Trade, Education, and The Shrinking Middle Class

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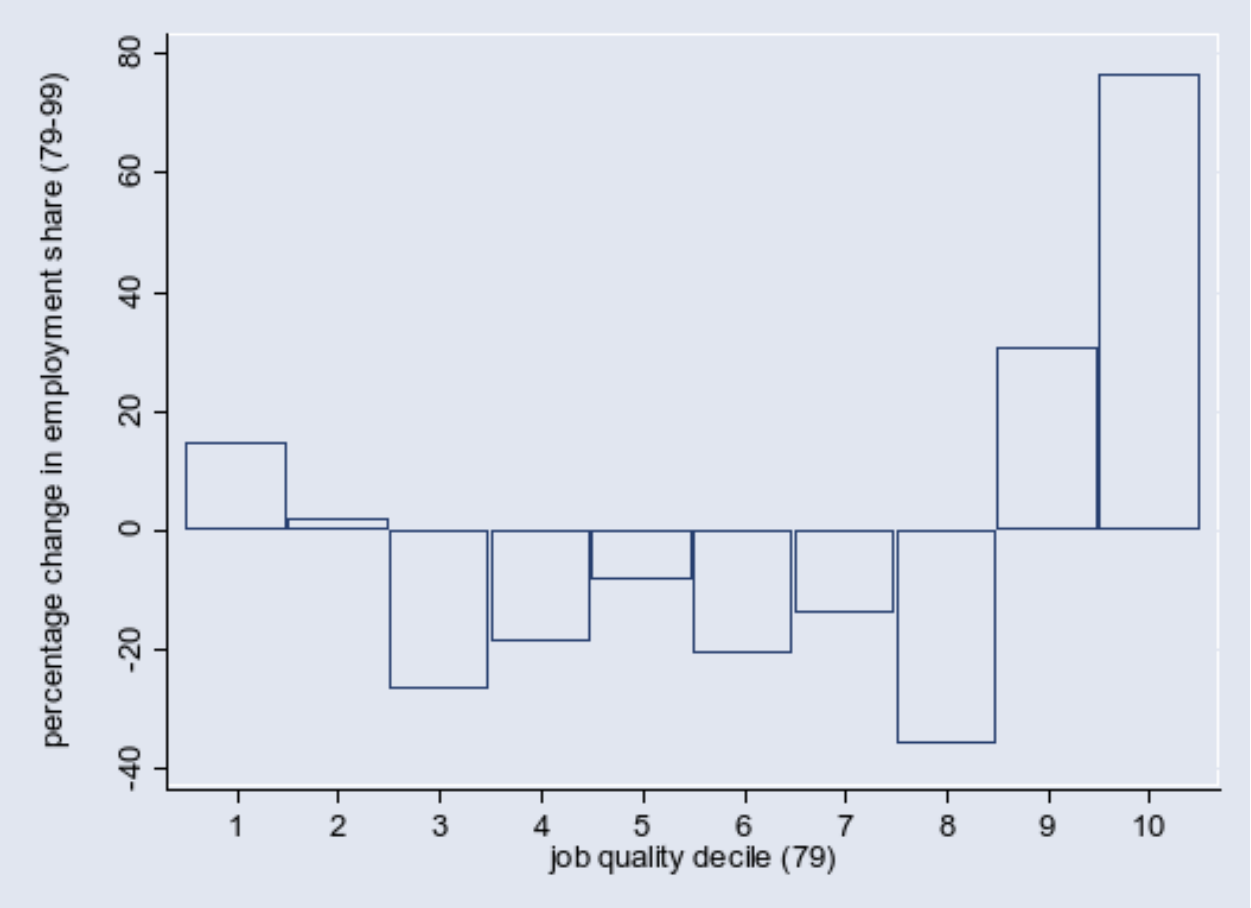
Motivation

Public perception at odds with trade models

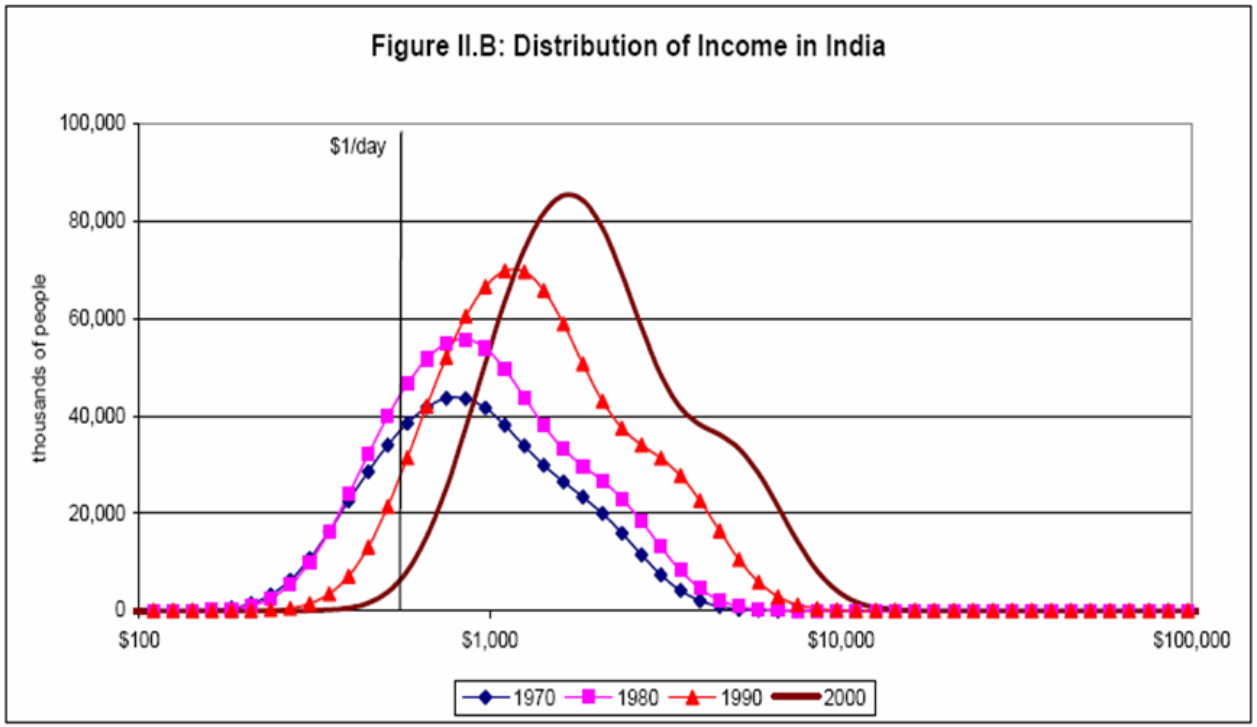
- Growing popular concern that the middle class is shrinking, likely due to globalization.
- Even those with a solid education no longer seem safe from losing jobs and social standing.
- At the same time, trade theory treats education crudely, most often as a binary variable.

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



Source: Goos/Manning (REStat 07)

Stylized Facts: Expanding Middle Class (India 1970-2000)



Source: Sala-i-Martin (QJE 06)

Overview

Our approach:

- Continuum of sectors model with trade in intermediate goods/tasks and endogenous skill acquisition.
- Agents of different ability levels self-select into occupational sectors by acquiring the corresponding human capital.
- Countries differ in educational institutions resulting in a different educational cost structure $\Rightarrow$ comparative advantage.
- Trade liberalization can (and generally will) lead to non-monotonic skill change within countries; welfare effects of trade typically non-monotonic; middle class may suffer most.

Roadmap

Outline of this talk:

- related literature
- the model
- a tractable example
- limited diversification
- policy analysis
- concluding remarks

Related Literature

Labor Literature: Documenting non-monotonic wage changes

- Autor/Levy/Murnane (QJE 03), Autor/Dorn (07), Goos/Manning (REStat 07), Falvey/Greenaway/Silva (08).

Trade Literature

- trade vs. technology: Krugman, Feenstra, and others;
- binary skill models: Blanchard/Willmann (08), and others;
- continuous sectors: Dornbusch/Fischer/Samuelson (AER 77, 80), Grossman/Rossi-Hansberg (08), Jim Anderson (08);
- heterogeneous firms and workers: Yeaple (JIE 05), Helpman/Itskhoki/Redding (08);
- similar results: Jung/Mercenier (08), Costinot/Vogel (09).

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, numeraire:
  - $Y = \psi(\vec{y})$ 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

- Cost of education for agent a to enter sector j (measured in units of Y):

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

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/ $w(j) \in C^1, \dot{w}(j) > 0 \; \forall j$.

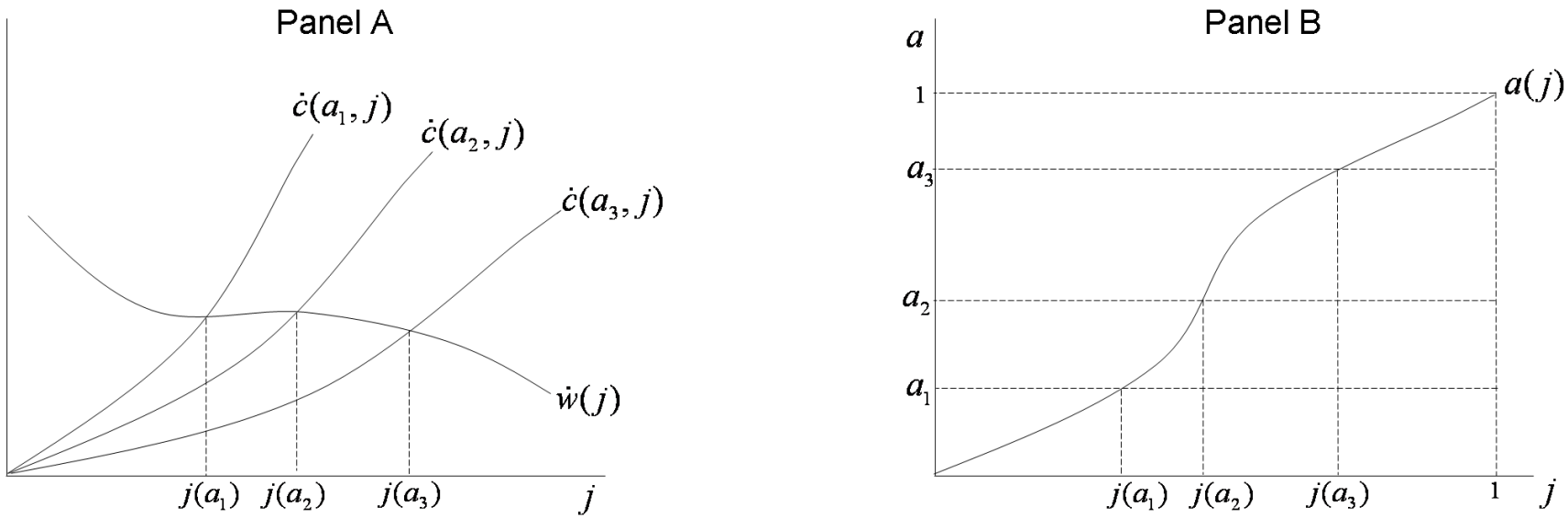


Figure: Monotonic Sorting across Occupations

Non-Monotonic Skill Change in an SOE

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

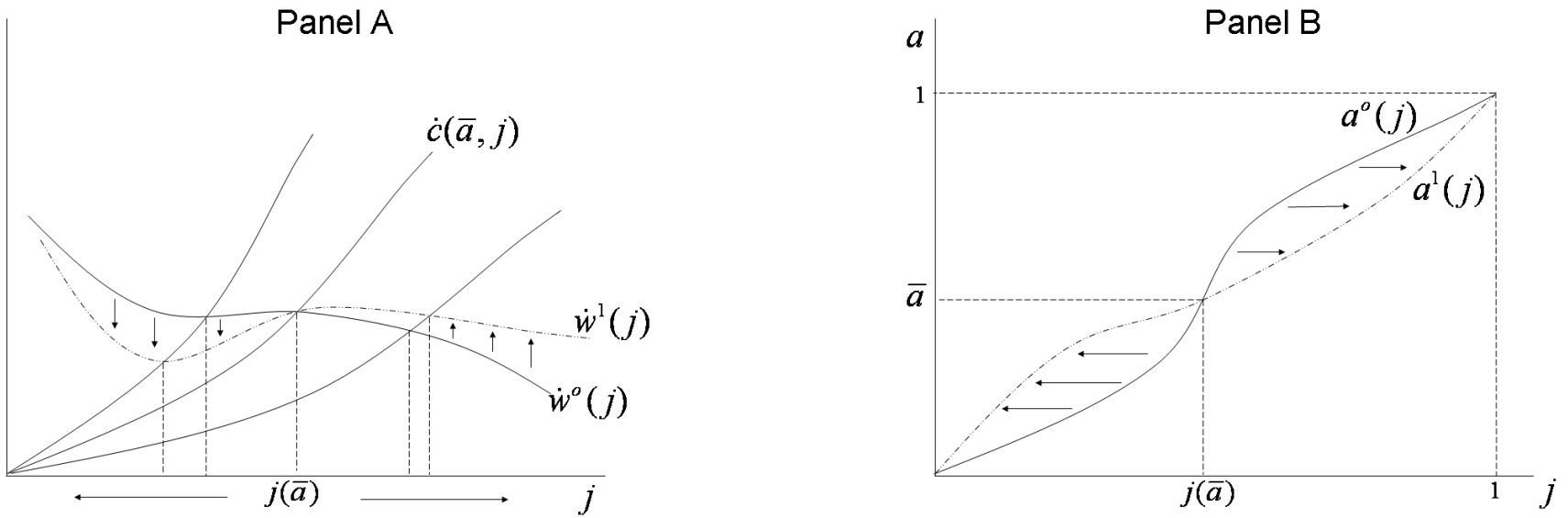


Figure: Low Ability Agents Sort Down; High Ability Sort Up

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:

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

- Balanced budget:

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

- 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 $a(j)$:

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

  which yields equilibrium wage schedule, $w(j)$.
- Use $w(j)$ to find equilibrium mapping functions $a(j)$ and $a^*(j)$ and supply schedules $y(j), y^*(j)$.
- 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:

$$c(j,a) = \frac{1-a}{a} \times \frac{2j^2}{5}$$

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

- Leontief final good production:
  - $\Rightarrow$ unit factor demand: $x(j) = x^*(j) = 1$
  - $\Rightarrow$ price index (with Y as numeraire): $1 = \int_0^1 w(j)dj$

Thought Experiment: Autarky $\rightarrow$ Free Trade

Closed Form Solutions for Wage Gradients

Using the functional form of the cost in the FOC's, and noting that Leontief implies $a(j) = j$ or $a'(j) = 1$ under autarky, we obtain:

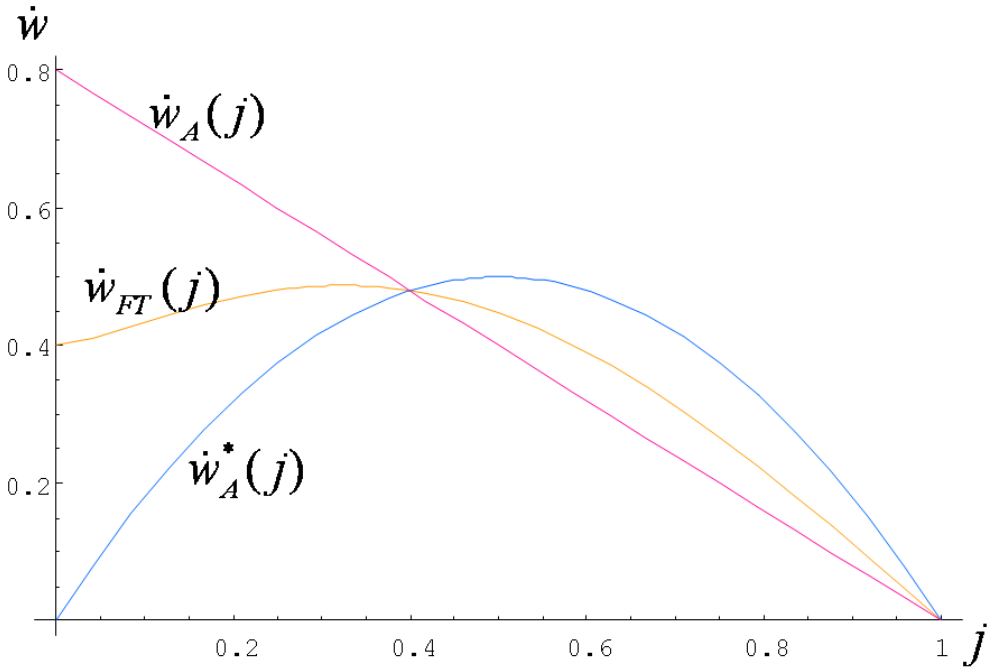
Autarky wage/price schedules

- $\dot{w}_A(j) = \frac{4(1-j)}{5}$
- $\dot{w}_A^*(j) = 2j(1-j)$

Free trade wage/price schedule

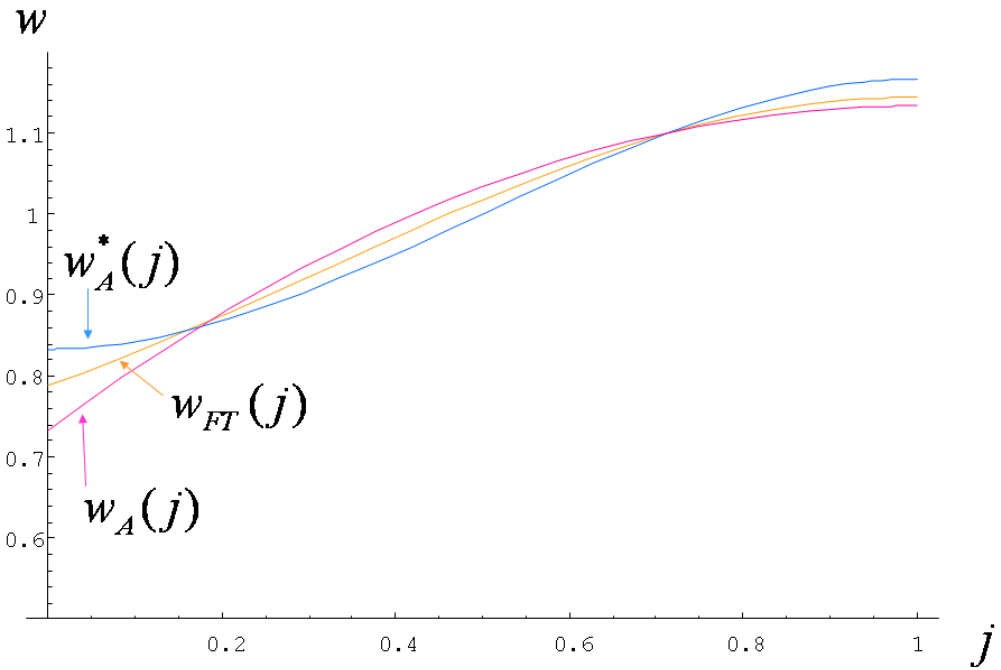
- $\dot{w}_{FT}(j) = \frac{j(2+j-10j^2)+\sqrt{j^2(4+j(4+4j(121+20j(-9+5j))))}}{10j}$.

Comparing Autarky and Free Trade Wage Gradients



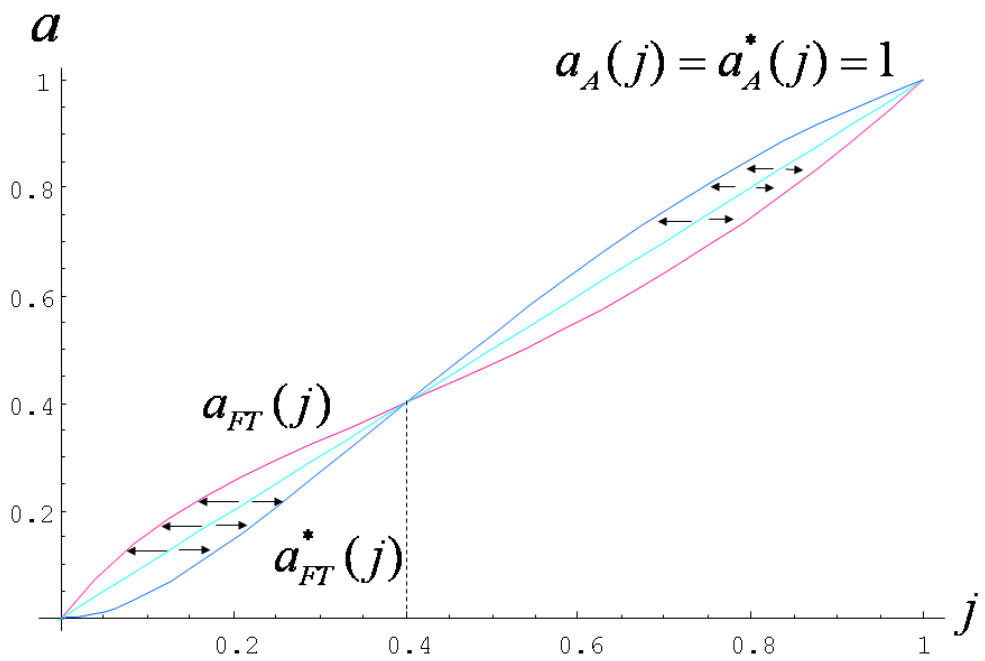
Slopes of the Equilibrium Wage Schedules

Equilibrium Wage/Price Schedule



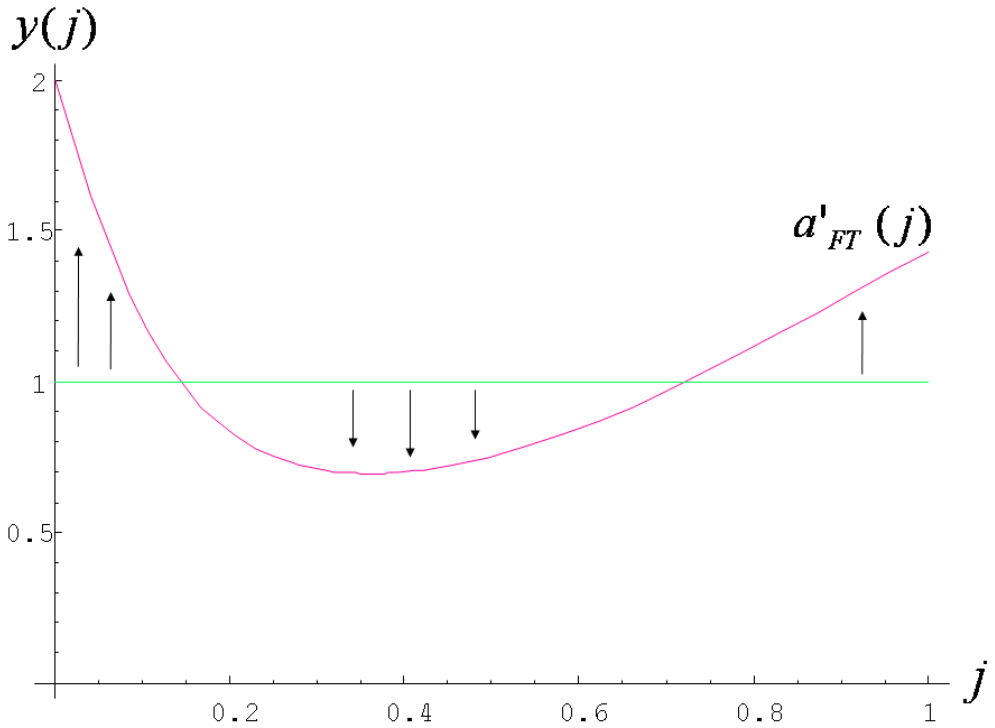
Where $w_0 = 1 - \int_0^1 \dot{w}(j)dj$

Ability-to-Sector Mappings



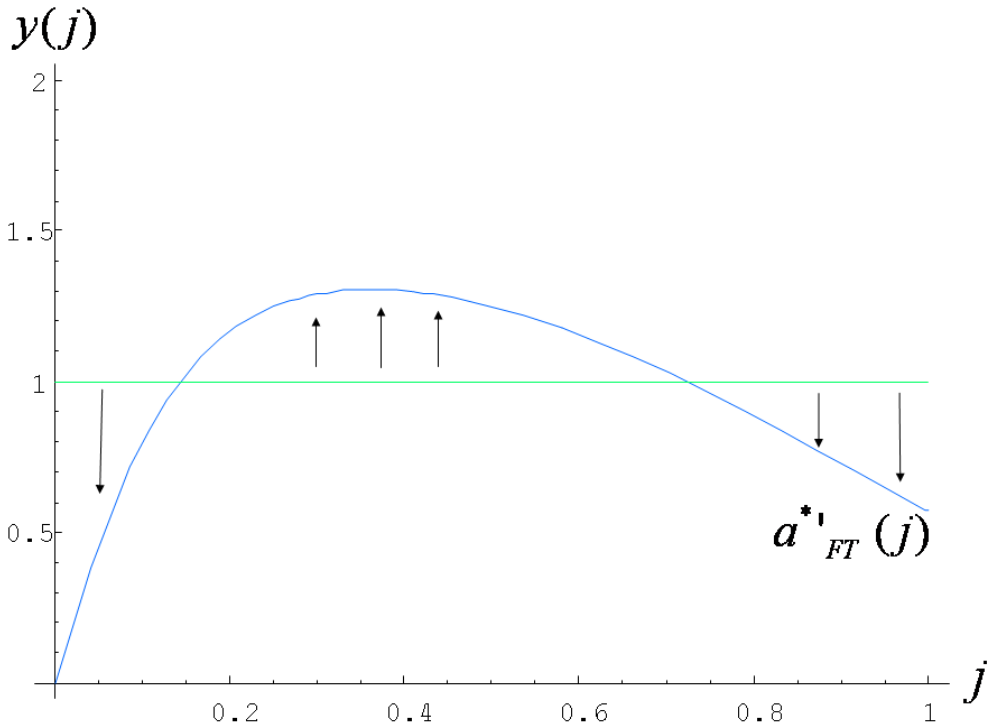
Non-Monotonic Skill Change at Home and Abroad

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

Two Components of Net Real Wages

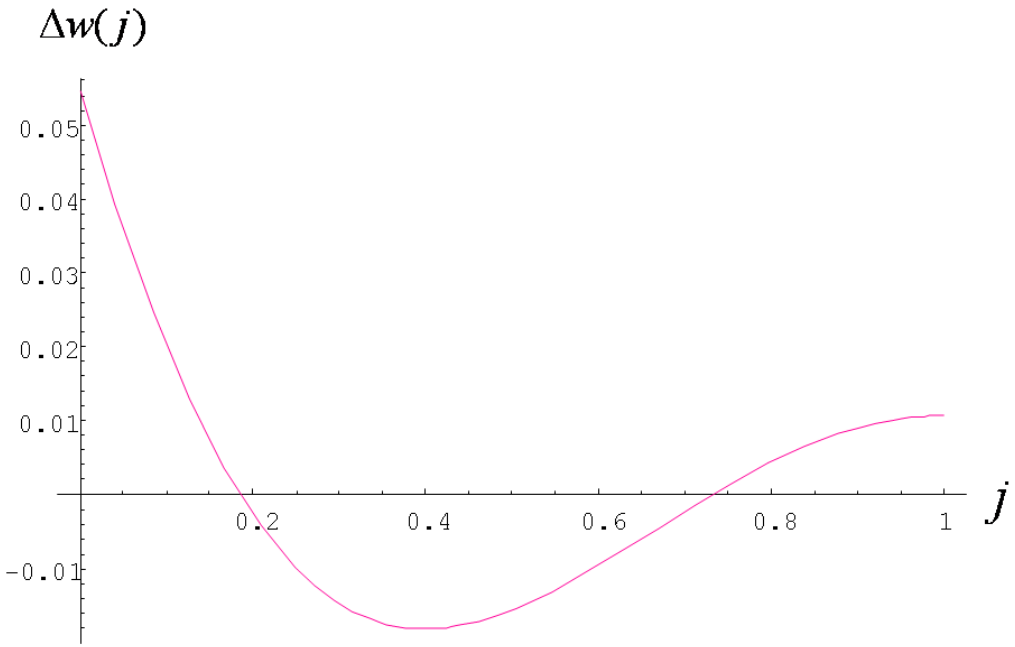
For a given agent, a:

- Real wage: $w(j(a))$
- Real cost of education: $c(j(a), a)$

Net Real Welfare Change

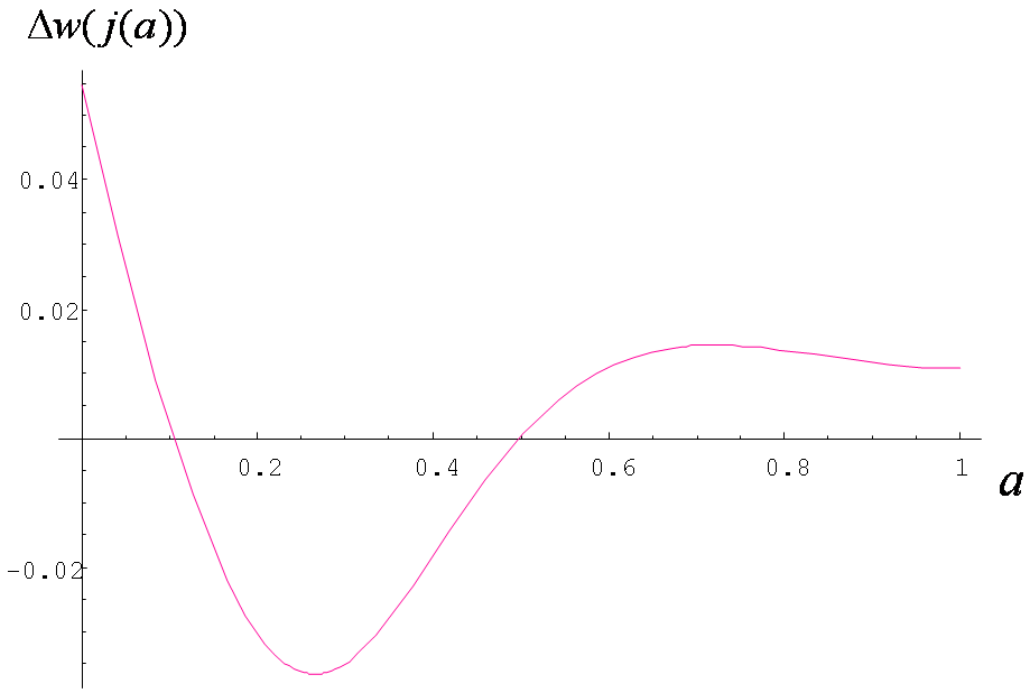
$$[w_{FT}(j_{FT}(a)) - w_A(j_A(a))] - [c(j_{FT}(a), a) - c(j_A(a), a)]$$

Change in the real wage in sector j Home



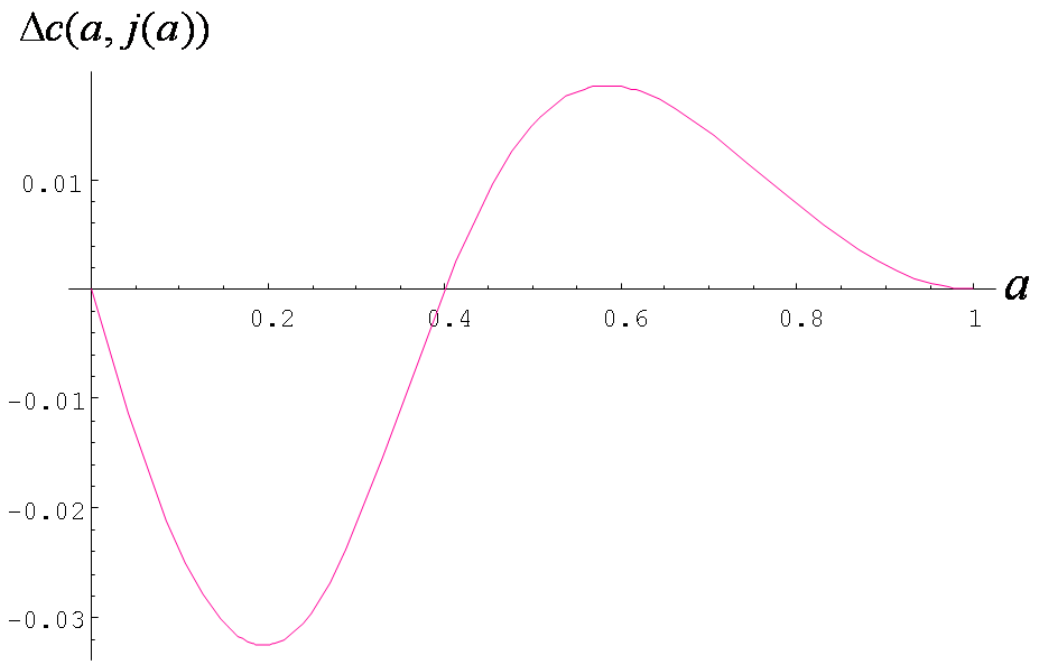
Change in Home's Real Wages by Sector

Change in the real wage of Home agent a



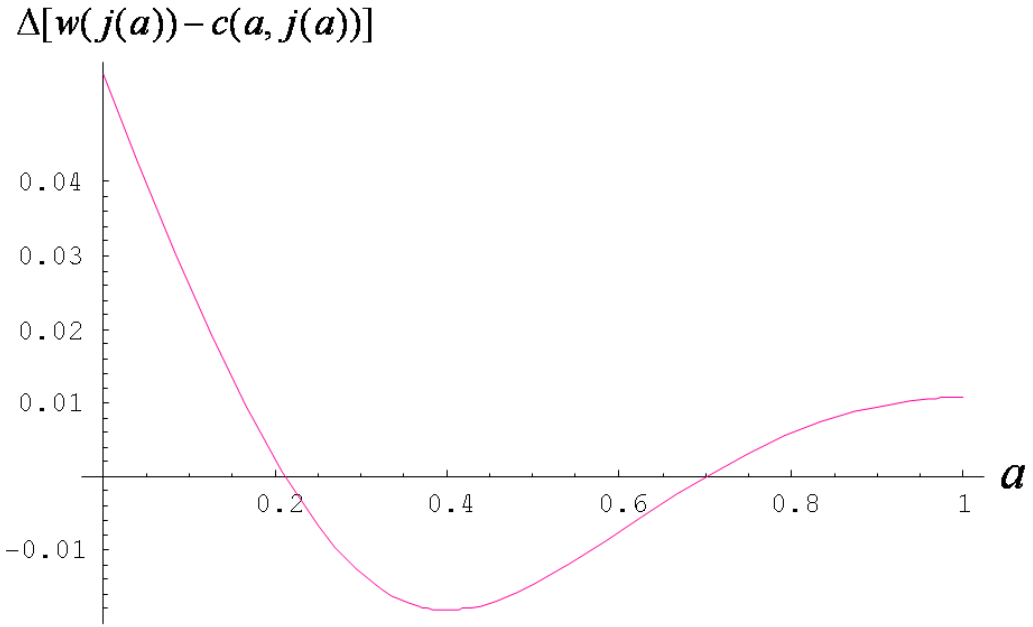
Change in Home's Real Wages by Agent

Change in the realized cost of education for Home workers



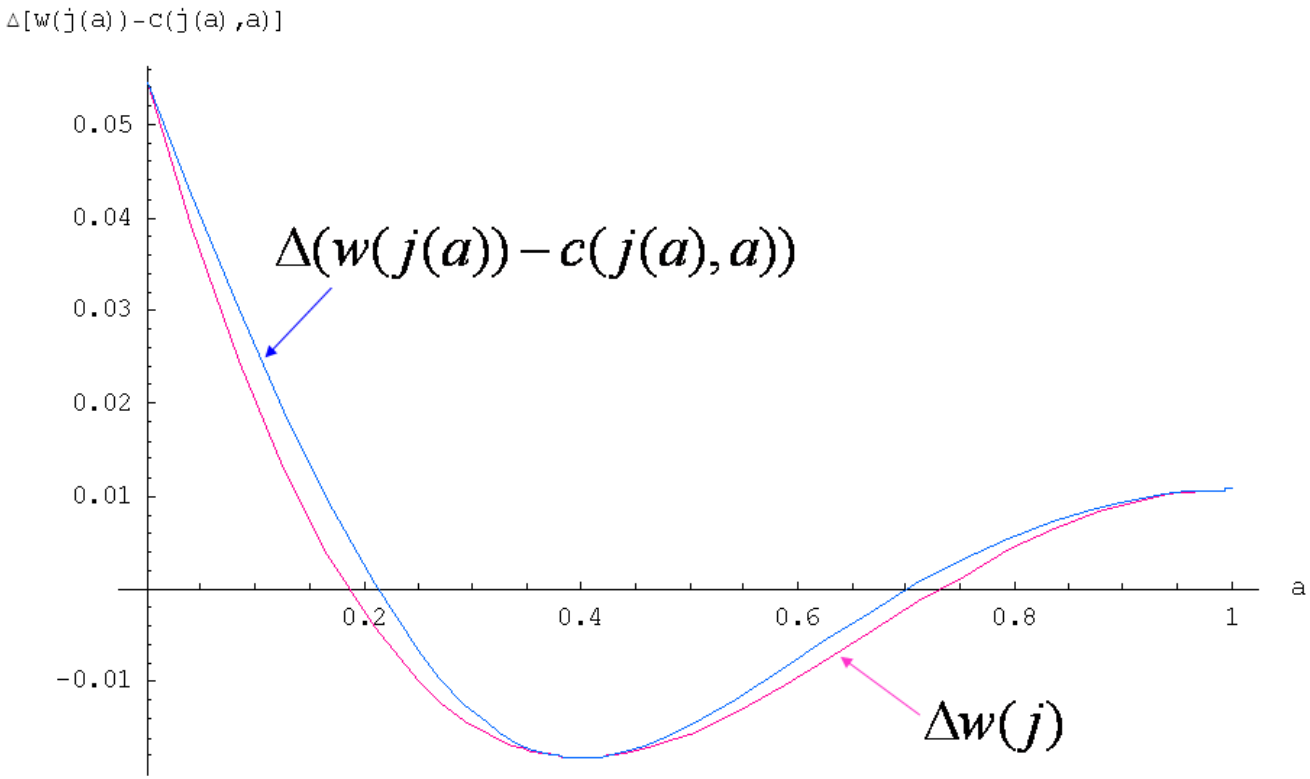
Change in the Cost of Education by Agent (Home)

Net Welfare Change for Home Workers

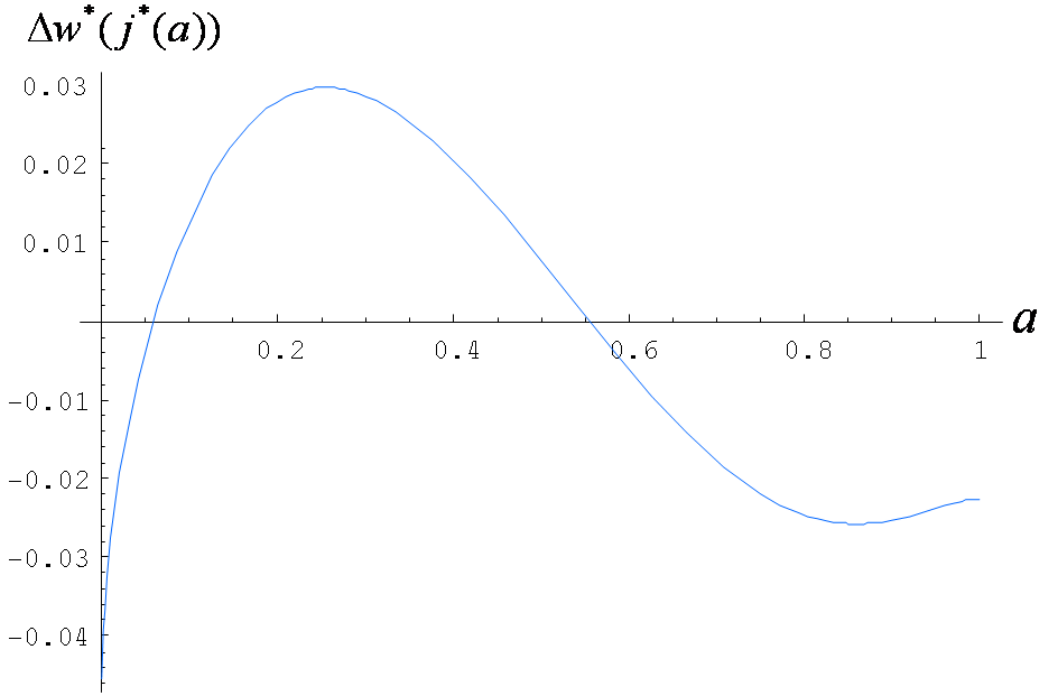


Middle Ability Agents Lose from Trade

Aside: A Short Run Perspective: Fixed Education Costs.

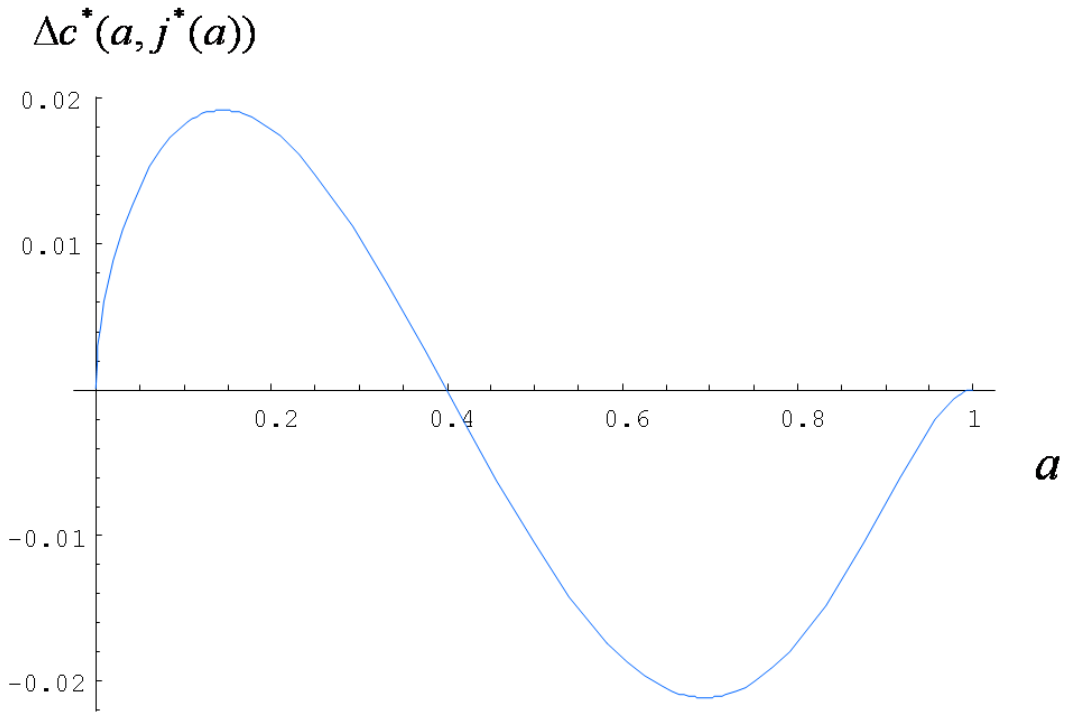


Foreign Real Wage Changes



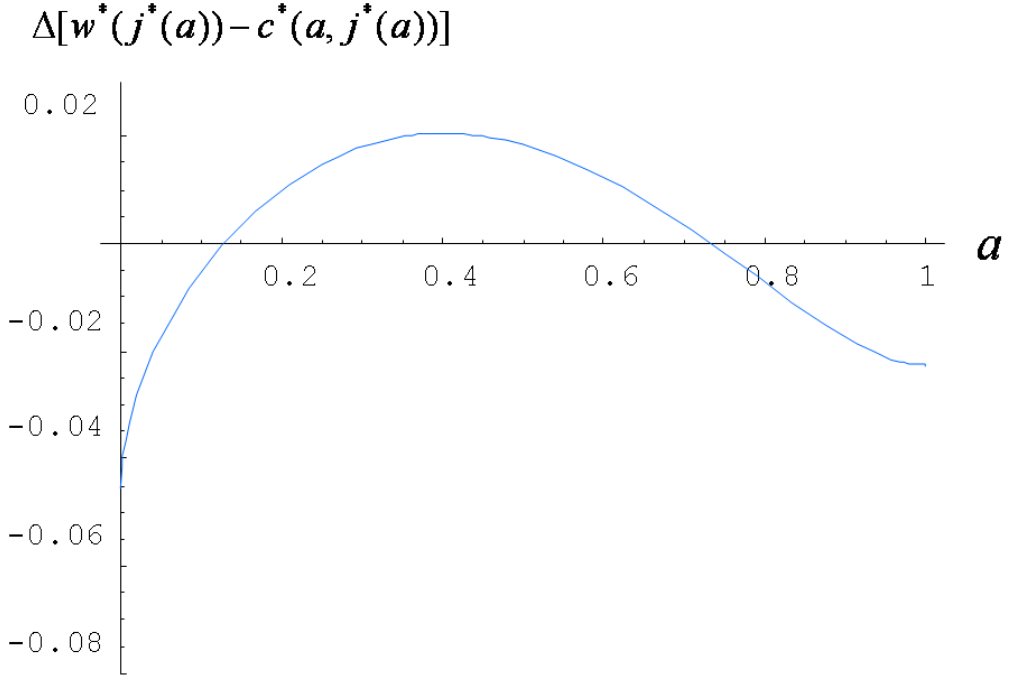
Change in the Foreign Real Wage by Agent

Foreign Real Cost of Education Changes



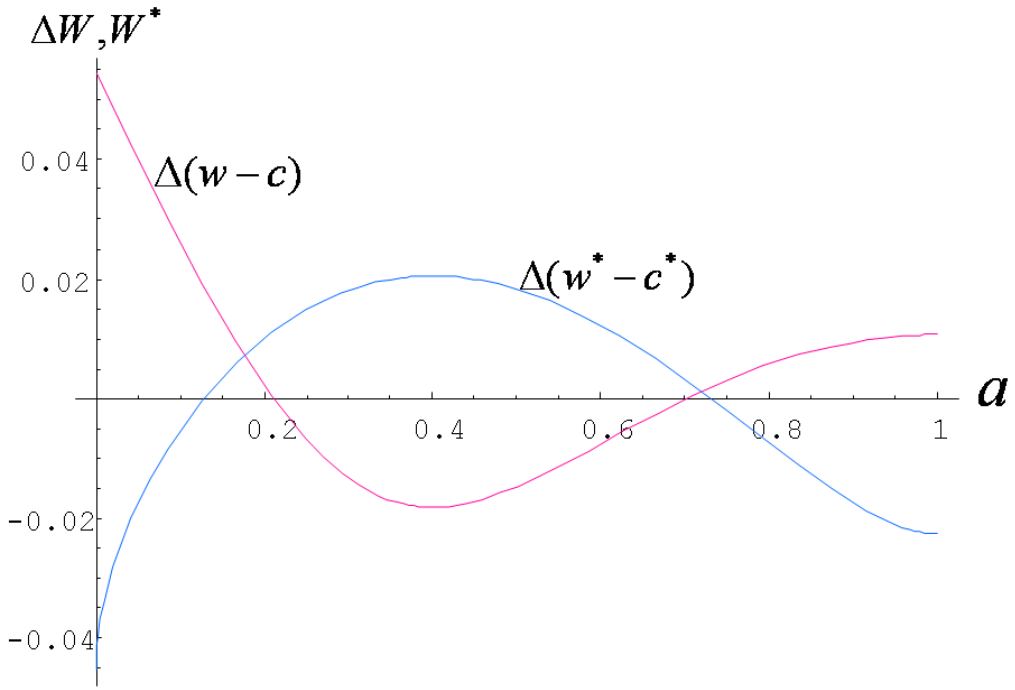
Change in the Cost of Education by Agent (Foreign)

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:
  - 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:
  - 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

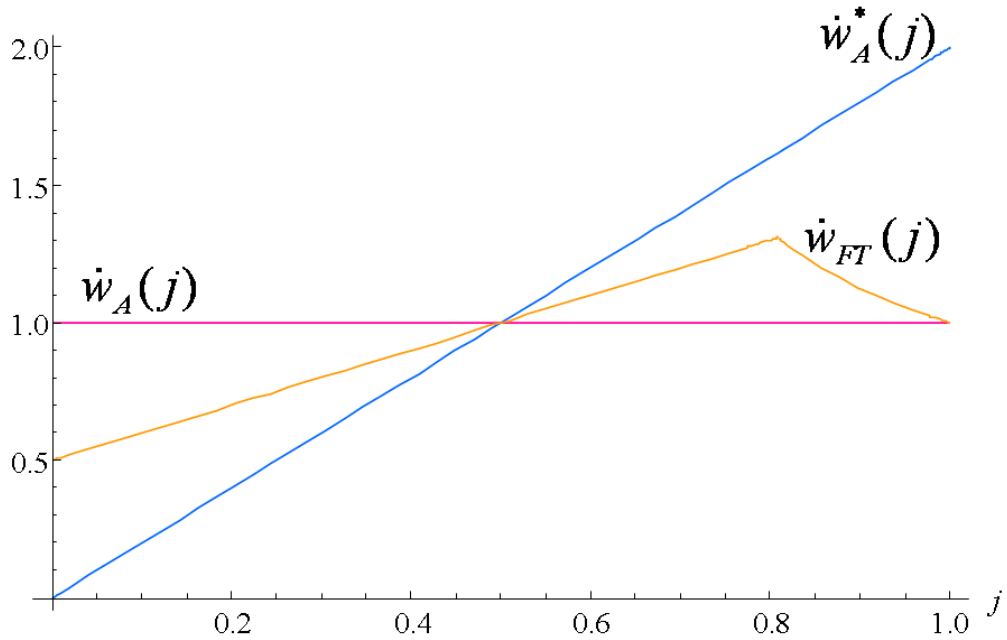
Limited Diversification

- in the example countries stay diversified over the entire range
- are our results robust if that is not the case
- modified example with limited diversification under trade:

$$c[j,a] = \frac{1}{a} * \frac{j^2}{2}$$

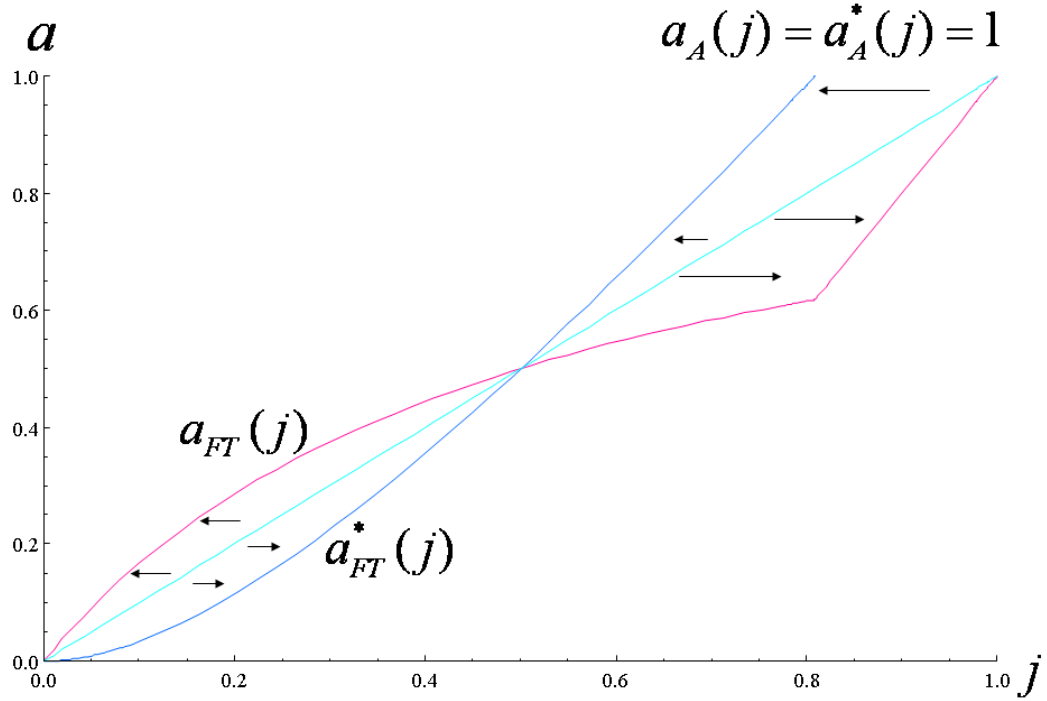
$$c^*[j,a] = \frac{1}{a} * \frac{2j^3}{3}$$

Wage Schedules with Limited Diversification



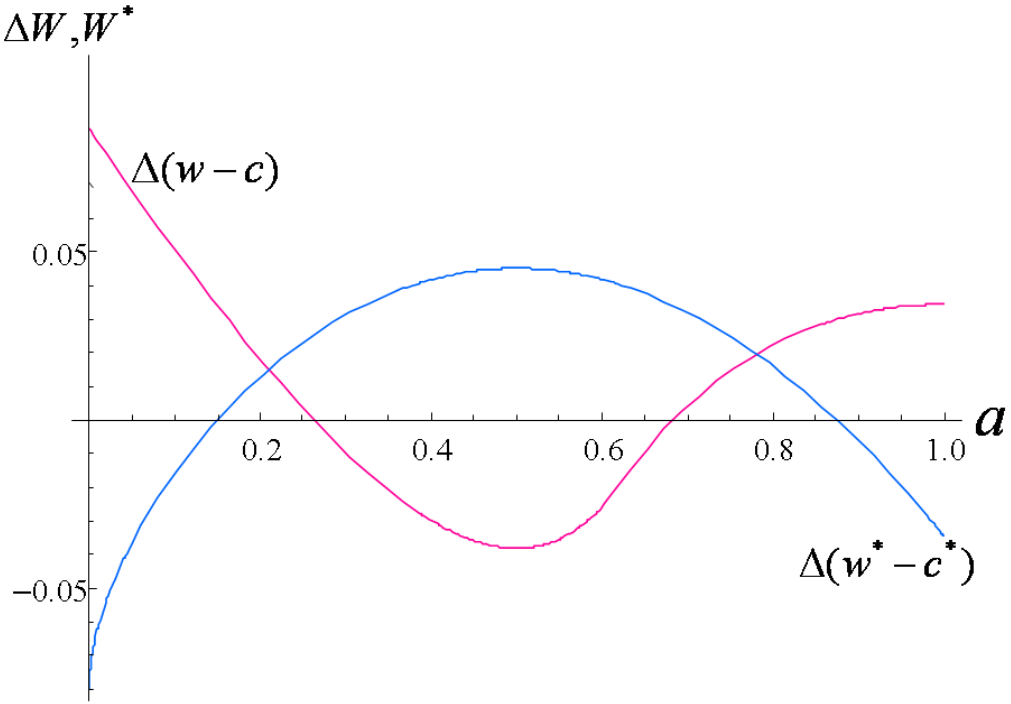
Wage Schedules under autarky and free trade

Aibility-Sector Mappings with Limited Diversification



Ability-sector mappings under autarky and free trade

Net Welfare Effects under Limited Diversification



Net welfare effects of trade liberalization

Educational Policy

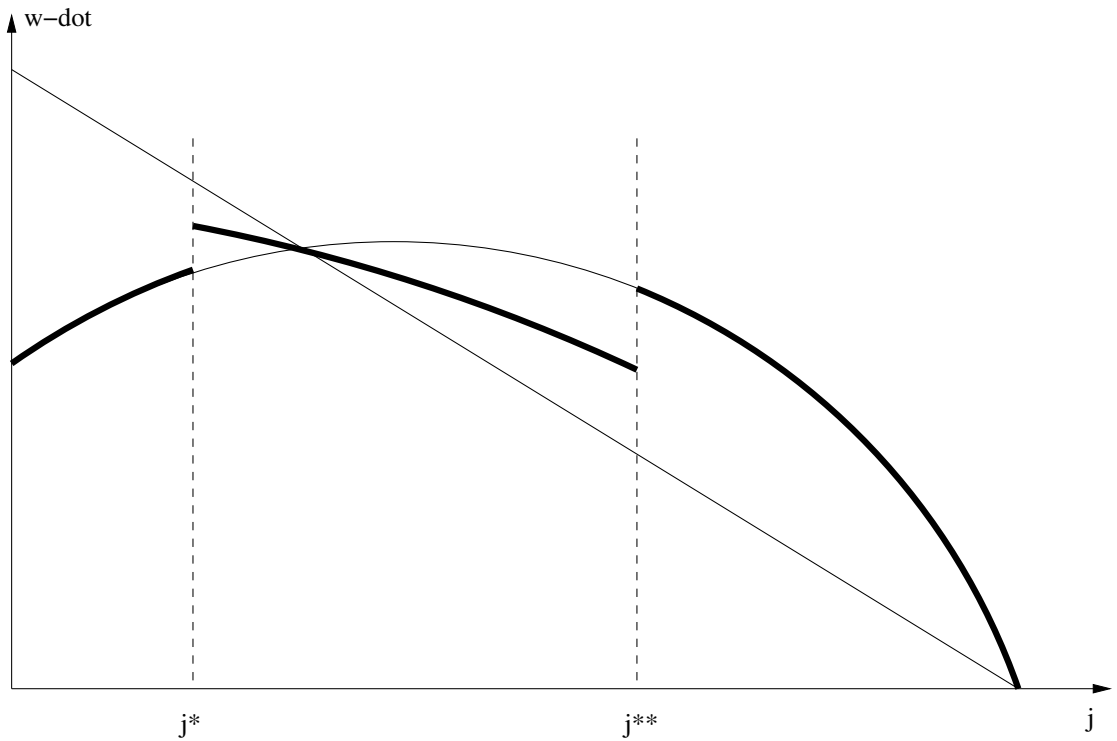
- such policy can take many possible forms
- we focus on educational subsidies
- augmented FOC: $\dot{c}(j,a) - \dot{s}(j) = \dot{w}(j)$
- same assumptions on $c - s$ as before on c
- Proposition:
  - if $\dot{s} = 0$, no effect
  - if $\dot{s} > 0$, sorting up
  - if $\dot{s} < 0$, sorting down
- to pop up middle class, target eg secondary education

Trade Policy

- very similar effects as educational policy
- FOC: $\dot{c}(j,a) = \dot{w}(j) + \dot{t}(j)$
- effect depends on sign of $\dot{t}$:
  - if $\dot{t} = 0$, no effect
  - if $\dot{t} > 0$, sorting up
  - if $\dot{t} < 0$, sorting down
- but in addition distortion on demand side
- potentially beneficial if country can affect its terms of trade

Trade Policy

Suppose we want to soften the impact of globalization by (partially) off-setting the price shock for imports:



Concluding Remarks

- 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.

Concluding Remarks

Work in progress ...

- Further generalizing results
- 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 welcome