Trade, Education, and The Shrinking Middle Class

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Public perception at odds with trade models

Growing popular concern that the middle class is shrinking, likely due to globalization.

Even those with a solid education no longer seem safe from losing jobs and social standing.

At the same time, trade theory treats education crudely, most often as a binary variable.

- Such models suggest that in DCs acquiring skills guarantees a well-paying job in an expanding high-tech sector.
- Corollary: LDCs with comparative advantage in low-skill sectors have little demand for highly educated workers.
- Key prediction: trade $\Rightarrow$ monotonic skill and welfare changes.

Source: Goos/Manning (REStat 07)

Source: Sala-i-Martin (QJE 06)
Stylized Facts: Expanding Middle Class (India 1970-2000)

Source: Sala-i-Martin (QJE 06)
Overview

Our approach:

- Continuum of sectors model with trade in intermediates (or tasks) and endogenous skill acquisition.
- Agents of different ability levels self-select into occupational sectors (tasks) by acquiring the corresponding human capital.
- Countries differ in educational institutions resulting in a different educational cost structure ⇒ comparative advantage.
- Trade liberalization can lead to non-monotonic skill change within countries; welfare effects of trade also generally non-monotonic; middle class may suffer most.
## Related Literature

### Labor Literature: Documenting non-monotonic wage changes, skill-acquisition

- Autor, Levy, and Murnane (QJE 03), Autor and Dorn (mimeo 07), Goos and Manning (REStat 07)

### Trade Literature

- Empirical trade/wage relationship: Krugman (08) and Lawrence (08)
- Offenders (binary skill models): Blanchard and Willmann (08) and many others
- Modelling Framework: Dornbusch, Fischer, and Samuelson (AER 77); Grossman and Rossi-Hansberg (08)
- Similar Objectives: Jung and Mercenier (08); Costinot and Vogel (08)
Model Set-up

Basics

- Two countries: Home and Foreign
- Population:
  - Heterogeneous agents; unit mass in each country
  - Agents differ in ability, indexed by $a \in [0, 1]$
  - Same ability distribution $F(a)$ in both countries
- Intermediates:
  - Continuum of tradeable intermediate sectors/tasks: $j \in [0, 1]$
  - Identity production function in each sector $\Rightarrow w(j) = p(j)$
- One final good, non-traded:
  - $Y = \psi(\vec{y})$ where $\psi(\cdot)$ is hd 1 in intermediates.
  - Unit demand for intermediate $j$: $x(j) \equiv x_j(\vec{w})$. 
Model Set-up

Cost of Education

- Monetary cost of education for agent $a$ to enter sector $j$:

$$c(j, a) \in C^2$$

where:

$$\frac{\partial c(j, a)}{\partial j} > 0 \quad \frac{\partial c(j, a)}{\partial a} < 0$$
$$\frac{\partial^2 c(j, a)}{\partial j \partial a} < 0 \quad \frac{\partial^2 c(j, a)}{\partial j^2} > 0.$$ 

- Less generally, let: $c(j, a) = h(a)g(j)$
Solving the Supply Side

**Optimal Sorting**

- Agents solve
  \[
  \max_j w(j) - c(j, a)
  \]
- FOC:
  \[
  \frac{\partial c(j, a)}{\partial j} \equiv \dot{c}(j, a) = \dot{w}(j)
  \]
  \[\Rightarrow a(j) = h^{-1}(\frac{\dot{w}}{\dot{g}})\]
- Lemma: \(a'(j) \geq 0\) as long as \(\dot{w}(j) > 0\).

- Supply of intermediate good/task \(j\) is: \(y^s(j) = a'(j)f(a(j))\)
- Output of final good is \(Y = \psi(\bar{y})\) where \(y(j) = y^s(j) + y^t_j\).
Small Open Economy

- Take wage/price schedule as fixed \( w(j) \in C^1, \dot{w}(j) > 0 \forall j. \)

**Figure:** Monotonic Sorting across Occupations
Consider an exogenous shift in wages from $w^0(j)$ to $w^1(j)$.
General Equilibrium with Two Large Countries

- Equilibrium Conditions (Free Trade):
  - Full employment:
    \[ \int_0^1 a'(j)f(a(j))dj = 1; \quad \int_0^1 a'^*(j)f(a^*(j))dj = 1 \]
  - Zero profit:
    \[ p = \int_0^1 w(j)x(j)dj; \quad p^* = \int_0^1 w(j)x^*(j)dj \]
  - Balanced budget:
    \[ pY^d = \int_0^1 [w(j(a)) - c(a, j(a))]da; \quad p^* Y^{d*} = \int_0^1 [w(j^*(a)) - c(a, j^*(a))]da \]

- Market clearing in intermediates:
  \[ a'(j)f(a(j)) + a'^*(j)f(a^*(j)) = x(j)Y^s + x^*(j)Y^{s*} \forall j \]
Characterize market clearing conditions as differential eq'n of \( w(j) \) using definition of \( a(j) \):

\[
\begin{align*}
    h^{-1}' \left( \frac{\dot{w}}{\dot{g}} \right) \left[ \frac{\ddot{g} \dot{w} - \dot{g} \ddot{w}}{\dot{g}^2} \right] f \left( h^{-1} \left( \frac{\dot{w}}{\dot{g}} \right) \right) + h^{-1}' \left( \frac{\dot{w}}{\dot{g}^*} \right) \left[ \frac{\ddot{g}^* \dot{w} - \dot{g}^* \ddot{w}}{\dot{g}^{*2}} \right] f^* \left( h^{-1} \left( \frac{\dot{w}}{\dot{g}^*} \right) \right) \\
    = x(j)Y^s + x^*(j)Y^{*s},
\end{align*}
\]

which yields equilibrium wage schedule, \( w(j) \).

Use \( w(j) \) to find equilibrium mapping functions \( a(j) \) and \( a^*(j) \), supply schedules \( y(j), y^*(j) \) and price indices \( p \) and \( p^* \).

Finally, the balanced budget condition pins down final good output, consumption, and the pattern of trade.
A Functional Form Example

Assumptions

- \( a \sim U[0, 1] \)
- Cost structure:
  
  \[
  c(j, a) = \frac{1 - a j^2}{a} \frac{2}{2} 
  \]
  
  \[
  c^*(j, a) = \frac{1 - a 2j^3}{a} \frac{3}{3} 
  \]

- Leontief final good production:
  
  \( \Rightarrow \) unit factor demand: \( x(j) = x^*(j) = 1 \)
  
  \( \Rightarrow \) price index: \( p = \int_0^1 w(j) dj \)
Thought Experiment: Autarky to Free Trade
Equilibrium Wage/Price Schedule

Price Levels under Autarky and Free Trade:
\[ p_A = 1.334; \quad p_A^* = 1.167; \quad p_{FT} = 1.244. \]
Closed Form Solutions for Wage Gradients

**Autarky wage/price schedules**

- $\hat{w}_A(j) = 1 - j$
- $\hat{w}_A^*(j) = 2j - 2j^2$

**Free trade wage/price schedule**

- $\hat{w}_{FT}(j) = \frac{j - 4j^3 + \sqrt{(4j^3 - j)^2 - 8j(4j^4 - 4j^3)}}{4j}$
Comparing Autarky and Free Trade Wage Gradients

Slopes of the Equilibrium Wage Schedules

Emily Blanchard, Gerald Willmann
Ability-to-Sector Mappings

Non-Monotonic Skill Change at Home and Abroad

\[ a_A(j) = a_A^*(j) = 1 \]
Change in Employment at Home

Shifting Sectoral and Educational Choices at Home: Vacating the Middle
Change in Employment in Foreign

Shifting Sectoral and Educational Choices in Foreign: Expansion of Middle Sector Employment
Welfare Analysis

Three Components of Net Real Wages

For a given agent, $a$:
- Nominal wage: $w(j(a))$
- Cost of education: $c(j(a), a)$
- Local price level: $p = \int_0^1 w(j) dj$.

Net Real Welfare Change

$$\left( \frac{w_{FT}(j_{FT}(a))}{p_{FT}} - \frac{w_A(j_A(a))}{p_A} \right) - \left( \frac{c(j_{FT}(a), a)}{p_{FT}} - \frac{c(j_A(a), a)}{p_A} \right)$$
Change in the real wage of Home agent $a$

$\Delta \frac{w(j(a))}{p}$

Change in Home’s Real Wages by Agent
Change in the real cost of education for Home workers

\[ \Delta \frac{c(a, j(a))}{p} \]

Change in the Cost of Education by Agent (Home)
Middle Ability Agents Lose from Trade
Foreign Real Wage Changes

\[ \Delta \frac{w^*(j^*(a))}{p^*} \]

Change in the Foreign Real Wage by Agent
Foreign Real Cost of Education Changes

\[
\Delta \frac{c^*(a, j^*(a))}{p^*}
\]

Change in the Cost of Education by Agent (Foreign)
Net Welfare Change for Foreign Workers

\[ \Delta \frac{w^*(j'(a)) - c^*(a, j'(a))}{p'} \]

Net Welfare Gains Accrue to Middle Ability Agents
Summary

Non-Monotonic Welfare Changes in Both Countries
Aggregate Gains from Trade

Magnitude of gains from trade

- **Aggregate gains from trade for Home: .22 percent**
  - Real wages rise most in low $j$ sectors, moderately in high $j$ sectors, and fall in middle $j$ occupations.
  - Real cost of education falls for low ability agents; rises for high ability.
  - Welfare gains at upper and lower ends of ability distribution, losses in the middle.

- **Aggregate gains for Foreign: .57 percent**
  - Real wages fall most in low $j$ sectors, moderately in high $j$ sectors, and rise for middle $j$ occupations.
  - Real cost of education rises for lower ability agents and rises for high ability.
  - Welfare losses at upper and lower ends of distribution; gains concentrated in the middle.
General Conclusions/Implications

- Education Policy and Comparative Advantage: Suggests more sophisticated strategies for targeting educational subsidies (i.e. primary, secondary, or tertiary levels and/or sector specific technical training)

- Political Economy: Suggests median voter may not be the average Joe – more nuanced.


- Testability: Would like to see evidence of non-monotonic skill change for wide cross section of countries.
Extensions

Just the beginning...

- Add differences in production technology to explore complementarity with ed. institutions.
- Non-traded goods/services
- Consider educational migration/outsourcing of education
- Use as stage game in dynamic political economy model
- Your suggestions very welcome!
Change in the real sectoral wage at Home

\[
\Delta \frac{w(j)}{p}
\]

Change in Home’s Real Wages by Sector
Stylized Facts: Rising Inequality and Income (China)

Source: Sala-i-Martin (QJE 06)