International Trade
Introduction: Trade Facts and the Gravity Equation

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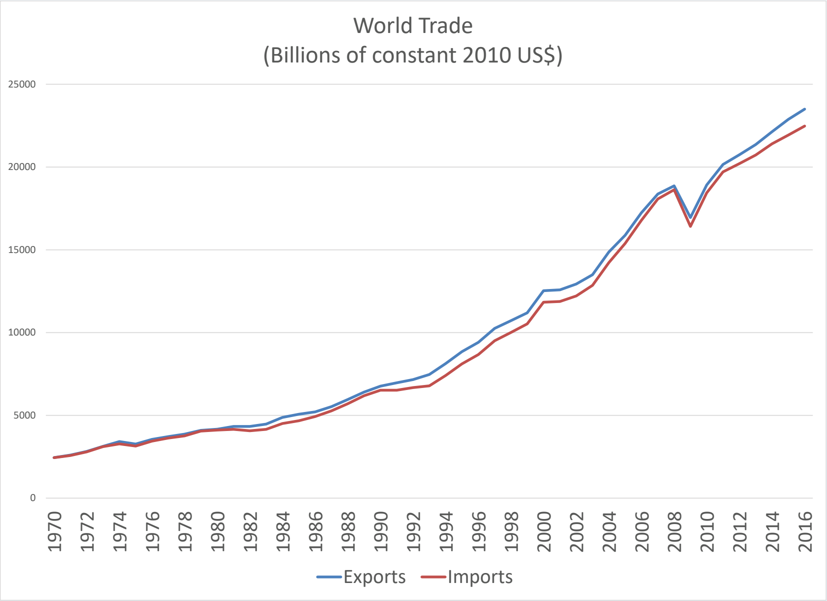
The Field of International Trade

The field of International Trade tries to answer the following questions:

- What explains the pattern of trade across countries?
- What explains the changes in trade patterns over time?
- Which goods do countries trade?
- Which kind of firms trade?
- What can explain the growth in trade? Does trade affect GDP growth?
- What are the effects of trade on the labor markets? Does trade affect income inequality?
- What is the role of outsourcing, foreign direct investment (FDI) and multinational production (MP)? What are the causes and the effects of the geographic fragmentation of production?

World Trade

- After WWII, unprecedented growth of trade volumes, both in absolute terms and as % of GDP.



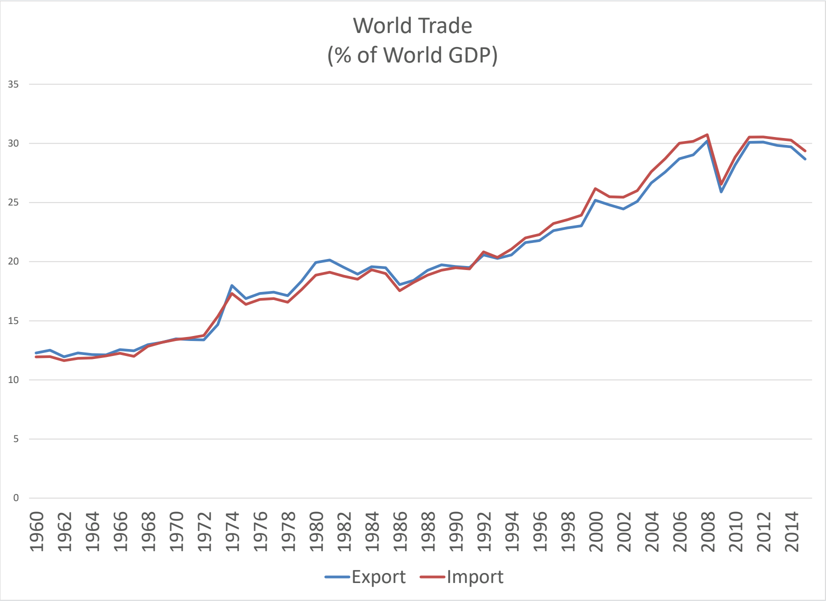


Figure 1: Volumes of World Trade

U.S. Trade

- In the last 50 years, volumes of trade in the U.S. increased ten-fold.
- Since the 70s, negative trade balance.

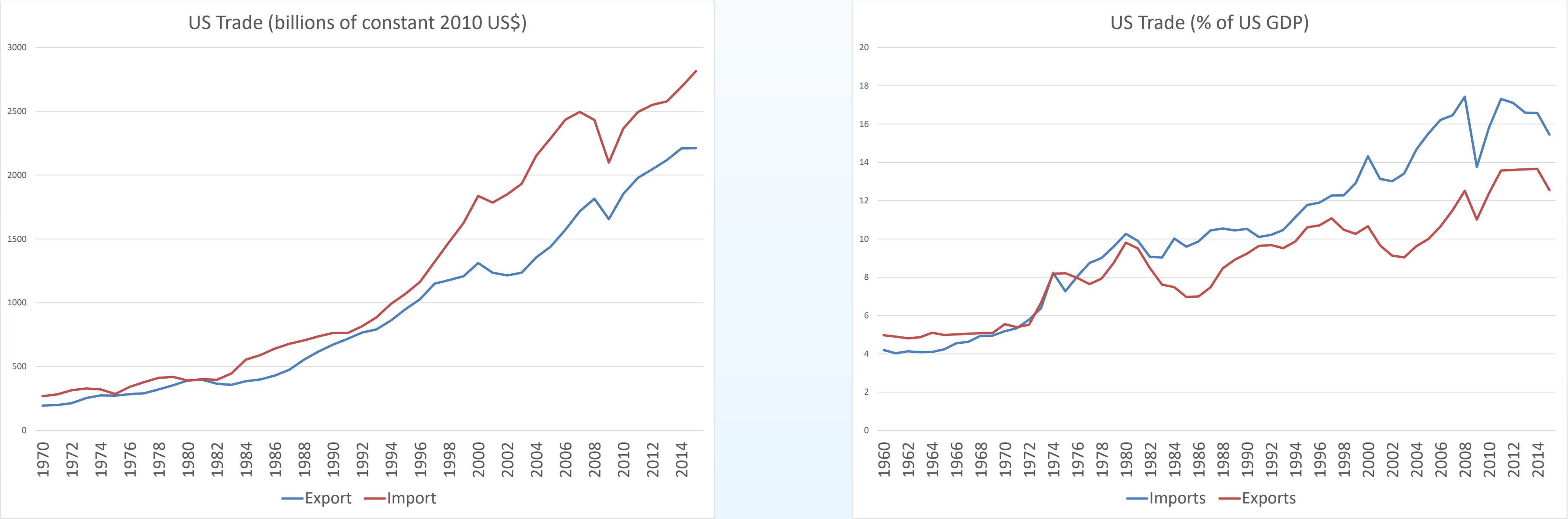


Figure 2: Volumes of US Trade

Trading Countries

- Major exporters (in absolute value): China, United States, Germany.
- Trade within U.S. + Europe accounts for about 1/3 of world total trade.
- Exports from U.S. + Europe account for almost 60% of world total export.

Europe and the Americas	59%
Asia	30.5%
Middle East and Russia	7.5%
Africa	1.5%
Australia and New Zealand	1.5%

Table 1: Share of world export, by area (2016). Source: WDI.

- About 42% of total trade flows happen between developed countries, about 37% between developing countries, about 21% between developed and developing countries.
- Rising importance of China: Chinese exports increased 40-fold in the last 30 years (they now account for 30% of Chinese GDP).

Trading Countries (cont.)

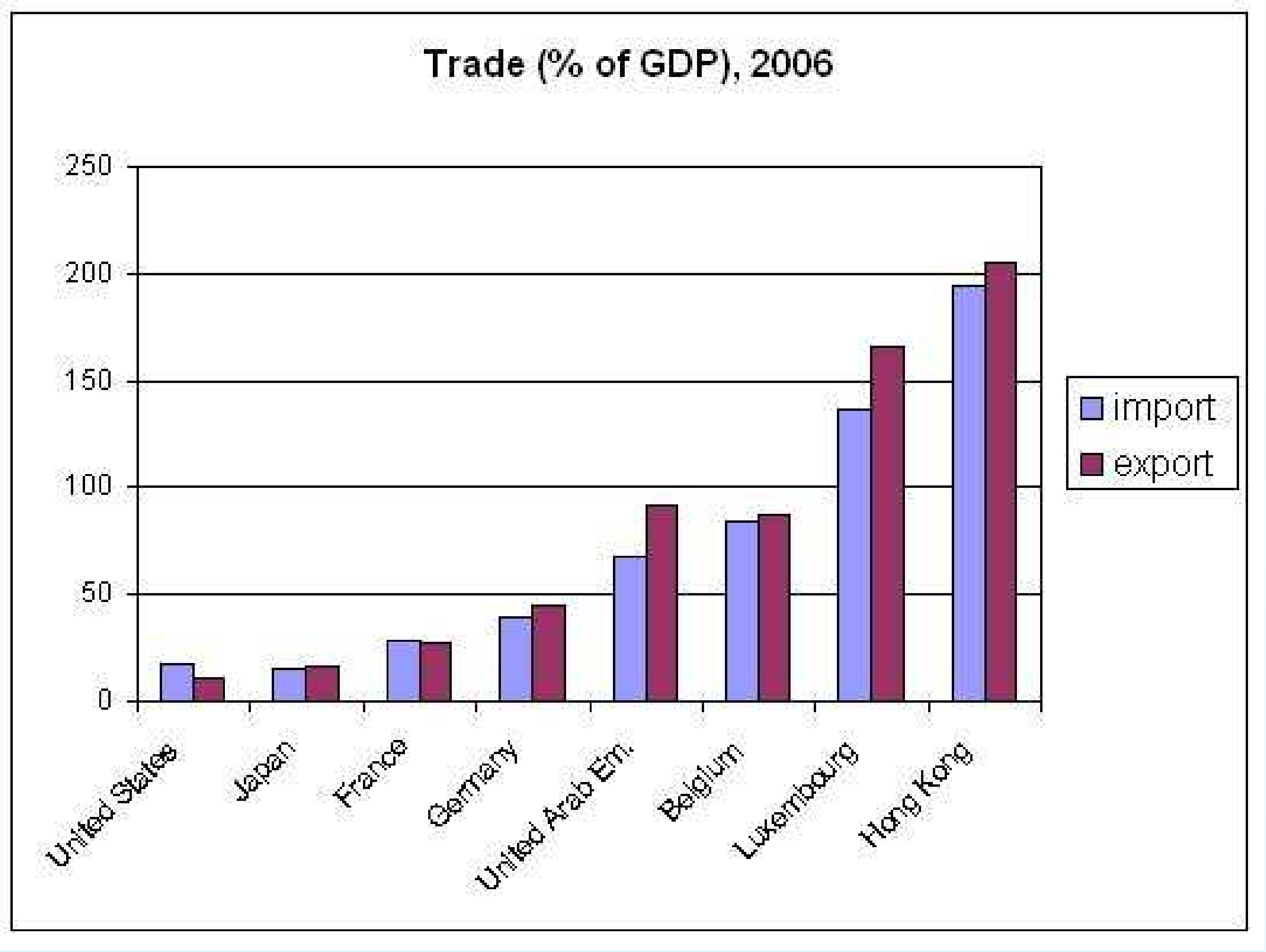
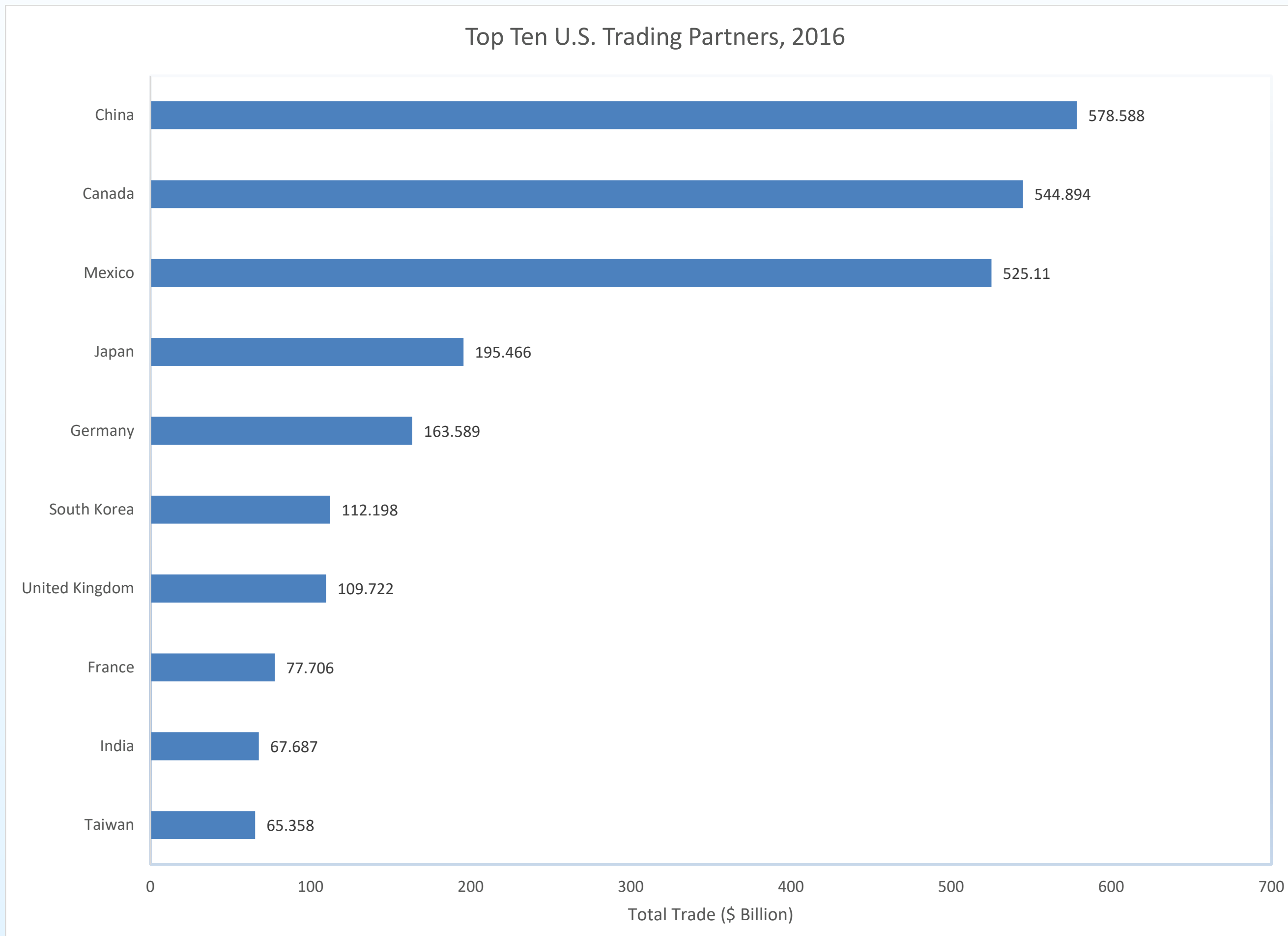


Figure 3: Trade as a % of GDP, selected countries.

U.S. Trading Partners



Large volumes of trade with **neighboring countries** and **large countries**

Helpman JEP 1999: what happened in the field 1960-1990

Well, even before that...

- 1817: Ricardo's *Principles of Political Economy and Taxation*

  THEORY OF COMPARATIVE ADVANTAGE: a country exports products in which its labor productivity is high relative to its labor productivity in other products, compared to the same magnitude for its trading partner(s).

- 1920s: Heckscher-Ohlin (HO)

  FACTOR ENDOWMENTS DETERMINE THE PATTERN OF TRADE: a country should export the product that is relatively intensive in using the factor with which the country is relatively well-endowed.

The intuitive content of the HO Theory made it the dominant framework in the early stages of the field...

Testing the Heckscher-Ohlin prediction

... attracting the attention of empirical research too:

- 1954: LEONTIEF PARADOX:

  Leontief found that the K/L ratio embodied in US imports exceeded the one in US exports (opposite to HO if we believe the US are more capital intensive than their trading partners).

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  Attempts based on pure accounting relationships and unrealistic assumptions: factor price equalization (FPE), common technologies and production structures across countries.

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- Trefler (1995): reconciles the HO model with the data by taking into account productivity differences.

Back to Ricardo?

- The empirical failure of the HO model motivated a “return” of the field to Ricardian frameworks: the data suggest the need to MODEL CROSS-COUNTRY DIFFERENCES IN TECHNOLOGY AND PRODUCTION STRUCTURE.
- Only in the early 2000s the Ricardian model comes back as the “textbook” framework that provides a good fit with the (aggregate) trade data (Eaton and Kortum, 2002).
- As of today, the EK model (with its extensions) remains the dominant framework to model bilateral trade flows across countries.

In the meantime...

The "New Trade Theory"

- Krugman (1979): new, complementary theory based on ECONOMIES OF SCALE and PRODUCT DIFFERENTIATION.

Motivated by:

1. Large volumes of trade between countries with similar factor proportions.
2. Large volumes of intra-industry trade.

(None of this can be driven by differences in factor endowments).

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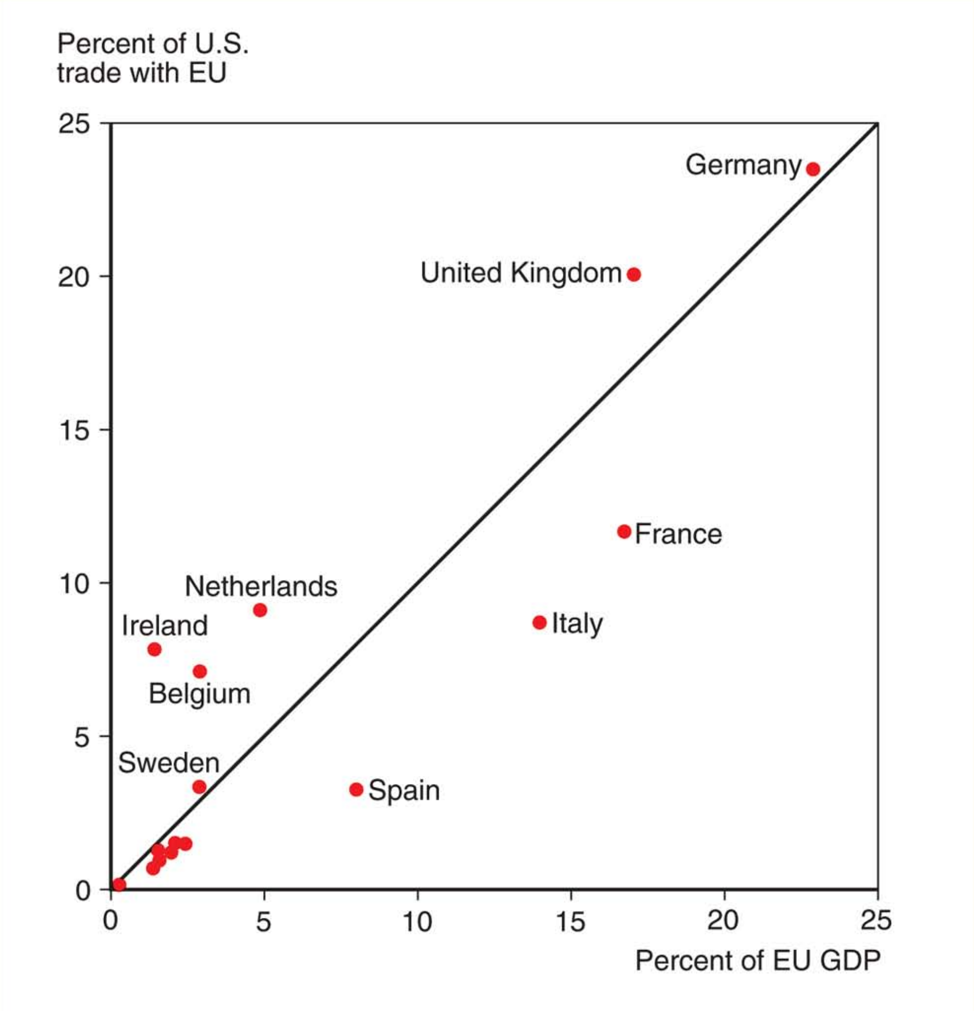
In the first half of this semester we will study the H-O model, Ricardian Trade Theory, and New Trade Theory.

Back to the Data: Trade and Size

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.



Trade and Distance

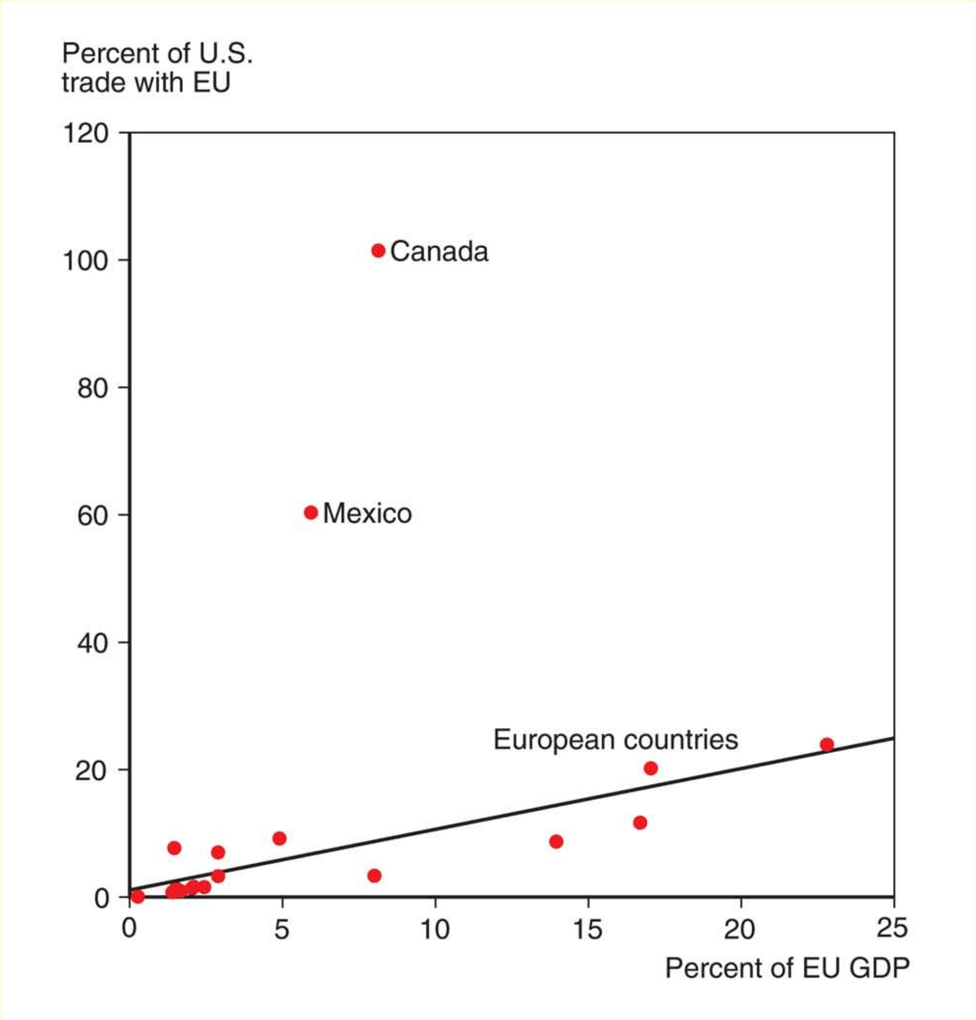
Introduction
Gravity
- Evidence
- Setup
- Border Effect
- Trade Costs
- Distance

Figure 2-3

Economic Size and Trade with the United States

The United States does markedly more trade with its neighbors than it does with European economies of the same size.

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



Trade, Size, and Distance: the Gravity Equation

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- This pattern can be tested empirically with the **Gravity Equation**:

$$T_{ij} = \alpha + \beta(GDP_i \times GDP_j) + \gamma D_{ij} + \varepsilon_{ij}$$

where:

  - T_{ij} denotes bilateral trade flows between countries i and j
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- There is "gravity" when:
  - $\hat{\beta} > 0$
  - $\hat{\gamma} < 0$.

Deriving the Gravity Equation

Consider a world where:

- every country is specialized in a distinct set of products;

- each country's population has the same homothetic preferences;

- trade is balanced;

- trade costs are positively related to the distance between the countries involved.

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GRAVITY: VOLUMES OF TRADE are positively related to the GDP LEVELS of the trading countries and negatively related to the DISTANCE between the trading countries.

[Notice: gravity needs a minimal set of assumptions to hold. It could be generated by a Ricardian model, by HO, or by the new trade theory models.]

The Gravity Equation under Free Trade

- y_k^i : country i's output of good k;
- $Y^i := \sum_{k=1}^{N} y_k^i$: country i's GDP;
- $Y := \sum_{i=1}^{I} Y^i$: world GDP;
- $s^i := Y^i / Y$: country i's share of world expenditure (GDP).

Exports from i to j of good k: $X_k^{ij} = s^j y_k^i$.
Total exports from i to j:

$$X^{ij} = \sum_{k=1}^{N} X_k^{ij} = s^j \sum_{k=1}^{N} y_k^i = s^j Y^i = \frac{Y^j Y^i}{Y} = s^j s^i Y (= X^{ji}).$$

Bilateral trade between i and j:

$$X^{ij} + X^{ji} = \frac{2 Y^j Y^i}{Y} = 2 s^j s^i Y. \tag{1}$$

The Role of Trade Barriers: The Border Effect

McCallum (1995): compare within-Canada and US-Canada trade.

$$lnX^{ij} = \alpha + \beta_1 ln(Y^i) + \beta_2 ln(Y^j) + \rho ln(d^{ij}) + \gamma\delta^{ij} + \varepsilon^{ij}$$

where d^{ij}= distance and $\delta^{ij} = 1$ if within-Canada trade, zero otherwise.

Results:

$\hat{\beta}_1, \hat{\beta}_2 \approx$ 1

$\hat{\rho} <$ 0 $\Rightarrow$ negative effect of distance

$\hat{\gamma} \approx$ 3 $\Rightarrow$ BORDER EFFECT: intranational trade is about 22 times larger than international trade!!!

$\Longrightarrow$ Need of introducing TRADE BARRIERS into the analysis!

BUT: This implies that prices may differ across countries: need for more microfoundation, including prices in the Gravity Equation.

A Simple Model

- X_k^{ij} : exports from i to j of good k ;
- c_k^{ij} : consumption in j of good k (produced in i), $X_k^{ij} = p_k^{ij} c_k^{ij}$;
- N^i : number of products produced in country i;
- p^i : F.O.B. price of goods produced in country i;
- $p^{ij} = T^{ij} p^i$: C.I.F. price of goods prod. in i and sold in j, $T^{ij} \geq 1$, $T^{ii} = 1$.

Assume each good is produced with the same technology: $p_k^{ij} = p^{ij},\ \forall k \Rightarrow c_k^{ij} = c^{ij},\ \forall k$.

Consumers'problem:

$$\begin{aligned} \max_{c^{ij}} U^j &= \left[\sum_{i=1}^{I} N^i (c^{ij})^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \\ s.t. & \quad \sum_{i=1}^{I} N^i p^{ij} c^{ij} = Y^j \end{aligned}$$

(where $\sigma > 1$). The solution takes the form:

$$X^{ij} = N^i \left(\frac{p^{ij}}{P^j}\right)^{1-\sigma} Y^j = \frac{Y^i Y^j}{(p^i)^\sigma \bar{y}} \left(\frac{T^{ij}}{P^j}\right)^{1-\sigma} \tag{2}$$

where $P^j = \left[\sum_{i=1}^{I} N^i (p^{ij})^{1-\sigma}\right]^{\frac{1}{1-\sigma}}$ and $\bar{y} = Y^i/(N^i p^i)$.

Estimating Price Indexes

Gravity Equation:

$$X^{ij} = \frac{Y^i Y^j}{(p^i)^\sigma \bar{y}} \left(\frac{T^{ij}}{P^j}\right)^{1-\sigma}$$

Estimating equation:

$$\Delta ln X^{ij} = \Delta ln(Y^i Y^j) + (1-\sigma)\Delta ln T^{ij} - \sigma \Delta ln p^i + (\sigma - 1)\Delta ln(P^j) + \varepsilon^{ij}$$

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But ideal price indexes are not observable! 3 approaches:

1. directly measure them as **GDP deflators**;
2. estimate them using the **market clearing conditions** of the model: Anderson and van Wincoop (2003);
3. proxy for them using **country fixed effects**.

Anderson and van Wincoop (2003)

Market clearing: $p^i y^i = \sum_{j=1}^{I} T^{ij} p^i c^{ij}$.

Theorem 1 *Assume trade costs are symmetric: $T^{ij} = T^{ji}$. Then an implicit solution to the market clearing condition is:*

$$p^i = \frac{1}{P^i} \left(\frac{s^i}{N^i} \right)^{\frac{1}{1-\sigma}} \tag{3}$$

which implies:

$$\left(P^j\right)^{1-\sigma} = \sum_{i=1}^{I} s^i \left(\frac{T^{ij}}{P^i} \right)^{1-\sigma} . \tag{4}$$

Why this is progress? Substituting (3) into the gravity equation, we obtain:

$$X^{ij} = \frac{Y^i Y^j}{Y} \left(\frac{T^{ij}}{P^i P^j} \right)^{1-\sigma} .$$

Anderson and van Wincoop (2003) (cont.)

Assume the following form for T^{ij}:

$$T^{ij} = \tau^{ij} + \rho ln(d^{ij}) + \varepsilon^{ij}. \tag{5}$$

The gravity equation $X^{ij} = \frac{Y^i Y^j}{Y}\left(\frac{T^{ij}}{P^i P^j}\right)^{1-\sigma}$ leads to the following estimation equation:

$$\begin{aligned} ln(X^{ij}/(Y^i Y^j)) &= \rho(1-\sigma)ln(d^{ij}) + (1-\sigma)\tau^{ij} + ... \\ &\quad + ln(P^i)^{\sigma-1} + ln(P^j)^{\sigma-1} + (1-\sigma)\varepsilon_{ij}. \end{aligned} \tag{6}$$

Estimation of system (4)-(6):

1. Run the estimation equation (6).
2. Use (5) to obtain predicted values for T^{ij}.
3. Use (4) to compute the “multilateral resistance terms” $(P^i)^{\sigma-1}$, $(P^j)^{\sigma-1}$).
4. Iterate until convergence.

Anderson and van Wincoop (2003) (cont.)

Results:

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4. Downsizing of **McCallum estimates** of the border effect for Canada: intranational trade is about 10 times higher than international trade for Canada $\Rightarrow$ McCallum larger number is due to the **omitted variables** P^i.

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4. Downsizing of **McCallum estimates** of the border effect for Canada: intranational trade is about 10 times higher than international trade for Canada $\Rightarrow$ McCallum larger number is due to the **omitted variables** P^i.
5. **Asymmetry of the border effect**: intranational trade is about 2.5 times higher than international trade for the US, suggesting a larger border effect for smaller countries.

Anderson and van Wincoop (2004) : “Trade Costs”

Exhaustive survey of the literature on measurement of trade costs.
Look at different types of trade costs:

1. Transportation costs
2. Policy barriers (tariff and non-tariff barriers)
3. Wholesale and distribution costs

and at sources of data on trade costs:

- direct measures
- indirect measures
  - from evidence on quantities
  - from evidence on prices.

Use gravity theory to infer trade costs from trade volumes and other observable variables.

Disdier and Head (2008) : "The Puzzling Persistence of the Distance Effect on Bilateral Trade"

Meta-analysis of the relation between **distance** and **bilateral trade flows** (look at 1,467 gravity estimates in 103 papers).

Main results:

- Persistence of the distance effect:
  1. Significant effect in all studies (with different samples and methodologies);
  2. NOT declining over time: the negative impact of distance on trade flows increased around 1950 and remained persistently high since then.
- Mean estimated distance effect: **-0.9** (a 10% increase in distance lowers bilateral trade by about 9%). This is a **large** effect, cannot arise only because of transportation costs!