Census.

As in the case of Autor, Dorn and Hanson (2013), a relevant concern related to the estimation of these equations is the risk of simultaneity bias. In particular, they used an Instrumental Variables (IV) approach to avoid biases that could result from shocks to U.S. product demand, which could lead to a positive correlation between employment (and wages) and U.S. imports from China. Similarly, we will use an IV approach to estimate equations (5) and (6).

In the case of the estimation of equation (5), simultaneity biases could arise, for instance, from the presence of correlation between Mexico's labor market indicators and a supply-side

[8] This variable corresponds to the number of persons that migrated to the U.S. during 1955-1959 as a percentage of the 1960 population of each state. We use historical information from this period to ensure that we capture an exogenous measure of the presence of well-established migration networks developed since the *Bracero* program was operating, which may have implied that in some regions of the country out-migration could have been another significant source of adjustment of the local labor markets as a response to trade-related shocks.

driven export expansion to the U.S. In order to avoid this, we will identify the effect of NAFTA on local labor market indicators by exploiting the variation in sector-level exports from Mexico to the U.S. induced by the reduction of U.S. tariffs applied to Mexican imports after NAFTA came into effect. That is, the instrumental variable we will use for $\Delta OPW_i{}^{US}$ in the estimation of Equation (5) will be

$$\Delta OPW_i^{IV} = \sum_j \frac{E_{ij}}{E_i} \frac{\Delta(1+t_j^{USMx})}{1+t_{j,1993}^{USMx}} \tag{7}$$

where E_{ij} is the number of workers in industry *j* in metro zone *i*, E_i is the total number of workers in metro zone *i*, $t_{j,1993}^{USMx}$ is the tariff effectively applied by the U.S. to imports from Mexican industry *j* in 1993, and $\Delta(1+t_j^{USMx}) = (1+t_{j,2000}^{USMx}) - (1+t_{j,1993}^{USMx})$ is the change in such tariffs from 1993 to 2000.[9] Note that this instrument can be interpreted as a sector-weighted average of the reduction of tariffs to export to the U.S. that each metro zone in Mexico experienced after NAFTA, where the weights are determined by the relative importance of each sector in the local labor market of the metro zone, according to the distribution of its initial employment levels. Using this instrument will allow us to isolate the effect of an increase of Mexican exports to the U.S. as a result of enhanced market access to the U.S. due to NAFTA induced-tariff reductions and to identify their effect on labor market outcomes, without our estimates being biased by potential increases in the Mexican supply.

We also estimate equation (6) with an IV strategy. Indeed, our estimation could be biased if shocks to U.S. product demand lead to increased imports from both Mexico and China. Thus, we use exactly the same approach as Autor, Dorn and Hanson (2013) for the estimation of the effect of China's competition in the U.S. on Mexico's labor markets. In particular, we instrument $\Delta IPW_i{}^{US}$ with a related measure, using the change in the imports of eight developed countries from China during the period of analysis (2000-2008): $\Delta IPW_i{}^{OC}$. The

[9] We used *effectively applied tariffs* imposed on Mexican products by the U.S., aggregated at group level (3 digits) of the Standard International Trade Classification System Rev. 3 (SITCrev3). The data were taken from the TRAINS (Trade Analysis and Information System) database of the UNCTAD, available at https://wits.worldbank.org/WITS/WITS/Restricted/Login.aspx. Tariffs aggregated at 3-digit level of the SITCrev3 in this database are computed both as simple averages and as weighted averages using trade flows as weights. We used the weighted average version of the tariffs instead of the simple average version, expressed in Ad-Valorem terms.

countries are Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain and Switzerland.[10] The ΔIPW_i^{OC} index is correlated with the index of exposure to Chinese competition in the U.S. market to the extent that the increase in the imports of the United States and of other developed countries from China has been due to an increase in China's export capacity. Likewise, we assume that the change in the imports of other countries from China is not associated with the dynamics of the Mexican labor market. This way, the instrument allows us to capture the part of the effect that is associated to a rise in China's export supply, isolating our estimates from the biases that could result from an increase in U.S. product demand. Figure 13 shows that our two original measures of local labor market exposure are significantly correlated with the corresponding measures we use as instruments. More formally, in both cases the null of weak instruments is rejected at any significance level with the F test of excluded instruments in the first stage regressions with Stock and Yogo's (2005) critical values.

In the following subsections, we describe the empirical results we obtained for the effect of the degree of exposure to NAFTA integration on local labor markets. We then present the estimates related to the effect of the degree of exposure to Chinese competition in the U.S. market. In both cases, we focus in sequence on the effects on unemployment, employment and wage dynamics after these shocks took place.

5.1. Effects of exposure to NAFTA integration on local unemployment dynamics

Table 1 exhibits the results of the estimation of Equation (5) with the IV procedure described above, using three measures of unemployment dynamics as dependent variable: (i) the change in the log of unemployed population from 1993 to year 2000; (ii) the change in the percentage of unemployed workers relative to the population older than 12 years old from 1993 to 2000; and (iii) the change in the unemployment rate, i.e. in the proportion of unemployed workers relative to the labor force. As may be noted, the results suggest a negative, statistically significant effect of NAFTA integration on the three measures of unemployment dynamics used. This is, we find that those metropolitan areas that exhibited a higher degree of exposure to NAFTA integration, given their initial productive structure,

[10] Data for imports of developed countries from China is also taken from the UN Comtrade Database.

presented in the following years a reduction in unemployment, as compared with regions less exposed to NAFTA integration.

To interpret the size of the effects obtained above, we also present the product of the estimated coefficients and a gap measure of the exposure index. That is, the effect that, according to the estimated coefficient, NAFTA integration would have on unemployment if a metro area with an exposure measure in the 25th percentile increased its exposure to the level of a metro area in the 75th percentile. We can note at the bottom row of Table 1 that, according to our estimates, if the NAFTA openness exposure index increased from the level of the 25th percentile to the level of the 75th percentile: (a) the number of unemployed workers would decrease in 24%; (b) the ratio of unemployed workers relative to the population in working age would decrease in 0.63 percentage points, and (c) the unemployment rate (unemployed population relative to labor force) would decrease in 1.05 percentage points.

In Table 2 we distinguish the estimates obtained for the subsample of cities in either border states or concentrated in the automotive industry, from the ones obtained for the rest of the country. In particular, we repeat the same specification described in Table 1, but this time the NAFTA exposure measure is interacted with a dummy variable that takes the value of 1 if the metro area is located in a border state and/or if it has a large presence of the auto industry. This allows us to obtain separate coefficients for the effect of NAFTA exposure on each group of metro areas. According to previous literature (e.g. Hanson, 2004; Chiquiar, 2008), given its more external market orientation, the border region's labor markets exhibited a larger effect of NAFTA integration than the rest of the country. Furthermore, as shown is Section 3 the metropolitan areas concentrated in the automotive industry also exhibit relatively large values of the NAFTA exposure measure. As can be seen, only the coefficients corresponding to metro areas that are in the border region or that specialize in the automotive industry turned out to be statistically significant. Thus, the results suggest that the decrease in unemployment that can be attributed to NAFTA integration was mostly concentrated in those metro zones.

5.2. Effects of exposure to NAFTA integration on local employment dynamics

Tables 3 and 4 present the results of the effect of NAFTA integration on several measures of local employment dynamics. In particular, we estimate its effects on the change in the log of the following measures between 1993 and 2000: (i) total employment; (ii) employment in the manufacturing industry; (iii) non-manufacturing employment; (iv) total skilled workers employed; (v) total unskilled workers employed; (vi) skilled workers employed in the manufacturing sector; and, (vii) unskilled workers employed in the manufacturing sector. We define skilled workers as those having an education level higher than middle school. Following the same strategy we used in previous regressions, we estimate the effect for the complete sample of metropolitan areas (Table 3) and for two groups aimed to distinguish the effect on metro areas located in border states or concentrated in the auto industry, from the rest (Table 4).

Using the whole sample of metro areas, we find that NAFTA exposure had a positive, statistically significant effect on manufacturing employment. Furthermore, as expected given Mexico's comparative advantage in unskilled labor abundant processes with respect to the U.S. (Hanson, 1996; Graham and Wada, 2000; Robertson, 2007), this result seems to have been driven fundamentally by a larger demand for unskilled workers in that sector. The results also seem to suggest a negative effect of NAFTA on overall skilled worker employment levels, although in the manufacturing industry in particular no such effect seems to have taken place. Related to this point, as will be seen in the results described below, NAFTA seems to have induced an overall across-the-board increase in wage levels in the border region. Thus, the negative effect in employment levels of skilled labor we find here may be associated with this increase in wages, in a context where the demand for skilled workers was falling relative to the demand for unskilled labor.

Once we focus on Table 4, we again find that most of the employment effects described above were observed in the metro areas of the border regions or concentrated in the auto industry. In contrast, we do not find statistically significant effects on employment levels in the rest of the country.[11] Thus, the results are consistent with the previous literature pointing

[11] However, the positive effect of NAFTA on skilled labor employment levels is found to be close to being significant at a 10% level in both subsamples.

to the fact that NAFTA seems to have led to an increasingly high level of specialization in unskilled labor intensive manufacturing processes in the border, leading to an increase in the demand for unskilled labor in this region (see e.g. Chiquiar, 2008).

5.3. Effects of exposure to NAFTA integration on local wage dynamics

Tables 5 and 6 present the results of the estimates related to the effects of NAFTA integration on local wage dynamics. We estimate the effects on the 1993-2000 log change in five real wage measures: (i) for the overall working population in the metro area; (ii) in the manufacturing sector; (iii) in the non-manufacturing sector; (iv) of skilled workers; and (v) of unskilled workers. Following the same strategy we used in previous regressions, we estimate the effect for the complete sample of metropolitan areas (Table 5) and for two separate groups defined by their location and auto industry concentration (Table 6).

We find that NAFTA integration seems to have led to overall wage increases across all groups of workers. However, according to Table 5, the wage increases were slightly higher in the manufacturing sector than in other sectors. Furthermore, these results seem to be driven mostly by the wage dynamics observed in the border region and in cities concentrated in the auto industry. In particular, according to the results in Table 6, it is in these precise regions where the positive effects of NAFTA on wages seem to have been generalized; in contrast, in the remainder of metropolitan areas the estimated effect of NAFTA on wages did not turn out to be statistically significant.

5.4. Effects of exposure to Chinese competition on local unemployment dynamics

We now proceed to present the results of a similar analysis as the one conducted in the previous subsections, but we now instead focus on the consequences of the degree of exposure to Chinese competition in the U.S. on local labor markets in Mexico. The basis for the analysis is the IV estimation of Equation (6) above, for different sets of dependent variables related to labor market outcomes.

First, in Table 7 we present the results of the estimation of the effects of the degree of exposure to Chinese competition on unemployment outcomes. We use the same three measures of unemployment dynamics as in the analysis above, but now we consider the changes in unemployment at the local level observed from year 2000 to 2008. As can be observed, the results suggest that the Chinese competition in U.S. markets seem to have led to an increase in unemployment. Indeed, even though the effect on unemployment levels is imprecisely estimated, the coefficients related to unemployment rates suggest a positive, statistically significant effect from the Chinese exposure variable.

In Table 8 we separate the metro areas sample into two groups: i) metro areas located in border states; and ii) metro areas located in non-border states. In contrast with the NAFTA effect estimates, here we do not consider the presence of the auto industry as an additional classification variable since, as mentioned before, it does not seem to be associated with the degree of exposure to Chinese competition. As may be noted and was to be expected given the discussion made above, the results suggest that the positive effect of the exposure to Chinese competition in the U.S. on Mexico's unemployment rates seems to have been observed mostly in the border region. Indeed, the coefficients of the regression are only significant in the case of the subsample of metro areas in the border region.

5.5. Effects of exposure to Chinese competition on local employment dynamics

The results for the estimates of the effect of the degree of exposure to Chinese competition on local employment levels are presented in Table 9 for the full sample of metro areas and in Table 10 for the border and non-border subsamples. Interestingly, for the full sample, we note that the only statistically significant coefficient is related to a negative effect of Chinese competition on unskilled labor employment levels in the manufacturing sector. When we conduct the analysis for each subsample, we may note that this effect is driven fundamentally by the negative, statistically significant effect of the exposure to Chinese competition on the border region's manufacturing employment of unskilled workers. Thus, overall the results suggest that the main channel through which the degree of exposure to Chinese competition in the U.S. affected Mexico's labor markets was through its negative effects on the demand for unskilled labor in the manufacturing industries located in the border region. It is relevant to note, however, that in Table 10 we find a statistically significant, positive effect of the China competition variable on the levels of manufacturing skilled labor employment in the non-border regions. This result tends to parallel the effect of NAFTA integration on skilled employment found in the previous analysis and suggests, as will be seen in the results below, that the general equilibrium negative wage effects of the Chinese competition shock seem to have led to an increase in the quantity demanded of skilled labor in manufacturing industries more oriented to the domestic market, outside of the border region of the country.

5.6. Effects of exposure to Chinese competition on local wage dynamics

Finally, we address the estimates of the effect of the degree of exposure to Chinese competition on local wage dynamics. In Table 11, we summarize the results for the full sample of metro zones. According to the results, the displacement of Mexican manufacturing products in the U.S. market seems to have led to a decrease in wages, apparently as a consequence of a fall in both skilled and unskilled wages in the non-manufacturing sector. In contrast, the coefficient related to the effect on wages in the manufacturing sector is not statistically significant. Thus, as in the case of Autor, Dorn and Hanson (2013), we find that Chinese competition in the U.S. had a negative impact in Mexico's labor markets through a decrease in manufacturing employment levels, but its negative wage effects were noted fundamentally in non-manufacturing sectors.

Furthermore, when we analyze the regional differences in these results, we may note in Table 12 that, while the same pattern is observed in non-border states, the decrease in wages after the Chinese competition shock described above was significantly more pronounced in the border region than in the rest of the country. Indeed, we may note that the reduction of wages in a metro area in the border zone moving from a Chinese competition exposure measure in that zone in the 25^{th} percentile to the level of a metro area in the 75^{th} percentile in the zone is more than twice as large as the decrease in wages observed in metropolitan zones not located in the border region, although these are also found to have decreased significantly as a consequence of the Chinese competition shock. These results are consistent with the fact that, as noted before, the border region had initially a production structure that was more similar to China's comparative advantages and, thus, was more prone to resent the negative consequences of China's enhanced presence in the U.S. product markets. However, some general equilibrium effects seem to have taken place after this shock, apparently leading to some spillover effects on wages in the rest of the country.

6. Conclusions

This paper analyzed the local labor market consequences on Mexico of trade integration with the U.S. and of enhanced competition from China in international markets. Given its initial comparative advantages, Mexico responded to NAFTA by specializing further in unskilled-labor intensive processes within the North American production chain. Moreover, given the transport cost advantage provided by the border zone in order to export finished manufactured products to the U.S., many of these activities located precisely in that region.

As it turned out, the industries and activities in which Mexico specialized in during the last years of the nineties overlapped considerably with those where China also had a comparative advantage. Thus, the accession of China to the WTO and its enhanced presence in U.S. product markets after year 2001 had a negative effect on Mexico's market share in U.S. manufacturing imports and seems to have induced a negative impact on Mexican labor markets, by displacing Mexican manufacturing exports and, therefore, leading to a decrease in labor demand in manufacturing sectors. These effects were especially felt in border regions where, as mentioned before, the industries that eventually faced the displacement effect of Chinese exports to the U.S. to a stronger extent were initially established.

It is finally relevant to emphasize that our overall results parallel significantly those found by Autor, Dorn and Hanson (2013) who also show that, even though Chinese import exposure in the U.S. led to decreases in manufacturing employment, it apparently did not decrease mean manufacturing wages in that country. In contrast, they find a negative effect on mean earnings in non-manufacturing sectors, both for college and non-college workers in the U.S. As they also do, our results therefore lead us to conclude that the negative shock to local manufacturing after the enhancement of Chinese competition in the U.S. seems to have not only reduced unskilled labor demand in the Mexican manufacturing sector, leading to an increase in the available supply of workers for the non-manufacturing sector, but it also reduced the demand for local non-traded services. These effects in combination may have therefore created strong downward pressure on wages in the Mexican non-manufacturing sector. However, in contrast with Autor, Dorn and Hanson (2013) who find that even within narrowly defined regions in the U.S. a large variation in local exposure to Chinese import exposure exists, we are able to identify in this paper a much clearer regional concentration within Mexico of the labor market gains of trade integration, and of the losses of enhanced competition in foreign markets. Indeed, given the geographical structure of Mexico, as was previously found in the literature, we also find that the labor market consequences of trade were especially strong in the border regions of the country, where the largest bulk of the export-oriented industry was located even before the start of NAFTA integration (see Chiquiar, 2005 and 2008).

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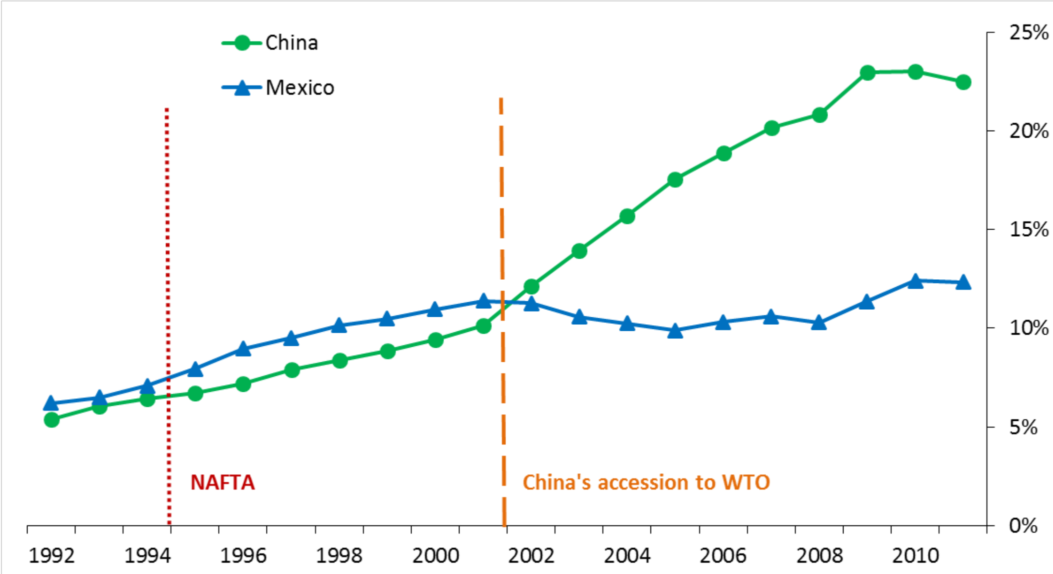
Figure 1
Market Share in Non-Oil U.S. Imports
Percentage



Source: Comtrade database, United Nations.

Figure 2
NAFTA effect: Map of Metropolitan Areas

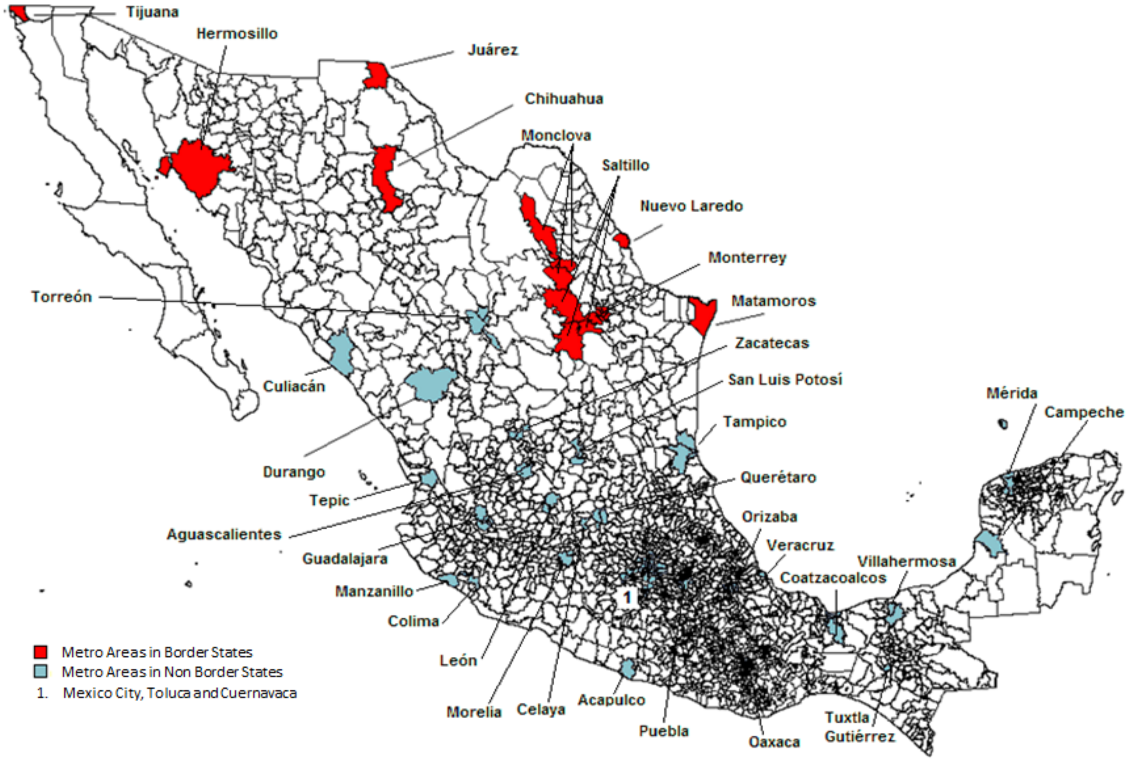


Figure 3
Chinese competition effect: Map of Metropolitan Areas

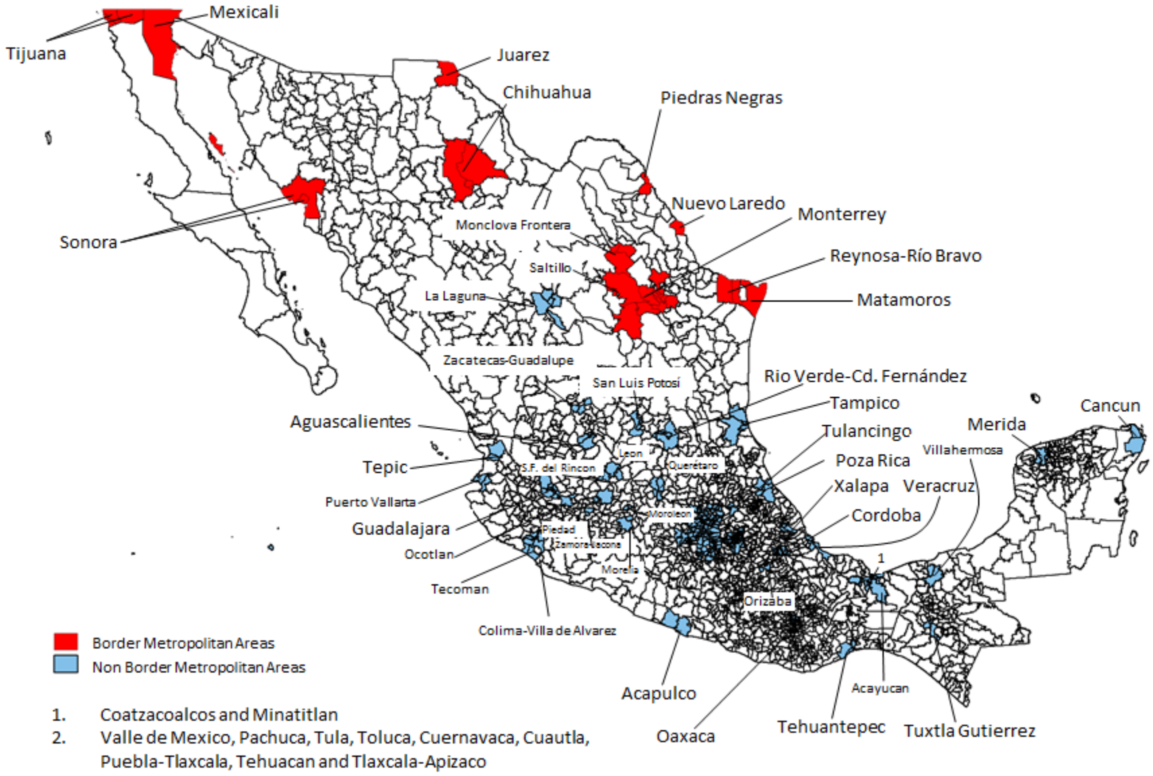
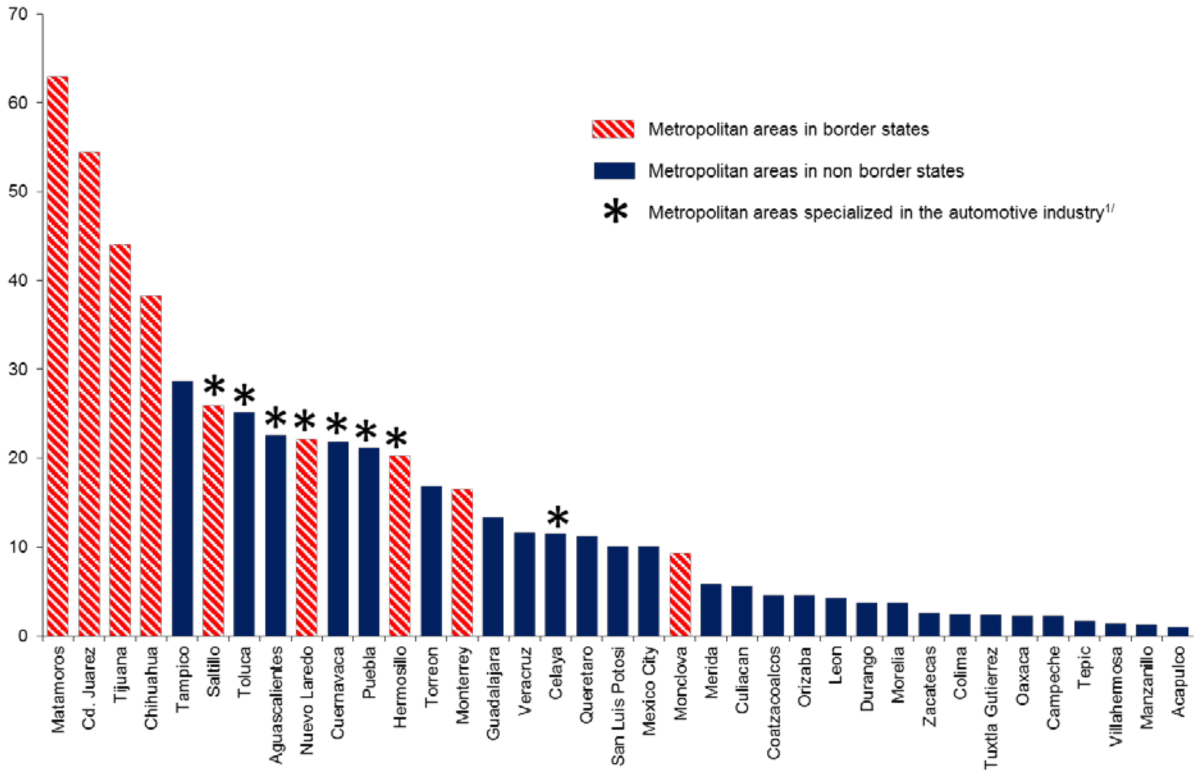
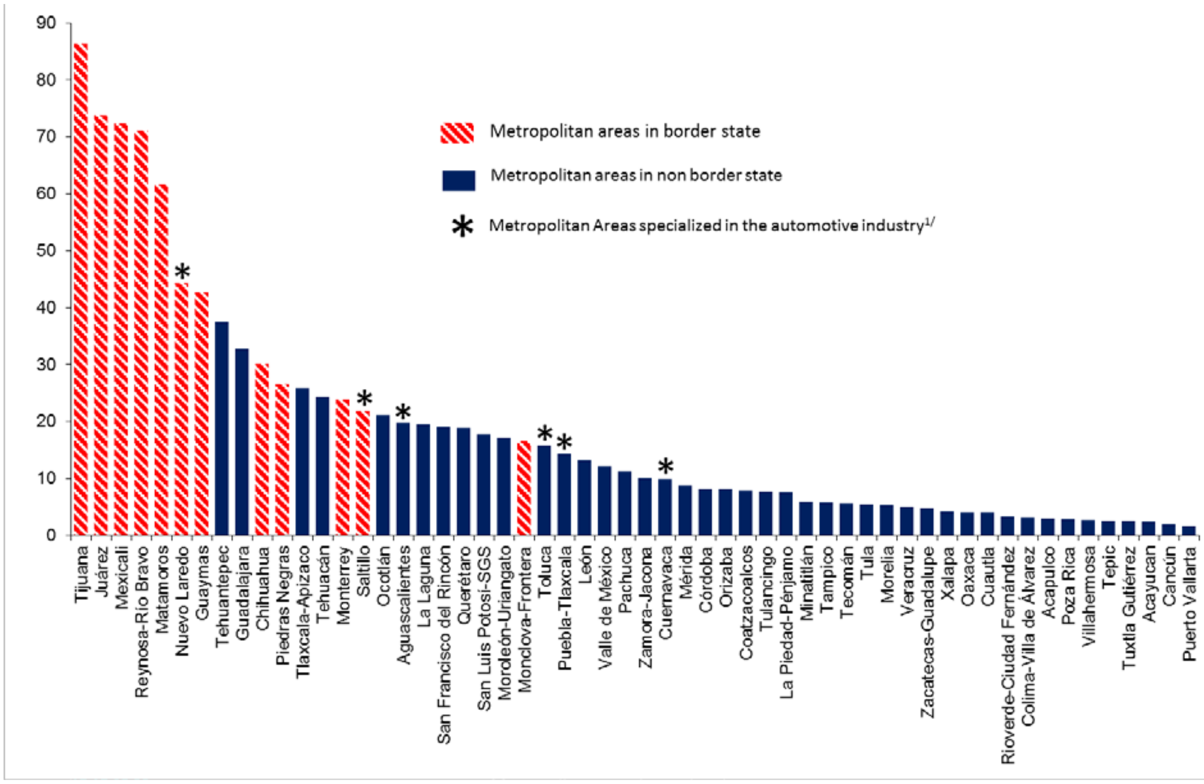


Figure 4
Exposure to NAFTA Integration ΔOPW_i^{US}



1/ The metro areas specialized in the automotive industry are assumed to be those for which this industry represents at least 29% of its exposure index to trade openness.

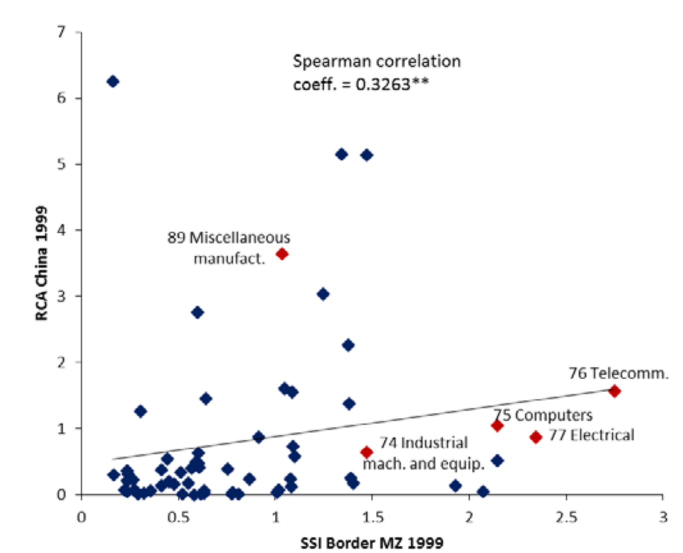
Figure 5
Exposure to Chinese Competition in U.S. markets ΔIPW_i^{US}

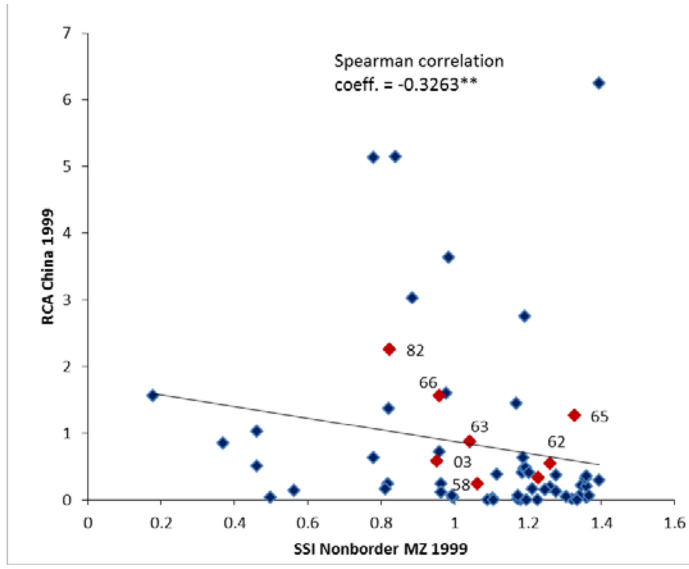


1/ The metro areas indicated with a star correspond to those that could be matched to cities specialized in the automotive industry based on the exposure index to trade openness as indicated in Figure 4.

Figure 6
China's Revealed Comparative Advantage (RCA) and Sectorial Specialization Index (SSI) of Mexican Metropolitan Zones

RCA of China vs. *SSI* of Metropolitan Zones in Border States	*RCA* of China vs. *SSI* of Metropolitan Zones in Nonborder States
(1999, SITC 2 digits)	(1999, SITC 2 digits)



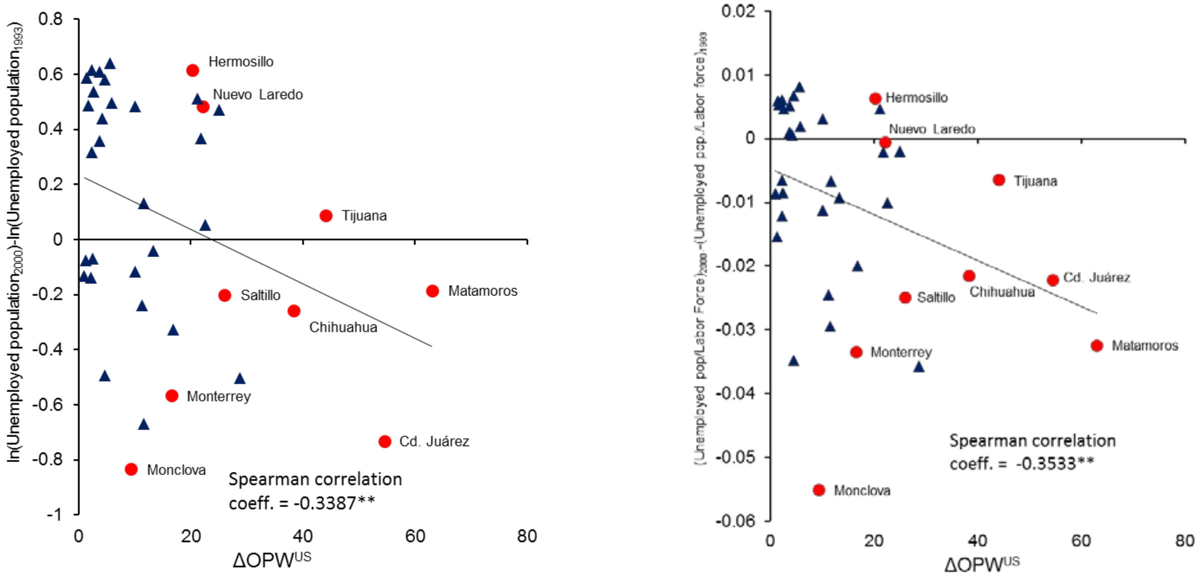


Source: China RCA: Comtrade database, United Nations. SSI index: Mexican Economic Census 1999, INEGI.
Note: One, two or three asterisks are added when the Spearman correlation is statistically significant at a 10, 5 or 1% level, respectively.

Figure 7
Unemployment in Mexico and exposure to NAFTA openness (ΔOPW_i^{US})

Logarithmic differences in unemployed population vs. measure of exposure

Change in unemployed population as a proportion of the labor force vs. measure of exposure

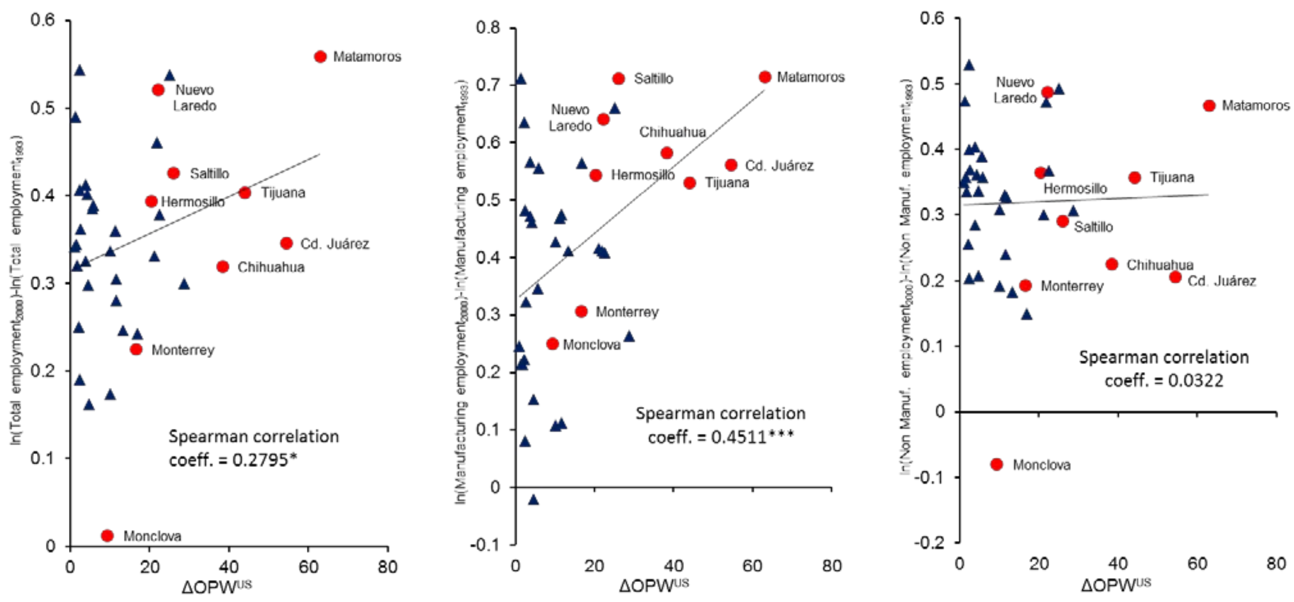


Source: ENEU (1993 and 2000), Economic Census (1994), and UN Comtrade.
Note: Circles denote metro areas in border states while triangles denote metro areas in non-border states. One, two or three asterisks are added when the Spearman correlation is statistically significant at a 10, 5 or 1% level, respectively.

Figure 8
Employment in Mexico and exposure to NAFTA openness (ΔOPW_i^{US})

Logarithmic differences of employed population vs. exposure measure

All sectors | Manufacturing | Non-manufacturing

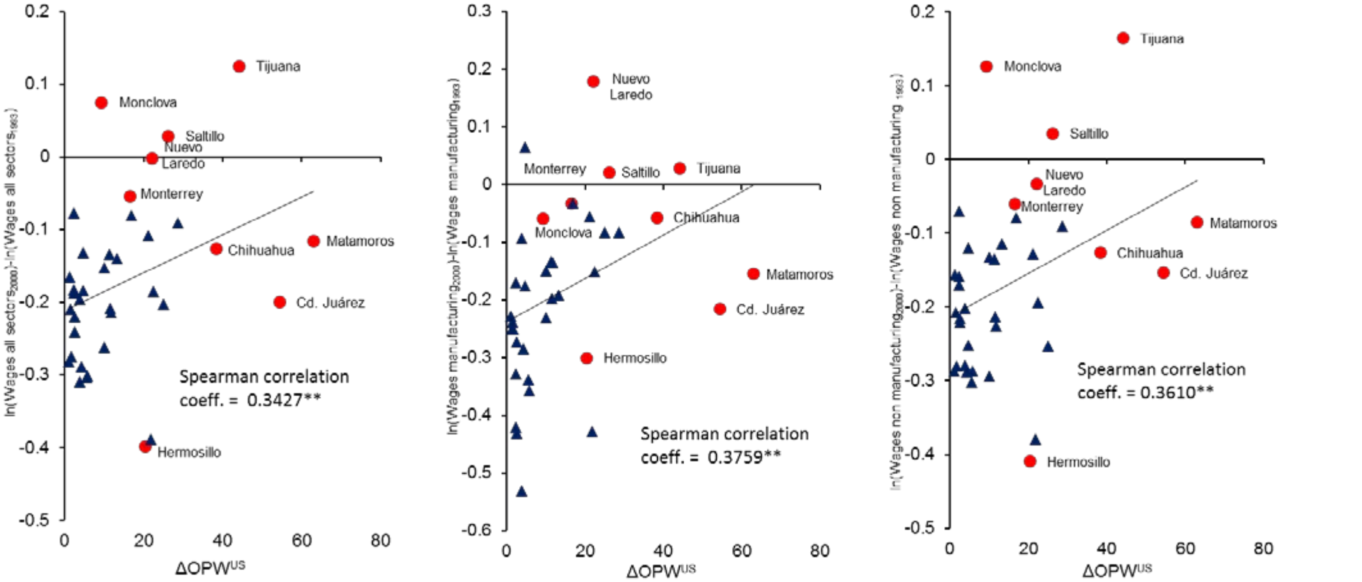


Source: ENEU (1993 and 2000), Economic Census (1994), and UN Comtrade.
Note: Circles denote metro areas in border states while triangles denote metro areas in non-border states. One, two or three asterisks are added when the Spearman correlation is statistically significant at a 10, 5 or 1% level, respectively.

Figure 9
Wages in Mexico and exposure to NAFTA openness (ΔOPW_i^{US})

Logarithmic differences in wages vs. exposure measure

All sectors | Manufacturing | Non-manufacturing

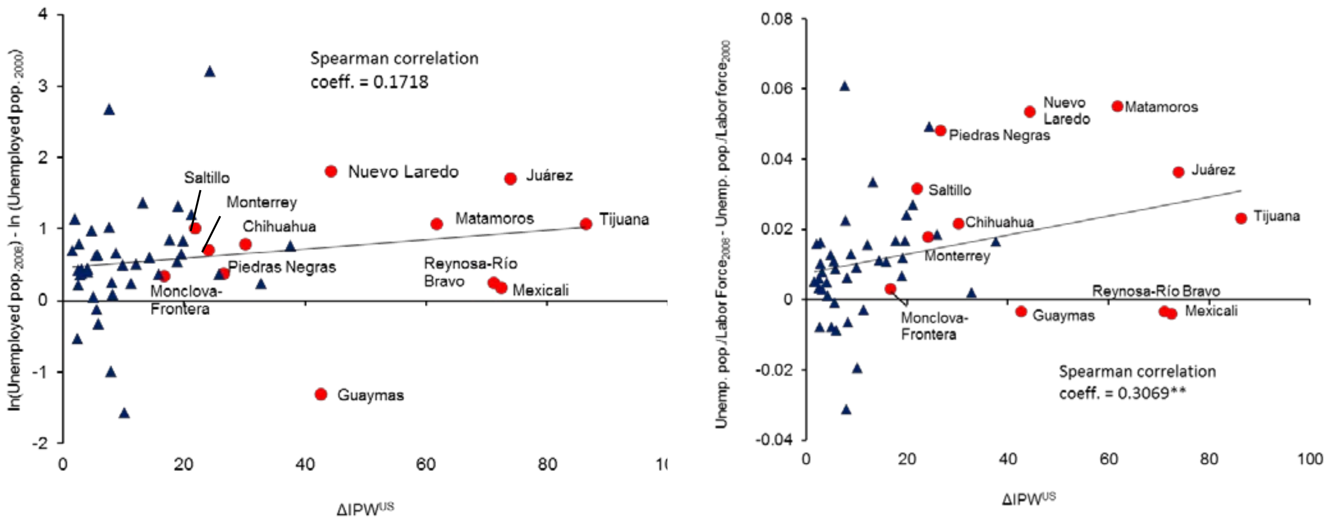


Source: ENE 2000, ENOE 2008, Economic Census 1999 and UN Comtrade.
Note: Circles denote metro areas in border states while triangles denote metro areas in non-border states. One, two or three asterisks are added when the Spearman correlation is statistically significant at a 10, 5 or 1% level, respectively.

Figure 10
Unemployment in Mexico and exposure to Chinese competition (ΔIPW_i^{US})

Logarithmic differences in unemployed population vs. measure of exposure

Change in unemployed population as a proportion of the labor force vs. measure of exposure

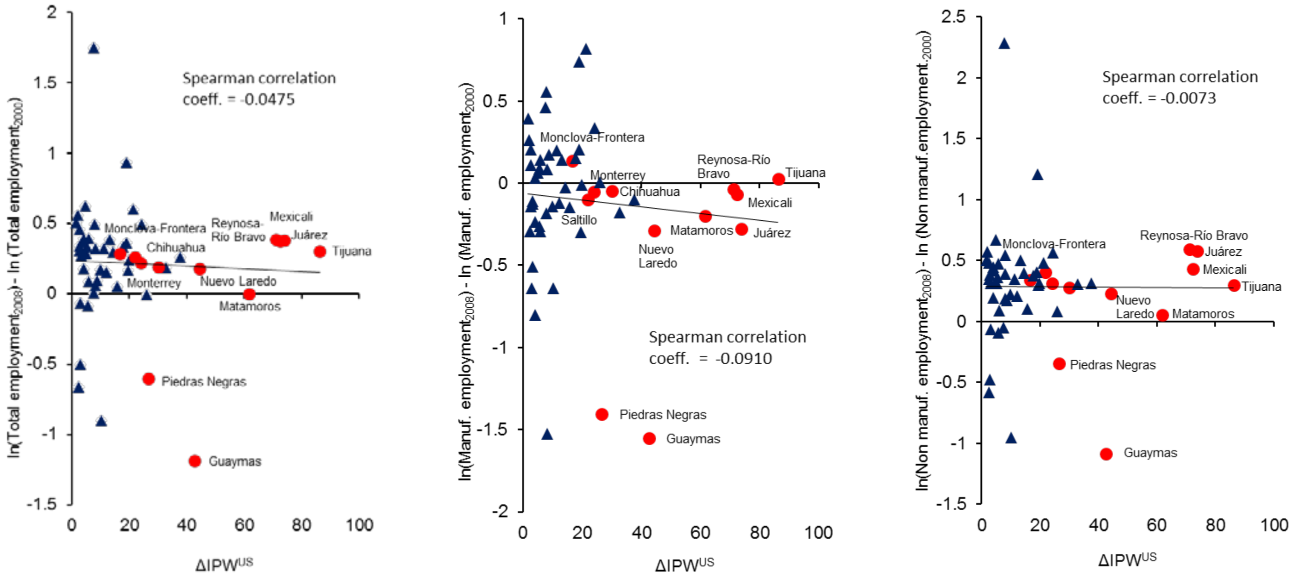


Source: ENE 2000, ENOE 2008, Economic Census 1999 and UN Comtrade.
Note: Circles denote metro areas in border states while triangles denote metro areas in non-border states. One, two or three asterisks are added when the Spearman correlation is statistically significant at a 10, 5 or 1% level, respectively.

Figure 11
Employment in Mexico and exposure to Chinese competition (ΔIPW_i^{US})

Logarithmic differences of employed population vs. exposure measure

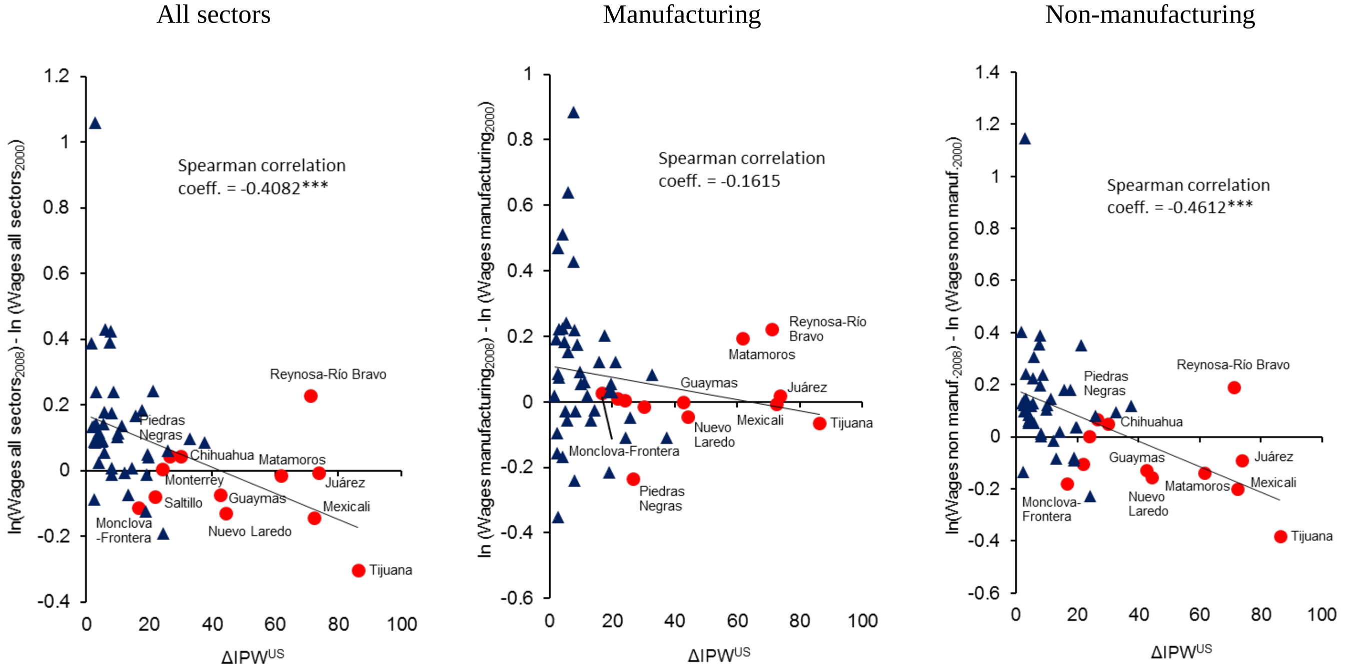
All sectors | Manufacturing | Non-manufacturing



Source: ENE 2000, ENOE 2008, Economic Census 1999 and UN Comtrade.
Note: Circles denote metro areas in border states while triangles denote metro areas in non-border states. One, two or three asterisks are added when the Spearman correlation is statistically significant at a 10, 5 or 1% level, respectively.

Figure 12
Wages in Mexico and exposure to Chinese competition (ΔIPW_i^{US})

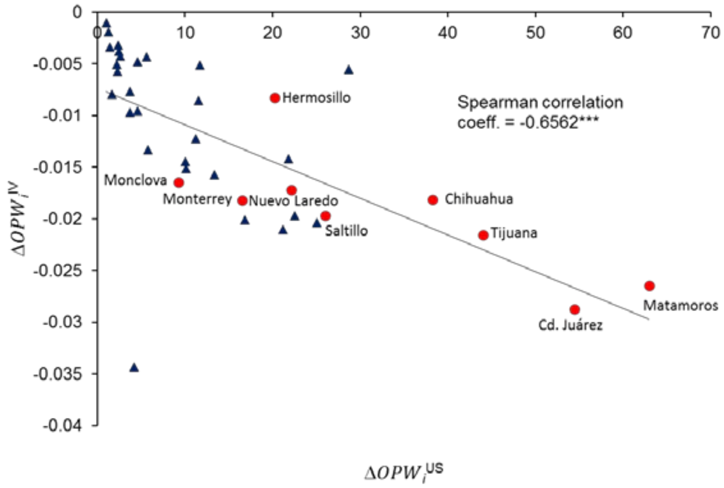
Logarithmic differences in wages vs. exposure measure



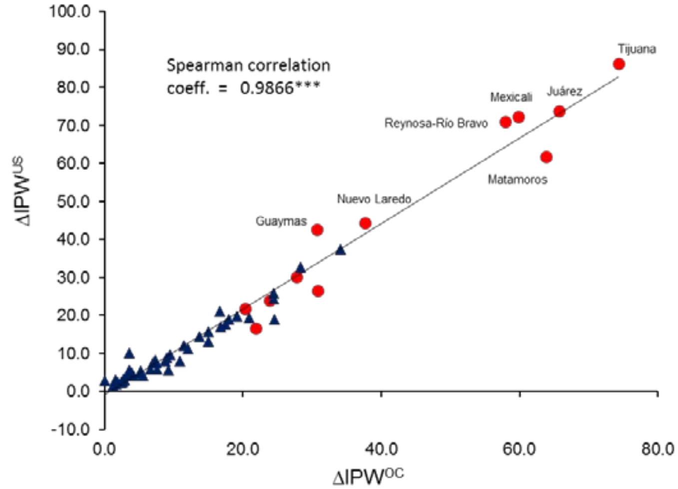
Source: ENE and ENOE (2000 and 2009), Economic Census (1994), and UN Comtrade.
Note: Circles denote metro areas in border states while triangles denote metro areas in non-border states. One, two or three asterisks are added when the Spearman correlation is statistically significant at a 10, 5 or 1% level, respectively.

Figure 13
Exposure Measures: Originals vs. Instruments

Measure of exposure to NAFTA openness (ΔOPW_i^{US}) and its corresponding tariff-based instrumental variable (ΔOPW_i^{IV})



Measure of exposure to Chinese competition in the U.S. market (ΔIPW_i^{US}) and measure of exposure to Chinese competition in other developed countries market (ΔIPW_i^{OC})



Source: Economic Censuses (1994 and 1999) and UN Comtrade.
Note: Circles denote metro areas in border states while triangles denote metro areas in non-border states. One, two or three asterisks are added when the Spearman correlation is statistically significant at a 10, 5 or 1% level, respectively.

Table 1
Estimation of the effect of NAFTA integration on unemployment

Dependent variable: unemployment	Log differences (1)	Change in variable as a ratio of working -age population (2)	Change in variable as a ratio of labor force (3)
ΔOPW^{US}_{NAFTA}	-0.0131**	-0.000348***	-0.000581***
s.e.	(0.00609)	(0.000131)	(0.000218)
p-value	0.0316	0.00775	0.00761
Additional controls	✓	✓	✓
Observations	37	37	37
R-squared	0.379	0.333	0.350
β x (ΔOPW^{US}_{NAFTA} Gap) x 100	-23.72%	-0.63 pp	-1.05 pp

All regressions are estimated by instrumental variables and in all cases the proportion of women who work, the proportion of the population with high school education and the percentage of residents migrating annually at the state level for 1955-1959 are included as controls.

Gap is defined as the difference between the 25th and the 75th percentile for the given independent variable and β is the coefficient on the ΔOPW^{US}_{NAFTA} variable.
Standard errors in parenthesis.
*** p<0.01, ** p<0.05, * p<0.1

Table 2
Estimation of the effect of NAFTA integration on unemployment
Regionally heterogeneous effects

Dependent variable: unemployment	Log differences (1)	Change in variable as a ratio of working-age population (2)	Change in variable as a ratio of labor force (3)
$\Delta OPW^{US}_{NAFTA} * d_{borderauto}$	-0.0125*	-0.000346**	-0.000577**
s.e.	(0.00712)	(0.000149)	(0.000249)
p-value	0.0788	0.0204	0.0204
$\Delta OPW^{US}_{NAFTA} * d_{rest}$	-0.00130	-0.000309	-0.000502
s.e.	(0.0310)	(0.000651)	(0.00109)
p-value	0.967	0.635	0.644
Additional controls	✓	✓	✓
Observations	37	37	37
R-squared	0.349	0.332	0.348
$\beta_{borderauto}$ x (ΔOPW^{US}_{NAFTA} $Gap_{borderauto}$) x 100	-22.59%	-0.63 pp	-1.04 pp
β_{rest} x (ΔOPW^{US}_{NAFTA} Gap_{rest}) x 100	-0.46%	-0.11 pp	-0.18 pp

All regressions are estimated by instrumental variables and in all cases the proportion of women who work, the proportion of the population with high school education and the percentage of residents migrating annually at the state level for 1955-1959 are included as controls.
Gap is defined as the difference between the 25th and the 75th percentile for the given independent variable and β is the coefficient associated to the ΔOPW^{US}_{NAFTA} variable.
Standard errors in parenthesis.
*** p<0.01, ** p<0.05, * p<0.1

Table 3
Estimation of the effect of NAFTA integration on employment

Dependent variable: logarithmic differences of employed population

Dependent variable: employment	**Total employment (1)**	**Manufacturing employment (2)**	**Non-manufacturing employment (3)**	**Skilled workers (4)**	**Unskilled workers (5)**	**Manufacturing skilled workers (6)**	**Manufacturing unskilled workers (7)**
ΔOPW^{US}_{NAFTA}	0.00161	0.00697**	-0.000974	-0.00558*	0.00745**	0.00391	0.00982**
s.e.	(0.00189)	(0.00291)	(0.00201)	(0.00305)	(0.00309)	(0.00348)	(0.00486)
p-value	0.396	0.0167	0.628	0.0676	0.0161	0.261	0.0433
Additional controls	✓	✓	✓	✓	✓	✓	✓
Observations	37	37	37	37	37	37	37
R-squared	0.092	0.260	0.046	0.093	0.349	0.403	0.341
β x (ΔOPW^{US}_{NAFTA} Gap) x 100	2.92%	12.62%	-1.76%	-10.10%	13.49%	7.08%	17.78%

All regressions are estimated by instrumental variables and in all cases the proportion of women who work, the proportion of the population with high school education and the percentage of residents migrating annually at the state level for 1955-1959 are included as controls.

Gap is defined as the difference between the 25th and the 75th percentile for the given independent variable and β is the coefficient of the ΔOPW^{US}_{NAFTA} variable.
Standard errors in parenthesis.
*** p<0.01, ** p<0.05, * p<0.1

Table 4
Estimation of the effect of NAFTA integration on employment
Regionally heterogeneous effects

Dependent variable: logarithmic differences of employed population

Dependent variable: employment	Total employment (1)	Manufacturing employment (2)	Non-manufacturing employment (3)	Skilled workers (4)	Unskilled workers (5)	Manufacturing skilled workers (6)	Manufacturing unskilled workers (7)
$\Delta OPW^{US}_{NAFTA} * d_{borderauto}$	0.00163	0.00734**	-0.00111	-0.00674	0.00826*	0.00285	0.0108*
s.e.	(0.00217)	(0.00355)	(0.00228)	(0.00441)	(0.00438)	(0.00489)	(0.00651)
p-value	0.453	0.0389	0.626	0.127	0.0592	0.560	0.0965
$\Delta OPW^{US}_{NAFTA} * d_{rest}$	0.00208	0.0143	-0.00374	-0.0291	0.0239	-0.0176	0.0300
s.e.	(0.00946)	(0.0155)	(0.00993)	(0.0193)	(0.0191)	(0.0213)	(0.0284)
p-value	0.826	0.356	0.706	0.131	0.211	0.410	0.291
Additional controls	✓	✓	✓	✓	✓	✓	✓
Observations	37	37	37	37	37	37	37
R-squared	0.084	0.156	0.064	-0.455	-0.001	0.097	0.093
$\beta_{borderauto}$ x (ΔOPW^{US}_{NAFTA} $Gap_{borderauto}$) x 100	2.95%	13.27%	-2.01%	-12.18%	14.93%	5.15%	19.52%
β_{rest} x (ΔOPW^{US}_{NAFTA} Gap_{rest}) x 100	0.74%	5.08%	-1.33%	-10.33%	8.48%	-6.25%	10.65%

All regressions are estimated by instrumental variables and in all cases the proportion of women who work, the proportion of the population with high school education and the percentage of residents migrating annually at the state level for 1955-1959 are included as controls.

Gap is defined as the difference between the 25^{th} and the 75^{th} percentile for the given independent variable and β is the coefficient associated to ΔOPW^{US}_{NAFTA} variable.
Standard errors in parenthesis.
*** p<0.01, ** p<0.05, * p<0.1

Table 5
Estimation of the effect of NAFTA integration on wages

Dependent variable: logarithmic differences of wages

Dependent variable: wages	Mean wage (1)	Mean wage in manufacturing sector (2)	Mean wage in non-manufacturing sector (3)	Skilled workers (4)	Unskilled workers (5)
ΔOPW^{US}_{NAFTA}	0.00398**	0.00550**	0.00418**	0.00664***	0.00461**
s.e.	(0.00190)	(0.00235)	(0.00201)	(0.00237)	(0.00192)
p-value	0.0366	0.0192	0.0372	0.00506	0.0165
Additional controls	✓	✓	✓	✓	✓
Observations	37	37	37	37	37
R-squared	0.105	0.213	0.117	0.083	0.172
β x (ΔOPW^{US}_{NAFTA} Gap) x 100	7.21%	9.96%	7.57%	12.02%	8.35%

All regressions are estimated by instrumental variables and in all cases the proportion of women who work, the proportion of the population with high school education and the percentage of residents migrating annually at the state level for 1955-1959 are included as controls.
Gap is defined as the difference between the 25th and the 75th percentile for the given independent variable and β is the coefficient of the ΔOPW^{US}_{NAFTA} variable.
Standard errors in parenthesis.
*** p<0.01, ** p<0.05, * p<0.1

Table 6
Estimation of the effect of NAFTA integration on wages

Regionally heterogeneous effects

Dependent variable: logarithmic differences of wages

Dependent variable: wages	Mean wage (1)	Mean wage in manufacturing sector (2)	Mean wage in non-manufacturing sector (3)	Skilled workers (4)	Unskilled workers (5)
$\Delta OPW^{US}_{NAFTA}*d_{borderauto}$	0.00388*	0.00556**	0.00408*	0.00680**	0.00486**
s.e.	(0.00218)	(0.00267)	(0.00230)	(0.00276)	(0.00223)
p-value	0.0752	0.0370	0.0761	0.0136	0.0292
$\Delta OPW^{US}_{NAFTA}*d_{rest}$	0.00211	0.00677	0.00211	0.00985	0.00964
s.e.	(0.00952)	(0.0116)	(0.0100)	(0.0120)	(0.00972)
p-value	0.824	0.561	0.833	0.413	0.322
Additional controls	✓	✓	✓	✓	✓
Observations	37	37	37	37	37
R-squared	0.095	0.222	0.110	0.048	0.147
$\beta_{borderauto}$ x (ΔOPW^{US}_{NAFTA} $Gap_{borderauto}$) x 100	7.01%	10.05%	7.37%	12.29%	8.78%
β_{rest} x (ΔOPW^{US}_{NAFTA} Gap_{rest}) x 100	0.75%	2.40%	0.75%	3.50%	3.42%

All regressions are estimated by instrumental variables and in all cases the proportion of women who work, the proportion of the population with high school education and the percentage of residents migrating annually at the state level for 1955-1959 are included as controls.
Gap is defined as the difference between the 25th and the 75th percentile for the given independent variable and β is the coefficient associated to the ΔOPW^{US}_{NAFTA} variable.
Standard errors in parenthesis.
*** p<0.01, ** p<0.05, * p<0.1

Table 7
Estimation of the effect of exposure to Chinese competition on unemployment

Dependent variable: unemployment	Log differences (1)	Change in variable as a ratio of working-age population (2)	Change in variable as a ratio of labor force (3)
ΔIPW^{US}	0.00287	0.000170**	0.000281**
s.e.	(0.00519)	(7.27e-05)	(0.000118)
p-value	0.580	0.0190	0.0169
Additional controls	✓	✓	✓
Observations	53	53	53
R-squared	0.170	0.203	0.207
β x (ΔIPW^{US}_{China} Gap) x 100	5.18%	0.31 pp	0.51 pp

All regressions are estimated by instrumental variables and in all cases the proportion of women who work, the proportion of the population with high school education and the percentage of residents migrating annually at the state level for 1955-1959 are included as controls.
Gap is defined as the difference between the 25th and the 75th percentile for the given independent variable and β is the coefficient of the ΔIPW_{China}^{US} variable.
Standard errors in parenthesis.
*** p<0.01, ** p<0.05, * p<0.1

Table 8
Estimation of the effect of exposure to Chinese competition on unemployment
Regionally heterogeneous effects

Dependent variable: unemployment	Log differences (1)	Change in variable as a ratio of working -age population (2)	Change in variable as a ratio of labor force (3)
$\Delta IPW^{US}_{China} * d_{border}$	0.00354	0.000170**	0.000284**
s.e.	(0.00521)	(7.34e-05)	(0.000119)
p-value	0.497	0.0204	0.0172
$\Delta IPW^{US}_{China} * d_{nonborder}$	0.0180	0.000165	0.000330
s.e.	(0.0133)	(0.000187)	(0.000304)
p-value	0.175	0.378	0.277
Additional controls	✓	✓	✓
Observations	53	53	53
R-squared	0.181	0.203	0.207
β_{border} x (ΔIPW^{US}_{China} Gap_{border}) x 100	16.44%	0.79 pp	1.32 pp
$\beta_{nonborder}$ x (ΔIPW^{US}_{China} $Gap_{nonborder}$) x 100	22.29%	0.20 pp	0.41 pp

All regressions are estimated by instrumental variables and in all cases the proportion of women who work, the proportion of the population with high school education and the percentage of residents migrating annually at the state level for 1955-1959 are included as controls.

Gap is defined as the difference between the 25th and the 75th percentile for the given independent variable and β is the coefficient associated to ΔIPW_{China}^{US} variable.

Standard errors in parenthesis.

*** p<0.01, ** p<0.05, * p<0.1

Table 9
Estimation of the effect of exposure to Chinese competition on employment

Dependent variable: logarithmic differences of employed population

Dependent variable: employment	Total employment (1)	Manufacturing employment (2)	Non-manufacturing employment (3)	Skilled workers (4)	Unskilled workers (5)	Manufacturing skilled workers (6)	Manufacturing unskilled workers (7)
ΔIPW^{US}	-0.00284	-0.00463	-0.00206	-0.00352	-0.00324	-0.00181	-0.00653**
s.e.	(0.00285)	(0.00307)	(0.00317)	(0.00329)	(0.00301)	(0.00391)	(0.00284)
p-value	0.320	0.132	0.516	0.284	0.281	0.643	0.0217
Additional controls	✓	✓	✓	✓	✓	✓	✓
Observations	53	53	53	53	53	51	53
R-squared	0.153	0.153	0.139	0.076	0.191	0.098	0.223
β x (ΔIPW^{US}_{China} Gap) x 100	-5.13%	-8.36%	-3.72%	-6.35%	-5.85%	-3.27%	-11.78%

All regressions are estimated by instrumental variables and in all cases the proportion of women who work, the proportion of the population with high school education and the percentage of residents migrating annually at the state level for 1955-1959 are included as controls.
Gap is defined as the difference between the 25th and the 75th percentile for the given independent variable and β is the coefficient of the ΔIPW^{US}_{China} variable.
Standard errors given in parenthesis.
*** p<0.01, ** p<0.05, * p<0.1

Table 10
Estimation of the effect of exposure to Chinese competition on employment
Regionally heterogeneous effects

Dependent variable: logarithmic differences of employed population

Dependent variable: employment	Total employment (1)	Manufacturing employment (2)	Non-manufacturing employment (3)	Skilled workers (4)	Unskilled workers (5)	Manufacturing skilled workers (6)	Manufacturing unskilled workers (7)
$\Delta IPW^{US}_{China} * d_{border}$	-0.00238	-0.00403	-0.00157	-0.00337	-0.00269	-0.000845	-0.00601**
s.e.	(0.00286)	(0.00303)	(0.00319)	(0.00332)	(0.00300)	(0.00383)	(0.00281)
p-value	0.407	0.184	0.623	0.310	0.370	0.825	0.0324
$\Delta IPW^{US}_{China} * d_{nonborder}$	0.00759	0.00893	0.00904	-9.85e-05	0.00920	0.0184*	0.00522
s.e.	(0.00731)	(0.00774)	(0.00813)	(0.00848)	(0.00767)	(0.00988)	(0.00717)
p-value	0.299	0.249	0.266	0.991	0.230	0.0619	0.467
Additional controls	✓	✓	✓	✓	✓	✓	✓
Observations	53	53	53	53	53	51	53
R-squared	0.163	0.190	0.143	0.073	0.207	0.154	0.256
β_{border} x (ΔIPW^{US}_{China} Gap_{border}) x 100	-11.05%	-18.71%	-7.29%	-15.65%	-12.49%	-3.92%	-27.90%
$\beta_{nonborder}$ x (ΔIPW^{US}_{China} $Gap_{nonborder}$) x 100	9.40%	11.06%	11.20%	-0.12%	11.39%	22.79%	6.46%

All regressions are estimated by instrumental variables and in all cases the proportion of women who work, the proportion of the population with high school education and the percentage of residents migrating annually at the state level for 1955-1959 are included as controls.

Gap is defined as the difference between the 25th and the 75th percentile for the given independent variable and β is the coefficient associated to the ΔIPW^{US}_{China} variable.

Standard errors given in parenthesis.

*** p<0.01, ** p<0.05, * p<0.1

Table 11
Estimation of the effect of exposure to Chinese competition on wages

Dependent variable: logarithmic differences of wages

Dependent variable: wages	Mean wage (1)	Mean wage in manufacturing sector (2)	Mean wage in non-manufacturing sector (3)	Skilled workers (4)	Unskilled workers (5)
ΔIPW^{US}	-0.00390***	-0.00146	-0.00490***	-0.00407***	-0.00467***
s.e.	(0.00128)	(0.00153)	(0.00137)	(0.00148)	(0.000988)
p-value	0.00235	0.343	0.000339	0.00601	2.31e-06
Additional controls	✓	✓	✓	✓	✓
Observations	53	53	53	53	53
R-squared	0.224	0.059	0.263	0.190	0.318
β x (ΔIPW^{US}_{China} Gap) x 100	-7.04%	-2.63%	-8.84%	-7.34%	-8.43%

All regressions are estimated by instrumental variables and in all cases the proportion of women who work, the proportion of the population with high school education and the percentage of residents migrating annually at the state level for 1955-1959 are included as controls.
Gap is defined as the difference between the 25th and the 75th percentile for the given independent variable and β is the coefficient of the ΔIPW^{US}_{China} variable.
Standard errors given in parenthesis.
*** p<0.01, ** p<0.05, * p<0.1

Table 12
Estimation of the effect of exposure to Chinese competition on wages

Regionally heterogeneous effects

Dependent variable: logarithmic differences of wages

Dependent variable: wages	**Mean wage** (1)	**Mean wage in manufacturing sector** (2)	**Mean wage in non-manufacturing sector** (3)	**Skilled workers** (4)	**Unskilled workers** (5)
$\Delta IPW^{US}_{China} * d_{border}$	-0.00403***	-0.00159	-0.00498***	-0.00428***	-0.00463***
s.e.	(0.00129)	(0.00154)	(0.00138)	(0.00148)	(0.000992)
p-value	0.00183	0.301	0.000319	0.00383	3.12e-06
$\Delta IPW^{US}_{China} * d_{nonborder}$	-0.00674**	-0.00452	-0.00670*	-0.00882**	-0.00379
s.e.	(0.00330)	(0.00392)	(0.00353)	(0.00378)	(0.00253)
p-value	0.0410	0.250	0.0576	0.0196	0.134
Additional controls	✓	✓	✓	✓	✓
Observations	53	53	53	53	53
R-squared	0.227	0.073	0.259	0.207	0.324
β_{border} x (ΔIPW^{US}_{China} Gap_{border}) x 100	-18.71%	-7.38%	-23.12%	-19.87%	-21.50%
$\beta_{nonborder}$ x (ΔIPW^{US}_{China} $Gap_{nonborder}$) x 100	-8.35%	-5.60%	-8.30%	-10.92%	-4.69%

All regressions are estimated by instrumental variables and in all cases the proportion of women who work, the proportion of the population with high school education and the percentage of residents migrating annually at the state level for 1955-1959 are included as controls.

Gap is defined as the difference between the 25th and the 75th percentile for the given independent variable and β is the coefficient associated to the ΔIPW^{US}_{China} variable.

Standard errors in parenthesis.

*** $p<0.01$, ** $p<0.05$, * $p<0.1$