Topics in International Economics

International Trade - Part I

Lecture 1

Ricardian Models of Trade

Ref: Dornbusch, Fischer & Samuelson (1977)

Eaton & Kortum (2002)

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Plan of the Course

- advanced course: knowledge of basic models and facts is assumed

- first part (Gino Gancia): emphasis on models
  1. state-of-the-art trade model (Ricardian, HO, differentiated products)
  2. dynamic trade models: product cycle trade, growth and multinational firms
  3. trade policy and taxation in open economy
  4. trade and inequality
  5. offshoring and inequality

- second part (Paula Bustos): emphasis on empirics

Ricardian Model: DFS

- review of Dornbusch, Fischer & Samuelson (1977)
- reason for trade: exogenous differences in technology across countries
- 2 countries, home h and foreign f (*)
- one factor of production, labor, in fixed supply (L and L^*)
- continuum $[0, 1]$ of goods
- perfect competition

Technology

- country-specific constant unit labor requirements: $a(z)$ and $a^*(z)$

- relative home productivity

$$A(z) \equiv \frac{a^*(z)}{a(z)}$$

rank all goods so that $A(z)$ is decreasing in z, assume it is continuous

- price = marginal cost:

$$P(z) = a(z)\, w \quad \text{and} \quad P^*(z) = a^*(z)\, w^*$$

where w and w^* are wages

- condition for home production: $P(z) < P^*(z)$ or

$$A(z) > \frac{w}{w^*} \equiv \omega$$

determinants of comparative advantage: technology and wages

Efficient Specialization

- represent the condition for home production $\omega < A(z)$ in the space (ω, z)
- given ω there is a good $\bar{z}$ such that $\omega = A(\bar{z})$
- goods with $z < \bar{z}$ are produced in home
- goods with $z > \bar{z}$ are produced in foreign
- yet, wages are endogenous:
  how do we solve for ω? look at the demand side

Preferences

- assumptions:
  1. preferences are identical
  2. preferences are represented by constant expenditure shares

$$b(z) = \text{ share of income spent in good } z$$

- trade balance:

$$wL \int_{\bar{z}}^{1} b(z)\, dz = w^* L^* \int_{0}^{\bar{z}} b(z)\, dz$$

  value of home import = value of foreign imports

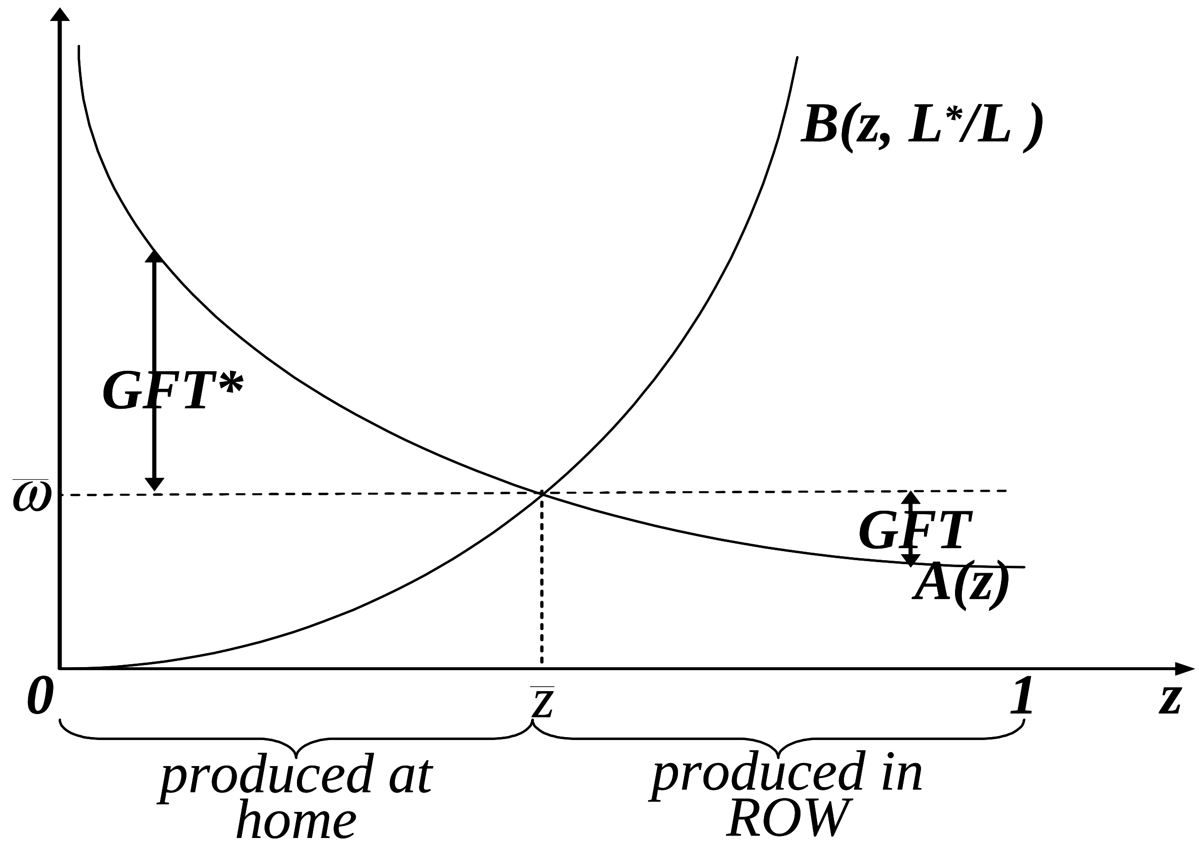
- rearrange:

$$\omega = \frac{L^*}{L} \frac{\int_0^{\bar{z}} b(z)\, dz}{\int_{\bar{z}}^{1} b(z)\, dz} = B\left(z, \frac{L^*}{L}\right)$$

  $\rightarrow$ upward sloping relationship in the space (ω, z)

Equilibrium

$$\omega = A(z) \quad \text{and} \quad \omega = B(z, L^*/L)$$



efficient specialization guarantees the gains from trade

DFS: Pros and Cons

- simple and powerful model:
  - useful to study the effect of country-size and technology on trade

- does not generalize easily to more than two countries

- where do differences in technology come from?

- model is silent on the deep cause for trade

Eaton & Kortum (2002): Goals

- generalization of DFS to N countries
- shows how distance and affects bilateral trade in a competitive model
- parameters are estimated from structural equations using bilateral trade and wage data
- model is used to perform exercises such as computing:
  1. gains from trade
  2. welfare effect of moving to free trade
  3. welfare effect of technology improvements in one country
- state-of-the-art Ricardian model, can be used for quantitative analysis

Eaton & Kortum (2002): Overview

- key parameters:
  1. "average" technology in each country (absolute adv.)
  2. technology heterogeneity (comparative adv.)
  3. (bilateral) geographical barriers

- main difficulty:
  - DFS becomes untractable with more that 2 countries

- solution: use a probabilistic formulation of technology
  - productivity across goods is drawn from a given distribution
  - cross-country differences are summarized by the parameters of the distribution
  - as in DFS, the identity of goods irrelevant

Simplified Model

- preferences:

$$U = \exp \int_0^1 \log Q(j) dj$$

  $Q(j) =$ quantity consumed of good j

- price of good j produced in country o sold in country n:

$$P_{n,o}(j) = MC = \frac{w_o d_{o,n}}{z_o(j)}$$

  where:
  - w_o is the wage in country o (origin)
  - $z_o(j)$ is productivity of country o in good j
  - $d_{o,n}$ (iceberg) cost of distance between o and n

- shopping around $\rightarrow$ price actually paid $=$ lowest across all sources

$$P_n(j) = \min_o \{P_{n,o}(j)\}$$

Technology

- $z_o(j)$ is the realization of a random variable Z_o with a Frechet distribution:

$$\Pr\left[Z_o(j) \leq z\right] = F_o(z) = e^{-T_o z^{-\theta}}$$

- $T_o > 0$ is country-specific, governs the mean
  high $T_o \rightarrow$ higher probability to draw a high $z_o(j)$

- $\theta > 1$ equal across countries, governs the dispersion

- given θ, technology across countries entirely summarized by the T_o

Distribution of Prices

- distribution of price offers from country o to n:

$$\Pr\left[P_{n,o}(j) \geq p\right] = \Pr\left[z_o\left(j\right) \leq \frac{w_o d_{o,n}}{p}\right] = e^{-T_o (w_o d_{o,n})^{-\theta} p^{\theta}}$$

- distribution of prices paid in n:
  Pr that good j costs more than $p =$ (joint) probability that prices from all sources are above p

$$\begin{aligned} \Pr\left[P_n(j) \geq p\right] &= \prod_{o=1}^{N} \left[e^{-T_o (w_o d_{o,n})^{-\theta} p^{\theta}}\right] = e^{-\phi_n p^{\theta}} \\ \text{with} \quad \phi_n &= \sum_{o=1}^{N} \left[T_o \left(\left(w_o d_{o,n}\right)^{-\theta}\right)\right] \end{aligned}$$

- realized prices in country n are $\sim$ Frechet with parameter ϕ_n
  1. prices tend to high if all w_o, $d_{o,n}$ are high and T_o low
  2. if $d_{o,n} = 1 \; \forall o, n \rightarrow$ same prices everywhere (LOP)
  3. otherwise, more remote countries have higher prices

Export Probability

- define the price distribution in country n

$$\Pr\left[P_n(j) \leq p\right] = 1 - e^{-\phi_n p^\theta} = G_n(p)$$

and similarly $G_{n,o}(p) = 1 - e^{-T_o(w_o d_{o,n})^{-\theta} p^\theta}$

- probability that o exports good j to n:

$$\pi_{n,o} = \Pr\left[P_{n,o}(j) \leq \min\left\{P_{n,s}(j); s \neq o\right\}\right]$$

$=$ probability that $P_{n,o}(j)$ is the lowest

- to find it, we integrate $\prod_{s \neq o} \left[1 - G_{n,s}(p)\right]$ ($=$ Pr that all other prices are higher than p) over all the possible realizations of p from o weighted by their probability

$$\pi_{n,o} = \int_0^\infty \prod_{s \neq o} \left[1 - G_{n,s}(p)\right] dG_{n,o}(p) = \frac{T_o \left(w_o d_{o,n}\right)^{-\theta}}{\phi_n}$$

Export Probability: Interpretation

- probability that o exports good j to n:

$$\pi_{n,o} = \frac{T_o \left(w_o d_{o,n}\right)^{-\theta}}{\phi_n} = \frac{T_o \left(w_o d_{o,n}\right)^{-\theta}}{\sum_{o=1}^{N} \left[T_o \left(\left(w_o d_{o,n}\right)^{-\theta}\right)\right]}$$

- think of $T_o \left(w_o d_{o,n}\right)^{-\theta}$ as country o "competitiveness" in market n. Depends on:
  1. technology
  2. wages
  3. distance

- the probability that o is the least cost supplier is the ratio of country o competitiveness to that of the sum of all nations

- note: if all countries share the same parameters and $d_{o,n} = 1 \rightarrow \pi_{n,o} = 1/N$

Bilateral Trade Equation

- by the law of large numbers, $\pi_{n,o}$ is also the fraction of goods that n buys from o

- given log preferences $\longrightarrow$ expenditure X_n in country n is equalized across all goods

- share of imports from country o is:

$$\frac{X_{n,o}}{X_n} = \pi_{n,o} = \frac{T_o \left(w_o d_{o,n}\right)^{-\theta}}{\phi_n}$$

  normalize it by the share of non-imported goods:

$$\frac{X_{n,o}/X_n}{X_{n,n}/X_n} = \frac{\pi_{n,o}}{\pi_{n,n}} = \frac{T_o}{T_n} \left(d_{o,n}\right)^{-\theta} \left(\frac{w_o}{w_n}\right)^{-\theta}$$

- not a closed form solution (why?), but trade volumes are expressed in terms of observable variables

Closing the Model

- to close the model, we need to solve for wages

- impose market clearing by country (income = expenditure):

$$w_o L_o = \sum_{i=1}^{N} \pi_{n,o} w_n L_n$$

  thus, the wage adjusts so that a country can sell all its output

- large system of nonlinear equations $\longrightarrow$ numeric results

- effect of country size on export probability: large countries have low wages
  $\longrightarrow$ larger countries have higher probability to export to a given destination
  $\longrightarrow$ large destination markets are more difficult to export to
  realistic?

Estimating the Model

- imports from o to n in logs:

$$\ln \frac{X_{n,o}}{X_{n,n}} = -\theta \ln d_{o,n} + \ln \left(T_o w_o^{-\theta}\right) - \ln \left(T_n w_n^{-\theta}\right)$$

- the LHS is constructed from observed trade data ($N \times N - N$ panel, $N = 19$ OECD countries, 342 obs.)

- following the gravity literature, $d_{o,n}$ is proxied by:
  distance + dummies for common language, common border, being part of same trade area

- $\ln \left(T_o w_o^{-\theta}\right)$ is identified by the source-country fixed effect

- then, using wage data, the T_o can be retrieved

Eaton & Kortum (2002): Counterfactuals

- once the parameters are estimated, the model can be used to simulate alternative scenarios

- in the paper, various estimates are reported

- moreover, the model in the paper is more general:

  1. CES preferences instead of CD

  2. second input: intermediate goods (can be imported)

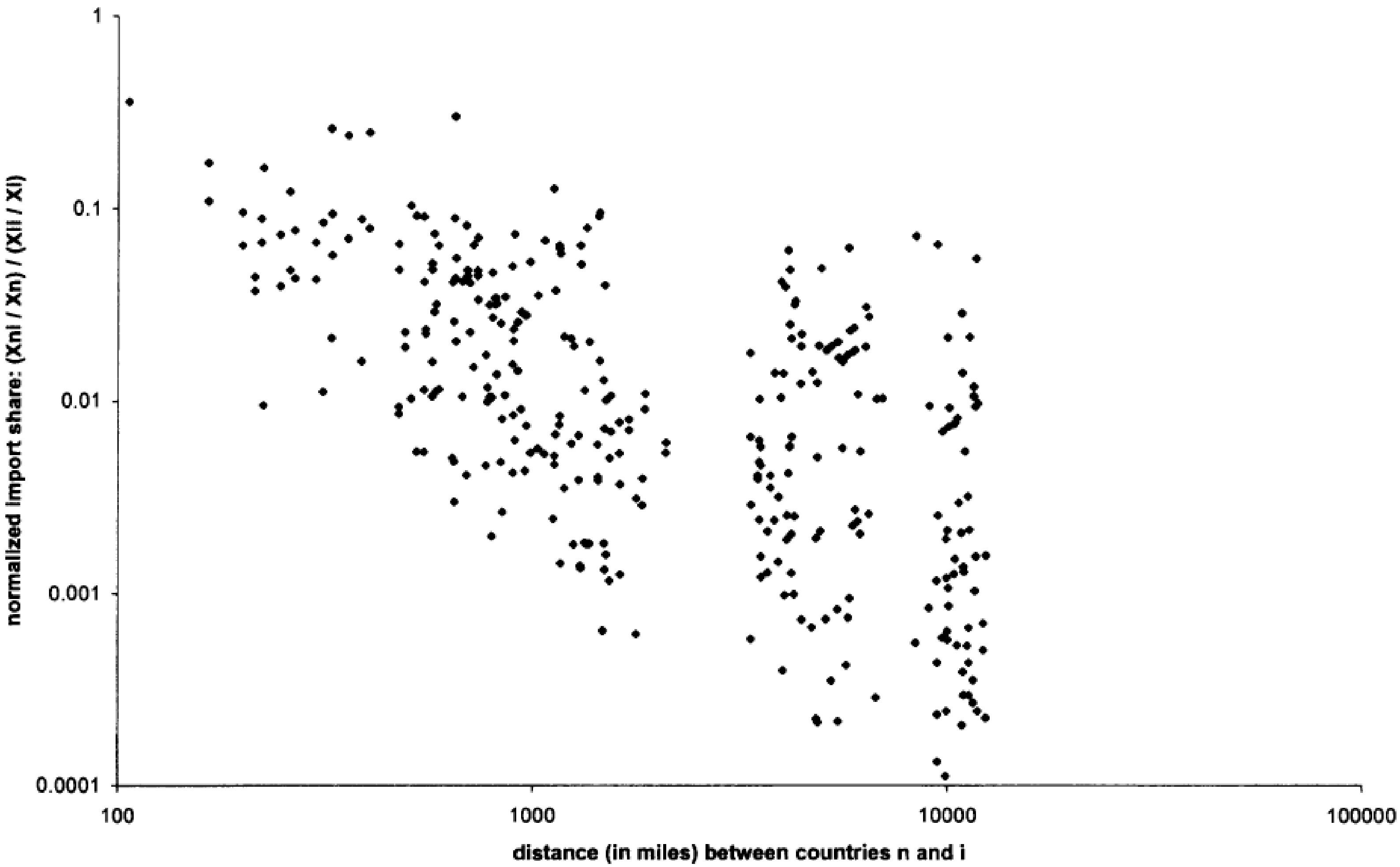


FIGURE 1.—Trade and geography.

TABLE VI

STATES OF TECHNOLOGY

Country	Estimated Source-country Competitiveness	Implied States of Technology $\theta = 8.28$	$\theta = 3.60$	$\theta = 12.86$
Australia	0.19	0.27	0.36	0.20
Austria	−1.16	0.26	0.30	0.23
Belgium	−3.34	0.24	0.22	0.26
Canada	0.41	0.46	0.47	0.46
Denmark	−1.75	0.35	0.32	0.38
Finland	−0.52	0.45	0.41	0.50
France	1.28	0.64	0.60	0.69
Germany	2.35	0.81	0.75	0.86
Greece	−2.81	0.07	0.14	0.04
Italy	1.78	0.50	0.57	0.45
Japan	4.20	0.89	0.97	0.81
Netherlands	−2.19	0.30	0.28	0.32
New Zealand	−1.20	0.12	0.22	0.07
Norway	−1.35	0.43	0.37	0.50
Portugal	−1.57	0.04	0.13	0.01
Spain	0.30	0.21	0.33	0.14
Sweden	0.01	0.51	0.47	0.57
United Kingdom	1.37	0.49	0.53	0.44
United States	3.98	1.00	1.00	1.00

Notes: The estimates of source-country competitiveness are the same as those shown in Table III. For an estimated parameter $\widehat{S}_i$, the implied state of technology is $T_i = (e^{\widehat{S}_i} w_i^{\theta})^{\beta}$. States of technology are normalized relative to the U.S. value.

THE GAINS FROM TRADE: RAISING GEOGRAPHIC BARRIERS

Country	Percentage Change from Baseline to Autarky					
	Mobile Labor			Immobile Labor		
	Welfare	Mfg. Prices	Mfg. Labor	Welfare	Mfg. Prices	Mfg. Wages
Australia	−1.5	11.1	48.7	−3.0	65.6	54.5
Austria	−3.2	24.1	3.9	−3.3	28.6	4.5
Belgium	−10.3	76.0	2.8	−10.3	79.2	3.2
Canada	−6.5	48.4	6.6	−6.6	55.9	7.6
Denmark	−5.5	40.5	16.3	−5.6	59.1	18.6
Finland	−2.4	18.1	8.5	−2.5	27.9	9.7
France	−2.5	18.2	8.6	−2.5	28.0	9.8
Germany	−1.7	12.8	−38.7	−3.1	−33.6	−46.3
Greece	−3.2	24.1	84.9	−7.3	117.5	93.4
Italy	−1.7	12.7	7.3	−1.7	21.1	8.4
Japan	−0.2	1.6	−8.6	−0.3	−8.4	−10.0
Netherlands	−8.7	64.2	18.4	−8.9	85.2	21.0
New Zealand	−2.9	21.2	36.8	−3.8	62.7	41.4
Norway	−4.3	32.1	41.1	−5.4	78.3	46.2
Portugal	−3.4	25.3	25.1	−3.9	53.8	28.4
Spain	−1.4	10.4	19.8	−1.7	32.9	22.5
Sweden	−3.2	23.6	−3.7	−3.2	19.3	−4.3
United Kingdom	−2.6	19.2	−6.0	−2.6	12.3	−6.9
United States	−0.8	6.3	8.1	−0.9	15.5	9.3

Notes: All percentage changes are calculated as $100 \ln(x'/x)$ where x' is the outcome under autarky ($d_{ni} \to \infty$ for $n \neq i$) and x is the outcome in the baseline.

THE GAINS FROM TRADE: LOWERING GEOGRAPHIC BARRIERS

Country	Percentage Changes in the Case of Mobile Labor					
	Baseline to Zero Gravity			Baseline to Doubled Trade		
	Welfare	Mfg. Prices	Mfg. Labor	Welfare	Mfg. Prices	Mfg. Labor
Australia	21.1	−156.7	153.2	2.3	−17.1	−16.8
Austria	21.6	−160.3	141.5	2.8	−20.9	41.1
Belgium	18.5	−137.2	69.6	2.5	−18.6	68.8
Canada	18.7	−139.0	11.4	1.9	−14.3	3.9
Denmark	20.7	−153.9	156.9	2.9	−21.5	72.6
Finland	21.7	−160.7	172.1	2.8	−20.9	44.3
France	18.7	−138.3	−7.0	2.3	−16.8	15.5
Germany	17.3	−128.7	−50.4	1.9	−14.3	12.9
Greece	24.1	−178.6	256.5	3.3	−24.8	29.6
Italy	18.9	−140.3	6.8	2.2	−16.1	5.7
Japan	16.6	−123.5	−59.8	0.9	−6.7	−24.4
Netherlands	18.5	−137.6	67.3	2.5	−18.5	65.6
New Zealand	22.2	−164.4	301.4	2.8	−20.5	50.2
Norway	21.7	−161.0	195.2	3.1	−22.9	69.3
Portugal	22.3	−165.3	237.4	3.1	−22.8	67.3
Spain	20.9	−155.0	77.5	2.4	−18.0	−4.4
Sweden	20.0	−148.3	118.8	2.7	−19.7	55.4
United Kingdom	18.2	−134.8	3.3	2.2	−16.4	28.5
United States	16.1	−119.1	−105.1	1.2	−9.0	−26.2

Notes: All percentage changes are calculated as $100\ln(x'/x)$ where x' is the outcome under lower geographic barriers and x is the outcome in the baseline.

The Benefits of Foreign Technology

Country	Welfare Consequences of Improved Technology			
	Higher U.S. State of Technology		Higher German State of Technology	
	Mobile Labor	Immobile Labor	Mobile Labor	Immobile Labor
Australia	27.1	14.9	12.3	4.4
Austria	9.3	2.9	61.8	5.4
Belgium	13.2	3.0	50.7	4.8
Canada	87.4	19.9	9.3	1.3
Denmark	12.2	6.2	62.5	7.1
Finland	11.3	4.3	37.5	3.0
France	10.1	4.2	39.2	3.0
Germany	9.7	−11.6	100.0	100.0
Greece	14.0	18.3	38.9	8.0
Italy	9.7	3.9	38.4	3.0
Japan	6.6	−0.8	5.9	−0.2
Netherlands	12.8	6.8	63.5	8.3
New Zealand	33.8	13.5	15.6	3.9
Norway	13.2	11.7	43.8	6.1
Portugal	14.3	8.6	39.6	4.7
Spain	9.6	7.0	27.3	3.3
Sweden	12.8	1.1	42.7	2.3
United Kingdom	14.6	0.5	38.3	1.6
United States	100.0	100.0	9.7	1.4

Notes: All numbers are expressed relative to the percentage welfare gain in the country whose technology expands. Based on a counterfactual 20 per cent increase in the state of technology for either the United States or Germany.

THE EUROPEAN COMMUNITY: WELFARE AND TRADE

Country	Effect of Removing all Tariffs on Intra-EC Trade: Aggregate Welfare		Imports from the EC	
	Mobile Labor	Immobile Labor	Mobile Labor	Immobile Labor
Australia	0.13	0.11	27.7	2.8
Austria	0.32	−0.07	−1.9	−3.4
Belgium*	−0.91	0.54	61.3	26.3
Canada	0.01	0.01	28.0	2.2
Denmark*	−0.27	0.18	49.9	30.8
Finland	0.28	−0.02	4.6	−2.9
France*	0.08	0.05	46.3	33.7
Germany*	−0.03	−0.03	58.5	41.9
Greece*	0.28	0.13	30.8	24.0
Italy*	0.14	0.04	44.9	36.4
Japan	0.07	−0.01	32.4	2.3
Netherlands*	−0.58	0.33	56.3	26.9
New Zealand	0.14	0.09	24.1	1.9
Norway	0.34	0.05	3.2	−2.9
Portugal*	0.03	0.10	44.0	32.8
Spain*	0.21	0.05	43.7	34.3
Sweden	0.31	−0.10	2.0	−3.3
United Kingdom*	−0.02	0.02	51.9	36.1
United States	0.10	0.03	27.8	2.2

Notes: All numbers are percentage changes from the baseline. In the baseline all trade is subject to a 5 percent tariff. The counterfactual is to remove tariffs between members (as of 1990) of the EC (appearing with a *). Each pair of columns shows the results of performing the counterfactual first for the case of mobile labor and then for the case of immobile labor.

Topics in International Economics

Advanced International Trade

Lecture 2

Trade with Increasing Returns and Imperfect Competition

Ref: Krugman (1980), Helpman & Krugman (1985)
Melitz & Ottaviano (2008)

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Monopolistic Competition with Transport Costs

- models with increasing returns and product differentiation where introduced to explain intra-industry trade

- workhorse model assumes monopolistic competition:

  1. firms produce differentiated goods
  2. fixed cost of production $\longrightarrow$ each variety is produced by a single firm
  3. each firm has market power on its own variety ($p \neq MC$)
  4. there is a large number of firms $\longrightarrow$ no *single* firm is big enough to affect industry output (no strategic interaction)
  5. free entry: profits are driven to zero

- if consumers like product variety and each variety is produced in one country only $\longrightarrow$ beneficial two-way trade in varieties

Preferences

- preferences (utility or aggregate production)

$$U = Y = \left[\int_0^n (c_i)^{\frac{\sigma-1}{\sigma}}\, di\right]^{\frac{\sigma}{\sigma-1}}, \quad \sigma > 1$$

  $n =$ number of "varieties," c_i quantity consumed of each

- "love of variety":
  suppose $p_i = p \ \forall i$ and $E =$ disposable income
  then, using $c_i = \frac{E}{np}$

$$U = n^{\frac{\sigma}{\sigma-1}} \frac{E}{np} = n^{\frac{1}{\sigma-1}} \frac{E}{p}$$

  for a given spending, welfare increases with n

CES Demand Functions

- utility maximization:

$$\max_{c_i} U = \left[\int_0^n (c_i)^{\frac{\sigma-1}{\sigma}}\, di\right]^{\frac{\sigma}{\sigma-1}} \quad \text{subject to } E = \int_0^n p_i c_i di$$

Lagrangian:

$$\mathcal{L} = U + \lambda \left[E - \int_0^n p_i c_i di\right]$$

FOC(i)

$$\frac{\partial \mathcal{L}}{\partial c_i} = 0 \rightarrow \left[\int_0^n (c_i)^{\frac{\sigma-1}{\sigma}}\, di\right]^{\frac{1}{\sigma-1}} (c_i)^{-\frac{1}{\sigma}} = \lambda p_i$$

- take the ratio of FOCs for goods i and j:

$$\frac{c_i}{c_j} = \left(\frac{p_i}{p_j}\right)^{-\sigma}$$

$\sigma =$ price elasticity of demand

Demand and the Price Index

- substitute $c_i = c_j \left(p_i/p_j\right)^{-\sigma}$ into U :

$$U = \left(\int_0^n p_i^{1-\sigma} di\right)^{\frac{\sigma}{\sigma-1}} \frac{c_j}{p_j^{-\sigma}} \rightarrow c_j = \frac{p_j^{-\sigma}}{\left(\int_0^n p_i^{1-\sigma} di\right)^{\frac{\sigma}{\sigma-1}}} U$$

  multiply by p_j and integrate over j:

$$\int_0^n p_j c_j dj = E = \left(\int_0^n p_j^{1-\sigma} dj\right)^{\frac{1}{1-\sigma}} U = PU$$

- $P \equiv \left(\int_0^n p_j^{1-\sigma} dj\right)^{\frac{1}{1-\sigma}}$ is the minimum cost of one unit of U $(= E/P)$

- then, we can express demand as:

$$c_i = \frac{p_i^{-\sigma}}{P^{1-\sigma}} E$$

  decreasing in own price, increasing in income and price of competitors

Transport Costs and Aggregate Demand

- iceberg transport costs:
  must ship $\tau > 1$ units for 1 unit to arrive

- effects:
  1. final price of imported unit $= \tau p_i$ were p_i is the factory price
  2. to consume c_i of imported varieties, $y_i = \tau c_i$ must be produced

- aggregate demand for home variety i:

$$y_i = c_i L + \tau c_i^* L^* = p_i^{-\sigma} \left[\frac{wL}{P^{1-\sigma}} + w^* L^* \left(\frac{\tau}{P^*} \right)^{1-\sigma} \right]$$

  where L and L^* are domestic and foreign population

- aggregate demand for foreign variety i^*:

$$y_{i^*} = \tau c_{i^*} L + c_{i^*}^* L^* = p_{i^*}^{-\sigma} \left[wL \left(\frac{\tau}{P} \right)^{1-\sigma} + \frac{w^* L^*}{(P^*)^{1-\sigma}} \right]$$

Firms

- for each firm i, the total cost function is:

$$TC_i = (F + \beta y_i)\, w$$

F = fixed cost in units of labor
β = (constant) marginal cost in units of labor
w = wage (cost of labor)

- firm i sets p_i in order to maximize profits,

$$\pi_i = p_i y_i - (\beta y_i + F)\, w$$

given the demand

$$y_i = p_i^{-\sigma} \left[\frac{wL}{P^{1-\sigma}} + w^* L^* \left(\frac{\tau}{P^*} \right)^{1-\sigma} \right] = A p_i^{-\sigma}$$

note: the firm takes $A = [\cdot]$ as parametric

Pricing

- recall:

$$\max_{p_i} \pi_i = A p_i^{-\sigma} (p_i - \beta w) - F w$$

FOC:

$$\frac{\partial \pi_i}{\partial p_i} = 0 \to p_i = \left(1 - \frac{1}{\sigma}\right)^{-1} \beta w = p$$

- thus, price = markup over MC

- note:
  1. markup is a negative function of demand elasticity σ
  2. τ does not affect demand elasticity $\to$ no effect on markup
  3. $p_i = p \to \pi_i = \pi$ for all domestic firms

Free Entry

- the number of firms n increases until profits are driven to zero

$$\pi = \frac{\beta w y}{\sigma - 1} - Fw = 0 \rightarrow y = \frac{F(\sigma - 1)}{\beta}$$

  $\rightarrow$ FE pins down firm scale

- to find n, we use y and labor market clearing:

$$L = n(\beta y + F) \rightarrow n = \frac{L}{\sigma F}$$

- some convenient normalizations:

$$\begin{aligned} \beta &= \frac{\sigma - 1}{\sigma} \rightarrow p = w \\ F &= \sigma^{-1} \rightarrow n = L \end{aligned}$$

Gains From Trade

- welfare

$$U = \frac{w}{P} = \frac{w}{\left[np^{1-\sigma} + n^*(\tau p^*)^{1-\sigma}\right]^{\frac{1}{1-\sigma}}}$$

- if countries are symmetric ($L = L^*$), $w = w^* = p = p^*$

$$U = L^{\frac{1}{\sigma-1}} \left(1 + \tau^{1-\sigma}\right)^{\frac{1}{\sigma-1}}$$

  welfare increases with L and decreases with $\tau \rightarrow$ GFT

- source of gains from trade: love of variety ($\sigma \rightarrow \infty : U = 1$ no GFT)

- a fall in τ affects the *intensive* margin of trade:
  higher consumption of each foreign variety

- the *extensive* margin (trade in new varieties) may be captured by changes in L and L^*

Country Size and Wages I

- suppose now that $L \neq L^*$. How do we solve for relative wages?

- one way to go is using trade balance (value of import = value of export):

$$n^* \tau p^* c_{i^*} = n \tau p c_i^*$$

- using $c_{i^*} = \frac{wL(\tau p^*)^{-\sigma}}{P^{1-\sigma}}$, $c_i^* = \frac{w^* L^*(\tau p)^{-\sigma}}{(P^*)^{1-\sigma}}$, substituting n and p and setting $w^* = 1$:

$$w^\sigma = \left(\frac{P}{P^*}\right)^{1-\sigma} = \frac{Lw^{1-\sigma} + L^* \tau^{1-\sigma}}{L^* + L\,(w\tau)^{1-\sigma}} = \frac{\lambda w^{1-\sigma} + \tau^{1-\sigma}}{1 + \lambda\,(w\tau)^{1-\sigma}}$$

where $\lambda \equiv L/L^*$

Country Size and Wages II

- we have found:

$$w^{\sigma} = \frac{\lambda w^{1-\sigma} + \tau^{1-\sigma}}{1 + \lambda (w\tau)^{1-\sigma}}$$

  with $\lambda \equiv L/L^*$

- note:
  $\lambda = 0 \rightarrow w^{\sigma} = \tau^{1-\sigma} < 1$
  $\lambda = 1 \rightarrow w = 1$
  $\lambda = \infty \rightarrow w^{\sigma} = \tau^{\sigma-1} > 1$

- in general, *bigger* countries have *higher* wages and lower price levels
  $\rightarrow$ very different from Ricardian models

- why?
  - locating a firm in a bigger market is more profitable (save on τ)
  - to compensate this (recall FE$\rightarrow$ $\pi = \pi^* = 0$) wages must be higher

Home Market Effect I

- what if wages cannot move? then bigger markets attract more firms
- suppose there is a second sector producing a homogeneous good not subject to transportation costs
- 1 worker produces 1 unit of the homogeneous good
- take the homogenous good as the numeraire
- assume this good is produced everywhere (no specialization)
- price = MC pins down the wage:

$$w = w^* = 1$$

- what can adjust to restore the equilibrium if $L \neq L^*$?

Home Market Effect II

- n and n^* will adjust. Assume $n, n^* > 0$. To find them, use market clearing (recall $w = w^* = p = p^* = 1$):

$$
\begin{aligned}
y &= \frac{\alpha L}{P^{1-\sigma}} + \frac{\alpha L^* t^{1-\sigma}}{(P^*)^{1-\sigma}} \\
y^* &= \frac{\alpha L^*}{(P^*)^{1-\sigma}} + \frac{\alpha L t^{1-\sigma}}{P^{1-\sigma}}
\end{aligned}
$$

where α is the share of income spent on the differentiated goods

- using $y = y^*$

$$
\frac{L}{L^*} = \lambda = \left(\frac{P}{P^*}\right)^{1-\sigma} = \frac{n + n^* \tau^{1-\sigma}}{n^* + n\tau^{1-\sigma}}
$$

can be solved for n/n^*

Home Market Effect III

- rearranging:

$$\frac{n}{n^*} = \frac{\lambda - \tau^{1-\sigma}}{1 - \tau^{1-\sigma}\lambda}$$

- Note:
  1. $\lambda = 1 \rightarrow n = n^*$
  2. $\frac{\partial n/n^*}{\partial \lambda} > 1 \rightarrow$ bigger countries get a more than proportional share of firms (net exporters of the differentiated good)
  3. when $\lambda \geq \tau^{\sigma-1} \rightarrow n^* = 0$ ($\lambda \leq \tau^{1-\sigma} \rightarrow n = 0$)

- country size is a source of comparative advantage in the differentiated sector *caveat:* result may disappear if the homogeneous good is subject to trade costs (see Davis, 1998)

- models of Economic Geography build on the HME to study how trade may lead to agglomeration of manufacturing in one country

The Pro-Competitive Effect of Trade I

- with CES preferences, demand elasticity is fixed and so is the markup

- disappointing:
  - in the workhorse trade model with market power foreign firms have no impact on competition (markup)

- yet, many consider trade as an important determinant of competition

- to study the pro-competitive effect, Krugman (1979) assumes σ to be a function of n

- yet, endogenous demand elasticities can be derived from first principles. We study two examples

Example 1

- simple departure from CES preferences:

$$U = \sum_{i=1}^{n} (c_i + \theta)^{\rho}, \quad \rho \in (0,1), \quad \theta > 0$$

$$\mathcal{L} = U + \lambda \left[E - \sum_{i=1}^{n} p_i c_i di\right]$$

$$\frac{\partial \mathcal{L}}{\partial c_i} = 0 \rightarrow \rho (c_i + \theta)^{\rho - 1} = \lambda p_i$$

- demand elasticity:

$$-\frac{dc_i/c_i}{dp_i/p_i} = \epsilon \left(1 + \frac{\theta}{c_i}\right)$$

where c_i is consumption per capita $(y_i = Lc_i)$ and $\epsilon = \frac{1}{1-\rho}$

- procompetitive effect of trade: with more varieties, per capita consumption of each variety falls, demand become more elastic, markup falls, profits fall, some firms exit, the remaining expand their output y_i

Example 2: Melitz & Ottaviano (2008)

- quasi-linear quadratic preferences

$$U = c_0 + \alpha \int_{i\in\Omega} c_i - \frac{\gamma}{2} \int_{i\in\Omega} c_i^2 - \frac{\eta}{2} \left(\int_{i\in\Omega} c_i \right)^2$$

where:

c_0 (> 0) is a numeraire good

$\Omega =$ set of available varieties

$\gamma > 0$ captures product differentiation (why?)

- substituting from the budget constraint $c_0 = E - \int_{i\in\Omega} c_i p_i$

$$U = E - \int_{i\in\Omega} c_i p_i + \alpha \int_{i\in\Omega} c_i - \frac{\gamma}{2} \int_{i\in\Omega} c_i^2 - \frac{\eta}{2} \left(\int_{i\in\Omega} c_i \right)^2$$

FOC:

$$\frac{\partial U}{\partial c_i} = 0 \rightarrow c_i = \frac{\alpha}{\gamma} - \frac{p_i}{\gamma} - \frac{\eta \int_{i\in\Omega} c_i}{\gamma}$$

MO (2008): Aggregate Demand

- integrating over all the N varieties:

$$\int_{i\in\Omega} c_i = N\frac{\alpha}{\gamma} - \frac{\int_{i\in\Omega} p_i}{\gamma} - N\frac{\eta\int_{i\in\Omega} c_i}{\gamma}$$
$$\int_{i\in\Omega} c_i = \frac{N\alpha - \int_{i\in\Omega} p_i}{N\eta+\gamma} = \frac{N\alpha - N\bar{p}}{N\eta+\gamma}$$

where $\bar{p} = (1/N)\int_{i\in\Omega} p_i$

- aggregate demand:

$$y_i = Lc_i = L\left(\frac{\alpha}{\gamma+N\eta} - \frac{p_i}{\gamma} + \frac{\eta}{\gamma}\frac{N\bar{p}}{N\eta+\gamma}\right)$$
$$y_i = 0 \text{ if } p_i = \frac{\gamma\alpha+\eta N\bar{p}}{\gamma+N\eta} \equiv p_{\mathsf{max}} \to y_i = \frac{L}{\gamma}\left(p_{\mathsf{max}} - p_i\right)$$

above p_{max} demand drops to zero (bounded marginal utility)

MO (2008): Firm Heterogeneity

- in MO (2008) unit costs c_i vary across firms. Operating profits:

$$\begin{aligned} \pi_i &= (p_i - c_i)\, y_i \\ FOC &: \quad \frac{\partial \pi_i}{\partial p_i} = 0 = y_i + \frac{\partial y_i}{\partial p_i}(p_i - c_i) \end{aligned}$$

note: $y_i = 0$ implies $p_i = c_i$, thus:

$$p_{\max} = \frac{\gamma\alpha + \eta N \bar{p}}{\gamma + N\eta} = c_{\max}$$

using $y_i = \frac{L}{\gamma}(p_{\max} - p_i)$

$$p_i = \frac{1}{2}(c_{\max} + c_i)$$

more productive firms charge lower prices but higher markups

MO (2008): Entry/Exit and Trade

- entry: paying a sunk cost f_E a new firm is born with cost c_i drawn from a distribution $G(c)$

- exit: firm with $c_i > c_{\text{max}}$ exit (or $\pi_i < 0$), the others make profits

$$\pi(c_i) = (4\gamma)^{-1}(c_{\text{max}} - c_i)^2$$

- free entry$\longrightarrow$ zero profits in expectation:

$$\mathbb{E}(\pi) = f_E$$

- pro-competitive effect of trade: more firms $\longrightarrow p_{\text{max}}$ falls
  1. least productive firms are forced out
  2. all remaining firms lower prices and markups

Conclusions

- models with IRS and imperfect competition can explain IIT
- very tractable, can be incorporated in more general models
- opened the field of New Economic Geography
- provide the starting point to study firm heterogeneity
- $\longrightarrow$ Nobel prize 2008

Topics in International Economics

Advanced International Trade

Lecture 3-4

Factor Proportions and International Trade

Ref: Helpman & Krugman (1985) ch. 1

Romalis (2004)

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The Heckscher-Ohlin (HO) Model

- the *law of comparative advantage* says that countries trade when autarky prices are different from free trade prices

- in the Ricardian model, comparative advantage arises from differences in technology

- yet, variation in autarky prices may arise from differences in factor endowments (capital, labor, skilled labor...)

- this possibility is explored in the Heckscher-Ohlin model

- main differences relative to the Ricardian model:

  1. there are at least two factors

  2. technology is identical in all countries

Heckscher-Ohlin Model: Assumptions

1. N factors, world endowment vector $\mathbf{V} = (V_1, ..., V_N)$

2. J countries with endowments $\mathbf{V}^j = (V_1^j, ..., V_N^j)$

3. factors are immobile across countries, perfectly mobile within countries

4. I goods produced with CRS:
   quasi-concave production functions represented by unit cost functions $c_i(\mathbf{w})$
   where $\mathbf{w}$ is the vector of factor prices

5. homothetic, well-behaved preferences represented by expenditure shares:
   $b_i(\mathbf{p})$ = share of spending on good i, $\mathbf{p}$ = vector of prices
   identical across countries

6. perfect competition in all markets

Integrated Equilibrium (IE): Pool All Factors in One Country

1. price = MC:

$$p_i = c_i(\mathbf{w}) \quad \forall i \in I$$

2. factor market clearing

$$\textstyle\sum_{i \in I} a_{ni}(\mathbf{w})\, x_i = V_n \quad \forall n \in N$$

where x_i is quantity of good i and

$$a_{ni}(\mathbf{w}) = \text{unit factor demand} = \frac{\partial c_i(\mathbf{w})}{\partial w_n} \quad \text{(Shephard Lemma)}$$

3. goods market clearing

$$b_i(\mathbf{p}) \textstyle\sum_{j \in I} p_j x_j = p_i x_i \quad \forall i \in I$$

- number of unknowns $(\mathbf{x}, \mathbf{p}, \mathbf{w})$ = number of equations
standard arguments guarantee existence and uniqueness

Factor Price Equalization (FPE)

- can we replicate the IE with trade in goods only?

- yes, if:
  1. every country uses the same "techniques" (input mix $\forall i$) as in IE
  2. full employment in all countries

- proof:
  1. same techniques $\longrightarrow$ same $\mathbf{w}$ (FPE) $\longrightarrow$ same $\mathbf{p}$ as IE
  2. full employment + same $(\mathbf{p}, \mathbf{w})$ $\longrightarrow$ same income and $\mathbf{x}$ as IE

- these conditions are satisfied if countries endowments are not too dissimilar

- FPE set = set of endowment distributions in which every country can fully employ its resources using the techniques of production used in the IE
  geometrically, it is just the set of convex combinations of the IE sectorial employment vectors

Heckscher-Ohlin-Vanek Theorem (FPE)

- countries "consume" world endowments proportionally to their relative income:

$$s^j V_n = \text{factor } n \text{ embedded in } j\text{'s consumption}$$

where s^j = country j share of world consumption (=income)

- the net factor content of county j import is:

$$F^j = s^j V - V^j$$

i.e. factor content of consumption - endowment

- a country is a net importer (exporter) of relatively scarce (abundant) factors:

$$F_n^j > 0 \Longleftrightarrow \frac{V_n^j}{V_n} < s^j$$

- yet, when $I > N$ the pattern of good trade is indeterminate

Pros and Cons of FPE

- FPE is a powerful result, both normative and positive
- FPE simplifies enormously the characterization of the equilibrium, for any number of countries
- yet it has crucial limitations
- factor prices are far from equalized in reality
- the pattern of trade is NOT indeterminate in reality, yet the basic model has very weak predictions

Romalis (2004)

- if we abandon FPE, the HO model gives sharper predictions on trade patterns

- yet, outside the FPE set countries are fully specialized → not realistic

- idea of Romalis (2004) → smooth out the model by combining:
  1. HO structure
  2. iceberg transportation costs
  3. monopolistic competition (IIT)

- results:
  1. no FPE
  2. more reasonable predictions supported by data

Simplified Model

- 2 countries, 2 factors:
  - skilled labor (wage s, supply H and H^*)
  - unskilled labor (wage w, supply L and L^*)

- continuum $[0, 1]$ of sectors, each producing differentiated goods

- preferences:

$$U = \int_0^1 \ln Q_z dz$$

  $Q_z =$ sub-utility from consumption in sector z:

$$Q_z = \left(\int_0^{n_z} \left(q_{z,i}^D \right)^\theta di \right)^{1/\theta}$$

  $n_z =$ measure of available varieties
  $q_{z,i}^D =$ quantity consumed of variety i in sector z
  $\sigma = \frac{1}{1-\theta} =$ elasticity of substitution between varieties

Transport Costs and Aggregate Demand

- iceberg costs: ship $\tau > 1$ for one unit to arrive

- home price index in sector z:

$$P_z = \left[n_z p_z^{1-\sigma} + n_z^*(\tau p_z^*)^{1-\sigma}\right]^{\frac{1}{1-\sigma}}$$

- aggregate demand for home variety (including units lost in transit):

$$q_z^S = p_z^{-\sigma}\left[\frac{Y}{P_z^{1-\sigma}} + Y^*\left(\frac{\tau}{P_z^*}\right)^{1-\sigma}\right]$$

where Y (Y^*) is domestic (foreign) income

Technology and Market Structure

- each variety is produced by a monopolist with total cost function:

$$TC_{z,i} = \left(\alpha + q_{z,i}^{S}\right) s^{z} w^{1-z}$$

$\alpha =$ fixed cost
$q_{z,i}^{S} =$ quantity produced
$z =$ industry index $=$ skill-intensity

- profits are maximized subject to demand with a price elasticity of σ

- price $=$ markup over marginal cost:

$$p_z = \frac{\sigma}{\sigma - 1} s^{z} w^{1-z}$$

free entry ($\pi = 0$) pins down firm scale:

$$q_z^S = q_z^{S*} = \alpha\left(\sigma - 1\right)$$

Industry Equilibrium I

- remove index z to simplify notation
- define $\tilde{p} = \frac{p}{p^*}$
- from price indexes (P/P^*):

$$\left(\frac{P}{P^*}\right)^{1-\sigma} = \frac{np^{1-\sigma} + n^*(\tau p^*)^{1-\sigma}}{n\left(\tau p\right)^{1-\sigma} + n^*(p^*)^{1-\sigma}} = \frac{\frac{n}{n^*}\tilde{p}^{1-\sigma} + (\tau)^{1-\sigma}}{\frac{n}{n^*}\left(\tau\tilde{p}\right)^{1-\sigma} + 1}$$

- from aggregate demand $(q_z^S/q_z^{S*} = 1)$:

$$\tilde{p}^{\sigma} = \frac{YP^{\sigma-1} + Y^*\left(\frac{P^*}{\tau}\right)^{\sigma-1}}{Y^*\left(P^*\right)^{\sigma-1} + Y\left(\frac{P}{\tau}\right)^{\sigma-1}} = \frac{Y + Y^*\left(\frac{P^*}{\tau P}\right)^{\sigma-1}}{Y^*\left(\frac{P^*}{P}\right)^{\sigma-1} + Y\left(\frac{1}{\tau}\right)^{\sigma-1}}$$

- given prices (note: s and $w \rightarrow \tilde{p}, Y, Y^*$) we can find the relative number of firms per sector

Industry Equilibrium II

- substitute $(P/P^*)^{1-\sigma}$ and solve

- interior equilibrium:

$$\frac{n}{n^*} = \frac{\tau^{2-2\sigma}\frac{Y^*}{Y} + 1 - \tilde{p}^{\sigma}\tau^{1-\sigma}\left(\frac{Y^*}{Y} + 1\right)}{\tilde{p}\left(\tau^{2-2\sigma} + \frac{Y^*}{Y}\right) - \tilde{p}^{1-\sigma}\tau^{1-\sigma}\left(\frac{Y^*}{Y} + 1\right)}$$

note:

$$\frac{\partial\left(n/n^*\right)}{\partial\tilde{p}} < 0$$

- more "competitive" countries (lower p) attract more firms
- larger effect when σ is high

- corner solutions:

$$\begin{aligned} n &= 0 \quad \text{if} \quad \tilde{p} > p_{\text{max}} \\ n^* &= 0 \quad \text{if} \quad \tilde{p} < p_{\text{min}} \end{aligned}$$

complete specialization when the price disadvantage is too large

General Equilibrium

- share of world revenue (in industry z) captured by home firms:

$$v_z = \frac{n_z p_z q^S}{n_z p_z q^S + n_z^* p_z^* q^{S*}} = \frac{n_z p_z}{n_z p_z + n_z^* p_z^*}$$

- Cobb-Douglas technology:

$$sH_z = zv_z (Y + Y^*)$$

  skilled wage bill $=$ share z of industry revenue

- integrating over all industries:

$$\frac{(Y + Y^*)}{s} \int_0^1 zv_z dz = H$$

- similar condition for L (and in foreign)

Failure of FPE

- proof by contradiction: assume $\tilde{p}_z = 1 \longrightarrow v_z = \bar{v}$ constant over $z \longrightarrow$

$$\frac{w}{s}\frac{\int_0^1 z dz}{\int_0^1 (1-z)\, dz} = \frac{H}{L}$$

  the LHS is the same across countries but $H/L \neq H^*/L^* \longrightarrow$ impossible

- if home has more skilled-labor $\longrightarrow$ full employment requires that home has a larger share of skill-intensive industries and/or uses skilled-labor more intensively in each industry

- in turn, these require:

$$\frac{s}{w} < \frac{s^*}{w^*}$$

  so that $\tilde{p}_z$ declines with z (home CA in skill-intensive industries)

- thus, locally abundant factors must be relatively cheap

The Role of Assumptions

- if $\tau = 1$ and endowments are in the FPE set:

$$\begin{aligned} \tilde{p}_z &= 1 \\ n/n^* &= 0/0 \rightarrow \text{ indeterminate!} \end{aligned}$$

- without FPE:

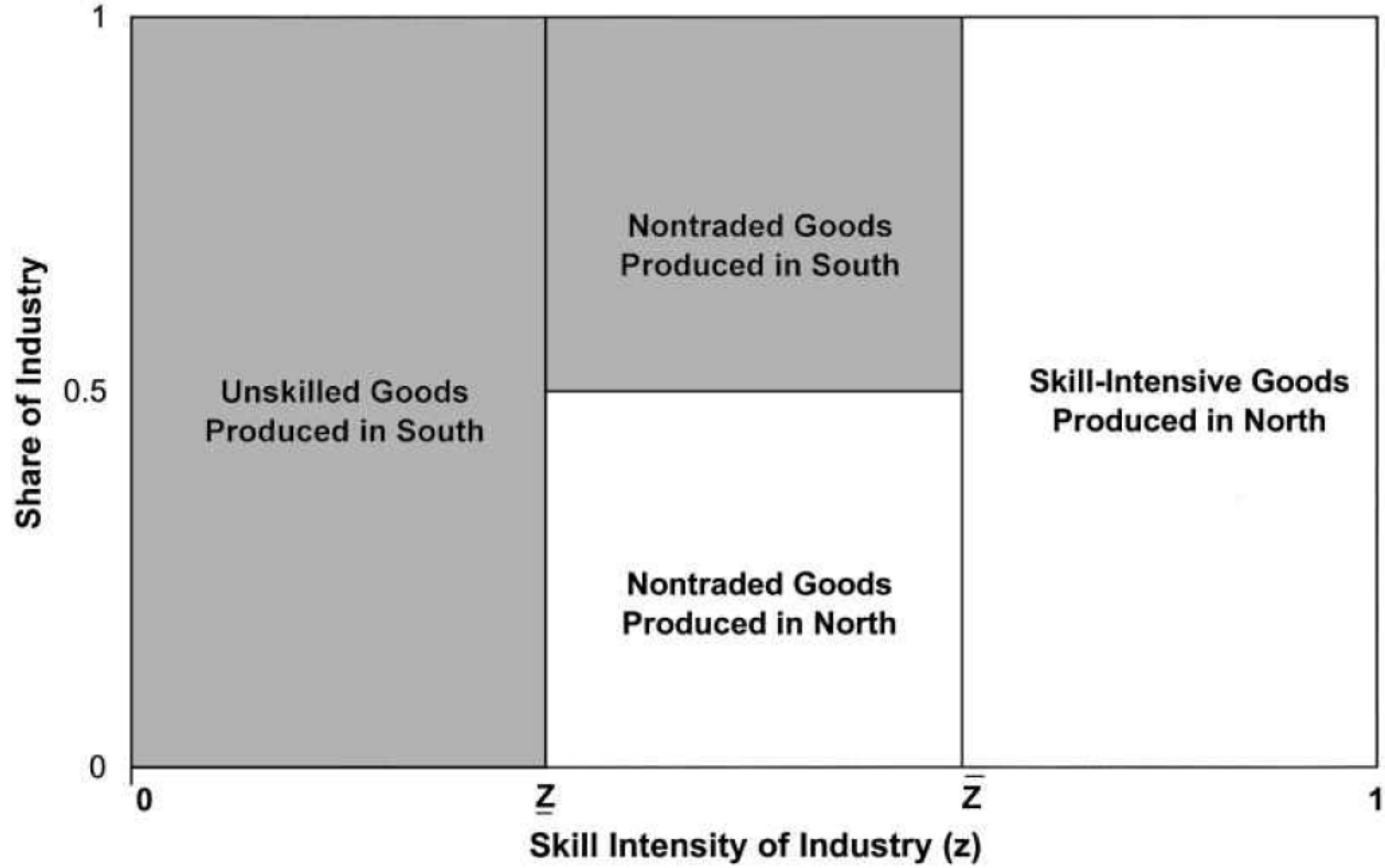
$$\sigma \rightarrow \infty \text{ (perfect competition) } \rightarrow \text{ complete specialization (no IIT)}$$

- role of transport costs:
  (1) brake FPE and (2)

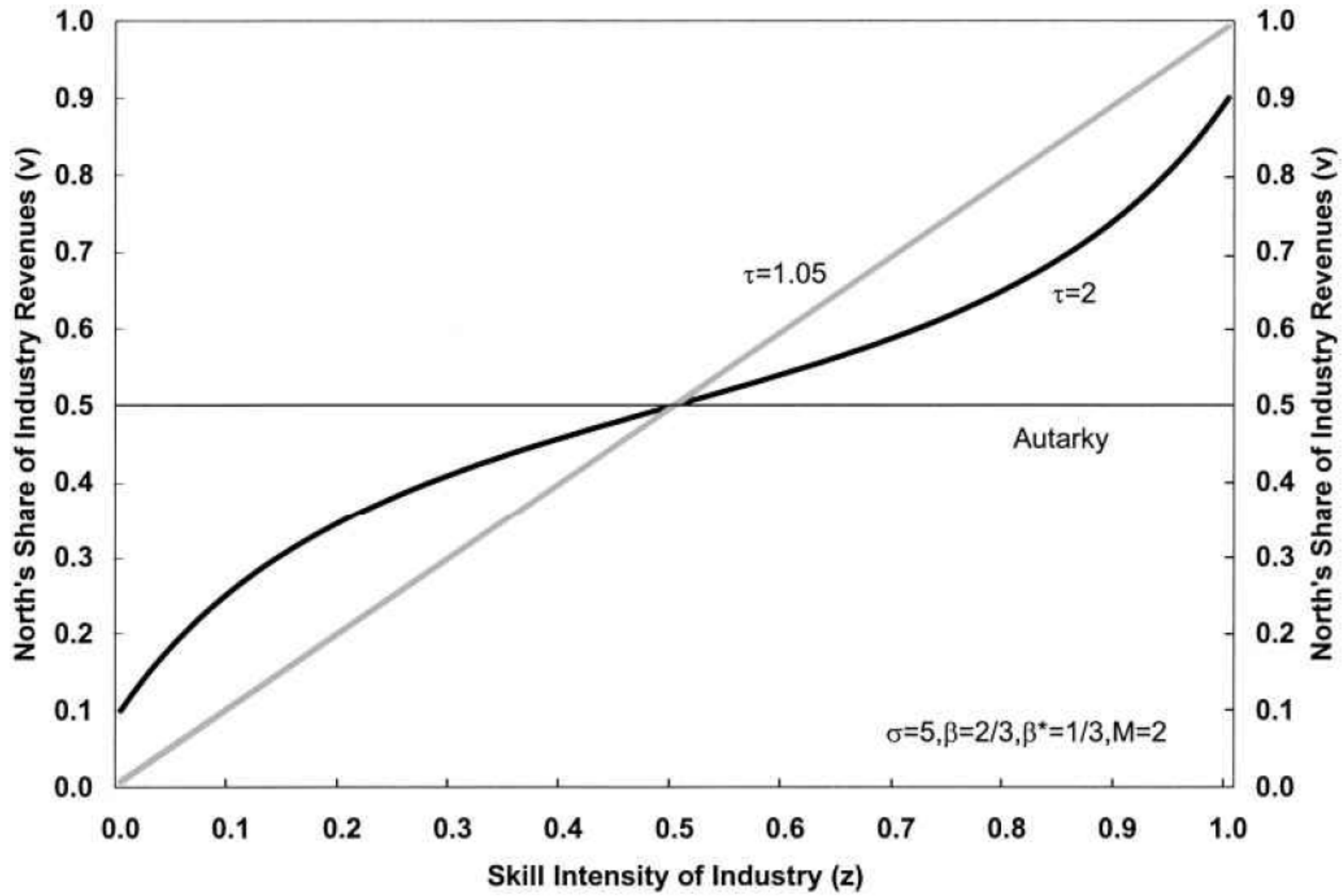
$$\tau > 1 \rightarrow \text{ lower volume of trade}$$

  especially in low CA goods

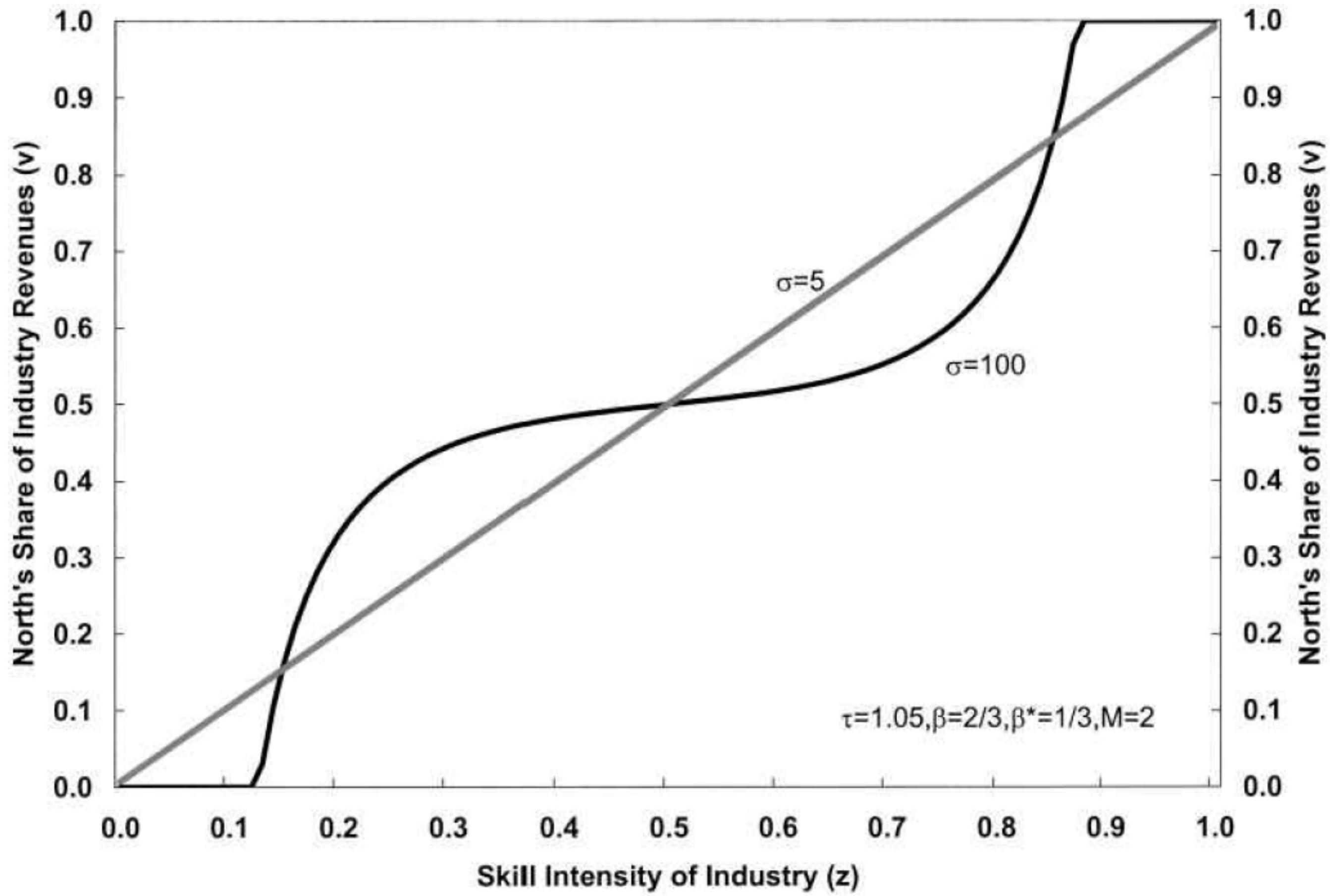
Perfect Competition + Transport Costs



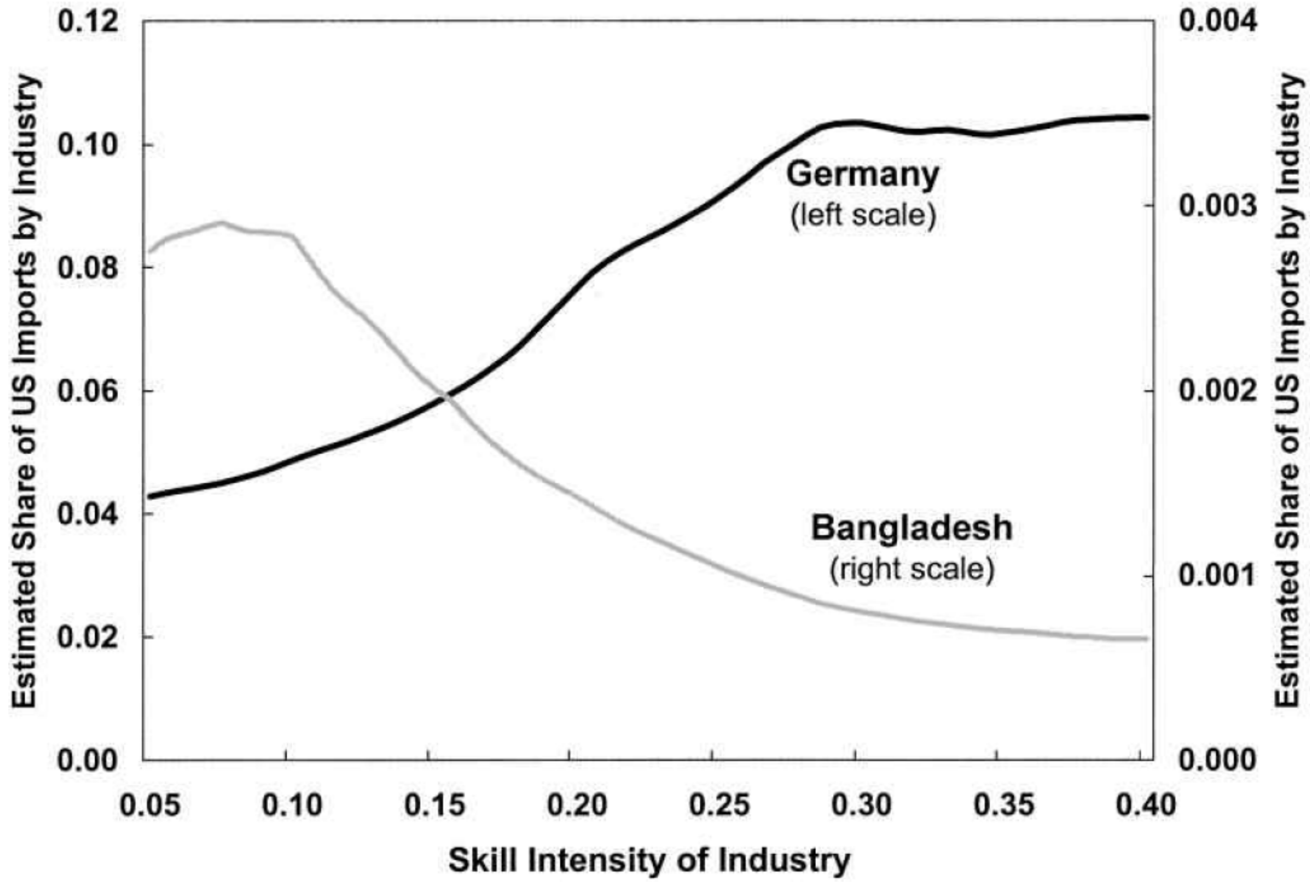
Transport Cost and Industry Location



σ and Industry Location



Quasi-HO Prediction



countries that are abundant in skilled labor capture larger shares of US imports in industries that are skill-intensive

Conclusions

- Romalis (2004) provides a fairly general model
- combines Krugman (1980) + HO with a continuum of industries
- advantages:
  1. breaks FPE
  2. bilateral pattern of trade is fully determined
  3. consistent with IIT
- disadvantage: no simple analytic solution
- can be tested with detailed sectorial trade data
- better empirical success than any other HO model

Topics in International Economics

Advanced International Trade

Lecture 5

Trade, Innovation and Imitation

Ref: Gancia & Zilibotti (2005) sections 1-3
Helpman (1993)

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Dynamic Models of Trade

- so far, all the models we have discussed are static

- yet, introducing dynamics is important for at least two reasons

- first, some trade patterns are dynamic in nature
  e.g., Vernon (1966) product cycle trade:
  - new goods are first introduced in rich countries
  - when a product reaches maturity, production moves to poor countries
  $\longrightarrow$ dynamic comparative advantage

- second, trade may affect the growth rate of countries
  $\longrightarrow$ may lead to dynamic gains or losses

Trade, Innovation and Imitation

- to study these issues, we focus on models where growth is driven by innovation

- innovation is one of the most important sources of long-run growth

- innovation is key to product cycle trade
  - innovation = introduction of new goods in rich countries (North)

- to obtain product cycle trade, assume that poor countries (South) can imitate new products with some lag

- key questions:
  1. effect of North-North trade on innovation
  2. effect of product cycle trade on innovation and North-South income differences

Models of Product Cycle Trade

- first model by Krugman (1979):
  - but assumes exogenous innovation rate

- more recent contributions:
  - Grossman & Helpman (1991)
  - Helpman (1993)

- in these models, poor countries "imitates" goods invented by rich countries

- in Antras (2005), instead, firms decide optimally
  (1) where to locate the phases of the production process
  (2) the mode of organization (contracting vs. FDI)

A Simple Model of Innovation and Imitation

- 2 countries (North/South), 1 factor (Labor)

- endogenous growth through horizontal innovation (Romer, 1990)

- preferences:

$$U = \int_0^\infty e^{-\rho t} \log c_t dt$$

  $\rho =$ discount factor

- maximizing U subject to an intertemporal budget constraint and a no Ponzi game condition yields:

$$\frac{\dot{c}_t}{c_t} = r_t - \rho$$

  where r_t is the interest rate

- remove time index (except when important)

Production

- aggregate output is a basket of differentiated varieties:

$$C \leq Y = E\left(\int_0^A x_i^\alpha di\right)^{1/\alpha} \quad \alpha \in (0,1)$$

  $A =$ measure of varieties
  $E = A^{\frac{2\alpha-1}{\alpha}} =$ "externality" useful to obtain balanced growth

- demand for varieties:

$$\max_{x_i} Y - \int_0^A p_i x_i di \rightarrow \frac{x_i}{x_j} = \left(\frac{p_j}{p_i}\right)^{\frac{1}{1-\alpha}}$$

  constant price elasticity $\sigma = \frac{1}{1-\alpha}$

- note $A = A^N + A^S$ where:
  $A^N =$ measure of goods only North can produce
  $A^S =$ measure of goods "imitated" by South

Market Structure

- technology: unit cost = wage

- market structure:
  in North $\rightarrow$ monopolistic competition
  in South $\rightarrow$ perfect competition (free imitation)

- pricing:

$$p^N = \frac{w^N}{\alpha} \quad \text{and} \quad p^S = w^S$$

- note: $p^S < p^N$ for two reasons:
  1. no markup in S
  2. consider equilibria with $w^N > w^S$ (empirically relevant case)

Imitation (South)

- goods produced in North are imitated at the exogenous rate m:

$$\dot{A}^S = mA^N$$

- define $\gamma \equiv \dot{A}/A$

- in a balanced growth path (BGP) $\frac{A^N}{A^S}$ is constant. This requires:

$$\begin{aligned}\gamma &= \frac{\dot{A}}{A} = \frac{\dot{A}^N}{A^N} = \frac{\dot{A}^S}{A^S} \\ &\rightarrow \dot{A}^S = mA^N = \gamma A^S \rightarrow \frac{A^N}{A^S} = \frac{\gamma}{m}\end{aligned}$$

- using $A^N + A^S = A$:

$$\frac{A^N}{A} = \frac{\gamma}{\gamma + m} \quad \text{and} \quad \frac{A^S}{A} = \frac{m}{\gamma + m}$$

Innovation (North)

- innovation = introduction of new goods

- cost of innovation: $1/\delta A$ units of labor
  externality: past innovations (A) lower the cost of current innovation

- thus, the innovation rate is:

$$\dot{A} = \delta A L_r \rightarrow \gamma = L_r \delta$$

  where L_r is the employment in innovation (research, to be solved for)

- value of innovation V^N = present discounted value of expected profit stream

- free entry in research:

$$V^N \leq w_t / \delta A_t$$

  ie, the value of innovation cannot exceed the cost (or there will be more entry)

Innovation: Asset Value of a Firm

- how do we find V^N? think of V^N as the market value of a firm

- must satisfy the following asset equation:

$$rV^N = \pi^N - mV^N + \dot{V}^N$$

- LHS $=$ return from investing V^N at the risk-free rate r

- RHS $=$ return from owning the firm:
  1. instantaneous profit
  2. at a flow rate m the good is imitated $\longrightarrow$ the capital V^N is lost
  3. if the good is not imitated, must include any capital gain/loss $\dot{V}^N$

Balanced Growth Path (BGP)

- in BGP (with $\gamma > 0$):

$$\text{value of innov.} = V^N = \frac{w_t}{\delta A_t} = \text{cost of innov.}$$

w_t and A_t will grow at the same rate $\rightarrow$ V^N constant $\rightarrow$ $\dot{V}^N = 0$

- setting $\dot{V}^N = 0$ into $rV^N = \pi^N - mV^N + \dot{V}^N$:

$$V^N = \frac{\pi^N}{r+m} = \frac{w^N}{\delta A}$$

- this equation will pin down r, but first we need to substitute π^N

BGP Continued

- production per firm in North:

$$x^N = \frac{L^N - L_r}{A^N} = \frac{1}{A^N}\left(L^N - \frac{\gamma}{\delta}\right)$$

because $\gamma = L_r\delta$ (labor market clearing)

- then, profits per product:

$$\begin{aligned} \pi^N &= \left(p^N - w^N\right) x^N = (1-\alpha)\, p^N x^N \\ &= \left(\frac{1-\alpha}{\alpha}\right) \frac{w^N}{A^N} \left(L^N - \frac{\gamma}{\delta}\right) \end{aligned}$$

where we have used the pricing rule

- thus:

$$V^N = \frac{\pi^N}{r+m} = \frac{w^N}{\delta A} \Longleftrightarrow \left(\frac{1-\alpha}{\alpha}\right)\left(\delta L^N - \gamma\right)\frac{A}{A^N} = r + m$$

Growth Rate (BGP)

- in BGP, c, w and Y all grow at the rate γ (verify this) $\rightarrow$ the Euler equation yields: $r = \gamma + \rho$

- also, in BGP $\frac{A^N}{A} = \frac{\gamma}{\gamma+m}$

- substituting r and $\frac{A^N}{A}$ we obtain an implicit expression for γ:

$$\frac{1-\alpha}{\alpha}\left(\delta L^N - \gamma\right)\frac{\gamma+m}{\gamma} = \gamma + \rho + m$$

  LHS: "value" of innovation, decreasing in γ
  RHS: "cost" of innovation (effective cost of capital), increasing in γ

- we can plot the LHS and the RHS as functions of γ in a graph
  $\rightarrow \gamma^{BGP} =$ intersection

North-North Trade and Growth

- North-North trade: integration between rich countries = increase in L^N

- effect:
$$\frac{1-\alpha}{\alpha}\left(\delta L^N - \gamma\right)\frac{\gamma+m}{\gamma} = \gamma+\rho+m$$
higher L^N $\longrightarrow$ higher LHS $\longrightarrow$ higher growth:
$$\frac{\partial\gamma}{\partial L^N} > 0$$

- why?
innovation is a fixed cost $\longrightarrow$ its value is proportional to the size of the market L^N (scale effect)

- trade can promote growth by increasing the size of markets

Product Cycle Trade and Growth

- an increase in m (rate of imitation) speeds up the product cycle

- long-run effect: changes in m affects both the value and the cost of innovation:
  $(+)$ more labor for R&D (LHS)
  (-) shorter expected profit duration (RHS)

- which effects dominates?
  $$\frac{\partial \log LHS}{\partial m} = \frac{1}{\gamma + m} > \frac{\partial \log RHS}{\partial m} = \frac{1}{\gamma + \rho + m} \rightarrow \frac{\partial \gamma}{\partial m} > 0$$
  $\rightarrow$ "complementarity" between innovation and imitation

- short-run effect: on impact A^N/A does not change (A^N and A are state variables)
  $\rightarrow$ on impact, no labor is freed in North, while expected profit duration falls:
  $$\frac{\partial \gamma}{\partial m} < 0$$

Innovation, Imitation and Inequality

- relative wages can be found combining relative demand, labor market clearing and pricing:

$$\begin{aligned} \frac{x_i}{x_j} &= \left(\frac{p_j}{p_i}\right)^{\frac{1}{1-\alpha}} \rightarrow \frac{L^S}{L^N - \frac{\gamma}{\delta}} \frac{A^N}{A^S} = \left(\frac{w^N}{\alpha w^S}\right)^{\frac{1}{1-\alpha}} \\ \frac{w^N}{w^S} &= \alpha \left(\frac{L^S}{L^N - \gamma/\delta} \frac{A^N}{A^S}\right)^{1-\alpha} = \alpha \left(\frac{L^S}{L^N - \gamma/\delta} \frac{\gamma}{m}\right)^{1-\alpha} \end{aligned}$$

- it can be shown that:

$$\frac{\partial \left(w^N / w^S\right)}{\partial m} < 0$$

imitation $\rightarrow$ more production in South $\rightarrow$ higher demand for L^S $\rightarrow$ higher Southern wage

Conclusions

- comparative advantage may be dynamic
- on top of static gains, trade can be beneficial by fostering innovation and growth
- imitation may spur innovation
- if m depends on IPR protection in South
  $\rightarrow$ weak IPR in poor countries may promote (rather than harm) growth!
- yet, the effect of m is overturned in other models
  the important result is that innovation and imitation *may* be complementary
- literature on trade and growth is vast
  some surveys: Grossman & Helpman (1991), Ventura (2005)

Topics in International Economics

Advanced International Trade

Lecture 6

Incomplete Contracts, Product Cycles and MN Firms

Ref: Antras (2005)

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Product Cycles, Revisited

- Vernon (1996):
  new goods are first produced in advanced countries
  when technology matures, production is relocated to poor countries to take advantage of low wages

- in Helpman (1993) relocation of production is exogenous to firms' decisions in North

- in reality, it is often North-based firms that decide to relocate part of production to low wage countries (through outsourcing/FDI)

- Antras (2005):
  - N firms want to move part of production to S to exploit low wages
  - but there is a cost due to contract incompleteness in N-S transactions
  - ownership (FDI) can help to alleviate the cost of incomplete contracts (Grossman & Hart)

Simple Model

- 2 countries (North and South)

- partial equilibrium (exogenous wages, $w^N > w^S$)

- 1 final good produced with two specialized inputs that require labor:
  hi-tech input (must be produced in North)
  low-tech input (can be produced in South)

- study the decision of a firm on:
  - where to locate production of the low-tech input
  - whether to make the low-tech input (vertical integration) or to buy it (outsourcing)

Demand

- demand for final good y:

$$y = \lambda p^{-\frac{1}{1-\alpha}}$$

$\lambda =$ collects all components of demand that are taken as parametric by the firm

- normalize $\lambda = 1$

- constant price elasticity: $\frac{1}{1-\alpha}$

- revenue:

$$py = p^{-\frac{\alpha}{1-\alpha}} = y^{\alpha}$$

Technology

- technology

$$y = \left(\frac{x_H}{1-z}\right)^{1-z} \left(\frac{x_L}{z}\right)^z$$

$x_H =$ hi-tech input ("R" - research center)
$x_L =$ low-tech input ("M" - manufacturing)

- 1 unit of x_H, x_L requires 1 unit of labor

- assume x_H must be produced in North
$\rightarrow$ think of R as a firm headquarter

- "R" must contract the provision of x_L with a possibly independent supplier "M" either in N or S

Incomplete Contracts: Assumptions

1. inputs are specialized (no value to third parties)

2. N-S contracts are incomplete:
   - N-S contracts specifying quantity and price of x_L cannot be enforced
   - for any ex-ante agreement, either R or M will want to renegotiate
   - surplus divided between R and M through ex-post Nash bargaining

3. simplification: there are many potential supplier M
   $\rightarrow$ similarly to free entry, all profits will go to R
   how? potential M compete for R offering "license fees" (transfer to R)

4. ownership (R "buys" M through FDI) does not solve contracting issues
   but it alters the bargaining power between R and M
   (property rights view of the firm due to Grossman & Hart)

Timing

1. organization stage:
   R chooses (1) whether to buy x_L from N or S and (2) from an independent supplier or an affiliated plant (FDI)
   transfer from M to R

2. production stage:
   x_H and x_L are produced

3. negotiation stage:
   symmetric Nash bargaining over surplus $py \longrightarrow$ each party gets half

4. y is produced and sold

Case A: M in North

- binding contracts can be written in N

- contract maximizes R ex-ante profits

$$\max_{x_H, x_L} \pi^N = y^\alpha - w^N x_H - w^N x_L$$

$$FOC : p = \frac{w^N}{\alpha}$$

price = usual markup over marginal cost
(unit cost function = $\left(w^N\right)^{1-z}\left(w^N\right)^z = w^N$)

- thus:

$$\pi^N = py - \alpha py = (1-\alpha)\,py = (1-\alpha)\left(\frac{w^N}{\alpha}\right)^{-\frac{\alpha}{1-\alpha}}$$

Case B: M in South, Independent Supplier (Outsourcing)

- total R profits:

$$\pi^S = y^\alpha - w^N x_H - w^S x_L$$

x_H is chosen to maximize R's share (1/2) of surplus:

$$x_H = \arg\max \frac{y^\alpha}{2} - w^N x_H \rightarrow \frac{\alpha(1-z)}{2}\frac{y^\alpha}{x_H} = w^N \rightarrow x_H = \frac{\alpha(1-z)}{2}\frac{y^\alpha}{w^N}$$

x_L is chosen to maximize M's share (1/2) of surplus:

$$x_L = \arg\max \frac{y^\alpha}{2} - w^S x_L \rightarrow \frac{\alpha z}{2}\frac{y^\alpha}{x_L} = w^L \rightarrow x_L = \frac{\alpha z}{2}\frac{y^\alpha}{w^L}$$

- note: both R and M underproduce (maximize $y^\alpha/2$ instead of y^α)

- why? due to ex-post bargaining, parties do not capture the full return to their investment (hold-up)

Case B: Prices and Profits

- using x_H and x_L in the demand function $p = y^{\alpha-1}$:

$$p = y^{\alpha(\alpha-1)} \left[\frac{\alpha}{2} \left(\frac{1}{w^N} \right)^{1-z} \left(\frac{1}{w^L} \right)^{z} \right]^{\alpha-1}$$

  using again the demand function, $y^{\alpha(\alpha-1)} = p^{\alpha}$:

$$p = \frac{2 \left(w^N \right)^{1-z} \left(w^L \right)^{z}}{\alpha}$$

  note I: over-inflated markup ($2/\alpha$ instead of $1/\alpha$) due to underproduction
  note II: marginal cost $= \alpha p/2$

- total R profits:

$$\pi^S = \left(p - \frac{\alpha p}{2} \right) y = \left(1 - \frac{\alpha}{2} \right) p^{-\frac{\alpha}{1-\alpha}} = \left(1 - \frac{\alpha}{2} \right) \left[\frac{2 \left(w^N \right)^{1-z} \left(w^L \right)^{z}}{\alpha} \right]^{-\frac{\alpha}{1-\alpha}}$$

Organization Choice and Product Cycles

- postpone case C (FDI), compare profits in case A and B:

$$\frac{\pi^N}{\pi^S} = \frac{1-\alpha}{1-\alpha/2}\left[\frac{1}{2}\left(\frac{w^N}{w^L}\right)^z\right]^{-\frac{\alpha}{1-\alpha}}$$

trade-off: low cost of labor against cost of incomplete contracts

- R prefers production in South if $\pi^S > \pi^N$:

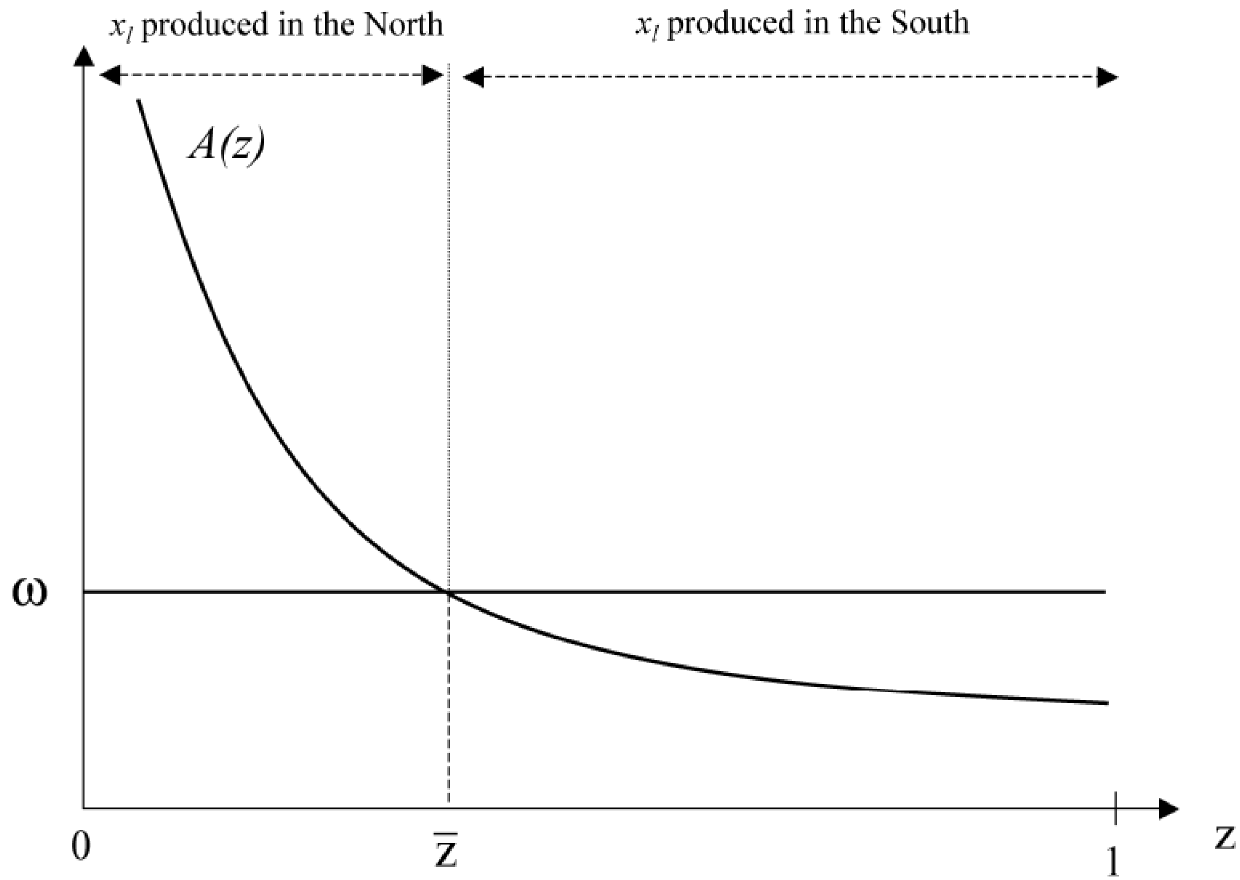
$$\pi^S > \pi^N \Leftrightarrow \frac{w^N}{w^L} > \left[2\left(\frac{1-\alpha}{1-\alpha/2}\right)^{\frac{1-\alpha}{\alpha}}\right]^{1/z} \equiv A(z)$$

- note: $A'(z) < 0 \rightarrow$ if z is high enough, manufacturing goes to South

- intuition:
  - the benefit of low w^L offsets the hold-up distortion only if manufacturing is sufficiently important (so that w^L is important)

Dynamics and Product Cycles

- suppose z increases over time (new goods require more R&D)



new goods are manufactured in North, more mature (high z) goods in South

Case C: M in South through FDI (Vertical Integration)

- Grossman & Hart's idea: ownership affects the distribution of ex-post rents

- ownership = more bargaining power to R: $\phi > 1/2$

- total R profits:

$$\pi_M^S = y^\alpha - w^N x_H - w^S x_L$$

where

$$x_H = \arg\max \phi y^\alpha - w^N x_H \rightarrow x_H = \phi\alpha(1-z)\frac{y^\alpha}{w^N}$$

$$x_L = \arg\max (1-\phi) y^\alpha - w^S x_L \rightarrow x_L = (1-\phi)\,\alpha z \frac{y^\alpha}{w^L}$$

- note: now underproduction of x_H is less severe, but x_L is lower

Case C: Prices and Profits

- as before, using x_H and x_L in the demand function $p = y^{\alpha-1}$:

$$p = y^{\alpha(\alpha-1)} \left[\alpha \left(\frac{\phi}{w^N}\right)^{1-z} \left(\frac{1-\phi}{w^L}\right)^{z}\right]^{\alpha-1}$$

  using again the demand function, $y^{\alpha(\alpha-1)} = p^{\alpha}$:

$$p = \frac{\left(w^N\right)^{1-z} \left(w^L\right)^{z}}{\alpha\,(\phi)^{1-z}\,(1-\phi)^{z}}$$

  note I: now the markup depends on ϕ and z

  note II: marginal cost $= \alpha\,(\phi)^{1-z}\,(1-\phi)^{z}\,p$

- total R profits:

$$\pi_M^S = \left[p - \alpha\,(\phi)^{1-z}\,(1-\phi)^{z}\,p\right] y$$

Product Cycle Revisited

- production mode is chosen comparing π^N, π^S and π^S_M

- if z is low enough (new goods)
  $\longrightarrow$ manufacturing in North (the wage advantage of S disappears as $z \to 0$)

- if z is high enough (mature goods)
  $\longrightarrow$ manufacturing in South through outsourcing

- intermediate z
  $\longrightarrow$ manufacturing may (depending on parameters) go to South through FDI

- intuition:
  it is more efficient to give stronger incentives (more bargaining power) to the party whose investment is more important

Conclusion

- a simple model of product cycles and firm boundaries

- important: $1/3$ of world trade is intra-firm

- Antras (2003):
  assumes that x_H is capital intensive
  $\longrightarrow$ study why integration prevails in capital intensive industries

- Antras & Helpman (2004) incorporate:
  1. firm heterogeneity in productivity
  2. differences in fixed cost of integration/outsourcing
  study optimal sourcing decision across firms and sectors

Topics in International Economics

Advanced International Trade

Lecture 7
Trade Policy and Taxation:
Terms of Trade Externalities

Ref: Helpman & Krugman (1989) ch. 1-2
Bagwell & Staiger (1999)
Epifani & Gancia (2009)

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Basic Effects of Trade Tariffs and Taxes

- for a given good x, define:

$$\begin{aligned} p^w &= \text{world price} \\ p &= \text{ domestic price} \end{aligned}$$

- if good x is imported, an ad valorem tariff of t implies:

$$p = (1 + t)\, p^w$$

- if good x is exported, an ad valorem export tax of t implies:

$$p^w = (1 + t)\, p$$

- the effect of an import tariff or an export tax is to drive a wedge between domestic and world prices

Welfare Loss from an Import Tariff (small country)

1. post-tariff welfare is lower than in free-trade but higher than in autarky
2. production moves closer to the autarky point
3. tariffs penalize both imports and exports
4. tariffs create revenue (we assume this is rebated to citizens)
5. increase the relative price of imports $\longrightarrow$ redistributional effects (Stolper-Samuelson)

Why Do Countries Use Protection?

- if free-trade is the first best, what is the rationale for policy barriers?

- some leading explanations:

  1. if a country can affect world prices, it may benefit from a tariff (optimum tariffs)

  2. tariffs redistribute income: e.g., if trade helps the relatively abundant factor, tariffs help the relatively scare factor → owners of scarce factors may lobby for protection

  3. uncertainty on who is going to gain from trade (within a country) may help explain a *status quo bias* against globalization

Optimum Tariff

- when a country is large relative to the world market, a fall in its imports will lower the import price

- each consumer is atomistic and does not internalize this effect

- a government that recognizes this effect may want to restrict imports (eg., through a tariff) to enjoy lower import prices

- a small tariff may lead to a favorable change in the Terms of Trade (TOT = price of export relative to the price of import)

Optimum Tariff: Analytical Argument

- optimality requires:

$$\text{domestic import price } p = \text{marginal cost of import}$$

- total cost of import:

$$C = p^w m$$

marginal cost of import:

$$\frac{\partial C}{\partial m} = p^w + m\frac{\partial p^w}{\partial m} = p^w\left(1 + \frac{\partial p^w}{\partial m}\frac{m}{p^w}\right)$$

- thus:

$$p = p^w(1+t) = \frac{\partial C}{\partial m} \rightarrow t = \frac{\partial p^w}{\partial m}\frac{m}{p^*}$$

$\rightarrow$ the optimal tariff is higher the more sensitive the world price is to changes in domestic imports
$\rightarrow$ the optimal tariff for a small country (unable to affect world prices) is zero

Optimum Tariff: Caveat

- if the other country *retaliates* and imposes a similar tariff, the relative price p^w will not change
  $\longrightarrow$ no country will gain

- yet, both countries will loose because the equilibrium with tariffs is closer to the autarky point
  $\longrightarrow$ some GFT do not materialize

- that countries are worse-off if all impose a tariff is just an indication that free-trade is Pareto efficient

- in fact, the "optimal" tariff is "optimal" from the viewpoint of an individual country only

Bagwell & Staiger (1999)

- the WTO principles of reciprocity and non-discrimination can neutralize TOT effects

- simplest 2 country 2 good case
  good 1: home export, world price $= \mathbf{1}$ (numeraire)
  good 2: home import, world price $= p^w$

- a tariff cut satisfies reciprocity if import levels (m and m^*) rise equally in both countries (exports: x and x^*)

$$\begin{aligned} \text{reciprocity} \quad &: \quad p^w_{t_0}\Delta m = \Delta m^* \\ \text{trade balance} \quad &: \quad \Delta m^* = p^w_{t_1}x^*_{t_1} - p^w_{t_0}x^*_{t_0} \\ \text{market clearing} \quad &: \quad p^w_{t_1}x^*_{t_1} - p^w_{t_0}x^*_{t_0} = p^w_{t_1}m_{t_1} - p^w_{t_0}m_{t_0} \\ &\rightarrow \quad p^w_{t_1} = p^w_{t_0} \end{aligned}$$

  no change in TOT

- in a multi-country world, non-discrimination is needed too

Terms of Trade Effects and Other Policies

- WTO may limit the TOT impact of trade policy
- yet, TOT effects may distort other domestic policies
- Epifani & Gancia (2009):
  TOT effects may induce governments to increase (inefficiently) domestic taxation
- effect is stronger if (1) TOT are very sensitive (2) volume of trade is high
- can explain a puzzling observation:
  - countries that trade more tend to have a larger public sector (Rodrik, 1998)

Epifani & Gancia (2009): Set-Up

- world economy:
  - large number N of symmetric small countries
  - continuum $[0, 1]$ of industries each producing differentiated goods
  - each countries produces ONE variety in EVERY industry (Armington)

- governments provide:
  - a country-specific public good financed through taxation g

- imperfect economic integration:
  - varieties are traded in a measure $\tau \in [0, 1]$ of sectors only
  - study how $\uparrow \tau$ affects g

Preferences

- focus on a single country (remove country-index)

- utility of representative agent:

$$U = \left(\exp \int_0^1 \log C_j dj\right)^{\eta} G^{1-\eta}, \quad \eta \in (0,1)$$

  where $G =$ country-specific public good
  $\eta =$ preference for private vs public goods

- note: log utility $\rightarrow P_j C_j = P_i C_i$

- $C_j =$ subutility from consumption of differentiated goods, $j \in [0,1]$:

$$C_j = \left(\sum_{i \in N} c_{j,i}^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}, \quad \sigma > 1$$

  $c_{j,i} =$ variety produced by country i in industry j
  $\sigma =$ elasticity of substitution

Demand and the Terms of Trade

- aggregate demand for the variety produced by country i in industry j :

$$y_{j,i} = \frac{p_{j,i}^{-\sigma}}{P_j^{1-\sigma}} E_j$$

where $P_j \equiv \left(\sum_{i \in N} p_{j,i}^{1-\sigma} \right)^{\frac{1}{1-\sigma}}$, $E_j =$ world expenditure

- symmetry in preferences and technology $\longrightarrow E_j = E$ and $P_j = P$

- countries are small:
  1. take E and P as parametric $\longrightarrow$ normalize $P = 1$
  2. for $j \in [0, \tau]$, export $y_{j,i}$ import C_j

- "terms of trade" (TOT): $\frac{p_{j,i}}{P} = \left(\frac{y_{j,i}}{E/P} \right)^{-1/\sigma} = \frac{p_{\text{export}}}{p_{\text{import}}}$

  note: a fall in $y_{j,i} \longrightarrow$ TOT improvement (more when σ is low)

Production

- unit cost = wage (in all sectors, including G) + perfect competition:

$$p_j = p = w \quad \forall j \in [0,1]$$

- public employment L_g :

$$gwL = wL_g \rightarrow L_g = gL$$

(tax revenue = wage bill)

- employment in a nontraded sector L_n:

$$(1-g)\, wL = wL_n \rightarrow L_n = (1-g)\, L$$

(after tax expenditure = revenue)

- employment in a trade sector L_τ:

$$L_\tau = (1-g)\, L$$

(symmetry + labor market clearing $L_g + (1-\tau)\, L_n + \tau L_\tau = L$)

Aggregation

- simplify $L = 1$

- due to symmetry, utility reduces to:

$$U = \left[\exp \int_0^1 \log C_j dj\right]^\eta G^{1-\eta} = \left[(C_n)^{1-\tau} (C_\tau)^\tau\right]^\eta G^{1-\eta}$$

where

$$\begin{aligned} g &= G \\ C_n &= 1 - g \end{aligned}$$

(nontraded production = consumption)

$$C_\tau = \frac{w(1-g)}{P} = (1-g)\left(\frac{L_\tau}{E}\right)^{-1/\sigma} = (1-g)^{1-\frac{1}{\sigma}} E^{1/\sigma}$$

(C_τ = after tax income/price; $w = p_\tau = (L_\tau/E)^{-1/\sigma}$)

Openness and Taxation I

- government objective function:

$$\underset{g}{Max}\, U = \left[(C_n)^{1-\tau}\,(C_\tau)^\tau\right]^\eta G^{1-\eta} = \left[(1-g)^{1-\frac{\tau}{\sigma}}\, E^{\tau/\sigma}\right]^\eta g^{1-\eta}$$

  take logs and set $\frac{\partial U}{\partial g} = 0$:

$$\frac{\eta}{1-g}\left(1-\frac{\tau}{\sigma}\right) = \frac{1-\eta}{g}$$

  RHS: marginal benefit of g
  LHS: marginal cost of g

- trade-off: private vs. public good consumption

- term $\frac{\tau}{\sigma}$ lowers the perceived cost of g
  why?
  - a drop in domestic production of traded goods induces a TOT improvement
  - effect is stronger if many goods are traded (high τ) and TOT are very sensitive (low σ)

Openness and Taxation II

- solving:

$$g = \frac{1-\eta}{1-\eta\tau/\sigma}$$

taxation grows with "globalization" (τ), the more so the smaller is σ

- alternative intuition:
  - tax revenue is spent 100% on domestic goods while only a fraction $(1-\tau)$ of wages is spent on domestic goods
  - g increases demand for domestic labor, the more so the higher is τ
  - just like a Keynesian intervention

World Planner

- recognizes that g will be identical across countries:

$$\begin{aligned} C_n &= L_n = 1 - g \\ G &= g \\ C_\tau &= N^{\frac{1}{\sigma-1}} (1-g) \end{aligned}$$

- then:

$$\begin{aligned} \underset{g}{Max}\ U &= \left[(C_n)^{1-\tau} (C_\tau)^{\tau} \right]^{\eta} G^{1-\eta} = \left[(1-g)\, N^{\frac{\tau}{\sigma-1}} \right]^{\eta} g^{1-\eta} \\ \frac{\partial U}{\partial g} &= 0 \rightarrow g = 1 - \eta \end{aligned}$$

- governments of open countries do not fully internalize the cost of taxation $\rightarrow$ overspending

- why no TOT effect for the world planner? if all countries behave symmetrically, no one can benefit from improved TOT

Empirical Analysis

1. new evidence on the correlation between g and τ using data for $\sim$ 150 countries between 1950-2000

2. correlation depends on a low σ, as for the TOT argument
   two proxy for σ:
   (i) share of differentiated products in total export (Rauch, 1999)
   (i) average σ of exports (Broda & Weinstein, 2006)

3. Rodrik (1998) alternative mechanism (openness increase risk and the demand for public insurance) less supported by the data

Openness, export differentiation and government size (fixed-effects, I)

Dependent variable: government consumption (% of GDP).
Export differentiation proxy (z_i^{ra}) built on Rauch (1999).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Openness	0·094***	0·039	−0·019	0·143	−0·022	−0·004	−0·222***	−0·152
	[0·014]	[0·026]	[0·023]	[0·090]	[0·023]	[0·026]	[0·043]	[0·122]
Openness × z_i^{ra}		0·111**	0·147***	0·166***	0·160***	0·135***	0·280***	0·283***
		[0·047]	[0·043]	[0·044]	[0·044]	[0·046]	[0·048]	[0·052]
Log of income			−2·820***	−1·717	−2·911***	−2·196**	−2·378***	−1·278
			[0·903]	[1·080]	[0·907]	[0·964]	[0·889]	[1·201]
Log of population			9·339***	8·678***	8·613***	9·313***	8·087***	7·576***
			[1·454]	[1·494]	[1·579]	[1·579]	[1·442]	[1·681]
Openness× log of income				−0·020*				−0·009
				[0·011]				[0·013]
Openness× institutional quality					−0·02			−0·003
					[0·017]			[0·020]
ToT variability						0·289		0·054
						[1·184]		[1·157]
Openness× ToT variability						−0·014		−0·012
						[0·017]		[0·017]
Openness× export concentration							0·414***	0·444***
							[0·074]	[0·081]
Time dummies			YES	YES	YES	YES	YES	YES
Observations	973	859	859	859	859	765	859	765
Countries	128	112	112	112	112	111	112	111
R^2	0·05	0·06	0·30	0·31	0·31	0·29	0·33	0·33

Conclusions

- TOT effects may (or may not) be small, but are rather pervasive
- the TOT motive suggests that countries, like a monopolist, have an incentive to restrict export (import) to get a higher (lower) price
- yet, in reality trade policy often includes export subsidies ($\longrightarrow$worse TOT!)
- models of political economy may explain why

Topics in International Economics

Advanced International Trade

Lecture 8

Trade Policy and Taxation:

The Political Economy of Protection

Ref: Grossman & Helpman (1994)

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Protection for Sale

- trade policy is set by politicians
  $\longrightarrow$ political economy models may help understand protection

- there are many models of political economy applied to protectionism
  we focus on lobbying rather than voting models

- main idea: in different industries there are special interest groups that stand to gain from protection

- lobbies can influence politicians
  (legally, though campaign contributions or donations, illegally through bribes)

- $\longrightarrow$ more powerful lobbies may induce politicians to use trade policy as a mean to redistribute profits from one sector to another

Grossman & Helpman (1994)

- an incumbent government trades off benefits for organized groups vs. distortions
- the model can explain the structure of protection across sectors
- interestingly, can explain export (even import) subsidies
- in the basic model, trade policy is used only to please some industries at the expenses of others
- Grossman & Helpman (1995) extend the model to add a TOT manipulation motive

Model Set-Up

- small open economy (world prices fixed p_i^w)

- population $= 1$

- one numeraire good (d_0) produced with labor only ($w = 1$)

- n goods produced with labor $+$ sector-specific factors

- in $L < n$ sectors owners of specific factors are organized in lobbies offering contributions in exchange of protection

- (incumbent) politicians care about welfare but also lobbies' contribution

Preferences

- quasi-linear utility:

$$U = d_0 + \sum_{i=1}^{n} u_i(d_i)$$

- substituting d_0 from the budget constraint $E = d_0 + \sum_{i=1}^{n} p_i d_i$:

$$U = E - \sum_{i=1}^{n} p_i d_i + \sum_{i=1}^{n} u_i(d_i)$$

$$FOCs : \frac{\partial U}{\partial d_i} = 0 \rightarrow u_i'(d_i) = p_i$$

- note: demand only depend on own price, no income effects
(extra income spent on d_0)

Indirect Utility

- indirect utility:

$$V = E + S(\mathbf{p})$$

where

$$S(\mathbf{p}) = \sum_{i=1}^{n} u_i(d_i) - \sum_{i=1}^{n} p_i d_i$$

is consumer's surplus on the n goods

- Roy's identity:

$$\frac{\partial V}{\partial p_i} = \frac{\partial S}{\partial p_i} = -d_i(p_i)$$

Production of Good i

- technology:

$$y_i = f\left(l_i, k_i\right)$$

$l_i =$ labor employment

$k_i =$ specific factor in fixed supply

- reward to k_i :

$$\pi_i = \max_{l_i} p_i f\left(\cdot\right) - l_i = \pi_i\left(p_i\right)$$

note I: π_i only depends on p_i

note II: changes in p_i affect the reward of the specific factor

- Hotelling lemma:

$$\pi_i'\left(p_i\right) = y_i\left(p_i\right) > 0$$

Agents and Lobbies

- individuals own labor and *may* own at most one specific factor:

$$\alpha_i = \text{ fraction of population owning } k_i$$

  with $\sum_{i=1}^{n} \alpha_i \leq 1$

- key assumption: agents cannot diversify their factor ownership

- in $L < n$ sectors, owners of specific factors are organized:
  offer political contributions $C_i(\mathbf{p})$ contingent on a vector of prices $\mathbf{p}$
  note: $\mathbf{p}$ will depend on trade policy

- $\alpha_L = \sum_{i \in L} \alpha_i =$ fraction of population represented by lobbies

Trade Policy

- trade policy: drives a wedge between domestic and world prices

$$\begin{aligned} p_i &> p_i^w \rightarrow \text{import tariff or export subsidy} \\ p_i &< p_i^w \rightarrow \text{import subsidy or export tax} \end{aligned}$$

- net (per capita) revenue from taxes/subsidies:

$$r(\mathbf{p}) = \textstyle\sum_{i=1}^{n} (p_i - p_i^w) [d_i(p_i) - y_i(p_i)] = \sum_{i=1}^{n} (p_i - p_i^w) m_i(p_i)$$

  where $m_i(p_i) = d_i(p_i) - y_i(p_i) =$ import if $m_i > 0$, export $m_i < 0$

- $r(\mathbf{p})$ is rebated uniformly to all agents

- note:

$$\frac{\partial r(\mathbf{p})}{\partial p_j} = \left(p_j - p_j^w\right) m_j'(p_j) + m_j(p_j)$$

  with $m_j'(p_j) < 0$

Welfare Functions I

- aggregate gross welfare (income + surplus of all agents)

$$W(\mathbf{p}) = \mathbf{1} + \sum_{i=1}^{n} \pi_i(p_i) + r(\mathbf{p}) + S(\mathbf{p})$$

note:

$$\frac{\partial W}{\partial p_j} = \frac{\partial \pi_j(p_i)}{\partial p_j} + \frac{\partial r(\mathbf{p})}{\partial p_j} + \frac{\partial S(\mathbf{p})}{\partial p_j} = \left(p_j - p_j^w\right) m_j'(p_j)$$

note: $W(\mathbf{p})$ is maximized under free-trade $p_j = p_j^w$

- government objective function:

$$G = \sum_{i \in L} C_i(\mathbf{p}) + aW(\mathbf{p})$$

government cares for:

(1) social welfare, with weight a and

(2) contributions (eg, may increase re-election probability)

Welfare Functions II

- joint welfare of lobby i:

$$V_i = W_i - C_i \quad \text{with} \quad W_i(\mathbf{p}) = l_i + \pi_i(p_i) + \alpha_i\left[r(\mathbf{p}) + S(\mathbf{p})\right]$$

note:

$$\begin{aligned}
\frac{\partial W_i}{\partial p_j} &= \frac{\partial \pi_i(p_i)}{\partial p_j} + \alpha_i\left[\frac{\partial r(\mathbf{p})}{\partial p_j} + \frac{\partial S(\mathbf{p})}{\partial p_j}\right] \\
\text{if } i &= j : \frac{\partial W_i}{\partial p_j} = (1-\alpha_i)\, y_j\left(p_j\right) + \alpha_i\left(p_j - p_j^w\right) m_j'(p_j) \\
\text{if } i &\neq j : \frac{\partial W_i}{\partial p_j} = -\alpha_i y_j\left(p_j\right) + \alpha_i\left(p_j - p_j^w\right) m_j'(p_j)
\end{aligned}$$

- starting at $p_j = p_j^w$:

$$\frac{\partial W_i}{\partial p_i} > 0 \quad \text{and} \quad \frac{\partial W_i}{\partial p_{j\neq i}} < 0$$

Contributions and Policies

- in sum:
  - social welfare is maximized under Free-Trade (FT: $p_j = p_j^w$)
  - owners of specific factors benefit from
  (1) higher than FT prices on the good they produce
  (2) lower than FT prices on other goods

- 2-stage game:

  1. lobbies choose contribution schedules $C_i(\mathbf{p})$ non-cooperatively

  2. the government sets policies taking $C_i(\mathbf{p})$ as given

- note: we can think of the government as choosing directly $\mathbf{p}$ (policy determined as residual)

Equilibrium

- look for a "truthful" SPNE $\left(\left\{C_i^o\right\}_{i\in L}, \mathbf{p}^o\right)$ where:

  1. $\mathbf{p}^o$ maximizes G:

  $$\nabla G = 0 \rightarrow \sum_{i\in L} \nabla C_i^o\left(\mathbf{p}^o\right) + a\nabla W\left(\mathbf{p}^o\right) = 0$$

  given contribution schedules, $\mathbf{p}^o$ is chosen to maximize gov't welfare

  2. $\mathbf{p}^o$ also maximizes joint welfare $V_j + G$, $\forall j \in L$:

  $$\nabla V_j = 0 \rightarrow \nabla C_j^o = \nabla W_j^o \quad \forall j \in L$$

  $\rightarrow$ the slope of the contribution schedule reveals lobby's preferences

- substituting (2) into (1):

  $$\sum_{i\in L} \nabla W_i^o\left(\mathbf{p}^o\right) + a\nabla W\left(\mathbf{p}^o\right) = 0$$

  note: $\mathbf{p}^o$ maximizes social welfare, with extra weight on lobbies

Protection for Sale I

- substitute $\frac{\partial W_i}{\partial p_j}$ and $\frac{\partial W}{\partial p_j}$ and sum over all $i \in L$:

$$\sum_{i \in L} \nabla W_i^o \left(\mathbf{p}^o\right) + a \nabla W \left(\mathbf{p}^o\right) = 0$$

if $j \in L$:

$$(1 - \alpha_L)\, y_j \left(p_j\right) + \alpha_L \left(p_j - p_j^w\right) m_j'(p_j) + a \left(p_j - p_j^w\right) m_j'(p_j) = 0$$

if $j \notin L$:

$$-\alpha_L y_j \left(p_j\right) + \alpha_L \left(p_j - p_j^w\right) m_j'(p_j) + a \left(p_j - p_j^w\right) m_j'(p_j) = 0$$

- rearranging:

$$p_j - p_j^w = \frac{I_j - \alpha_L}{\alpha_L + a} \cdot \frac{y_j \left(p_j\right)}{-m_j'(p_j)}$$

with $I_j = 1$ if $j \in L$, zero otherwise
$\rightarrow$ organized industries are protected: $p_j > p_j^w$ (import tariff or export subsidy)
$\rightarrow$ unorganized industries are harmed: $p_j < p_j^w$ (import subsidy or export tax)

Protection for Sale II

- recall:

$$p_j - p_j^w = \frac{I_j - \alpha_L}{\alpha_L + a} \cdot \frac{y_j\left(p_j\right)}{-m_j'(p_j)}$$

- the deviation from FT is smaller if:

1. $m_j'(p_j)$ is high (policy very distortionary)
2. a is high (high weight on social welfare)
3. $y_j\left(p_j\right)$ low (little to gain from protection)

- if $\alpha_L = 1 \rightarrow$ all groups are organized $\rightarrow$ free trade
  why? contributions of interest groups cancel out!

Conclusions: Protection for Sale

- Grossman & Helpman (1994) aim at explaining the structure of protection across sectors

- some empirical tests provide supportive evidence

- Goldberg & Maggi (1999):
  cross-industry variation in protection is correlated to the extent of political contributions and import penetration as in the model

- open question:
  why is trade policy a preferred instrument to redistribute income?

Conclusions: Other Approaches

- we have briefly discussed two broad reasons for protection:
  1. "optimal" tariffs
  2. political economy

- there is a third type of explanation: second best theory

- in presence of distortions (imperfect competition, commitment problems, externalities) that cannot be corrected directly, restrictions to trade may be welfare improving

- large literature with a large collection of cases

Topics in International Economics

Advanced International Trade

Lecture 9

Trade, Offshoring and Inequality

Ref: Epifani & Gancia (2008)

Grossman & Rossi-Hansberg (2008)

Feenstra (2004) Chapter 4

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Trade and Within-Country Inequality

- there is a widespread concern that trade may increase within-country inequality

- within-country inequality can be measure in various ways:

  1. returns to college education

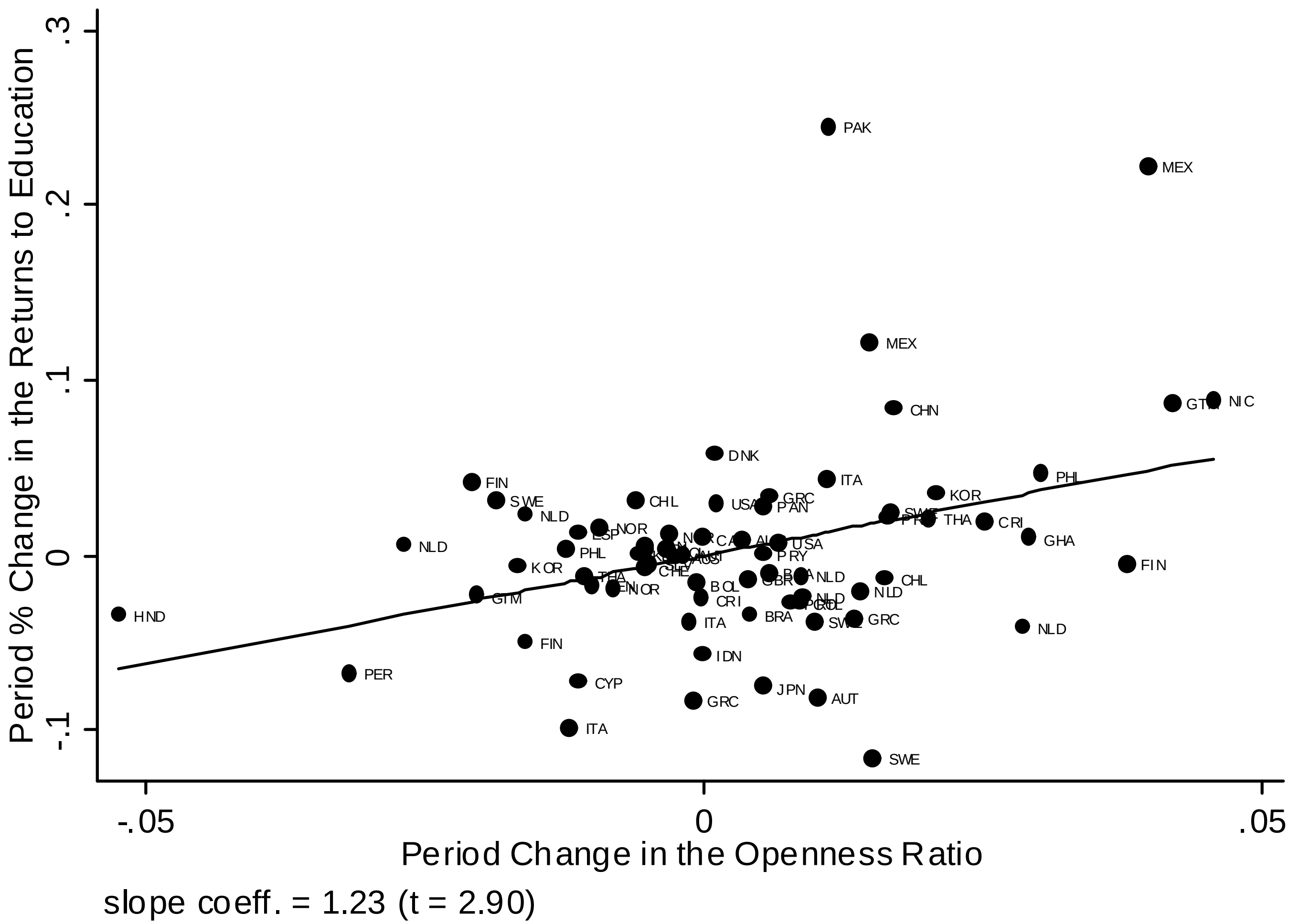
  2. skill premium $= \frac{\text{wage of white-collar workers}}{\text{wage of blue collar workers}}$

  3. Gini coefficient of the income distribution

- trade models studied so far do not predict a uniform effect of trade on inequality in all countries

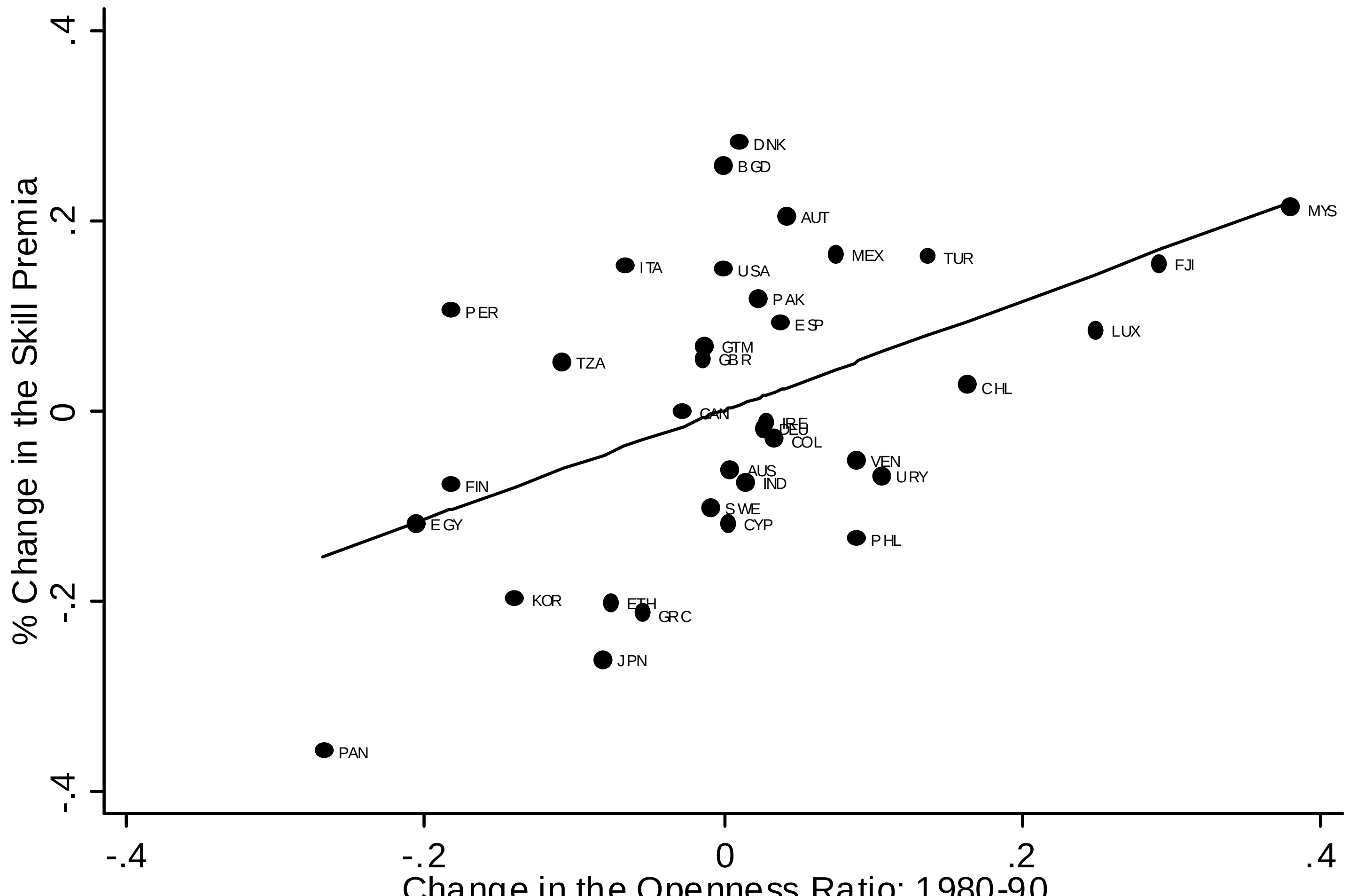
- eg, the HO model suggest that trade increases the skill premium in relatively skill-abundant countries and reduces it in skill-scarce countries

Evidence: Trade and Returns to Education



sample: 40 countries observed between the early 60s and the late 90s

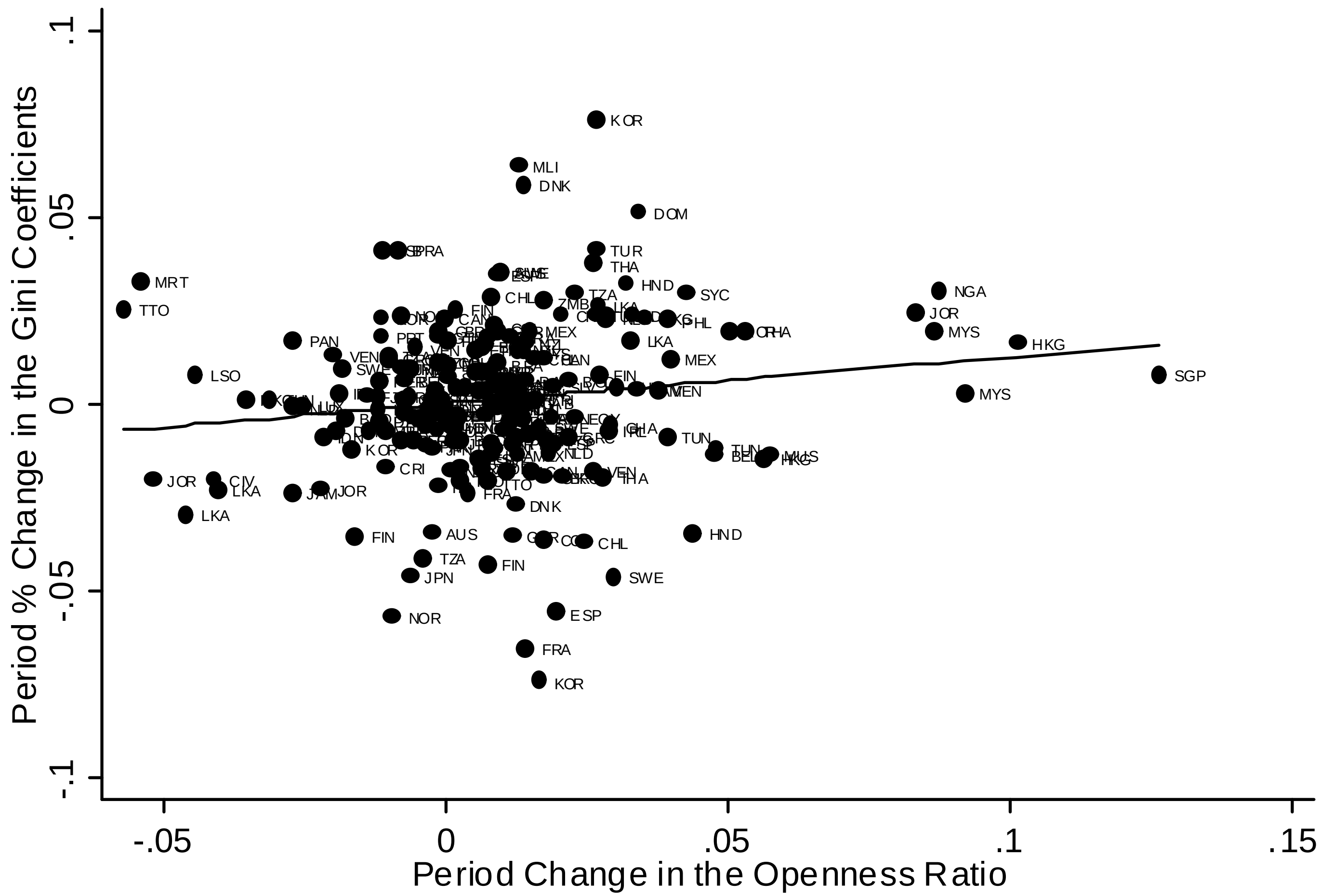
Evidence: Trade and the Skill Premium



slope coeff. = 0.58 (t = 3.96)

sample: 35 countries observed between 1980 and 1990

Evidence: Trade and Income Distribution



slope coeff. = 0.13 (t = 2.40)

sample: 68 countries observed between the early 60s and the late 90s

Epifani and Gancia (2008)

- models of monopolistic competition and IIT can explain why trade openness may lead to a pervasive increase in inequality

- key assumptions:

  1. skilled workers (H) produce differentiated goods subject to stronger IRS

  2. unskilled workers (L) produce more homogenous goods, subject to lower IRS

- effect of trade: create bigger markets
  IRS stronger in the H-sector $\longrightarrow$ skilled workers benefit more from bigger markets

- thus, skill is more valuable in large international markets

Preferences

- CES utility

$$U = \left[(Y_l)^{\frac{\epsilon-1}{\epsilon}} + (Y_h)^{\frac{\epsilon-1}{\epsilon}}\right]^{\frac{\epsilon}{\epsilon-1}}$$

  $Y_h =$ skill-intensive basket
  $Y_l =$ unskilled labor-intensive basket

- relative demand:

$$\left(\frac{P_h}{P_l}\right)^{-\epsilon} = \frac{Y_h}{Y_l}$$

  where P_h (P_l) is the price of Y_h (Y_l)

Sectorial Production

- Y_h and Y_l are CES baskets of sector-specific varieties

$$Y_i = \left[\int_0^{n_i} y_i(v)^{\frac{\sigma_i - 1}{\sigma_i}} dv\right]^{\frac{\sigma_i}{\sigma_i - 1}}, \quad i = h, l$$

note: n_i and σ_i are sector-specific

- key assumption: $\sigma_h < \sigma_l \rightarrow$ skill-intensive varieties are more differentiated

- price indexes:

$$P_i = \left[\int_0^{n_i} p_i(v)^{1-\sigma_i} dv\right]^{1/(1-\sigma_i)}, \quad i = h, l$$

Firms - Monopolistic Competition

- one firm = one variety, total cost function:

$$TC_i = (F_i + c_i y_i) w_i, \quad i = h, l$$

  note: sector h only employs H, sector l only L

- price = markup over MC

$$p_i(v) = \left(1 - \frac{1}{\sigma_i}\right)^{-1} c_i w_i = w_i, \quad \text{when } c_i = \left(1 - \frac{1}{\sigma_i}\right)$$

- free entry:

$$\pi_i(v) = \left(\frac{y_i}{\sigma_i} - F_i\right) w_i = 0 \rightarrow y_i = F_i \sigma_i = 1, \quad \text{when } F_i = 1/\sigma_i$$

- labor market clearing: $n_h = H$ and $n_l = L$

Skill Premium with Symmetric Countries

- $M+1$ symmetric countries $\rightarrow$ same wages everywhere

- price indexes:

$$\begin{aligned} P_h &= \left[H w_h^{1-\sigma_i} + MH\left(t w_h\right)^{1-\sigma_h}\right]^{1/(1-\sigma_h)} \\ &= w_h H^{1/(1-\sigma_h)}\left(1+Mt^{1-\sigma_h}\right)^{1/(1-\sigma_h)} \end{aligned}$$

  similar expression for P_l

- from aggregate demand:

$$\begin{aligned} \frac{w_h H}{w_l L} &= \frac{P_h Y_h}{P_l Y_l} = \left(\frac{P_h}{P_l}\right)^{1-\epsilon} \rightarrow \\ \left(\frac{w_h}{w_l}\right)^{\epsilon} &= \frac{L^{(\sigma_l-\epsilon)/(\sigma_l-1)}}{H^{(\sigma_h-\epsilon)/(\sigma_h-1)}} \frac{\left(1+Mt^{1-\sigma_h}\right)^{(\epsilon-1)/(\sigma_h-1)}}{\left(1+Mt^{1-\sigma_l}\right)^{(\epsilon-1)/(\sigma_l-1)}} \end{aligned}$$

  the skill premium is a function of H/L and, when $\epsilon \neq 1$ of M and t

Biased Globalization

- trade integration between identical countries (higher M, lower t) increases the skill-premium when $\epsilon > 1$ and $\sigma_h < \sigma_l$

- intuition: $\sigma_h < \sigma_l \to$ gains from trade/variety are stronger in the H sector

- now assume $\sigma_l = \sigma_h = \sigma$, but $t_h \neq t_l$:

$$\frac{w_h}{w_l} = \left(\frac{L}{H}\right)^{\frac{\sigma-\epsilon}{\epsilon}} \left(\frac{1 + Mt_h^{1-\sigma}}{1 + Mt_l^{1-\sigma}}\right)^{\frac{\epsilon-1}{\epsilon}}$$

$$\to \frac{\partial (w_h/w_l)}{\partial t_h} < 0 \text{ and } \frac{\partial (w_h/w_l)}{\partial t_l} > 0$$

  a factor benefits from a reduction in its own trade cost

- in both cases: trade increases "productivity" more in one sector
  when $\epsilon > 1$ productivity increases the relative reward of the factor used intensively

Feenstra and Hanson (1997, 1999): Outsourcing and Inequality

- the relocation of economic activities, say, from US to Mexico can increase wage inequality in *all* countries

- why? because outsourced activity are low-skill intensive relative to US standards, but skill-intensive relative to Mexican standards

- thus, the skill-intensity of production (and thus the demand for skill) increases both in US and Mexico

- Feenstra and Hanson (1999) show that outsourcing in 1979-1990 (imported intermediate inputs as a share of total materials) explains 15-24% of the increase in the wage share of skilled workers in US

- Feenstra and Hanson (1997) show that the shift in Mexican manufacturing towards foreign assembly plants in 1975-1988 explains up to 45% of the increase in the wage share of skilled workers

A New View: Trade in Tasks

- so far, the focus of theory has been on trade in complete products

- improvements in transportation and communication have led to a new form of exchange:
  - trade in value-adding tasks performed in different locations
  - boom of offshoring in manufacturing and business functions

- Grossman & Rossi-Hasberg (2008):
  - model where production requires tasks that can be separated geographically
  - benefit of offshoring: move production to low-wage countries
  - but tasks differ in the cost of offshoring

  $\longrightarrow$ in equilibrium, only some tasks are offshored

- key question: effect of offshoring on domestic wages

- new result: offshoring of unskilled tasks can benefit domestic unskilled workers!

Grossman & Rossi-Hansberg (2008): Set Up

- two goods x and y, two factors H (wage s) and L (wage w)

- in both sectors, production requires a continuum of tasks performed by each factor
  L-tasks $i \in [0, 1]$
  H-tasks $i \in [0, 1]$

- no task substitutability:
  all tasks must be performed exactly once to produce one unit

- tasks require labor:
  a_{fj} = units of factor $f = H, L$ needed to perform one task in sector $j = x, y$
  $\rightarrow$ unit labor requirement $= \int_0^1 a_{fj} di = a_{fj}$

- assume a_{fj} is exogenous and x is skill-intensive:

$$\frac{a_{Hx}}{a_{Lx}} > \frac{a_{Hy}}{a_{Ly}}$$

Offshoring

- tasks can be performed abroad through offshoring
- simplest case: only L-tasks can be offshored
- some task can be offshored more easily than others
- performing task i abroad requires foreign labor:

$$a_{Lj}\beta t_j(i) \quad \text{with} \quad \beta t_j(i) \geq 1, \quad j = x, y$$

  thus, offshoring requires extra labor costs (monitoring, communication)

- order tasks so that $t_j'(i) > 0$ (from easier to harder to offshore), assume $t_j(i)$ to be continuous in i
- benchmark case:
  offshoring costs are similar in the two industries $t_x(i) = t_y(i) = t(i)$

Equilibrium Offshoring I

- trade-off: cheap labor (if $w > w^*$) against offshoring costs

- marginal task I (same for x and y):

$$w = \beta t\left(I\right) w^*$$

  all tasks $i < I$ are performed abroad

- pricing ($=$ MC if production is positive):

$$p_j \leq w a_{Lj} \left(1 - I\right) + w^* a_{Lj} \int_0^I \beta t\left(I\right) di + s a_{Hj} \quad j = x, y$$

  p $=$ cost of domestic L $+$ foreign L and domestic H

- using $\frac{w}{\beta t(I)} = w^*$: $$p_j \leq w a_{Lj} \left[1 - I + \frac{\int_0^I t(i) di}{t(I)}\right] + s a_{Hj} \quad j = x, y$$

Equilibrium Offshoring II

- thus:

$$p_j \leq w a_{Lj} \Omega(I) + s a_{Hj} \quad j = x, y$$

with $\Omega(I) = 1 - I + \frac{\int_0^I t(i) di}{t(I)}$

- note:
  1. $w\Omega(I) =$ average cost of low-skilled labor (domestic + foreign)
  2. $\Omega(I) < 1$ if $I > 0$ with:

$$\frac{\partial \Omega(I)}{\partial I} = -\frac{\int_0^I t(i)\, di}{[t(I)]^2} t'(I) < 0$$

$\rightarrow$ offshoring reduces the cost of L-tasks

- (domestic) factor market clearing:

$$\begin{aligned} \left(a_{Lx}x + a_{Ly}y\right)(1 - I) &= L \\ a_{Hx}x + a_{Hy}y &= L \end{aligned}$$

Productivity Effect

- which factor gains from a fall in β (offshoring cost)?

- consider a small economy (fixed prices) producing both $y > 0$ and $x > 0$

- pricing conditions:

$$\begin{aligned} 1 &= w\Omega a_{Lx} + sa_{Hx} \\ p &= w\Omega a_{Ly} + sa_{Hy} \end{aligned}$$

  uniquely determine $(w\Omega)$ and s independently on β

- effect of a fall in $\beta \longrightarrow$ more offshoring $(I \uparrow) \longrightarrow$ Ω falls (save on L costs) but $(w\Omega)$ and s do not depend on $\beta \rightarrow \hat{w} = -\hat{\Omega} > 0$ and $\hat{s} = 0$!

- offshoring $\sim$ L-augmenting technical progress! L benefits, H does not

Productivity Effect: Magnitude

- using $w = \beta t(I) w^* \rightarrow \hat{w} = \hat{\beta} + \hat{t}(I)$:

$$\hat{t}(I) = \frac{t'(I)}{t(I)} = \hat{w} - \hat{\beta}$$

substituting into $\partial\Omega / \partial I$:

$$\frac{\partial\Omega}{\partial I} = -\frac{\int_0^I t(i)\, di}{t(I)} \frac{t'(I)}{t(I)} = -\frac{\int_0^I t(i)\, di}{t(I)} \left(\hat{w} - \hat{\beta}\right)$$

using $\hat{\Omega} = \frac{\partial\Omega/\Omega}{\partial I}$ and $\hat{w} = -\hat{\Omega}$:

$$\hat{\Omega} = -\frac{1}{\Omega} \frac{\int_0^I t(i)\, di}{t(I)} \left(-\hat{\Omega} - \hat{\beta}\right) = \frac{\int_0^I t(i)\, di}{(1 - I)\, t(i)} \hat{\beta}$$

- the productivity effect is larger if many tasks are already offshored (high I)

Generalizations

- techniques (a_{fj}) can be endogenized (will depend on adjusted factor prices $\frac{w\Omega}{s}$)
  $\longrightarrow$ same results

- large country case: with more L-offshoring, $\frac{x}{y}\downarrow$, $p\downarrow$
  a fall in the relative price of the L-intensive good tend to lower w
  (*relative price effect*, Stolper-Samuelson)

- complete specialization: offshoring frees up domestic L workers
  to be reabsorbed, w may fall (*labor supply effect*, Feenstra & Hanson)

- overall, the effect on w can go either way

Conclusions

- trade/offshoring can affect factor prices (skill premium) through mechanisms other than Stolper-Samuelson

- trade/offshoring can have effects similar to (biased) changes in productivity

- thus, difficult to distinguish between trade and biased technical change

- moreover, trade may induce firms to invest in new technologies

- second part of the course (Paula Bustos):
  a more micro-level look at the link between trade, technology and factor prices