Does Skill Abundance Still Matter?

The Evolution of Comparative Advantage in the 21st Century

Shin Kikuchi, MIT

January 24, 2025

Skill Abundance and Comparative Advantage

- Skill Abundance: Central for comparative advantage (**Heckscher–Ohlin**)
  - Skill-abundant countries specialize in skill-intensive sectors

“Illustrating” the Idea of Heckscher-Ohlin

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United States

India

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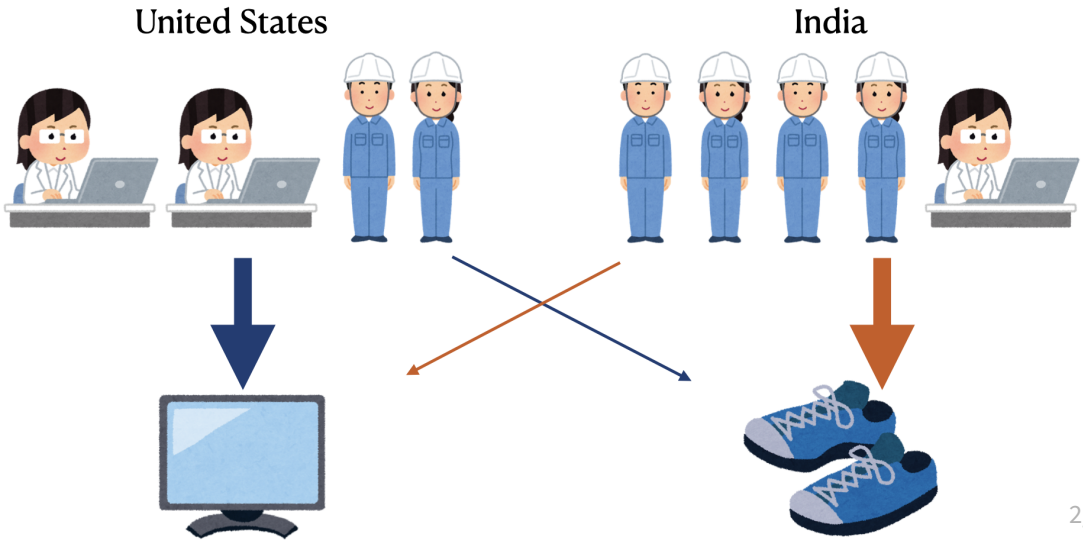

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- **This paper: What about the 21st century?**

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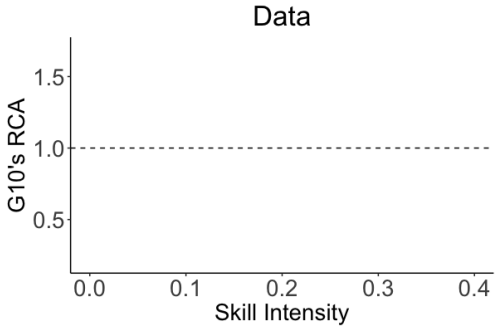

Note: Binned-scatter for 396 4-digit sectors. Data from UN Comtrade & NBER CES Manuf. DB ‣ go

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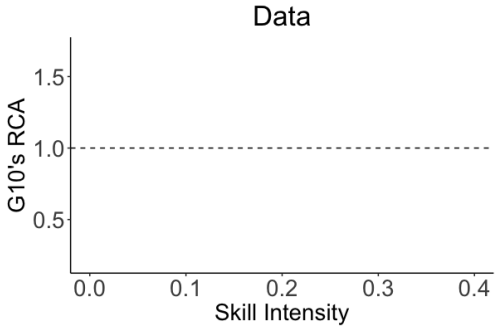

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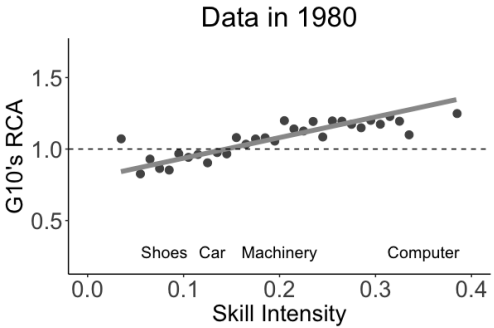

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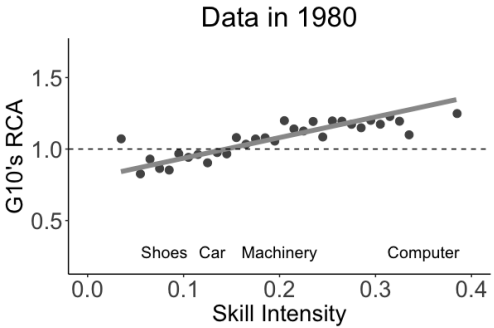

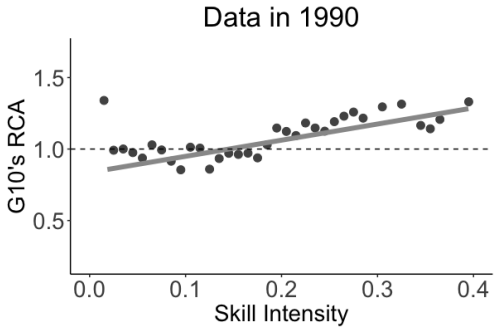

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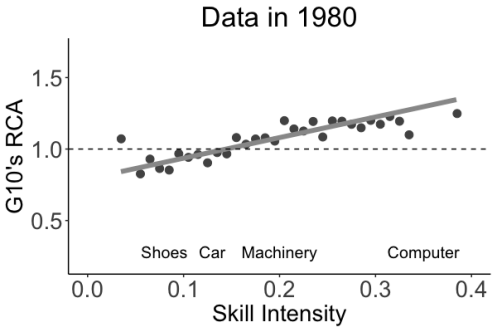

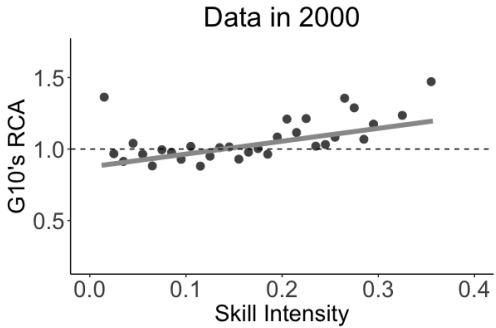

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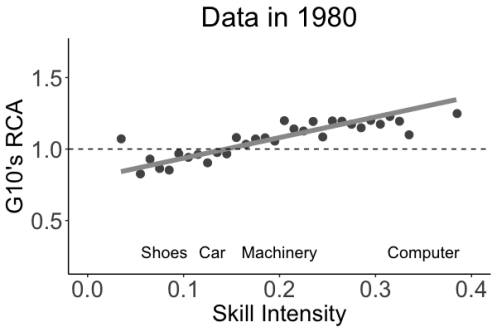

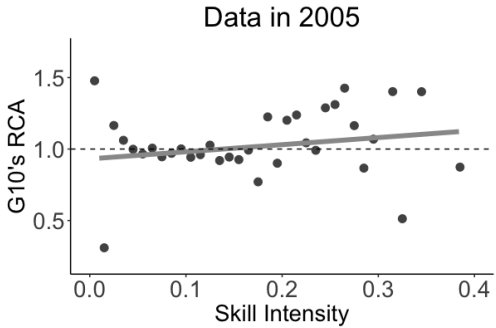

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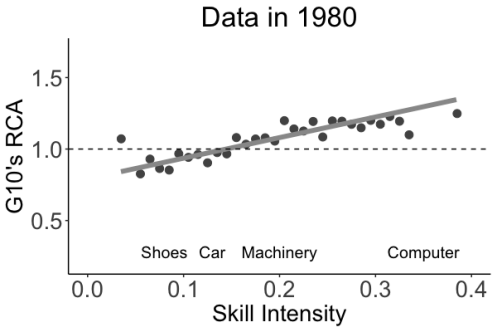

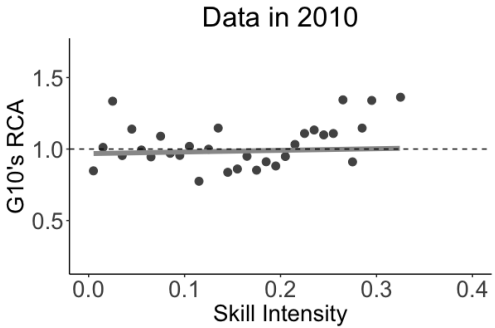

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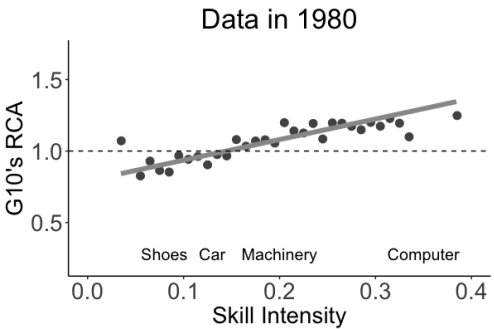

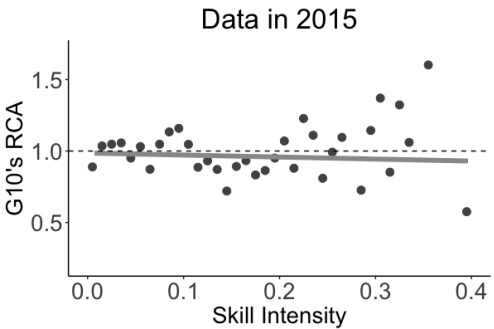

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∗ **Bonus: Implications for Cost of Trump Tariff?**

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- **Conditional on automation, HO-like predictions still survive**

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- Implications of automation
  - Shifts of manufacturing from South to North
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$\rightarrow$ **Skill abundance matter in 1980s; Not anymore post-2000.**

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$\rightarrow$ **Automation** $\Rightarrow$ **Comparative Advantage and Inequality**

FACTS: SKILL ABUNDANCE NO LONGER MATTERS

Identifying Comparative Advantage: Refresher

- Multi-sector Eaton-Kortum Model (Chor (2010), Costinot et al (2012))

Exporter i, Importer j, Sector s: $\ln \text{Export}_{i,j,s} = \underbrace{-\theta}_{\text{Trade Elas.}} \underbrace{\ln c_{i,s}}_{\text{Unit Cost}} + \underbrace{\tilde{\eta}_{i,j} + \tilde{\eta}_{j,s}}_{\text{FEs}}$

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- $\beta > 0$: **Skill-abundant countries specialize in skill-intensive sectors**

Specification: PPML (Skip if Needed)

- What we want to run:

$$\ln \text{Exports}_{i,j,s} = \beta \left[\text{Skill Intensity}_s \times \text{Skill Abundance}_i\right] + \eta_{i,j} + \eta_{j,s} + \varepsilon_{i,j,s}$$

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$$\ln \text{Exports}_{i,j,s} = \beta \left[\text{Skill Intensity}_s \times \text{Skill Abundance}_i\right] + \eta_{i,j} + \eta_{j,s} + \varepsilon_{i,j,s}$$

- Well-known issue: **Lots of zeros in** $\ln$ **Exports**$_{i,j,s}$

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- This presentation: log-specification without the error term (to keep things tidy)
  - "Correct" structural relationship w/o errors

Skill Abundance as a Source of Comparative Advantage

Do skill-abundant countries export more skill-intensive goods?

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- $\eta_{i,j}$: Exporter-Importer FEs: control distances, productivity level diffs,...
- $\eta_{j,s}$: Importer-Sector FEs: control tariffs, expenditure shares,...

Expect $\beta > 0$: Skill-abundant countries export skill-intensive goods more

Skill Abundance as a Source of Comparative Advantage

Do skill-abundant countries export more skill-intensive goods?

$$\ln \text{Exports}_{i,j,s,\mathbf{t}} = \beta_{\mathbf{t}} \left[\text{Skill Intensity}_{s,\mathbf{t}} \times \text{Skill Abundance}_{i,\mathbf{t}}\right] + \eta_{i,j,\mathbf{t}} + \eta_{j,s,\mathbf{t}},$$

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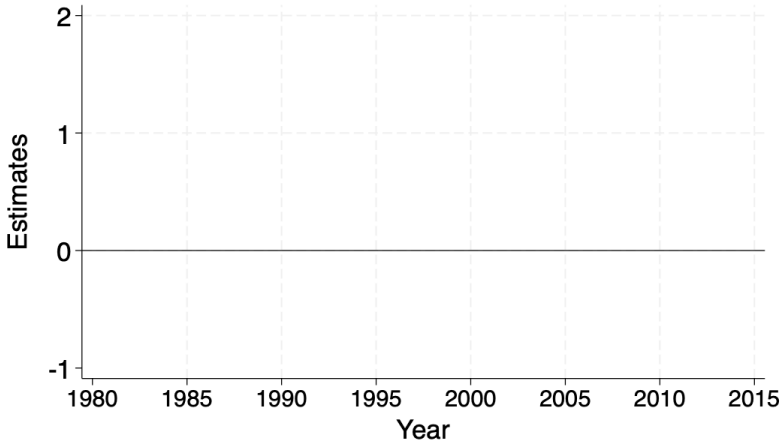
Expect $\beta_{\mathbf{t}} > 0$: Skill-abundant countries export skill-intensive goods more

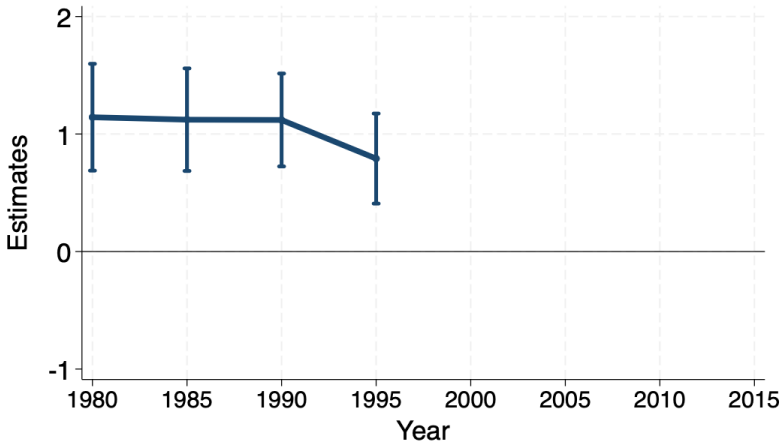
Skill Abundance $\Rightarrow$ CA in Skill-Intensive Sectors?

$$\ln \text{Exports}_{i,j,s,t} = \beta_t \left[\text{Skill Intensity}_{s,t} \times \text{Skill Abundance}_{i,t}\right] + \eta_{i,j,t} + \eta_{j,s,t},$$



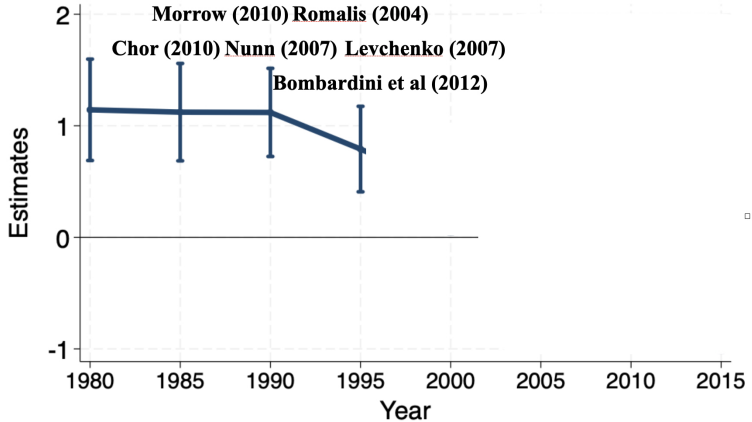
Skill Abundance $\Rightarrow$ CA in Skill-Intensive Sectors before 2000

$$\ln \text{Exports}_{i,j,s,t} = \beta_t \left[\text{Skill Intensity}_{s,t} \times \text{Skill Abundance}_{i,t}\right] + \eta_{i,j,t} + \eta_{j,s,t},$$



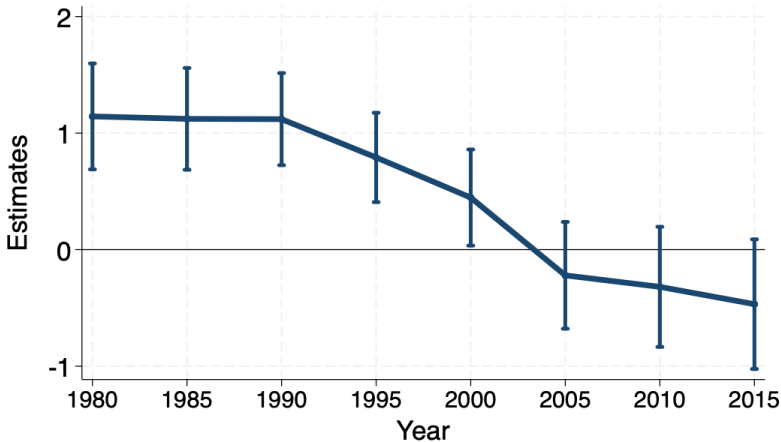
Results before 2000 are Consistent with Previous Papers

$$\ln \text{Exports}_{i,j,s,t} = \beta_t \left[\text{Skill Intensity}_{s,t} \times \text{Skill Abundance}_{i,t}\right] + \eta_{i,j,t} + \eta_{j,s,t},$$



Skill Abundance $\not\Rightarrow$ CA in Skill-Intensive Sectors after 2000

$$\ln \text{Exports}_{i,j,s,t} = \beta_t \left[\text{Skill Intensity}_{s,t} \times \text{Skill Abundance}_{i,t}\right] + \eta_{i,j,t} + \eta_{j,s,t},$$

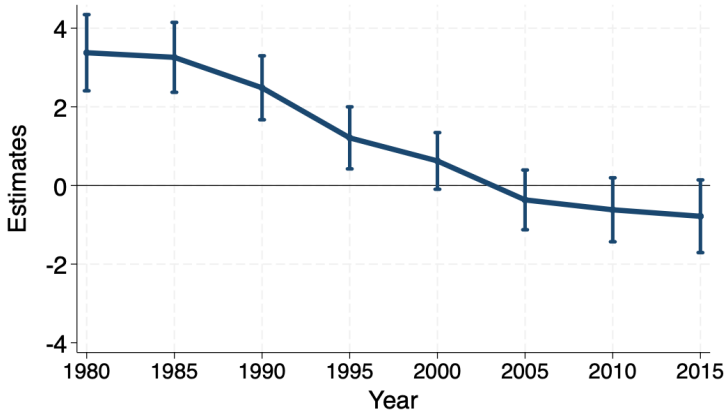


Fixing RHS at 1980's values

$$\ln \text{Exports}_{i,j,s,t} = \beta_t \left[\text{Skill Intensity}_{s,\mathbf{1980}} \times \text{Skill Abundance}_{i,\mathbf{1980}}\right] + \eta_{i,j,t} + \eta_{j,s,t},$$

Change in Patterns of CA Comes from Exports

$$\ln \text{Exports}_{i,j,s,t} = \beta_t \left[\text{Skill Intensity}_{s,\mathbf{1980}} \times \text{Skill Abundance}_{i,\mathbf{1980}}\right] + \eta_{i,j,t} + \eta_{j,s,t},$$

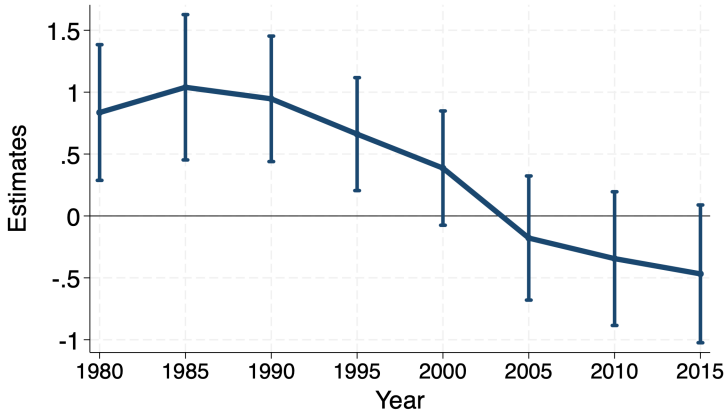


Fixing RHS at 2015's values

$$\ln \text{Exports}_{i,j,s,t} = \beta_t \left[\text{Skill Intensity}_{s,\mathbf{2015}} \times \text{Skill Abundance}_{i,\mathbf{2015}}\right] + \eta_{i,j,t} + \eta_{j,s,t},$$

NOT Driven by Attenuating Skill Measurement

$$\ln \text{Exports}_{i,j,s,t} = \beta_t \left[\text{Skill Intensity}_{s,\mathbf{2015}} \times \text{Skill Abundance}_{i,\mathbf{2015}}\right] + \eta_{i,j,t} + \eta_{j,s,t},$$



Robustness Checks

- Other sources of comparative advantage? ‣ Capital ‣ Institution
- Driven by small countries? ‣ Weighted
- Some exporter-sector unobserved het., or IRS? ‣ Pool years and i-s FEs
- Different skill measures? ‣ High School ‣ Predicted by Demographics
- Total exports, instead of bilateral exports (Romalis 2004, Nunn 2007,...) ‣ go
- Different measures of sectoral factor intensity (Chor 2010)
  - $\ln(H_S/L_S)$, instead of α_S^H ($\equiv$ Skilled Payroll Share to Value-Added) ‣ go
- Including service sectors (WIOD, later in this presentation)

POTENTIAL HYPOTHESES: AUTOMATION AND OFFSHORING

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- What can make domestic skill abundance less relevant for CA after the 1990s?

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- Two massive technical progress, replacing low-skill labor
  - Automation: Replace low-skill labor with machines
  - Offshoring: Replace low-skill labor with foreign inputs

“Illustrating” The Idea: Automation and Offshoring

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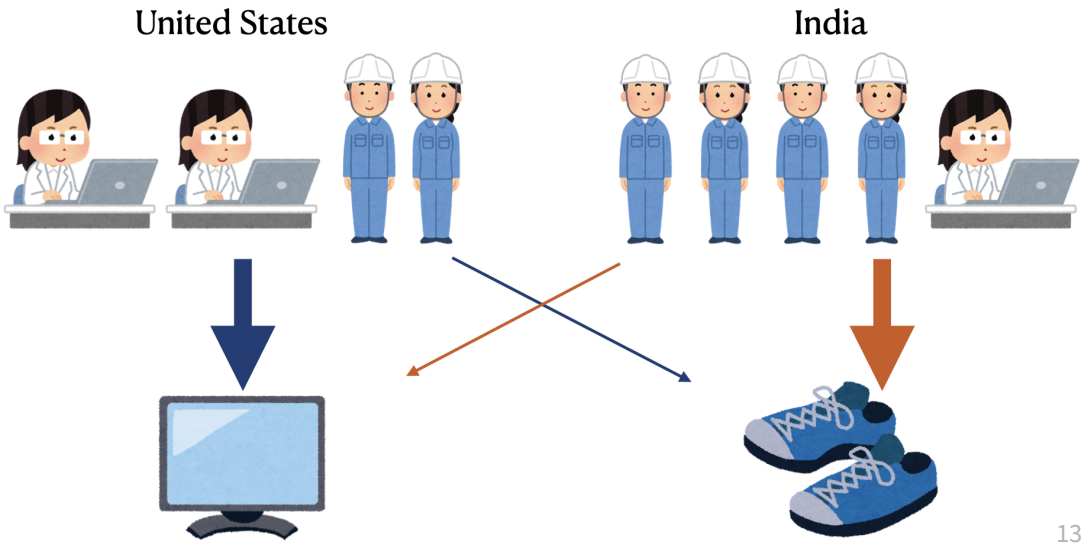
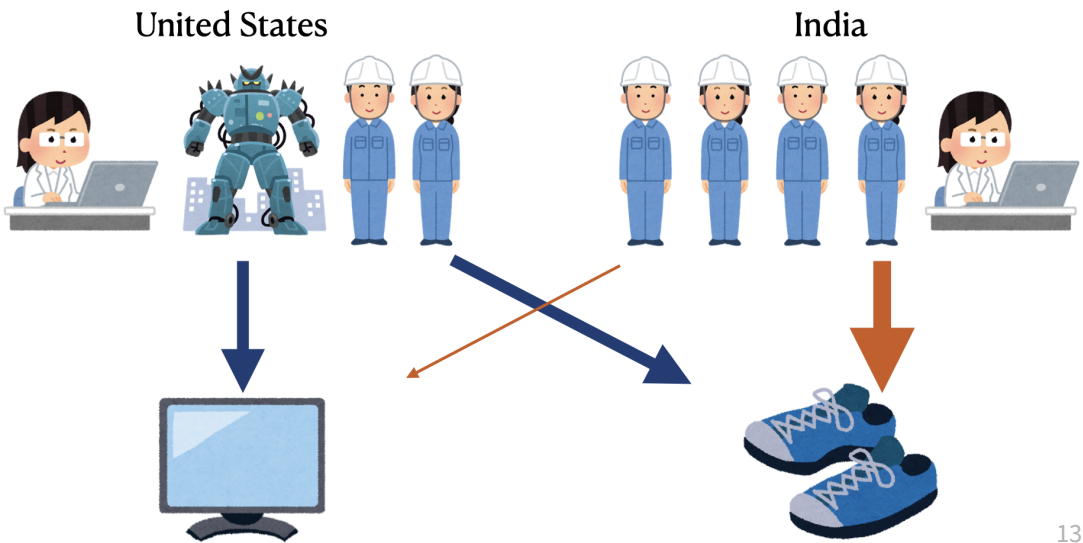
United States

India

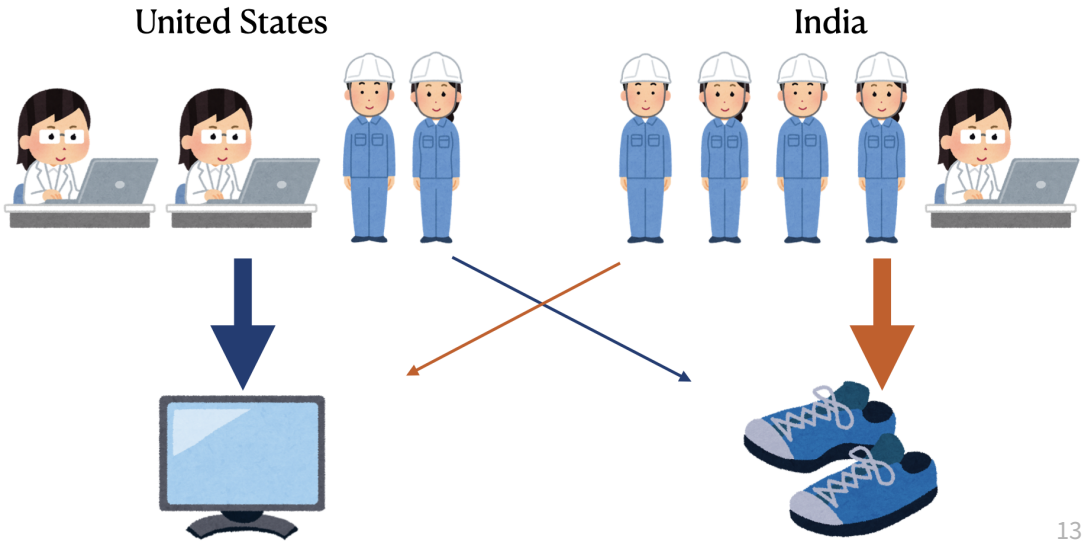
US for Electronics, India for Shoes



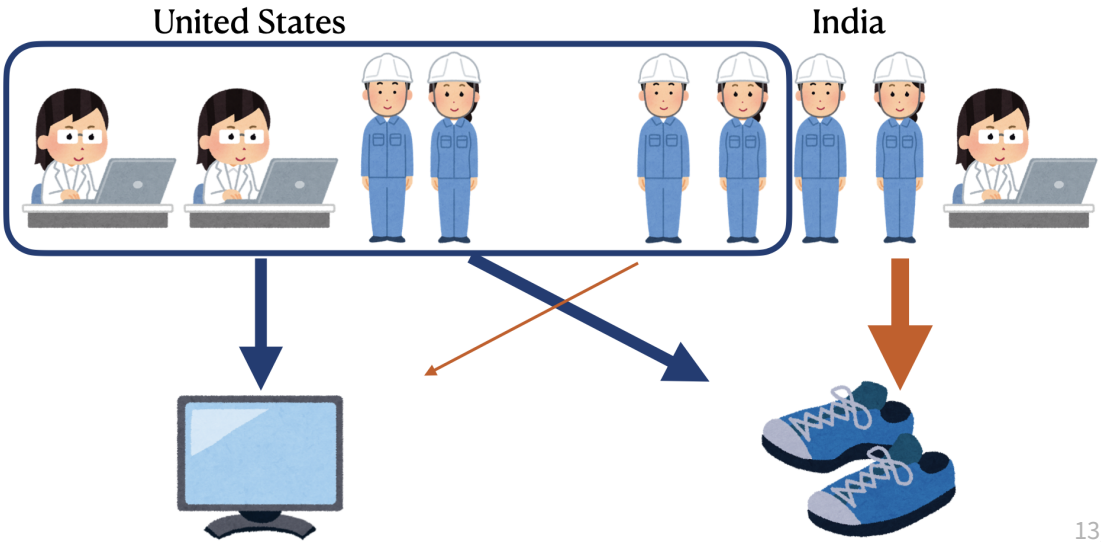
With Robots, US is now Competitive in Shoes



“Illustrating” The Idea: Automation and Offshoring



With Offshoring, US is now Competitive in Shoes



Potential Hypotheses: Automation and Offshoring

- What can make domestic skill abundance less relevant for CA after the 1990s?

- Two massive technical progress, replacing low-skill labor
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Potential Hypotheses: Automation and Offshoring

- What can make domestic skill abundance less relevant for CA after the 1990s?
- Two massive technical progress, replacing low-skill labor
  - Automation: Replace low-skill labor with machines
  - Offshoring: Replace low-skill labor with foreign inputs
- This section: Explore heterogeneous effects across countries and sectors
  - Descriptive analysis for heterogeneous effects (for now)
  - Causal analysis using the model (later)

Specification for Heterogeneous Effects: Automation

$$\ln \text{Exports}_{i,j,s,t} = \underbrace{\beta_t^0 \left(1 + \beta_t^A HA_{i,s}\right)}_{=\beta_t} \cdot \left[\text{Skill Intensity}_{s,t} \times \text{Skill Abundance}_{i,t}\right] + \eta_{i,j,t} + \eta_{j,s,t},$$

- $HA_{i,s}$: High-automation dummy (below/above the median robot adoption)
  - Robot adoption: Robot stock per workers from IFR & WIOD

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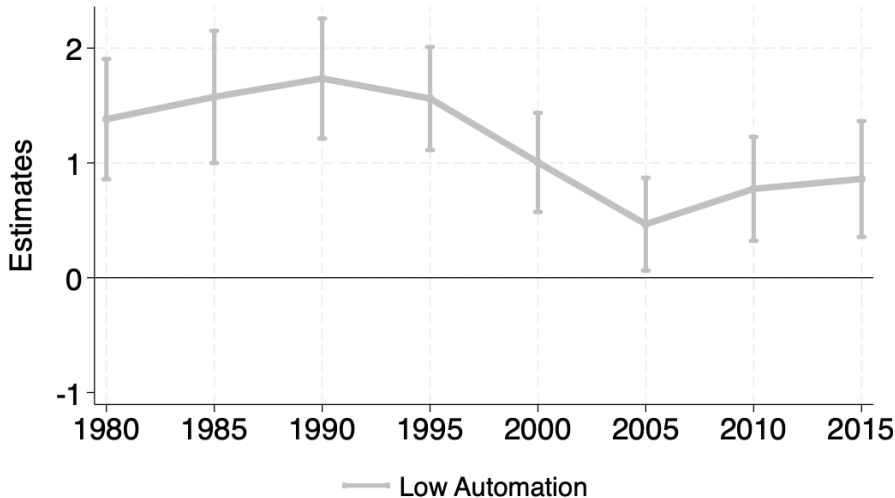
- $HA_{i,s}$: High-automation dummy (below/above the median robot adoption)
  - Robot adoption: Robot stock per workers from IFR & WIOD
- Expect β_t^A to decrease if there is a relationship btw change & automation

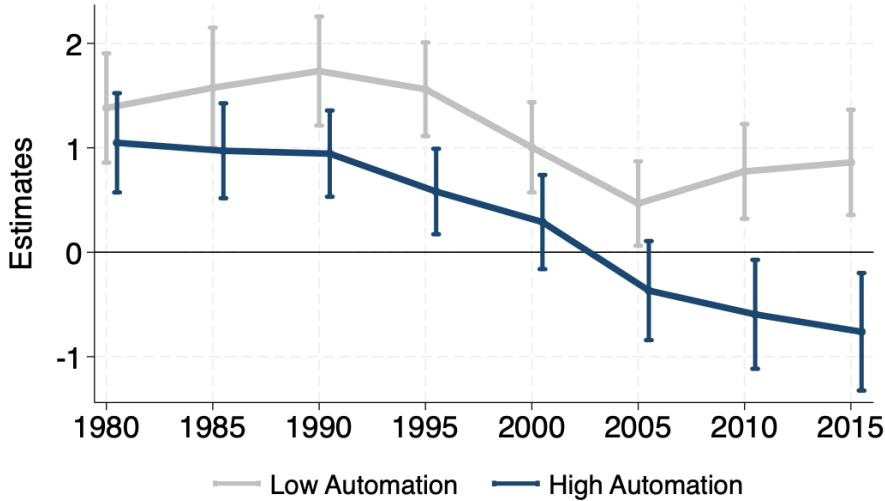
Skill Abundance Still Matters Absent Automation

Plot $\widehat{\beta}_t^0$



Skill Abundance Still Matters Absent Automation

Plot $\widehat{\beta}_t^0$ and $\widehat{\beta}_t^0 + \widehat{\beta}_t^A$



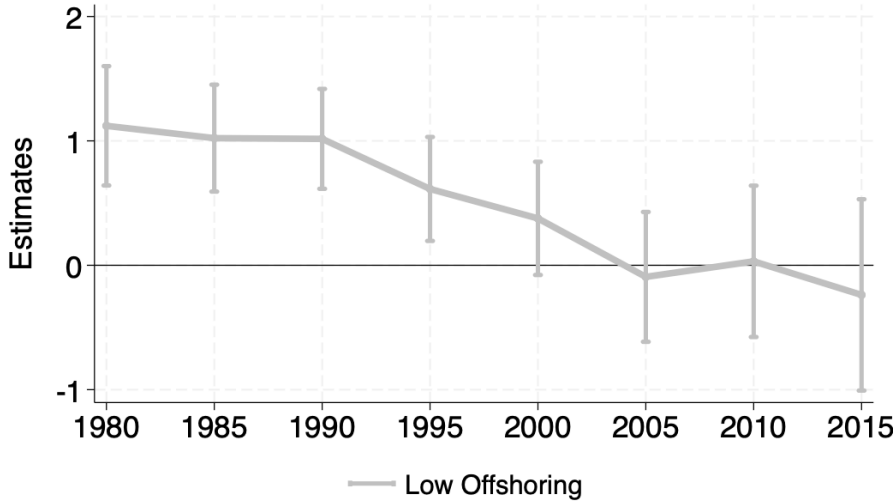
Specification for Heterogeneous Effects: Offshoring

$$\ln \text{Exports}_{i,j,s,t} = \underbrace{\beta_t^0 \left(1 + \beta_t^O HO_{i,s}\right)}_{=\beta_t} \cdot \left[\text{Skill Intensity}_{s,t} \times \text{Skill Abundance}_{i,t}\right] + \eta_{i,j,t} + \eta_{j,s,t},$$

- $HO_{i,s}$: High-offshoring dummy (below/above the median offshoring)
  - Offshoring share: (Intermediate imports) / (Total intermediates) from WIOD
- Expect β_t^O to decrease if there is a relationship btw change & offshoring

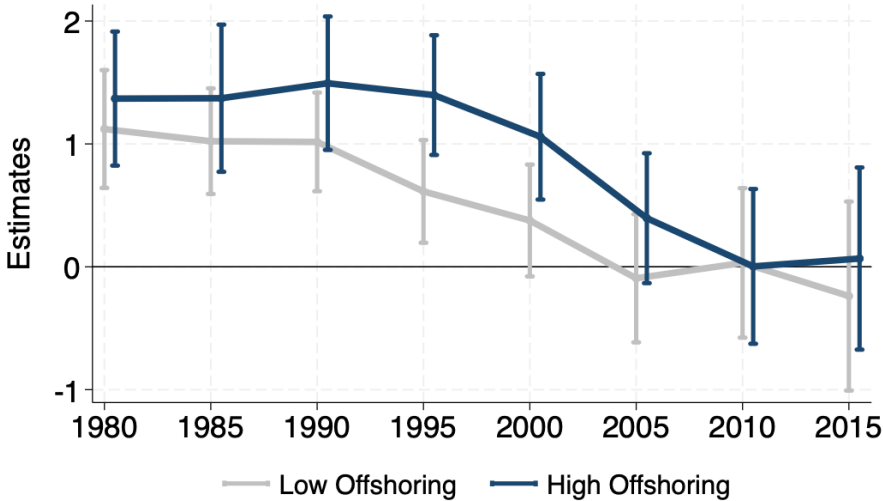
Skill Abundance does not Matter Even Absent Offshoring

Plot $\widehat{\beta}_t^0$



Skill Abundance does not Matter Even Absent Offshoring

Plot $\widehat{\beta}_t^0$ and $\widehat{\beta}_t^0 + \widehat{\beta}_t^O$



Now, Using Continuous Measures...

$$\ln \text{Exports}_{i,j,s,t} = \beta_t^0 \left(1 + \beta_t^A \text{Auto}_{i,s} + \beta_t^O \text{Ofs}_{i,s}\right) \cdot \left[\text{Skill Int.}_{s,t} \times \text{Skill Abd.}_{i,t}\right] + \eta_{i,j,t} + \eta_{j,s,t}$$

	1995	2010	1995	2010
Skill Intensity x Abundance	1.26	-0.33		
	(0.23)	(0.28)		
x Automation (log robot stock)				
x Offshoring Share (×100)				

Same Results from Continuous Measures

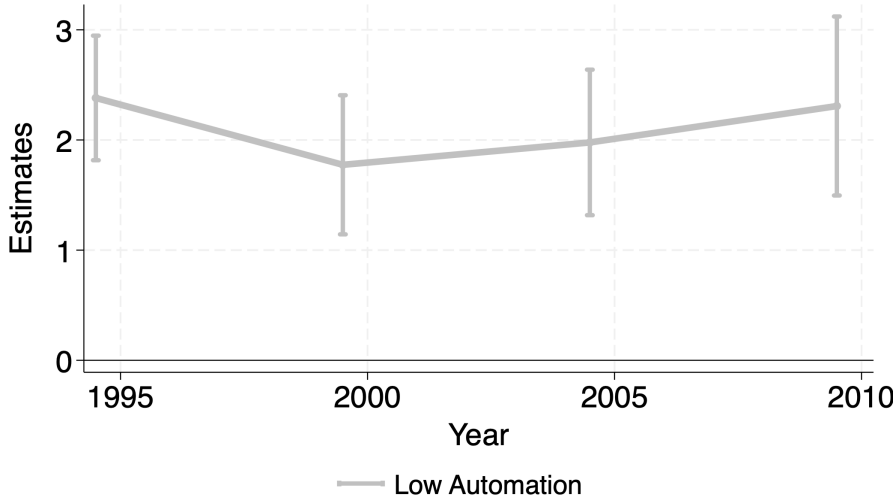
$$\ln \text{Exports}_{i,j,s,t} = \beta_t^0 \left(1 + \beta_t^A \text{Auto}_{i,s} + \beta_t^O \text{Ofs}_{i,s}\right) \cdot \left[\text{Skill Int.}_{s,t} \times \text{Skill Abd.}_{i,t}\right] + \eta_{i,j,t} + \eta_{j,s,t}$$

	1995	2010	1995	2010
Skill Intensity x Abundance	1.26	-0.33	3.00	**3.49**
	(0.23)	(0.28)	(0.41)	(0.57)
x Automation (log robot stock)			-0.19	**-0.35**
			(0.05)	(0.06)
x Offshoring Share (×100)			0.04	0.05
			(0.05)	(0.07)

Note: Automation measure: 12.2 for German cars, 2.3 for Indian textiles

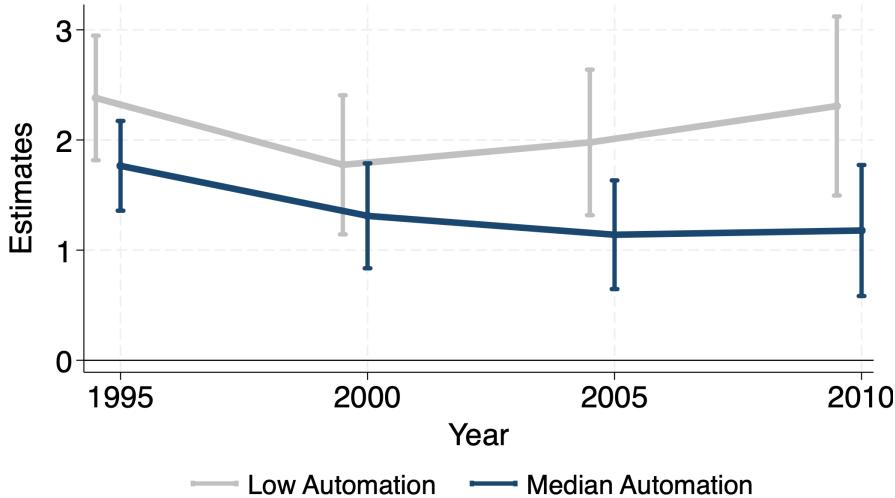
Skill Abundance Still Matters Absent Automation

Fitted values for groups with automation of 10th percentiles (with zero offshoring)



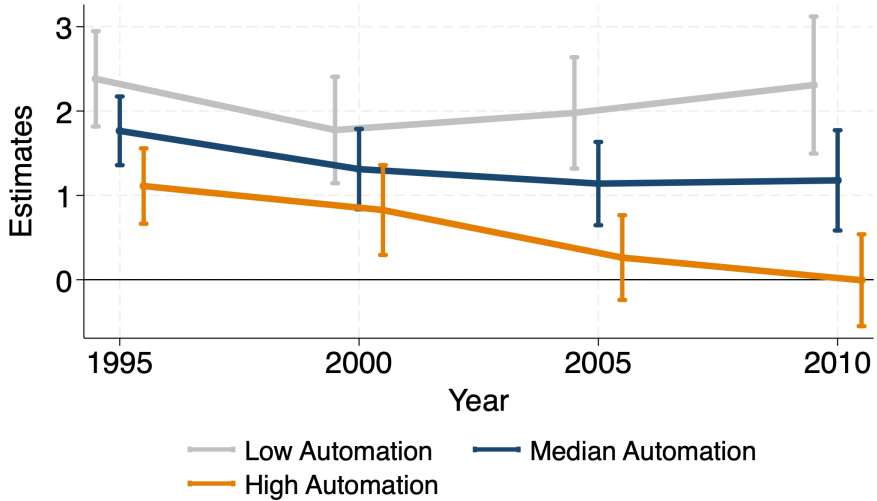
Skill Abundance Still Matters with Median Automation

Fitted values for groups with automation of 10th and 50th percentiles



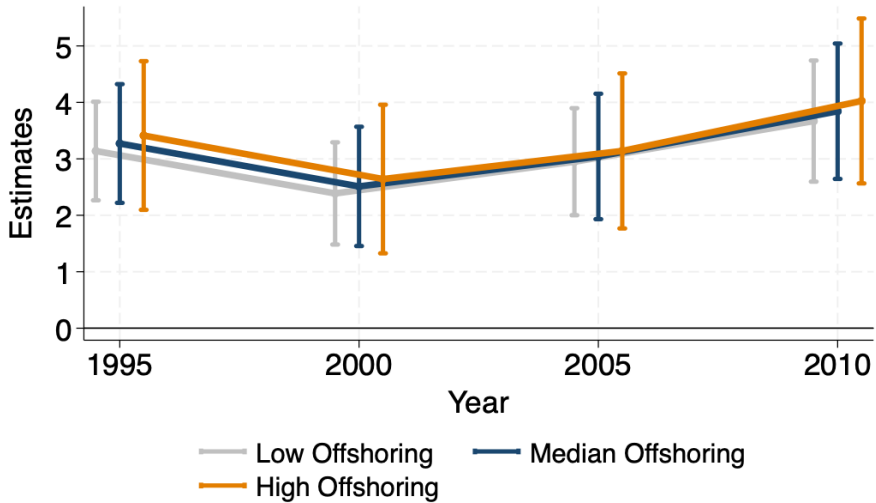
Skill Abundance Still Matters Absent Automation

Fitted values for groups with automation of 10th, 50th, and 90th percentiles



Offshoring Seems Unrelated to Change in Pattern

Fitted values for groups with offshoring of 10th, 50th, and 90th percentiles



Controlling China Shock does not Change Results

	1995	2010	1995	2010
Skill Intensity x Abundance	1.26	-0.33		
	(0.23)	(0.28)		
x Automation (log robot stock)				
x Offshoring Share (×100)				
x China's RCA				

Controlling China Shock does not Change Results

	1995	2010	1995	2010
Skill Intensity x Abundance	1.26	-0.33	2.43	**3.51**
	(0.23)	(0.28)	(0.45)	(0.46)
x Automation (log robot stock)			-0.15	**-0.31**
			(0.05)	(0.05)
x Offshoring Share (×100)			0.03	0.11
			(0.05)	(0.06)
x China's RCA			0.20	**0.34**
			(0.12)	(0.13)

Takeaway: **China shocks strengthen the Heckscher-Ohlin force**

Summary of Empirical Facts

- **Skill abundance becomes less important in comparative advantage** over time
  - Less important with higher **automation**
  - Offshoring has surprisingly no relationship

MODEL: TRADE WITH AUTOMATION AND OFFSHORING

Model: Big Picture

- Purpose of the model:
  - Quantify the roles of automation and offshoring in the change in CA
  - Demonstrate the causal effect of automation and offshoring

- Basic idea:
  - Producing low-skill intensive goods used to require production labor
  - Automation & offshoring $\Rightarrow$ Skill-abundant countries become competitive
    - ⋆ e.g. Germany, South Korea, Japan
    - ⋆ e.g. Shoes, Car assembling...

Model: Overview

- Multi-sector Eaton-Kortum model with input-output linkages

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  - **New: Task framework for automation and offshoring**
- Trade and preference: Cobb-Douglas across sectors, CES (EK) within a sector

Model: Overview

- Multi-sector Eaton-Kortum model with input-output linkages
  - **New: Task framework for automation and offshoring**
- Trade and preference: Cobb-Douglas across sectors, CES (EK) within a sector
- Supply: Multiple production factors
  - Primary: Labor: $H_{i,s}$ (high-skilled), $L_{i,s}$ (low-skilled)
  - Additional (produced using outputs: roundabout)
    - ⋆ Automation Capital: $A_{i,s}$
    - ⋆ Intermediate: $X_{i,s}$ (domestic), $O_{i,s}$ (foreign, offshored)

Demand: Standard Multi-Sector Eaton Kortum Model

- Country i, j, Sector s
- Preference across sectors: Cobb-Douglas with expenditure share of $\mu_{j,s}$

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- Country i, j, Sector s
- Preference across sectors: Cobb-Douglas with expenditure share of $\mu_{j,s}$
- Trade share (gravity equation) within sectors:

$$\pi^{F}_{i,j,s} = \frac{(c_{i,s} \cdot \tau_{i,j,s})^{-\theta}}{\sum_{l}^{\mathcal{I}} (c_{l,s} \cdot \tau_{l,j,s})^{-\theta}}$$

  - Unit cost: $c_{i,s}$:endogenously determined from production processes (next)
  - Trade cost: $\tau_{i,j,s}$
  - Trade elasticity $\theta > 0$
    - ⋆ From the production side of Eaton-Kortum (same agg. from Armington)

Supply 1/2: Task Framework in Production

- Eaton-Kortum + Task Framework

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- Eaton-Kortum + Task Framework
- Gross Output ($z_{i,s}(\omega)$: Fréchet) for variety ω

$$Y_{i,s}(\omega) = z_{i,s}(\omega) \cdot (H_{i,s}(\omega))^{\alpha_s^H} \cdot (T_{i,s}(\omega))^{1-\alpha_s^H}.$$

Supply 1/2: Task Framework in Production

- Eaton-Kortum + Task Framework
- Gross Output ($z_{i,s}(\omega)$: Fréchet) **for variety** ω

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Supply 1/2: Task Framework in Production

- Eaton-Kortum + Task Framework
- Gross Output

$$Y_{i,s} = z_{i,s} \cdot (H_{i,s})^{\alpha_s^H} \cdot (T_{i,s})^{1-\alpha_s^H}.$$

Supply 1/2: Task Framework in Production

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- Production function for each task ($\psi_{i,s}^f(x)$ task-specific tech)

$$T_{i,s}(x) = \underbrace{\psi_{i,s}^A(x) A_{i,s}(x)}_{\text{Automation Capital}} + \underbrace{\psi_{i,s}^L(x) L_{i,s}(x)}_{\text{Production Labor}} + \underbrace{\psi_{i,s}^X(x) X_{i,s}(x)}_{\text{Domestic Input}} + \underbrace{\psi_{i,s}^O(x) O_{i,s}(x)}_{\text{Foreign Input}}$$

Suppl 2/2: Task Allocation $\mathcal{T}^f_{i,s}$, Task Share $\Gamma^f_{i,s}$

- Task production cost using factor f: $c^f_{i,s}(x) \equiv w^f_{i,s} / (\psi^f_{i,s}(x))$ for $f \in \{A, L, X, O\}$

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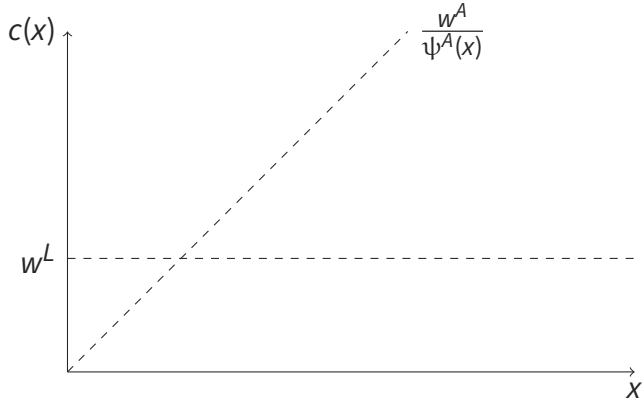
  $\mathcal{T}^f_{i,s} = \left\{ x : f = \text{argmin}_{f'} c^{f'}_{i,s}(x) \right\}, \quad \rightarrow \Gamma^f_{i,s}$: measure of $\mathcal{T}^f_{i,s}$, for $f \in \{A, L, X, O\}$

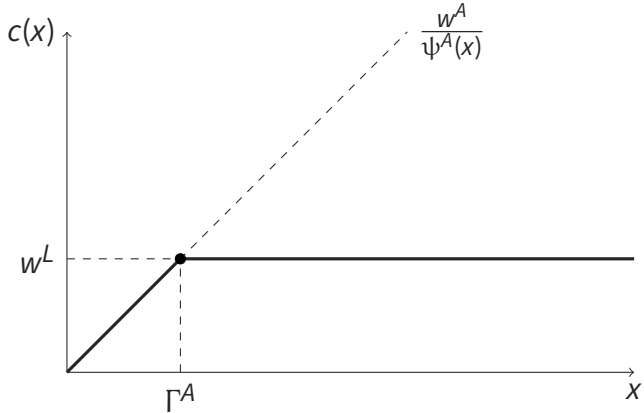
At Glance: Task Allocation and Task Share

- Suppose no intermediate and constant labor productivity $\psi^L(x) = 1$.



At Glance: Task Allocation and Task Share

- Suppose no intermediate and constant labor productivity $\psi^L(x) = 1$.
- Cost minimization (task allocation) $\Rightarrow$ Automation share $\Gamma_i^A = \Gamma^A$



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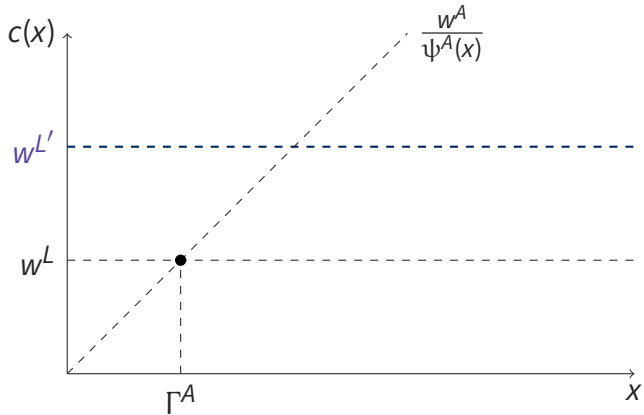
- Suppose wage increases to $w^{L\prime}$



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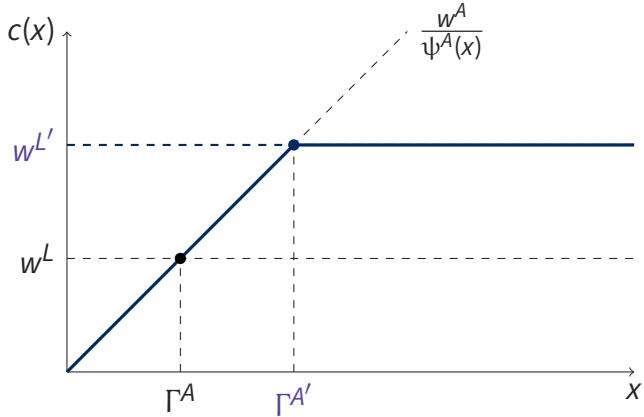
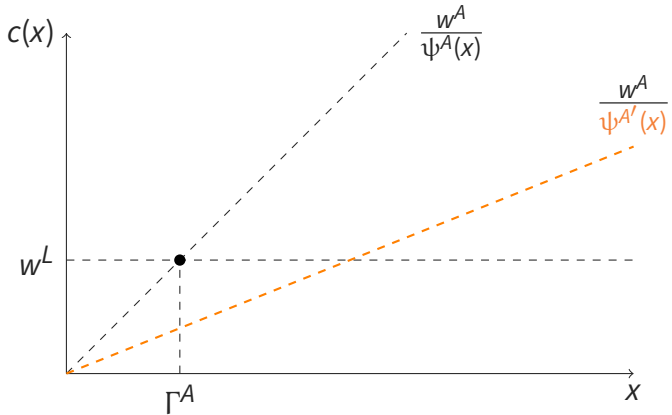


At Glance: Task Allocation and Task Share

- Suppose no intermediate and constant labor productivity $\psi^L(x) = 1$.
- Now, consider automation shock $\psi^A(x)$ from $\psi^{A'}(x)$



At Glance: Task Allocation and Task Share

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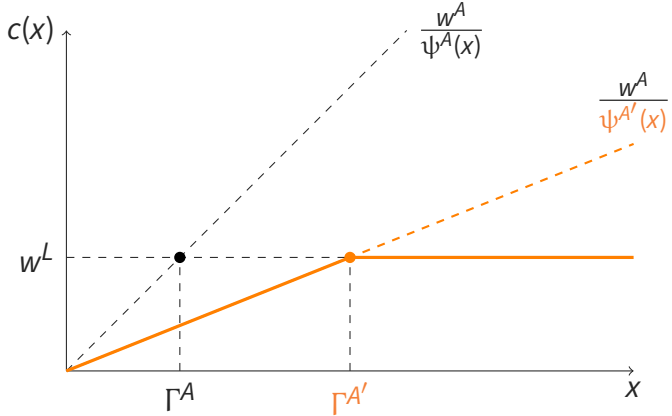
- Automation share increases to $\Gamma^{A'}$



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- Unit cost of production:

$$c_{i,s} = \Lambda_s \cdot (w^H_i)^{\alpha^H_s} \cdot \left[\left(\frac{w^A_{i,s}}{\Gamma^A_{i,s}} \right)^{\Gamma^A_{i,s}} \cdot \left(\frac{w^L_i}{\Gamma^L_{i,s}} \right)^{\Gamma^L_{i,s}} \cdot \left(\frac{w^X_{i,s}}{\Gamma^X_{i,s}} \right)^{\Gamma^X_{i,s}} \cdot \left(\frac{w^O_{i,s}}{\Gamma^O_{i,s}} \right)^{\Gamma^O_{i,s}} \right]^{1-\alpha^H_s}$$

Equilibrium Conditions ▸ Two Country

Given factor endowments $\{H_i, L_i\}$, an equilibrium is a set of wages $\{w_i^H, w_i^L\}$

- Consumers maximize utility by choosing from which countries to buy
  $\rightarrow$ trade share $\pi_{i,j,s}$, as a function of unit cost $\{c_{i,s}\}$
- Unit cost, $c_{i,s}$, as a function of $\{w_i^H, w_i^L\}$
  - $\{w_{i,s}^A, w_{i,s}^X, w_{i,s}^O\}$ are functions of $\{w_i^H, w_i^L\}$ with IO coef.
- Goods and Labor Markets Clear

QUANTIFICATION

Quantitative Analysis: Effects of Automation and Offshoring

- Two Exercises:
  1. Can changes in $\Gamma^{A}_{i,s,t}$ (automation) and $\Gamma^{O}_{i,s,t}$ (offshoring) explain $\widehat{\beta}_t$?
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$$p^A_{i,s,t}A_{i,s,t} = \underbrace{p^K_{i,s,t0}K_{i,s,t0}}_{\text{Capital Income}} \cdot \underbrace{\frac{p^M_{US,s,t0}M_{US,s,t0}}{p^K_{US,s,t0}K_{US,s,t0}}}_{\text{Machine-Capital Ratio}} \cdot \underbrace{\frac{p^R_{i,s,t}R_{i,s,t}}{p^R_{i,s,t0}R_{i,s,t0}}}_{\text{Increases in Robots}} \cdot$$

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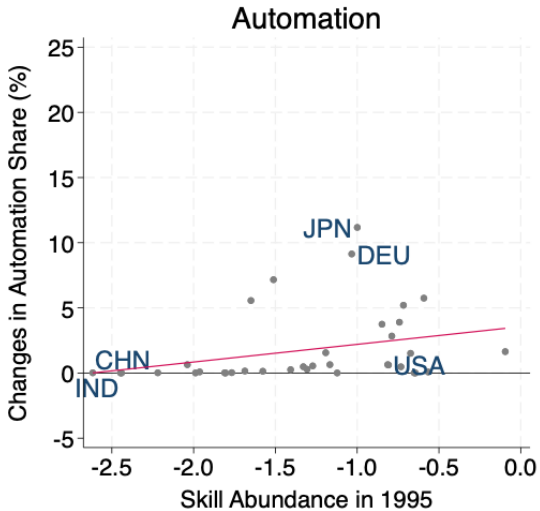
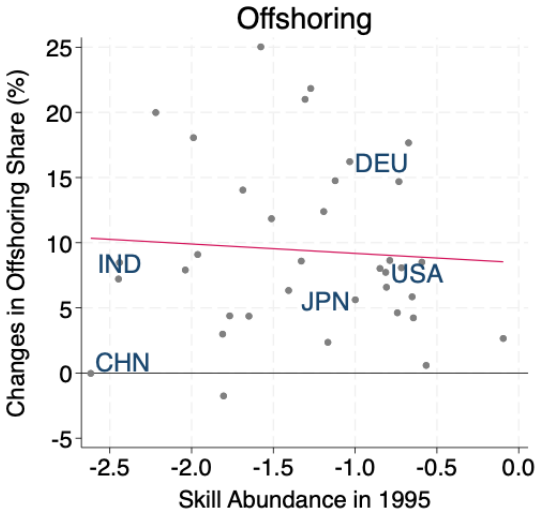
    - ⋆ for automation, the shape param. to be 1.2
    - ⋆ for offshoring, it's EK's trade elasticity.

Data: More Automation in Skill-Abundant Countries





Calibration

Description	Parameter	Value & Source
Panel A: Time-Invariant Parameters (fixed in 1995)		
Trade Elas.	θ	4 (Standard)
Expenditure Share	$\mu_{i,s}$	Data (WIOT)
Factor Endowment	H_i, L_i	Data (WIOT)
Factor Share	$\alpha^H_{i,s}$	Data (WIOT)
Input-Output Coef.	$\alpha^X_{i,r,s}, \alpha^A_{i,r,s}$	Data (WIOT) & Ding (2023)
Panel B: Time-Variant Shocks		
Automation Productivity	$\widehat{\psi^A_{i,s}}$	Match $\widehat{\Gamma^A_{i,s}}$
Offshoring Productivity (1/Cost)	$\widehat{\psi^O_{i,s}}$	Match $\widehat{\Gamma^O_{i,s}}$

RESULTS: CHANGES IN COMPARATIVE ADVANTAGE

1. Automation and Offshoring on Changes in $\widehat{\beta}$

- Question: How much can $\Gamma^{A}_{i,s,t}$ and $\Gamma^{O}_{i,s,t}$ explain the path of $\widehat{\beta}_t$?

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3. Construct counterfactual trade flow: $(X_{i,j,s,t})'$
   - Data (World Input-Output Database, incl. Service)
   - Case 1. Only Automation: Change $\Gamma^{A}_{i,s,t}$
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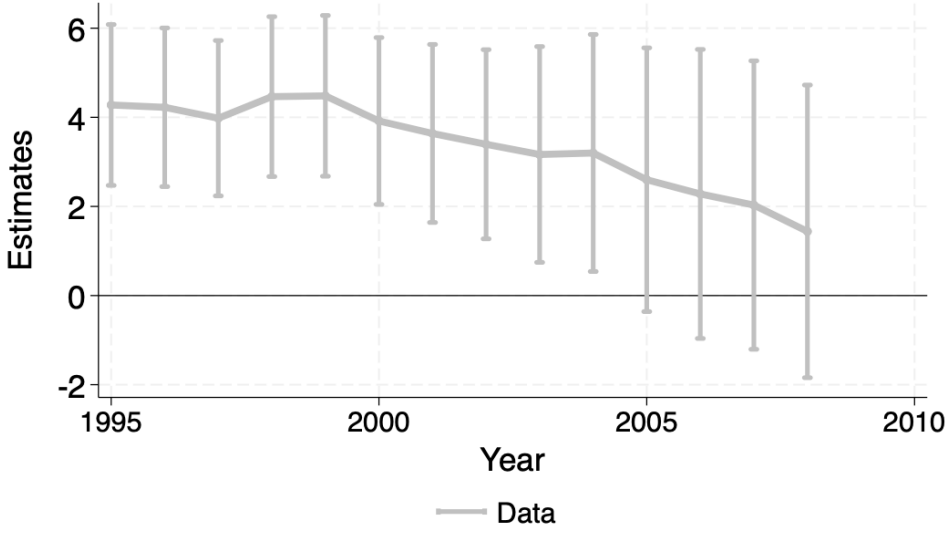
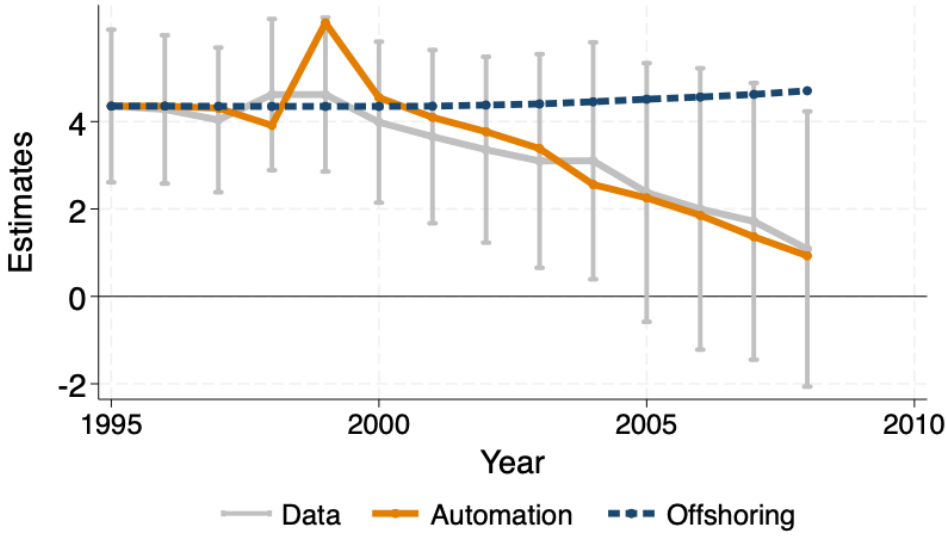
4. Run the same regression as in data but for counterfactual economies

$$\ln(X_{i,j,s,t})' = \beta_t \left[\alpha^{H}_{s,t_0} \times \ln\left(\frac{H_{i,t_0}}{L_{i,t_0}} \right) \right] + \eta_{i,j,t} + \eta_{j,s,t} + \varepsilon_{i,j,s,t}.$$

$\widehat{\beta}_t$ Decreases Even Using WIOD



Automation, Not Offshoring, Causes the Decline



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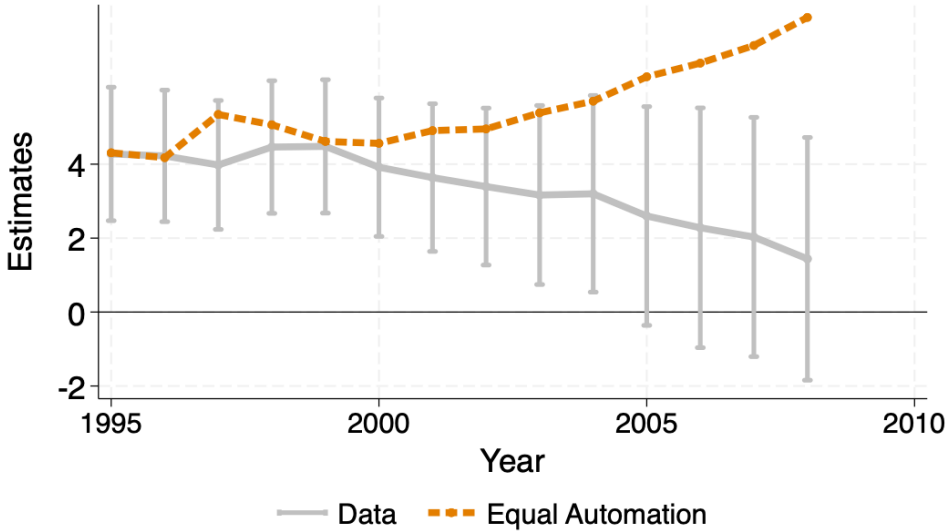
- Experiment: Suppose all the countries increase automation equally...

Equal Automation Cannot Explain the Decline



RESULTS: MACRO IMPLICATIONS OF AUTOMATION AND OFFSHORING

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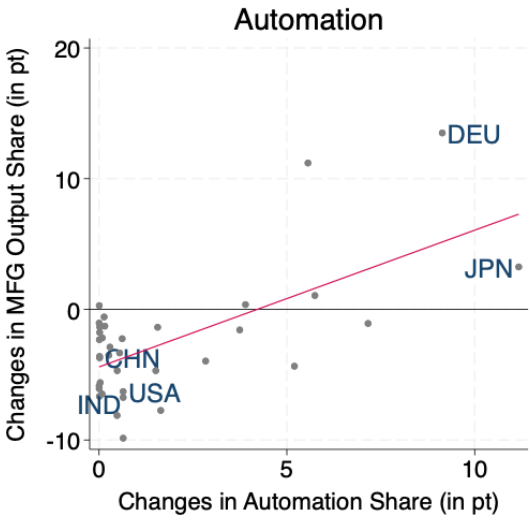
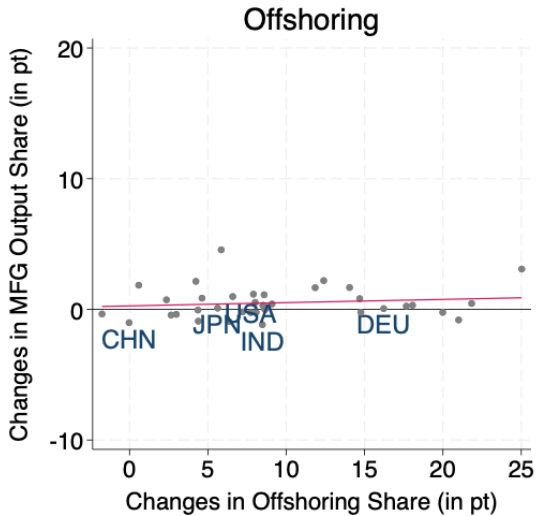
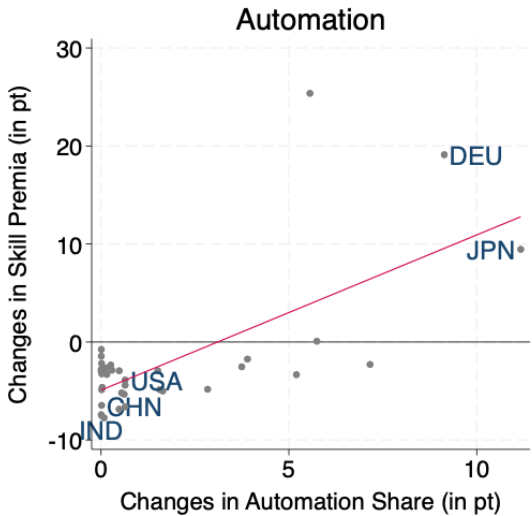
- “Causal effect” (model prediction), not aiming to explain these macro trends

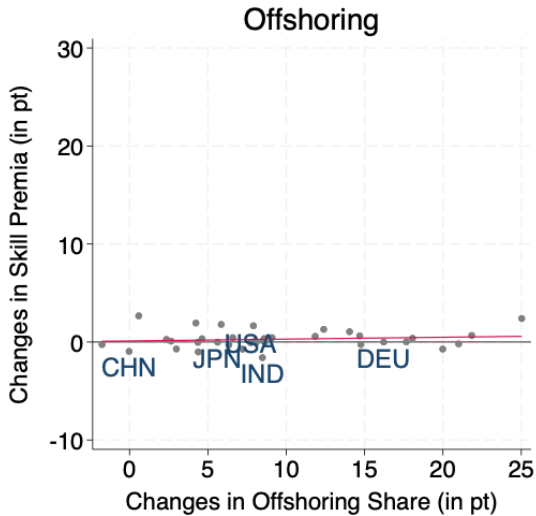
Manufacturing Shifts to High-Automation Countries



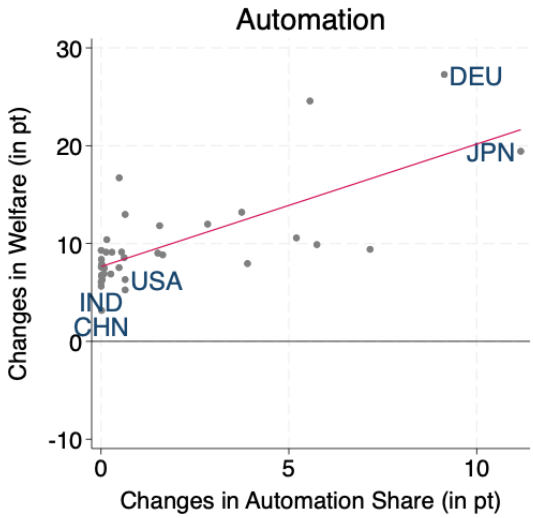


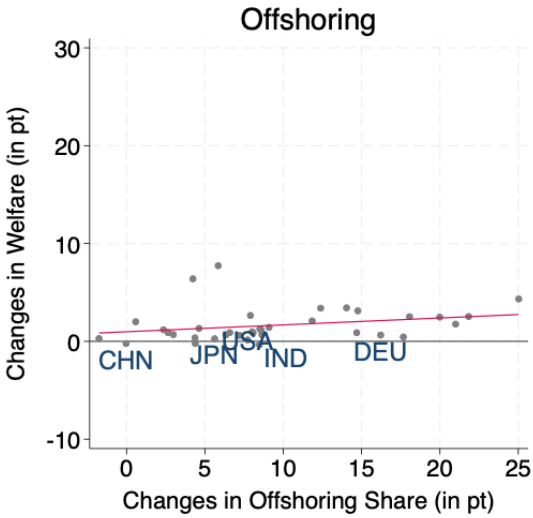
Skill Premia Increases Only in High-Automation Countries





Welfare Increases Everywhere





CONCLUSION

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  - Does this change in CA explain the middle-income traps?
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- Simulation with/without automation in the US
  - Case 1. Automation level in 2023
  - Case 2. Automation level in 1995

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	US	China	Canada	Mexico
Automation level in 1995				
Automation level in 2023				

Tariff Does Not Increase Welfare...

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Automation level in 2023	-1.1%	-1.0%	-1.3%	-1.3%

Even Worse with More Automation: Robots are from China

- Does automation reduce the cost of tariffs?
- Trump tariff, Season 2 (60% for China, 25% for Canada/Mexico)
  - compute welfare using the same model (multi-factor EK with IO linkages)

Welfare Effects of Trump Tariff (Season 2)

	US	China	Canada	Mexico
Automation level in 1995	-0.9%	-0.7%	-0.9%	-0.9%
Automation level in 2023	-1.1%	-1.0%	-1.3%	-1.3%

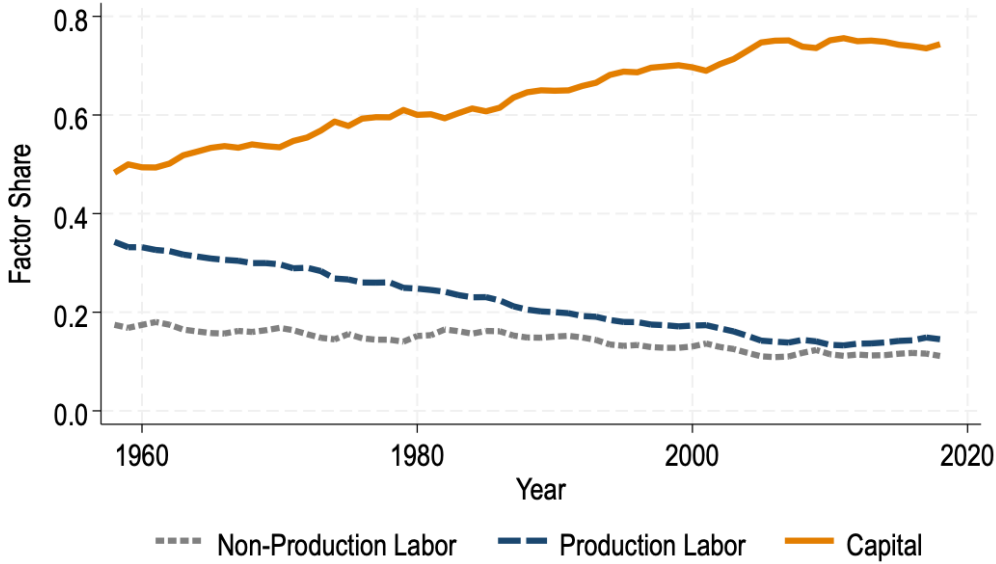
- Worse with more automation b/c **US imports machines and robots from China**
  - Machinery & mechanical appliances: about half of US imports from China

APPENDIX

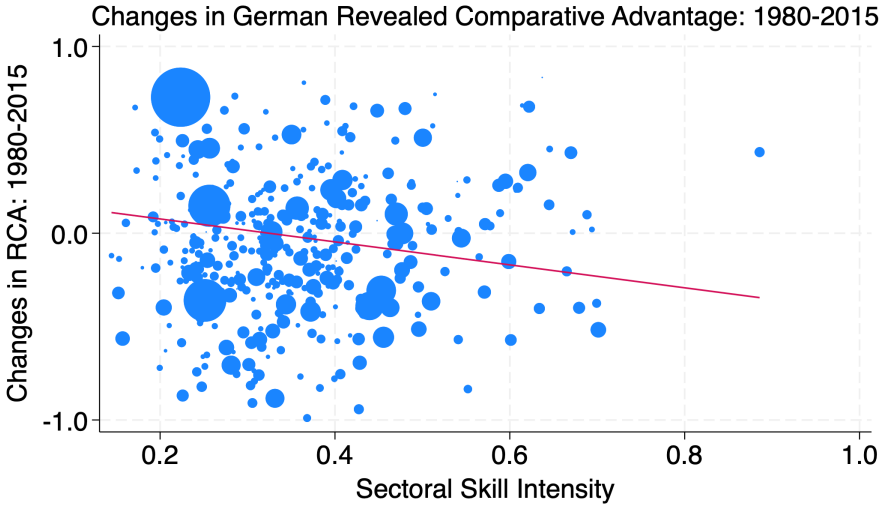
FACTS

Factor Share in the US over time

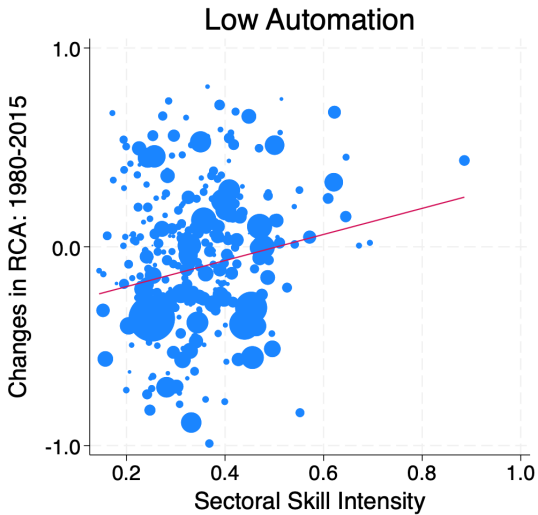
back

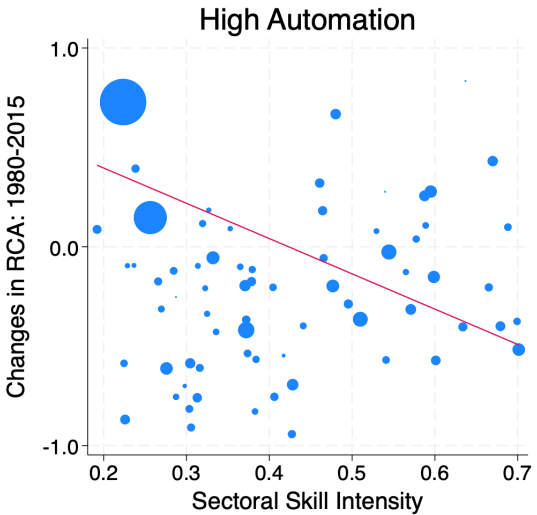


Germany


Changes in German Revealed Comparative Advantage: 1980-2015
Changes in RCA: 1980-2015
1.0
0.0
-1.0
0.2
0.4
0.6
0.8
1.0
Sectoral Skill Intensity

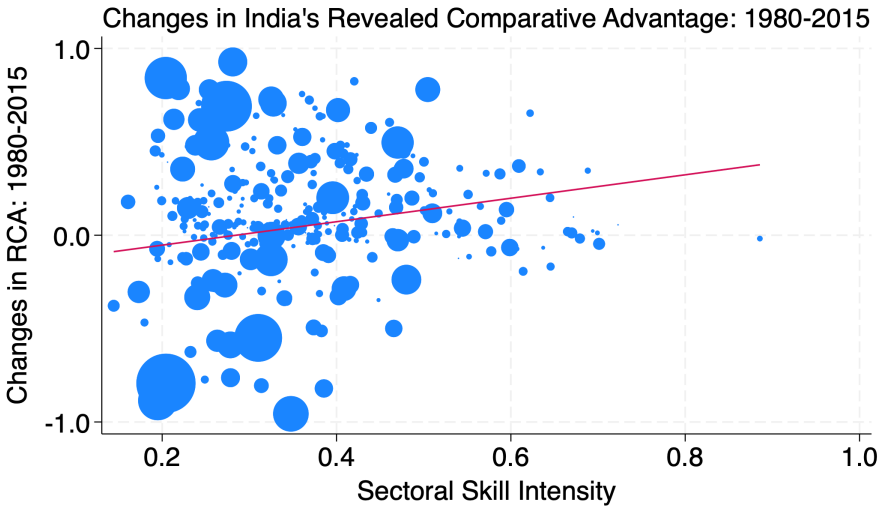
Germany by Degrees of Automation





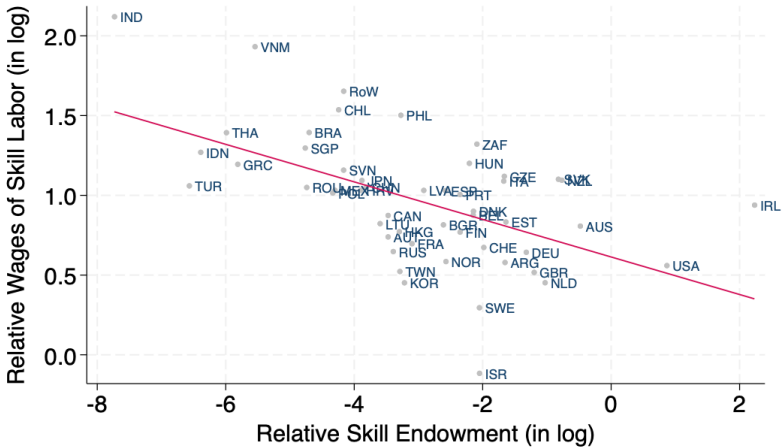
India

back


Changes in India's Revealed Comparative Advantage: 1980-2015
Changes in RCA: 1980-2015
1.0
0.0
-1.0
0.2
0.4
0.6
0.8
1.0
Sectoral Skill Intensity

Relative Skilled Wages Decreasing in Skill Endowment

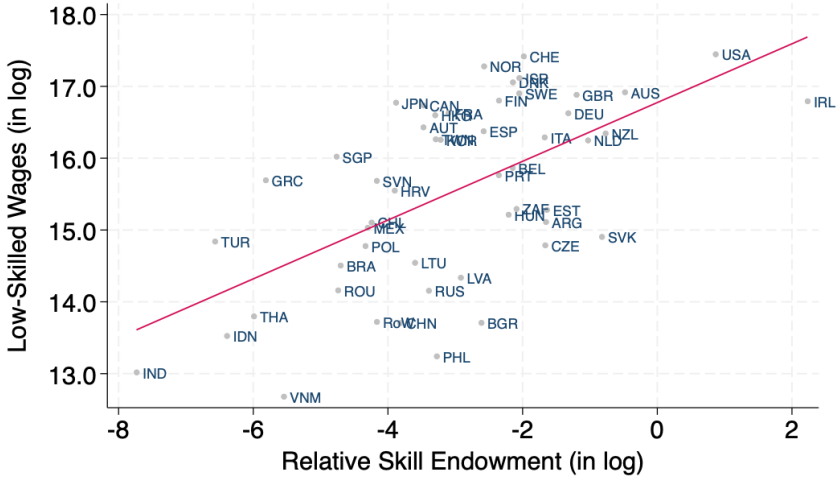
$$\ln(w_i^H/w_i^L) = -\gamma_{HL} \cdot \ln(H_i/L_i)$$



Note: Data from GTAP, 2004

Unskilled Wages Increasing in Skill Endowment

back



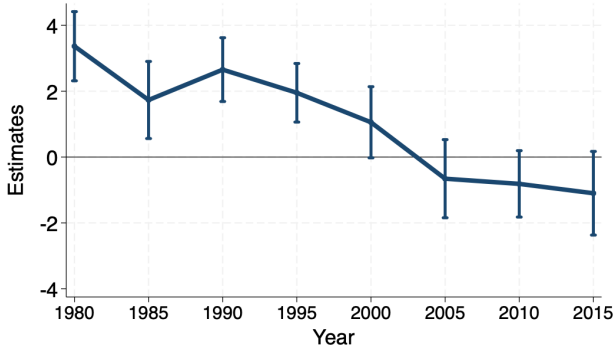
Note: Data from GTAP, 2004

ROBUSTNESS

Controlling Capital Intensity

back

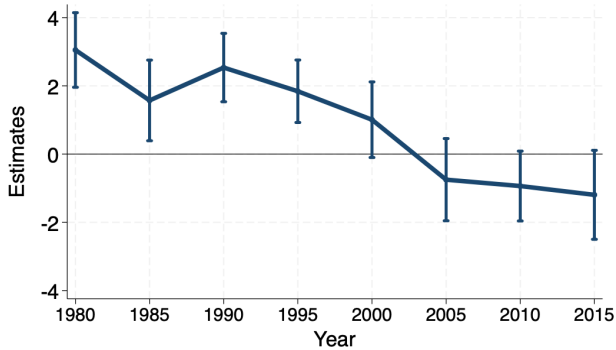
$$\ln X_{i,j,s,t} = \beta_t \left[\alpha^H_{s,t} \times \ln \left(\frac{H_{i,t}}{L_{i,t}} \right) \right] + \beta^K_t \left[\alpha^K_{s,t} \times \ln \left(\frac{K_{i,t}}{L_{i,t}} \right) \right] + \eta_{i,j,t} + \eta_{j,s,t}$$



Controlling Capital Intensity and Institutions

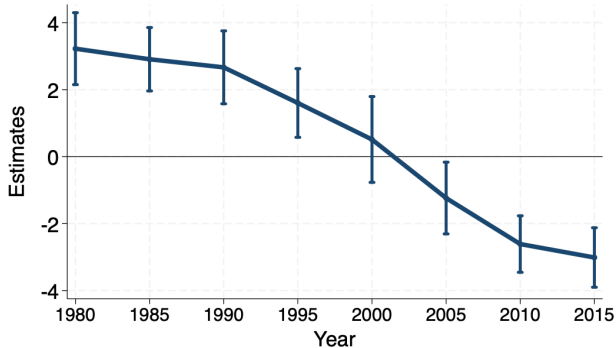
back

$$\ln X_{i,j,s,t} = \beta_t \left[\alpha^H_{s,t} \times \ln \left(\frac{H_{i,t}}{L_{i,t}} \right) \right] + \sum_{f \in \{K,I\}} \beta^F_t \left[\alpha^F_{s,t} \times \ln \left(\frac{F_{i,t}}{L_{i,t}} \right) \right] + \eta_{i,j,t} + \eta_{j,s,t}$$



Weighted by Country Export

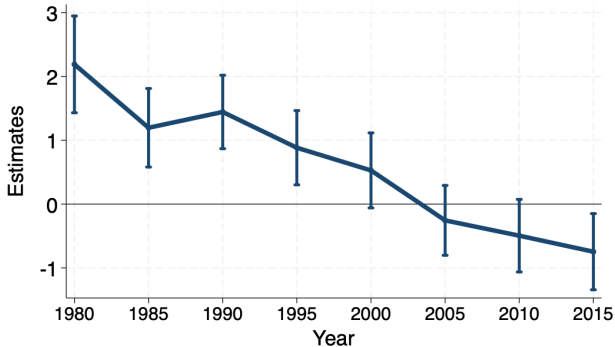
back



Pool and control Origin-Sector FEs

back

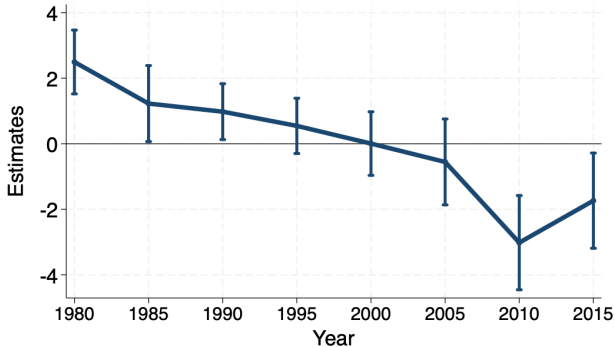
$$\ln X_{i,j,s,t} = \beta_t \left[\alpha^H_{s,t} \times \ln \left(\frac{H_{i,t}}{L_{i,t}} \right) \right] + \eta_{i,s} + \eta_{i,j,t} + \eta_{j,s,t}$$



High-school Graduates as Skilled

back

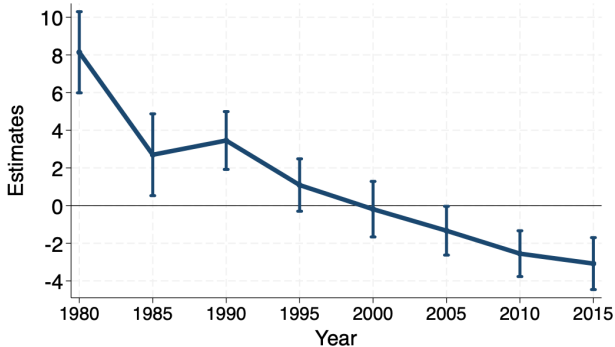
$$\ln X_{i,j,s,t} = \beta_t \left[\alpha^H_{s,t} \times \ln \left(\frac{HS_{i,t}}{NHS_{i,t}} \right) \right] + \eta_{i,j,t} + \eta_{j,s,t}$$



Instrument Skill Endowment by Cohort IV

back

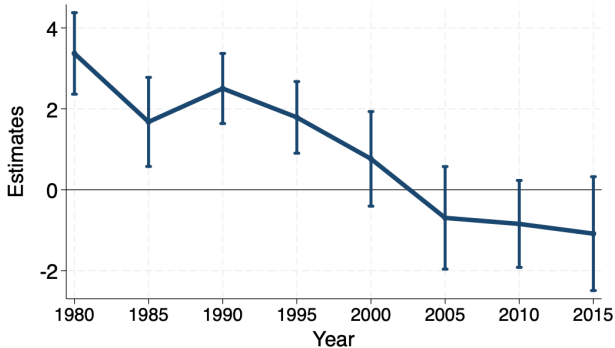
$$\ln X_{i,j,s,t} = \beta_t \left[\alpha^H_{s,t} \times \ln \left(\frac{H_{i,t}}{L_{i,t}} \right) \right] + \eta_{i,j,t} + \eta_{j,s,t}$$



Romalis (2004): Total Export

back

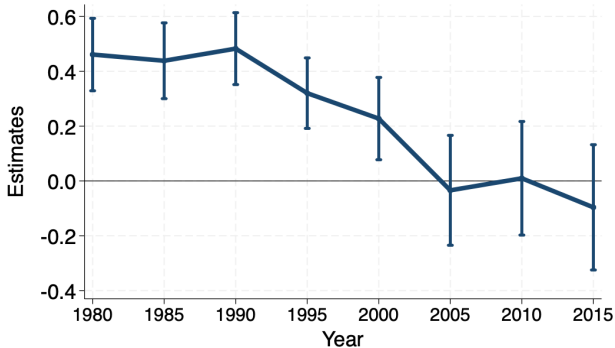
$$\ln X_{i,s,t} = \beta_t \left[\alpha^H_{s,t} \times \ln \left(\frac{H_{i,t}}{L_{i,t}} \right) \right] + \eta_{i,t} + \eta_{s,t}$$



Chor (2011): Num of Workers as Factor Intensity

back

$$\ln X_{i,j,s,t} = \beta_t \left[\ln \left(\frac{H_{s,t}}{L_{s,t}} \right) \times \ln \left(\frac{H_{i,t}}{L_{i,t}} \right) \right] + \eta_{i,j,t} + \eta_{j,s,t}$$

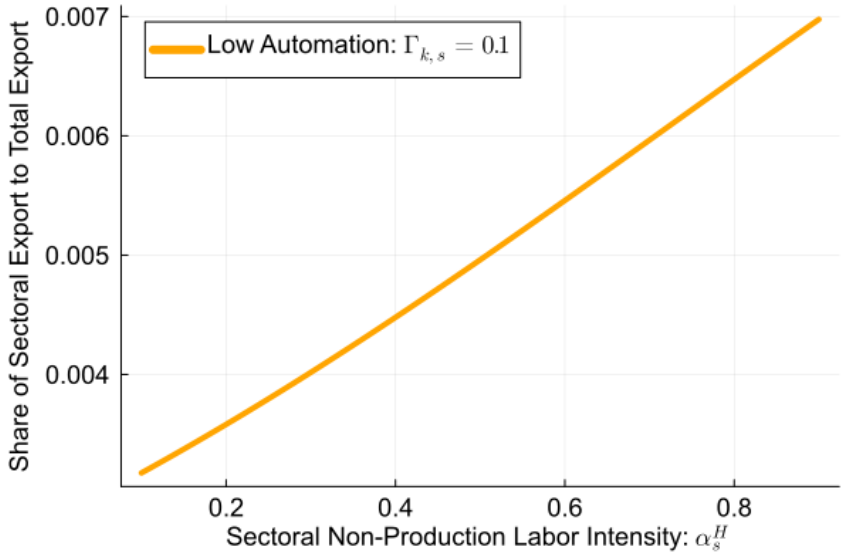


TWO COUNTRY ILLUSTRATION: AUTOMATION

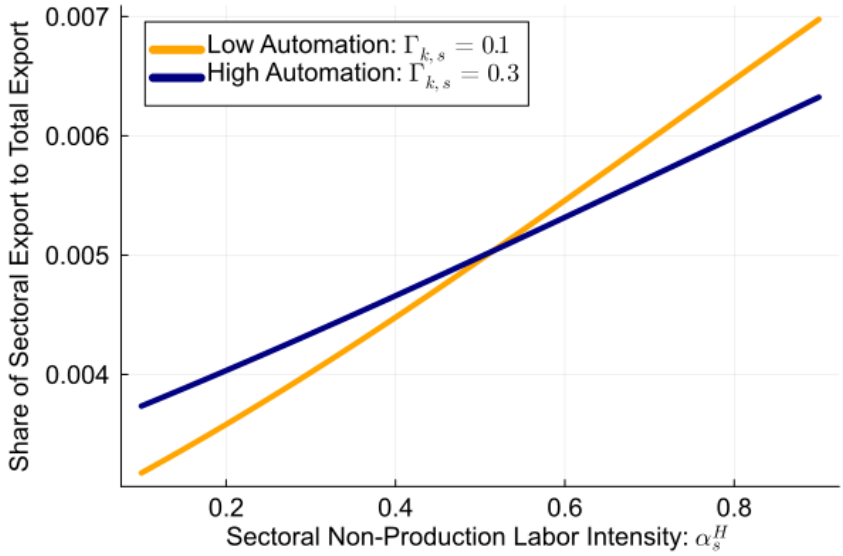
Two Country Illustration: Automation

- North (40% are H) and South (25% are H)
- Actual factor intensity across 397 SIC sectors
- Set $\alpha_s^G = \alpha_s^M = 0$ (focus on value-added)
- Exogenous changes in factor intensity common across sectors & countries
  - Automation: Increase $\Gamma_{i,s}^K = 0.1$ to 0.3
- Show export share of each sector in North against α_s^H – Slope is β^H

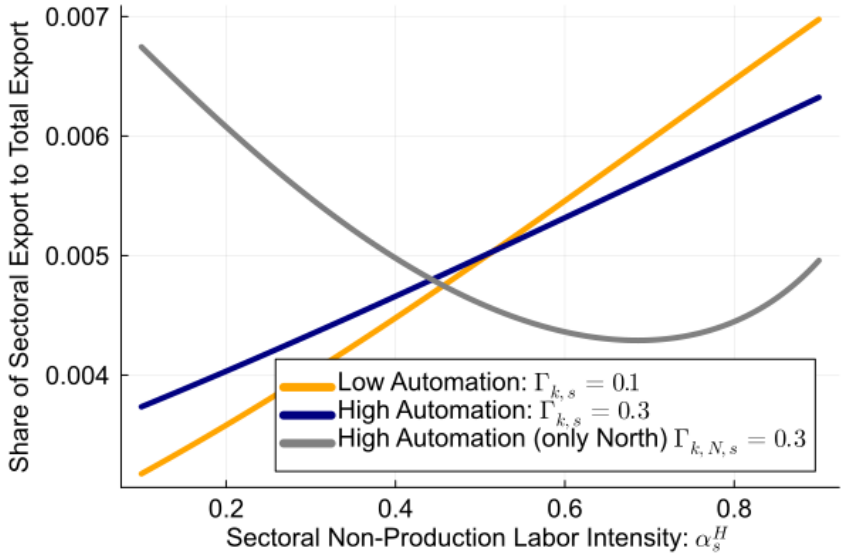
North Specialize in Skill-Intensive Sectors



Automation Makes Skills Less Important

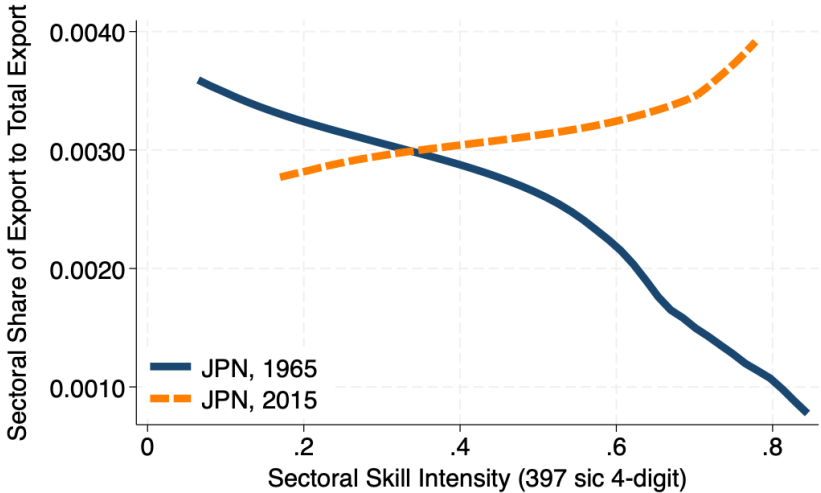


If Only North Automates, Sign Flips



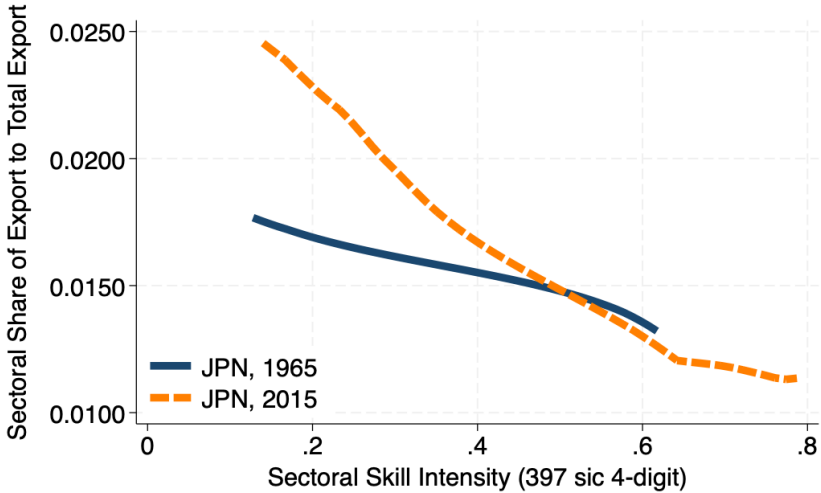
Example: Within Low-Automation Sectors, Japan Specializes in Skill Intensive Industries

Back



Example: Within High-Automation Sectors, Japan Specializes in Low-Skill Intensive Industries

Back



TOY MODEL: TASK AND COMPARATIVE ADVANTAGE

Model

- Small open economy with two sectors ($s = 1, 2$)
- Demand

$$q_S = (c_S)^{1-\sigma} \cdot \overline{Q_S}$$

- Production (micro-foundation = task framework)

$$Y_S = \zeta \cdot (H_S)^{\alpha_S} \left((L_S)^{\Gamma} (M_S)^{1-\Gamma} \right)^{1-\alpha_S}, \quad \alpha_1 = 1 - \alpha_2 = \alpha > 1/2$$

  - M_S: machines or foreign factors supplied at a fixed price r

- Factor market clearing

$$\sum_{s=1,2} H_S = H, \quad \sum_{s=1,2} L_S = L$$

Equilibrium

- Wages $\{w^L, w^H\}$ that satisfy

$$w^L L = \Gamma(1-\alpha)(c_1)^{1-\sigma} + \Gamma\alpha(c_2)^{1-\sigma}, \quad w^H H = \alpha(c_1)^{1-\sigma} + (1-\alpha)(c_2)^{1-\sigma}$$

- Unit cost

$$c_s = \left(w^H\right)^{\alpha_s} \left((w^L)^{\Gamma}(r)^{1-\Gamma}\right)^{1-\alpha_s}$$

Comparative Advantage

- A change in factor endowment $\widehat{H} = -\widehat{L}$ (=compare two small countries)
- Up to 1st order, CA in H-intensive sector ($s = 1$)

$$\widehat{c_2} - \widehat{c_1} = \underbrace{-(2\alpha - 1)\widehat{\omega}}_{\text{Skill Premium}<0} \quad \underbrace{-(1 - \Gamma)(2\alpha - 1)\widehat{w^L}}_{\text{Task Displacement}}$$

- Skill premium ($\widehat{\omega} \equiv \widehat{w^H} - \widehat{w^L}$) and wages

$$\widehat{\omega} = \underbrace{-2\widehat{H}}_{\text{Labor Supply}} + \underbrace{(2\alpha - 1)(\sigma - 1)\left(\widehat{c_2} - \widehat{c_1}\right)}_{\text{GE Effect}}, \quad \widehat{w^L} = \frac{(\sigma - 1)(2\alpha - 1) - 1}{2 + (1 - \Gamma)(\sigma - 1)(2\alpha - 1)}\widehat{\omega}$$

Comparative Advantage if $\Gamma = 1$

Proposition 1: Rybczynski (1955)

An increase in skilled labor $\widehat{H} > 0$ strengthens comparative advantage in a skill-intensive sector.

$$\widehat{c_2} - \widehat{c_1} = \frac{2(2\alpha - 1)}{1 + (2\alpha - 1)^2(\sigma - 1)}\widehat{H}$$

Comparative Advantage if $\Gamma < 1$

Proposition 2: Acemoglu-Restrepo meets Rybczynski

An increase in skilled labor $\widehat{H} > 0$ strengthens comparative advantage in a skill-intensive sector. However, the elasticity is lower when labor share Γ is lower.

$$\widehat{c_2} - \widehat{c_1} = \frac{2(2\alpha - 1)}{\frac{1}{\eta(\Gamma)} + (2\alpha - 1)^2(\sigma - 1)}\widehat{H} \tag{1}$$

where $\eta(\Gamma) = 1 - \frac{1-(\sigma-1)(2\alpha-1)}{\frac{2}{1-\Gamma}+(\sigma-1)(2\alpha-1)} \in (0, 1)$ is increasing in Γ.

ROLES OF CHANGES IN COMPARATIVE ADVANTAGE FOR INCIDENCE OF AUTOMATION

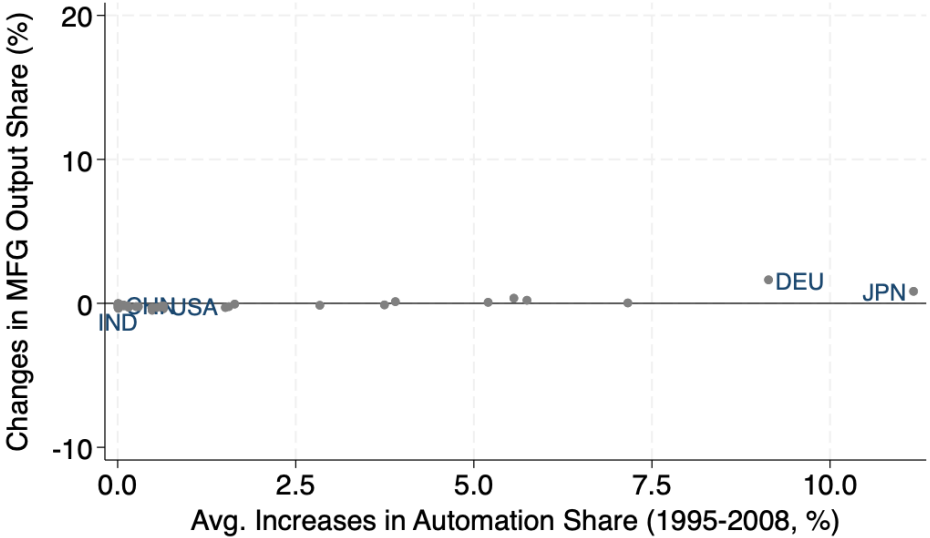
Automation, Globalization, and Inequality

- Automation $\rightarrow$ shifts MFG to High-Automation countries
- Demand for H increases in High-Automation countries
- Demand for L increases in Low-Automation countries
  - Move to Service sectors, which are more L–intensive

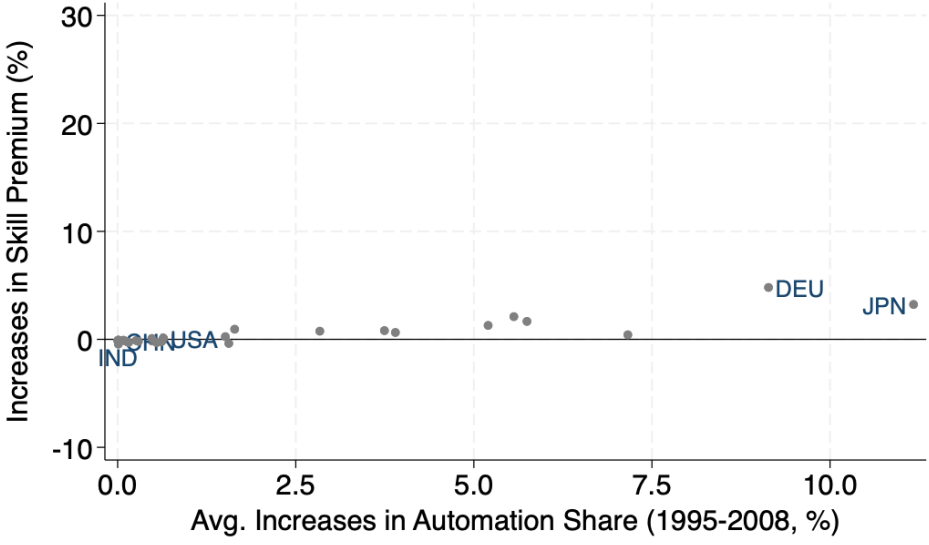
Automation, Globalization, and Inequality

- Automation $\rightarrow$ shifts MFG to High-Automation countries
- Demand for H increases in High-Automation countries
- Demand for L increases in Low-Automation countries
  - Move to Service sectors, which are more L–intensive
- Roles of Trade?
  - Now, set the trade elasticity $\theta = 1$, instead of $\theta = 4$
  - This kills sectoral reallocation via expenditure switch across countries

θ = 1: Lower Elas. Makes MFG Shifts Less



$\theta = 1$: Skill Premia Increases Everywhere



$\theta = 1$: Welfare Increases Everywhere, but Less