Does Skill Abundance Still Matter?

The Evolution of Comparative Advantage in the 21st Century

Shin Kikuchi, MIT

January 16, 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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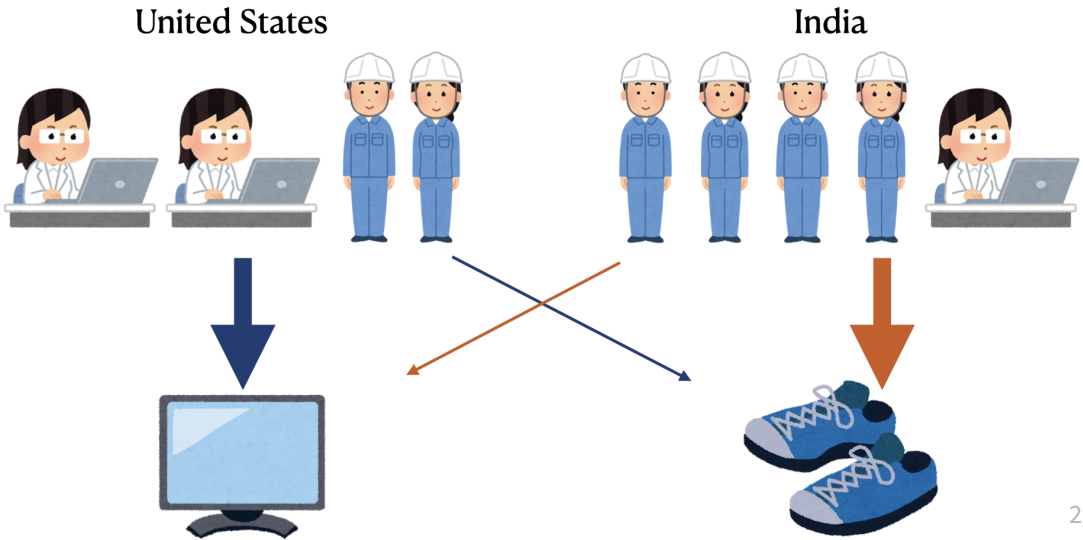

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- **This paper: What about the 21st century?**

At a Glance: Skill Abundance and Comparative Advantage

G10’s Revealed Comparative Advantage (RCA) in Skill Intensive Sectors:

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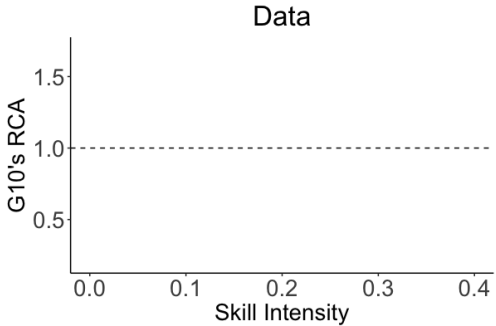

Note: Binned-scatter plots for 396 4-digit sectors. Data from UN Comtrade and NBER CES Manuf. DB

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G10's Revealed Comparative Advantage (RCA) in Skill Intensive Sectors:

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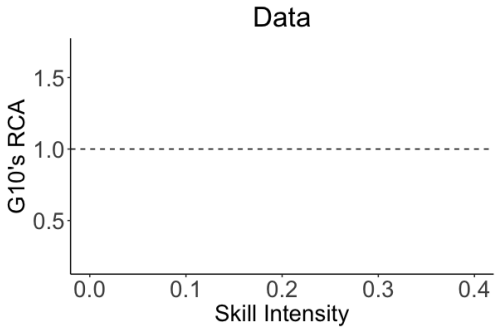

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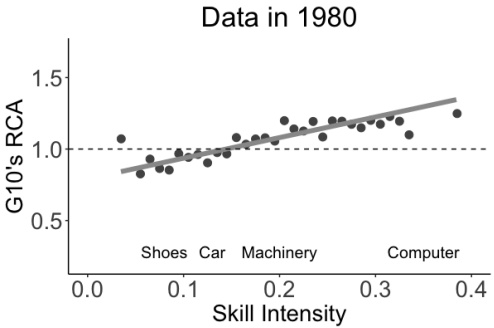

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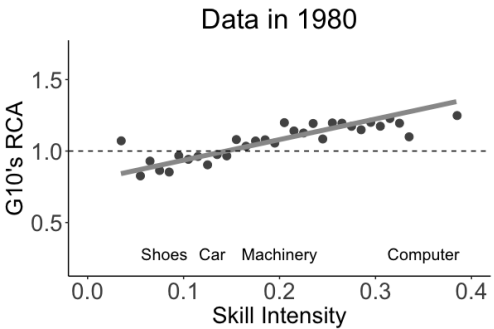

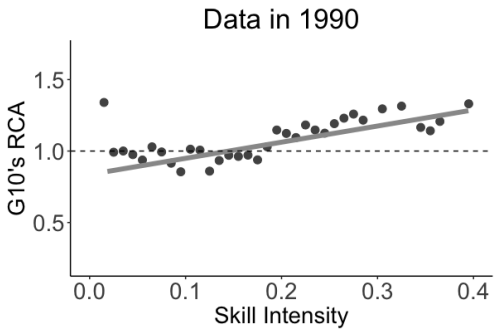

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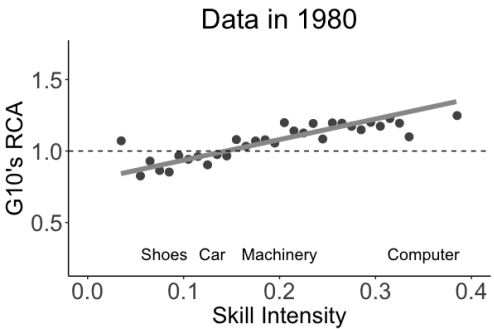

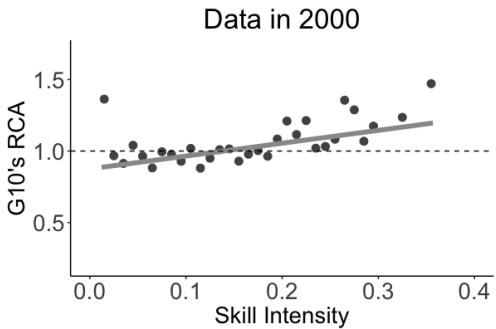

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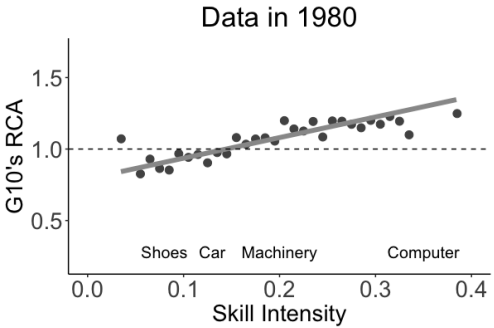

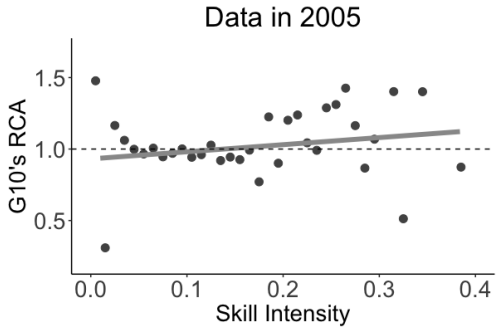

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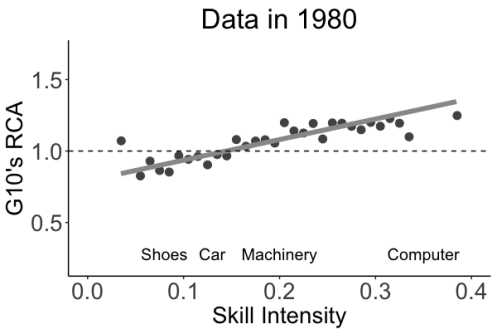

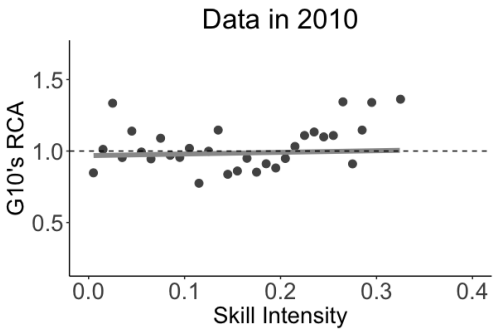

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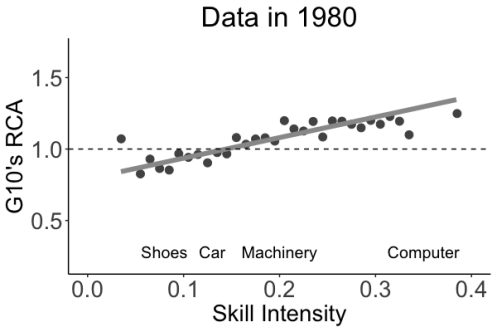

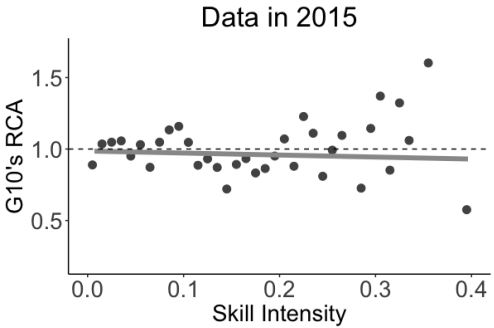

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3. What are the macro implications?
   - Manufacturing shifts to North; Inequality expands within & across countries

Key Contributions

1. **New Facts on the sources of comparative advantage:**
   - **Ricardian:** MacDougall (1951), Stern (1962), Balassa (1963), Golub & Hsieh (2000), Nunn (2007), Levchenko (2007), Manova (2008), Costinot (2009), **Costinot et al (2012)**
   - **HO:** Leamer (1980, 1984), Bowen et al (1987), Trefler (1993, 1995), Harrigan (1997), Davis & Weinstein (2001), Schott (2001), **Romalis (2004)**, Morrow (2010), **Chor (2010)**
   - **Mean Reversion:** Levchenko & Zhang (2016), Hanson, Lind, Muendler (2018)

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$\rightarrow$ **Skill abundance matter in 1980s; Not anymore post-2000.**

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2. **Consequences of technology and globalization on inequality:**
   - **Technology:** Katz & Murphy (1992), Berman et al (1994), Acemoglu (2002), Autor et al (2003), Acemoglu & Autor (2011), Autor & Dorn (2013), **Acemoglu & Restrepo (2018,2022)**
   - **Offshoring: Feenstra & Hanson (1997, 1999, 2001), Grossman Rossi-Hansberg (2008, 2012)**, Hummels et al (2014), Boehm et al (2020)
   - **Interaction of Tech and Trade:** Xu (2001), Acemoglu (2002), Thoenig & Verdier (2003), Burstein et al (2013), Parro (2013), Burstein & Vogel (2017), Morrow & Trefler (2022)
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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**

Skill Abundance as a Source of Comparative Advantage

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

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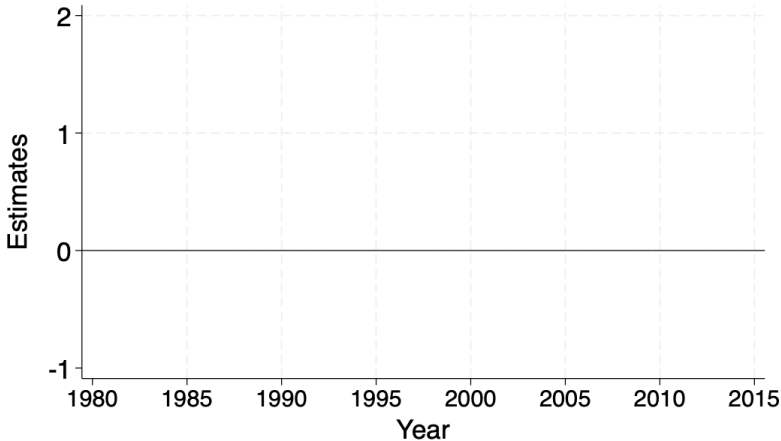

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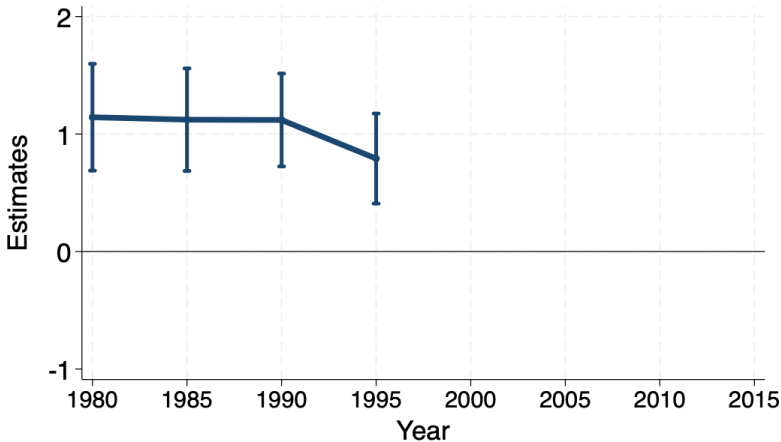
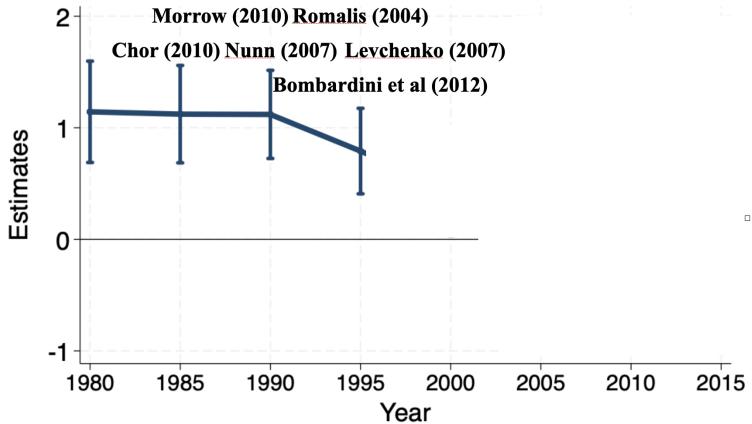


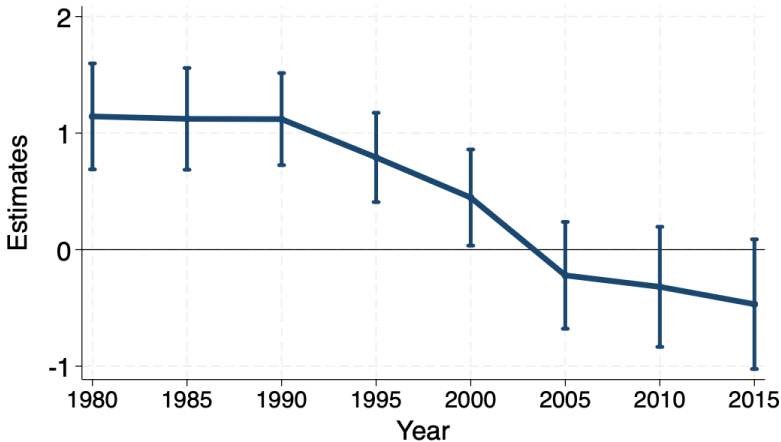
Results before 2000 are Consistent with Previous Papers

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



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

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

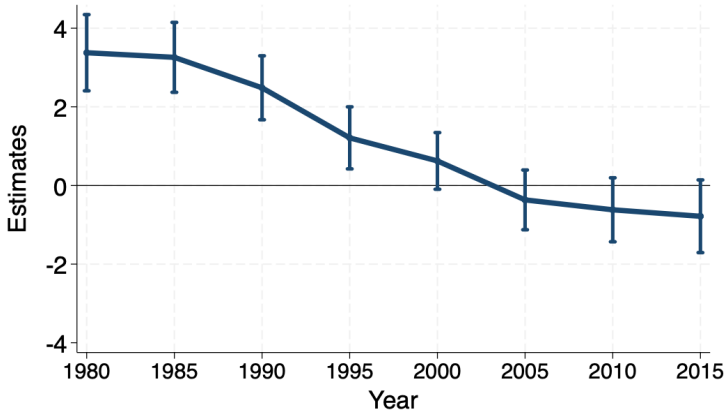


Fixing RHS at 1980's values

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

Change in Patterns of CA Comes from Exports

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

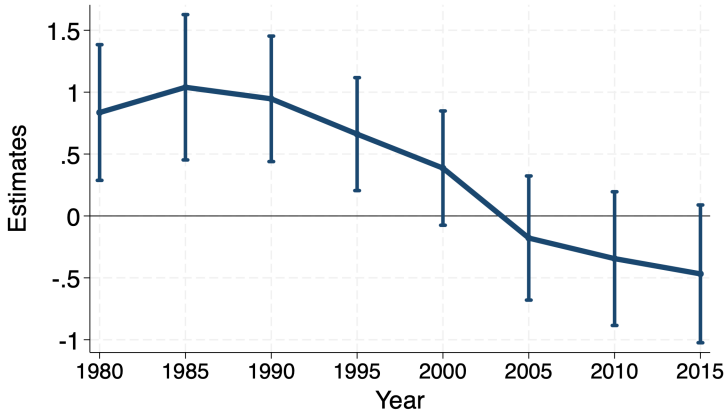


Fixing RHS at 2015's values

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

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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  - 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)
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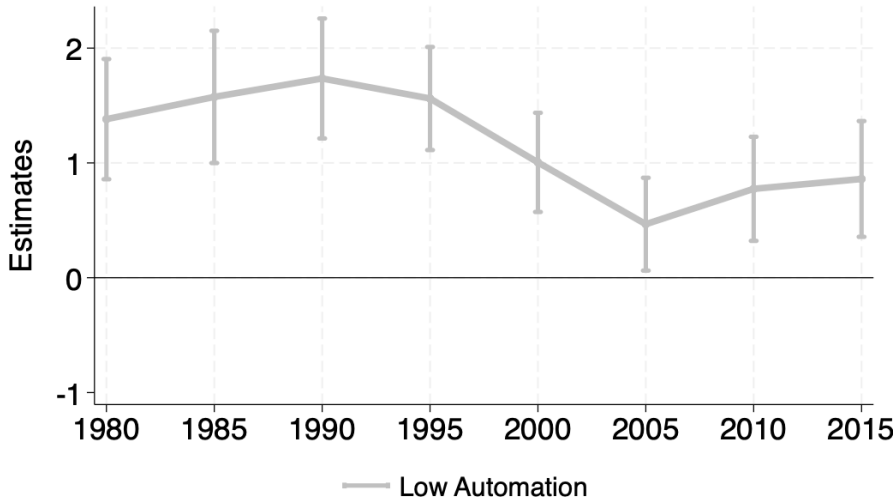
- Expect β_t^A to decrease if there is a relationship btw change & automation

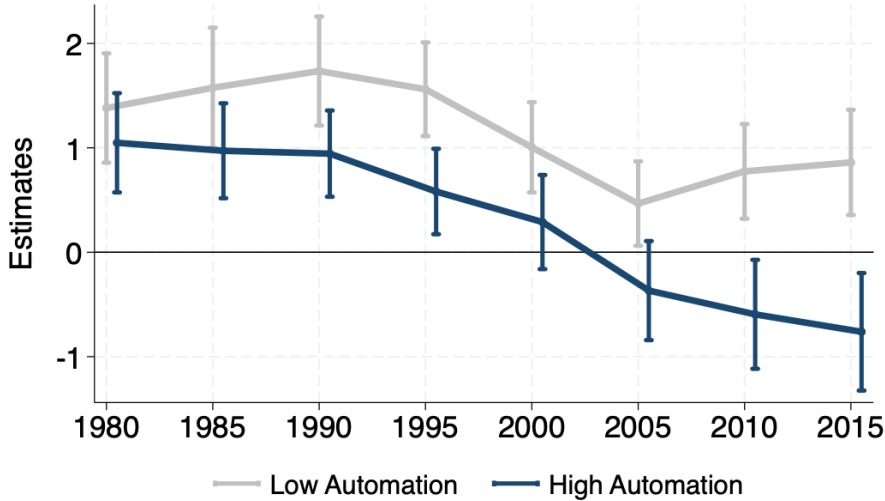
Skill Abundance Still Matters Absent Automation

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



Skill Abundance Still Matters Absent Automation

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



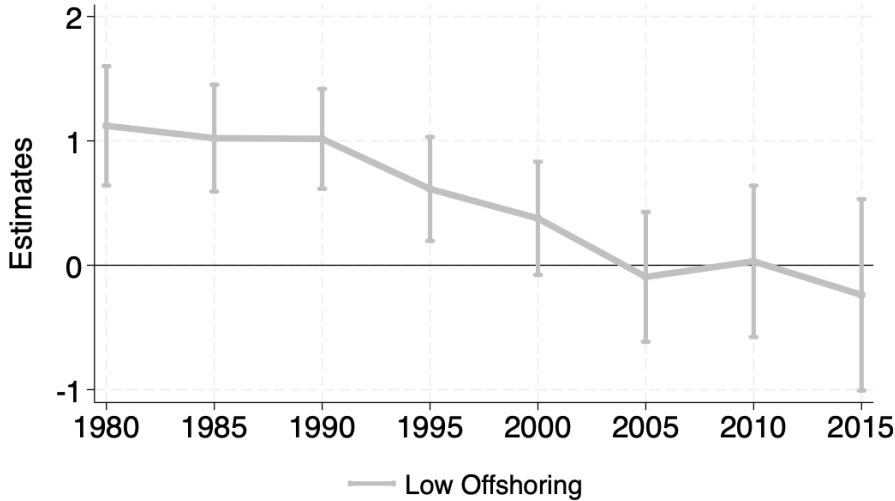
Specification for Heterogeneous Effects: Offshoring

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

- $HO_{i,s}$: 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

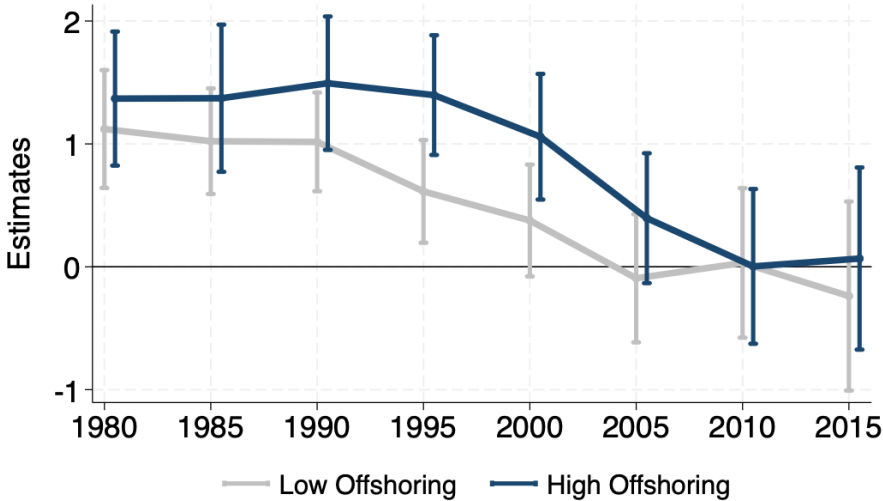
Skill Abundance does not Matter Even Absent Offshoring

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



Skill Abundance does not Matter Even Absent Offshoring

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



Summary of Empirical Facts

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

QUANTITATIVE MODEL: TRADE WITH AUTOMATION AND OFFSHORING

Model: Overview

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

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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)

Quantitative Analysis: Effects of Automation and Offshoring

- Two Exercises:
  1. Can changes in automation and offshoring explain $\widehat{\beta}_t$?
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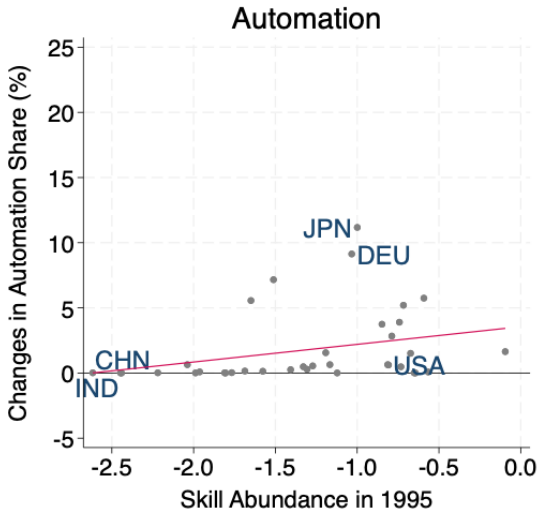
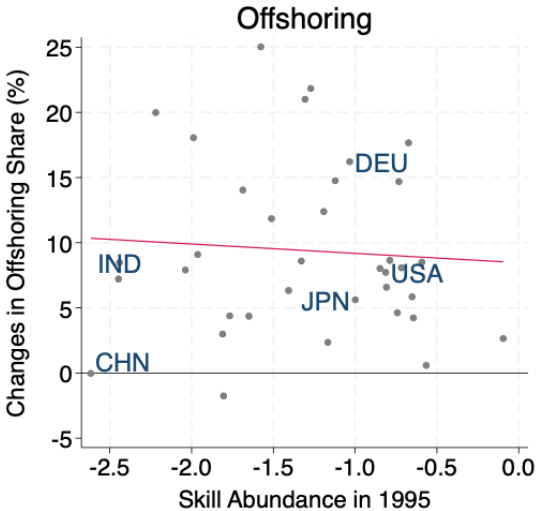
- **Automation and Offshoring Shocks:** Changes in productivity to match

Data: More Automation in Skill-Abundant Countries





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

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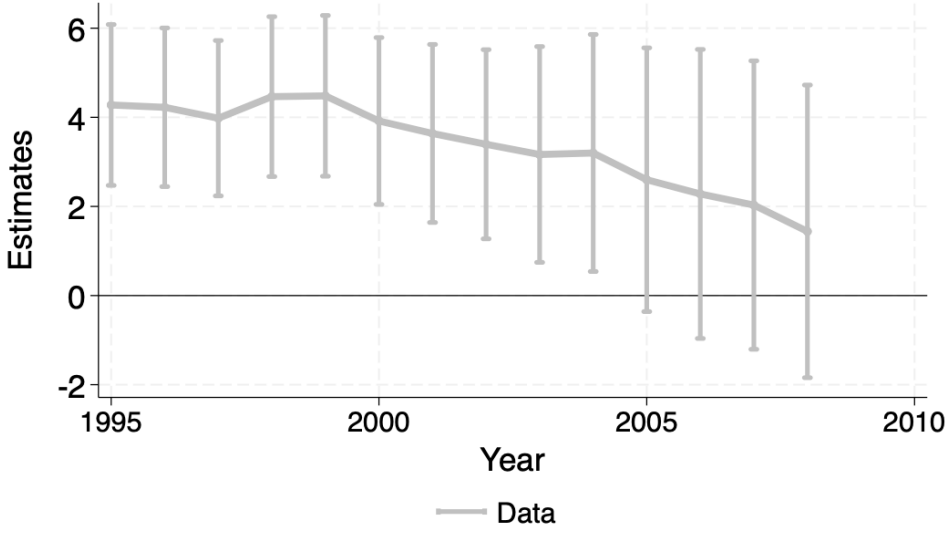
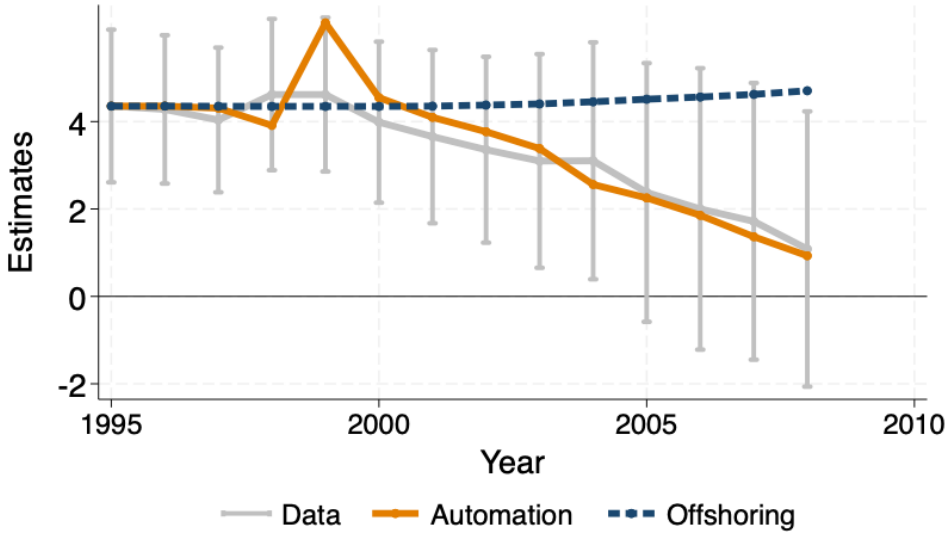
4. Run the same regression as in data but for counterfactual economies

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

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



Automation, Not Offshoring, Causes the Decline



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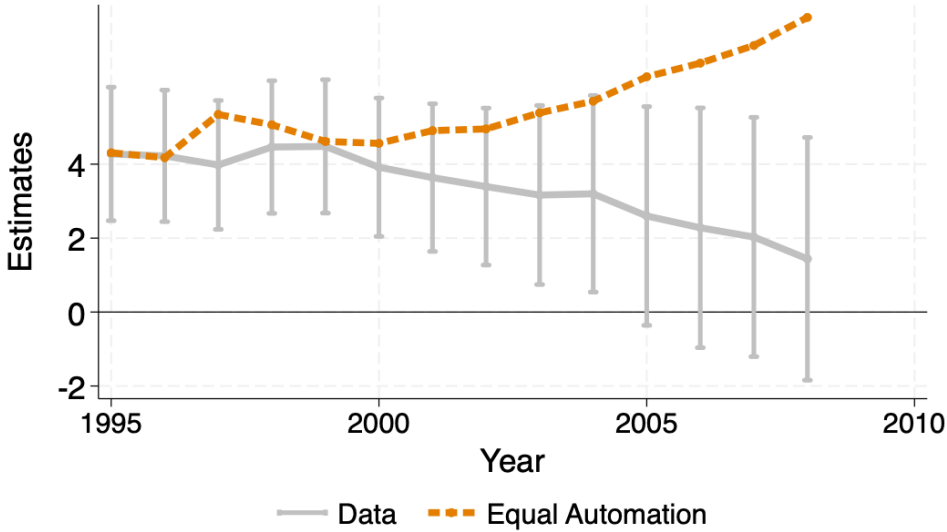
- Why does automation, not offshoring, matter?
- One observation: Automation happens disproportionately in $L-$ scarce countries
- Experiment: Suppose all the countries increase automation equally...

Equal Automation Cannot Explain the Decline



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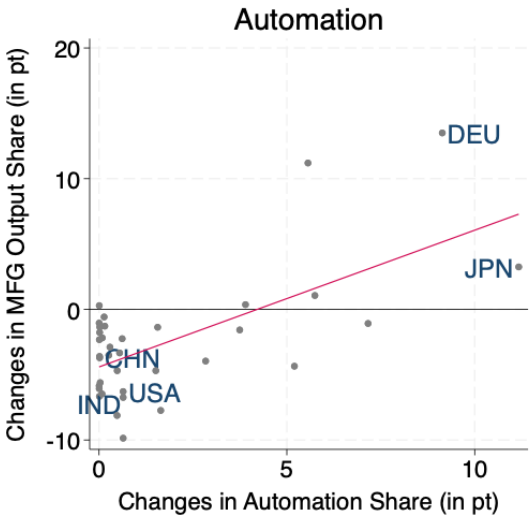
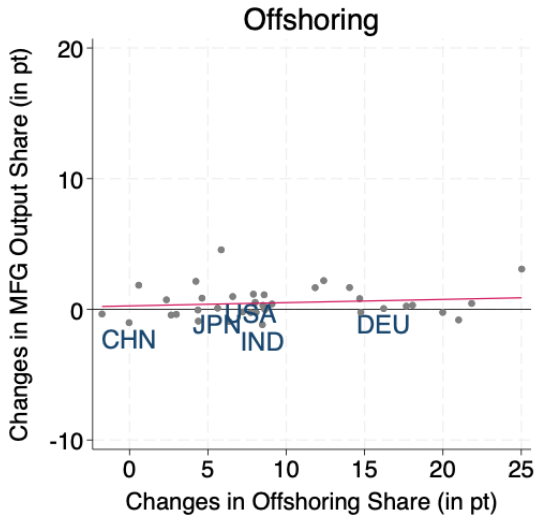
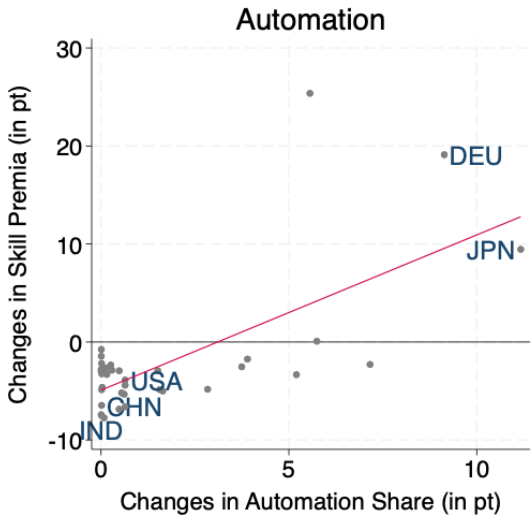
  - Welfare (inequality across countries)
- “Causal effect” (model prediction), not aiming to explain these macro trends

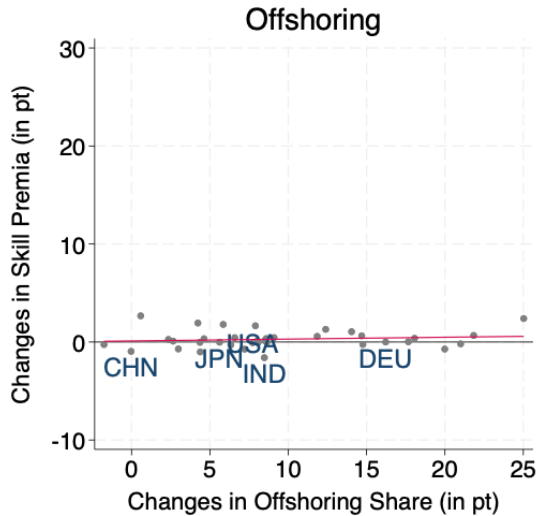
Manufacturing Shifts to High-Automation Countries



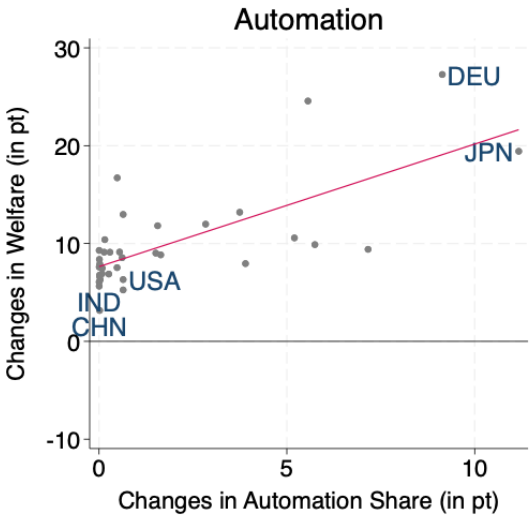


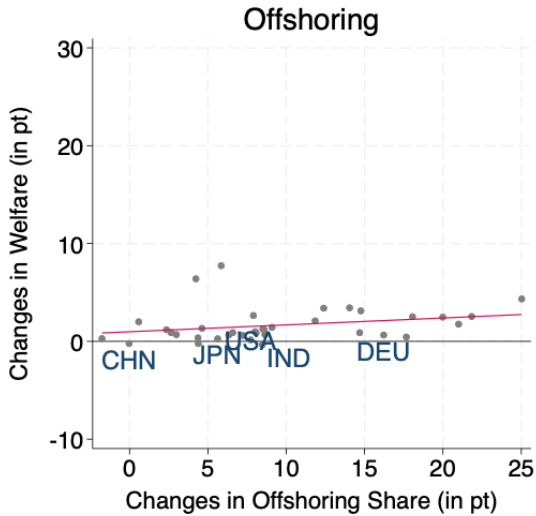
Skill Premia Increases Only in High-Automation Countries





Welfare Increases Everywhere





CONCLUSION

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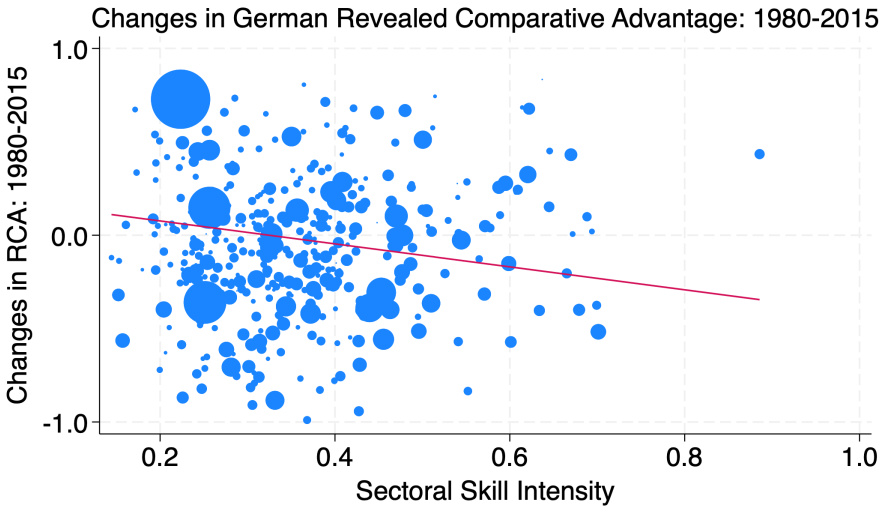
  - **Automation** causes the decline; Offshoring has small effects
- Automation relocates manufacturing from South to North
  - Inequality within & across countries increases
- Work in progress:
  - Does automation facilitate reshoring and reduce the costs of decoupling?
  - Does this change in CA explain the middle-income traps?
  - Does a robot tax *import* China shocks and backfire in an open economy?
  - Will AI erode the comparative advantage of skill-abundant countries?

APPENDIX

FACTS

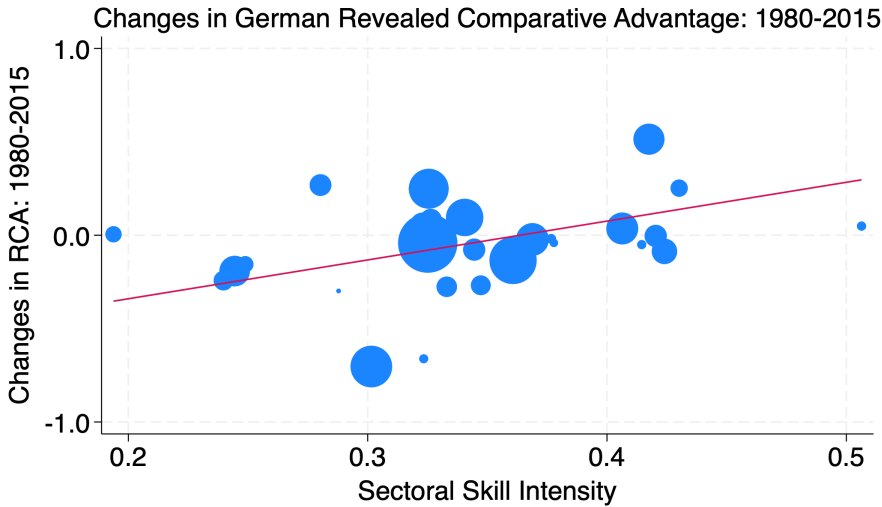
Germany

back



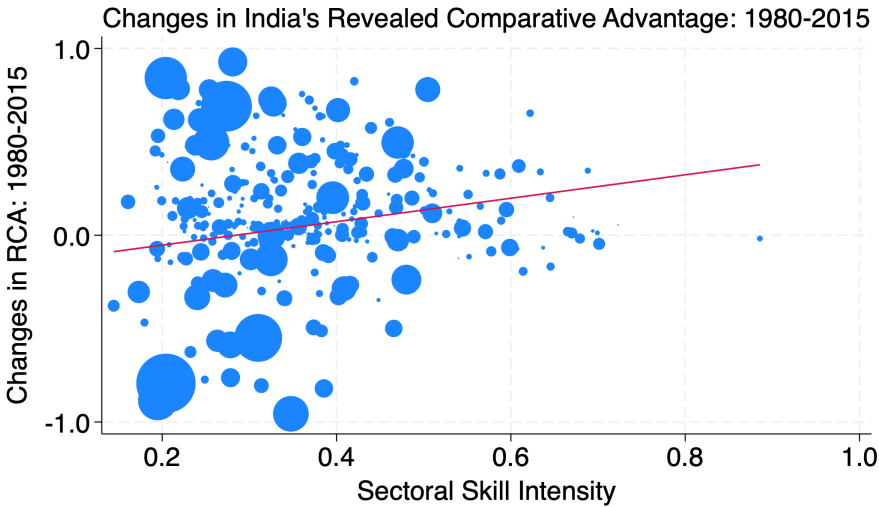
Germany (Low-Automation)

back



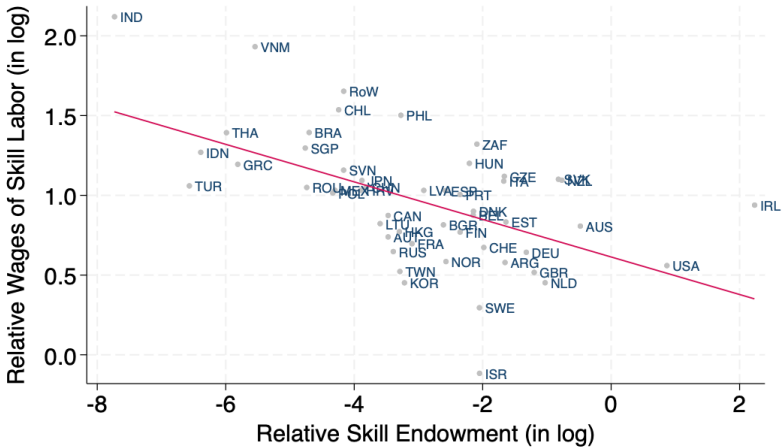
India

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

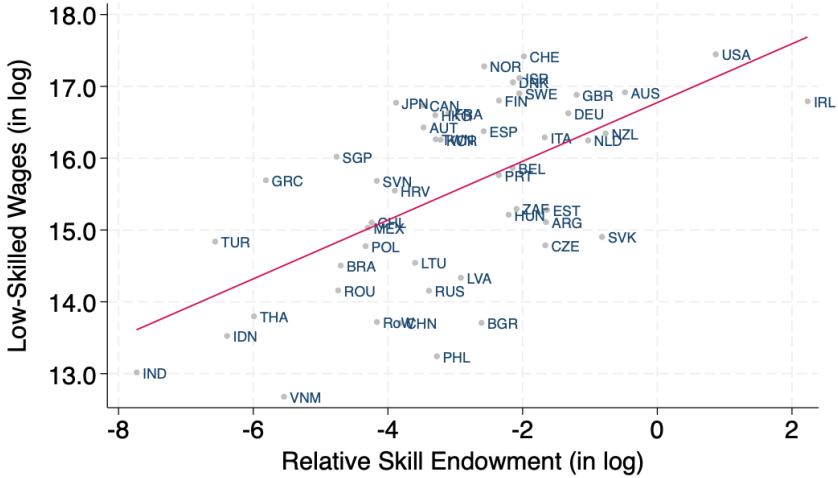
$$\ln(w_i^H/w_i^L) = -\gamma_{HL} \cdot \ln(H_i/L_i)$$



Note: Data from GTAP, 2004

Unskilled Wages Increasing in Skill Endowment

back



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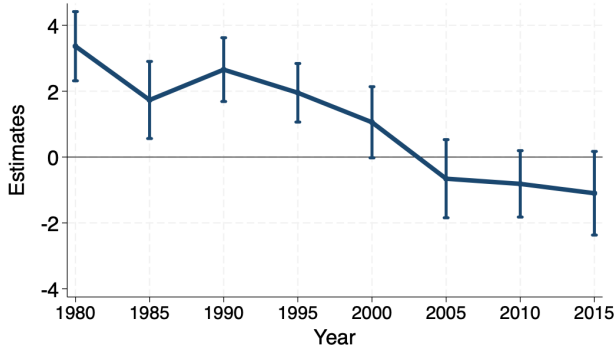
ROBUSTNESS

Controlling Capital Intensity

back

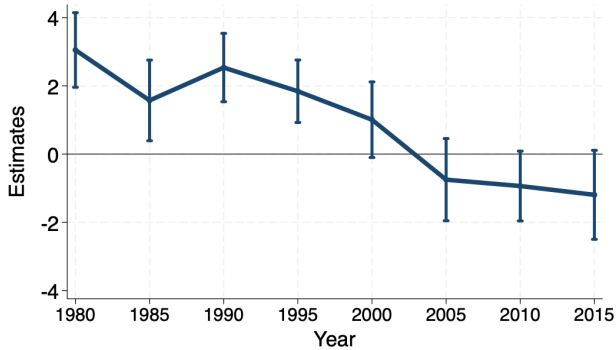
$$\ln X_{i,j,s,t} = \beta_t \left[\alpha^H_{s,t} \times \ln \left(\frac{H_{i,t}}{L_{i,t}} \right) \right] + \beta^K_t \left[\alpha^K_{s,t} \times \ln \left(\frac{K_{i,t}}{L_{i,t}} \right) \right] + \eta_{i,j,t} + \eta_{j,s,t}$$



Controlling Capital Intensity and Institutions

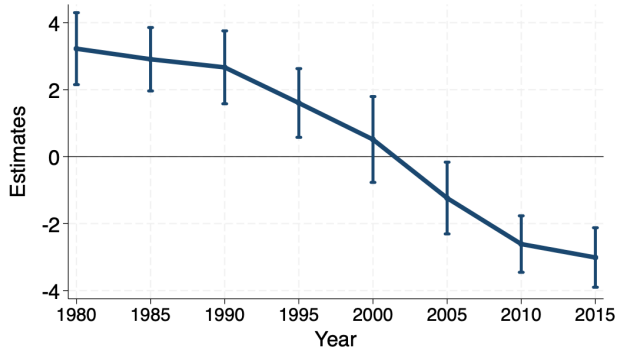
back

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



Weighted by Country Export

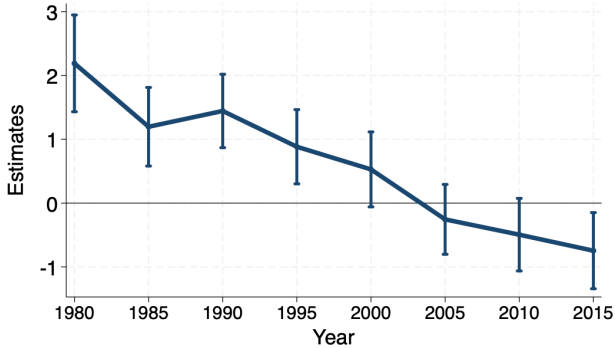
back



Pool and control Origin-Sector FEs

back

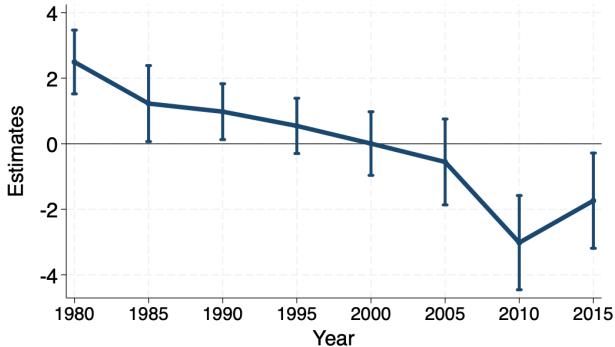
$$\ln X_{i,j,s,t} = \beta_t \left[\alpha^H_{s,t} \times \ln \left(\frac{H_{i,t}}{L_{i,t}} \right) \right] + \eta_{i,s} + \eta_{i,j,t} + \eta_{j,s,t}$$



High-school Graduates as Skilled

back

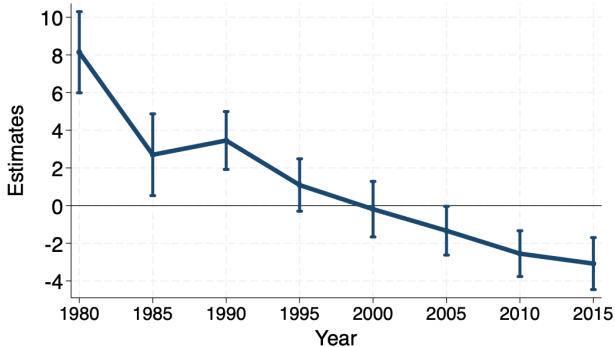
$$\ln X_{i,j,s,t} = \beta_t \left[\alpha^H_{s,t} \times \ln \left(\frac{HS_{i,t}}{NHS_{i,t}} \right) \right] + \eta_{i,j,t} + \eta_{j,s,t}$$



Instrument Skill Endowment by Cohort IV

back

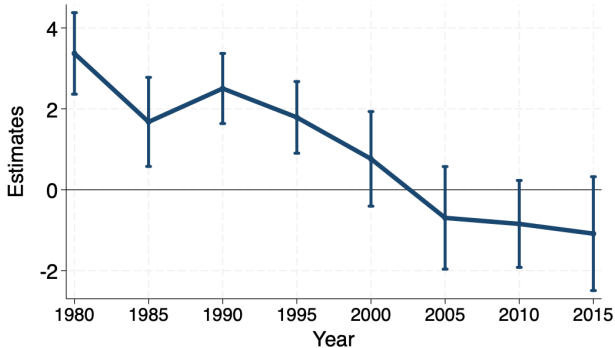
$$\ln X_{i,j,s,t} = \beta_t \left[\alpha^H_{s,t} \times \ln \left(\frac{H_{i,t}}{L_{i,t}} \right) \right] + \eta_{i,j,t} + \eta_{j,s,t}$$



Romalis (2004): Total Export

back

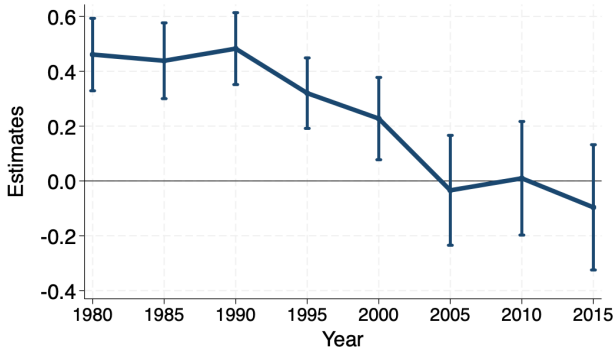
$$\ln X_{i,s,t} = \beta_t \left[\alpha^H_{s,t} \times \ln \left(\frac{H_{i,t}}{L_{i,t}} \right) \right] + \eta_{i,t} + \eta_{s,t}$$



Chor (2011): Num of Workers as Factor Intensity

back

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



EMPIRICS: CONTINUOS MEASURES

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

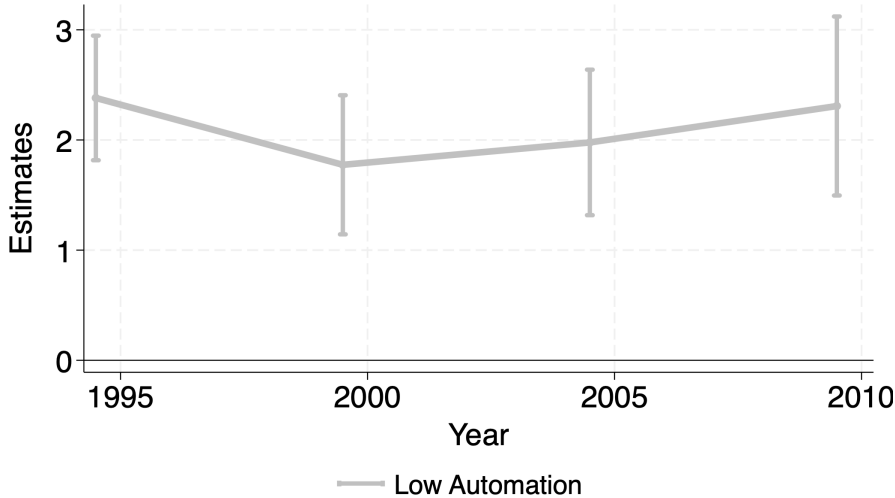
$$\ln \text{Exports}_{i,j,s,t} = \beta_t^0 \left(1 + \beta_t^A \text{Auto}_{i,s} + \beta_t^O \text{Ofs}_{i,s}\right) \cdot \left[\text{Skill Int.}_{s,t} \times \text{Skill Abd.}_{i,t}\right] + \eta_{i,j,t} + \eta_{j,s,t}$$

	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

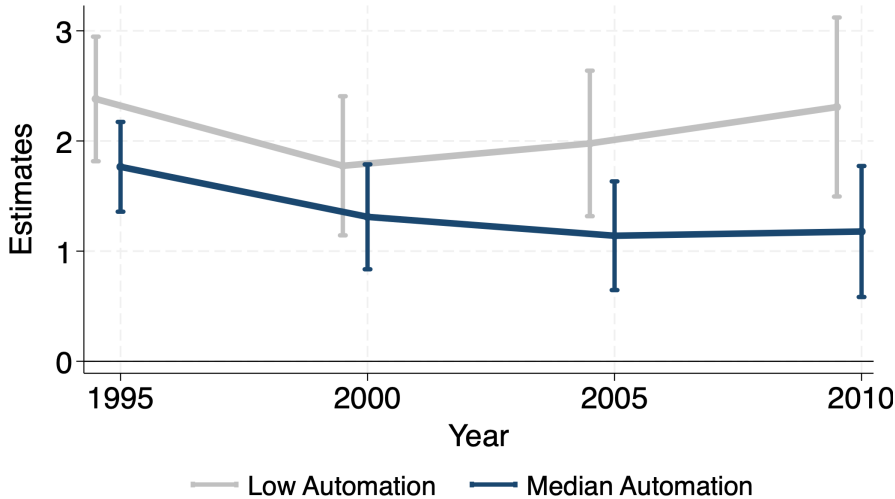
Skill Abundance Still Matters Absent Automation

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



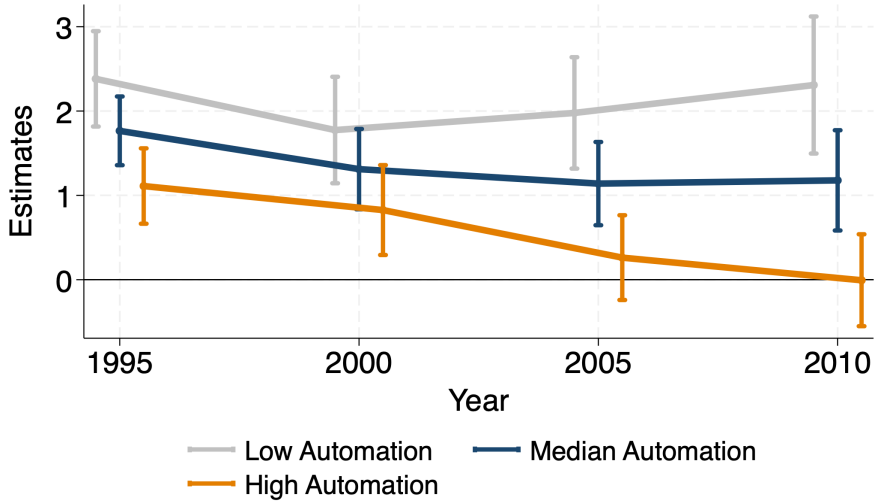
Skill Abundance Still Matters with Median Automation

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



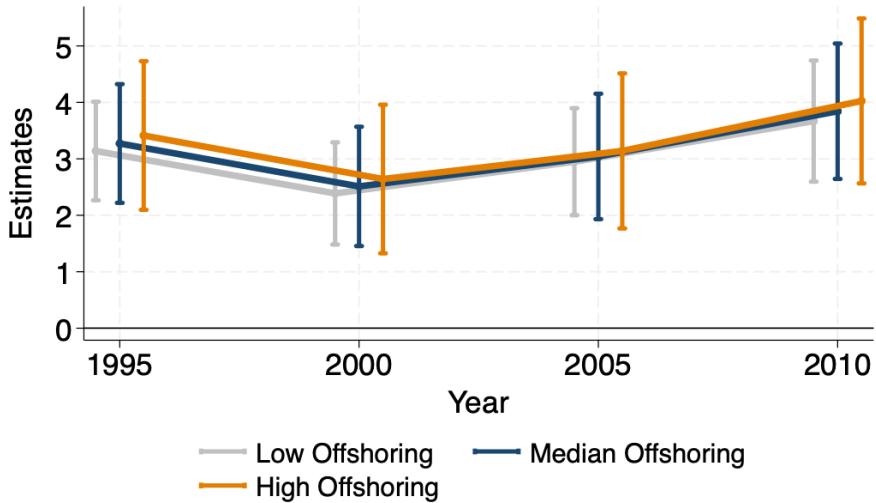
Skill Abundance Still Matters Absent Automation

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 ($\times$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**

MODEL: DETAILS

Demand: Standard Multi-Sector Eaton Kortum Model

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

Demand: Standard Multi-Sector Eaton Kortum Model

- 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
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Supply 1/2: Task Framework in Production

- Eaton-Kortum + Task Framework
- Gross Output

$$Y_{i,s} = z_{i,s} \cdot (H_{i,s})^{\alpha_s^H} \cdot (T_{i,s})^{1-\alpha_s^H}, \quad T_{i,s} = \exp\left(\int_0^1 \ln \underbrace{T_{i,s}(x)}_{\text{Task}} dx \right).$$

- 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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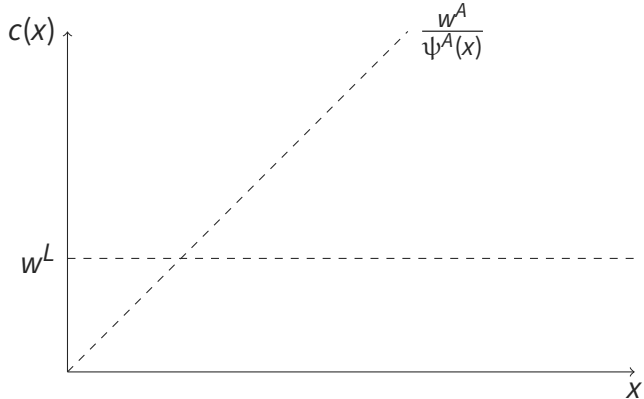
- Cost minimization $\Rightarrow$ Task Allocation and Task Share

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

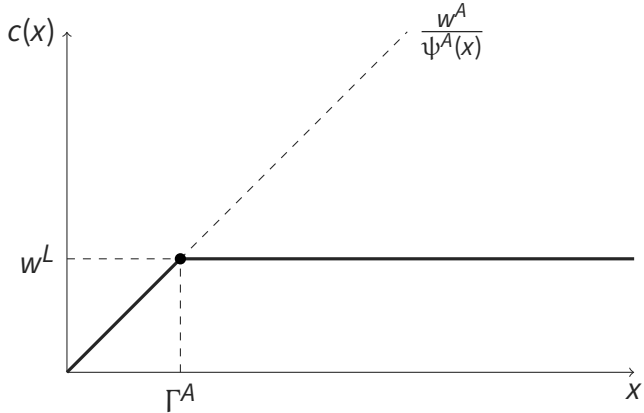
At Glance: Task Allocation and Task Share

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



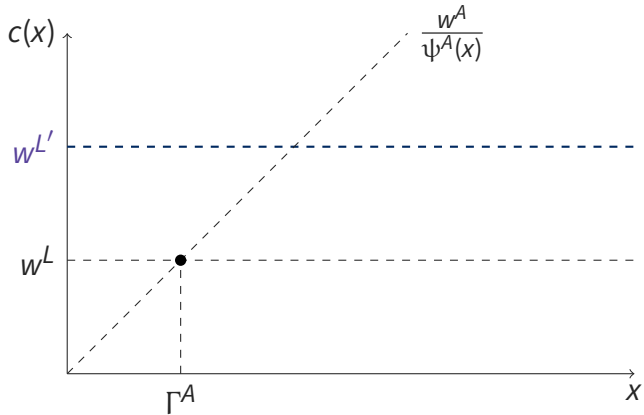
At Glance: Task Allocation and Task Share

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



At Glance: Task Allocation and Task Share

- Suppose no intermediate and constant labor productivity $\psi^L(x) = 1$.
- Suppose wage increases to $w^{L\prime}$



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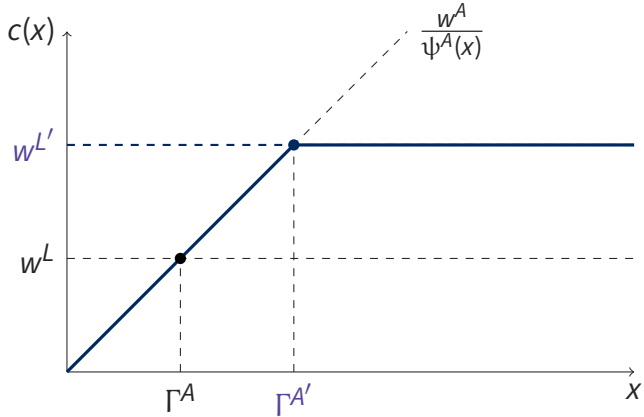
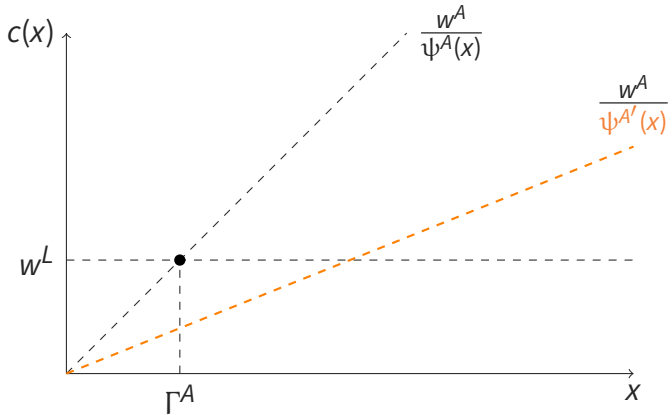


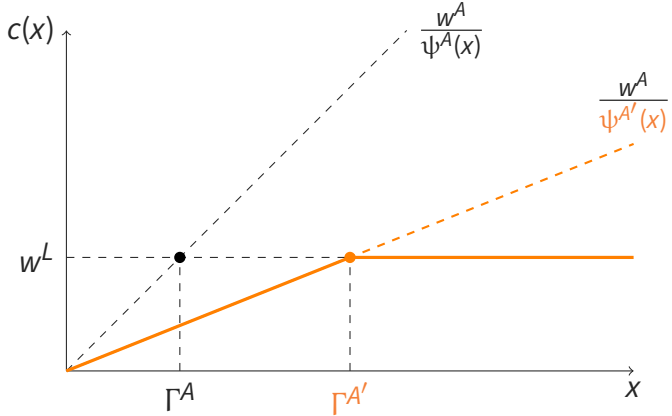
At Glance: Task Allocation and Task Share

- 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

- Suppose no intermediate and constant labor productivity $\psi^L(x) = 1$.
- Automation share increases to $\Gamma^{A'}$



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 $f \in \{A, L, X, O\}$
- Cost minimization $\Rightarrow$ Task Allocation and Task Share

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

- 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

Calibration

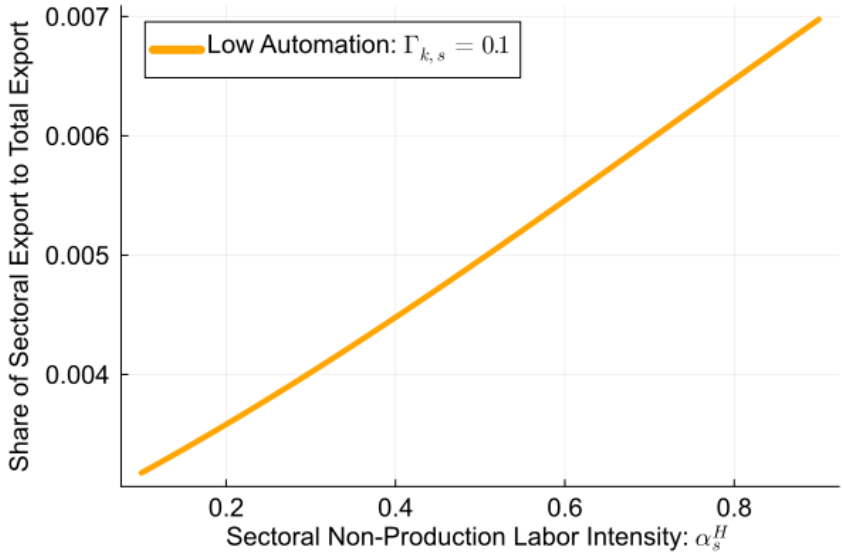
Description	Parameter	Value & Source
Panel A: Time-Invariant Parameters (fixed in 1995)		
Trade Elas.	θ	4 (Standard)
Expenditure Share	$\mu_{i,s}$	Data (WIOT)
Factor Endowment	H_i, L_i	Data (WIOT)
Factor Share	$\alpha^H_{i,s}$	Data (WIOT)
Input-Output Coef.	$\alpha^X_{i,r,s}, \alpha^A_{i,r,s}$	Data (WIOT) & 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 $\widehat{\Gamma^O_{i,s}}$

TWO COUNTRY ILLUSTRATION: AUTOMATION

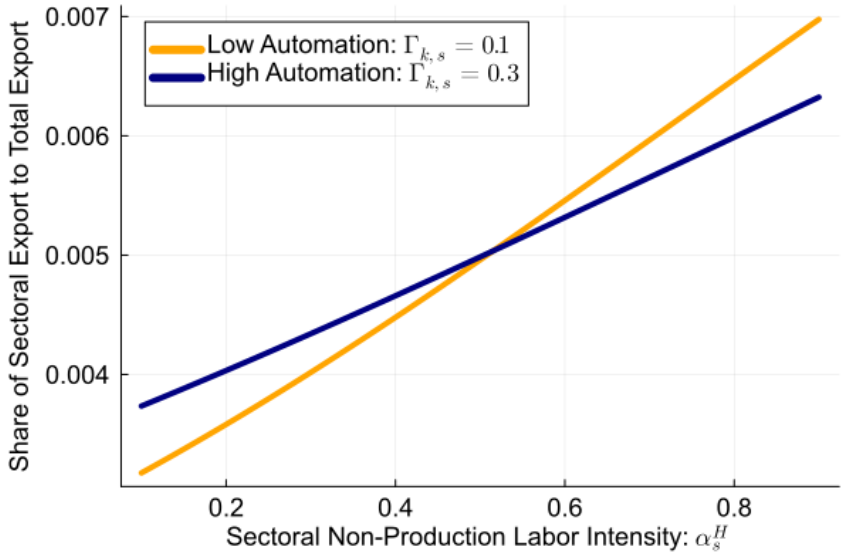
Two Country Illustration: Automation

- 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

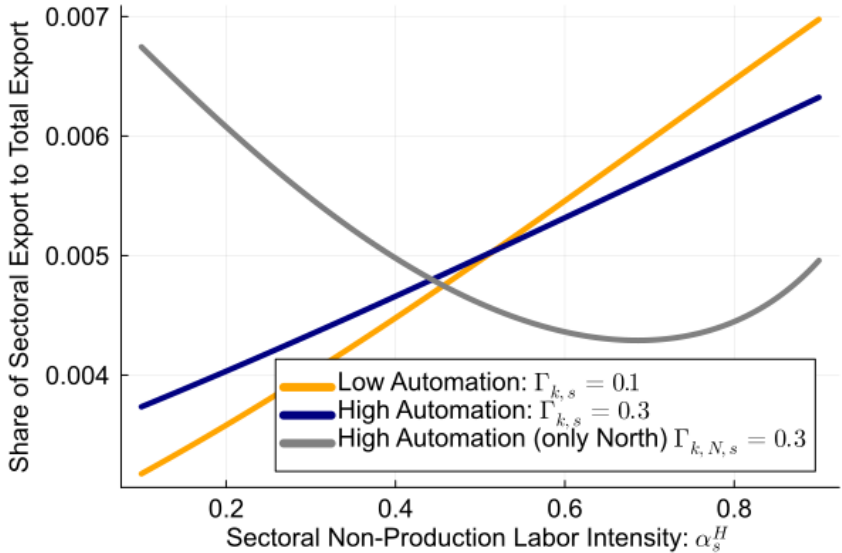
North Specialize in Skill-Intensive Sectors



Automation Makes Skills Less Important

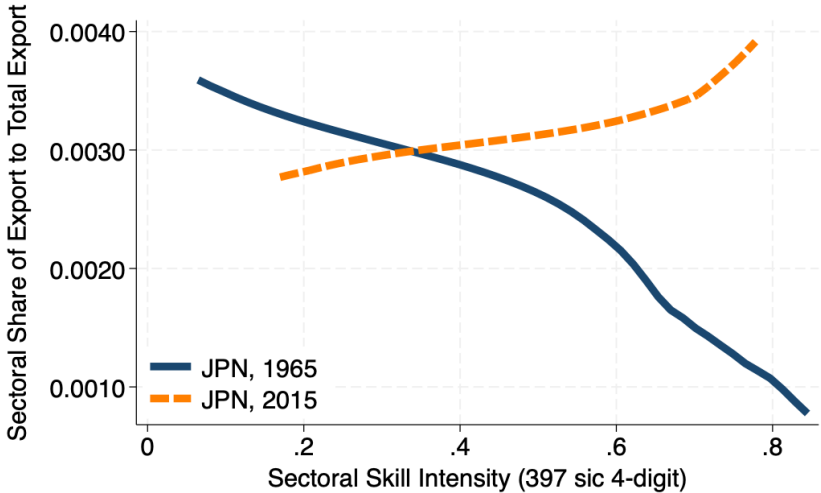


If Only North Automates, Sign Flips



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

Back



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

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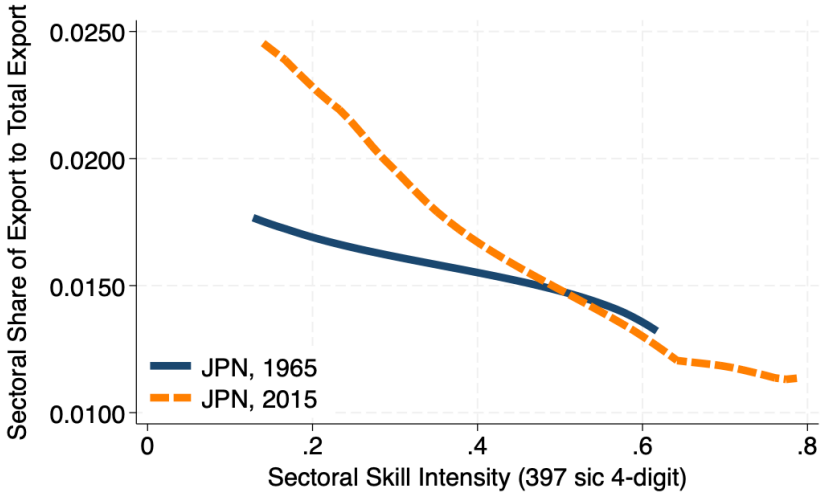


TOY MODEL: TASK AND COMPARATIVE ADVANTAGE

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

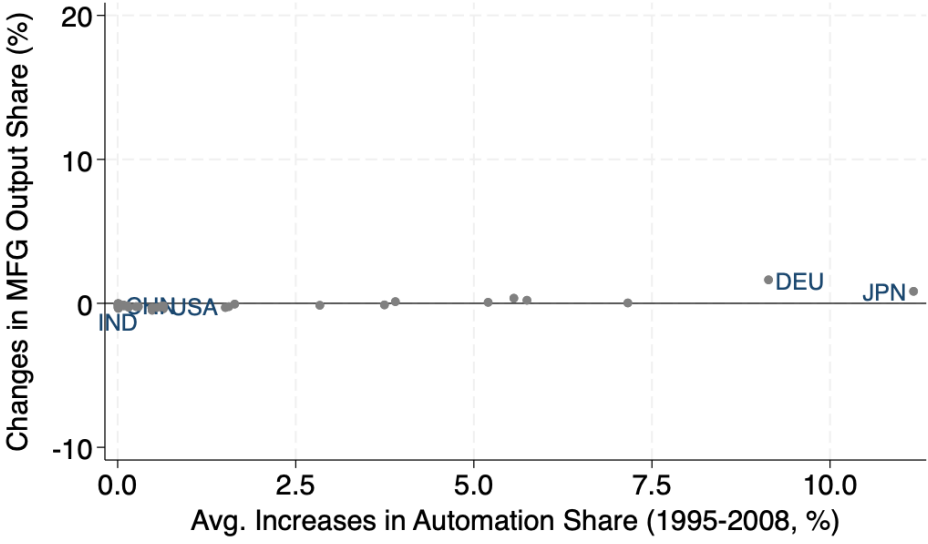
Automation, Globalization, and Inequality

- 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

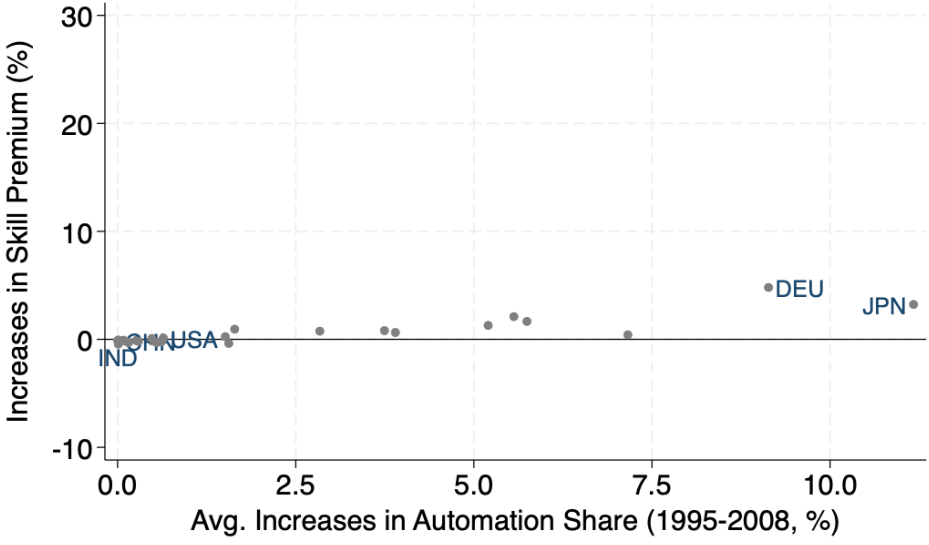
Automation, Globalization, and Inequality

- 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