

## The Political Economy of Automation and Fragmented Production: Evidence from Mexico

Carles Boix, Valentina González-Rostani & Erica Owen | October 2025 | IPES

# Motivation

- ▶ Previous research focuses on PE effects of automation in advanced economies
- ▶ Yet, automation in the Global North may also be a shock to the South
- ▶ Fragmented production means robots in the U.S. may replace offshore labor

Caterpillar moving manufacturing from Mexico to Victoria, bringing 200 jobs





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- ↑ Violent organized crime
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- ↑ Violent organized crime
- ↑ Support for Left-wing populists

**Approach:**

- ▶ Analyze Mexican CZs using a shift-share IV for U.S. robot adoption
- ▶ Trace how automation in the Global North affects economic and political dynamics in the Global South via **offshoring**

## Literature Gap & Relevance

- ▶ **Automation in advanced economies:**
  - Boosts productivity but hurts certain workers (job loss, wage decline)  
(e.g. Acemoglu & Restrepo, 2019a; Bonfiglioli et al., 2024; Dauth et al., 2021; Graetz & Michaels, 2018)
  - Impacts politics (alienation, far-right populism)  
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- ▶ **Global South overlooked:** Developing countries traditionally benefited from offshoring, but rising foreign automation may undercut this advantage.
- ▶ **Slowdown of offshoring and potential *reshoring*:** Negatively affects labor markets in exposed economies (Antràs, 2020; Faber, 2020; Rodrik, 2018)

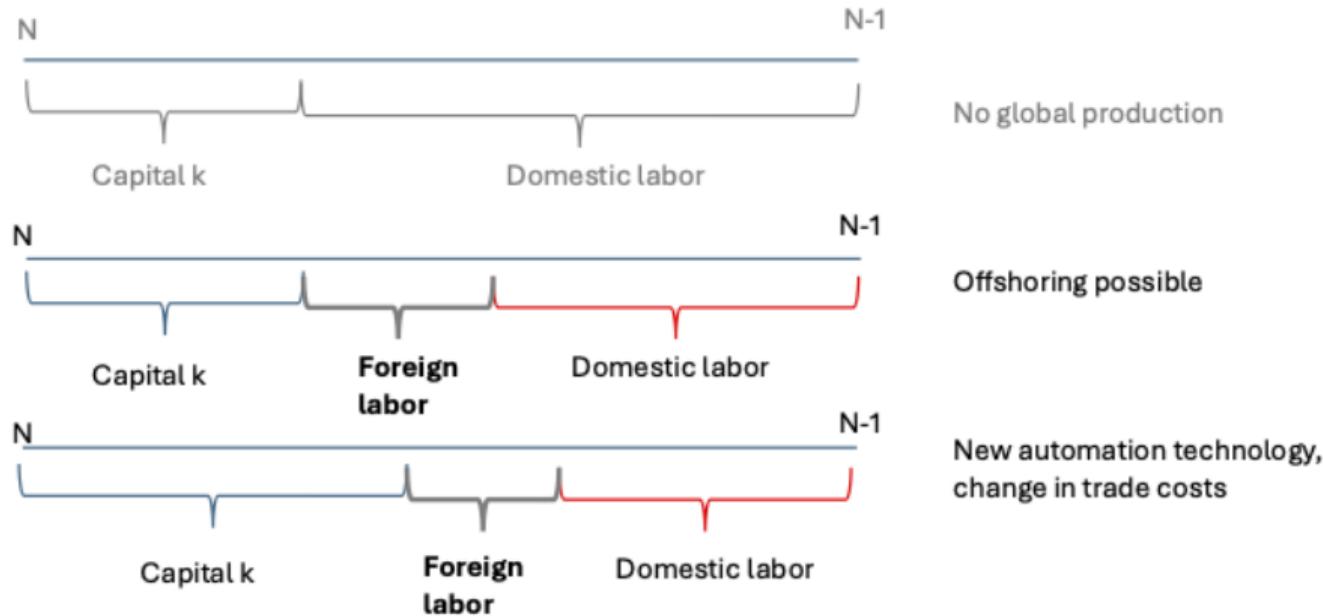
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**Our focus:** How Northern automation shocks transmit through GVC to reshape labor and politics in the Global South.

# The Economic Consequences of Automation

- ▶ Task model of production (Acemoglu & Autor, 2011; Acemoglu & Restrepo, 2019b)



- ▶ In Global South, foreign automation leads to lower employment, rising informality (Faber, 2020), mixed evidence on exports, evidence of reshoring

# Foreign Robots & Organized Crime

- ▶ Negative labor-market shocks can boost illicit activity (Cavazos Hernandez & Sivakumar, 2022; Dell, Feigenberg, & Teshima, 2019; Dube, García-Ponce, & Thom, 2016)
- ▶ Organized crime offers employment (esp. when legal opportunities shrink)
- ▶ As wages and legal employment ↓ in robot-exposed regions, the opportunity cost of crime falls
- ▶ Hardship + lack of exit options lead some to illicit activities

**H1:** Exposure to foreign robots increases violent organized crime

# Foreign Robots & Populism

- ▶ Persistent legacy of Left populism in Latin America
- ▶ Frustration with Washington Consensus reforms and renewed rise of Left-wing populist movements (Aksoy, Guriev, & Treisman, 2024; Baker & Greene, 2011; Edwards, 2019; Feierherd, Larroulet, Long, & Lustig, 2023)
- ▶ Growing demand for social protection and redistribution (Murillo, Oliveros, & Vaishnav, 2010; Wiesehomeier & Doyle, 2013)

**H2:** Exposure to foreign robots increases support for Left-wing populist movements

# Empirical Setting and Dependent Variables

**Unit of analysis:** 1.8K Mexican CZs.

**Time frame:** 1990–2015, 2000–2024.

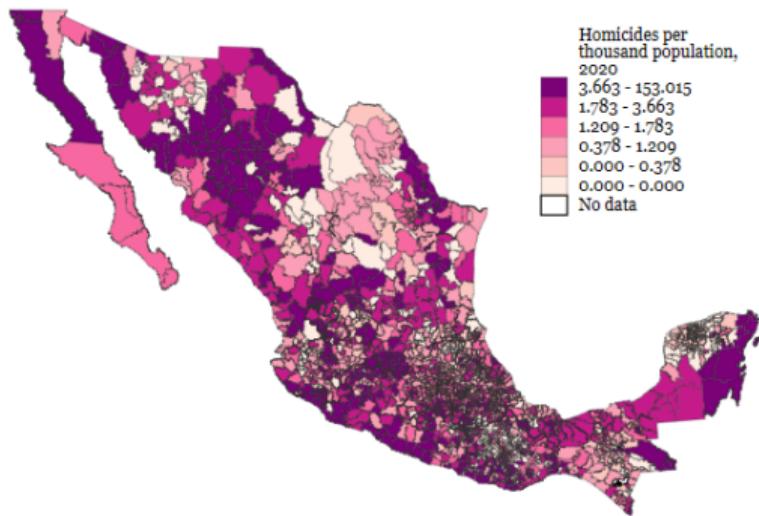
## Organized crime:

- ▶ Homicide rates per 10,000 (INEGI, 2018)
- ▶ Narcocrime incidents (CISEN data, 2015–2019).
- ▶ Organized crime based on news (NLP tools).

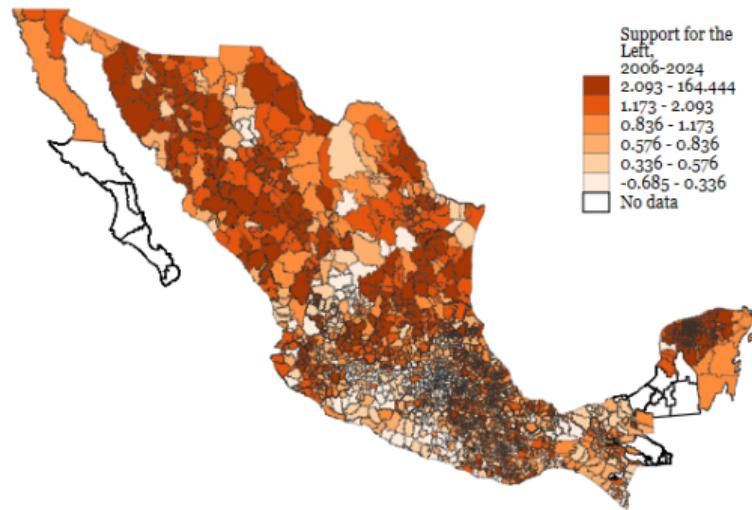
## Politics

- ▶ Vote share for left- (i.e. Morena); other parties

# Commuting Zone-level Variation in DVs



Violent crime



Support for the Left

# Independent Variable

Domestic Robot Exposure (Control)



- ▶ Bartik-style measure: IFR robot counts  $\times$  industry employment shares (CZs).

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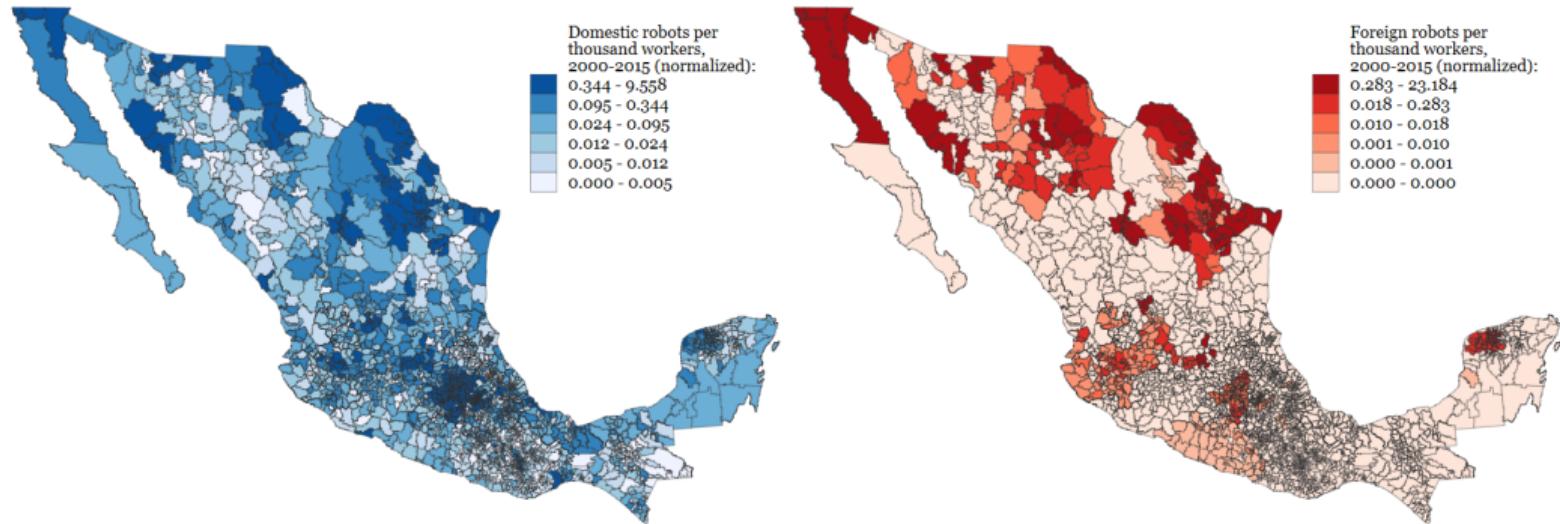
## Foreign Robot Exposure



- ▶ Bartik-style measure: 1990 industry employment  $\times$  U.S. robot adoption  $\Delta$   
+ exposure in regions specialized in industries that automated more in the U.S.
- ▶ Adjusted for offshoring intensity:
  - ▶ UN Comtrade + BLS data (SIC72  $\rightarrow$  IFR industries).
  - ▶ Maquiladora employment weights (CEPAL, 1994).

We follow Faber (2020), relying on IFR robots & Mexican Census data.

# Exposure to Domestic and Foreign Robots, 2000–2015



Domestic Robots & Foreign Robots

## Empirical Strategy

- ▶ **Identification:** Exploit variation in exposure across regions.



$$\text{Exposure Foreign Robots}_{c(t_0, t_1)} = \sum_{i \in I} \ell_{ci, 1990}^f \left( \frac{\left( R_{i, t_1}^{US} - R_{i, t_0}^{US} \right) O_{i, 1992}}{L_{i, 1990}^f} \right)$$

$$\text{where } O_{i, 1992} = \frac{I_{i, 1992}^{MXUS}}{Y_{i, 1992}^{US}}$$

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- ▶ **Shift-Share instrument:** Instead of  $\Delta R^{US}$  we use  $\Delta R^{WLD} = R_{i, t_1}^{WLD} - R_{i, t_0}^{WLD}$
- ▶ **Regression framework:**
$$Y_c = \beta \text{Exposure (Foreign)}_c + \gamma \text{Exposure(MX)}_c + \mathbf{X}_c + \varepsilon_c$$
- ▶ Controls from Faber (2020) include routine task share, manufacturing share, exposure to NAFTA, China import shock, share male, region and period fixed effects

## Results: Foreign Robot Exposure Raises Violence

IV	(1)	(2)	(3)	(4)	(5)
	Crimes	Homicides	Kidnapping	Narco	Human Traffic
Exposure to foreign robots					
Demographics	✓	✓	✓	✓	✓
Industry	✓	✓	✓	✓	✓
Region	✓	✓	✓	✓	✓
Observations	1802	1802	1802	1802	1802
R <sup>2</sup>	0.170	0.203	0.132	0.409	0.122
F	12.09	9.267	21.68	6.305	15.00
Kleibergen-Paap Wald F-stat	172.7	172.7	172.7	172.7	172.7

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R <sup>2</sup>	0.546	0.429	0.293	0.328
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# Additional Tests

## Robustness

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- ▶ Alternative proxies
  - ▶ Organized crime (NLP proxy) from newspapers
  - ▶ President elections: post-shock = 2018 election or 2018–2024
- ▶ First-difference (where possible)
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## Mechanism (Suggestive)

- ▶ Negative labor market shock, decline in employment and exports
- ▶ Economic channel, not “deaths of despair” (no rise in family violence)
- ▶ Political alienation pathway: exposed regions report fewer strikes

## Conclusions

- ▶ Automation crosses borders.   US robot adoption ↑ ⇒  
 labor demand ↓ ⇒ violent organized crime and Left-wing populism ↑

# Conclusions

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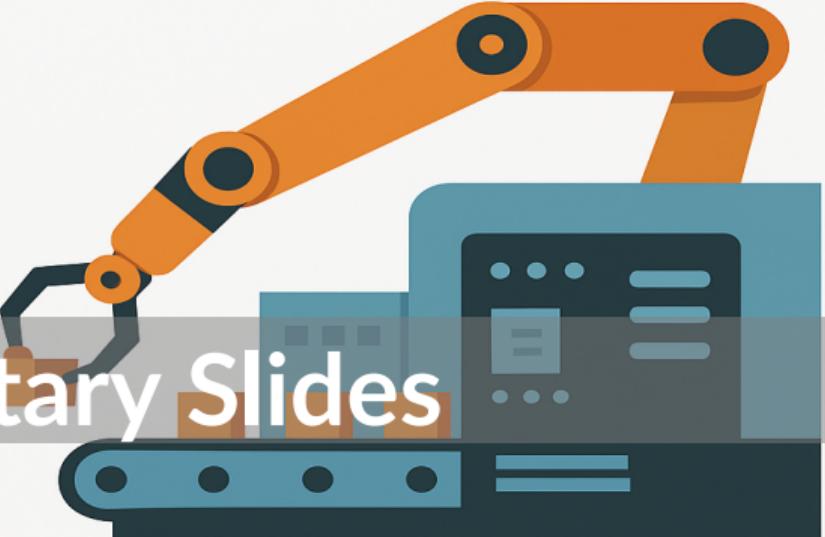
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**Thank you!**

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# Supplementary Slides



# Appendix - Index

- ▶ Motivation ▶ Export Manufacturing Plants
- ▶ Data ▶ IV ▶ DV - details ▶ DV Maps  
▶ Control Variables

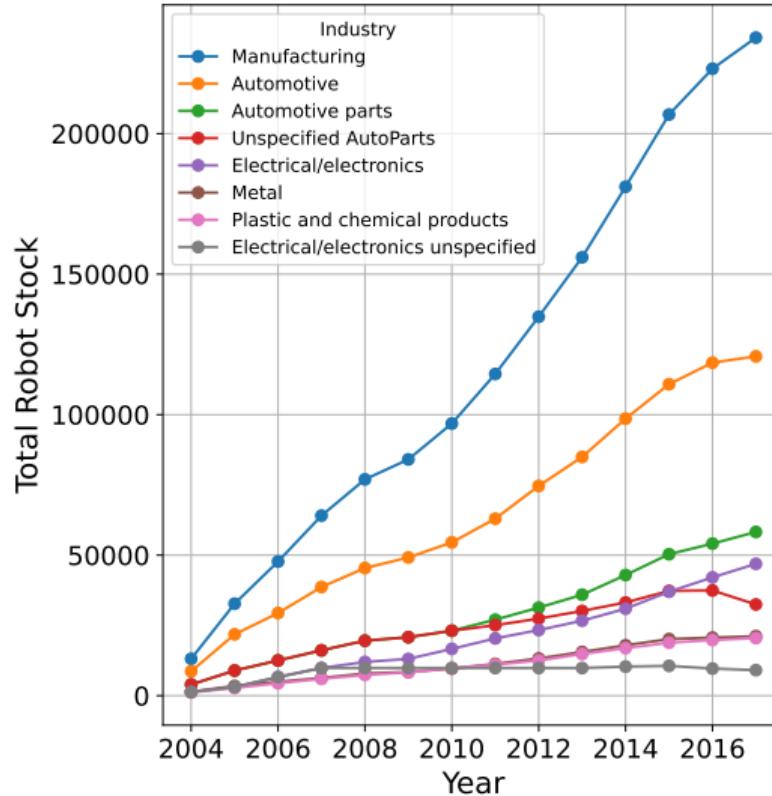
- ▶ Empirical Strategy ▶ Empirical Strategy ▶ Shift Share
- ▶ Equation ▶ Control - China
- ▶ Results ▶ Emigration ▶ Organized Crime ▶ Vote  
▶ Employment & Exports

- Back:
- ▶ Question ▶ Motivation/Example ▶ Changes in exports plants ▶ Contribution/Literature ▶ Theory
  - ▶ Data & Empirical Setting ▶ Empirical Strategy Details ▶ Maps Robots ▶ Results - Employment & Exports ▶ Results ▶ Final Remarks

## Mexico: Presidents & Parties

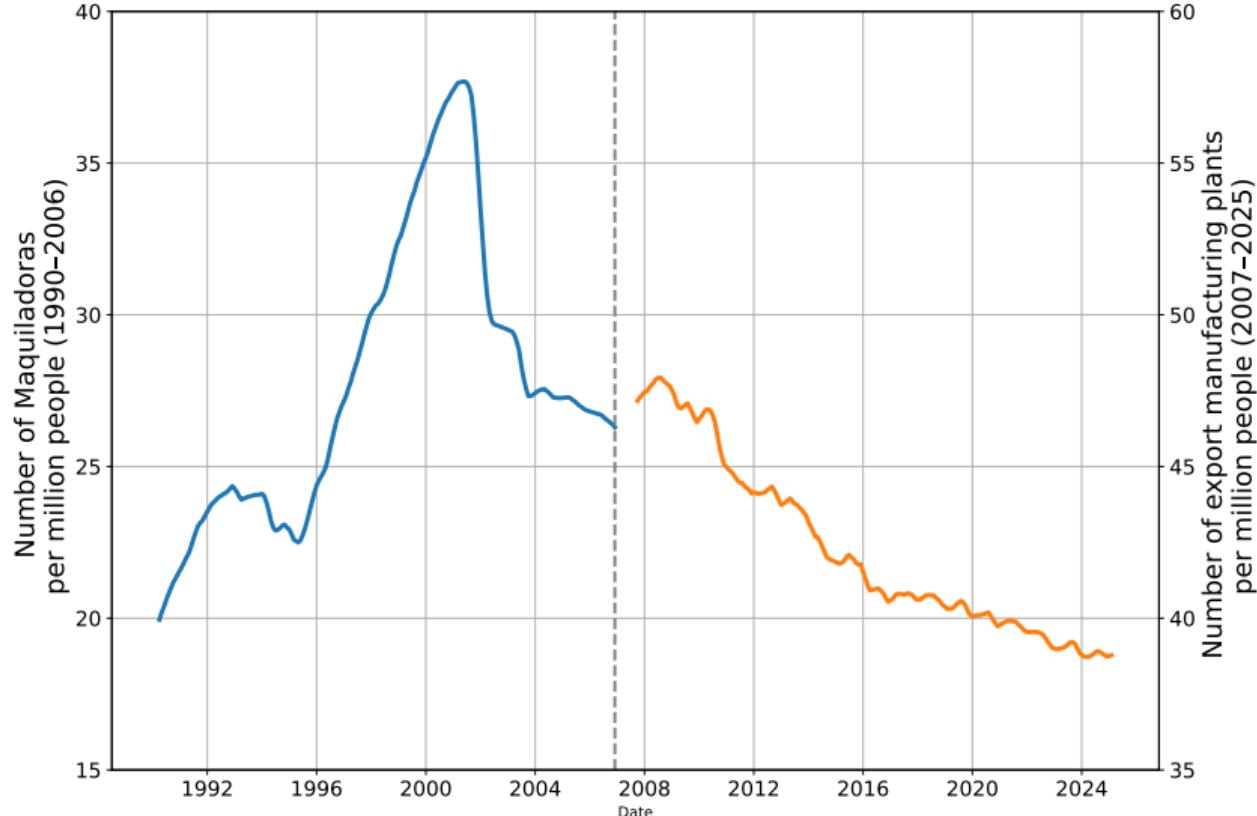
Term	President	Party
1994–2000	Ernesto Zedillo	PRI
2000–2006	Vicente Fox	PAN
2006–2012	Felipe Calderón	PAN
2012–2018	Enrique Peña Nieto	PRI
2018–2024	Andrés Manuel López Obrador	Morena
2024–present	Claudia Sheinbaum	Morena

# U.S. Robot Adoption



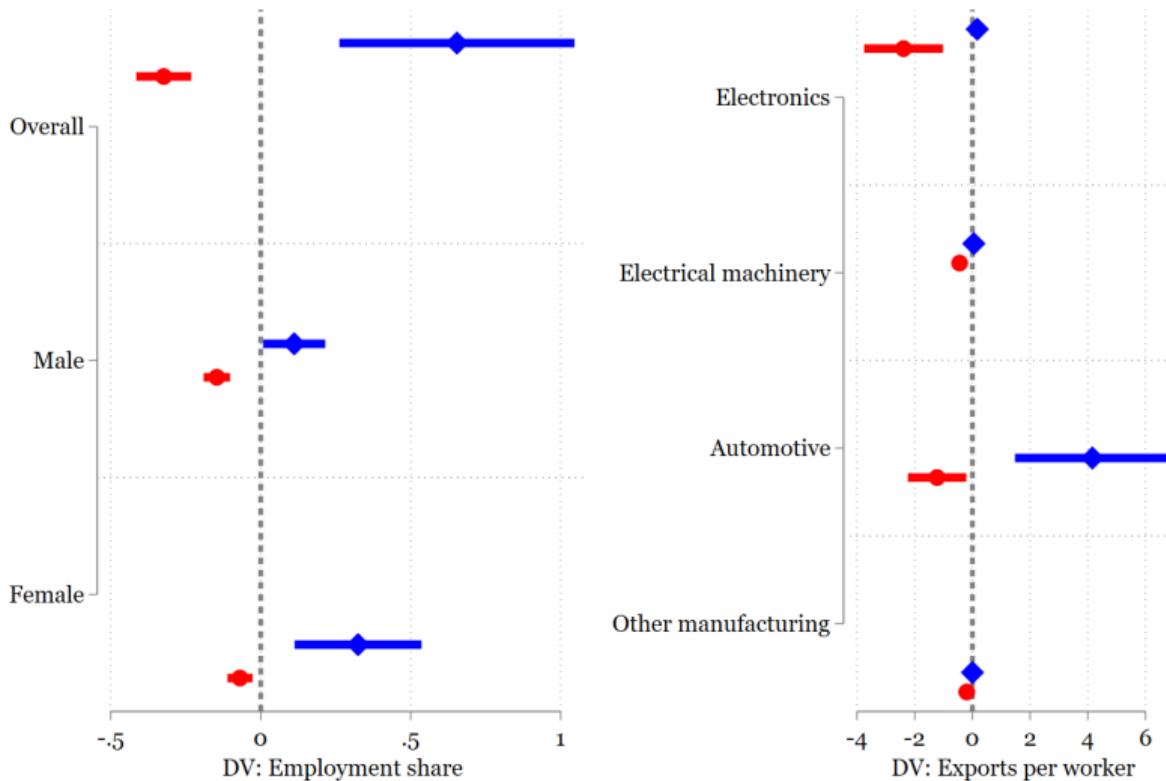
Note: This figure plots robot stock trends by industry in the United States, focusing on the eight industries with the highest total robot stocks from 2004 onwards. Data from the International Federation of Robotics (IFR), 1993–2017.

# Mexico's Manufacturing Shift and U.S. Integration



Note: This figure plots the 4-month moving averages of **maquiladoras** and **export manufacturing plants** per million inhabitants in Mexico. Authors' own elaboration based on data from INEGI.

## Evidence of mechanism: Foreign robots reduce employment + exports



### Domestic Robots & Foreign Robots

Note: Authors' analysis of labor market and trade outcomes using Faber replication data, 2000–2015.

## Empirical Strategy

The empirical strategy follows the work of Acemoglu and Restrepo (2020) and Faber (2020). First, the exposure to domestic robots is measured as:

$$\text{Exposure to domestic robots}_{c(t_0, t_1)} = \sum_{i \in I} \ell_{ci, 1990} \left( \frac{R_{i, t_1}^{MX} - R_{i, t_0}^{MX}}{L_{i, 1990}} \right)$$

where  $R_{i, t_1}^{MX}$  and  $R_{i, t_0}^{MX}$  represent the number of robots in industry  $i$  at time  $t_1$  and  $t_0$  in Mexico, respectively, while  $\ell_{ci, 1990}$  is the share of employment in industry  $i$  out of total employment in the region  $c$  in 1990, and  $L_{i, 1990}$  is the total employment in industry  $i$  in 1990.

$$\text{Exposure to foreign robots}_{c(t_0, t_1)} = \sum_{i \in I} \ell_{ci, 1990}^f \left( \frac{(R_{i, t_1}^{US} - R_{i, t_0}^{US}) O_{i, 1992}}{L_{i, 1990}^f} \right)$$

where  $R_{i, t_1}^{US}$  and  $R_{i, t_0}^{US}$  are the estimated number of robots in industry  $i$  at times  $t_1$  and  $t_0$  in the US, respectively,  $\ell_{ci, 1990}^f$  is the share of export-producing employment in industry  $i$  out of total CZ in 1990,  $L_{i, 1990}^f$  is the total foreign employment in industry  $i$ , and  $O_{i, 1992}$  is the initial share of inputs into industry-good  $i$  that are offshorable.

## Shift-Share

We address potential endogeneity arising from the correlation between robot adoption and unobserved factors affecting local labor markets by employing an instrumental variable approach, using the increase in robots in the rest of the world as an instrument for robot adoption in Mexico.

$$\text{External exposure to domestic robots}_{c(t_0, t_1)} \equiv \sum_{i \in I} \ell_{ci, 1990} \left( \frac{R_{i, t_1}^{WLD} - R_{i, t_0}^{WLD}}{L_{i, 1990}} \right)$$

$$\text{External exposure to foreign robots}_{c(t_0, t_1)} \equiv \sum_{i \in I} \ell_{ci, 1990}^f \left( \frac{\left( R_{i, t_1}^{WLD} - R_{i, t_0}^{WLD} \right) \hat{O}_{i, 1990}}{L_{i, 1990}^f} \right)$$

The superscript WLD denotes the sum over European countries that are also incorporating technology (i.e., excluding the US and Mexico) for which industry-level data are available from 1993 onward. To address potential endogeneity in our initial offshoring to Mexico proxy, we follow Feenstra and Hanson (1999) and Faber (2020) in defining it as the share of imported intermediate inputs from the same industry over total non-energy intermediates in U.S. industry  $i$  in 1990 (across all source countries).

## Equation

The equation we will estimate is as follows:

$$\Delta Y_{c(t_1)} = \alpha + \beta^d \text{Exp. to domestic robots}_{c(t_0, t_1)} + \beta^f \text{Exp. to foreign robots}_{c(t_0, t_1)} \\ + \mathbf{X}_{c,t_0} \gamma + \delta_t + \varepsilon_{c(t_0, t_1)}$$

## Control Variables: China

$$\text{Exp. to Chinese import competition}_{c(t_0, t_1)} = \sum_{i \in I} \ell_{ci, t_0} \left[ \frac{I_{i, t_1}^{\text{CNMX}} - I_{i, t_0}^{\text{CNMX}} + O_{i, t_0} (I_{i, t_1}^{\text{CNUS}} - I_{i, t_0}^{\text{CNUS}})}{L_{i, t_0}} \right]$$

where  $I_{i, t_1}^{\text{CNMX}}$  and  $I_{i, t_0}^{\text{CNMX}}$  represent the value of imports from China to Mexico in industry  $i$  at times  $t_1$  and  $t_0$ , respectively, and  $I_{i, t_1}^{\text{CNUS}}$  and  $I_{i, t_0}^{\text{CNUS}}$  represent the same for imports to the US.  $L_{i, t_0}$  is the total employment in industry  $i$  at time  $t_0$ , and  $O_{i, t_0}$  is the initial share of imported intermediate goods in US industry  $i$ .

## Data: Independent Variable – Robot Exposure

Source: Faber (2020), using IFR data on industrial robots and Mexican Census data.

### Domestic Robots (control):

- ▶ Bartik-style measure combining IFR robot counts and industry employment shares across CZs.
- ▶ Reflects automation based on 1990 industrial composition.

### Foreign Robots (Offshoring):

- ▶ Measures U.S. offshoring intensity by industry.
- ▶ Uses UN Comtrade and BLS data; mapped from SIC72 to IFR industries.
- ▶ Weighted by Maquiladora employment data from CEPAL (1994).

## Data: Dependent Variables Crime

### Crime Measures:

- ▶ Homicide rates per 10,000 (INEGI, 2018).
- ▶ Narcocrime incidents (CISEN data, 2015–2019).
- ▶ Crime data aggregated from municipalities to CZs.

### Proxy Approach:

- ▶ Total homicide rate used as a proxy for organized crime, following prior literature.

# Data: Controls – Economic and Demographic Context

## CZ Employment Occupation Characteristics (Faber 2020):

- ▶ Routine task share (based on U.S. crosswalk from Autor (2013)).
- ▶ Industry shares: manufacturing, total employment-to-population (1990 and change to 2015).

## NAFTA Exposure:

- ▶ Based on 1990 employment shares and industry tariff changes from NAFTA.
- ▶ Computed as  $\sum_i \ell_{ci, 1990} \Delta \tau_i$

## Chinese Import Exposure:

- ▶ Bartik-style measure using Chinese imports to Mexico and the U.S.
- ▶ Includes indirect effects via offshoring to U.S.

## Demographics:

- ▶ Share male and with only primary education (1990).
- ▶ Region and period fixed effects.

## Results - Organized Crime

OLS	(1) Crimes	(2) Homicides	(3) Kidnapping	(4) Narco	(5) Human Traffic
External exposure to domestic robots	-7.017** (3.353)	-0.781** (0.322)	-0.0107 (0.0189)	-0.792 (0.559)	0.00185 (0.00616)
External exposure to foreign robots	0.747 (0.718)	0.211** (0.100)	0.0100** (0.00388)	0.592** (0.285)	0.00336** (0.00155)
Demographics	✓	✓	✓	✓	✓
Industry	✓	✓	✓	✓	✓
Region	✓	✓	✓	✓	✓
Observations	1802	1802	1802	1802	1802
R <sup>2</sup>	0.166	0.197	0.130	0.455	0.127
IV	(1) Crimes	(2) Homicides	(3) Kidnapping	(4) Narco	(5) Human Traffic
Exposure to domestic robots	-6.638** (3.103)	-0.734** (0.297)	-0.00981 (0.0175)	-0.733 (0.543)	0.00187 (0.00580)
Exposure to foreign robots	0.833 (0.769)	0.234** (0.114)	0.0111*** (0.00397)	0.654* (0.336)	0.00369** (0.00184)
Demographics	✓	✓	✓	✓	✓
Industry	✓	✓	✓	✓	✓
Region	✓	✓	✓	✓	✓
Observations	1802	1802	1802	1802	1802
R <sup>2</sup>	0.170	0.203	0.132	0.409	0.122
F	12.09	9.267	21.68	6.305	15.00
Kleibergen-Paap Wald F-stat	172.7	172.7	172.7	172.7	172.7

Table: Impact of exposure to robots on violence.

## Results - Vote

OLS	(1) Sheinbaum (Left)	(2) Galvez (Right)	(3) Alvarez (Center)	(4) Null
External exposure to domestic robots	0.0194 (0.0119)	-0.0166 (0.0131)	-0.00280 (0.00443)	0.000837 (0.000602)
External exposure to foreign robots	0.00721** (0.00274)	-0.00452 (0.00283)	-0.00267* (0.00151)	0.000172 (0.000191)
Demographics	✓	✓	✓	✓
Industry	✓	✓	✓	✓
Region	✓	✓	✓	✓
Observations	1800	1800	1800	1800
R <sup>2</sup>	0.537	0.422	0.292	0.328
IV	(1) Sheinbaum (Left)	(2) Galvez (Right)	(3) Alvarez (Center)	(4) Null
Exposure to domestic robots	0.0186* (0.0106)	-0.0159 (0.0120)	-0.00274 (0.00414)	0.000801 (0.000559)
Exposure to foreign robots	0.00792*** (0.00277)	-0.00495* (0.00297)	-0.00294* (0.00160)	0.000189 (0.000202)
Demographics	✓	✓	✓	✓
Industry	✓	✓	✓	✓
Region	✓	✓	✓	✓
Observations	1800	1800	1800	1800
R <sup>2</sup>	0.546	0.429	0.293	0.328
F	45.39	49.80	16.95	17.32
Kleibergen-Paap Wald F-stat	172.7	172.7	172.7	172.7

Table: Impact of exposure to robots on emigration.

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