Import Competition and Domestic Response: New Evidence from Mexico*

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Abstract

How does import competition affect the innovative activity of firms? Employing a new data set of Mexican manufacturers from 1998 and 2004, we exploit the emergence of China on the world markets as an exogenous competition shock. Innovation is captured through the introduction of quality control systems such as ISO 9000 or Just in Time, as well as traditional measures such as firm productivity and R&D expenditures. While China's emergence as a force in global trade tends to lower the rate of innovation of the typical Mexican firm, the largest firms respond by raising their rate of innovation, and this result is strongest for our direct measures of firm technology, ISO 9000 and Just in Time adoption. We also find that differences across firms in their innovation responses are more pronounced than the differences in terms of market share reallocation.

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1 Introduction

The domestic response to import competition has long been considered central to understanding countries' success in economic development. The consequences of different foreign trade regimes in the early years since World War II were summarized in the classic studies by Bhagwati (1978) and Krueger (1978). Subsequent work drew attention to the role of imperfect competition, while the most recent research points to two issues as crucial.[1] First, the presence of firms heterogeneity lead to a reallocation of market shares across different firms in response to increased import competition, and second, import competition could affect the incentives to innovate of heterogeneous firms asymmetrically.

This paper studies the static and dynamic efficiency effects of import competition by examining the responses of Mexican plants to a major shock, the greater competition from China as a consequence of its accession to the World Trade Organzation in 2001. Relying on unique information on technology upgrading from firm survey data, a key finding is that the degree to which plants upgrade their operations in response to a competition shock varies across plants.

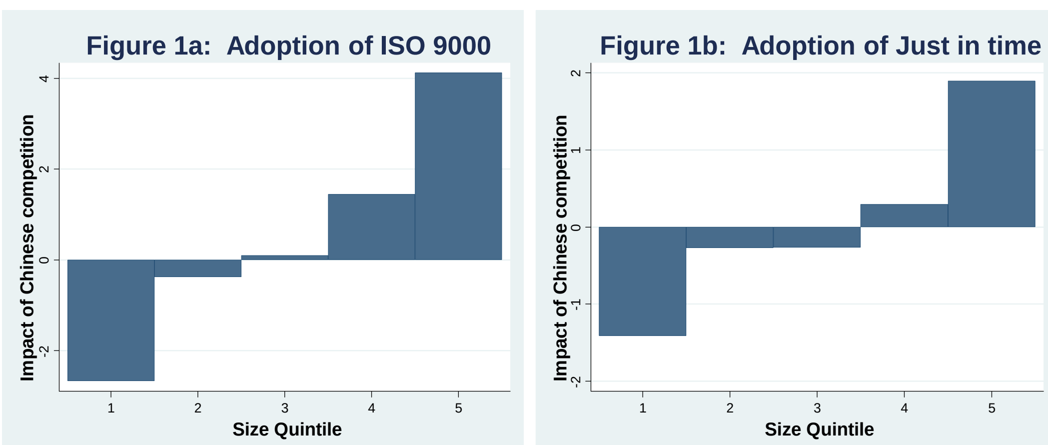

Figure 1 shows that the adoption of the ISO 9000 standard and Just-in-Time management

[1] A good survey covering the period until the year 2000 is Tybout (2003).

techniques increases with more competition for plants that are relatively large, while smaller plants innovate less in the face of increased competition. We also find that China's move into the world economy has reduced the incentives of the typical Mexican plant to innovate, consistent with a Schumpeterian rent dissipation effect. There is less evidence in our analysis that increased competition from China has reallocated market shares from smaller to larger Mexican plants.

Our work relates to a recent literature which emphasizes that the impact of intensified competition might vary across firms. First of all, it has been highlighted in a series of papers that the position of the firm relative to others matters for the impact of changes in competition on innovation (Aghion, Howitt, and others).[2] According to the escape-competition effect relatively productive firms will increase innovation when competition increases, while low productivity firms tend to throw in the towel and innovate less. This is the within-firm effect of competition on industry efficiency. Second, intensified competition can raise industry efficiency if it reallocates market shares from low- to high-efficiency firms, as shown in the trade model of Melitz (2003); this is the between-firm effect of competition on efficiency.

There has been a small but rapidly growing literature that seeks to provide empirical evidence on these effects. China is clearly the elephant in the room among the recently emerging forces of competition.[3] Also exploiting the China shock to world trade, Bloom, Draca, and van Reenen (2009) and Iacovone, Rauch, and Winters (2010) find that the new competition results in market share gains for relatively strong firms in importing countries; however, these authors do not study dynamic effects of import competition.[4] Other work focuses on within-firm adjustments.

[2] Here we use the term firm and plant interchangeably.

[3] And this has affected Mexico particularly strongly, see Freund and Ozden (2006), Hanson and Robertson (2007).

[4] While these papers document market share reallocations in response to new import competition, it is important to keep in mind that FDI may generate similar effects; see, e.g., Iacovone, Javorcik, Keller, and Tybout's (2009) analysis of Wal-Mart's effect on its Mexican suppliers.

In particular, Aghion, Blundell, Griffith, Howitt, and Prantl (2009) show that a reduction of entry barriers in the U.K. leads to higher patenting and productivity especially of the relatively strong firms.[5] Our analysis integrates these approaches by investigating both heterogeneous within- and between firm responses to intensified competition.

A major difficulty is that innovation at the firm level is rarely observed. Researchers typically study the effect of innovation by analyzing total factor productivity outcomes, which can raise a number of major issues because of unavailable price data (Erdem and Tybout 2004, De Loecker 2007).[6] Other approaches to address this issue are to relate import competition to changes in the number of products that domestic firms produce (Goldberg, Khandewal, Pavcnik, and Topalova 2009), or to study the effect of import competition on innovation with the help of trade data (Fernandes and Paunov 2010, Amiti and Khandewal 2010). There is no need for these approaches in the present work, because we have information on directly observable aspects of firm innovation such as the adoption of ISO 9000 certification and Just-in-Time techniques. [7] Both business case studies and recent research stress the effect of such changes in management techniques (Womack, Jones, and Roos 1990, and Bloom and van Reenen 2007, respectively).

This reasearch also relates to the large literature on the impact of international trade on firm behavior, including Pavcnik (2002), Fernandes (2007), Muendler (2005), which we extend by documenting differences in within-firm responses to import competition. Finally, while our focus is on the firm's response through its own innovative activity, it is worth noting that such

[5] Iacovone (2009) shows that Mexican plants that were relatively close to the technology frontier benefited more from the NAFTA reforms than plants that were far from the frontier. Schor (2003) finds that the within-plant productivity gains from tariff reductions in Brazil between 1986 and 1998 did typically *not* depend on the size of the plant.

[6] At the same time, Bloom, Draca, and van Reenen (2009) and Aghion, Blundell, Griffith, Howitt, and Prantl (2009), for example, also employ data on R&D, patenting, and information technology intensity.

[7] This things are x and y

technological improvements could also originate from other firms. In particular, recent work on technology spillovers has shown that such learning effects tend to be large for relatively small and unproductive firms (Keller and Yeaple 2009).

The remainder of the paper is as follows. The next section introduces our empirical strategy, while Section 3 gives an overview of the data that will be used. The empirical results are discussed in section 4, while a number of conclusions are drawn in section 5 of the paper.

2 Estimating within- and between-firm responses to changes in competition

The empirical approach is this paper is quite simple. We relate various plant-level outcome variables y_{ijt}, for example its adoption of the ISO 9000 standards, to measures that capture the change in import competition, $comp_{ijt}$, Mexican plants have face been facing through China's emergence on world markets

$$y_{ijt} = \beta_0 + \beta_1 comp_{ijt} + \gamma X + u_{ijt}, \tag{1}$$

where i indexes the plant, j the 2-digit industry, and t time;[8] the term X is a vector of other observable determinants of y_{ijt} including time and industry fixed effects, and u_{ijt} is an error term. There are a number of generic problems in estimating this equation, including endogeneity, that will be addressed below. If β_1 can be consistently estimated, it represents the mean impact of competition on the outcome variable. Theory indicates that this can be positive or negative; for example, if the escape-competition effect dominates, it will be positive, whereas if

[8] We will be exploiting changes between the years $t = 1998$ and $t = 2004$.

the Schumpeterian rent dissipation effect is particularly strong, it will be negative.[9]

We are particularly interested in whether the relationship between innovation and competition on the one, and market share and competition on the other hand depends on characteristics of the firm. According to much of recent theory, the technological capability of a firm is reflected in its size, and in this draft we focus on whether the impact of intensified competition varies with the size of the firm. This leads to the following specification:

$$y_{ijt} = \beta_0 + \beta_1 comp_{ijt} + \beta_2 size_{ijt} + \beta_3 \left(size_{ijt} \times comp_{ijt} \right) + \gamma X + u_{ijt}, \tag{2}$$

where $size_{ijt}$ are log sales of the firm in the initial period. If firms are differentially affected by competition, β_3 will be different from zero, and specifically, if larger firms innovation more in response to intensified competition, then $\beta_3 > 0$. Given that some of our variables, in particular ISO 9000 adoption and Just in Time production, are limited dependent variables that take on only values of zero or one, we will not only use linear regressions but also probit models.

Before we specify our estimation equations and show the results, the following section gives an overview of our data sources.

3 Data

In this article we use data provided by *Instituto Nacional de Estadística y Geografía* (INEGI), a Mexican statistical agency. We use their annual surveys of manufacturing plants from the years 2005 and 1999, which cover information on plants in the years 2004 and 1998. These surveys of the *Encuesta Nacional de Empleo, Salarios, Tecnología y Capacitación* (ENESTyC),

[9] See Bloom, Draca, and van Reenen (2009) for more discussion of the different theories that are relevant here.

provide information on a large range of plant characteristics, such as technology, employment and salaries.

The survey includes all Mexican plants with more than 100 employees, and uses a sampling procedure that ensures representativeness to include smaller firms. The data attaches a unique identified to each plant that remained the same over time. Thus we are able to match the survey answers for some plants across time. Further, not all plants answered all questions, hence the sample size varies for different measures of innovative activity.[10]

Our measure of import competition is based on the change in the imports from China in Mexico for a narrowly defined industry.[11] We merge the survey information with the well known international trade data from COMTRADE. We use the bridge created by Iacovone, Rauch, Winters (2010) to link the CMAP 6 classification used by INEGI with the HS classification from COMTRADE, which allows us to link the manufacturing data with the Chinese import share in Mexico. We also employ the change in the Chinese import share in the United States as an alternative measure of import competition change in Mexico. This is useful if advances of Chinese firms in the Mexican market are endogenous to the performance of Mexican firms, because to the extent that Chinese firms capture market share in the U.S., this captures their strength in general, and not something specific about the Mexican market.

Table 1 shows summary statistics on our main variables. Note that because few plants actually report R&D expenditures, the median R&D is zero in both sample years, namely 1998 and 2004, and even the mean R&D expenditures are zero (rounded to three digits) in the earlier

[10] Non-response does not appear to be systematically related to plant characteristics. Also, the survey design changed over time, and not all questions are directly comparable across the two surveys. We do not use answers that are not directly comparable.

[11] We are in the process of adding policy measures–the change in tariffs–for a subset of industries as additional measures of changes in import competition.

year. About one third of all firms have adopted ISO 9000 standards and Just in Time production techniques, with, interestingly, the fraction falling over time for the Just in Time variable. This indicates that such quality upgrading innovations are by no means irreversible. The Origin of iron machinery variable captures whether these inputs are imported or not, which we take as a quality indicator. These imports of inputs have become less frequent between the years 1998 and 2004, consistent with the idea that intensified competition from China required the firms to reduces the expenditures on imported intermediates.

We now turn to our estimation results.

4 Estimation results

Competition and Innovation We start by examining the impact of competition from China on within-firm technology upgrading of Mexican firms. Our first set of results are for the following estimation equation

$$
\begin{aligned}
y_{ijt} = \; & \beta_0 + \eta_j + post_t + \gamma_1 \ln(q_{ijt}) + \gamma_2 \ln(dist_{ij}) + \gamma_3 MexCity_{ij} + \\
& \beta_1 comp_{ijt} + \beta_2 \left(post_t \times comp_{ijt}\right) + \beta_3 \left(post_t \times comp_{ijt} \times size_{ijt}\right) + u_{ijt},
\end{aligned} \tag{3}
$$

which is essentially a difference-in-difference estimation where we allow in addition that the effect to vary by the initial size of the firm, as captured by β_3. Here, the control variables are as follows: $post_t$ is a time fixed effect (1 in the year 2004, zero in 1998), η_j are industry fixed effects at the CMAP two-digit level, q_{ijt} are sales, $dist_{ij}$ is the distance from the plant to the U.S. border, and $MexCity$ is a dummy variable whether the plant is located in Mexico City. Our interest lies in the effect of changes in import competition from China; to this effect, the variable $comp_{ijt}$ is Mexico's import share from China at the six-digit industry level.

We are concerned that the observed degree of import penetration of China in Mexico is endogenous. One possibility is that Chinese firms make greater inroads into the Mexican market whenever the Mexican competitors are particularly weak, for example. Therefore, the Chinese import share in the United States is considered as an alternative measure of competition as well, to which we will refer as the US competition measure. China's export success in the US market will share many common elements with its export success in Mexico, while at the same time the specific characteristics of Mexican industries play hardly any role for China's export success in the United States.

The results for specification (3) are given, for two sets of outcome variables y_{ijt}, in Table 2a and Table 2b. The first two columns in Table 2a report the results where y_{ijt} is the ISO 9000 dichotomous variable. Among these on the left, we employ the Chinese import share in Mexico as the measure of competition, and on the right it is the US competition measure. The estimates for the $post_t$ variable essentially reflect the overall increase in ISO 9000 adoption over time (see Table 1). We also see that larger firms are more likely to have adopted ISO 9000 standards, whereas the further a firm is away from the US border, the lower is the chance that it has ISO 9000 certification.

The difference-in-difference effect from Chinese competition is negative ($Post \times Competition$), which is consistent with the idea that it has become harder for the average firm to maintain ISO 9000 in the face of competition from China. However, there is evidence that this effect varies by firm size, as the triple interaction coefficients indicate–initially larger firms are more likely to have ISO 9000 certification in our sample. The remaining results of Table 2a, on Just in Time production and R&D expenditures, are in line with the idea that large firms are more likely to upgrade their technology in the face of intensified competition, although the estimates are not always significant.

In Table 2b, we show analogous results on three more outcome variables: the Origin of Machine tools, Origin of Automated Equipment, and total factor productivity (TFP). The figures for the first two of these refer to the fraction of a particular input that is imported. Imported intermediates are often of a higher quality than domestically sourced intermediates.[12] The results on these additional measures of innovation are consistent with what we saw ealier: larger firms are more likely to upgrade their technology than smaller firms.

We are still concerned that these results reflect to some extend composition effects, and in the following we exploit the panel nature of our data to compute for each plant that is in the sample in both years the difference for each variable between 2004 and 1998. This eliminates any plant characteristic that is constant over time, such as the plant's distance from the US border. The resulting long-difference estimator is similar to including plant fixed effects in the regression. The estimating equation becomes

$$\Delta y_i = \beta_0 + \beta_1 \Delta comp_i + u_i, \tag{4}$$

where we drop the t subscript because we have one cross-section of observations for the 2004/1998 difference. Augmenting this specification to allow for heterogeneous effects, we specify

$$\Delta y_i = \beta_0 + \beta_1 \Delta comp_i + \beta_2 size_i + \beta_3 \left(size_i \times \Delta comp_i \right) + u_i. \tag{5}$$

[12] Note that the number of observations for the Origen regressions is smaller than for the other variables; this is due to missing data. TFP is computed from a simple regression of sales on capital and labor, in logs.

Note that equation (5) includes the initial size of the plant, $size_i$, even though this variable is time-invariant and hence would be differenced out by the Δ operator. We do so because with the interaction variable $size \times comp$ in the regression, not including $size$ linearly may result in a misspecified regression model.

Table 3a shows the results for equation (4) while Table 3b below presents our results for equation (5).[13] Looking at the impact from intensifed Chinese competition in Table 3a across the various measures of innovation, it appears that the average impact is negative. In particular, import competition has a negative impact on adoption of Just in Time, ISO 9000 (not significant), R&D, the share of managers in the total work force, as well as TFP.[14]

When we allow for heterogeneous effects, the results in Table 3b show quite different results across the various measures of within-plant innovation. First of all, while the impact of competition lowers ISO 9000 and JIT adopted on average, this is not the case for relatively large firms; the interaction effect β_3 for both is positive and quite precisely estimated. In contrast, for the other proxies of innovation, import competition does not seem to matter.[15] While the point estimate on *comp* tends to be negative, it is never significant at standard levels. And while there is some evidence that larger firms tend to increase their R&D spending in the face of Chinese competition (point estimate on $comp \times size$ of 0.007 for R&D), is not significant once we account for the fact that larger firms tend to spend more on R&D in general (coefficient of 0.001 on $size$).

The last column of Table 3b shows the impact of competition on TFP. In contrast to the difference-in-difference results above, the average impact is positive while the size interaction is

[13] As our measure of competition, we employ our preferred variable, the Chinese import share in the US.

[14] The exception to this is that the ratio of white to blue collar workers is positively affected by import competition.

[15] This is even though the extended specification (5) is preferred to (4) in terms of regression fit.

negative, although neither is significant. Mostly, TFP growth tends to be lower for relatively large firms, which could in part simply reflect a reversion to the mean effect. given that the TFP measure is derived from sales (i.e., size). Hence, these TFP results may reflect some of the well-known measurement problems that arise frequently in this context. In stark contrast, we obtain much stronger results for ISO 9000 adoption and Just in Time production, our two direct measures of organizational change.

By estimating linear probability models, we have so far not specifically dealt with the fact that ISO 900 and Just in Time are limited dependent variables (0 or 1). We therefore have estimated probit regressions for these two variables. The results are given in Table 4.[16] The first two columns show the results for ISO 9000 adoption, first with a continuous size interaction and in the second column with a non-parametric formulation that allows for different effects for each size quintile.

Generally, the probit results confirm the least-squares results from above: the general impact of Chinese import competition on Mexican plants has been to reduce ISO 9000 adoption, however, the effect varies strongly by the size of the plant, with large plants having a higher incentive to upgrade their technology. The results from column 2, which are shown in Figure 1 above, strikingly confirm these results. Columns 3 and 4 show the analogous results for the Just in Time measure, and they are qualitatively similar to those for ISO 9000 adoption. Overall, we find striking evidence that the within-firm impact of intensified import competition varies strongly across plants. The pattern of our results is in line with the escape-competition effect emphasized by Aghion, Howitt, and others.

We now turn to analyzing the extent to which intensified import competition has led to a

[16]All specifications include plant fixed effects.

reallocation of market shares in our sample.

Competition and Market Share Reallocation To examine the relationship between import competition and between-firm market share reallocation, we employ the specification (5) with the change in log plant sales as the dependent variable:

$$\Delta \ln(q_i) = \beta_0 + \beta_1 \Delta comp_i + \beta_2 size_i + \beta_3 \left(size_i \times \Delta comp_i\right) + u_i.$$

Table 5 shows the results, where on the left the measure of competition is the Chinese import share in Mexico, and on the right it is the Chinese import share in the United States.

When only the import competition variable is included in the regression, we see that competition from China on average lowers the sales of Mexican plants. The introduction of the *size* and $size \times \Delta comp$ variables leads to mixed results, with the estimate for the size-competition variable using the preferred US competition measure being negative but insignificant. We find strong evidence that there is some reversion to the mean in the sample, in that the coefficient on initial size is estimated negative. In comparison to that, the market share reallocation due to intensified import competition from China appear to be much smaller.

To summarize, from our analysis so far it appears that in the face of new import competition, the differences across firms in terms of their innovative behavior–their forward looking activity–are magnified relative to differences across firms in terms of current sales.

We now turn to some concluding discussion.

5 Conclusions

Innovation is a broad term that includes many different phenomena, which might not be all effected in the same way by competition. In this study we are able to analyze the impact of competition on several distinct measures of innovation. We find that the incentives to adopt new management systems such as ISO 9000 and Just in Time is much stronger for larger than for smaller firms. Moreover, our results looking at these variables are much sharper than for less direct measures of firm technology, such as R&D expenditures, TFP, or the share of highly skilled workers. These results underline the usefulness of opening the black box of firm technology and employ information on directly observable features of technology in quantitative analyses.

The Schumpeterian hypothesis that monopolists have a greater incentive to innovate than firms facing tough competition has been revisited by new theory and empirical results finding that more competition may on balance actually increase the rate of innovation. In our analysis of the impact of China's emergence as a force in international trade, we find that the rate of innovatison of Mexican plants tends to fall, not rise. This may be specific to the shock we are analyzing, which is extraordinary in many respects. At the same time, there is strong evidence that larger firms tend to innovate more than smaller firms in the face of new competition. Import competition is thus a force that sharpens the difference between strong-performing and weak-performing firms, a result that is in line with the more qualitative body of research on countries' foreign trade strategies that has been accumulated since World War II.

Our study shows that while innovation rates vary strongly in response to intensified competition, there is less evidence for a reallocation of market shares in our analysis compared to other studies. In part this may be because by focusing on continuing plants we do not account for exit in our analysis.[17] Another explanation might be that it takes more time than is covered by our sample for market shares to substantially change; in that case, however, the market share changes may also be in part due to the differential rates of innovation. While our study has generated some new results, it clearly remains a major challenge to distinguish the static and dynamic effects of changes in import competition.

In our study of how different types of innvation differ in their response to innovation, we are limited to the measures included in the surveys at hand. Further studies might highlight other outcome variables, such as wages, destinations, product introduction or changes of management practices.

[17] Another reason might be that we control for the general reversion-to-the-mean effect in our analysis by including initial size.

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Table 1: Summary Statistics

	Year	Mean	Median	Standard Deviation
Sales	1998	11.521	11.402	1.336
	2004	11.933	11.897	1.491
ISO 9000	1998	0.214	0.000	0.411
	2004	0.392	0.000	0.488
Just in Time	1998	0.344	0.000	0.475
	2004	0.255	0.000	0.436
% expenditure for R&D	1998	0.000	0.000	0.001
	2004	0.011	0.000	0.020
White over blue collar	1998	0.685	0.363	1.541
	2004	0.496	0.309	0.777
Share of managers	1998	0.027	0.018	0.047
	2004	0.025	0.014	0.065
Expenditure for Training	1998	4.326	4.248	1.857
	2004	4.626	4.605	1.852
Origin of iron machinery	1998	0.960	1.000	0.197
	2004	0.442	0.000	0.497

Notes: Sales and expenditures for worker training are in logs.

Table 2a: Innovation in response to increased competition -- industry fixed effects results

	ISO 9000		Just in Time		R&D Expenditures	
	MX	US	MX	US	MX	US
	(1)	(2)	(3)	(4)	(5)	(6)
Post	0.196^	0.191^	-0.086^	-0.098^	0.011^	0.0111^
	(0.025)	(0.028)	(0.024)	(0.027)	(0.001)	(0.001)
ln sales	0.098^	0.094^	0.037^	0.030^	0.0007	0.0005**
	(0.008)	(0.009)	(0.009)	(0.01)	(0.002)	(0.0002)
ln dist	-0.064^	-0.066^	-0.009	-0.009	0.001	0.001
	(0.023)	(0.024)	(0.021)	(0.021)	(0.001)	(0.001)
Mex City	-0.042*	-0.038	-0.053^	-0.047**	-0.0017**	-0.002^
	(0.023)	(0.023)	(0.019)	(0.019)	(0.001)	(0.0007)
Competition	0.078	-0.316*	0.093	-0.293*	-0.001	0.004*
	(0.265)	(0.163)	(0.258)	(0.177)	(0.003)	(0.002)
Post x Competition	-2.544*	-3.347^	-3.040^	-5.076^	-0.045	-0.132^
	(1.348)	(0.989)	(1.392)	(1.442)	(0.060)	(0.047)
Post x Competition x Size	0.201*	0.282^	0.262**	0.447^	0.003	0.0103^
	(0.107)	(0.088)	(0.123)	(0.128)	(0.005)	(0.004)
Observations	2774	2774	3590	3590	2774	2774

Notes: Dependent variable on top; measure of competition either Chinese exports to Mexico or to the US as indicated; all specifications include industry fixed effects. Robust standard errors clustered at the CMAP-6 level in parentheses; ^sig at 1%; **sig at 5%; * sig at 10%

Table 2b: Innovation in response to increased competition -- results with industry fixed effects

	Origin Machine Tools		Origin Autom. Equipment		TFP	
	MX	US	MX	US	MX	US
	(1)	(2)	(3)	(4)	(5)	(6)
Post	-0.539^	-0.559^	-0.275^	-0.266^	0.506^	0.512^
	(0.026)	(0.028)	(0.020)	(0.023)	(0.033)	(0.038)
ln sales	0.0497^	0.0481^	0.0474^	0.0423^	0.952^	0.948^
	(0.009)	(0.009)	(0.008)	(0.008)	(0.011)	(0.011)
ln dist	0.0271	0.030	-0.019	-0.018	-0.029	-0.029
	(0.022)	(0.022)	(0.024)	(0.024)	(0.018)	(0.018)
Mex City	-0.0312	-0.0228	-0.0291	-0.0252	0.018	0.021
	(0.029)	(0.029)	(0.027)	(0.026)	(0.025)	(0.025)
Competiion	-0.057	-0.0563	-0.091	-0.0568	0.626**	0.427**
	(0.150)	(0.125)	(0.145)	(0.132)	(0.245)	(0.191)
Post x Competition	-5.300*	-4.569*	-5.801**	-6.874^	-3.836^	-4.195^
	(2.864)	(2.544)	(2.708)	(1.973)	(1.065)	(1.065)
Post x Competition x Size	0.496**	0.431**	0.474**	0.546^	0.266^	0.319^
	(0.226)	(0.204)	(0.203)	(0.156)	(0.086)	(0.086)
Observations	1372	1372	1470	1470	2558	2558

Notes: Dependent variable on top; measure of competition either Chinese exports to Mexico or to the US as indicated; all specifications include industry fixed effects. Robust standard errors clustered at the CMAP-6 level in parentheses; ^sig at 1%; **sig at 5%; * sig at 10%

Table 3a: Innovation and competition using within-firm changes

	ISO 9000	Just in Time	R&D	White/ Blue collar	Management Share	Origin machine tools	Origin autom. eq.	TFP
Competition	-0.030	-0.390**	-0.011*	0.941**	-0.021	0.416	-0.368	-0.462**
	(0.153)	(0.169)	(0.006)	(0.373)	(0.014)	(0.278)	(0.262)	(0.208)
Constant	0.191^	0.133^	0.011^	-0.211^	0.001	-0.534^	-0.239^	0.512^
	(0.016)	(0.017)	(0.001)	(0.062)	(0.002)	(0.028)	(0.026)	(0.023)
R-squared	0.001	0.004	0.002	0.003	0.001	0.004	0.003	0.004
# of obs.	1,418	1,418	1,418	1,156	1,168	556	593	1,306

Table 3b: Heterogeneous effects of competition on innovation

	ISO 9000	Just in Time	R&D	White/ Blue collar	Management Share	Origin machine tools	Origin autom. eq.	TFP
Competition	-2.823**	-3.522**	-0.086	-2.110	-0.034	-0.419	-3.379	1.480
	(1.172)	(1.575)	(0.053)	(2.101)	(0.124)	(2.236)	(2.094)	(2.255)
Size	-0.001	0.011	0.001**	-0.022	0.001	0.071^	0.026	-0.066^
	(0.011)	(0.013)	(0.0004)	(0.021)	(0.002)	(0.016)	(0.017)	(0.018)
Competition x Size	0.247**	0.280**	0.007	0.270	0.001	0.082	0.264	-0.180
	(0.107)	(0.140)	(0.005)	(0.177)	(0.011)	(0.191)	(0.173)	(0.195)
Constant	0.254**	0.008	-0.0001	0.042	-0.012	-1.367^	-0.549**	1.279^
	(0.125)	(0.150)	(0.0005)	(0.249)	(0.020)	(0.189)	(0.215)	(0.209)
R-squared	0.003	0.010	0.011	0.004	0.001	0.043	0.016	0.028
# of obs.	1,418	1,418	1,418	1,156	1,168	556	593	1,306

Notes: Dependent variable is the change of the variable on top for a given plant between the years 2004 and 1999 using least-squares; competition measure is Chinese exports in United States. Size is log sales in initial year. Robust standard errors clustered at the CMAP-6 level in parentheses; ^sig at 1%; **sig at 5%; * sig at 10%

Table 4: Import competition and heterogeneous innovative activity – probit regressions

	ISO 9000		Just in Time	
Competition	-6.984^ (0.804)		-5.147^ (0.622)	
Size	0.383^ (0.011)		0.169^ (0.008)	
Competition x Size	0.744^ (0.070)		0.486^ (0.053)	
Competition x Size Quintile 1		-2.865^ (0.263)		-1.544^ (0.191)
Competition x Size Quintile 2		-0.505^ (0.188)		-0.332** (0.144)
Competition x Size Quintile 3		-0.050 (0.182)		-0.309** (0.150)
Competition x Size Quintile 4		1.398^ (0.189)		0.288** (0.143)
Competition x Size Quintile 5		4.089^ (0.238)		1.919^ (0.165)
Constant	-5.260^ (0.131)	-1.120^ (0.021)	-2.897^ (0.094)	-1.139^ (0.018)
Quintile Size Dummies included		Yes		Yes
# of obs.	2,836	2,836	2,836	2,836

Notes: Dependent variable is ISO 9000 or Just in Time adoption; probit regressions with plant fixed effects; measure of competition is Chinese exports to the US. Robust standard errors in parentheses. ^sig 1%, ** sig 5%, and * sig 10% level

Table 5: Market share reallocation in response to Chinese import competition

	Mexico		Unites States	
	(1)	(2)	(3)	(4)
Competition	-0.636**	-1.485	-0.420**	1.822
	(0.266)	(1.833)	(0.208)	(2.185)
Size		-0.080^		-0.068^
		(0.017)		(0.018)
Competition x Size		0.061		-0.207
		(0.156)		(0.189)
Constant	0.496^	1.416^	0.503^	1.297^
	(0.021)	(0.194)	(0.024)	(0.205)
R-squared	0.003	0.025	0.003	0.027
# of obs.	1,418	1,418	1,418	1,418

Notes: Dependent variable is change in log sales for a given firm between the years 2004 and 1999; estimation method is least-squares. The column header gives the measure of import competition, either Chinese imports in Mexico or in the United States. Robust standard errors clustered at CMAP-6 given in parentheses. ^ sig 1%, ** sig 5%, and * sig 10% level