International Competition and Industrial Evolution: Evidence from the Impact of Chinese Competition on Mexican Maquiladoras

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NAFTA and Mexican Manufacturing

Question: Did NAFTA make Mexican manufacturing plants more productive? If so, through which channels?

- Rafael E. De Hoyos and Leonardo Iacovane (2008) "Economics Performance under NAFTA: A Firm-Level Analysis of the Trade Productivity Linkages"
- NAFTA stimulated the productivity of Mexican plants via:
  1) Increase in import competition
  2) A positive effect on access to imported intermediate products
- Fully integrated (export and import) firms benefited more

NAFTA and Maquiladoras

Question: Why maquiladoras under NAFTA continue to exist and grow?

- Manufacturing advantage: maquilas are part of a foreign chain of production owned in their majority by foreigners with a "know-how" to supply goods and services to the U.S. with capital and technological advantages vs. Mexican firms.
- Regulation advantage: maquiladoras continue to be excluded from the rules of origin and are allowed the temporary importation of goods without covering import tax values and other tax benefits.
- Even after 2001, there is no incentive for a foreign company not to register as a maquiladora, if it is part of a foreign chain of production re-exporting its goods to the U.S.

Evidence from the Impact of Chinese Competition on Mexican Maquiladoras

Outline

I. Plant-level Maquila Information
II. Question and Methodology
III. Empirical Models and Results
IV. Concluding Remarks

I. Plant-level Maquila Information

Contribution:

— First-time access to the maquila information at the plant level.

— Plant-level evidence can improve and complement previous industry research.

— Plant-level analysis allows for the heterogeneity of plant characteristics to be addressed.

— Plant-level studies across different manufacturing and service industries are scarce.

I. Plant-level Maquila Information

Micro-level data:

— The data set consists of 27,548 plant year observations: 3,769 plants and 1,455 firms.

— From 1990-2006

— It includes the 17 major maquiladora cities: 11 border and 6 non-border.

— Very valuable dataset to analyze the behavior and evolution.

II. Question and Methodology

Question:

— Analyze the impact of intensified competition from China on Mexican export assembly plants, on a plant's *growth, entry, exit and productivity*.

II. Question and Methodology

Methodology:

— Competition in the third, North, market

— Instrumental approach is used

— Robustness checks are performed

II. Question and Methodology

Methodology:

- Measure of Chinese competition for maquiladoras

$$IMPCH_{jt} = \frac{M_{jt}^{CH}}{M_{jt} + Q_{jt} - X_{jt}} \qquad (1)$$

where M_{jt}^{CH} denotes the value of imports of industry j products coming from China to the US at period t. M, Q and X denote total US imports, US production and US exports respectively.

II. Question and Methodology

Methodology:

- We identify two main groups
- Based on the first and last quartiles of Chinese import penetration in the U.S.
- Before WTO accession of China in 1999
- *HighCHT* high degree of Chinese threat (apparel, footwear, electric and electrical, toys and sporting goods)
- *LowCHT* minimum Chinese threat (chemicals, transportation/auto parts and food products)

II. Question and Methodology

Methodology:

— Skill = technicians + administrative

— TFP = KLEM approach multi-factor productivity gross output measures

III. Empirical Models and Results

$$lnY_{ijst} = \alpha_0 + \alpha_1 X_{ijst} + \alpha_2 Z_{jt} + \alpha_3 IMPCH_{jt} + \alpha_4 IMPCH_{jt} * x_{ijst} + \sum_{ts} \delta_{ts}^{YS} Year_t * State_s + u_i + \epsilon_{ijst} \quad (2)$$

where Y_{ijst} refers to the variable of interest at plant i in industry j located in state s at year t

X_{ijst} = time varying plant level controls (multi-plant dummy, age dummies)

Z_{jt} = time varying industry controls (U.S. import penetration w/China and Mexico, U.S. industry hourly wages, U.S. industrial production)

Interaction term (productivity, skill-intensity, capital-labor ratio)

State- by-Year fixed effects

Industry control variable $$IMP_{jt} = \frac{M_{jt} - M_{jt}^{CH} - M_{jt}^{MX}}{M_{jt} + Q_{jt} - X_{jt}} \quad (3)$$

III. Empirical Models and Results

- *Endogeneity problem, unobserved factors affect the variables of interest and Chinese share import penetration*
  - *Instrument:* $IMPCH_{j99} * \frac{CHIMP_t}{WIMP_t}$
  - *Default instrument:* $\frac{OAdvCHIMP_{j99}}{OAdvTOTIMP_{j99}} * \frac{CHIMP_t}{WIMP_t}$
  - IMP_{jt}*: industry specific exchange rates for U.S. industries (weights for each trading partner currency lnMERlag and lagIMP)*
  - *Should capture the supply side driven growth components of Chinese imports independent from U.S. demand factors*

II. Empirical Models and Results

Table 3
The impact of Chinese competition on employment.

Panel A			
	(1)	(2)	(3)
Specification	OLS	OLS	OLS
Dependent variable	*lnE*	*lnE*	*lnE*
$IMPCH_{jt}$	−2.984***	−3.630***	−3.354***
	(0.467)	(0.587)	(0.596)
IMP_{jt}		−1.354*	−0.957
		(0.586)	(0.572)
$lnUSPI_{jt}$			0.078
			(0.046)
$RelWage_{jt}$			−0.755
			(0.415)
Age Dummy 1	0.446***	0.446***	0.444***
	(0.074)	(0.075)	(0.075)
Age Dummy 2	0.433***	0.438***	0.439***
	(0.047)	(0.047)	(0.047)
Multi-plant Dummy	−0.102***	−0.103***	−0.100***
	(0.027)	(0.027)	(0.027)
Plant fixed effects	✓	✓	✓
Year by state fixed effects	✓	✓	✓
Number of plants	3769	3769	3769
Number of observations	27,548	27,548	27,548
R^2	0.068	0.069	0.070

Column (2):
$IMPCH_{jt}$ 1.00 s.d. increase in Chinese share import penetration is associated with 0.14 s.d. (25 p.p.) decrease
IMP_{jt} 0.07 s.d. decrease a 1.00 s.d. increase in the general import rate

Column (3):
$IMPCH_{jt}$ 1.00 s.d. increase in Chinese share import penetration is associated with 23 p.p. decrease

II. Empirical Models and Results

Panel A		
	(4)	(5)
Specification	IV	IV
Dependent variable	*lnE*	*lnE*
$IMPCH_{jt}$	−4.859***	−4.077***
	(1.036)	(0.822)
IMP_{jt}		−1.416*
		(0.652)
$lnUSPI_{jt}$		
$RelWage_{jt}$		
Age Dummy 1	0.442***	0.447***
	(0.073)	(0.075)
Age Dummy 2	0.431***	0.443***
	(0.047)	(0.047)
Multi-plant Dummy	−0.105***	−0.126***
	(0.027)	(0.026)
Plant fixed effects	✓	✓
Year by state fixed effects	✓	✓
Number of plants	3769	3721
Number of observations	27,548	26,354
R^2		

Panel B: First Stage IV	(4)	(5)
	$IMPCH_{jt}$	$IMPCH_{jt}$
$\frac{OAdvCHIMP_{j89}}{OAdvTOTIMP_{j89}} * \frac{CHIMP_t}{WIMP_t}$	6.858***	7.929***
	(0.553)	(0.684)
LagIMP		−0.407***
		(0.048)
lnMERLag		0.031
		(0.023)
R^2	0.323	0.564
F-test of excluding instruments	153.99	70.09
		IMP_{jt}
$\frac{OAdvCHIMP_{j89}}{OAdvTOTIMP_{j89}} * \frac{CHIMP_t}{WIMP_t}$		0.045
		(0.394)
LagIMP		0.893***
		(0.030)
lnMERLag		−0.034
		(0.021)
R^2		0.850
F-test of excluding instruments		258.78
Hansen J test (P-value)		0.157

II. Empirical Models and Results

Table 4
The impact of Chinese competition on employment growth I.

Panel A			
	(1)	(2)	(3)
Specification	OLS	OLS	OLS
Dependent variable	ΔlnE	ΔlnE	ΔlnE
$IMPCH_{jt}$	−0.887*	−1.825***	−1.502**
	(0.445)	(0.543)	(0.548)
IMP_{jt}		−1.732**	−1.332*
		(0.542)	(0.551)
$RelWage_{jt}$			−0.074
			(0.317)
$lnUSPI_{jt}$			0.105*
			(0.045)
Age Dummy 1	−0.651***	−0.649***	−0.648***
	(0.096)	(0.096)	(0.096)
Age Dummy 2	−0.608***	−0.599***	−0.597***
	(0.057)	(0.056)	(0.055)
Multi-plant Dummy	0.077***	0.076***	0.079***
	(0.019)	(0.019)	(0.019)
Plant fixed effects	✓	✓	✓
Year by state fixed effects	✓	✓	✓
Number of plants	3540	3540	3540
N	23,743	23,743	23,743
R^2	0.156	0.158	0.159

Column (2):
$IMPCH_{jt}$ 1.00 s.d. (6.4 p.p.) increase in Chinese share import penetration is associated with 0.16 s.d. (12 p.p.) decrease

Column (3):
$IMPCH_{jt}$ 1.00 s.d. increase in Chinese share import penetration is associated with 0.13 s.d. (10 p.p.) decrease
$lnUSPI_{jt}$ 1.00 s.d. increase in U.S. production increase is associated with 0.05 s.d. (3 p.p.) increase

II. Empirical Models and Results

Panel A		
	(4)	(5)
Specification	IV	IV
Dependent variable	ΔlnE	ΔlnE
$IMPCH_{jt}$	−4.881***	−3.898***
	(1.221)	(0.845)
IMP_{jt}		−2.311***
		(0.676)
$RelWage_{jt}$		
$lnUSPI_{jt}$		
Age Dummy 1	−0.655***	−0.645***
	(0.096)	(0.094)
Age Dummy 2	−0.608***	−0.591***
	(0.057)	(0.055)
Multi-plant Dummy	0.071***	0.080***
	(0.020)	(0.020)
Plant fixed effects	✓	✓
Year by state fixed effects	✓	✓
Number of plants	3540	3509
N	23,743	22,597
R^2		

Panel B: First Stage IV	(4)	(5)
	$IMPCH_{jt}$	$IMPCH_{jt}$
$\frac{OAdvCHIMP_{j99}}{OAdvTOTIMP_{j99}} * \frac{CHIMP_t}{WIMP_t}$	6.994***	8.377***
	(0.715)	(0.861)
LagIMP		−0.421***
		(0.048)
lnMERLag		0.033
		(0.022)
R^2	0.278	0.560
F-test of excluding instruments	95.61	50.38
		IMP_{jt}
$\frac{OAdvCHIMP_{j99}}{OAdvTOTIMP_{j99}} * \frac{CHIMP_t}{WIMP_t}$		0.149
		(0.650)
LagIMP		0.886***
		(0.030)
lnMERLag		−0.033
		(0.022)
R^2		0.837
F-test of excluding instruments		175.33
Hansen J test (P-value)		0.502

II. Empirical Models and Results

Table 5
The impact of Chinese competition on employment growth II.

	(1)	(2)	(3)
Dependent variable	ΔlnE	ΔlnE	ΔlnE
$IMPCH_{jt}$	−1.598**	−1.737***	−1.709***
	(0.494)	(0.491)	(0.499)
IMP_{jt}	−1.598**	−1.681**	−1.721***
	(0.521)	(0.509)	(0.504)
$lnTFP_{ijt}$	0.204***	0.168***	0.172***
	(0.051)	(0.043)	(0.043)
Skill Intensity $(NP/P)_{ijt}$		0.025	
		(0.020)	
Capital–labor ratio $(K/L)_{ijt}$			0.053
			(0.028)
$IMPCH_{jt} * lnTFP_{ijt}$	−0.768		
	(0.727)		
$IMPCH_{jt} *$ Skill Intensity $(NP/P)_{ijt}$		−0.066	
		(0.119)	
$IMPCH_{jt} *$ Capital labor ratio $(K/L)_{ijt}$			−0.276
			(0.359)
Plant-level controls	Yes	Yes	Yes
Year by state fixed effects	✔	✔	✔
Plant fixed effects	✔	✔	✔
Number of plants	3068	3062	3050
Number of observations	18,222	18,206	18,159
R^2	0.156	0.157	0.160

None of the interactive terms are significant, no indication that intensified Chinese competition causes a disproportionate decrease in employment growth, especially in low productivity, low-skill and low-capital plants.

II. Empirical Models and Results

Table 6
The Impact of Chinese Competition on Maquiladora Exits.

Panel A			
	(1)	(2)	(3)
Specification	Probit	Probit	Probit
Variables	χ	χ	χ
IMPCH	1.701**	2.248***	2.046***
	(0.602)	(0.590)	(0.605)
IMP		1.232**	1.000
		(0.452)	(0.555)
RelWage			1.114*
			(0.502)
lnUSIP			−0.034
			(0.068)
Age Dummy 1	0.031	0.026	0.026
	(0.046)	(0.046)	(0.046)
Age Dummy 2	0.161***	0.153**	0.150**
	(0.048)	(0.048)	(0.048)
Multi-plant Dummy	0.051	0.050	0.050
	(0.034)	(0.034)	(0.034)
Year by state fixed effects	✓	✓	✓
Industry fixed effects	✓	✓	✓
Pseudo R^2	0.11	0.11	0.11
N	25,559	25,559	25,559

Column (2):
IMPCH a marginal change from the average 6% leads to a 27% increase in probability of plant exits
IMP a marginal change is associated with a 15% increase.

II. Empirical Models and Results

Panel A		
	(4)	(5)
Specification	IV	IV
Variables	χ	χ
IMPCH	3.624***	2.306**
	(0.992)	(0.782)
IMP		0.939*
		(0.464)
RelWage		
lnUSIP		
Age Dummy 1	0.036	0.019
	(0.046)	(0.040)
Age Dummy 2	0.163***	0.149***
	(0.048)	(0.039)
Multi-plant Dummy	0.055	0.038
	(0.034)	(0.033)
Year by state fixed effects	✓	✓
Industry fixed effects	✓	✓
Pseudo R^2		
N	25,559	24,365

Panel B: First Stage IV

	$IMPCH_{jt}$	$IMPCH_{jt}$
$\frac{OAdvCHIMP_{j99}}{OAdvTOTIMP_{j99}} * \frac{CHIMP_t}{WIMP_t}$	6.718***	8.745***
	(0.778)	(0.049)
LagIMP		−0.422***
		(0.003)
lnMERlag		0.051***
		(0.003)
		IMP_{jt}
$\frac{OAdvCHIMP_{j99}}{OAdvTOTIMP_{j99}} * \frac{CHIMP_t}{WIMP_t}$		0.270***
		(0.032)
LagIMP		0.922***
		(0.002)
lnMERlag		−0.036***
		(0.002)

III. Empirical Models and Results

$$ENTRY_{jt} = \gamma_0 + \gamma_1 Z_{jt} + \gamma_2 IMPCH_{jt} + \sum_t \delta_t^Y Year + \sum_j \delta_j^I Industry_j + \epsilon_{jt}$$

$ENTRY_{jt}$ total number of entrants in industry j at period t

Z_{jt} = time varying industry controls (U.S. import penetration w/China, U.S. industry hourly wages, U.S. industrial production)

General level of competitiveness of U.S. market: industry specific exchange rate (using import partners shares)

Year-fixed effects

Industry- fixed effects

III. Empirical Models and Results

Table 7
The impact of Chinese competition on entry to Mexican offshoring industry.

	(1)	(2)	(3)	(4)	(5)
Specification	Negative binomial	Negative binomial	Negative binomial	Negative binomial	Negative binomial
Variables	*ENTRY*	*ENTRY*	*ENTRY*	*ENTRY*	*ENTRY*
IMPCH	−4.798***	−5.709***	−4.752***	−4.311***	−4.929***
	(1.102)	(1.070)	(1.064)	(1.060)	(1.034)
IMP		−2.057*			−1.659*
		(0.822)			(0.837)
RelWage ($\frac{MXWage_{jt}}{USWage_{jt}}$)			−2.789*		−2.723*
			(1.086)		(1.091)
Industry specific exchange rate ($lnMER_{jt}$)				−3.950***	−3.920***
				(0.971)	(0.953)
$ln(\alpha)$ (Over-dispersion parameter)	−2.860***	−2.937***	−2.882***	−3.088***	−3.207***
	(0.235)	(0.250)	(0.237)	(0.270)	(0.292)
Industry fixed effects	✔	✔	✔	✔	✔
Year fixed effects	✔	✔	✔	✔	✔
N	176	176	176	176	176
χ^2	978.266	1081.993	1112.863	1114.511	1347.349

Impact of Chinese competition and other countries, as well as labor cost savings and demand in U.S. markets are important factors in affecting entry.

III. Empirical Models and Results

Table 9
The impact of Chinese competition on productivity.

Panel A				
	(1)	(2)	(3)	(4)
	OLS	OLS	OLS	OLS
Dependent variable	lnTFP	lnTFP	lnTFP	lnTFP
IMPCH	0.456***	0.411***	0.442***	0.393**
	(0.101)	(0.100)	(0.124)	(0.124)
IMP		−0.106		−0.110
		(0.092)		(0.097)
Age Dummy 1	−0.015	−0.015	−0.016	−0.016
	(0.009)	(0.009)	(0.009)	(0.009)
Age Dummy 2	−0.014*	−0.014*	−0.012	−0.011
	(0.006)	(0.006)	(0.006)	(0.006)
Multi-plant Dummy	0.013*	0.013*	0.012	0.012
	(0.006)	(0.006)	(0.006)	(0.006)
Entrant Dummy			0.012	0.012
			(0.007)	(0.007)
Entrant*IMPCH			0.030	0.024
			(0.081)	(0.081)
Exit Dummy			−0.021*	−0.021
			(0.011)	(0.011)
Exit*IMPCH			0.168	0.168
			(0.095)	(0.094)
R^2	0.065	0.065	0.062	0.062
Number of plants	3257	3257	3062	3062
N	20,742	20,742	18,572	18,572
Year by state fixed effects	✓	✓	✓	✓
Plant fixed effects	✓	✓	✓	✓

Column (2):
IMPCH 1.0 s.d. increase in Chinese competition in the U.S. market increases the logarithm of plant productivity by 0.11 s.d.(3.0 p.p.).
Column (3):
Exit Dummy
productivity levels are on average 2% lower when exiting vs. previous years.

III. Empirical Models and Results

Panel A

	(5)	(6)
	IV	IV
Dependent variable	lnTFP	lnTFP
IMPCH	0.462**	0.563***
	(0.165)	(0.162)
IMP		−0.132
		(0.098)
Age Dummy 1	−0.015	−0.015
	(0.009)	(0.009)
Age Dummy 2	−0.014*	−0.013*
	(0.006)	(0.006)
Multi-plant Dummy	0.013*	0.015*
	(0.006)	(0.006)
Entrant Dummy		
Entrant*IMPCH		
Exit Dummy		
Exit*IMPCH		
R^2		
Number of plants	3257	3169
N	20,742	19,942
Year by state fixed effects	✓	✓
Plant fixed effects	✓	✓

Panel B: First Stage IV

	(5)	(6)
	$IMPCH_{jt}$	$IMPCH_{jt}$
$\frac{OAdvCHIMP_{j99}}{OAdvTOTIMP_{j99}} * \frac{CHIMP_t}{WIMP_t}$	6.593***	7.626***
	(0.549)	(0.671)
R^2	0.339	0.537
F-test of excluding statistics	144.16	66.73
		IMP_{jt}
$\frac{OAdvCHIMP_{j99}}{OAdvTOTIMP_{j99}} * \frac{CHIMP_t}{WIMP_t}$		−0.063
		(0.377)
LagIMP		0.898***
		(0.029)
lnMERlag		−0.035
		(0.022)
R^2		0.832
F-test of excluding statistics		273.83

IV. Concluding Remarks

Findings and Conclusions:

- Employment in Mexican maquiladoras is negatively affected by the competition with China.
- Plant growth, entry and survival probabilities are also found to respond negatively to Chinese competition.
- Competition is found to especially affect the most unskilled labor-intensive sectors leading to sectoral reallocation.

IV. Concluding Remarks

Findings and Conclusions:

— Strong evidence for within-plant productivity improvement of maquiladoras due to heightened competition from China.

— A substantial role of competition from China in the recent slowdown of the Mexican maquiladora industry.

IV. Concluding Remarks

Conclusions and contributions:

— Opens the discussion whether and how competition from lower-wage locations can compel traditionally labor-intensive industries in low-wage countries to move up in the global production chain.