Comparative Advantage and Ricardian Trade

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International Trade II, Chapter 2

Introduction

What is trade theory about?

1. Explaining trade patterns: why do nations export what they do?

2. Explaining the impact of trade: how does trade affect goods and factors prices, output and welfare

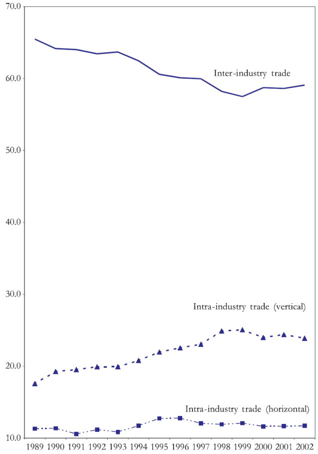
Trade theories

Two main types of trade theories

1. Trade based on cross-country differences: predict inter-industry trade
   - Technology differences: Ricardian model
   - Factor endowment differences: HOS / HOV
2. Trade based on economies of scale, imperfect competition and product differentiation: predict intra-industry trade
   - Krugman, Brander-Krugman, Melitz

Inter- or intra-industry trade?

Figure 4: *Evolution 1989–2002 of the Trade Types (per cent of world trade)*



Note: Non-allocated trade flows have not been plotted. They account for roughly 3 per cent of total trade flows each year. We rely on a sub-sample of data passing the filters in every year, as explained in the text.
Source: COMTRADE, authors' calculations.

Why do countries trade?

- Answer of comparative advantage theories: because they are **different**
- They have different “abilities” to produce different goods
- They are better off producing what they do the best, and importing the rest
- Tricky part is to explain what is “best”

Outline

I - Law of comparative advantage and the Ricardian model

II - Testing for comparative advantage

III - A primer on the size of the gains from trade

Comparative advantage

- **“Best”** is what you produce **relatively** better
- **Definition of comparative advantage** (A. Deardorff): “Ability to produce a good at a lower cost, relative to other goods, compared to another country”
- **Law of comparative advantage**: Nations tend to export the goods that are relatively cheap in autarky
$$(p^{Ak} - p) \cdot M^k \geq 0 \text{ for all } k$$
- In words, countries tend to export goods in which they have a CA, i.e., goods with autarky price relative lower than equilibrium prices under free trade
- Matter of relative efficiency
- Gains from trade resulting from a more efficient allocation of each nation’s productive resources

The Ricardian model

All trade models based on comparative advantage are characterized by differences across countries (technology, endowments, institutions...)

...which generate differences in autarky prices and in turn induce specialization.

The Ricardian model

Assumptions of the Ricardian model

- 2 countries, Home and Foreign (*)
- 2 goods, X and Y
- 1 production factor, L, mobile across industries, not across countries
- Perfect competition, CRS, homothetic preferences
- Different **technologies** (unexplained): quantity of L needed to produce one unit of good (=1/MPL): a_X, a_X^*, a_Y, a_Y^*

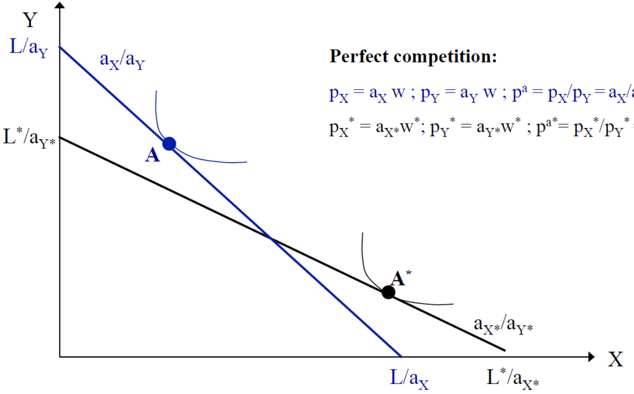
  $\rightarrow$ Opportunity costs of X in terms of Y: $\frac{a_X}{a_Y}$, $\frac{a_X^*}{a_Y^*}$
- **Definition**: A country has a comparative advantage in the production of a good if the relative price of this good is lower than in the other country
- Assume $\frac{a_X}{a_Y} > \frac{a_X^*}{a_Y^*}$ (Foreign has a CA in good X)

The Ricardian model

Autarky prices

- Within a given country, wages earned in the two industries must be the same
- $w = p_i / a_i \quad \forall i = X, Y$
- If both goods are produced, $p_X / a_X = p_Y / a_Y$
- Therefore $p = p_X / p_Y = a_X / a_Y$

Ricardian model: the autarky equilibrium



Perfect competition:

$p_X = a_X\, w\ ;\ p_Y = a_Y\, w\ ;\ p^a = p_X/p_Y = a_X/a_Y$

$p_X^* = a_{X*} w^*;\ p_Y^* = a_{Y*} w^*\ ;\ p^{a*} = p_X^*/p_Y^* = a_{X*}/a_{Y*}$

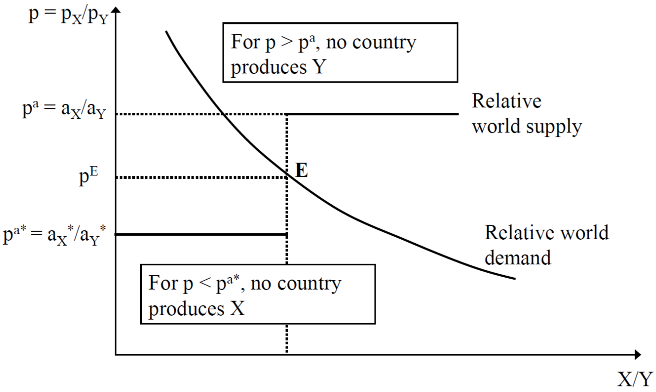
$\rightarrow$ Relative price of X higher in Home than in foreign

The Ricardian model

Trade specialization

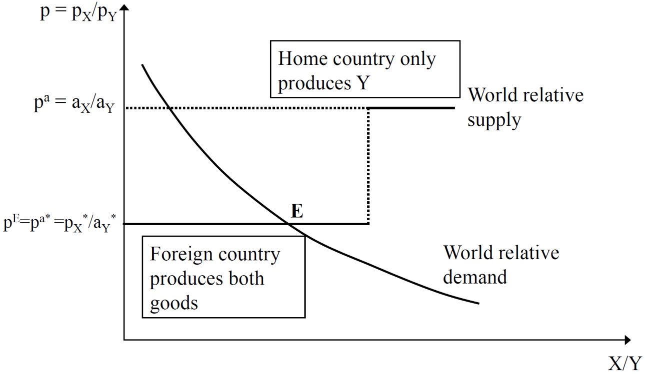
- Lower relative price of good X in Foreign is an incentive to trade
- $\frac{p_X}{p_Y} > \frac{p_X^*}{p_Y^*}$
- Foreign producers would win by exporting X and importing Y
- Home producers would win by exporting Y and importing X
- What is the equilibrium price p at which world supply equals world demand?
- Under free trade, it lies in between the two autarky prices

Ricardian model: free trade equilibrium



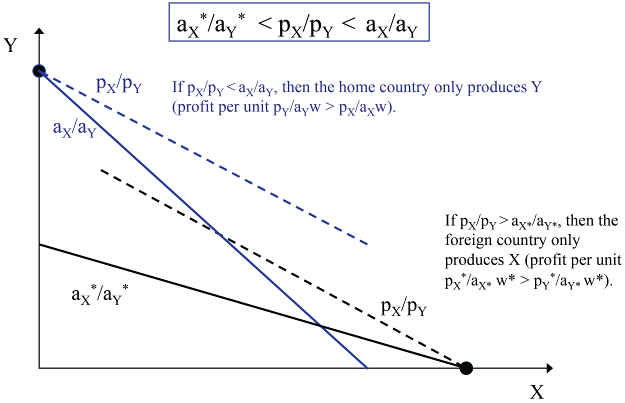
- **Full specialization** if $\frac{a_X}{a_Y} > p = \frac{p_X}{p_Y} > \frac{a_X^*}{a_Y^*}$
- Relative quantity produced: $X/Y = \frac{L^*/a_X^*}{L/a_Y}$

Ricardian model: free trade equilibrium



- **Partial specialization** if $p = \frac{a_X}{a_Y}$ or $p = \frac{a_X^*}{a_Y^*}$ (when can this happen?)

Ricardian model: free trade equilibrium



- Additional consumption possibilities
- Both countries are better off under free trade
- What happens if one country remains diversified?

Ricardian model: questions

- Which country gains the most?
- What happens to real wages?
- What happens in case of technology transfers?

The Ricardian model: wages

Wages

- International equilibrium prices: $\frac{a_X^*}{a_Y^*} \leq \frac{p_X}{p_Y} \leq \frac{a_X}{a_Y}$
- Wages are the same in both sectors and therefore do not influence CA and gains from trade
- Under full specialization, we have $w = p_Y/a_Y$ and $w^* = p_X/a_X$
- Real wage do not change in terms of the export good, but increase in terms of the import good
- Real wages increase in both counties
- How large is the gain depends on preferences and the pattern of absolute advantage

The Ricardian model: technology transfers

Back to Samuelson (2004)'s example

$$\pi_1^{US} = 2, \quad \pi_2^{US} = 1/2, \quad \pi_1^{Ch} = 1/20, \quad \pi_2^{Ch} = 2/10$$
$$L^{US} = 100 < L^{Ch} = 1000$$

- Autarky prices $(p_1/p_2)^{US} = 1/4 < (p_1/p_2)^{Ch} = 4$
- US produces good 1 only, China good 2
- Full specialization: 200 units of good 1 and 200 units of good 2
- Free trade price: $(p_1/p_2)^{FT} = 1$
- What happens if we increase (i) π_2^{Ch}; (ii) π_1^{Ch}?

The Ricardian model: technology transfers

Samuelson (2004)

$$\pi_1^{US} = 2, \quad \pi_2^{US} = 1/2, \quad \pi_1^{Ch} = 1/20, \quad \pi_2^{Ch} = 8/10$$

$$L^{US} = 100 < L^{Ch} = 1000$$

- Autarky prices $(p_1/p_2)^{US} = 1/4 < (p_1/p_2)^{Ch} = 16$
- World output increases
- Full specialization: 200 units of good 1 and 800 units of good 2
- US gains as $(p_2/p_1)^{FT}$ decreases
- China can gain or lose depending on assumptions

The Ricardian model: technology transfers

Samuelson (2004)

$$\pi_1^{US} = 2, \quad \pi_2^{US} = 1/2, \quad \pi_1^{Ch} = 8/10, \quad \pi_2^{Ch} = 2/10$$

$$L^{US} = 100 < L^{Ch} = 1000$$

- Autarky prices $(p_1/p_2)^{US} = 4 = (p_1/p_2)^{Ch} = 4$
- No more comparative advantage
- Importance to consider the changes in productivity

Testing for comparative advantage

Law of comparative advantage

Basic idea

- **The basic law of comparative advantage:**

  $$(p^{Ak} - p) \cdot M^k \geq 0 \text{ for all } k$$

  In words, countries tend to export goods in which they have a CA, i.e., goods with autarky price relative lower than equilibrium prices under free trade
- **Principle of comparative advantage:** CA $\rightarrow$ differences in relative autarky prices $\rightarrow$ basis of trade
- With price normalization, we can show that $(p^{Ak} - p) \cdot M^k \geq 0$ imply

  $$corr(p^{Ak} - p, M^k) \geq 0$$

Testing for comparative advantage

- CA: $(p^{Ak} - p) \cdot M^k \geq 0$ for all k
- Denote t the net *export* vector ($t \equiv -M$)
- Then $p^A \cdot t \leq 0$ (w/o. k, p stand for the price **vector**)

$\rightarrow$ An economy's net export vector evaluated at autarky prices is negative

$\rightarrow$ Trade has to be in deficit under old prices

- Comments from empirical perspective
  - Weak prediction (compare with coin toss model)
  - Need only data on autarky prices and trade flows
  - Impossible to observe p^A and t at the same time (i.e. latent variable problem)
  - Periods of autarky rarely observed...

Bernhofen and Brown (JPE, 2004)

Bernhofen and Brown (2004) exploit a natural experiment: Japan’s final years of complete economic and political isolation (1851-53)

- Opening of markets mid-1859
- Compute trade evaluated at autarky prices for the period 1868-1875

“What if” story: comparison between the observed free trade regime (1870s) and an autarky regime at the same time period (1870s) that would have prevailed had Japan not opened its doors to world markets

Bernhofen and Brown (JPE, 2004)

Nice natural experiment because

- Well developed market economy (rich record of price data)
- Two centuries of autarky
- Relatively simple production technology in this time period
- Forced by Western powers to move to free trade at the end of the 1850s

Japan opening up

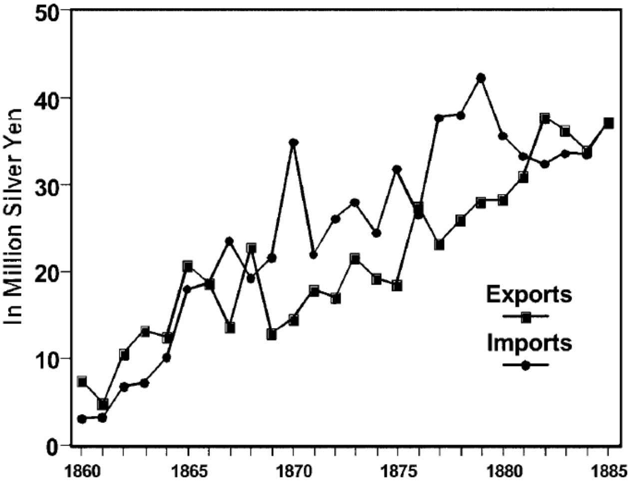


FIG. 3.—The development of Japan's external trade, 1860–85. Source: Sugiyama (1988, table 3-4).

Empirical methodology

<u>Bernhofen and Brown (2004)</u>

- 1850's: period 1, autarky price $p_1^{A'}$ observed
- 1870's: period 2, autarky price $p_2^{A'}$ unobserved
- Law of comparative advantage: $p_2^{A'} T \leq 0$

Assume $p_2^{A'} = p_1^{A'} + \varepsilon$ and $\varepsilon T \leq 0$

Use $p_1^{A'} T \leq 0$ as a test

Assumptions required by BB (2004) approach

- Japan's underlying technology and tastes haven't changed (a lose condition for $\varepsilon T \leq 0$ to hold)
- Perfect competition under autarky
- Japan is price taker on international markets $\rightarrow$ there still is perfect competition after opening to trade
- No export subsidies $\rightarrow$ no pattern of trade reversals

Results: graphical

NB: y-axis is $p - p^A$, not p^A (but recall that $p \cdot t = 0$ by balanced trade)
The graph effectively showed $corr(p^A - p, M) \geq 0$

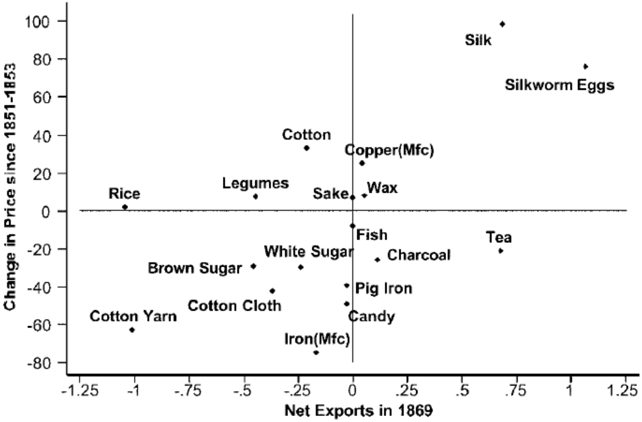


FIG. 4.—Net exports and price changes for 1869. Source: Japan Bureau of Revenue (1893) for trade data and Kinyu Kenkyukai (1937), Miyamoto (1963), Ono (1979), Yamazaki (1983), and Mitsui Bunko (1989) for price data.

Results: by year and product / data type

TABLE 2

APPROXIMATE INNER PRODUCT IN VARIOUS TEST YEARS (Millions of Ryō)

	YEAR OF NET EXPORT VECTOR							
COMPONENTS	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**

SOURCE.—For sources of price data, see Sec. IV*B* and n. 17. For rows 3 and 5, current silver yen values are converted to values of 1851–53 by deflating them with the price indices for exports and imports found in Shinbo (1978, table 5–10).

NOTE.—All values are expressed in terms of millions of ryō. The ryō equaled about $1.00 in 1873 and was equivalent to the yen when it was introduced in 1871. The estimates are of the approximation of the inner product ($\tilde{\mathbf{p}}_1^a\mathbf{T}$) valued at autarky prices prevailing in 1851–53. An explanation of the assumptions underlying the approximation is contained in the text.

Comments

- Theory says nothing about which goods are ‘up’ and which are ‘down’ in Figure 3, only that the scatter plot should be upward-sloping
- Low power test. Harrigan (2003 Handbook chapter on Empirical Trade): “I think I can speak for many economists who have taught this theory with great fervor when I say ‘thank goodness’”
- Why is $p^A \cdot t$ growing in magnitude over time?

A primer on the size of the gains from trade

How large are the gains from trade?

- Many approaches to this question
- Today we will discuss some recent answers employing a ‘reduced-form’ approach
  - Bernhofen and Brown (AER, 2005)
  - Frankel and Romer (AER, 1999)
- “Structural approach” with quantitative trade models (not covered in this class)
- Estimating GT is of fundamental interest in International Trade

Bernhofen and Brown (2005)

- Measure gains (to a representative Japan consumer) of Japan's opening up in 1858
- Consider Slutsky compensation to consumers in 1858 under autarky:

$$\Delta W = e(p^A_{1858}, c_{1958}) - e(p^A_{1858}, c^A_{1958})$$

$\rightarrow$ How much transfer so that the representative consumer can afford her free-trade *consumption bundle* (NB: not *welfare*) under autarky prices?

- By WARP, c_{1958} was not affordable in 1858 or else it would have been chosen

Towards an observable expression

- Rearrange this to get something observable (let y be output)

$$\begin{aligned}
\Delta W &= e(p^A_{1858}, c_{1958}) - e(p^A_{1858}, c^A_{1958}) \\
&= p^A_{1858} \cdot c_{1858} - p^A_{1858} \cdot c^A_{1858} \\
&= p^A_{1858} \cdot (c_{1858} - y_{1858}) + p^A_{1858} \cdot (y_{1858} - y^A_{1858}) \\
&= -p^A_{1858} \cdot t_{1958} - p^A_{1858} \cdot (y^A_{1858} - y_{1858}) \\
&\leq -p^A_{1858} \cdot t_{1858}
\end{aligned}$$

  The last equation follows from profit maximization
- Note that t_{1958} is counterfactual too. BB (2005) makes similar assumption to that in BB (2004)
- Then the above statistic puts an upper-bound on GT. Recall page 4: $p^A \cdot t \leq 0$, hence $\Delta W \geq 0$

Results

These gains in terms of ryo translate into 5.4-9.1% of GDP

TABLE 2—CALCULATIONS OF THE PER CAPITA GAINS FROM TRADE
(*In gold ryō*)

	$p^a_{1850s}T_i$ (i = 1868 ... 1875)								$p^a_{1850s}\tilde{T}_{1850s}$
Group of goods	1868	1869	1870	1871	1872	1873	1874	1875	
(1) Goods with observed autarky prices	−0.05	0.03	0.16	0.08	−0.01	0.02	0.03	0.05	0.037
(2) Goods with estimated autarky prices	0.02	0.02	0.02	0.02	0.04	0.07	0.05	0.08	0.035
(3) Woolens and muskets	0.08	0.08	0.12	0.15	0.22	0.26	0.17	0.19	0.141
Gains per capita in ryō	0.05	0.13	0.30	0.25	0.24	0.34	0.26	0.32	0.219

Sources: Nakai (1989), Miyamoto (1963), Ono (1979), Kinyu Kenkyukai (1937), Yamazaki (1983), and Great Britain, *Consular Reports*, for the ports of Nagasaki and Kanagawa in 1859 and in 1860; von Scherzer (1872, p. 262) and Lühdorf (1857, pp. 141, 248–249) for price data. See the text for the estimate of the autarky valuation of imports of woolens and imports of muskets, and of goods without observed autarky prices. Crawcour and Yamamura (1970, Table A1) provide the exchange rate used to convert the inner product from momme into ryō.
Notes: The inner product is decomposed into three groups of commodities: the goods for which autarky prices are available from the existing historical sources; woolens; and goods with estimated autarky prices. $p^a_{1850s}\tilde{T}_{1850s}$ is the average of the annual estimates from 1868 through 1875 with the additional assumption that GDP per capita grew by an annual rate 0.4 percent from 1851–1853 to the test period.

Interpretation I

- "Small" (upper-bound) effects in BB (2005) is surprising to some
- What potential gains/losses from trade are not being counted in BB (2005) calculation?
- A partial list often mentioned in the literature (and which we will return to throughout this course)
  - Selection of more productive domestic firms
  - New goods available (for consumption and production)
  - Pro-competitive effects of openness to trade
  - 'Dynamic effects' of openness to trade (typically defined as something, e.g. innovation or learning, that moves the PPF)
  - Institutional change driven by openness to trade
- Some more pedestrian answers
  - A few percentage points of GDP is nothing to spit at (i.e. "small" relative to what?)
  - GT depend on how much you trade (and Japan may trade much more in the future than in 1859)

Frankel and Romer (1999)

- Extremely influential paper (one of AER's most highly cited articles in recent decades)
- FR (1999) takes a huge question ('Does trade cause growth?') and answers it with more attention to the endogenous nature of trade than previous work
  - Key idea: FR instrument for a country's trade (really, its 'openness') by using a measure of distance: how far that country is from large (i.e., rich) potential trade partners

Empirical methodology (first stage, Part I)

- First-stage regression has two parts
- First is based on well-known gravity equation (much to say later)
- Key idea: bilateral trade flows fall with bilateral trade costs (and variables like bilateral distance, and whether two countries share a border, appear to be correlated with trade costs)
- Gravity equation estimated is the following (NB: as we shall see later, this isn't really conventional by modern standards):

$$ln(\frac{X_{ij} + M_{ij}}{GDP_i}) = a_0 + a_1 lnD_{ij} + a_2 N_i + a_3 N_j + a_4 B_{ij} + e_{ij} \quad (1)$$

$$\equiv \mathbf{aX}_{ij} + e_{ij} \quad (2)$$

- Where $(X_{ij} + M_{ij})$ is exports plus imports between country i and j, D_{ij} is distance, N is population and B_{ij} is a shared border dummy. FR (1999) also control for each country's area, landlocked status, as well as interactions between these variables and B_{ij}

First-stage results (Part I)

The gravity equation

TABLE 1—THE BILATERAL TRADE EQUATION

	Variable	Interaction
Constant	−6.38	5.10
	(0.42)	(1.78)
Ln distance	−0.85	0.15
	(0.04)	(0.30)
Ln population (country i)	−0.24	−0.29
	(0.03)	(0.18)
Ln area (country i)	−0.12	−0.06
	(0.02)	(0.15)
Ln population (country j)	0.61	−0.14
	(0.03)	(0.18)
Ln area (country j)	−0.19	−0.07
	(0.02)	(0.15)
Landlocked	−0.36	0.33
	(0.08)	(0.33)
Sample size	3220	
R^2	0.36	
SE of regression	1.64	

Notes: The dependent variable is $\ln(\tau_{ij}/\mathrm{GDP}_i)$. The first column reports the coefficient on the variable listed, and the second column reports the coefficient on the variable's interaction with the common-border dummy. Standard errors are in parentheses.

Empirical methodology (first stage, Part II)

- Now FR (1999) aggregate the previously estimated gravity regression over all of country i 's imports from all of its bilateral partners, j:

$$\hat{T}_i \equiv \sum_{i \neq j} \frac{\widehat{X_{ij} + M_{ij}}}{GDP_i} = \sum_{i \neq j} e^{\hat{\mathbf{a}}\mathbf{X_{ij}}}$$

- This constructed variable $\hat{T}_i$ is then used as an instrument for how much a country is actually trading (which they, somewhat confusingly, denote by T_i). Think of $\hat{T}_i$ as 'gravity predicted trade'

- That is, the real first-stage regression is to regress T_i (total exports plus imports over GDP) on $\hat{T}_i$ and controls

First-stage results (Part II)

The real first stage (i.e. regress T_i on $\hat{T}_i$ and controls). SE's corrected for generated regressor (Murphy and Topel, JBES 2002)

TABLE 2—THE RELATION BETWEEN ACTUAL AND CONSTRUCTED OVERALL TRADE

	(1)	(2)	(3)
Constant	46.41	218.58	166.97
	(4.10)	(12.89)	(18.88)
Constructed trade share	0.99		0.45
	(0.10)		(0.12)
Ln population		−6.36	−4.72
		(2.09)	(2.06)
Ln area		−8.93	−6.45
		(1.70)	(1.77)
Sample size	150	150	150
R^2	0.38	0.48	0.52
SE of regression	36.33	33.49	32.19

Notes: The dependent variable is the actual trade share. Standard errors are in parentheses.

Empirical methodology (second stage, Part I)

- Now, finally, FR (1999) run the regression of interest—'Does trade cause growth?'

$$ln\frac{Y_i}{N_i} = a + bT_i + c_1N_i + c_2A_i + u_i$$

- Here, $\frac{Y_i}{N_i}$ is GDP per capita and A_i is area
- FR run this regression using both OLS and IV
  - The IV for T_i is $\hat{T}_i$

OLS and IV results

TABLE 3—TRADE AND INCOME

	(1)	(2)	(3)	(4)
Estimation	OLS	IV	OLS	IV
Constant	7.40	4.96	6.95	1.62
	(0.66)	(2.20)	(1.12)	(3.85)
Trade share	0.85	1.97	0.82	2.96
	(0.25)	(0.99)	(0.32)	(1.49)
Ln population	0.12	0.19	0.21	0.35
	(0.06)	(0.09)	(0.10)	(0.15)
Ln area	−0.01	0.09	−0.05	0.20
	(0.06)	(0.10)	(0.08)	(0.19)
Sample size	150	150	98	98
R^2	0.09	0.09	0.11	0.09
SE of regression	1.00	1.06	1.04	1.27
First-stage F on excluded instrument		13.13		8.45

Notes: The dependent variable is log income per person in 1985. The 150-country sample includes all countries for which the data are available; the 98-country sample includes only the countries considered by Mankiw et al. (1992).

Why does trade increase GDP per capita?

Capital deepening, schooling (S_i), or TFP? 1960 levels or 1960-1990 growth?

TABLE 4—TRADE AND THE COMPONENTS OF INCOME

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable	$\frac{\alpha}{1-\alpha}\ln(K_i/Y_i)$		$\phi(S_i)$		$\ln A_i$		$\ln(Y/N)_{1960}$		$\Delta \ln(Y/N)$	
Estimation	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
Constant	−0.72	−1.29	0.10	−0.37	7.47	3.05	7.45	4.27	−0.50	−2.65
	(0.34)	(0.93)	(0.30)	(0.81)	(0.74)	(2.84)	(1.03)	(3.07)	(0.39)	(1.66)
Trade share	0.36	0.59	0.18	0.37	0.27	2.04	0.38	1.66	0.45	1.31
	(0.10)	(0.36)	(0.08)	(0.31)	(0.21)	(1.10)	(0.29)	(1.19)	(0.11)	(0.65)
Ln population	0.02	0.04	0.06	0.07	0.21	0.32	0.09	0.17	0.12	0.18
	(0.03)	(0.04)	(0.03)	(0.03)	(0.06)	(0.11)	(0.09)	(0.12)	(0.03)	(0.06)
Ln area	0.04	0.07	−0.01	0.01	−0.13	0.08	−0.02	0.13	−0.03	0.07
	(0.02)	(0.05)	(0.02)	(0.04)	(0.05)	(0.14)	(0.07)	(0.15)	(0.03)	(0.08)
Sample size	98	98	98	98	98	98	98	98	98	98
R^2	0.13	0.13	0.09	0.08	0.14	0.06	0.03	0.02	0.24	0.20
SE of regression	0.32	0.33	0.28	0.29	0.69	0.92	0.96	1.06	0.36	0.47
First-stage F on excluded instrument		8.45		8.45		8.45		8.45		8.45

Note: Standard errors are in parentheses.

Comments I

- These are big effects, that surprised many people. Possible explanations
  - The IV results are still biased upwards. (A small amount of endogeneity in an IV gets exaggerated by the IV method.) Countries that are close to big countries are rich not just because of trade, but because of spatially correlated true determinants of prosperity (e.g. ‘institutions’)
  - ‘Openness’ is proxying for lots of true treatment effects of proximity to neighbors: multinational firms, technology transfer, knowledge spillovers, migration, political spillovers. Not just ‘trade’
  - The dynamic effects of ‘openness’ accumulated over a long period of time are larger than the static one-off effects of opening up to trade
- Effects are many orders of magnitude higher than BB (2005) results, but not clear how to compare them
  - BB (2005) focus on consumption/welfare. FR (1999) focus on production
  - We would expect measured GDP to fall in Japan between 1858 and 1859 (Why?)

Comments II

- It's very surprising that the IV coefficients are larger than the OLS coefficients
- Possible explanations are
  - Weak instrument (but the F-stat on the first stage is reasonably high)
  - OLS is not biased after all
  - Sampling variation: OLS and IV coefficients not statistically distinguishable from one another.
  - Measurement error ("Trade is an [imperfect] proxy for the many ways in which interactions between countries raise income - specialization, spread of ideas, and so on.")
  - Heterogeneous treatment effects—IV only gets at the LATE, which might be higher than ATE (i.e. what OLS estimates if unbiased)

Conclusion

- CA seems to hold, in one place where tested
- GT appear to vary considerably across estimates
  - But GT are hard to measure. There are aspects of welfare (e.g. change in the number of varieties available) that are not captured in the studies we've seen above, but which might be important (or not!)
  - Also very hard to get exogenous change in ability to trade

Areas for future research

- Are there other ways (or places) in which to test CA?
- Can we find more natural experiments that affect regions' abilities to trade, to shed more light on the size of GT?
- More work is needed on quantifying empirically (ideally as non-parametrically as possible) the different mechanisms behind GT
- Are there ways to formalize the connection (or lack thereof) between reduced-form estimates of GT (that we saw today) and GT predicted by quantitative models of trade? See Donaldson (2015, ARE) for a discussion

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