ECBS 6060: International Trade
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Lecture 2: Patterns of trade

Setup

The country has

- endowments (vector) $\mathbf{v}$
- production $\mathbf{x}$
- consumption $\mathbf{c}$
- prices p

Technology and tastes

- Technology is represented by the revenue function

$$r(p, \mathbf{v}) = \max_{\mathbf{x}} p\mathbf{x} : (\mathbf{x}, \mathbf{v}) \text{ feasible.}$$

- Tastes are represented by the expenditure function

$$e(p, u) = \min_{\mathbf{c}} p\mathbf{c} : u(\mathbf{c}) = u.$$

Supply and demand

- Supply of goods (production)

$$\mathbf{x} = r_p(p, \mathbf{v}).$$

- Demand for goods (consumption)

$$\mathbf{c} = e_p(p, u).$$

Autarky equilibrium

- *Autarky*: the economy is closed, markets have to clear *within* the country.
- In equilibrium, each product market clears,

$$r_p(p, v) = e_p(p, u).$$

- Expenditure equals revenue

$$r(p, v) = e(p, u).$$

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- Expenditure equals revenue

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- What about factor markets?
- What about profit maximization?
- What about utility maximization?

Trading equilibrium

- We start with the small open economy.
- The world price is p^w (arbitrary).
- At this price, the world buys and sells any amount.
- Net import of goods:

$$\mathbf{m}(p^w) = \mathbf{c}(p^w) - \mathbf{x}(p^w).$$

Equilibrium conditions

- Balanced trade:

$$0 = p^w \mathbf{m} = p^w(\mathbf{c}^w - \mathbf{x}^w) = p^w[e_p(p^w, u^w) - r_p(p^w, \mathbf{v})].$$

- Use Euler's theorem:

$$r(p, \mathbf{v}) = e(p, u).$$

Equilibrium conditions

- Goods market are now global, so local markets do not have to clear.

$$\mathbf{m}(p^w) = e_p(p, u) - r_p(p, \mathbf{v}).$$

- What about factor markets?

Gains from trade

- Let p^a denote the vector of autarky prices.

$$\begin{aligned} e(p^w, u^a) &\leq p^w \mathbf{c}^a \\ &= p^w \mathbf{x}^a \\ &\leq r(p^w, \mathbf{v}) \\ &= e(p^w, u^w) \end{aligned}$$

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1. Definition of the expenditure function.
2. Autarky equilibrium.
3. Definition of the revenue function.
4. Open-economy equilibrium.

Gains from trade

- Since $e(p, u)$ is increasing in u,

$$u^w \geq u^a.$$

- Welfare is higher under trade than under autarky.
- Note that this holds for any p^w.

Graphical illustration with PPS

Discussion

- Moving from autarky to free trade always improves *aggregate welfare*.
- What we assumed:
  1. representative consumer/producer
  2. constant returns to scale technologies
  3. perfect competition
  4. no externalities / market failures

The equivalence of trade and technology

- Trade is a "technology" to transform export goods into import goods.
- As long as technology use is voluntary, having access to it is welfare improving.
- There may be important distributional consequences (to be discussed later).
  - Attitudes toward trade should be similar to attitudes toward technical progress.

2-country case

- Because the country gains for any p^w, when two countries open up to trade, *both gain*.

Patterns of trade

Patterns of trade

- How much can we say about the patterns of trade without talking about technologies, endowments, and tastes?
- Quite a lot. These are all summarized in the *autarky equilibrium price*.
- Deardorff (1980, JPE) derived the law of comparative advantage.

The law of comparative advantage

- Balanced trade:

$$p^w \mathbf{m} = 0.$$

- Autarky consumption is affordable at world prices,

$$p^w \mathbf{c}^a \leq p^w \mathbf{c}^w.$$

Why?

The law of comparative advantage

- Balanced trade:

$$p^w \mathbf{m} = 0.$$

- Autarky consumption is affordable at world prices,

$$p^w \mathbf{c}^a \leq p^w \mathbf{c}^w.$$

Why?

1. $p^w \mathbf{x}^a \leq p^w \mathbf{x}^w$ by revenue maximization. ($\mathbf{x}^a$ is still feasible to produce, but brings less revenue.)
2. $p^w \mathbf{x}^a = p^w \mathbf{c}^a$ by market clearing.
3. $p^w \mathbf{x}^w = p^w \mathbf{c}^w$ by balanced trade.

The law of comparative advantage

- Autarky consumption is affordable under free trade, yet not chosen.
- By the *weak axiom of revealed preference*:

$$p^a \mathbf{c}^w > p^a \mathbf{c}^a.$$

- By revenue maximization,

$$p^a \mathbf{x}^w \leq p^a \mathbf{x}^a.$$

- Subtract the value of production, $p^a \mathbf{x}^w$ and $p^a \mathbf{x}^a$:

$$p^a(\mathbf{c}^w - \mathbf{x}^w) = p^a \mathbf{m} > p^a(\mathbf{c}^a - \mathbf{x}^a) = 0.$$

- *The autarky cost of the net import vector is positive.*
- Equivalently,

$$(p^a - p^w)\mathbf{m} > 0.$$

The 2-good case

- For two goods, this means $m_i > 0$ if and only if $p_i^a > p_i^w$.
- The country exports the product which has a low autarky price relative to the world price.
- The country imports the product which has a high autarky price relative to the world price.
- (How does this relate to "Buy cheap, sell dear?")
- There is no such strong conclusion for the n-good case. We only have a correlation of prices and trade patterns.

The 2-country case

- In a 2-country world, net imports of country 1 are net exports of country 2:

$$\mathbf{m} = -\mathbf{M}.$$

- (We use uppercase letters for country 2.)
- The law of CA holds in both countries

$$p^a \mathbf{m} > 0,$$
$$P^a \mathbf{M} > 0.$$

- Summing the two

$$(p^a - P^a)\mathbf{m} > 0.$$

The 2×2 case

- Goods flow from the low autarky price country to the high autarky price country.

$$(p^a - P^a)\mathbf{m} > 0.$$

- Balanced trade

$$p^w m = 0.$$

- With two goods, this implies

$$\frac{p_1^a}{p_2^a} < \frac{p_1^w}{p_2^w} < \frac{P_1^a}{P_2^a}$$

  if good 1 is exported and the reverse if good 2..
- We can narrow down the prices in trade equilibrium.
- Again, no such strong conclusion for the n-good case.

Evidence on general trade theorems

Trade and welfare

Estimable equation

- Let $y_i = Y_i/L_i$ denote GDP *per capita* of country i.
- $T_i = (X_i + M_i)/Y_i$ measures the trade openness of country i.
- One way of capturing the benefits of trade is to say that
  - per capita income is increasing in openness.

Estimable equation

- Let $y_i = Y_i/L_i$ denote GDP *per capita* of country i.
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  - per capita income is increasing in openness.

$$y_i = \beta_0 + \beta_1 T_i + u_i$$

Identification problem

- β_1 should measure the effect of a change in T_i *holding other factors fixed* (u_i)
- Countries with high T_i have different u_i.
  - Reverse causality: richer countries trade more.
  - Omitted variables: institutions, macro policies may affect both y_i and T_i.
- Both lead to an endogeneity bias.
  - Coefficient estimated by OLS does not capture *causal* effect.

Natural experiments

- These are events creating variation in openness *uncorrelated with* income.
- Two key assumptions:
  1. event (or other variable) correlated with trade
  2. holding trade fixed, uncorrelated with income

Four natural experiments

1. Japan 1851
2. US 1808
3. Suez Canal 1967
4. Air freight 1950–1990

Law of comparative advantage

Empirical tests

- It is difficult to test these predictions directly, because autarky prices are a counterfactual construct.
- We rarely see countries both in trade and in autarky with the same technology, endowments and preferences.
- Bernhofen and Brown (2004, JPE): Japan's opening in the 19th century.
- Irwin (2005, RIE): self-imposed trade embargo of the U.S. in 1808.

The natural experiment of Japan

- Japan cut itself off from all trade between 1639 and 1853.
- (Except for a small Dutch trading post off the Nagasaki harbor.)
- At the pressure of Western powers, it opened rapidly between 1853 and 1858.

Measurement

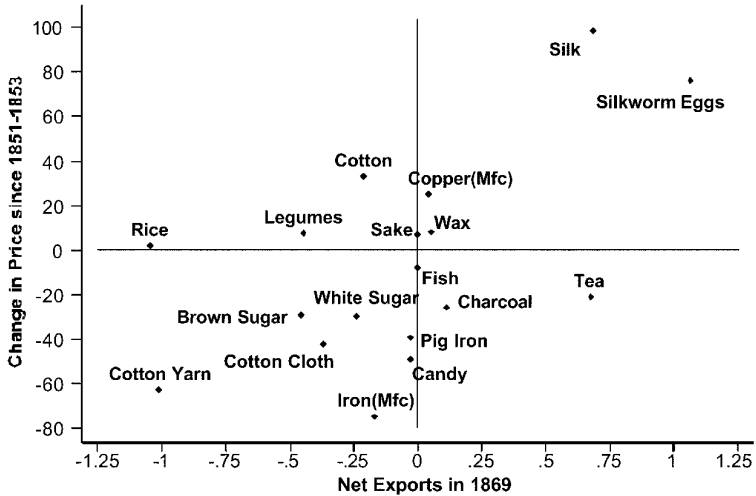
- Autarky: 1851–53 (so that production possibilities and tastes are close to trade period)
- Trade: 1868–75.
- Prices are from merchant's books.

Export and import commodities of Japan

Product	Imports (%)	Exports (%)
Agricultural nonfood:		
Silk		35.9
Silkworm eggs		15.7
Other (vegetable wax and cotton)	2.2	2.7
Agricultural food:		
Tea		28.2
Rice	10.8	
Sugar	9.9	
Other foods	4.2	8.2
Other raw materials:		
Fuel (coal and charcoal)		1.9
Other	3.1	2.9
Textiles		.2
Cotton yarn	15.1	
Cotton cloth	18.4	
Woolens	19.2	
Other textiles	1.8	
Other manufactures		4.3
Weapons and ammunition	2.7	
Machinery and instruments	1.4	
Miscellaneous manufactures	11.2	

SOURCE.—Japan Bureau of Revenue (1893).
NOTE.—The trade shares of each commodity group are based on total imports and exports for the period 1868–75.

Change in prices and net export



Autarky cost of the net export vector

Components	Year of Net Export Vector							
	1868	1869	1870	1871	1872	1873	1874	1875
1. Imports with observed autarky prices	−2.24	−4.12	−8.44	−7.00	−5.75	−5.88	−7.15	−7.98
2. Imports of woolen goods	−.98	−.82	−1.29	−1.56	−2.16	−2.50	−1.56	−2.33
3. Imports with approximated autarky prices (Shinbo index)	−1.10	−.95	−.70	−.85	−1.51	−2.08	−1.60	−2.65
4. Exports with observed autarky prices	4.07	3.40	4.04	5.16	4.99	4.08	5.08	4.80
5. Exports with approximated autarky prices (Shinbo index)	.09	.03	.07	.07	.15	.07	.11	.10
Total inner product (sum of rows 1–5)	**−.18**	**−2.47**	**−6.31**	**−4.17**	**−4.28**	**−6.31**	**−5.11**	**−8.06**

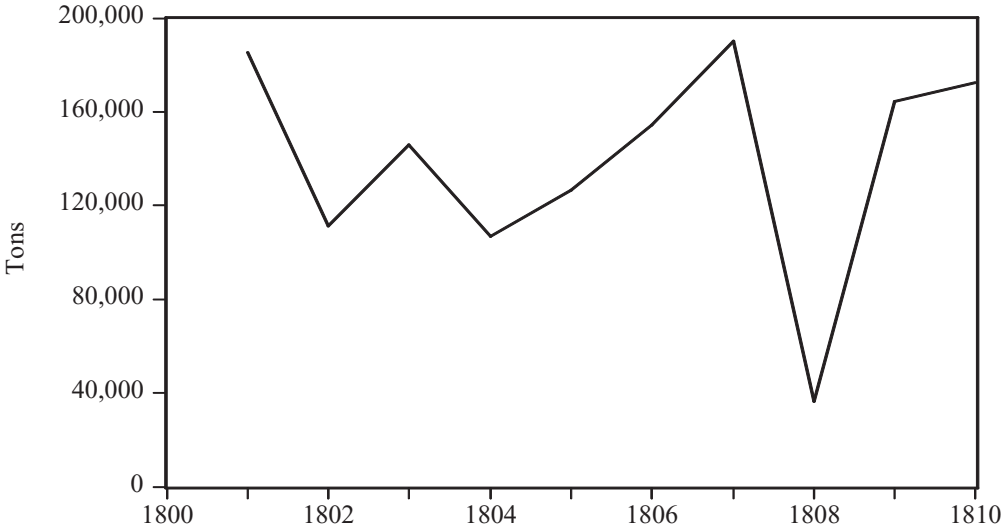
Results

- Autarky prices of export goods were generally lower than trade prices.
- Autarky prices of import goods were generally higher than trade prices.
- The autarky cost of the net import vector was negative.
- Confirming the law of comparative advantage.
- Bernhofen and Brown (2005, AER): autarky may have cost up to 8–9% of Japan's GDP

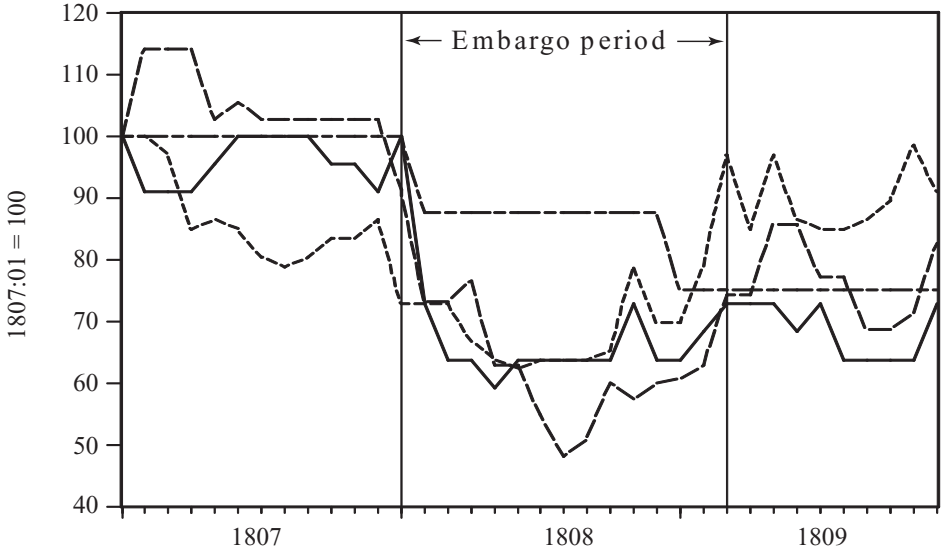
The natural experiment in the U.S.

- In 1807, U.S. Congress enacted an embargo on maritime trade.
  1. To protect American vessels and crew from British (and French) harassment.
  2. To put economic costs on Britain.
- The embargo was widely observed and almost "sealed off" the U.S. from the ROW.
- Domestic prices of export and import goods have changed substantially.

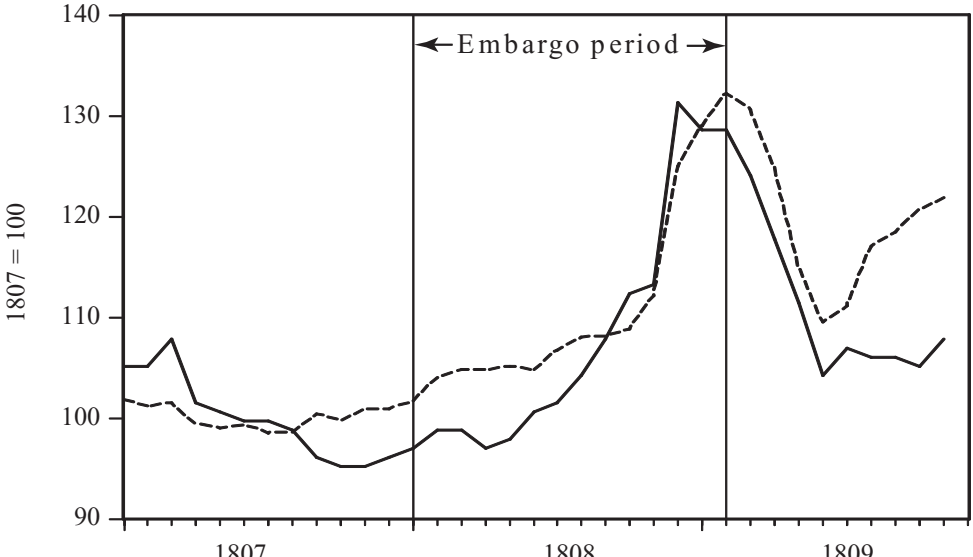
Tonnage of American ships entering Britain



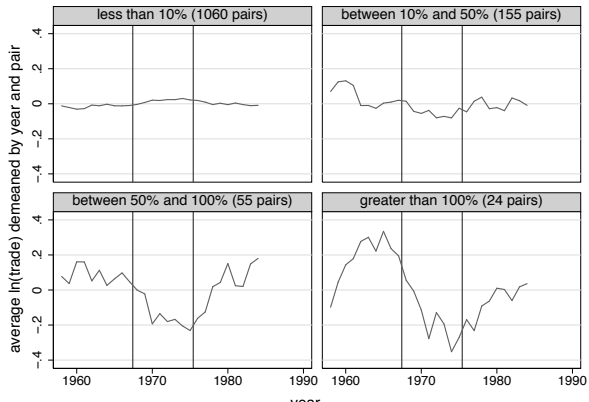
Domestic wholesale price of export commodities



Price index of import commodities



The Suez Canal closure reduced trade between country pairs (Feyrer 2009)



Source: IMF direction of trade database, author's calculations.
The vertical lines mark the closing and reopening of the Canal in 1967 and 1975.
Residuals from a regression with country pair and year dummies.

Thereby leading to lower GDP per capita (Feyrer 2009)

	(1)	(2)	(3)	(4)	(5)	(6)
IV RESULTS						
	ln(GDP per capita)					
ln(trade)	0.228*	0.253**	0.157**	0.170**	0.179**	0.159**
	(0.087)	(0.094)	(0.052)	(0.063)	(0.062)	(0.057)
FIRST STAGE						
	ln(trade)					
Suez Shock	-0.941**			-1.318**		
	(0.245)			(0.263)		
ln(Predicted Trade)		3.301**			4.817**	
		(0.950)			(0.941)	
ln(Predicted Trade) dynamic			3.341**			3.022**
			(0.676)			(0.651)
Instrument R-squared	0.010	0.010	0.023	0.018	0.019	0.020
Instrument F-Stat	14.8	11.9	24.4	25.1	26.1	21.5

Results

- Exports became cheaper, imports became more expensive.
- Consistently with the law of comparative advantage.