Chapter 11: The Gravity Equation

International Trade Theory

ITAM

Objective

Discuss some systematic patterns related to who trades with whom, revealed in the data.

- Specifically, to analyze the effect of distance and size on trade volumes.

Main U.S. Trading Partners

Geography and size are important determinants of bilateral trade flows.

- 5 largest U.S. trading partners in 2003: Canada, Mexico, China, Japan and Germany.
- The largest 10 trading partners with the US accounted for 68% of the value of U.S. trade in 2003.

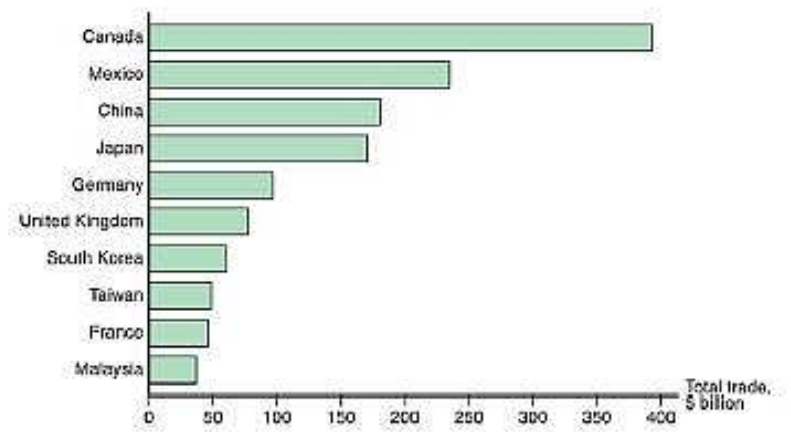


Figure 2-1

Total U.S. Trade with Major Partners, 2003

U.S. trade—measured as the sum of imports and exports—is mostly with 10 major partners.

Source: U.S. Department of Commerce.

Size Matters

The size of an economy is positively related to the volume of imports and exports.

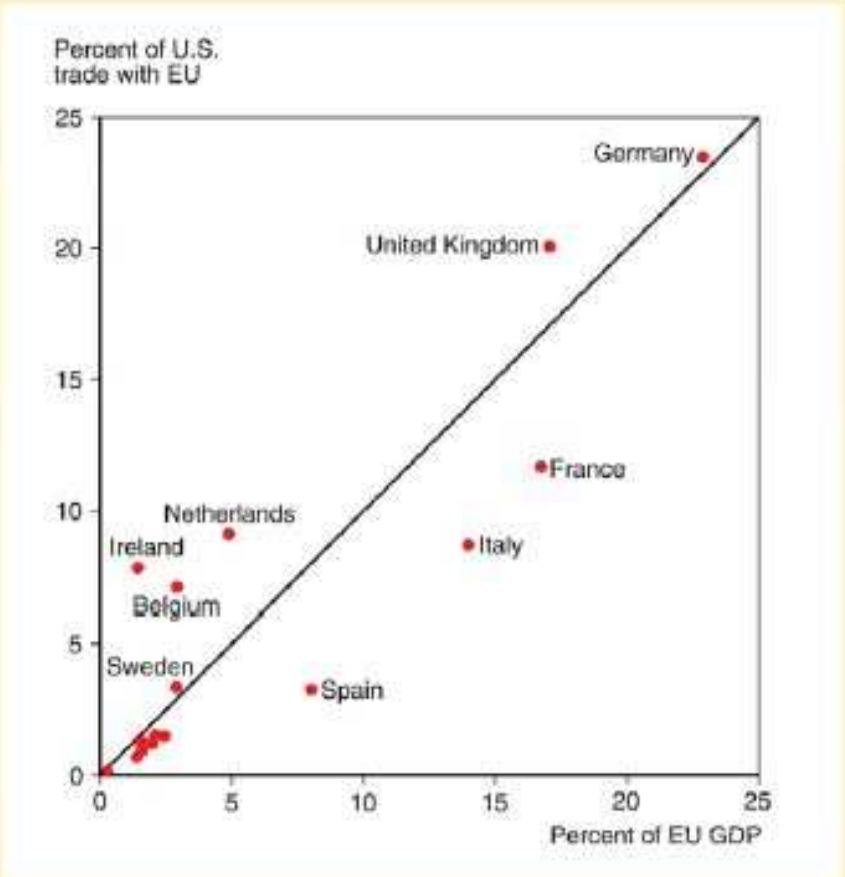
- Larger economies produce more goods and services, so they have more to sell in the export market.
- Larger economies generate more income from the goods and services sold, so people are able to buy more imports.

Size Matters: U.S. - EU Trade

Figure 2-2

The Size of European Economies, and the Value of Their Trade with the United States

Source: U.S. Department of Commerce, European Commission.



Size Matters: Imports and Market Size

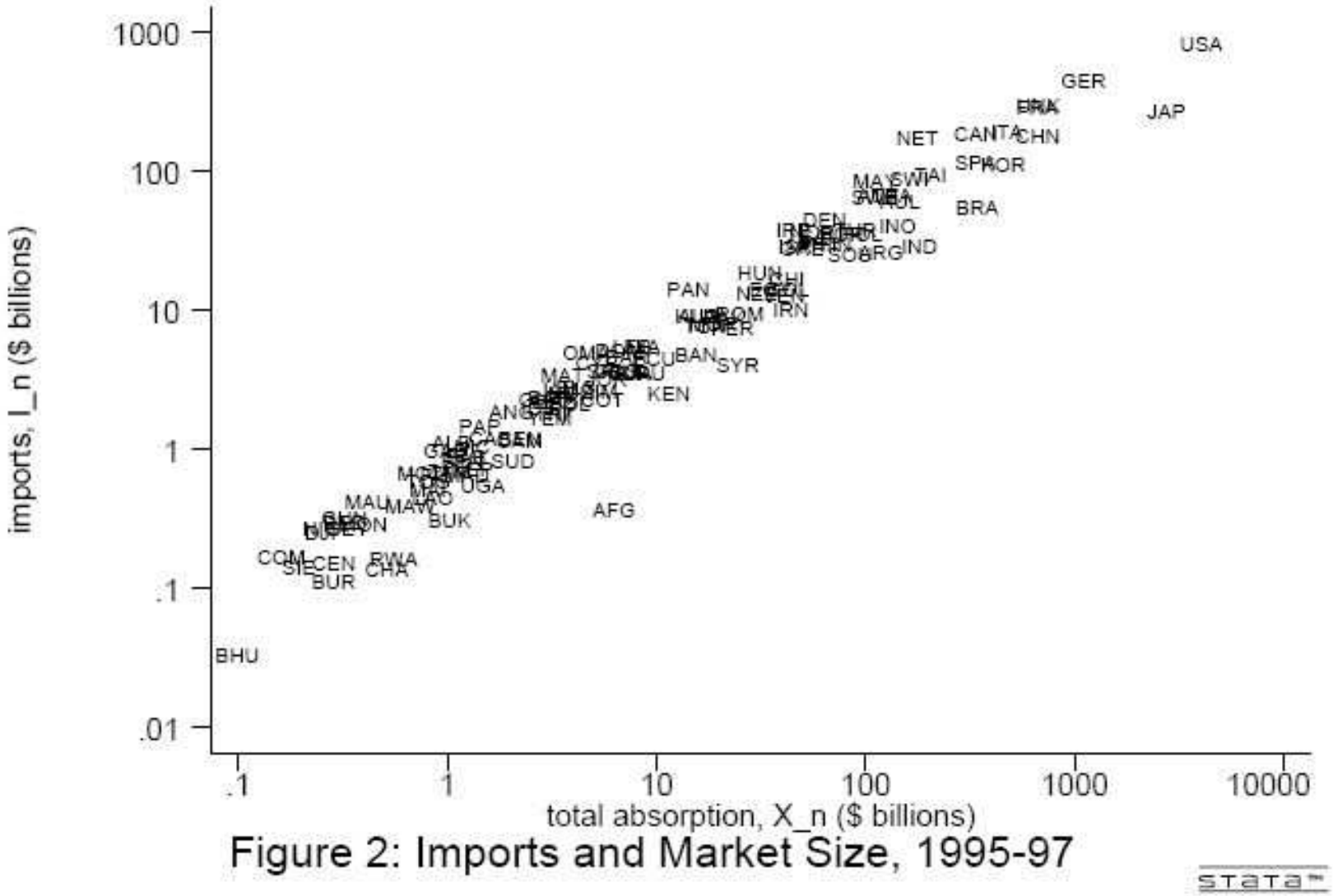


Figure 2: Imports and Market Size, 1995-97

Market Penetration and Size

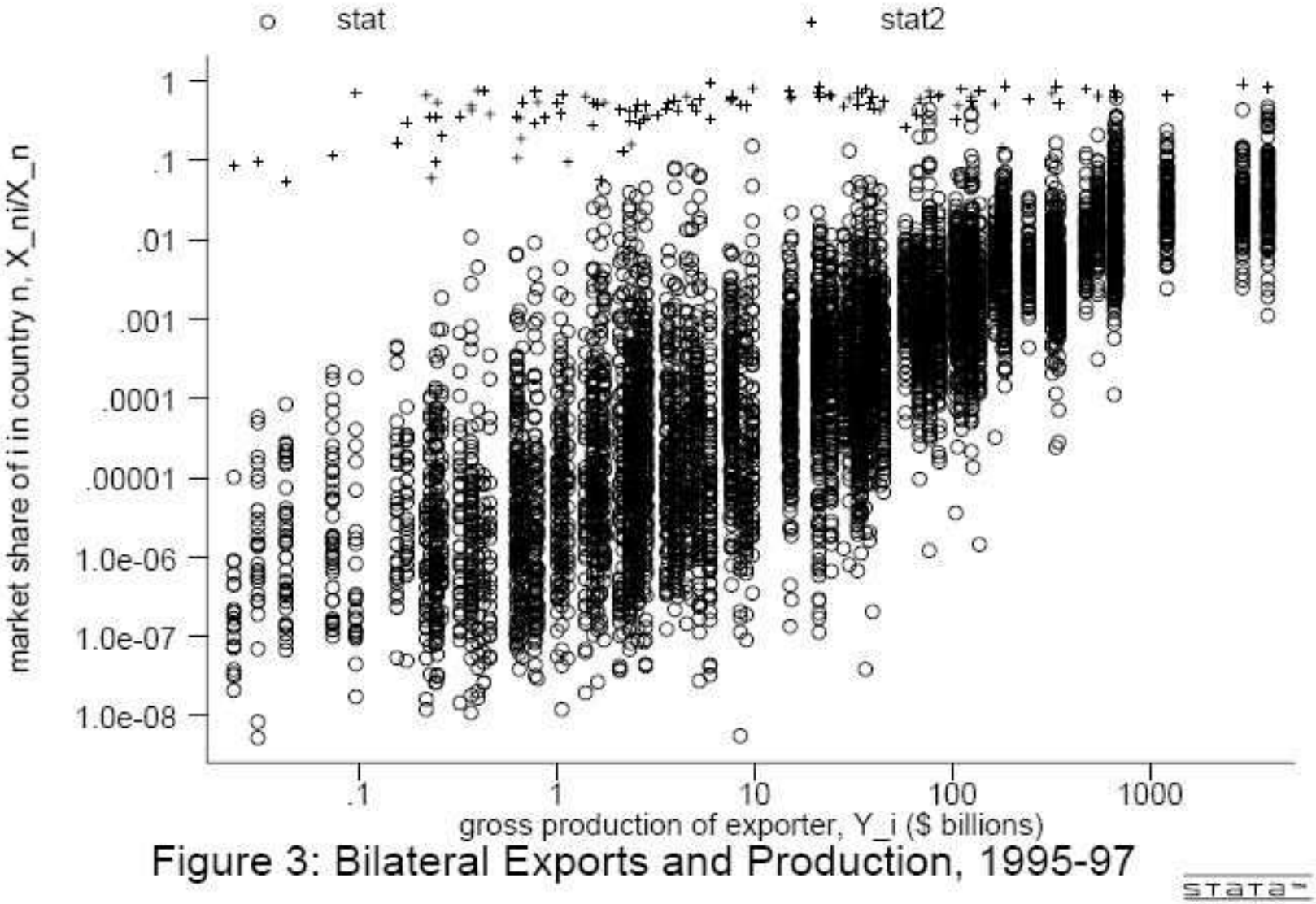
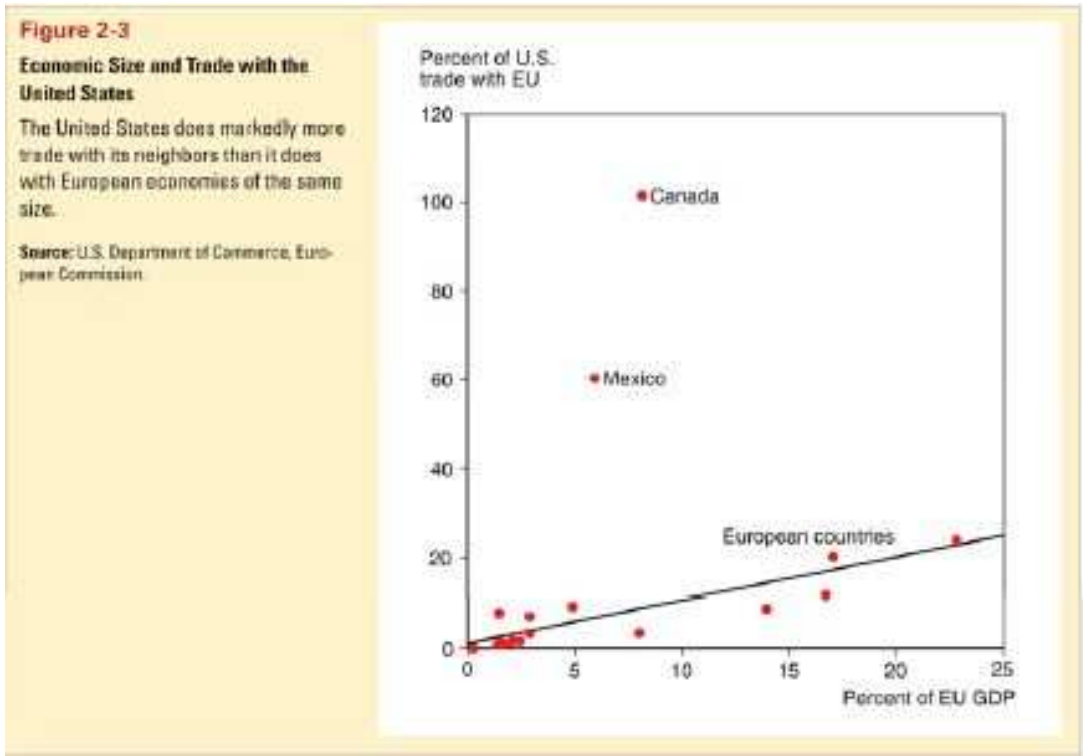


Figure 3: Bilateral Exports and Production, 1995-97

Role of Distance

Distance between markets will reduce trade flows:

- Directly through higher costs of transports.
- Indirectly through less personal contact and communication.



Geography Matters

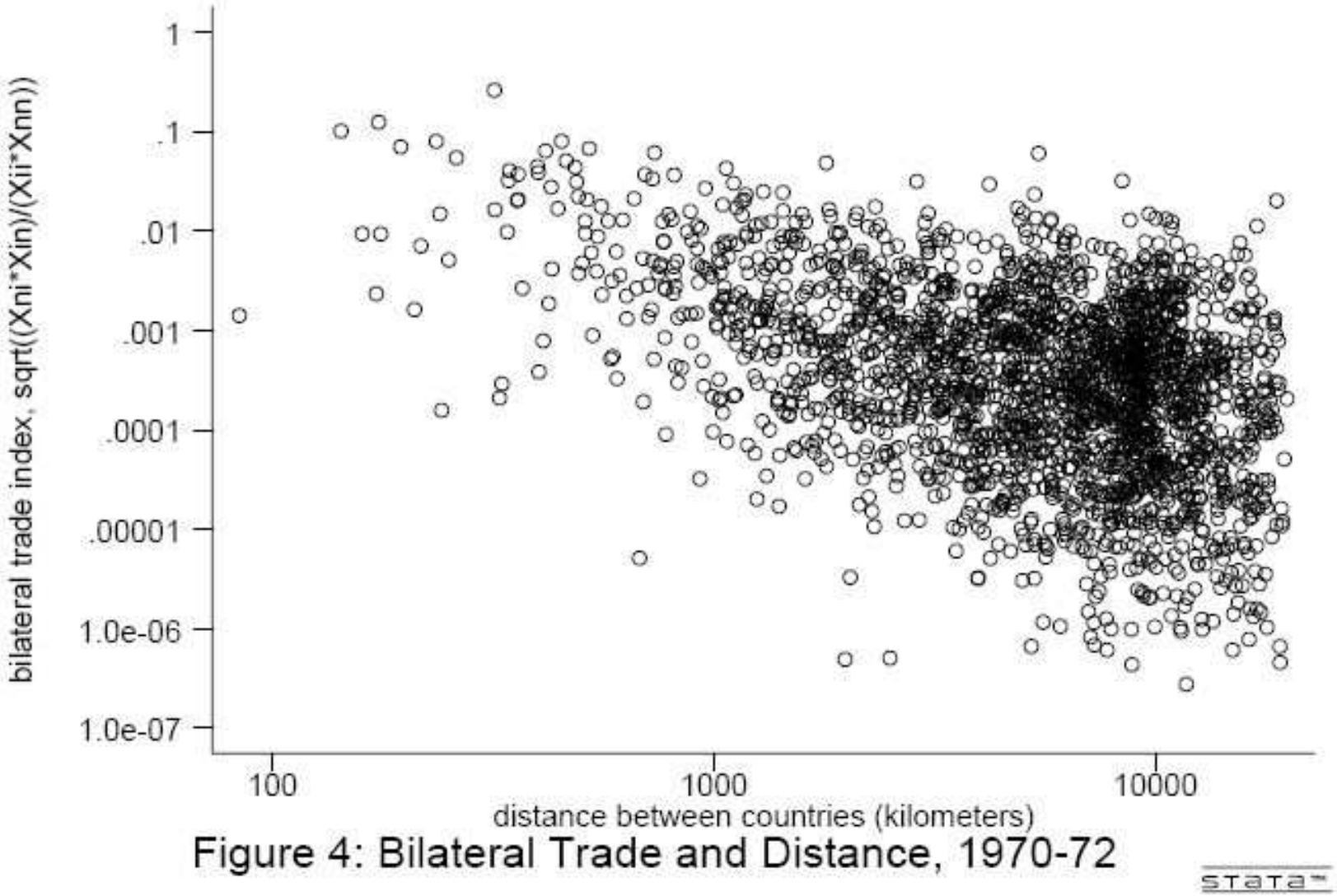


Figure 4: Bilateral Trade and Distance, 1970-72

The Gravity Equation

In its basic form, the gravity model assumes that only size and distance are important for trade in the following way:

$$T_{ij} = A\frac{Y_i Y_j}{D_{ij}}$$

- T_{ij} is the value of trade between country i and country j,
- A is a constant,
- Y_i the GDP of country i,
- Y_j is the GDP of country j,
- D_{ij} is the distance between country i and country j,

Reminds us of Newton's law of gravitation: gravitational attraction is proportional to product of masses and inversely proportional to square of distance.

The Gravity Equation

- The assumptions needed to get proportionality of GDPs are strong.
- A more general form is

$$T_{ij} = A\frac{Y_i^a Y_j^b}{D_{ij}^c}$$

  where a, b, and c are allowed to differ from 1.
- The gravity equation is very easy to run (widely available data online - e.g., Andrew K. Rose's website)
- Perhaps surprisingly, the gravity model works fairly well in predicting actual trade flows.
- Coefficients a, b and c are all close to 1.

Geography Beyond Distance

There are many other determinants of bilateral trade flows.

- The evidence confirms the “statistical significance” of:
  - sharing a common border (beyond the effect of distance);
  - sharing a common language or colonial links;
  - having signed a free trade agreement;
  - having cultural ties.

Estimating the Role of Geography

Table: Geographic Barriers for OECD Countries (1996)

Variable	Denoted by	Coefficient	Std. Error	Implied % Effect on Cost
Distance [0,375)	$-\frac{1}{\theta} dist_1$	-3.76	0.16	75.85
Distance [375,750)	$-\frac{1}{\theta} dist_2$	-3.91	0.13	79.80
Distance [750,1500)	$-\frac{1}{\theta} dist_3$	-4.25	0.12	89.09
Distance [1500,3000)	$-\frac{1}{\theta} dist_4$	-4.47	0.17	95.43
Distance [3000,6000)	$-\frac{1}{\theta} dist_5$	-6.26	0.08	155.67
Distance [6000,maximum]	$-\frac{1}{\theta} dist_6$	-6.65	0.09	171.15
Shared Border	$-\frac{1}{\theta} brdr$	0.65	0.13	-9.34
Shared Language	$-\frac{1}{\theta} lang$	0.30	0.10	-4.41
EU	$-\frac{1}{\theta} tblk_1$	0.19	0.14	-2.88
NAFTA	$-\frac{1}{\theta} tblk_2$	-0.39	0.35	6.01

Note: Given an estimated coefficient, b, the implied percentage effect on cost is estimated as $100(e^{-\theta b} - 1)$.

How Wide is The Border?: Intra versus Inter-National Trade

- Other things equal, countries trade more with their neighbors.
- But borders significantly impede inter-national trade flows relative to intra-national trade flows.

TABLE 2-3 Trade with British Columbia, as Percent of GDP, 1996

Canadian Province	Trade as Percent of GDP	Trade as Percent of GDP	U.S. State at Similar Distance from British Columbia
Alberta	6.9	2.6	Washington
Saskatchewan	2.4	1.0	Montana
Manitoba	2.0	0.3	California
Ontario	1.9	0.2	Ohio
Quebec	1.4	0.1	New York
New Brunswick	2.3	0.2	Maine

Source: Howard J. Wall, "Gravity Model Specification and the Effects of the U.S.-Canadian Border," Federal Reserve Bank of St. Louis Working Paper 2000-024A, 2000.