International Spillovers of China's High-Tech Industrial Policies: Evidence from Germany

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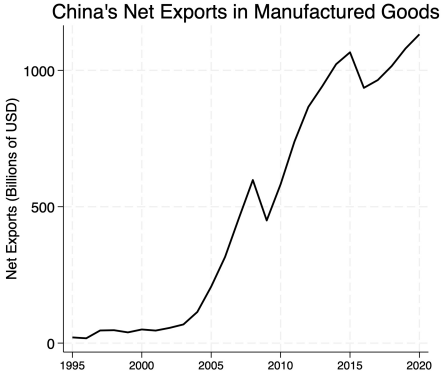
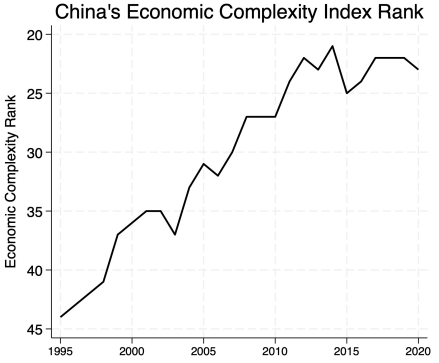
Motivation: China's Export Boom and Rising Economic Complexity

- Trade liberalization and integration into the global market (e.g., ADH Annual Review 2016)
- Extensive use of industrial policy (Fang et al., 2025)$\longrightarrow$ Need to better understand its role





Note: Economic Complexity Index (ECI) from Hausmann and Hidalgo (2014)

Research Questions:

- What is the role of China's industrial policies (IPs) in driving exports and upgrading toward higher-value production?
- How do China's IPs affect related industries and workers in Germany? Figure
  - Global leader in high-tech manufacturing (ranked 2nd in Economic Complexity)
  - One of China's largest trading partners

This Paper:

- Studies China's IPs targeting high-tech manufacturing since 1999
  - Uses newly assembled data from policy documents
  - Exploits the staggered rollout of policies at the product level between 1996 and 2017
  - Leverages industry-level variations in exposure to IPs through input–output linkages

Preview of Results:

- Domestic impacts:
  - Expanded exports of IP-targeted products (+70%)
  - Increased imports of **targeted final capital goods** from Germany
- German upstream industries:
  - Benefited from a **positive demand shock**, exporting more to China
  - Experienced employment (+5%) and wage growth
- German downstream industries:
  - Increased imports from China
  - Showed no evidence of negative effects on overall employment or wages

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Contributions:

- Explains China's "unusual" early move into high-tech exports at its income level
- Demonstrates how domestic IP generate cross-border effects via input–output linkages

Policy

Guidance for Current Priorities in Key High-Tech Industrialization

- Issued by the central government in 1999, revised in 2001, 2004, 2007, and 2011.
- Aimed to **guide resource allocation** and **promote technological upgrading**
- Defined national prioritied industries: ICT, Machinery, Biotechnology, Aerospace, Clean Energy, New Materials, and High-Tech Transportation
- Implementation: adopted by provinces through **tax incentives, subsidies, and land-access policies** (27 of 34 provinces issued related measures)
- Within each priority sector, the *Guidance* identifies products with:
  - Strong market potential and strategic importance
  - Achievable short- to medium-term development goals

Example: Machine Tools Manufacturing

"Current priorities include developing open-architecture CNC systems and automatic modeling technology, integrating CAD/CAM/CAE software, and achieving large-scale production of high-precision CNC machine tools, multi-axis CNC machines, and flexible CNC production lines . . . "

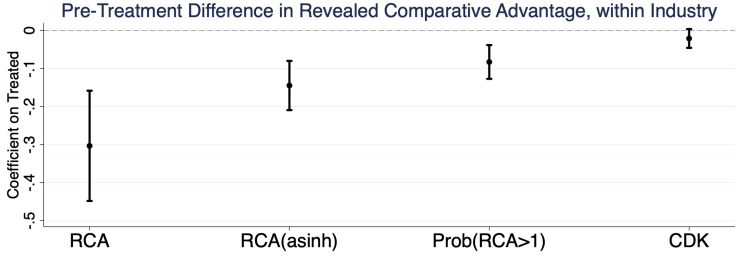
- **Compare treated and control within industry:**

  Computer Numerical Control (CNC) vs Traditional Machine Tools

IP-Targeted Products	**Control Products**
High-Precision CNC Machine Tools	Traditional Lathes, Drilling & Milling
Flexible CNC Production Lines	Woodworking Machinery
Semiconductor Chip Welding Equip.	Grinding & Polishing Machines
Laser Processing & 3D Printers	Bending & Shearing Machines
. . .	. . .
34 treated products (6-digit HS)	58 control products (6-digit HS)

Main Data

- **Treatment at product level**
  - 1,136 product names from the *Guidance* mapped to **368** tradable products (6-digit HS)
  - 228 products (62%) were treated in the first two waves (1999, 2001)
  - Most are final capital goods (40%) and processed industrial suppliers (29%)
  - Policies primarily targeted products with initial comparative disadvantage, consistent with infant-industry protection motive



Main Data

- **German industry-level outcomes**
  - 2% sample of German administrative worker data 1993-2017 (SIAB)
    - ⋆ Report average daily wage, industry of establishment, and occupation
  - Covers 61 manufacturing industries after harmonizing with the input–output table
- **Number of granted patents**
  - OECD Triadic Patent Database (EPO PATSTAT)
    - ⋆ Contains **high-quality patents** filed in all three offices: USPTO, EPO, and JPO
    - ⋆ Includes granted patents filed by Chinese firms or inventors
- **Annual trade flows**
  - BACI-CEPII dataset 1996-2017

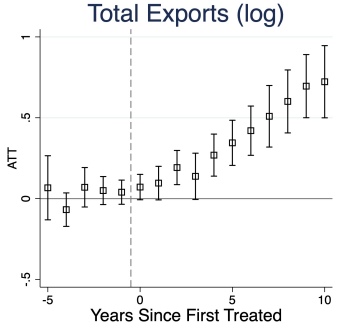
Empirical Specification

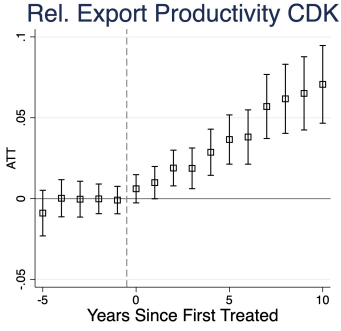
$$y_{p,t} = \sum_k \beta_k \times \mathbf{1}\{t - G_p = k\} + \alpha_p + \alpha_{j(p),t} + \epsilon_{pt}$$

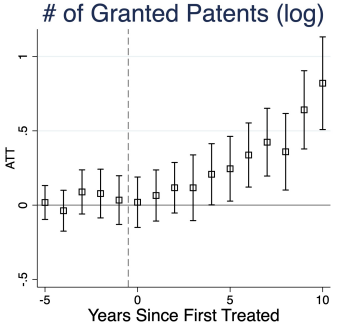
- p: product; $j(p)$: industry of product p
- $G_p = \{1999, 2001, 2004, 2007, 2011\}$: year in which product p was first treated
- Controls: 3-digit industry-by-year fixed effects
- Estimator: Callaway and Sant'Anna (2021) DiD, using never-treated products as controls
- Outcomes:
  - Total exports, number of granted patents, and relative export productivity (CDK) (Costinot, Donaldson, Komunjer (2012))
  - Bilateral trade with Germany, subsampled into final capital goods and processed industrial supplies

China: Export Competitiveness and Innovation Gains

- Treated products experienced a 70% increase in exports relative to controls by year nine
- Showed improvement in CDK, and a 50% increase in granted patents
- Exhibited gains in unit values and were exported to higher-income destinations Quality







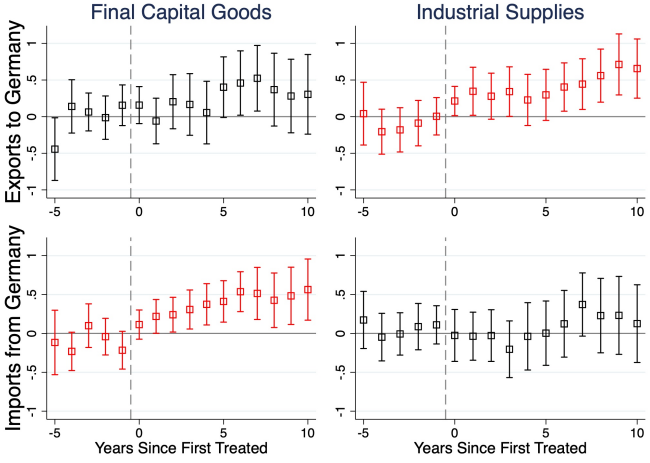
China: Increased Dependence on German Capital Goods

Other Goods Competition

- Treated capital goods remain difficult to substitute domestically, even with IPs support
- $\Rightarrow$ Asymmetric trade response reflects a complementary industrial structure

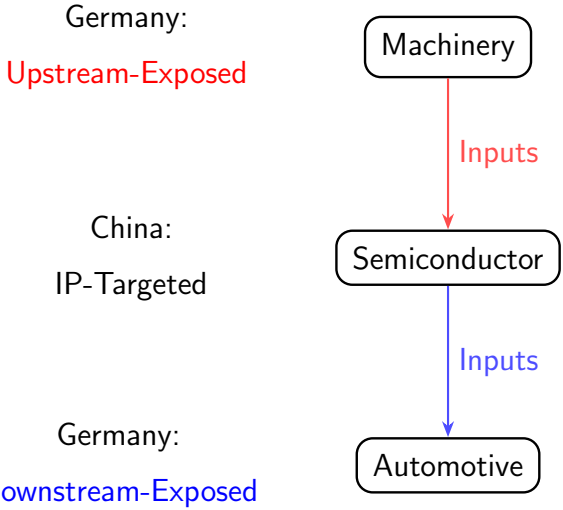
China's **Exports** to Germany

China's **Imports** from Germany



From Product Targeted to Industry Exposure: Channels

- Effects of IPs propagate to upstream suppliers and to downstream buyers



From Products to Industry: Exposure Measurement

Upstream (Supplier) Exposure of industry j:

$$\text{Upstream Exposure}_j = \sum_i \mathit{OutputShare}_{j \to i} \times \mathit{TreatedShare}_i$$

$\Rightarrow$ Captures how intensively industry j's *customers* are targeted by IPs

Downstream (Buyer) Exposure of industry j:

$$\text{Downstream Exposure}_j = \sum_i \mathit{InputShare}_{i \to j} \times \mathit{TreatedShare}_i$$

$\Rightarrow$ Captures how intensively industry j's *suppliers* are targeted by IPs

Notes: TreatShare_i is computed as the 1996–1998 average share of products targeted by IPs, based on China's exports to the rest of the world (excluding Germany).

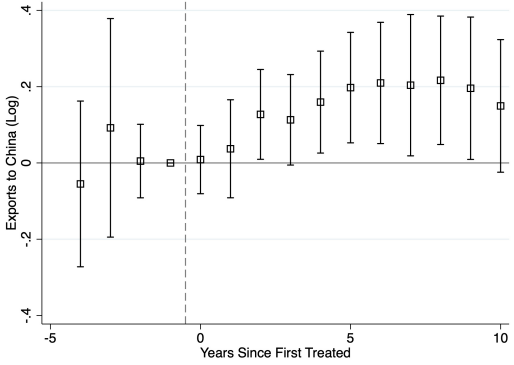
Industry Level Specification

$$y_{jt} = \alpha_j + \alpha_t + \sum_{k \neq 1998} \beta^k (\text{Upstream Exposure}_j \times \text{Year}_t^k) + \sum_{k \neq 1998} \gamma^k (\text{Downstream Exposure}_j \times \text{Year}_t^k) + \sum_{k \neq 1998} (\Omega_j \times \text{Year}_t^k) + \epsilon_{jt}$$

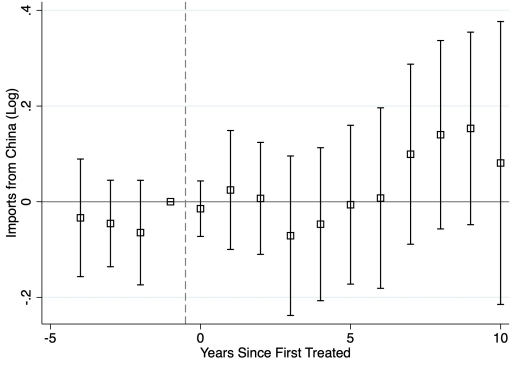
- β^k, γ^k: Effect of 1 s.d. increase in exposure on outcomes relative to 1998
- y_{jt}: Industry-level outcomes (1993–2009)
  - Bilateral trade with China
  - Full-time employment; average daily wage
  - Share of production workers; share of engineers
- Ω_j: pre-treatment characteristics including average share of university-educated, female, and German workers, changes in the industry's share of total employment over 1987-1992

Upstream Suppliers: Exported More to China

- One s.d. increase in upstream exposure $\Rightarrow$ 20% higher exports to China
- Reflects a **positive demand shock** from China's IPs



(a) Germany's Exports to China



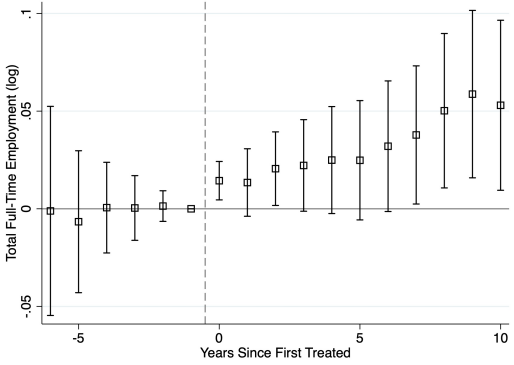
(b) Germany's Imports from China

Upstream Suppliers: Gains in Employment and Wage

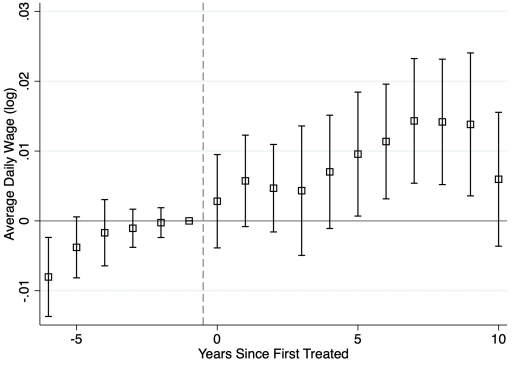
Occ Composition

- + 1 s.d. upstream exposure ⇒ 5% higher full-time employment and 1.5% higher wage
- More production workers and more young worker entering these industries

Entrants



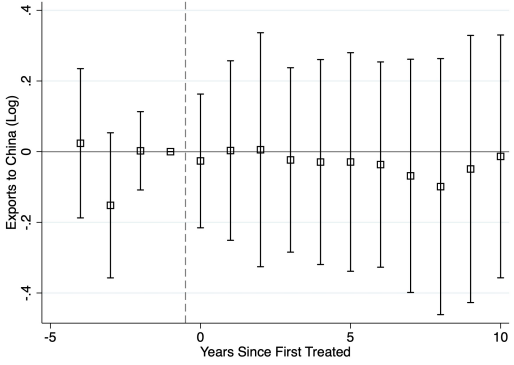
(a) Full-time Employment (Log)



(b) Average Daily Wage (Log)

Downstream Buyers: Imported More from China

- + 1 s.d. downstream exposure → 20% increase in imports from China



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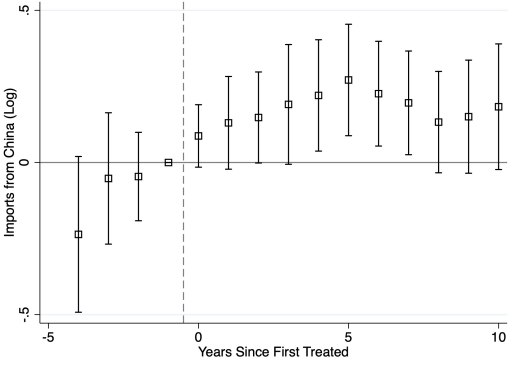
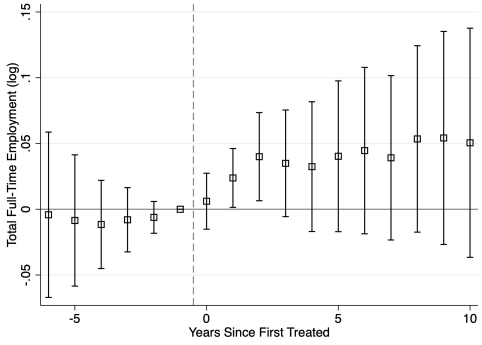


(b) German Imports from China

Downstream Buyers: Mild Gains in Employment and Wage

- Import competition would harm workers if it was replacing domestic production
- Possibility: Cheaper imported inputs raised labor demand



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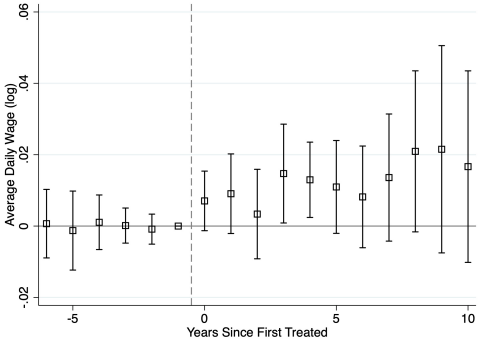
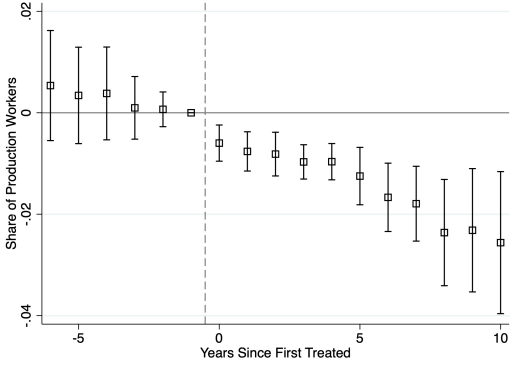


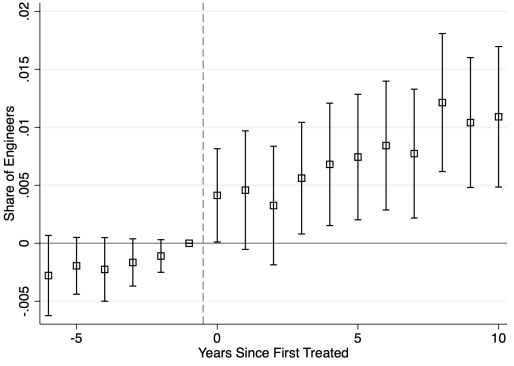
(b) Average Daily Wage (Log)

Downstream Buyers: Within-Industry Compositional Shift

- + 1 s.d. downstream exposure ⇒ + 1 pp increase (+20.8%) in the share of engineers, and + 2 pp decline (-2.9%) in the share of production workers.



(a) Share of Production Workers



(b) Share of Engineers

Conclusion

- China's industrial policies promoted exports of targeted high-tech products
- IP also had cross-border effects through global input-output linkages
  - German upstream suppliers benefited from a positive demand shock
  - German downstream buyers adjusted workforce composition
- Countries may benefit from foreign IPs in the short run
  - But gains depend on having **key technologies or products that are hard to substitute**
  - Implies potential distributional effects across countries

Thank you!

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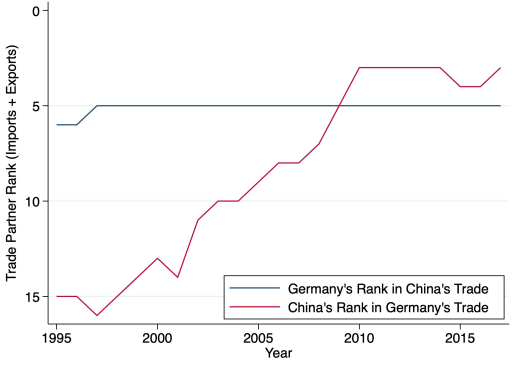
Germany: manufacturing powerhouse and key trade partner of China

Back

- Germany's Exports account for around 30%-40% of GDP during the 2000s.

(a) Rank 2nd in Economic Complexity Index



(b) China's 5th Largest Trade Partner

Note: ECI was developed by Hausmann and Hidalgo using global trade data.

Export Competitiveness Improvement and Quality Upgrading

Back

- Effects on CDK and RCA are similar to Lane (QJE 2025) for Korea's IP on HCI

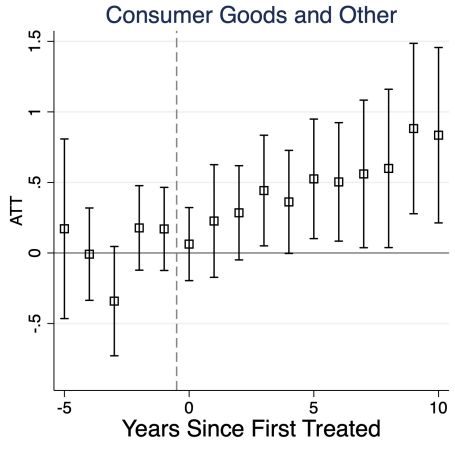
Table 1: Treatment Effect on Export Performance and Quality for China's Exports

	Competitiveness		Technological or Quality Upgrading		
	(1) RCA(CDK)	(2) RCA(Balassa)	(3) Patents(log)	(4) Unit Price(log)	(5) Destination GDPpc[1]
Post (0 to 4)	0.016***	0.058**	0.105	0.070*	95.018
	(0.00)	(0.03)	(0.07)	(0.04)	(329.88)
Post (5 to 9)	0.051***	0.184***	0.400***	0.106**	975.486**
	(0.01)	(0.06)	(0.10)	(0.05)	(427.54)
Pre (-5 to -1)	-0.001	-0.009	0.036**	0.001	-73.806
	(0.00)	(0.01)	(0.02)	(0.02)	(122.51)
Ind×Year FE	Y	Y	Y	Y	Y

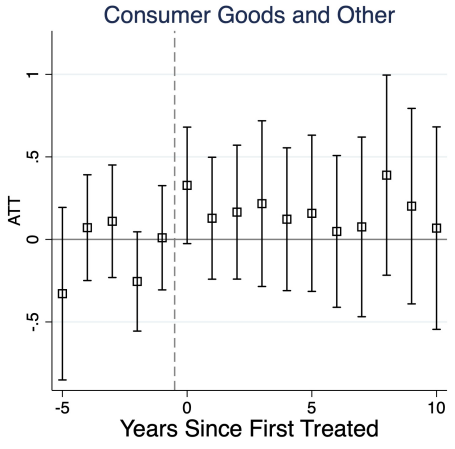
[1] Destination GDP pp: export-weighted average GDP pc among all destinations

China-Germany Trade: Other Products

Back



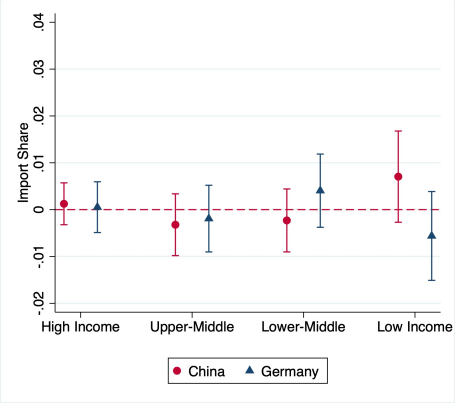
(a) CN to DE



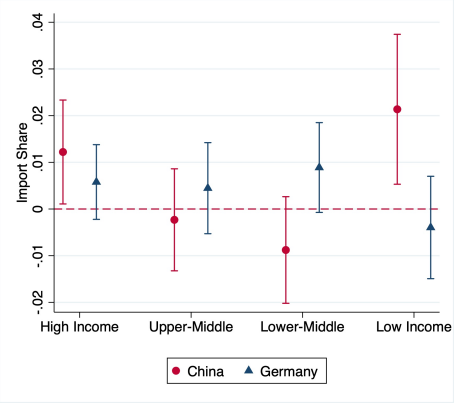
(b) DE to CN

China's Export Growth Without Germany's Loss Back

- Dependent variable: import share of Chinese products or German products in each country group



(a) ATT between 0-4 years

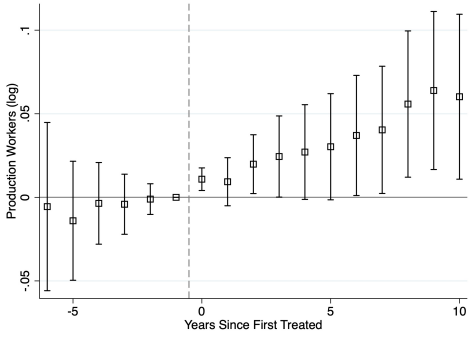


(b) ATT between 5-9 years

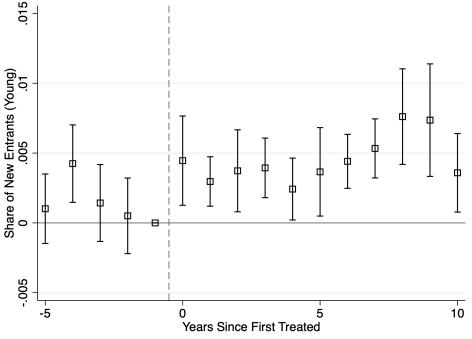
Upstream Suppliers: More Production Workers and Young Entrants

Back

- Expansion in upstream-exposed industries is driven by growth in production workers and young entrants (under 30)



(a) Production Workers (log)



(b) Share of New Entrants

Upstream Suppliers: Stable Occupational Composition

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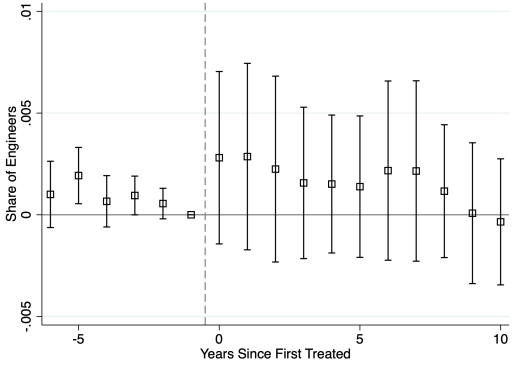
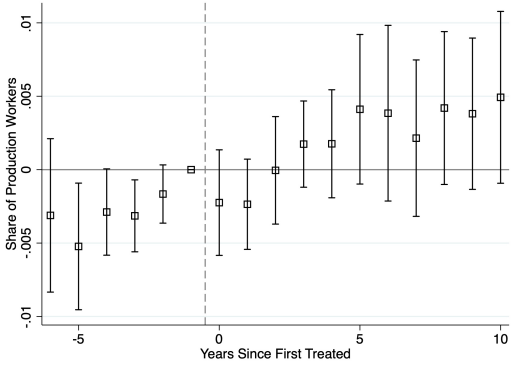


(a) Share of Engineers



(b) Share of Production Workers