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Trade as an Engine of Creative Destruction: Mexican Experience with Chinese Competition

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Abstract

This paper exploits the surge in Chinese exports from 1994 to 2004 as a natural experiment to evaluate the effects of a unilateral low wage trade and competition shock to producers in Mexico. We find that this shock causes selection at both firm and product levels as its impact is highly heterogeneous both on the intensive and extensive margins. Sales of smaller plants and more marginal products are compressed and are more likely to cease, while larger plants and products exhibit an opposite response. Similar results hold both for the domestic market and for competition facing Mexican exporters in a third market (i.e. the United States).

Keywords: China, Mexico, multi-product-firm, trade shock
JEL Classifications: F14, L11

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1 Introduction

Between 1990 and 2007 Chinese exports grew from 62 billions USD to 1.2 trillions USD, at the staggering average rate of about 20 percent per year. China became the world's largest exporter in 2009, and the second largest economy of the world in 2010. The emergence of China and its impact on producers worldwide has been the focus of the attention of both policy-makers and researchers. At the same time, policy makers concerned about the adverse consequences of such a shock have been voicing their concerns and argued for protecting their industries.[1]

The emergence of China has caused angst among policy-makers on all continents and at all levels of development. However, as argued in Winters and Yusuf (2007), in the near term there is probably relatively little to fear for OECD countries because their specialization in sophisticated products and in capital goods insulates their main producers from much of the competition. The pressure on the less sophisticated sectors and firms is in some sense pushing in the direction of improved overall economic performance by speeding up creative destruction. Similarly, policy-makers in low income countries often worry that China will leave no room for them in the markets for labor-intensive manufactures, but in fact as China becomes richer, its comparative advantage is shifting away from the simplest goods towards a middle range. Thus low income countries are also relatively insulated from the force of Chinese competition. Arguably the most direct competition is on middle-income countries whose established positions in manufactured markets have come under threat. This is the focus of this paper.

Our main contributions by this paper are to close two gaps in the literature. First, we provide a detailed investigation of the causal impact of competition on the intensive and extensive margins of both products as well as plants. Second, we recognize that competition may be felt as strongly in export markets as at home, and hence also evaluate these impacts on a third country market.[2] To our knowledge this has not been done before. On both markets we find strongly heterogeneous effects of the competitive shock on the extensive (firm exit and survival) and intensive (sales of plants) margins. We also find evidence of product reallocation within plants as competition pressures them to focus on their core competencies.[3]

We reach these results by treating the emergence of China on the export markets as a natural experiment of a strong and sudden surge in the competition facing Mexican manufacturing producers. As depicted in figure 1 Chinese exports to Mexico and the United States increased

[1] Some examples from the media to highlight this point: "[We] must not repeat the mistakes of the nineties, when an 'invasion' of Chinese products destroyed entire sectors of our industry [...]" (Medium Enterprises Association of Argentina, April 6, 2004), or: "I made it very clear to Minister Bo Xilai that we will take the legal steps to give Brazilian industry the right to protect itself" (Brazilian minister for Industry, Development and Commerce after meeting with his Chinese counterpart, October 4, 2005.) See also Arroba et al. (2008).

[2] We should underscore that the share of Mexican exports to the US is larger than 85%; in this sense we are analyzing the impact on nearly the whole Mexican exports.

[3] In this context see also Iacovone, Javorcik (2008), Eckel et al. (2009).

substantially in terms of both value and share during the period considered. The share of trade from China in Mexican imports grew from 0.007 in 1994 to 0.084 in 2004, a factor of 12. In comparison, the import share from Africa and Oceania to Mexico changed by a factor of 1.04, from other Asian countries by a factor of 1.35 and from South America by a factor from 1.41. These share increases were contrasted by falls in the shares of North America and Europe by factors of 0.96 and 0.84. In values, all these continental groups increased the values of their exports to Mexico. This does not suggest that China has crowded out other developing country imports, but rather that China appears to be the larger part of a broad tendency raising the importance of developing countries in Mexican imports. This sizeable growth was matched by only a moderate increase of trade flows in the other direction; the share of Chinese imports from Mexico increased from 1.9 to 2.8 percent from 1994 to 2004.[4] Hence we interpret the situation at hand as a unilateral trade shock and not a mutual trade expansion.

Turning to export markets, Mexico is one of the countries that is likely to be strongly affected by Chinese competition, given that within NAFTA Mexico has had a comparative advantage for the production of labor intensive goods and that China's exports to the USA have increased strongly. The share of imports from China in total US imports increased from six percent in 1994 to 14 percent in 2004. Given that the large majority of Mexican exports (over 85 percent) go to the United States, we can be sure that the competition shock will affect Mexican exports rather than just induce a geographical reallocation. The objective of this study is to provide an example of how trade can work as a force of creative destruction that leads to competition enhancing readjustments within and across firms. For this reason we focus on both reallocation between firms and within firms, at product level.

There have been several recent studies of the impact of Chinese competition at sectoral level.[5] These studies have shown where the pressure has arisen and its final effect, but they are not able to address the details of how economies adjust to this pressure. Adjustment is undertaken by firms which find their market positions eroded and it is only by studying firms that we are able to see whether Chinese competition induces an active response in terms of, say, innovation, introducing new products or giving up on old ones, new investment, etc, or a passive one in terms of cuts in investment and employment. A situation in which the shock considered has different impacts on different plants, and also brings about a reallocation within plants can not be described at sectoral level. These answers are important missing elements in the discussion of the full impact of China's emergence on incomes and growth.

Firm-level studies of Chinese competition are rare. Among the few examples are Bernard, Jensen and Schott (2006) or Fernandes and Paunov (2008). However, none of the existing

[4]Source: COMTRADE. See also Dussel Peters (2007).

[5]See for example Freund, Ozden (2006), Hanson, Robertson (2007), Lederman et al. (2008), Soloaga et al. (2007), Devlin et al. (2006), Lall et al. (2005).

studies investigates the impact of competition at product level, or analyzes it on a third export market.

In addition to these findings our results are also relevant for firms and policy makers alike. We show how the rise of China affected production patterns in Mexico, and suggest that larger, more productive firms and products are relatively shielded from the adverse effects that this competition generates.

The rest of the article is organized as follows: Section 2 discusses some related empirical articles and models from the theoretical literature, section 3 describes the applied data and strategy. Section 4 describes the results of the investigation, and section 5 evaluates some additional explanations that might be brought forward. Section 6 concludes.

2 Related Literature

Our work is related to several areas of research. Most studies analyzing the impact of the emergence of China on the world markets deal with the effect on developed countries, for which the pressure possibly has a constructive intersectoral effect. We ask about a country whose comparative advantage lies firmly in the same sort of sectors and sophistication as China's, as Mexico's comparative advantage within NAFTA does.

First, there exists a large number of studies that rely on sectoral trade flows data to assess the competitive threat from Chinese exports to Latin American producers (Freund, Ozden (2006), Hanson, Robertson (2007), Lederman et al. (2008), Soloaga et al. (2007), Devlin et al. (2006), Lall et al. (2005)). Other studies have evaluated the impact of Chinese exports on wages and employment for various parts of Latin America, see Levinsohn (1999) for Chile, Pavcnik and Goldberg (2005) and Eslava, Haltiwanger, Kugler and Kugler (2009) for Colombia, Pavcnik, Blom, Goldberg and Schady (2004) for Brazil and Pavcnik (2002) for Chile. A sectoral study of the effects that Chinese imports to the US had on Mexican imports to the US finds some evidence for crowding out on this third market (see Iranzo and Ma (2006)). In a broad study Jenkins, Dussel Peters and Mesquite Moreira (2008) emphasize that the emergence of China brings about winners and losers in Latin America, and its effect tends to be asymmetrical.

Previous firm level studies highlight that foreign competition not only hurts producers but also pushes them to improve their efficiency and organization. In a paper that is closely related methodologically in their use of Chinese exports as a natural experiment, Bloom, Draca and Van Reenen (2008) find that imports from China to Europe increased the innovative activity of surviving firms in Europe, while decreasing the chances of survival and employment. Bernard, Jensen and Schott (2004) show that Chinese competition in the US boosts high wage and high skill companies, and causes the decline of low wage and low skill industries. Bernard, Jensen and Schott (2006) investigate how firms react to exposure to international trade and show that plant survival and growth are negatively correlated with competition, but skill intensity, and industry switching positively.[6]

The question of the impact of trade on product level and within-firm reallocations however is largely unexplored. The few exceptions are Bernard, Redding and Schott (2010), who find that the impact of product switching on US manufacturing growth is as large as that of firm exit and entry to the market, Baldwin and Gu (2005) who find evidence that competition reduces the diversification of Canadian producers, Eckel, Iacovone, Javorcik and Neary (2009), who show that Mexican producers tend react to NAFTA trade liberalization by focusing on their core competencies.

In terms of theory, numerous theoretical articles on emerging trade models and multi-product firms are closely related to our analysis, and provide related hypotheses. Bernard, Redding and Schott (2009) develop a model of multi-product firms that predicts the demise of the less productive firms and products resulting from trade liberalization. We test and confirm this hypothesis in our data. Their model however does not predict the asymmetric sales shifts across and within plants we describe, since it relies on a CES demand and thus constant markups. The model by Eckel and Neary (2010) suggests that within-firm adjustments as a consequence of trade reforms might generate substantial gains due to higher efficiency, and is also closely related in generating our predictions. Further related models include the neo-Schumpeterian growth models pioneered by Aghion et al. (2005).

Mayer, Melitz and Ottaviano (2009) is closely related to our study as it extends Melitz and Ottaviano (2009) by introducing a multi-product dimension. This model predicts that a bilateral trade liberalization leads to an increase in competitive pressure, which in turn leads firms to drop their marginal products (the ones that also have a lower share in production), and reallocate their resources to an increased production of the remaining goods. The inter-firm reallocations generate an additional aggregate productivity increase. For export markets they predict that more competition will lead to the dropping of less substantial products and firms. This model does not however lead to these predictions when a unilateral trade shock is analyzed (for example a unilateral productivity shock, or decrease of trade costs). Additional short-run assumptions are required to reach hypotheses that are consistent with our findings.

All the mentioned models derive hypotheses closely related to those that we test. In appendix 2 we provide our own toy model, which demonstrates under simple and general assumptions an intuitive way to think about the effects of Chinese competition in partial equilibrium. The essence of this toy model is to consider a retailer in Mexico: If (1) China succeeds by undercutting existing prices, (2) a lower cost product or plant is larger and (3) switching from the

[6] In this context see also Arroba et al. (2008), Bernard and Jensen (2007) and Yusuf et al. (2007) and Teshima (2009).

Mexican producer to the Chinese producer comes at a retailer specific fixed cost, we find that a share of the retailers switch from Mexican to Chinese producers. Conditional on quality, this switching probability is higher for smaller plants. Analogous to the literature we consider a multi-product plant to be a collection of products with correlated productivities. This simple view generates all the hypotheses we consider: (a) Exit is more likely for smaller products, (b) sales reduction is proportionally larger for smaller products, (c) exit is more likely for smaller products and (d) exit is more likely for smaller plants. See appendix 2 for a formalization of this idea.

3 Data and Empirical Strategy

Mexico is one of the countries most intensely affected by the emergence of Chinese exports (see Freund and Ozden (2006), Hanson and Robertson (2007)). Between 1994 and 2004 the value of Chinese imports to Mexico increased exponentially from 0.5 to 14.4 billion USD, which corresponds to an increase of the share of Chinese imports in total imports from 0.6 to 7.3 percent (see left graph in figure 1). In the same period China's exports to the US increased from 41 to 201 billion USD, which corresponds to an increase from 6 to 14 percent of US imports and reflects a substantial impact on the US market (see right graph in figure 1).

To investigate this relationship we rely on the Monthly Industrial Survey (EIM) data on Mexican plants provided by the Mexican Institute of Statistics (INEGI). This dataset covers about 85 percent of all Mexican industrial output. This unique survey contains detailed information on sales and exports of each of the products manufactured by Mexican plants as well as information on employment broken down by skills.[7] Further, we use trade data from COMTRADE[8] at the classification level HS-1996 (the well known harmonized coding system from the World Customs Organization).[9]

[7]These datasets have been used and described in previous studies, see for example Iacovone 2008b and Iacovone and Javorcik 2008

[8]For bilateral trade transactions we rely on reported imports since it is generally believed that importer-reported data tend to be more accurate.

[9]The INEGI production database relies on the Mexican Industrial Classification CMAP-1994 (Clasificacin Mexicana de Actividades y Productos) at product level (i.e. 8-digit), while the trade data is based on the HS-1996 classification provided by the World Custom Organization at 6-digit level. The Mexican eight digit data gives a detailed description of products. For example: In the category of alcoholic beverages it distinguishes between detailed products such as Vodka, Whiskey or Gin. We match the individual product code manually using its description. We conduct this match of these databases relying on the English and Spanish HS 1996 classification obtained from the Export Helpdesk of the European Union (Export Helpdesk, 2009) and the Spanish language HS classification obtained from the SICA project from the Ecuadorian Ministry of Agriculture and Livestock (SICA, 2009). The only CMAP products that we do not consider are those for which a correspondence was not possible to make, mainly the broadly defined "other" categories. Whenever more than one HS code corresponds to one CMAP product we use the average trade value across the different HS codes. The full created matching correspondence between CMAP and HS codes is available on request.

After merging the trade and plant-product level datasets we are left with information on 2744 individual products and a number of plants varying between 6219 and 4439 because of attrition during our sample period (from 1994 to 2004). The main variables of this dataset are described in table 1. The specific measure of exposure to foreign competition, calculated at individual plant-product-level, is the share of China in total imports in the market concerned, while at the plant level we compute the weighted average of this measure for the products of each plant, where the weights are equal to the sales share of each product.

Using this combined dataset we estimate equations of the following form:

$$y_{it} = \beta_1 Z_{it-1} + \beta_2 Z_{it-1} x_{it-1} + \beta_3 X_{it-1} + D_t + F_i + \epsilon_{it}, \tag{1}$$

where y_{it} is a plant specific outcome variable of interest for plant i at time t, Z_{it} a measure of the Chinese competition shock, X_{it} a set of sector and firm characteristics, and $Z_{it}x_{it}$ the interaction of the Chinese competition with x_{it}, a subset of X_{it}. Several other studies have used the import penetration rate from China or broader classes of low-wage countries, for example Broda, Romalis (2009), Bernard, Jensen and Schott (2006) or Bloom, Draca and Van Reenen (2008). D_t denotes a year fixed effect and F_i is a plant fixed effect.[10] Our measure of Chinese competition Z_{it-1} is the share of China in total imports to either the US or Mexico. The control variables we use are the value of total imports, plant size, the Herfindahl index of product market competition, the export share and the ratio of white to blue collar workers (skill share). Additionally we control for log total imports to Mexico or the US respectively.[11] The two outcomes of interest in this study are sales and exit. Exit is defined as:

$$y_{it} = \begin{cases} 1 & \text{in the last year that the plant is in the sample} \\ 0 & \text{in all other years} \end{cases}$$

We drop the last year of the sample (2004) in the exit regressions, since for this year we can't distinguish plants that exit from those that do not. We focus on these two outcomes, since hypotheses in recent theoretical papers have focused on sales and exit probability in their hypotheses (see discussion in Section 2). We leave the study of other outcomes of interest for future work.

We estimate a similar model to investigate the effect on product level. The only difference is that we rewrite the equation in terms of plant-product i, which involves product specific outcomes, control variables on product and plant level, and plant-product level fixed effects. In

[10] D_t is a variable equal to zero in all years except t, and one in t, F_i is equal to zero for all plants except for plant i.

[11] The Chinese competition variable is a fraction of total imports. Additionally, we also control for the value of total imports, although our results are robust to the exclusion of this control variable.

all our regressions we cluster standard errors on the level at which we observe the competition from China.[12]

We are aware of potential endogeneity of our main variables of interest (Z_{it} and its interaction) which may bias our estimates of β_1 and β_2. One reason for endogeneity would be reverse causality. Thus we instrument Chinese exports to Mexico with Chinese exports to the EU and separately Chinese exports to the world excluding US, the EU and Mexico. Further we create the interactions of these export values with x_{it} which provides us with additional instruments for the regressions that involve interaction terms. China's export strategy was mainly to copy existing products at lower prices. Thus, as is widely believed, at the heart of the rise of China lie policies within China, local policy making, the successful attraction of FDI, the establishment of joint ventures with Western firms and other policy decisions within China (see Keefer (2007) or Huang (2003)). All these are largely independent of strategic decisions of Mexican plants. Ideally an instrument could measure production within China directly, but absent detailed product level data for the time period considered, we have to rely on Chinese exports to the destinations mentioned above as a correlated measure.

A potential concern about the exogeneity of the instruments is that product-year specific global technological trends might affect both Chinese exports and Mexican firms and thus invalidate our instruments. There are three answers to this: First, if China is still catching up in technology level for manufacturing and not at the frontier, it is not immediately affected by technology changes at the frontier. Second, if a technology shock were to shift the productivity of certain goods globally, it is likely that the corresponding productivity impacts on China and Mexico would be positively correlated, since both these countries have a labor comparative advantage. Thus the instrument would be positively correlated with the error term of the regression, and bias the IV results against us towards zero. We find however, that the IV results are eigher the same or larger[13] in absolute value than the OLS estimates. Third, in table 13 we rerun our main specifications and include in addition industry-year fixed effects in the IV estimations. These pick up technology shocks that impact related products. As discussed below, apart from being less precisely estimated, the results are little changed by the inclusion of these additional control variables.

Another typical concern to related studies is the comparability of treatment and control groups, ie. if plants and products affected by competition from China differ initially from those that are not. As depicted in figure 1, Chinese trade to Mexico increased considerably after 1998, while the Chinese shock before that period was less dramatic. We create an indicator of firms

[12]At the product level the competition varies at 8 digit CMAP codes, which is the cluster we apply. At the plant level competition varies at plant level only, since competition for each plant is a weighted mean of its products and thus plant specific. Given that we apply plant fixed effects, we do not apply clusters in the plant regressions. Such clustering treatment is consistent with Moulton (1990).

[13]See discussion below.

that were affected by Chinese competition during the years 1998-2004, and regress log sales at firm level for the years 1994-1998 on that variable. In this sample of over 26.000 observations we do not find differences in initial sales between firms facing later competition and firms that do not (with a p-value of 0.912).[14]

A final concern is that when we estimate the equation with sales as outcome, we use a lag-dependent variable and an interacted lag-dependent variable in panel data with fixed effects. As shown by Nickell (1981), the coefficient on the lagged variable is likely downward biased. The size of the bias for such estimations in finite samples, and in particular the bias for the interacted variable is to our knowledge unknown. In Appendix 1 we run a simulation to show that the coefficient on the lag-dependent variable, its interaction and the exogenous variable used in the interaction are all three biased towards zero; hence our results are likely to underestimate the true size and significance of the impact in these regressions. Moreover,the biases for our two main variables of interest (the competition from China measure, and the competition interacted with sales) are small.[15]

4 Results

Sectoral level

For the sake of comparability with the literature we start with sectoral regressions. Our results highlight the importance of going beyond sectoral OLS regressions.[16] For this exercise we aggregate the data to six digit CMAP level, which leaves 205 sectors in 10 years (2050 observations). We regress total sectoral sales on Chinese competition. In the OLS regressions we find no significant effect of the Chinese import share on sectoral sales in Mexico. This is in line with the results of other studies involving aggregate data, which also find a small or insignificant impacts (for example Wood and Mayer (2009)). However, we find a positive effect of the Chinese import share to the US on exports of Mexican plants to the US.

The instrumental variable estimates, on the other hand, are negative and significant at 1 percent level for both the export and the domestic market. The first stage of the IV estimates shows a strong positive correlation between Chinese exports to Mexico and the US and both instruments. Thus we find evidence of competitive pressure on Mexican manufactures due to

[14] A similar exercise for exit can't be undertaken in the same way, given that competition is plant-year specific, and we do not observe future competition for plants that exit. With log export sales the corresponding p-value is 0.07, hence it is also not significantly different at five percent level of significance. The lower p-value in the export market might reflect the fact that Chinese exports to the US were already pronounced in the years 1994-1998.

[15] In 1000 data simulations we cannot reject that the estimate is equal to its true value in 88 percent of estimates for the competition measure, and 82 percent for the interaction (see appendix 1 for details).

[16] The tables with the results and other tables are provided in the web-based appendix published at http://personal.lse.ac.uk/rauchf, or available at request.

Chinese competition both domestically and in the third market. The difference between the OLS and the IV regressions highlights the need to take into account endogeneity problems, which seem to be especially severe in the context of a sectoral analysis.

Our key argument is, however, that these results at sectoral level hide an important amount of heterogeneity at firm and product level. With this objective in mind we move to a finer degree of disaggregation and investigate the impact of Chinese competition on both the extensive and intensive margin, at plant and product level.

Plant level regressions

In all the following plant regressions we exclude some data outliers such as plants claiming to export more than they sell overall and plants characterized by extreme values in the rates of Chinese imports growth.[17]

At plant level we first investigate the relationship between the Chinese competition and plant exit from the market using OLS and IV (see table 2). The plant exit variable used as an outcome in table 2 is a dummy variable that is equal to one if a plant has positive sales at times $t-1$ and t, and no sales at time $t+1$, and zero otherwise. Hence this variable indicates the year during which a plant leaves the market. We control for the following lagged variables on plant level: the log total imports to Mexico, log total sales of the plant, the Herfindahl index as a proxy for sectoral competition (a measure which is also a weighted mean of the competition for each of the product manufactured by the plants), the plant's export share and the ratio of white to blue collar workers. Additionally we include plant and year fixed effects. This rich set of control variables allows us to condition the results on numerous sources of difference between Mexican firms.

In the first column we find that when excluding the main interaction term between size and Chinese competition, Chinese domestic competition in $(t-1)$ appears to have no significant conditional mean effect on plant exit in the OLS regressions, a result which is confirmed by the IV regression in the third column. In the second column we include an interaction between plant sales and Chinese competition. As suggested by the literature (see for example Mayer et al. (2009), Melitz (2003), Melitz et al. (2009)) we think of plant size being correlated with productivity and/or managerial ability. In this latter specification we uncover a significant asymmetric effect: plants with smaller overall sales are more affected by Chinese competition than larger plants. The marginal effect of competition on the probability of exit is estimated to be $0.77-0.07\ln(\text{sales})$ in OLS. The mean and median log plant sizes are around eleven, and the size percentile at which the mean estimated effect is zero is around 70. This significant result

[17]We exclude those instances when Chinese imports increase by more than 300 percent or decrease by more than 90 percent within a year, since given that the trade values are weighted means of product competition such huge changes are more likely to reflect changes in the product mix than in actual competition. In total these outliers amount to about 10 percent of the data. Our results are robust to the inclusion of outliers, however.

for the extensive margin also holds in the IV regression.[18]

One first stage for column 3 and two first stages for the two interacted variables in column four are presented in the last three columns. The variable "China comp. -EU -US" shows the export share of China to the world with the exception of the EU and the US, and "China comp EU" shows the export value of China to the EU. The terms "interaction instrument 1" and "interaction instrument 2" are the interactions of these instruments with the variables interacted in the IV regressions.[19] The p-value of the Sargan test of exogeneity of instruments, the p-value of a test of underidentification and the F-value of the first stage are also displayed. The F-statistics suggests a strong explanatory power of the first stage, with strong positive correlation of exports to the EU and to the rest of the world with Chinese exports to Mexico. In the first stages for column (4), the interaction instruments have more explanatory power than the mean effects; the joint effect remains positive.

We repeat a similar estimation with outcome variable plant exit from export market in table 3 (again OLS, IV and first stage). In these regressions we focus on the subset of firms that have a positive export share only, and analyze how the shock of Chinese exports to the US affected their likelihood of exiting from export markets. As before we control for log imports to the US, competition, firm size, the skill share and the export share of firms. A similar pattern emerges: An increase of Chinese competitive pressures in the export market does not increase the probability of Mexican plants withdrawing from exports in the first column. This mean effect is also not significant in the IV regression. The sales interaction however shows in OLS and IV the same asymmetric effect that we found for exit from the domestic market. A positive exit probability for small plants becoming smaller for larger plants. The first stages continue to have high explanatory power. In the first stages to the US, Chinese exports to the rest of the world have a small effect compared to Chinese exports to the EU and become widely insignificant when we add interactive sales.

Next we turn to investigate plant's responses on the intensive margin, ie. plant sales. Table 4 shows the OLS results where log plant level domestic sales are the explained variables. First of all, we show in the first column that we do not find any average affect due to increased Chinese competition. However, when we include an interaction term between the degree of Chinese competition and plant size we find that while on average an increase in competition reduces plant-level sales, this effect is highly asymmetric, as the larger a plant is (in the regression measured by export sales) the less it responds by reducing its sales. In other words, Chinese competition pushes smaller and less productive plants to become even smaller while larger and

[18] If the IV coefficients are larger than OLS this is usually interpreted as unobserved response heterogeneity, which is commonly observed in similar contexts. Detailed discussions of this problem can be found for example in Lileeva and Trefler (2009) or Card (2001).

[19] For example: "interaction instrument 1" in the regression with the export share interaction is equal to the first instrument ("China comp world-EU-US (t-1)") times the lagged export share.

more productive ones are less or not affected (column 2). This combined effect is modestly significantly different from zero in OLS, but strongly significant in IV.

In the corresponding export market regressions for exporting plants (see table 5) the same pattern emerges. We do not find an average effect of competition from China on the export markets in IV, but again we find in both OLS and IV that the impact of competition is asymmetric forcing smaller plants to reduce their exports sales while the larger ones' response is the opposite, as shown by the coefficient on the interaction term between Chinese competition on the plant's sales. The first stages of tables 4 and 5 show that Chinese exports to Mexico are more strongly correlated with Chinese exports to the World outside of the US, the EU and Mexico than with Chinese exports to the EU, while we observe the opposite for Chinese exports to the US.

Quantile regressions
In the previous section we highlight an important asymmetric effect of size on exit and sales; namely that larger plants appear less effected by the adverse effects of the Chinese competition shock. However, in the previous model we impose a linear restriction on the heterogeneous effect to size. To explore the nature of this asymmetric effect further, and also to allow for different effects at different levels, we perform quantile regressions and quantile IV regressions of the domestic size regression (see table 6 and table 7).[20] In these tables we demean variables on plant level to imitate the effect of plant fixed effects. The only outcome variable in the quantile regressions is sales, since they can not be computed for binary outcomes. On the right hand side we include employment, so that the denominator of the skill share variable (which indicates the share of white collar workers) does not drive its coefficient. In table 8 we modify the standard regression by adding employment interaction at nine different sales quantiles, such that the column titled $Q1$ provides the estimates for distributional changes at the 10^{th} percentile. Results in OLS and IV suggest a concave relationship between Chinese competition and sales. OLS estimates are negative at 10 percent level of significance for plants below the 70^{th} percentile, and become insignificant above. The IV estimates for the plants at the 90^{th} percentile become positive. In both estimates we find a large slope at the lower end of the sales distribution.

In table 8 we use the ratio of white to blue collar workers as a measure of skill intensity of plants, and interact this measure with the log value of Chinese imports to Mexico. The coefficients on Chinese competition show again the tendency to disappear with size. We use the estimates of this table to draw the marginal effect of competition on a size-sales surface. This allows us also to show that the impact of competition for firms with the same size but different skill shares, as well as the impact of holding the skill share constant and varying size. Figure 2 displays this

[20] For the implementation of the quantile IV regressions we use the strategy and codes developed by Chernozhukov and Hansen (2006).

size - skill surface. The figure suggests that the effect of competition is most hurtful for the smallest and least skill intensive plants, and it increases when moving along either dimension, the size or the skill axis. Industries that are either very large (such as textile fibers) or very skill intensive (such as elevator construction) or both (automotive parts) were not affected by the Chinese shock.

Product level
Next we investigate the extensive margin responses at product-level. Similar to the definition of plant exit, product drop at time t is equal to one if a product is manufactured at time $t-1$ and t, but not at $t+1$ and $t+2$.[21] In these regressions we control again for log total imports, for the skill share, product market competition, the number of products of a firm, the export share of that product, and the share that the product has within the firm.

Table 9 shows the overall drop of products as a consequence of Chinese competition. In this exercise we restrict the sample to multi-product plants, those plants that produce more than one product. In all product regressions we use plant-product fixed effects (such that product i produced in plant j differs from product i produced in plant k, and also from product l produced in plant j) and cluster robust standard errors by product categories (CMAP 8-digit). On average, we find a positive and significant effect of Chinese competition on the probability of exit in the OLS and the IV regressions. The second and forth column introduce an interaction with the share of products within plants. Our choice to use sales shares instead of sales is motivated by a wish to get closer to predictions from the multi-product literature. We think of a product with a larger share as a more profitable product (Mayer et al. 2009) or "core products" (Eckel and Neary 2010, Eckel et al 2009). Also at product level we find evidence of selection effects as the impact of Chinese competition is asymmetric across products. Core products, or the ones that represent a larger a larger share of plant's sales, are less likely to be dropped. This heterogeneous responses at product level are confirmed in our IV regressions as shown in the fourth column of Table 9. The first stages show again a positive correlation between Chinese exports to Mexico and other parts of the world, and the F-statistics are reasonably high.

We repeat the exercise focusing only on products sold in the export market, restricting the sample to exporting plants. The only change in the specification for these product-level regression consists in controlling additionally for the exit of plants from export market. Product drop from export at time t is defined, as before, equal to one when a product is exported at time $t-1$, in t, but not $t+1$ and $t+2$. In these regressions we control additionally for the exit of plants from all markets, and from export markets. The coefficients on the variable measuring the degree of Chinese competition in the US market are not significant when this variable is not interacted

[21] Alternatively we have tested the robustness of our results by defining product drop at time t equal to one if a product is manufactured at time $t-1$ and t, but not at $t+1$ and our results are substantially unchanged.

with the share of product on total plant sales. However, once more we find, both in OLS and IV regressions, evidence of reallocation and heterogeneous responses as the interaction between the degree of Chinese competition and the share of products sales is negative and significant. This indicates that core products are less likely to exit export market in the face of Chinese competition.

Next we investigate the responses along the intensive margin at product level. We use sales as outcome and not shares, to avoid having a mechanical effect that shrinking product shares imply increasing product shares for other products. Table 11 confirms once more the "creative destruction" effect of competition and its reallocative consequences with less important products being forced to contract while "core" products expand. In column 1 of Table 11 we show there is actually no mean effect of competition; however, when we introduce an interaction term between competition and the product's share in column 2 we find that there is a significant asymmetric effect. The coefficient on the variable capturing competition alone is negative and significant, but it is counterbalanced by the interaction term so that while competition forces a contraction along the intensive margin on average this effect is attenuated, and eventually reversed, for the "core products". These results are consistent across OLS and IV estimation (column 2 and 4 in Table 11). The only case when an "asymmetric" effect of competition does not emerge is Table 12 where we present the product-level response to the Chinese competition on the export market. In this case, both in the OLS and IV estimations, we find a significant and negative effect of Chinese competition on product-level sales. The interaction is still significant, but the overall effect never changes sign. Thus these results suggest that firms restructure production to focus on their core products on both the domestic and export market.

The product regressions all include firm-product fixed effects and thus provide within plant-product effects. A less strict setting is provided in the appendix, where we replace the plant-product fixed-effects by industry fixed effects at CMAP-8 digits. The results remain similar in sign but change in magnitude and level of significance.

Quantile regressions can not be applied at the product level straight-forwardly, since in the product regressions on sales the interactions are size shares and the outcomes size. Thus when we perform a quantile regression of the interaction equation in table 11 (first column) this can not be directly compared with the second column, since the quantiles represent sales and not sales shares. In the web based appendix we provide these quantile results, which show that the effect of competition is significantly negative for small products, and positive for large products and not significantly different from zero for the medium ones.

Summary

Our results consistently provide evidence of the asymmetric effect of Chinese competition on Mexican firms: Smaller plants and products are more likely to exit, while larger plants and "core products" are largely shielded from the competition shock. The outcome is summarized in figures 3 and 4. The x-axis shows sales or sales share centiles for plants and products respectively, while the y-axis gives the marginal effect of competition, derived from the corresponding IV regressions using the coefficient on Chinese competition and on the interaction term multiplied by the corresponding size. The shapes and significance of these curves reflect the results previously described: larger plants and products are less effected by Chinese competition in terms of sales and exit probability. Magnitudes can be readily obtained from these graphs; for example the exit graph in figure 4 suggests that an increase of one percent in imports of a certain good from China increases exit probability by 0.5 for these products on the domestic market if they occupy 10 percent of plant sales, but have no effect on the exit probability for goods that occupy 90 percent of plant's sales.[22]

5 Robustness and additional findings

To demonstrate robustness and plausibility of our results, we perform various robustness tests.[23] A first concern is that some plants and products did not face any competition from China during the period analyzed, which could contribute to generate noise in the results. To address this concern we rerun the results on plant level separately for the 20 percent of plants most affected by competition and the 20 percent least affected, measured by mean competition. When we rerun estimations similar to the second columns of tables 2, 3, 4 and 5 in the sample of plants that are most effected from competition, we find coefficients on Chinese competition and the interaction of Chinese competition that are statistically significantly different from zero, and indistinguishable from the coefficients obtained in the full sample. In the sample of bottom 20 percent competition coefficients are not significantly different from zero, which reflects that in this sample there is very little information about Chinese competition.

A second robustness check is used as a "placebo" test. We evaluate if future competition from China has any impact on current plant sales. Specifically, we analyze the effect of competition to be faced four years after (which should not influence performance in the present), and repeat the sales regressions presented in the second column of tables 4 and 5. We can not reject that the coefficients on competition from China and its interaction are equal to zero. This demonstrates that the emergence of Chinese competition for certain products was not anticipated over the period of four years.

Third, Mexican policy makers were active in filing anti-dumping cases against Chinese compe-

[22]For the computation of these graphs we use only the two coefficients that include our measure of the competition from China, which represents the estimated marginal effect. If however the partial derivative of any other coefficient with respect to competition is non-zero, the intercept of the graphs would be shifted.

[23]For reason of space we do not include these robustness checks, however all the tables are available upon request.

tition early on (the anti-dumping data was taken from Bown (2009)). A sixth of the products in our sample was subject to an attempted Mexican anti-dumping complaint, which presents room for alternative interpretations of our findings. In particular, we face the problem of endogeneity of the anti-dumping cases, which might create a different link between competition and our outcome variables of interest. To address these issues we repeat the plant level analysis only for those products where no anti-dumping cases were filed. Our results remain similar in terms of size and significance in the subsample where no anti-dumping cases were filed.

A fourth concern relates to specific developments in the technology of certain goods, which may affect all Chinese exports and Mexican firm behavior directly and thus invalidate the IV strategy. To confront this concern we include industry-year fixed effects in the main specifications.[24] The main results remain the same in size and significance, and are not significantly different in terms of magnitudes (see table 13).

Fifth, some of the marginal effects graphs and quantile regressions suggest a beneficial impact of Chinese competition on plants at the top end of the sales or skill distribution. One dimension through which Chinese exports may affect Mexican production in a beneficial way might be through reducing the prices of imports (see Amiti, Konings 2007). This might be an additional channel influencing both plant exit probability and also sales, and omitting it could bias our estimates. To account for this concern we generate a measure of the Chinese shares in inputs using the input-output tables for 2003 provided by INEGI and the Chinese trade values from COMTRADE.[25] For the computation we weight each sector listed as input by its imports share, and the import share by the Chinese share in inputs for that sector. This is equal to the weighted sum of inputs imported from China at sectoral level where the weights are given by the coefficient of the input-output table. Total imports from China for a sector are positively correlated with Chinese imports for inputs to that sector as apparent from a figure we provide in the web based appendix. The robustness table in the web based appendix provides columns that are identical to columns (2) in tables 2, 3, 4 and 5, but we only provide the main variables of interest and add the new inputs variable. This table shows two results. First, in the first four columns we show that the main results presented earlier hold when we add a control proxying for the Chinese imported inputs penetration. While in certain caess the significance of the coefficients is marginally reduced, qualitatively the results remain the same. Second, the effect of the Chinese import penetration mimics that of the exposure to Chinese import competition: for small firms it increases their probability of exit and reduces sales, while the contrary holds for larger firms. This provides evidence that the larger plants are able to capture potential

[24] These are based on HS-2 digit industry measures. A more disaggregated level such as HS-6 would be perfectly correlated with Chinese competition, and thus take out the variation of our right hand site variable of interest.

[25] Given the size of the available input-output table this variable is computed at sectoral level (with 32 sectors) only.

benefits of Chinese competition on the input markets better than their smaller competitors. This might be an important channel through which plants of different size are differently affected by competition, but other asymmetric elements probably remain present.

6 Conclusions

The huge increase of Chinese exports in recent decades provided us with a quasi-natural experiment to evaluate the impact of a surge in competition on the extensive and intensive margin both at plant and product-level. In this study, for the first time to our knowledge, we analyze the impact of such competitive pressures both on the domestic market and the export market at sectoral, plant and product level.

We find that the surge of China challenged Mexican firms, and led to plant exit, exit of product and sales contraction. These effects are asymmetric however. First, and most crucially, while smaller and less productive plants are forced to shrink and exit from the market, this effect is attenuated and eventually reversed for larger and more productive plants. Second, this process of "creative destruction" and market selection operates not only at firm- but also at product-level. Such heterogeneous micro-level dynamics are hidden by average effects at sectoral level, pointing towards the need to use firm- and product-level data and allow for heterogeneous effect through interaction terms.

These results confirm that the rise of Chinese exports has significantly influenced existing production patterns, a finding of great relevance to policy makers and firms worldwide. We show that while a crowding out effect is observed for less productive plants, the more productive larger plants can cope with this competition. While we do not measure it directly, this heterogeneity increases averages productivity in the sectors affected. These results do not of course tell us how the advent of China as a world trading power has affected Mexican welfare. They pay no regard to consumers' benefits, nor to the extent to which competition in manufacturing has led to growth in other sectors. Even within manufacturing the extent of the aggregate shock is not always clear. What the results do show, however, is why Chinese competition might face political resistance and that one proactive response to it may be to 'move up market'. The future of Mexican manufacturing appears to lie in greater efficiency and sophistication and that policy responses to Chinese competition should be in this direction rather than defensive. Thus, for example, policy should permit and facilitate change, rather than frustrate it by supporting failing firms. It should recognize the centrality of large and efficient firms to the response, rather than focusing on small and medium enterprises, and it should promote skills and innovation by permitting them to earn high rewards when they succeed. These are not new messages - many policy-makers have advocated this at a firm or a sectoral, or even an economy-wide level - but this paper is the first to have produced evidence for that proposition.

These results reinforce the messages emerging from the recent theoretical literature on heterogeneous firms spurred by the seminal paper of Melitz (2003) and recently expanded towards the introduction of a further layer of heterogeneity at product-level (Eckel and Neary 2010, Bernard et al 2009, Mayer et al 2009).

Still pending for future research is to understand more in detail the mechanisms through which these "heterogeneous" responses operates at firm- and product-level, such as the role of innovation, firm organizational practices, skills and workers' training.

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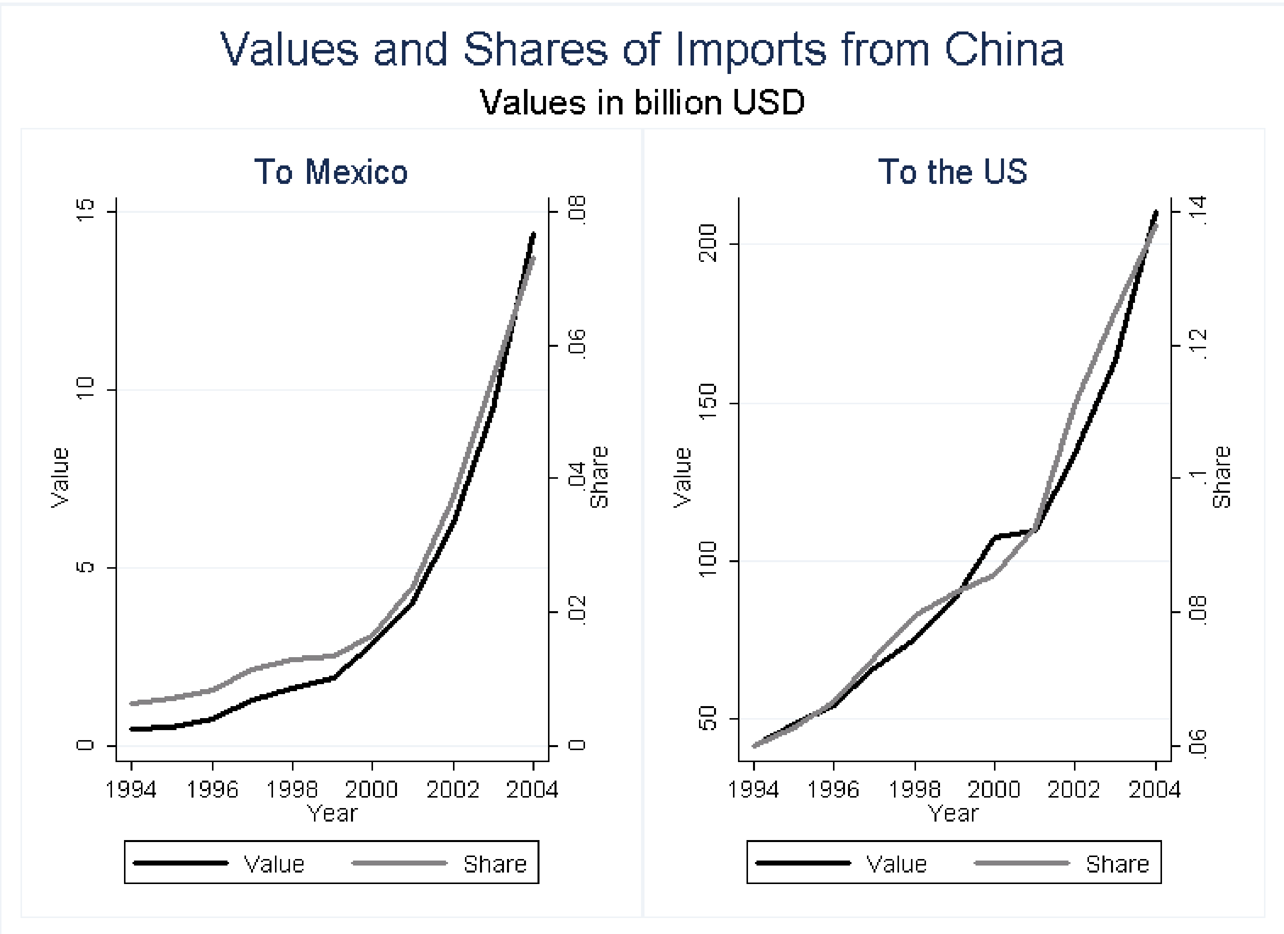
Figure 1: Impact of Chinese exports on the US and Mexico



Note: Left scales: import values (billion USD), right scales: share of China in total imports of market. Source: COMTRADE.

Table 1: Descriptive statistics

Plant data variables				
	Mean	**S. D.**	**Min.**	**Max.**
China comp. Mex	0.02	0.06	0.00	0.86
China comp. US	0.02	0.09	0.00	0.95
Export share	0.10	0.22	0.00	1.00
Log sales	10.54	1.91	0.00	18.01
Log export sales	9.21	2.45	0.00	17.84
Skill share	0.31	0.20	0.00	1.00
Nr. of products	3.18	2.93	1.00	33.00
Herfindahl	0.08	0.09	0.01	1.00
Product data variables				
China comp. Mex	0.02	0.06	0.00	0.96
China comp. US	0.08	0.15	0.00	1.00
Share	0.32	0.36	0.00	1.00
Log sales	8.49	2.63	0.00	18.00
Log export sales	8.14	2.63	0.00	17.84

Note: This table presents main variables used in the regressions. *China comp. Mex* and *China comp. US* denote the shares of Chinese in total imports, *Skill share* the ratio of white to blue collar workers, and *Share* the sales share of products within plants.

Table 2: Domestic plant exit; OLS, IV and first stage

	OLS		IV		First stages		
	(1) Exit	(2) Exit	(3) Exit	(4) Exit	(Fs 3) Chn comp Mex	(Fs 4) Chn comp Mex	(Fs 4) Chn x sales
Chn. comp. Mex (t-1)	0.0266	0.770**	-0.0446	1.258**			
	(0.0463)	(0.319)	(0.110)	(0.514)			
Log imports (t-1)	-0.00157	-0.00150	-0.00155	-0.00142	0.000258	0.000240	0.00337
	(0.00141)	(0.00141)	(0.00144)	(0.00144)	(0.000198)	(0.000197)	(0.00214)
Log tot. sales (t-1)	-0.0576***	-0.0563***	-0.0575***	-0.0553***	0.000619**	-0.00103***	-0.00817**
	(0.00357)	(0.00357)	(0.00225)	(0.00238)	(0.000307)	(0.000328)	(0.00356)
Herf. (t-1)	0.0891*	0.0924**	0.0904**	0.0969***	0.0126**	0.0115**	0.160***
	(0.0459)	(0.0460)	(0.0367)	(0.0367)	(0.00501)	(0.00498)	(0.0541)
Exp. share (t-1)	-0.0139	-0.0137	-0.0139	-0.0135	0.000214	-0.000280	-0.00620
	(0.0133)	(0.0133)	(0.0119)	(0.0119)	(0.00164)	(0.00163)	(0.0177)
Skill share (t-1)	-0.00553	-0.00733	-0.00561	-0.00889	-0.00291	-0.00180	-0.0342
	(0.0176)	(0.0175)	(0.0147)	(0.0148)	(0.00202)	(0.00201)	(0.0218)
Chn. x sales (t-1)		-0.0696**		-0.125***			
		(0.0272)		(0.0454)			
Chn. comp. -US -EU (t-1)					0.0161***	-0.00129	-0.175**
					(0.00141)	(0.00781)	(0.0849)
Chn. comp. EU (t-1)					0.428***	-0.0792**	-5.584***
					(0.00701)	(0.0349)	(0.379)
Interaction instrument 1						0.00194**	0.0354***
						(0.000798)	(0.00867)
Interaction instrument 2						0.0488***	0.973***
						(0.00336)	(0.0365)
Year f.e.	Yes	Yes	Yes	Yes			
Plant f.e.	Yes	Yes	Yes	Yes			
Observations	35828	35828	35376	35376	35376	35376	35376
Sargan p - value					0.706	0.239	0.239
F-Statistic					448.4	418.3	448.0

Note: Domestic exit indicates plants that leave the sample. Robust standard errors used, stars give significance at one (***), five (**) and ten (*) percent level of significance. The variable *Chn. comp. Mex* is the share of China in total Mexican imports. The last three columns show one first stage for the the instrumented variable in column three and two first stages for the instrumented variables in column four.

Table 3: Exit from export; OLS, IV and first stage

	OLS		IV		First stages		
	(1)	(2)	(3)	(4)	(Fs 3)	(Fs 4)	(Fs 4)
	Exit exp	Exit exp	Exit exp	Exit exp	Chn comp US	Chn comp US	Chn x sales
Chn. comp. US (t-1)	0.0321	0.798***	0.162	1.577***			
	(0.0608)	(0.221)	(0.212)	(0.579)			
Log US imports (t-1)	-0.00390	-0.00393	0.000344	-0.000222	0.00545***	0.00545***	0.0550***
	(0.00410)	(0.00411)	(0.00436)	(0.00438)	(0.000650)	(0.000650)	(0.00658)
Log exp. sales (t-1)	-0.0369***	-0.0319***	-0.00996***	8.96e-05	-0.000343	-0.000395	0.0613***
	(0.00466)	(0.00471)	(0.00344)	(0.00510)	(0.000533)	(0.000540)	(0.00546)
Herfindahl (t-1)	0.0596	0.0586	0.0467	0.0498	-0.0293**	-0.0295**	-0.302**
	(0.0908)	(0.0912)	(0.0922)	(0.0925)	(0.0143)	(0.0143)	(0.144)
Exp. share (t-1)	0.0804***	0.0827***	0.0311	0.0279	0.00872**	0.00883**	0.0880**
	(0.0304)	(0.0303)	(0.0275)	(0.0276)	(0.00424)	(0.00425)	(0.0430)
Skill share (t-1)	-0.000652	-0.00819	-0.00963	-0.0260	0.00812	0.00849	0.0281
	(0.0475)	(0.0476)	(0.0456)	(0.0462)	(0.00706)	(0.00709)	(0.0716)
Chn x sales (t-1)		-0.0777***		-0.136***			
		(0.0202)		(0.0508)			
Chn. comp. -US -EU (t-1)					-0.0264***	-0.00610	-0.362
					(0.00741)	(0.0503)	(0.508)
Chn. comp. EU (t-1)					0.621***	0.451***	-8.942***
					(0.0204)	(0.136)	(1.372)
Interaction instrument 1						-0.00189	0.0253
						(0.00455)	(0.0460)
Interaction instrument 2						0.0152	1.351***
						(0.0121)	(0.122)
Year f.e.	Yes	Yes	Yes	Yes			
Plant f.e.	Yes	Yes	Yes	Yes			
Observations	11414	11414	12089	12089	12089	12089	12089
Sargan p-value					0.317	0.207	0.207
F-Statistic					143.1	126.4	173.6

Note: Note: Exit from export indicates plants that leave the export sample. Only exporters considered. Robust standard errors used, stars give significance at one (***), five (**) and ten (*) percent level of significance. The variable *Chn. comp. US* is the share of Chinese in total US imports. The last three columns show one first stage for the the instrumented variable in column three and two first stages for the instrumented variables in column four.

Table 4: Ln Domestic Sales; OLS, IV and first stage

	OLS		IV		First stages		
	(1)	(2)	(3)	(4)	(Fs 3)	(Fs 4)	(Fs 4)
	Dom. sales	Dom. sales	Dom. sales	Dom. sales	Chn comp Mex	Chn comp Mex	Chn x sales
Chn. comp. Mex (t-1)	0.0177	-1.200*	-0.485*	-6.743***			
	(0.117)	(0.689)	(0.259)	(1.401)			
Log imports (t-1)	-0.000420	-0.000497	-0.000247	-0.000691	-0.0003	-0.0003	-0.00210
	(0.00497)	(0.00497)	(0.00390)	(0.00391)	(0.0002)	(0.0002)	(0.00234)
Log tot. sales (t-1)	0.658***	0.656***	0.658***	0.645***	-0.0002	-0.0002	0.0107***
	(0.0136)	(0.0137)	(0.00597)	(0.00661)	(0.0003)	(0.0003)	(0.00365)
Herf. (t-1)	-0.527***	-0.533***	-0.518***	-0.550***	0.0100**	0.0101**	0.157***
	(0.129)	(0.130)	(0.0940)	(0.0944)	(0.00510)	(0.00510)	(0.0560)
Exp. share (t-1)	-0.956***	-0.957***	-0.955***	-0.960***	0.00111	0.001	0.0107
	(0.0645)	(0.0644)	(0.0322)	(0.0323)	(0.00175)	(0.00175)	(0.0192)
Skill share (t-1)	-0.0554	-0.0520	-0.0564	-0.0384	-0.002	-0.002	-0.0484**
	(0.0488)	(0.0489)	(0.0391)	(0.0393)	(0.0002)	(0.0002)	(0.0233)
Chn x sales (t-1)		0.113*		0.594***			
		(0.0601)		(0.130)			
Chn. comp. -US -EU (t-1)					26.61***	16.22***	-106.7***
					(0.475)	(2.824)	(31.03)
Chn. comp. EU (t-1)					-0.261**	1.369**	14.85**
					(0.132)	(0.604)	(6.638)
Interaction instrument 1						-0.155***	-1.894***
						(0.0575)	(0.632)
Interaction instrument 2						0.985***	37.37***
						(0.264)	(2.901)
Year f.e.	Yes	Yes	Yes	Yes			
Plant f.e.	Yes	Yes	Yes	Yes			
Observations	39254	39254	38774	38774	38774	38774	38774
Sargan p-value					0.683	0.453	0.453
F-Statistic					522.0	277.5	454.9

Note: Robust standard errors used, stars give significance at one (***), five (**) and ten (*) percent level of significance. The variable *Chn. comp. Mex* is the share of Chinese in total imports. The last three columns show one first stage for the the instrumented variable in column three and two first stages for the instrumented variables in column four. The instruments have been adjusted with a factor of 10^{-8} to improve legibility.

Table 5: Ln Export Sales; OLS, IV and first stage

	OLS		IV			First stages	
	(1)	(2)	(3)	(4)	(Fs 3)	(Fs 4)	(Fs 4)
	Exp sales	Exp sales	Exp sales	Exp sales	Chn comp US	Chn comp US	Chn x sales
Chn. comp. US (t-1)	-0.498**	-3.033***	-0.632	-3.511***			
	(0.196)	(0.702)	(0.491)	(0.948)			
Log US. Imports (t-1)	0.0269**	0.0277**	0.00615	0.00674	0.006***	0.006***	0.0644***
	(0.0128)	(0.0128)	(0.0134)	(0.0134)	(0.001)	(0.001)	(0.00682)
Log Mex. imports (t-1)	0.00521	0.00530	0.0266**	0.0274**	-0.001**	-0.001**	-0.0144**
	(0.0141)	(0.0141)	(0.0122)	(0.0122)	(0.0006)	(0.0006)	(0.00635)
Log exp. sales (t-1)	0.423***	0.404***	0.423***	0.403***	¡0.001	¡0.001	0.0271***
	(0.0192)	(0.0197)	(0.0119)	(0.0132)	(¡0.001)	(¡0.001)	(0.00657)
Herf. (t-1)	-0.575**	-0.580**	-0.579**	-0.585**	-0.0384***	-0.0379***	-0.409***
	(0.261)	(0.260)	(0.278)	(0.277)	(0.0143)	(0.0143)	(0.145)
Log exp. share (t-1)	0.276***	0.268**	0.277***	0.269***	0.00766*	0.00670	0.0466
	(0.106)	(0.106)	(0.0886)	(0.0885)	(0.00457)	(0.00458)	(0.0464)
Skill share (t-1)	-0.136	-0.109	-0.135	-0.106	0.0107	0.0114	0.0697
	(0.156)	(0.157)	(0.141)	(0.141)	(0.007)	(0.00731)	(0.0740)
Chn exp x sales (t-1)		0.260***		0.289***			
		(0.0650)		(0.0805)			
Chn. comp. -US -EU (t-1)					-0.0362***	-0.143***	-2.279***
					(0.0088)	(0.0278)	(0.281)
Chn. comp. EU (t-1)					0.776***	0.993***	-1.676**
					(0.019)	(0.0695)	(0.704)
Interaction instrument 1						0.0123***	0.235***
						(0.00300)	(0.0304)
Interaction instrument 2						-0.0243***	0.960***
						(0.00721)	(0.0730)
Year f.e.	Yes	Yes	Yes	Yes			
Plant f.e.	Yes	Yes	Yes	Yes			
Observations	12139	12139	11771	11771	11771	11771	11771
Sargan p-value					0.165	0.334	0.334
F-Statistic					195.4	176.1	232.7

Note: Robust standard errors used, stars give significance at one (***), five (**) and ten (*) percent level of significance. The variable *Chn. comp. US* is the share of Chinese in total US imports. The last three columns show one first stage for the the instrumented variable in column three and two first stages for the instrumented variables in column four. Only exporters considered.

Table 6: Quantile regression - plant sales

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
Log Chn imports (t-1)	-0.025***	-0.009**	-0.006**	-0.004*	-0.003*	-0.004*	-0.003	-0.000	0.004
	(0.006)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)
Log total imports (t-1)	-0.029*	-0.019**	-0.011**	-0.002	-0.002	0.001	0.005	0.011	0.012
	(0.012)	(0.007)	(0.004)	(0.003)	(0.003)	(0.004)	(0.004)	(0.006)	(0.009)
Log nr employees (t-1)	-0.039	-0.009	-0.003	-0.002	0.010*	0.024***	0.040***	0.052***	0.088***
	(0.022)	(0.011)	(0.007)	(0.005)	(0.005)	(0.005)	(0.006)	(0.008)	(0.015)
Log sales (t-1)	0.749***	0.745***	0.748***	0.751***	0.743***	0.723***	0.704***	0.672***	0.612***
	(0.020)	(0.010)	(0.005)	(0.004)	(0.004)	(0.005)	(0.005)	(0.008)	(0.015)
Herfindahl (t-1)	-0.971***	-0.441***	-0.370***	-0.330***	-0.303***	-0.241***	-0.286***	-0.296**	-0.615***
	(0.242)	(0.127)	(0.074)	(0.059)	(0.056)	(0.064)	(0.069)	(0.092)	(0.162)
Export share (t-1)	0.030	0.020	0.025	0.056**	0.037	0.056*	0.053*	0.072*	0.116*
	(0.077)	(0.042)	(0.025)	(0.020)	(0.019)	(0.022)	(0.025)	(0.034)	(0.058)
Skill share (t-1)	-0.282**	-0.121*	-0.044	-0.013	-0.004	0.008	0.014	0.022	0.046
	(0.095)	(0.051)	(0.030)	(0.024)	(0.023)	(0.026)	(0.028)	(0.038)	(0.064)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demeaned at plant level	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Quantile regressions at the nine centiles of the distribution, $Q1$ gives the quantile regression at the 10^{th} percentile. To mimic plant fixed effects all variables were demeaned at plant level. Stars denote significance at one (***), five (**) and ten (*) percent level of significance.

Table 7: Quantile IV regression - plant sales

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
Log Chn imports (t-1)	-0.4199***	-0.2522***	-0.1959***	-0.1635***	-0.1106***	-0.0591	-0.0336	0.0246	0.1112***
	(0.0423)	(0.0433)	(0.0461)	(0.0411)	(0.0339)	(0.03)	(0.0362)	(0.032)	(0.0284)
Log total imports (t-1)	0.2127***	0.1655***	0.1323***	0.1164***	0.0812***	0.0485**	0.0371	-0.0027	-0.0508***
	(0.0311)	(0.0366)	(0.0363)	(0.0331)	(0.0261)	(0.0234)	(0.0301)	(0.0241)	(0.0208)
Log nr employees (t-1)	0.03	0.0514**	0.0448***	0.0429**	0.0372***	0.0401***	0.0554***	0.0567***	0.0757***
	(0.0251)	(0.0208)	(0.0168)	(0.0151)	(0.0129)	(0.011)	(0.0116)	(0.0135)	(0.0152)
Log sales (t-1)	0.7523***	0.7419***	0.7517***	0.7482***	0.7503***	0.7383***	0.719***	0.6841***	0.6036***
	(0.0165)	(0.0136)	(0.0109)	(0.0104)	(0.0095)	(0.0086)	(0.0081)	(0.0095)	(0.0105)
Herfindahl (t-1)	-1.5433***	-0.9707***	-0.6478***	-0.5031***	-0.3769***	-0.3545***	-0.2624***	-0.2546***	-0.4116***
	(0.2107)	(0.1664)	(0.1353)	(0.1167)	(0.0871)	(0.0917)	(0.1028)	(0.0941)	(0.1352)
Export share (t-1)	0.1338*	0.0739*	0.0657	0.0613*	0.0625*	0.0688**	0.0564*	0.0477	0.0608
	(0.0732)	(0.0498)	(0.0411)	(0.0393)	(0.0331)	(0.0289)	(0.029)	(0.03)	(0.0447)
Skill share (t-1)	-0.3725***	-0.1942***	-0.0838*	-0.0557	-0.0102	0.0076	0.0201	0.0468	0.0845*
	(0.0966)	(0.0589)	(0.0466)	(0.0431)	(0.0377)	(0.0335)	(0.0351)	(0.0416)	(0.0499)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demeaned at plant level	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

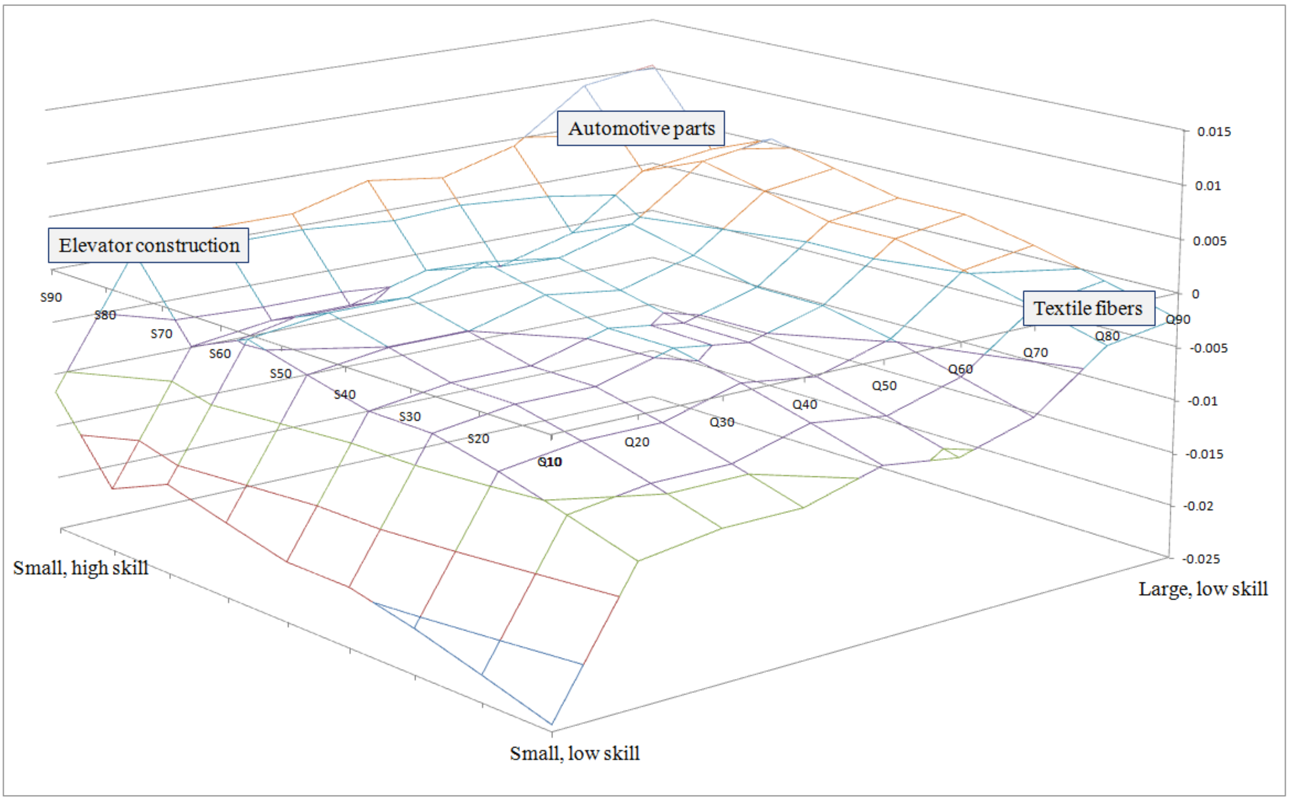
Note: Quantile IV regressions at the nine centiles of the distribution, $Q1$ gives the quantile regression at the 10^{th} percentile. *Log Chn imports* was instrumented with Chinese exports to Europe, and Chinese exports to the world except the EU, the US and Mexico. To mimic plant fixed effects all variables were demeaned at plant level. Stars denote significance at one (***), five (**) and ten (*) percent level of significance.

Table 8: Quantile - skill interaction, plant sales

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
Log Chn imports (t-1)	-0.024**	-0.012**	-0.011***	-0.011***	-0.009***	-0.010***	-0.008**	-0.003	-0.002
	(0.008)	(0.005)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)	(0.006)
Log total imports (t-1)	-0.029**	-0.020**	-0.012**	-0.004	-0.003	-0.001	0.003	0.010	0.009
	(0.012)	(0.006)	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)	(0.006)	(0.009)
Log nr employees (t-1)	-0.040	-0.009	-0.003	0.000	0.009*	0.025***	0.038***	0.054***	0.091***
	(0.022)	(0.011)	(0.006)	(0.005)	(0.005)	(0.005)	(0.006)	(0.008)	(0.014)
Log sales (t-1)	0.749***	0.744***	0.748***	0.750***	0.742***	0.723***	0.703***	0.671***	0.612***
	(0.020)	(0.009)	(0.005)	(0.004)	(0.004)	(0.004)	(0.005)	(0.008)	(0.015)
Herfindahl (t-1)	-0.959***	-0.439***	-0.369***	-0.327***	-0.301***	-0.234***	-0.276***	-0.281**	-0.611***
	(0.243)	(0.122)	(0.074)	(0.061)	(0.056)	(0.058)	(0.068)	(0.094)	(0.152)
Export share (t-1)	0.031	0.024	0.029	0.053	0.046*	0.055**	0.055*	0.070*	0.117*
	(0.078)	(0.041)	(0.025)	(0.020)	(0.019)	(0.020)	(0.024)	(0.034)	(0.056)
Skill share (t-1)	-0.271*	-0.162*	-0.136**	-0.098**	-0.075*	-0.068	-0.086*	-0.039	-0.038
	(0.127)	(0.068)	(0.042)	(0.036)	(0.033)	(0.035)	(0.041)	(0.055)	(0.088)
Chn x Skill (t-1)	-0.004	0.010	0.017*	0.020***	0.017*	0.019***	0.020**	0.011	0.021
	(0.019)	(0.011)	(0.007)	(0.006)	(0.005)	(0.006)	(0.007)	(0.009)	(0.013)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demeaned at plant level	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Quantile IV regressions at the nine centiles of the distribution, $Q1$ gives the quantile regression at the 10^{th} percentile. To mimic plant fixed effects all variables were demeaned at plant level. Stars denote significance at one (***), five (**) and ten (*) percent level of significance.

Figure 2: Marginal effect of competition



This figure shows the marginal effect of competition as estimated in table 8. The axis from left to right displays initial size percentiles, the axis running back and forth skill share percentiles, and the vertical axis the effect of competition on size. For example: The front corner shows a negative marginal effect of Chinese competition on size for the firm at the 5th percentile of size (Q5) and the 1 percent percentile of skillshare (S1).

Table 9: Product drop overall

	OLS		IV		First stages		
	(1)	(2)	(3)	(4)	(Fs 3)	(Fs 4)	(Fs 4)
	Prod drop	Prod drop	Prod drop	Prod drop	Chn comp	Chn comp	Chn comp int
Chn comp Mex (t-1)	0.0879**	0.150**	0.327***	0.522***			
	(0.0399)	(0.0588)	(0.124)	(0.164)			
Log imports (t-1)	0.404	0.406	0.348	0.355	-0.280	-0.258	-0.000702
	(1.954)	(1.956)	(1.733)	(1.739)	(0.450)	(0.453)	(0.120)
Log tot sales (t-1)	-0.554	-0.558	-0.423	-0.435	-0.324*	-0.319*	-0.145*
	(1.692)	(1.692)	(1.520)	(1.520)	(0.189)	(0.189)	(0.0837)
Herf. (t-1)	-0.817	-0.807	-0.589	-0.559	-0.358*	-0.330*	-0.0364
	(0.801)	(0.800)	(0.716)	(0.714)	(0.185)	(0.183)	(0.0796)
Nr prod (t-1)	-0.285***	-0.289***	-0.280***	-0.293***	-0.0143	-0.0116	-0.00280
	(0.0613)	(0.0613)	(0.0549)	(0.0551)	(0.00873)	(0.00839)	(0.00399)
Exp. share (t-1)	-0.102	-0.108	-0.0958	-0.112	-0.0320*	-0.0293*	-0.0129*
	(0.133)	(0.133)	(0.120)	(0.122)	(0.0174)	(0.0176)	(0.00667)
Skill share (t-1)	0.0795***	0.0808***	0.0798***	0.0841***	-0.00227	-9.827***	-6.237**
	(0.0262)	(0.0247)	(0.0235)	(0.0194)	(0.00198)	(3.767)	(2.603)
Chn x share (t-1)		-0.249*		-0.797***			
		(0.129)		(0.268)			
Chn comp -US -EU (t-1)					0.111	0.0943	0.0345
					(0.0679)	(0.0678)	(0.0232)
Chn comp EU (t-1)					0.481***	0.513***	-0.000958
					(0.0626)	(0.0667)	(0.0106)
Interaction instrument 1						-1,417	4,282***
						(870.3)	(810.5)
Interaction instrument 2						615.4***	390.4**
						(236.0)	(163.1)
Observations	85770	85770	83276	83276	83276	83276	83276
F-stat					17.01	15.26	10.75
Sargan p					0.230	0.334	0.334

Note: Robust standard errors used, stars give significance at one (***), five (**) and ten (*) percent level of significance. The last three columns show one first stage for the the instrumented variable in column three and two first stages for the instrumented variables in column four. Variables are adjusted to improve legibility: *Nr prod* and *Exp share* by a factor of 10^{-1}, *skill share* by 10^{-2}, *total imports* by 10^{-3}, *product share* by 10^{-4} and the *Herfindahl* index by 10^{10}. Firm-product and year controls used.

Table 10: Product drop from export

	OLS		IV		First stages		
	(1)	(2)	(3)	(4)	(Fs 3)	(Fs 4)	(Fs 4)
	Prod drop	Prod drop	Prod drop	Prod drop	Chn comp	Chn comp	Chn comp int
Chn comp US (t-1)	-0.0542	0.0695	-0.0442	0.159			
	(0.0567)	(0.0821)	(0.0992)	(0.127)			
Log imports (t-1)	-0.00338	-0.00342	-0.00338	-0.00344	-0.000327	-0.000319	-0.000290
	(0.00464)	(0.00463)	(0.00405)	(0.00404)	(0.00235)	(0.00235)	(0.000955)
Log tot sales (t-1)	0.0143	0.0163	0.0146	0.0177	-0.0168**	-0.0166**	-0.00226
	(0.0397)	(0.0398)	(0.0346)	(0.0347)	(0.00711)	(0.00710)	(0.00295)
Herf. (t-1)	1.746	1.769	1.760	1.784	-0.544***	-0.540***	-0.161***
	(1.693)	(1.690)	(1.487)	(1.480)	(0.136)	(0.136)	(0.0502)
Nr prod (t-1)	0.0203*	0.0201*	0.0202*	0.0200*	0.00280	0.00271	0.00104
	(0.0120)	(0.0120)	(0.0105)	(0.0104)	(0.00269)	(0.00269)	(0.00136)
Exp. share (t-1)	0.00235	0.00298	0.00230	0.00345	0.00470*	0.00489*	0.00199*
	(0.0164)	(0.0164)	(0.0143)	(0.0143)	(0.00276)	(0.00273)	(0.00115)
Skill share (t-1)	-0.0582**	-0.0345	-0.0582***	-0.0171	-0.00418	0.00302	0.0146***
	(0.0247)	(0.0260)	(0.0216)	(0.0239)	(0.00565)	(0.00624)	(0.00344)
Chn x share (t-1)		-0.375***		-0.652***			
		(0.114)		(0.171)			
Chn comp -US -EU (t-1)					0.266***	0.279***	-0.0256
					(0.0375)	(0.0511)	(0.0169)
Chn comp EU (t-1)					0.780***	0.840***	-0.0759**
					(0.0947)	(0.104)	(0.0308)
Interaction instrument 1						-0.158	0.878***
						(0.174)	(0.156)
Interaction instrument 2						-0.0385	0.297***
						(0.0700)	(0.0495)
Observations	16687	16687	15837	15837	15837	15837	15837
F statistic					20.18	19.87	22.12
Sargan p					0.244	0.291	0.291

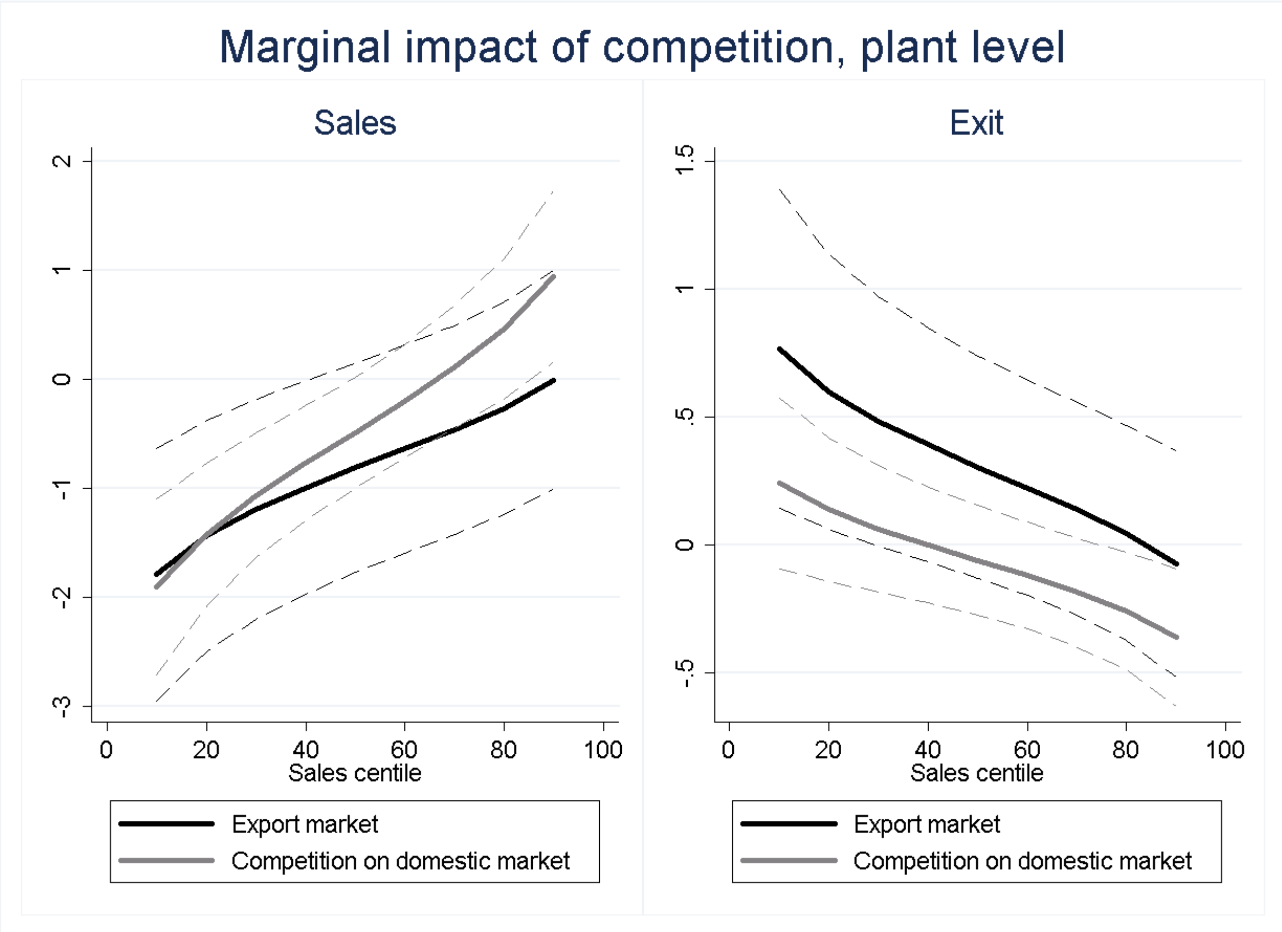
Note: Robust standard errors used, stars give significance at one (***), five (**) and ten (*) percent level of significance. Additional controls for the exit of a firm from export markets and firm exit were used. The last three columns show one first stage for the the instrumented variable in column three and two first stages for the instrumented variables in column four. The *Herfindahl* index is adjusted by a factor of 10^{10} to improve legibility. Firm-product and year controls used.

Table 11: Product sales

	OLS		IV		First stages		
	(1)	(2)	(3)	(4)	(Fs 3)	(Fs 4)	(Fs 4)
	Prod sales	Prod sales	Prod sales	Prod sales	Chn comp	Chn comp	Chn comp int
Chn comp Mex (t-1)	-0.197	-0.868***	-1.287**	-3.876***			
	(0.185)	(0.262)	(0.602)	(0.832)			
Log imports (t-1)	0.0239**	0.0243**	0.0261**	0.0265**	0.000329	0.000313	9.86e-05
	(0.0103)	(0.0103)	(0.0108)	(0.0108)	(0.000527)	(0.000527)	(0.000143)
Log tot sales (t-1)	-0.286***	-0.287***	-0.239***	-0.238***	-0.00490**	-0.00482**	-0.00182*
	(0.0773)	(0.0768)	(0.0751)	(0.0751)	(0.00206)	(0.00206)	(0.000930)
Herf. (t-1)	0.155**	0.155**	0.176***	0.172**	-0.00297	-0.00295	-0.000385
	(0.0631)	(0.0630)	(0.0678)	(0.0674)	(0.00187)	(0.00187)	(0.000838)
Nr prod (t-1)	-0.0132	-0.00852	0.0106	0.0287	-0.00159*	-0.00184**	-0.000411
	(0.0247)	(0.0246)	(0.0242)	(0.0240)	(0.000919)	(0.000933)	(0.000471)
Exp. share (t-1)	0.413***	0.416***	0.384***	0.406***	-0.00192	-0.00212	-0.000995
	(0.0550)	(0.0550)	(0.0545)	(0.0548)	(0.00187)	(0.00189)	(0.000722)
Skill share (t-1)	6.827	6.652	6.234	162.0	-0.0459**		
	(8.833)	(8.663)	(7.719)	(171.7)	(0.0215)		
Chn x share (t-1)		1.894***		10.38***			
		(0.425)		(1.735)			
Chn comp -US -EU (t-1)					0.0745***	0.0736***	0.0201***
					(0.0190)	(0.0191)	(0.00614)
Chn comp EU (t-1)					0.542***	0.566***	-0.00790
					(0.0677)	(0.0702)	(0.00989)
Interaction instrument 1						-8,770	50,824***
						(7,344)	(7,638)
Interaction instrument 2						329,884	604,870
						(460,420)	(514,798)
Observations	107601	107601	91517	91517	91517	91517	91517
F statistic					19.21	18.92	11.83
Sargan p					0.991	0.949	0.949

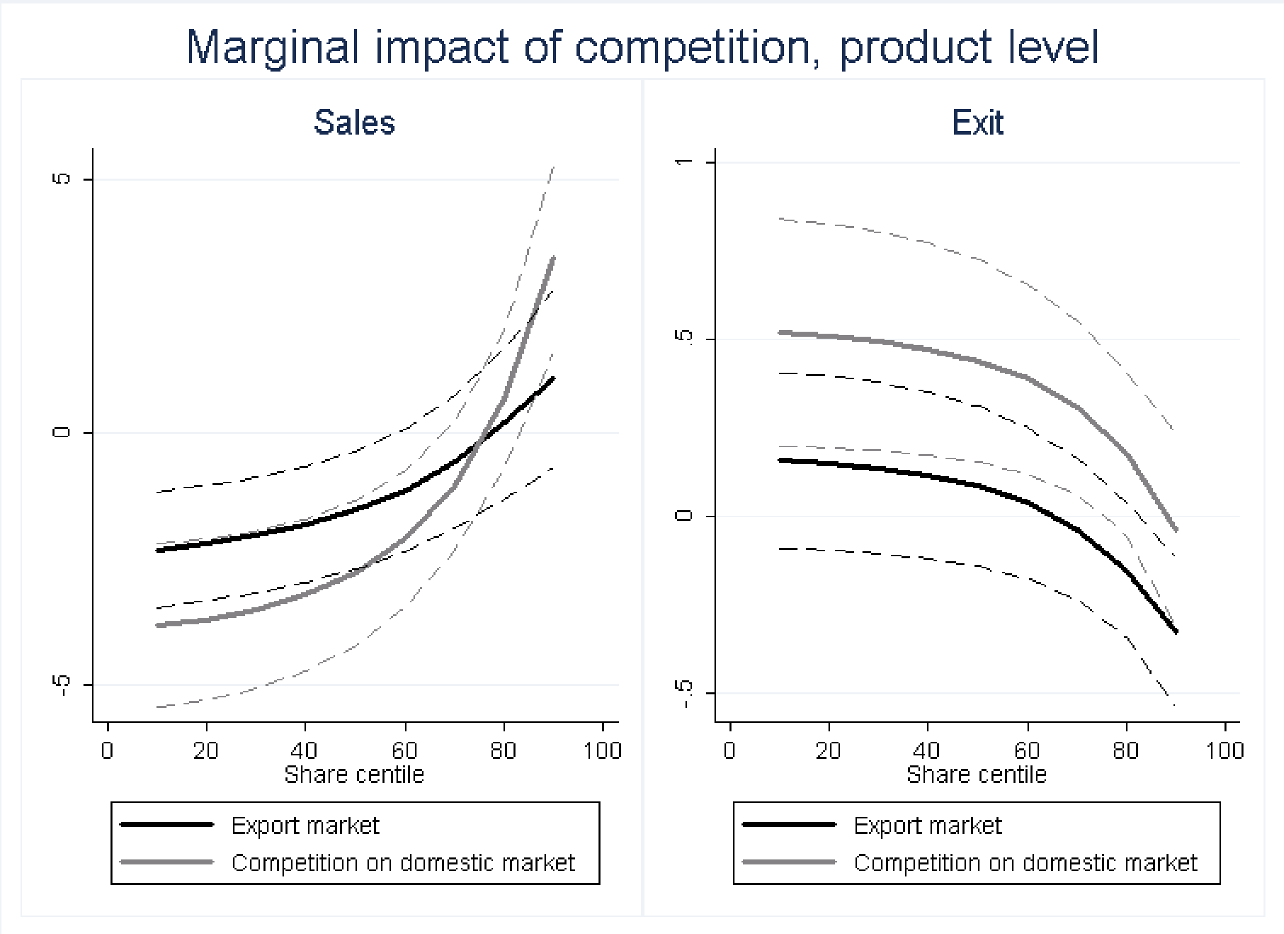
Note: Robust standard errors used, stars give significance at one (***), five (**) and ten (*) percent level of significance. Additional controls for the exit of a firm from export markets and firm exit were used. The last three columns show one first stage for the the instrumented variable in column three and two first stages for the instrumented variables in column four. The *Herfindahl* index is adjusted by a factor of 10^{10} to improve legibility. Firm-product and year controls used.

Figure 3: Marginal effect of competition, plant level



Based on the fourth column of the IV regressions reported in tables 2, 3, 4 and 5.

Figure 4: Marginal effect of competition, product level



Based on the fourth column of the IV regressions reported in tables 9, 10, 11 and 12.

Table 12: Export sales product

	OLS		IV		First stages		
	(1)	(2)	(3)	(4)	(Fs 3)	(Fs 3)	(Fs 4)
	Prod sales	Prod sales	Prod sales	Prod sales	Comp Chn US	Comp Chn US	Share interaction
Chn comp US (t-1)	-0.794**	-1.876***	-1.079*	-2.393***			
	(0.319)	(0.368)	(0.573)	(0.585)			
Log imports (t-1)	0.129***	0.129***	0.129***	0.129***	0.000715	-0.000380	-2.50e-05
	(0.0461)	(0.0461)	(0.0403)	(0.0403)	(0.00196)	(0.00214)	(0.000791)
Log tot sales (t-1)	-0.140	-0.160	-0.148	-0.172	-0.00746	-0.0112	0.000912
	(0.217)	(0.217)	(0.190)	(0.190)	(0.00718)	(0.00758)	(0.00379)
Herf. (t-1)	0.373	0.350	0.323	0.291	-0.0724***	-0.0936***	-0.0281***
	(0.903)	(0.903)	(0.795)	(0.797)	(0.0176)	(0.0216)	(0.00661)
Nr prod (t-1)	-0.000195	0.00264	-0.000372	0.00299	-0.000248	-0.000436	-0.000462**
	(0.0119)	(0.0117)	(0.0104)	(0.0103)	(0.000461)	(0.000490)	(0.000186)
Exp. share (t-1)	1.436***	1.424***	1.438***	1.423***	0.00303	0.00282	0.00150
	(0.0913)	(0.0908)	(0.0800)	(0.0794)	(0.00254)	(0.00265)	(0.00110)
Skill share (t-1)	1.85e-05	1.54e-05	0.179	0.141	7.84e-05	-0.00932***	0.000824
	(1.68e-05)	(1.54e-05)	(0.147)	(0.133)	(0.00336)	(0.00355)	(0.00233)
Chn x share (t-1)		3.421***		4.074***			
		(0.660)		(0.854)			
Chn comp -US -EU (t-1)					0.282***	2.893	-3.017***
					(0.0391)	(2.879)	(1.020)
Chn comp EU (t-1)					0.832***	1.020***	-0.138***
					(0.0902)	(0.109)	(0.0337)
Interaction instrument 1						-0.183	1.175***
						(0.149)	(0.148)
Interaction instrument 2						0.794	10.93***
						(3.543)	(3.505)
Observations	21049	21049	19802	19802	19802	19802	19802
F statistic					29.07	24.61	20.89
Sargan					0.469	0.444	0.444

Note: Robust standard errors used, stars give significance at one (***), five (**) and ten (*) percent level of significance. Additional controls for the exit of a firm from export markets and firm exit were used. The last three columns show one first stage for the the instrumented variable in column three and two first stages for the instrumented variables in column four. The *Herfindahl* index is adjusted by a factor of 10^{10} to improve legibility. Firm-product and year controls used.

Table 13: Robustness 3, Industry-year fixed effects

	IV (1) Exit	IV (2) Exit exp	IV (3) Sales	IV (4) Exp sales
Chn comp (t-1)	1.193**		-6.736***	
	(0.516)		(1.393)	
Sales (t-1)	-0.0549***		0.644***	
	(0.00241)		(0.00663)	
Sales int (t-1)	-0.134***		0.623***	
	(0.0454)		(0.130)	
Chn comp US (t-1)		1.562***		-3.916***
		(0.593)		(0.963)
Exp sales (t-1)		0.00139		0.399***
		(0.00517)		(0.0132)
Exp sales int (t-1)		-0.136***		0.313***
		(0.0516)		(0.0808)
Herfindahl (t-1)	0.0618*	0.0311	-0.524***	-0.473*
	(0.0373)	(0.0938)	(0.0952)	(0.280)
Exp share (t-1)	-0.0204*	0.0240	-0.970***	0.276***
	(0.0120)	(0.0277)	(0.0322)	(0.0889)
Skill share (t-1)	-0.00367	-0.0239	-0.0300	-0.0976
	(0.0148)	(0.0465)	(0.0391)	(0.142)
Total imports (t-1)	-0.00210		-0.00207	
	(0.00148)		(0.00397)	
Total imports US (t-1)		-0.000313		0.0118
		(0.00443)		(0.0136)
Plant fixed effects	Yes	Yes	Yes	Yes
Industry-year fixed effects	Yes	Yes	Yes	Yes
Observations	35376	12089	38774	11771
Sargan p	0.0755	0.268	0.225	0.0918

Note: Robust standard errors used, stars give significance at one (***), five (**) and ten (*) percent level of significance. These regressions are identical to the fourth column of plant OLS regressions in tables 2, 3, 4 and 5, except for the additional inclusion of HS-2-year control variables. An example of such a control are fertilizers in the year 2000.

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7 Appendix 1: Bias

As is often highlighted in the econometric literature, a fixed effects model with lagged dependent variables is likely biased. While the size of that bias for a model with a lagged dependent variable has been described (Nickell (1982)), we are not aware of a formulation of the bias of an interacted lag dependent variable. To investigate this bias we undertake a simple simulation exercise.

We generate a panel data of 1000 firms over a time period of 10 years. We generate a simulated competition variable, which is distributed iid. uniformly between 0 and 1 (just as the Chinese imports share in the previous analysis is bounded by 0 and 1). In the first period sales are exogenously given and distributed iid. standard normally. In each further period we generate sales for firm i in period t as:

$$Sales_{it} = Competition_{it-1}\beta_1 + Sales_{it-1}\beta_2 + Sales_{it-1}Competition_{it-1}\beta_3 + \epsilon_{it}$$

The error terms ϵ_{it} are iid. standard normally distributed. We assume the parameters: $\beta_1 = -0.5$, $\beta_2 = 0.5$, $\beta_3 = 0.5$. After computing the data we estimate above model with the inclusion of firm fixed effects. To see the direction and size of the biases of the coefficients, we repeat described data generation and estimation 1000 times. Table 14 reports how often the estimated coefficient was significantly (at five percent level) below or above its true value, and how often we could not reject that it is equal to zero. This count reads as follows:

Table 14: Simulation results

Coefficient	Below	Above	Zero
Competition (β_1)	3	118	0
Sales(β_2)	1000	0	0
Interaction (β_3)	182	2	0

The coefficient on the lagged sales is always below its true value of 0.5 (at five percent level of significance), and always above zero. The coefficient on lagged competition is 118 times above its true value of -0.5, three times below it and never zero. This suggests a modest attenuation bias. The interaction is over 180 times below its true value of 0.5, and two times above it. Hence we find evidence for an attenuation bias for all three coefficients that is most pronounced for lagged sales. The OLS sales regressions are thus potentially biased in a way that would lead us to underestimate the true size of the effects, and lower the significance of our estimates.

8 Appendix 2: Model

In great part, the competitive success of Chinese exports results from their ability to undercut the prices charged by other suppliers (as argued by among others Broda and Romalis (2009)). In a simple model we want to illustrate that if cost undercutting is the main characteristic of Chinese exports, we might expect heterogeneous results for firms and products on the Mexican market. While this toy model is not a rich description of the economy, it is a simple guide for the empirical investigation, and contains a general way to think about unilateral competition.

Consider a Mexican retailer i that sells a good of a certain quality. Initially the store sells only a domestic product, that it obtains from a Mexican producer at costs c^H. For our argument it is irrelevant how the plant producing the item determines the price at which it sells the product. We just assume that this price is increasing in marginal costs.

We further define that if one domestic firm has lower costs than another for the same product at the same quality, the lower cost firm has production advantages (which might consist for example of a better management or lower production costs), as in Melitz (2003). We refer to these differences as higher productivity, and think of the more productive firm as one that can deliver equal quality for a lower price. As in the literature on multi-product firms we further assume that the costs of a product contain an element of firm productivity, such that the costs of a product of a given firm are positively correlated, conditional on product differences. Thus the price at which a producer offers a good might be characterized as the product from a random draw from a product productivity distribution and a firm productivity distribution, or in our case we may write $c^H = f(\varphi^F, \varphi^P)$, where φ^F denotes a firm productivity, and φ^P a product productivity (this assumption was used for example in Bernard, Redding and Schott (2009)).

The retailer has local monopoly power, and sells the good at price $p_i(c^H) \geq c^H$ to the local consumers, from which it faces a downward sloping demand. We assume the price function $p(c)$ to be increasing in costs. The profits from selling the domestic product are in one period equal to $(p_i(c^H) - c^H)q_i^H$, where q_i^H is the optimal quantity of the product sold if the purchase price to the store is c^H. The store discounts future periods with the discount factor δ, which is assumed to be between zero and one. Then present plus discounted future profits are equal to: $(p_i(c^H) - c^H)q_i^H/(1-\delta)$.

We consider the situation in which a foreign competitor (from China) enters the market to compete with the domestic producer by delivering a perfect substitute for that good at cost c^F. We assume that the Chinese competitors also take their productivity from a random distribution and after observing their productivity decide if they want to enter the Mexican market or not. If the foreign competitor offers a lower price than the local producer ($c^F < c^H$), the retailer might consider switching supplier. We assume that store i can undertake such a change for the fixed switching cost f_i. We assume the switching costs f_i to be heterogeneous across stores. A varying cost element emerges if it is costly to exit existing contracts, and these existing contracts have different expiry dates. Another reason for heterogeneity in switch costs is, that the costs for writing different contracts with the new suppliers will also depend on the nature and structure of the retailer, or variation in the difficulty to overcome language barriers. Finally, different levels of risk aversion or judgment of the reliability of the new producer might again lead to different expectations of the switching cost. Hence if N stores sell a similar product, a situation could emerge in which some of the stores change the suppliers while others do not.

The retailer changes supplier if $[(p_i(c^F)-c^F)q_i^F-(p_i(c^H)-c^H)q_i^H]/(1-\delta) > f_i$, and is indifferent between changing or not if the inequality is an equality. If $c^F < c^H$ the left hand side of the inequality must be greater than zero, since even at initial quantities this cost reduction would result in greater profit for the store. Using a similar argument it can be shown that profits of store i must be decreasing in costs c.

From this simple setting, we generate several propositions:

Proposition 1: A product from a more productive firm sells at larger quantities. By definition we characterize a more productive product as one that is passed on to the stores at lower costs conditional on quality. Given the assumptions of a downward sloping demand and a price function $p(c)$ that is increasing in costs, a lower cost product will be sold at a lower price $p_i(c^H)$ conditional on the market for that product, and hence at higher quantities.

Proposition 2: A more productive firm sells larger quantities. If a high and a low productivity firm produce the same number of products, from proposition 1 the more productive firm must sell larger overall quantities. Given downward sloping demand in the market of each good, a productive firm with lower expected costs is more likely to sell in addition also a higher number of products.

Proposition 3: Entry of a competitor is more likely to cause smaller products to exit from the market. Everything equal, the greater the cost difference between the domestic and the foreign producer $(c^F - c^H)$ is, the more likely is a store to switch to the foreign producers. Conditional on product, a product with higher costs is smaller (proposition 1), hence smaller products are more likely to be dropped as a competitor enters the market.

Proposition 4: Entry of a competitor is more likely to cause smaller firms to exit the market. A firm exits the market if all its products do. Hence from proposition 2 and 3 the statement must hold.

Proposition 5: Conditional on survival, entry of a competitor reduces sales of a small product more than sales of a large product. In this model we think of sales reduction as a partial replacement of the Mexican product by some retailers, and not by others due to differences in the fixed costs f_i. Since a replacement by all stores is more likely for the small products (proposition 3), also the replacement by some of the stores must be more likely.

Proposition 6: Conditional on survival, entry of a competitor reduces sales of a small firm more than sales of a large firm. The same argument as in proposition 5 can be made with respect to proposition 4.

These propositions coincide largely with predictions made by the emerging models on multi-product firms in international trade referenced in the literature section. From this simple model we take the motivation to focus on product and firm exit as well as sales as interesting dependent variables, and expect a heterogeneous effect across products and firms of different size. The model might also be used to predict the effects of competition on a shared third market also, hence we do not expect the results for Mexican exporters on the export market to be very different from the domestic effects.

This model also creates an incentive to upgrade productivity for the established producers when faced with competition. Such a relationship was found by Bloom, Draca and Van Reenen (2008) for European manufacturing firms. Thus our finding (see section 4) that large firms grow as a reaction to Chinese competition is not inconsistent with the model sketched.

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