Trade, Education, and The Shrinking Middle Class

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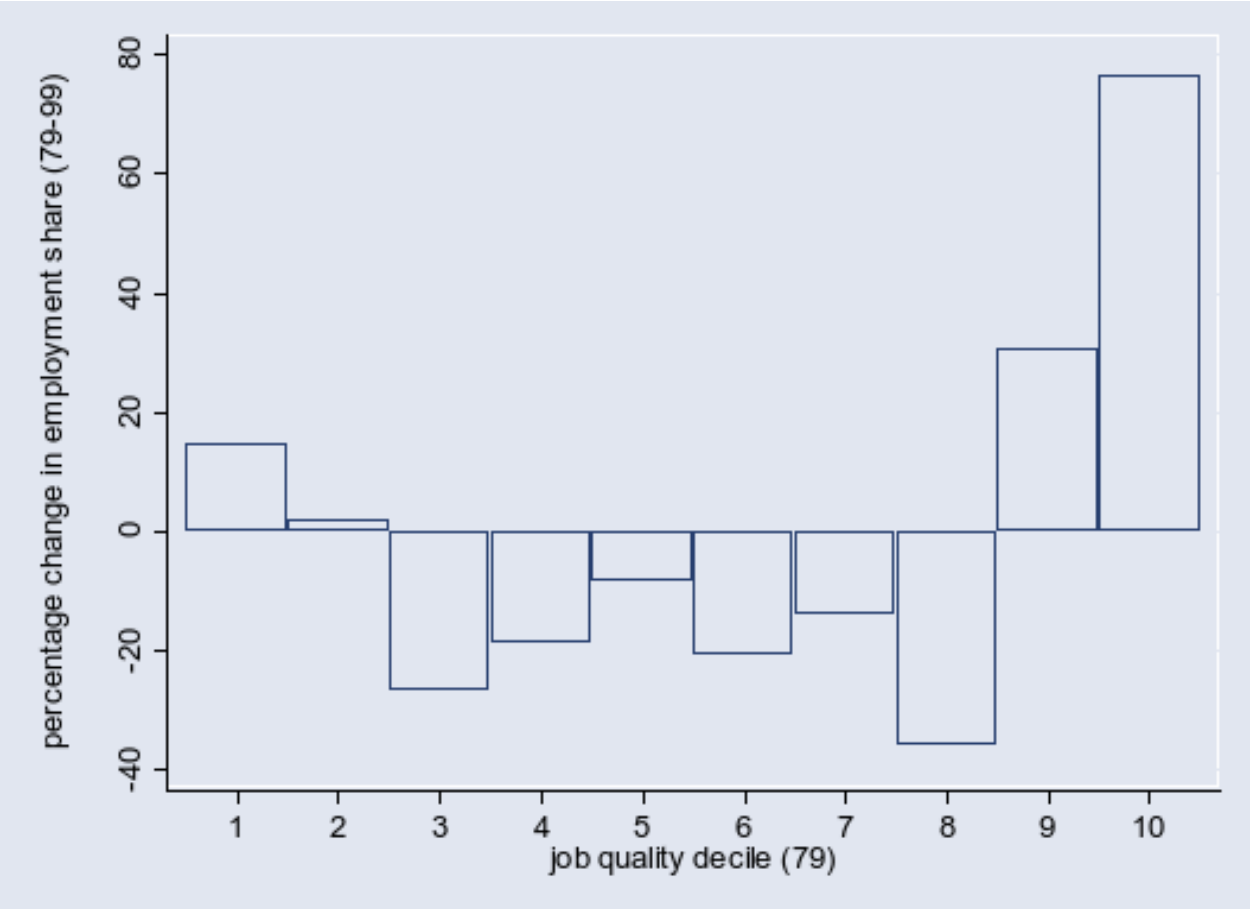
NBER ITI Summer Institute
July 29 2008

Motivation

Public perception at odds with trade models

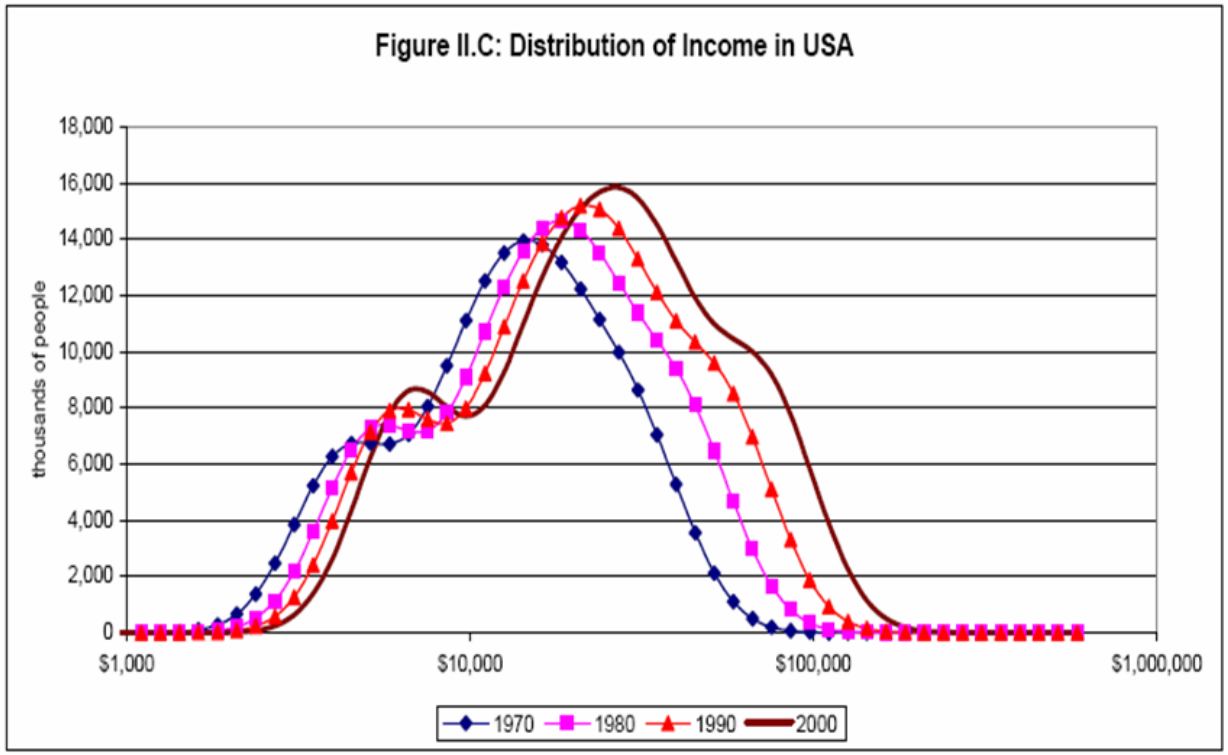
- Growing popular concern that the middle class is shrinking, likely due to globalization.
- Even those with a solid education no longer seem safe from losing jobs and social standing.
- At the same time, trade theory treats education crudely, most often as a binary variable.
  - Such models suggest 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.

Stylized Facts: Polarization of Job Quality (U.K 1979-1999)



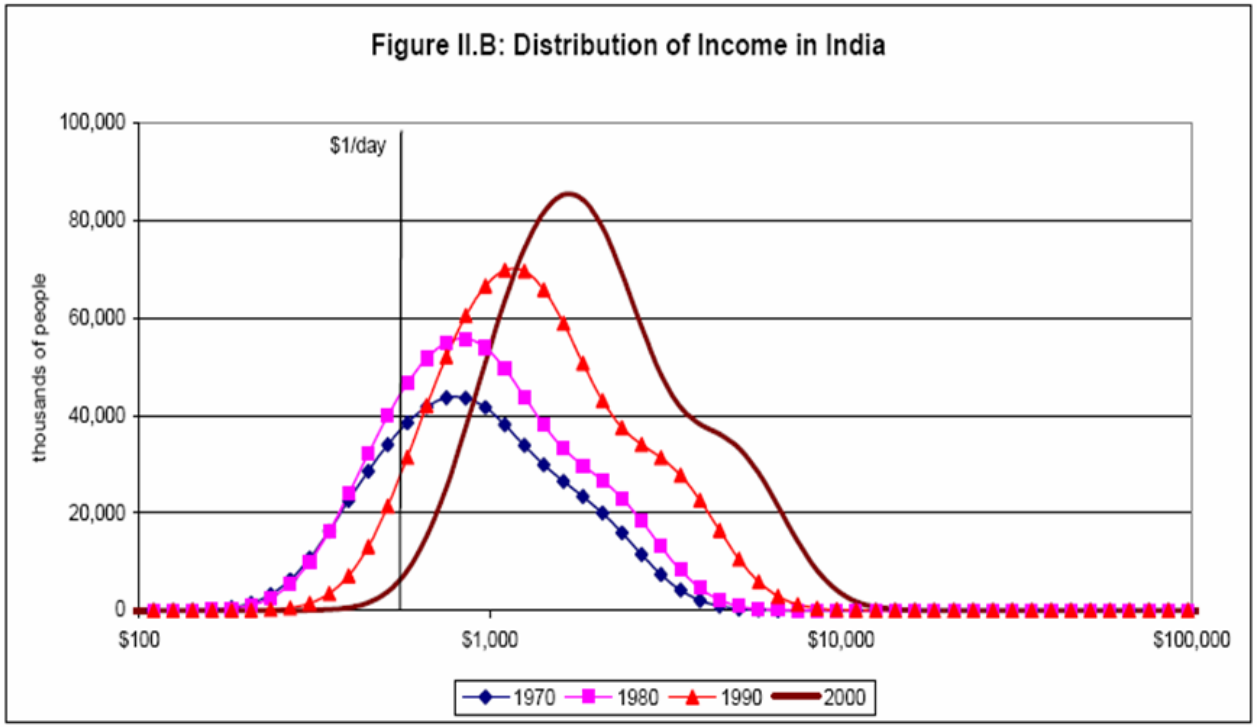
Source: Goos/Manning (REStat 07)

Stylized Facts: Increasing Income Inequality (U.S 1970-2000)



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 $\Rightarrow$ 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:

$$\frac{\partial c(j,a)}{\partial j} > 0 \qquad \frac{\partial c(j,a)}{\partial a} < 0$$

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

- 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:

$$\frac{\partial c(j,a)}{\partial j} \equiv \dot{c}(j,a) = \dot{w}(j)$$

$$\Rightarrow a(j) = h^{-1}(\dot{w}/\dot{g})$$

- 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 $Y = \psi(\vec{y})$ where $y(j) = y^s(j) + y_j^t$.

Small Open Economy

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

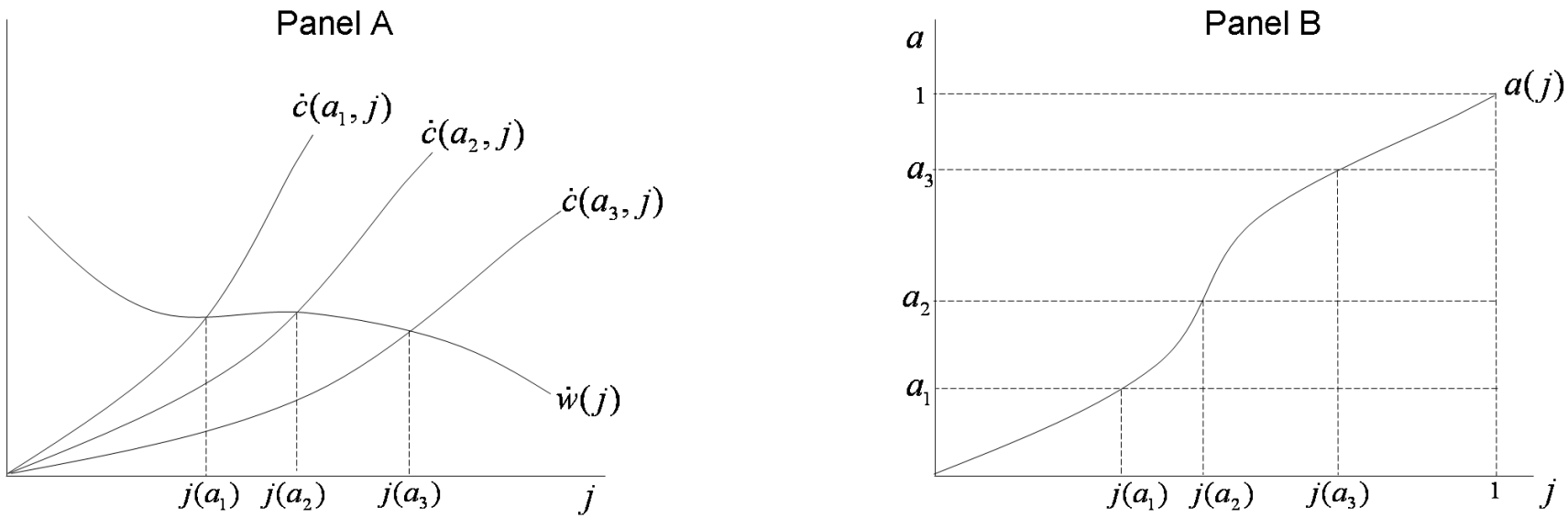


Figure: Monotonic Sorting across Occupations

Non-Monotonic Skill Change in an SOE

- Consider an exogenous shift in wages from $w^o(j)$ to $w^1(j)$.

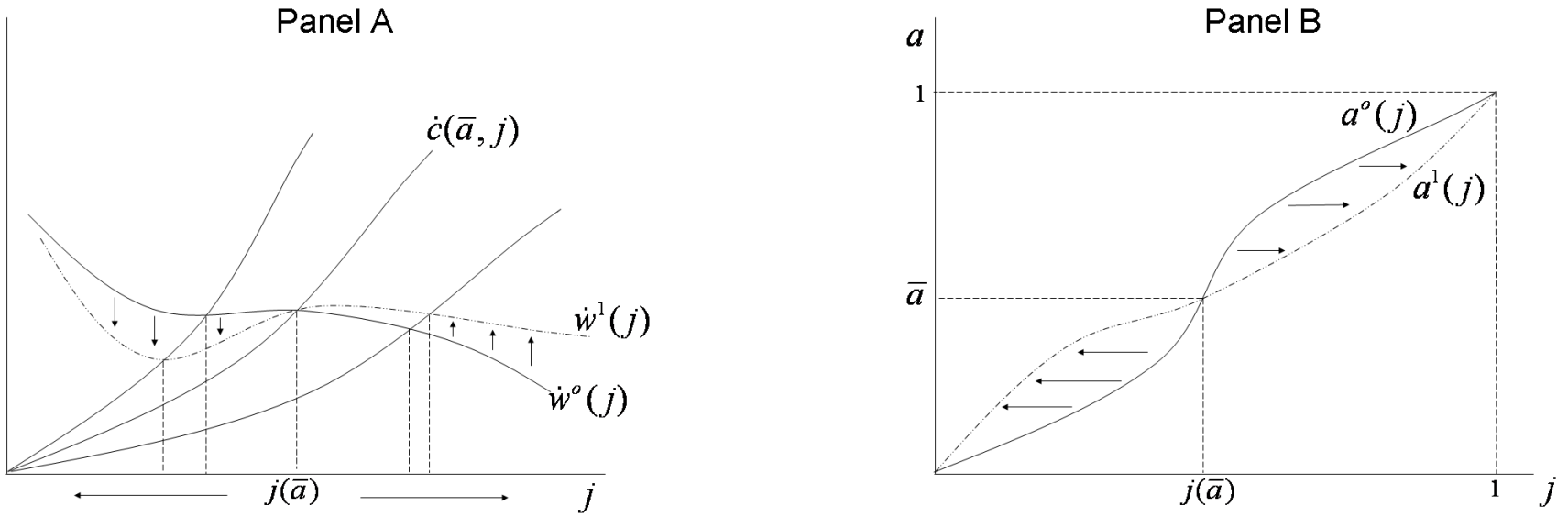


Figure: Low Ability Agents Sort Down; High Ability Sort Up

General Equilibrium with Two Large Countries

- Equilibrium Conditions (Free Trade):
  - Full employment:

$$\int_0^1 a'(j)f(a(j))dj = 1; \qquad \int_0^1 a'^*(j)f(a^*(j))dj = 1$$

  - Zero profit:

$$p = \int_0^1 w(j)x(j)dj; \qquad p^* = \int_0^1 w(j)x^*(j)dj$$

  - Balanced budget:

$$pY^d = \int_0^1 [w(j(a)) - c(a, j(a))]da; \qquad p^*Y^{d*} = \int_0^1 [w(j^*(a)) - c(a, j^*(a))]da$$

- Market clearing in intermediates:

$$a'(j)f(a(j)) + a'^*(j)f(a^*(j)) = x(j)Y^s + x^*(j)Y^{s*} \forall j$$

General Equilibrium Solution

Solution Strategy

- Characterize market clearing conditions as differential eq'n of $w(j)$ using definition of $a(j)$:

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

- 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

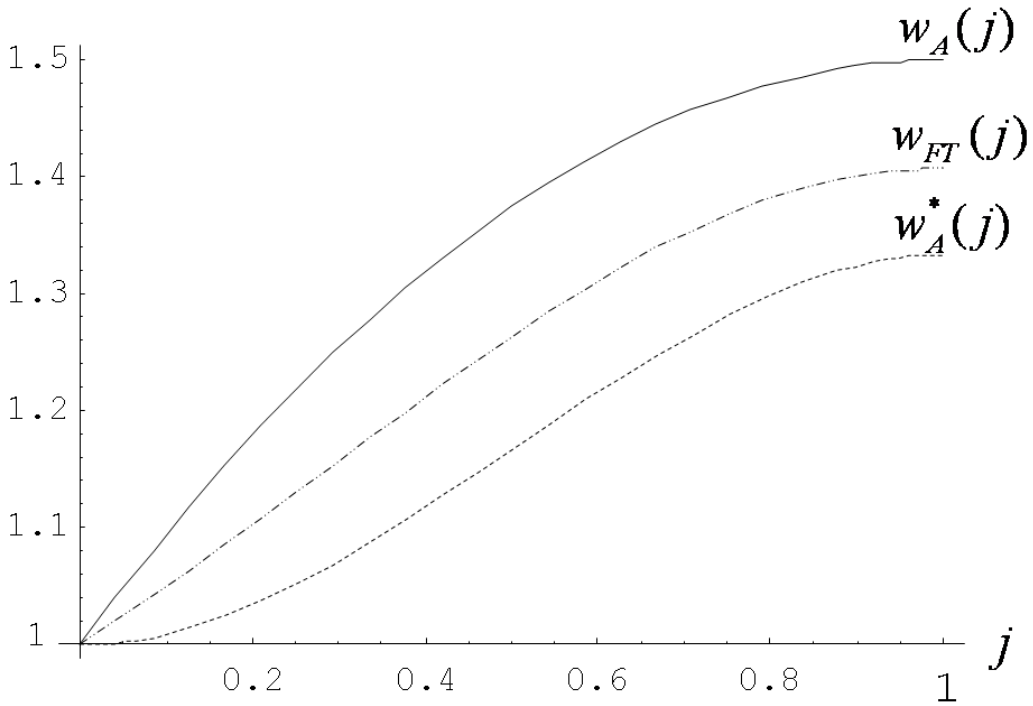
- $a \sim U[0,1]$
- Cost structure:

$$c(j,a) = \frac{1-a}{a}\frac{j^2}{2}$$

$$c^*(j,a) = \frac{1-a}{a}\frac{2j^3}{3}$$

- 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:
$p_A = 1.334$; $p_A^* = 1.167$; $p_{FT} = 1.244$.

Closed Form Solutions for Wage Gradients

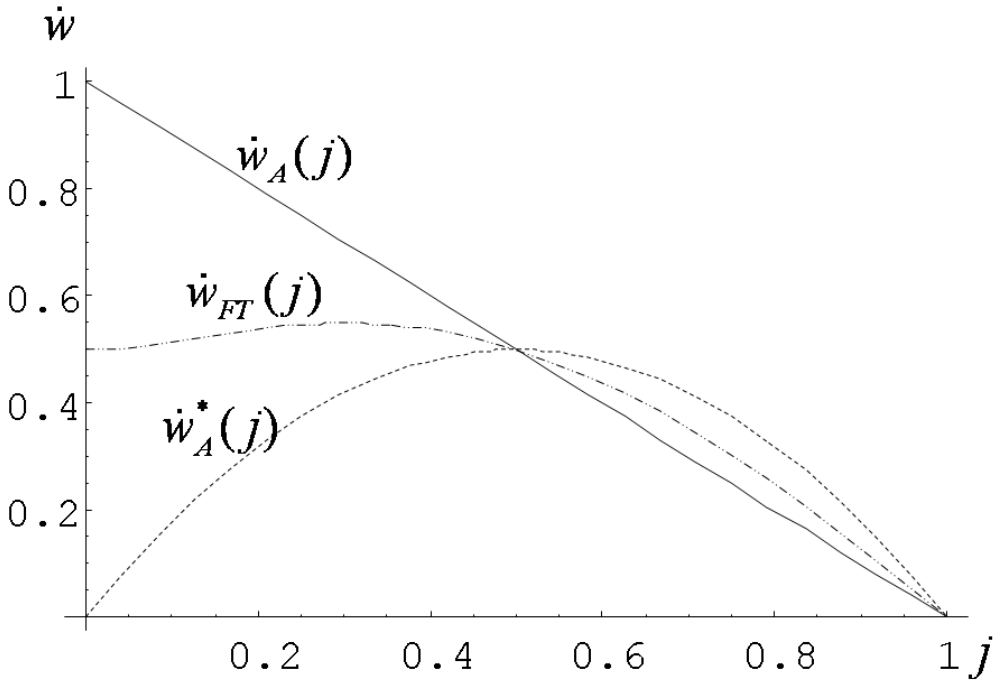
Autarky wage/price schedules

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

Free trade wage/price schedule

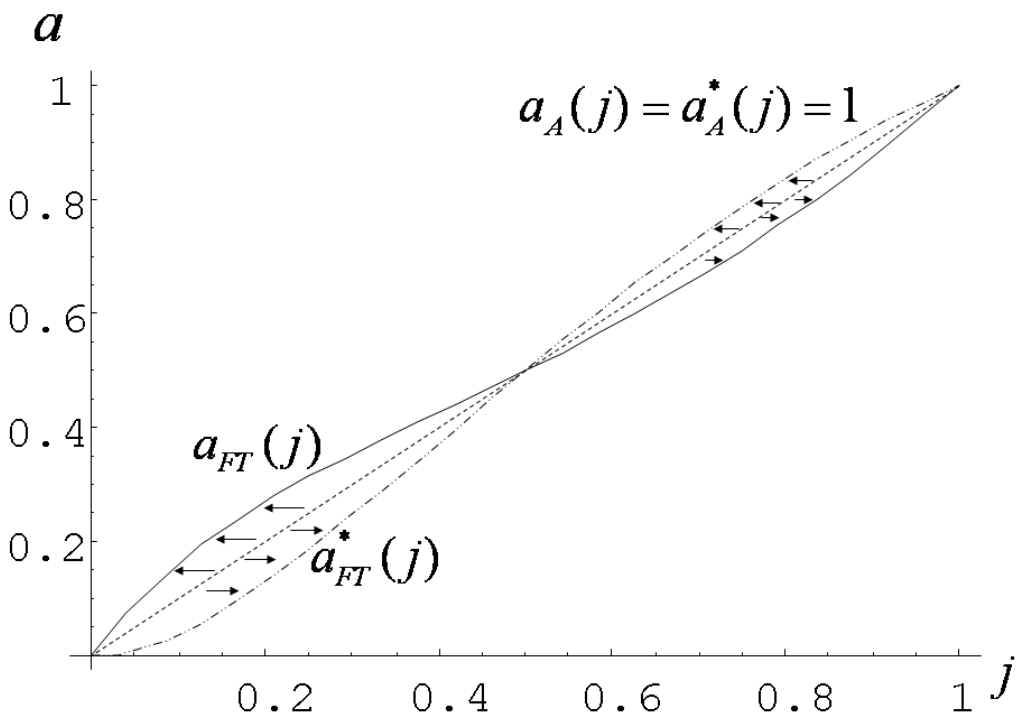
- $\dot{w}_{FT}(j) = \frac{j - 4j^3 + \sqrt{(4j^3 - j)^2 - 8j(4j^4 - 4j^3)}}{4j}$

Comparing Autarky and Free Trade Wage Gradients



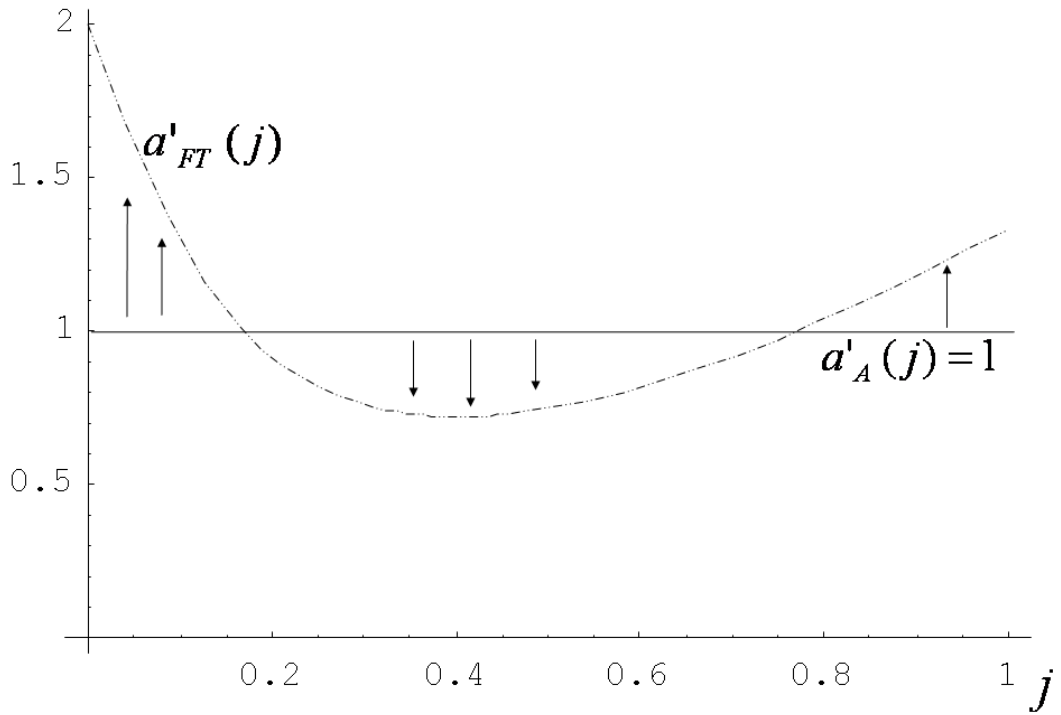
Slopes of the Equilibrium Wage Schedules

Ability-to-Sector Mappings



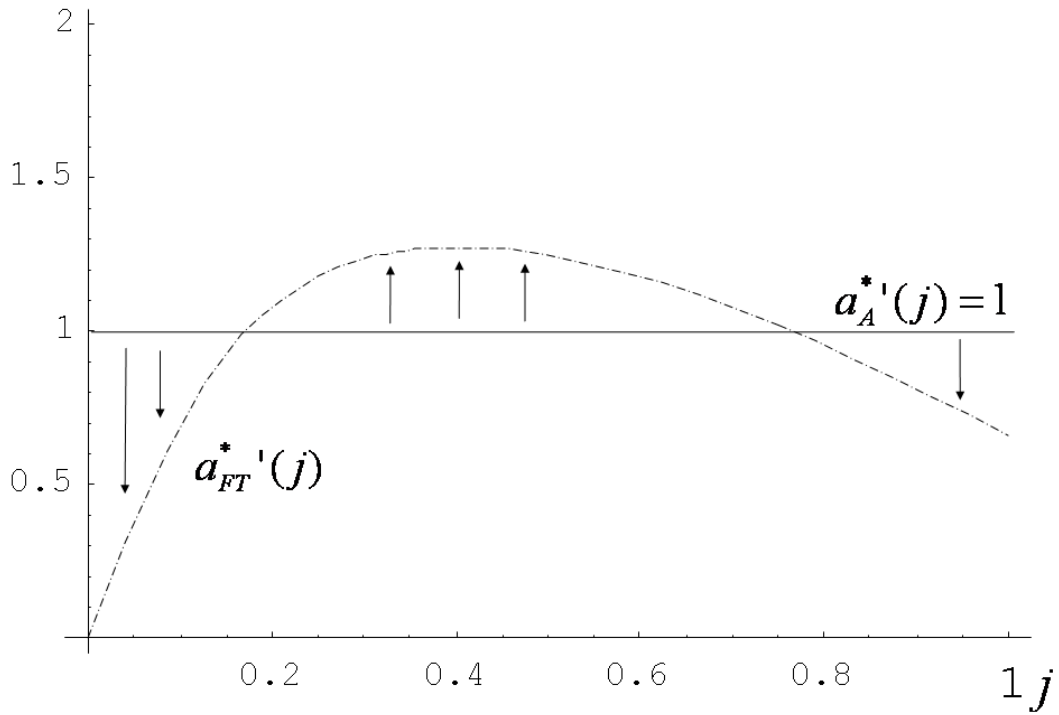
Non-Monotonic Skill Change at Home and Abroad

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

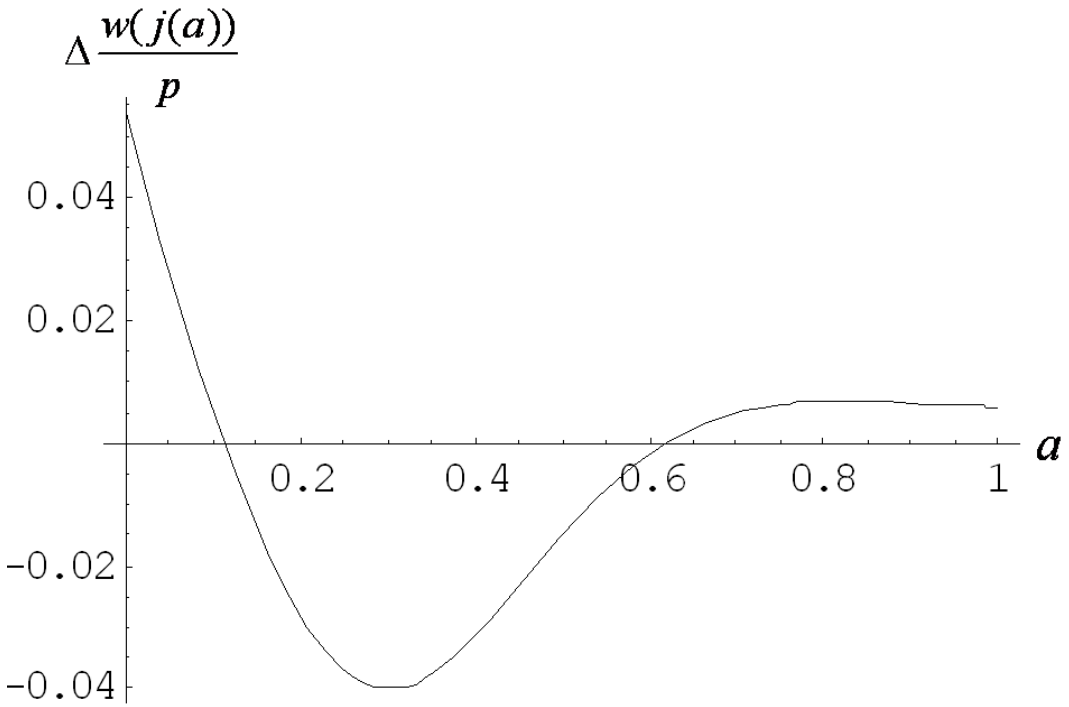
For a given agent, a:

- 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

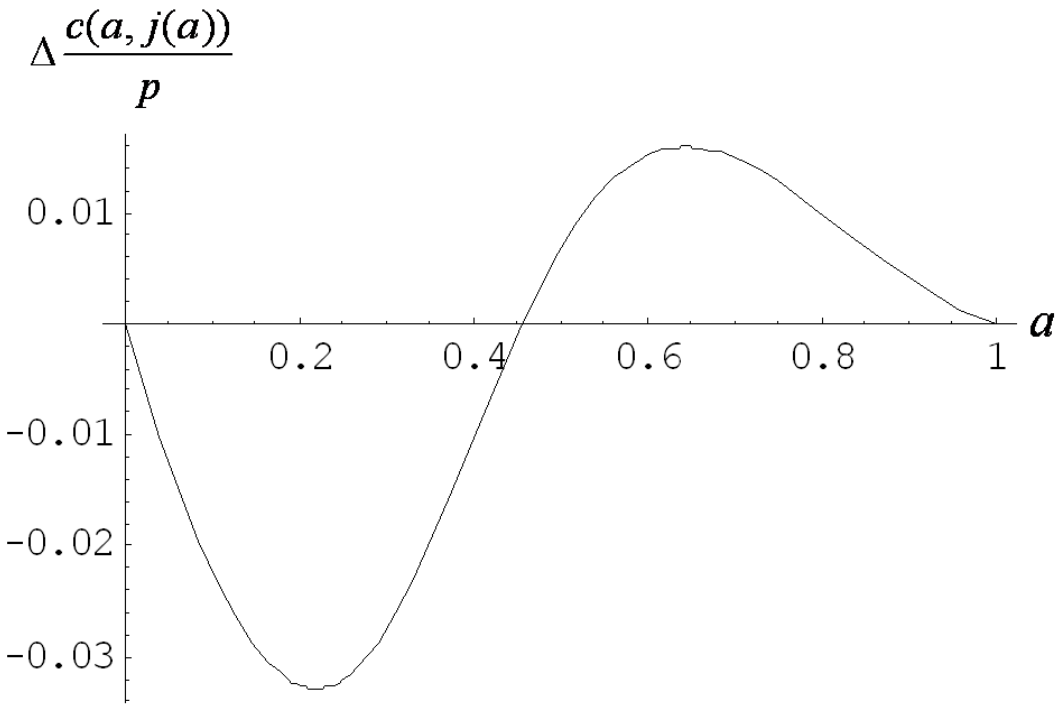
$$\left(\frac{w_{FT}(j_{FT}(a))}{p_{FT}} - \frac{w_A(j_A(a))}{p_A} \right) - \left(\frac{c(j_{FT}(a), a)}{p_{FT}} - \frac{c(j_A(a), a)}{p_A} \right)$$

Change in the real wage of Home agent a



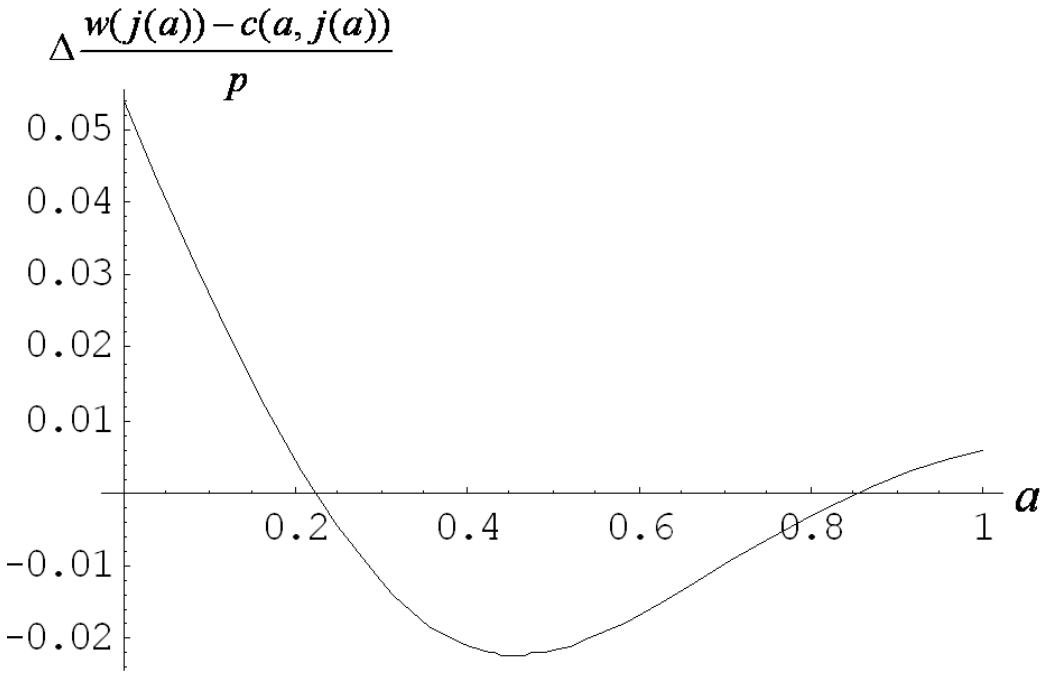
Change in Home's Real Wages by Agent

Change in the real cost of education for Home workers



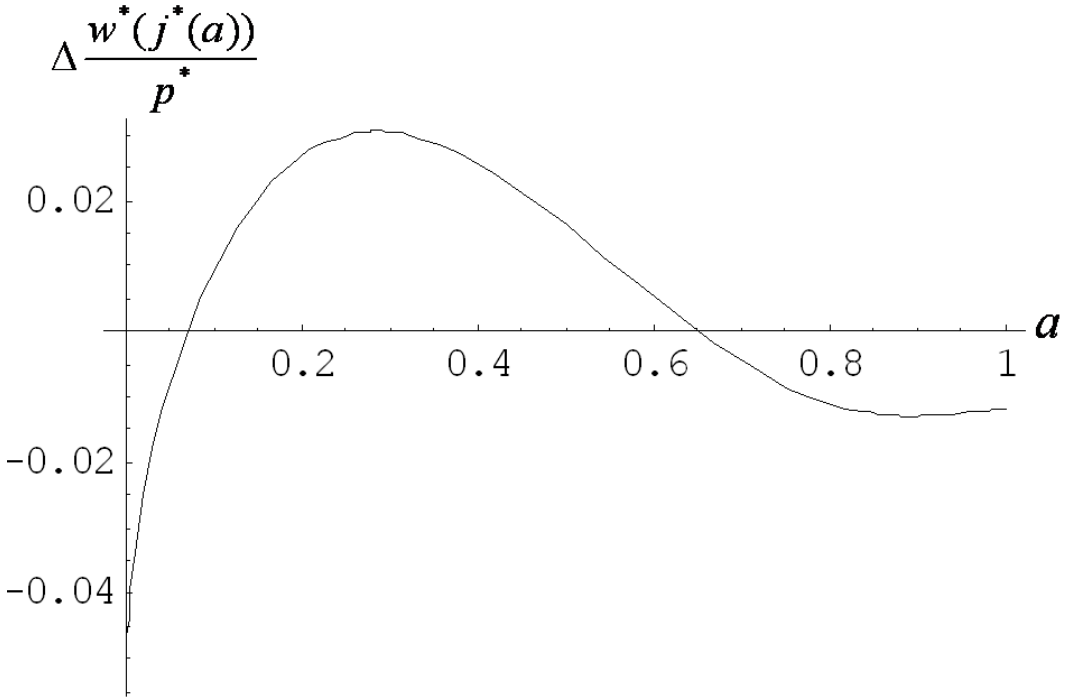
Change in the Cost of Education by Agent (Home)

Net Welfare Change for Home Workers



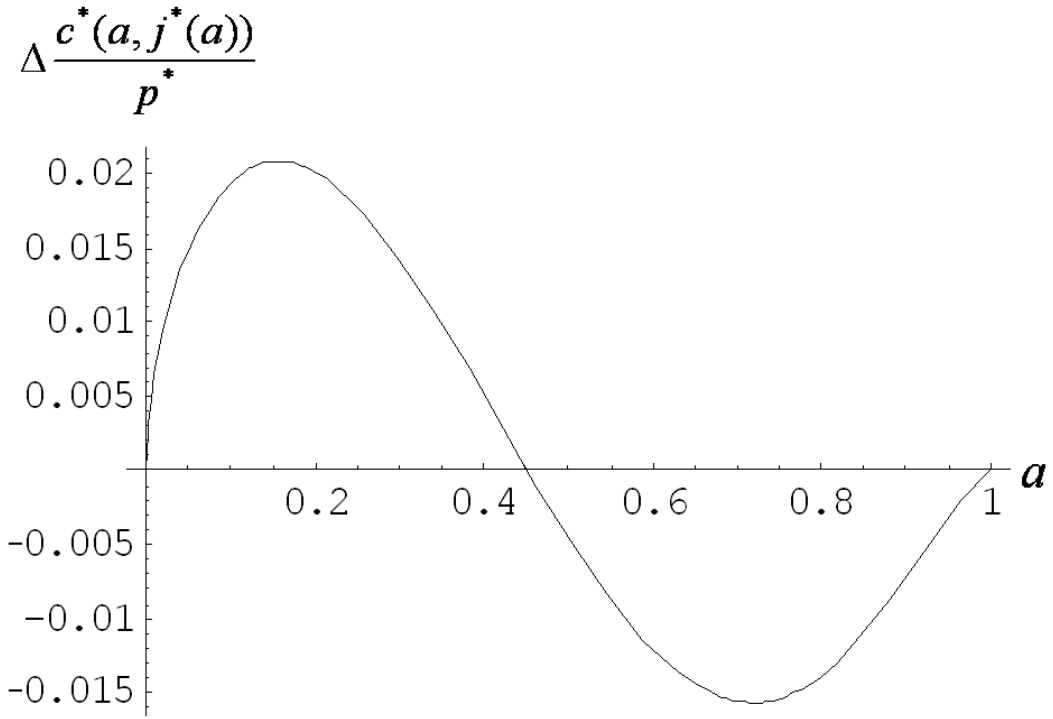
Middle Ability Agents Lose from Trade

Foreign Real Wage Changes



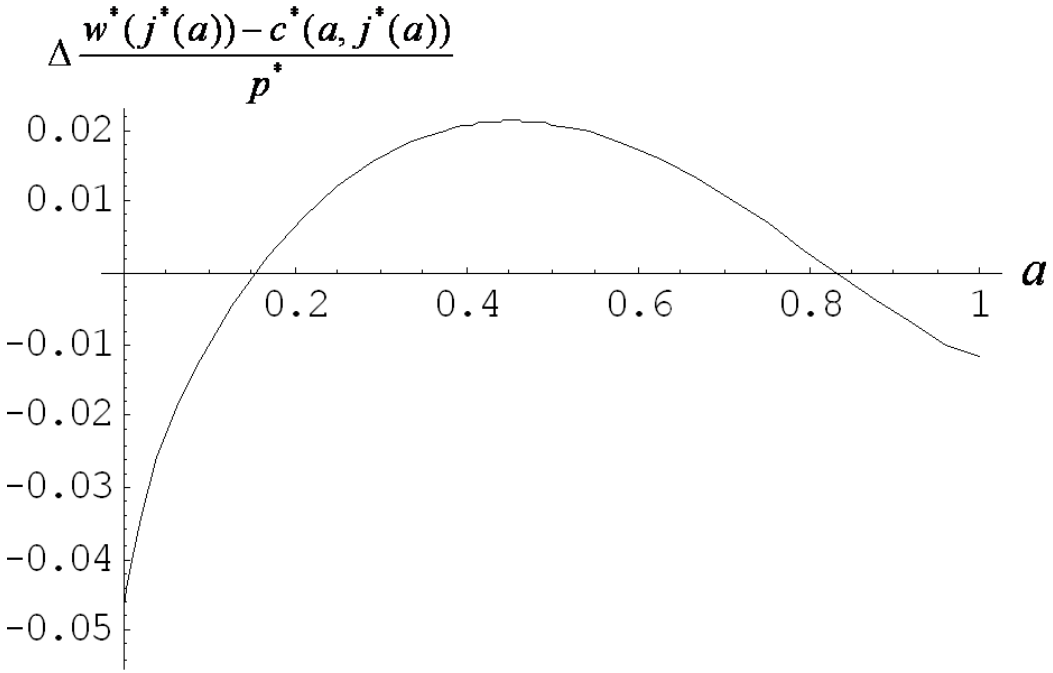
Change in the Foreign Real Wage by Agent

Foreign Real Cost of Education Changes



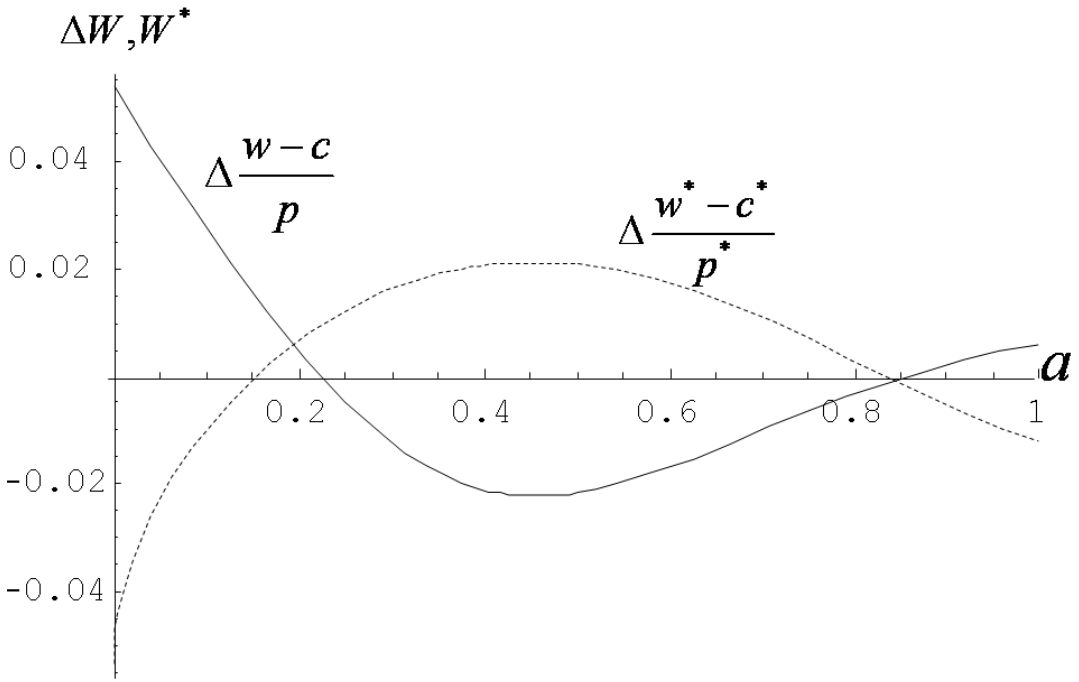
Change in the Cost of Education by Agent (Foreign)

Net Welfare Change for Foreign Workers



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.

  $\Rightarrow$ 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.

  $\Rightarrow$ Welfare losses at upper and lower ends of distribution; gains concentrated in the middle.

General Conclusions/Implications

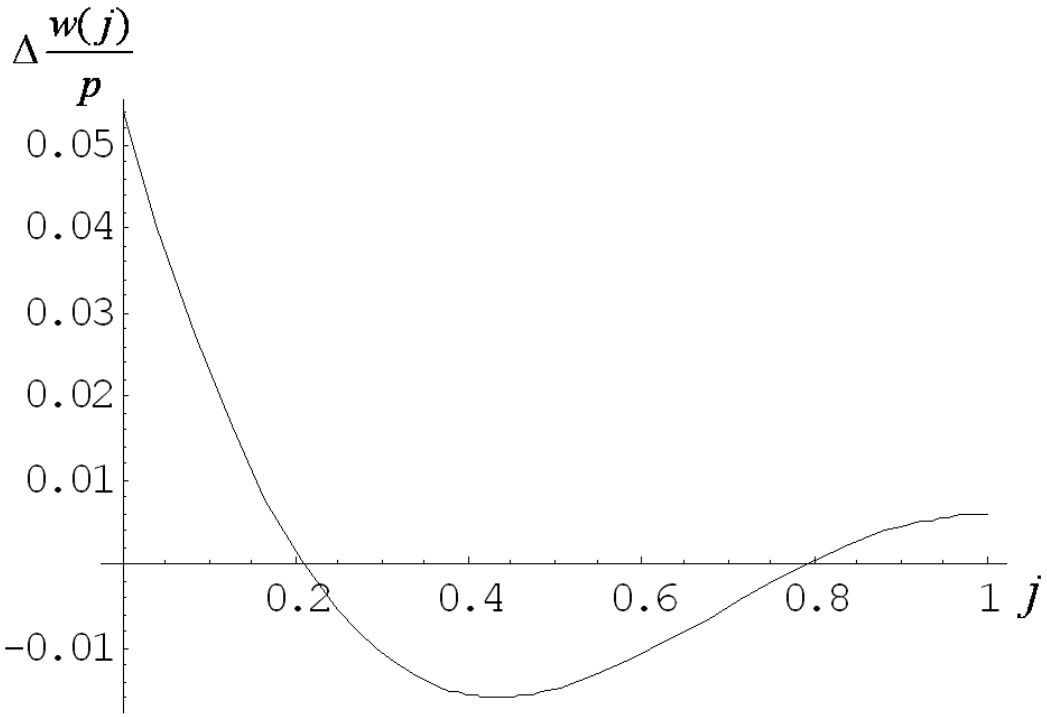
- Education Policy and Comparative Advantage: Suggests more sophisticated strategies for targeting educational subsidies (i.e. primary, secondary, or tertiary levels and/or sector specific technical training)
- Political Economy: Suggests median voter may not be the average Joe – more nuanced.
- Empirical Implications: Differentiating effect of trade on wages needs to account for endogeneity of workers' skill sets. Identification problem: measurability of ed. costs.
- Testability: Would like to see evidence of non-monotonic skill change for wide cross section of countries.

Extensions

Just the beginning...

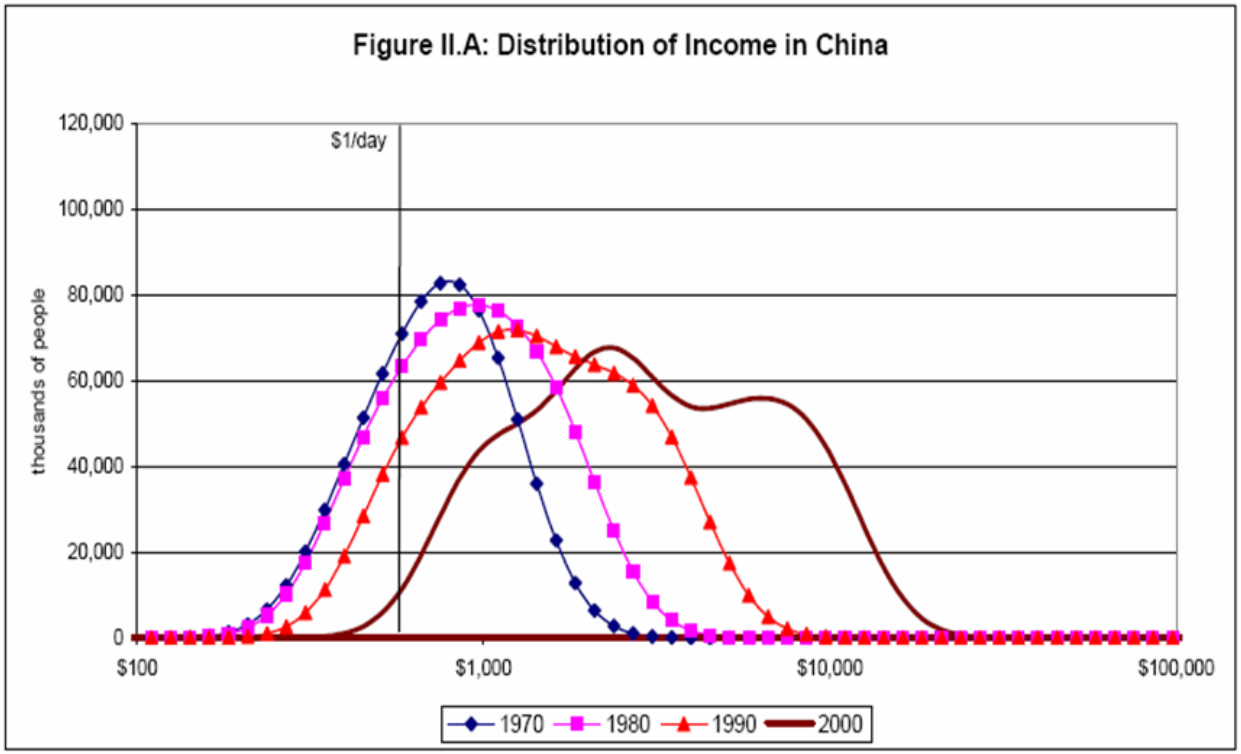
- Add differences in production technology to explore complementarity with ed. institutions.
- Non-traded goods/services
- Consider educational migration/outsourcing of education
- Use as stage game in dynamic political economy model
- Your suggestions very welcome!

Change in the real sectoral wage at Home



Change in Home's Real Wages by Sector

Stylized Facts: Rising Inequality and Income (China)



Source: Sala-i-Martin (QJE 06)