

International Trade

lecture #3

New Trade Theory & the Gravity Equation

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University of Roma TorVergata, October 2007

Outline

Trade Analysis as a Science: theory + empirics

The end of comparative advantage ?

A Krugman-type model

The gravity model

Replicating Anderson-Van Wincoop

International comparable data

1. UN System → data availability
2. Linder Paradox
3. Intra-Industry: Trade overlap and the Gruber-Lloyd index

The end of comparable advantage ?

1. Trade in similar goods → similar countries
2. How: firms' choices and consumer preferences
3. Analytics: scale economies and love for varieties

A Krugman-type model

Ingredients.

The **Love-of-varieties** (Dixit-Stiglitz, 1977) utility function

$$U = \sum_{i=1}^N v(c_i) = \sum_{i=1}^N c_i^{\frac{\sigma-1}{\sigma}}$$

- $v' > 0$ and $v'' < 0$
- U is **symmetric** over the product varieties
- the **elasticity of substitution** between varieties, σ , is positive (>1) and, if $N \rightarrow \infty$, equal to the **price elasticity of demand**, η .
- if σ is constant (CES) the **scale effect is irrelevant**.
- N is endogenous

A Krugman-type model

Ingredients (cont.).

The firm's **labour requirement** is

$$L_i = \alpha + \beta \cdot y_i$$

• *Average cost.* $\frac{w \cdot L_i}{y_i} = \frac{w \cdot \alpha}{y_i} + w \cdot \beta$

• *Marginal cost.* $w \cdot \beta$

A Krugman-type model

Equilibrium

Under monopolistic competition: (a) $MR=MC$; (b) $p=AC$.

- *PP line.*
$$p \left(1 - \frac{1}{\eta} \right) = w \cdot \beta \rightarrow \frac{p}{w} = \beta \cdot \left(\frac{\eta}{\eta - 1} \right)$$
- *ZZ line.*
$$p = \left(\frac{w \cdot \alpha}{y} \right) + w \cdot \beta \rightarrow \frac{p}{w} = \beta + \left(\frac{\alpha}{L \cdot c} \right)$$

If $d\eta/dc < 0$ the PP line is upward sloping

With $y=Lc$ the ZZ line is downward sloping

A Krugman-type model

Endogenous N

We obtain the number of firms (varieties) as:

$$L = \sum_{i=1}^N L_i = \sum_{i=1}^N (\alpha + \beta \cdot y_i) = N \cdot (\alpha + \beta \cdot y) = N \cdot (\alpha + \beta \cdot L \cdot c)$$

Hence

$$N = \left(\frac{1}{\left(\alpha / L \right) + \beta \cdot c} \right)$$

What is the effect of **international trade** with an **identical** country ?

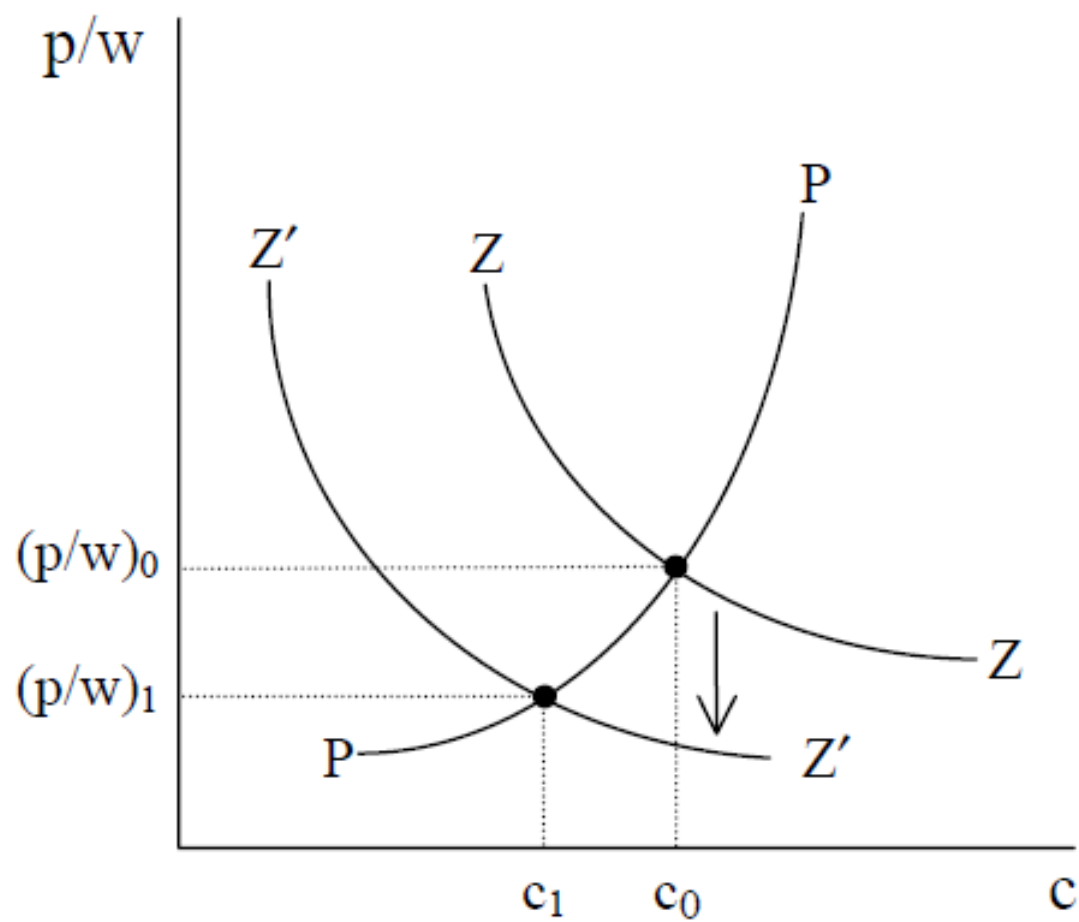


Figure 5.2

Main effects

- Trade is advantageous even for identical countries
- Gains from trade: (a) more **competition**, $p \downarrow$, $w/p \uparrow$; (b) total number of **varieties increases**.
- **Scale economies, varieties or selection ?**
- Evidence in favor of the latter ! Productivity in Canada was increased due to free trade with the U.S. from the selection effect, not the scale effect [Trefler, 2001; Feenstra, 2006]

Empirics: the gravity equation

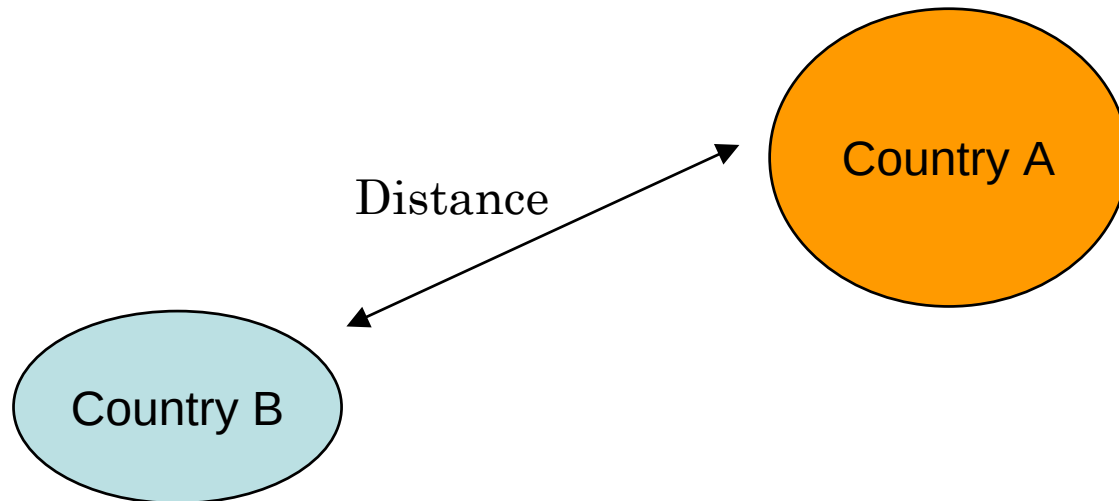
- The natural empirical counterpart of the Krugman-type symmetric model is the gravity equation.
- In its simplest form, the gravity equation (Tinbergen, 1962) states that the **bilateral trade between two countries is directly proportional to the product of the countries GDP's**. Thus, larger countries will tend to trade more with each other, and countries that are more *similar* in their relative sizes will also trade more.
- McCallum (1995) estimated the following equation:

$$\ln x_{ij} = \alpha_1 + \alpha_2 \ln y_i + \alpha_3 \ln y_j + \alpha_4 \ln d_{ij} + \alpha_5 \delta_{ij} + \varepsilon_{ij}$$

x_{ij} is exports from region i to region j , y_i and y_j are gross domestic production in the regions and d_{ij} is the distance between regions i and j , and δ_{ij} is a dummy variable equal to one for inter-provincial trade and zero for state-province trade. For the year 1988 McCallum estimated this equation using data for all 10 provinces and for 30 states that account for 90% of U.S.-Canada trade.

Foundations of gravity models: Newton's Law

- Econometric model (ex-post analysis)
- Initially, no theoretical foundations.
- Distance and Size determine bilateral trade



2.A The theoretical foundations of gravity models: Newton's Law

- Specification similar to Newton's Law

$$F_{ij} = K \cdot \frac{y_i^{\alpha_1} \cdot y_j^{\alpha_2}}{d_{ij}^{\alpha_3}}$$

y = Size (GDP, POP) d = distance

2.B Estimated gravity equation ...Newton's Law-based Normal Trade

- Normal trade

$$\ln(\text{Trade}_{ij}) = C + a \ln(\text{GDP}_i) + b \ln(\text{GDP}_j) + c \ln(\text{distance}_{ij}) + u_{ij}$$

3.A The theoretical foundations of gravity models

- reduced form of a intra-industry trade model

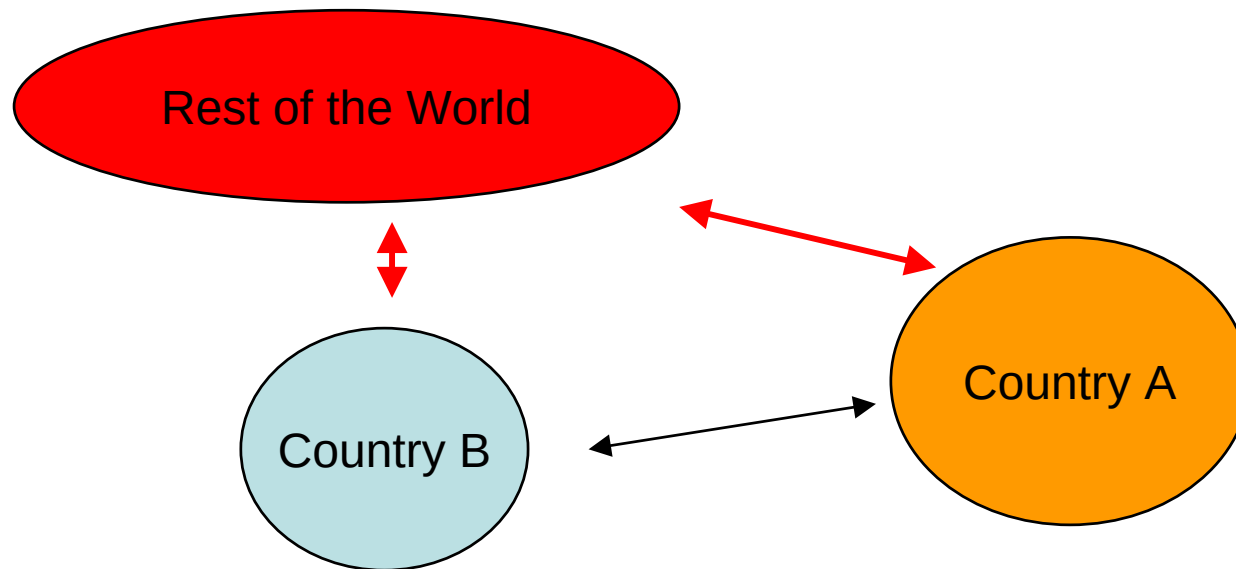
$$F_{ij} = \frac{y_i \cdot y_j}{y_w} \left(\frac{T_{ij}}{p_i \cdot p_j} \right)^{1-\sigma}$$

P= Multilateral Resistance Term

See Anderson and van Wincoop (2004), Head (2003)

Remoteness

- Countries distance from the Rest of the World matters for their bilateral trade



3.B Estimated gravity equation ...Theoretically Founded Normal Trade

- Normal trade with Resistances

$$\ln(\text{Trade}_{ij}) = C + a \ln(\text{GDP}_i) + b \ln(\text{GDP}_j) + \\ + c \ln(\text{distance}_{ij}) + d \ln(\text{Remoteness})_i + \\ + e \ln(\text{Remoteness})_j + u_{ij}$$

Where the Remoteness term is calculated as:

$$\text{Sum}_k \text{ distance}_{kj} / \text{GDP}_k$$

3.B Estimated gravity equation ...Normal Trade

- Normal trade with fixed effects

$$\ln(\text{Trade}_{ijt}) = C + a \ln(\text{GDP}_{it}) + b \ln(\text{GDP}_{jt}) + c \ln(\text{distance}_{ij}) + d \text{Dummy}_i + e \text{Dummy}_j + u_{ijt}$$

3.B Estimated gravity equation ...Normal Trade

- Normal trade normalizing for a third country

$$\ln (\text{Trade}_{ij} / \text{Trade}_{kj}) = C + a \ln (\text{GDP}_i / \text{GDP}_k) + c \ln (\text{distance}_{ij} / \text{distance}_{kj}) + u_{ij}$$

“Augmenting” the gravity equations

- Income per capita (higher income countries trade more)
- Adjacency
- Common language, colonial links
- Institutions, infrastructures, labour flows,...
- Surprisingly, bilateral tariff barriers often missing!!!

“Augmenting” gravity model

- Traditional approach to evaluate the impact of RTAs: Trade creation and trade diversion

$$\ln(\text{Trade}_{ij}) = \mathbf{a} \ln(\text{GDP}_i) + \mathbf{b} \ln(\text{GDP}_j) +$$

$$\mathbf{c} (\text{adjacency, language ..}) + \mathbf{d} (\text{Dummy}_{ij}) +$$

$$\mathbf{g} (\text{intra-RTA}_{ij}) + \mathbf{h} (\text{extra-RTA}_{ij}) + \mathbf{u}_{ij}$$

$$\mathbf{g} (\text{intra-RTA}_{ij}) + \mathbf{h} (\text{extra-RTA}_{ij}) + \mathbf{u}_{ij}$$

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ij

“Augmenting” gravity model

- ...the problem of endogeneity of FTA (Baier and Bergstrand, 2005)

$$d\ln TradeShare_{ij, t-(t-1)} = \mathbf{b} \, dRTA_{ij, t-(t-1)} + \mathbf{d} \, Dummy_{i, t-(t-1)} \\ + e \, Dummy_{j, t-(t-1)} + \mathbf{u}_{ij}$$

n*t Country-and-time fixed effects

Example

- “Does the WTO promote trade?” A. Rose, AER 2004.
- “WTO promotes trade strongly, but unequally”
- What have we learned?
- Application using Stata

What did Rose do?

- Augmented gravity model

$$\begin{aligned} \text{Ln(Trade}_{ijt}) = & b_1 \text{Ln(Distance}_{ij}) + b_2 \text{Ln(GDP}_i \text{GDP}_j)_t \\ & + b_3 (\text{other control variables}) + c_1 \text{Bothin}_{ijt} + c_2 \\ & \text{Onein}_{ijt} + u_{ijt} \end{aligned}$$

- Rose argues that there is no evidence that GATT/WTO membership increases a country's trade. $c_1 = -0.04$ is not significant

Why Rose may be wrong?

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1. Between 1950 and 1994, 63 developing countries joined the GATT, BUT they did not have commitments to liberalize their trade regimes;
2. A transition period for tariff reduction is generally allowed for
3. In many circumstances, countries benefited already from MFN treatment or preferential tariffs before the accession to GATT/WTO;
4. In other cases, acceding countries removed important barriers to trade incompatible with WTO prior to accession.
5. Many developing countries are exporters of fuels and minerals, and have a comparative advantage in agriculture. Fuels and minerals always faced low tariffs in developed countries on the one hand while agriculture still remains a highly protected sector.
6. Points 1 to 5 imply that impact of membership should be higher in developed countries

Recent studies on GATT/WTO membership

- Issues neglected in Rose's papers:
 1. failure to distinguish country and sector asymmetries in terms of de facto liberalization ([excessive pooling](#))
 2. the omission of zero trade observations ([selection bias](#)).
- When (1) and (2) are taken into account GATT/WTO membership has a positive impact on trade

(1) Excessive pooling

a) Across countries

- Developing countries that were not required to liberalised should not be included (Subramanian and Wei, 2006)

$$c_1=1.08$$

- Developing countries that were informal WTO members should also be included (Tomz et al. 2005)

$$c_1=0.17$$

b) Time and Industries

- Agriculture, textile, clothing and footwear have not be included in GATT liberalization effort, therefore should no be included (Subramanian and Wei, 2006)

(1) Excessive Pooling (cont')

- Fixed effects (FE):

- Country-specific FE

Note: Rose find a positive effect that GATT/WTO increases trade by 16%!

$C_1=0.16$ (Rose); $C_1=0.54$ (Tomz et al.)

- Country-pairs FE

$C_1=0.13$ (Rose); $C_1=0.48$ (Tomz et al.)

(2) Selection bias

- GATT/WTO membership may affect the probability that two countries trade (the extensive margin of trade)

➡ neglecting zero trade observation bias the results

- See Felbermayr and Koler, 2005; Helpman, Melitz and Rubinstein, 2005; Liu, 2006

$C_1 = 0.5, 0.3$ and 1.45 respectively

Lessons from gravity models' applications

- The property of standard gravity models of explaining a large percentage of the variation in the data does not guarantee that the part of the variation relevant for the policy variable is properly controlled for.
 - A large number of studies that use the "standard" gravity approach simply plugs in an additional variable, the policy variable of interest, in an *ad hoc* manner.
 - Many studies do not take into account that *relative, as well as absolute, distance* and trade costs matter for understanding bilateral trade.
 - Disregarding *zero trade* observations introduces a sample selection bias in the estimations.
- Gravity models explain the direction of bilateral trade flows and do *not* imply anything about *welfare*.
- Gravity models are *ex post* analysis models. They explain how a policy already implemented has worked in the past, but they are not intended to be used for predictions.

Application using STATA

- Open Rose (2004) data base (A.Rose homepage)
- Run Rose's principal equation (Table 1 in Rose's paper)
- Add time and country fixed effects
- Estimate Rose's model on first differences

Foundations and replica of the Anderson-Van Wincoop Gravity model

Homework

- Problem 5.2 in **RF04**

Replicate

- Run the program “gravity_1.do” to replicate the gravity equations in columns (1)-(3) of Table 5.2.
- Run the program “gravity_2.do” to replicate gravity equation using fixed-effects, i.e., column (5) in Table 5.2. Then answer:
 - (a) How are these results affected if we allow the provincial and state GDP's to have coefficients different from unity?
 - (b) What coefficients are obtained if we introduce separate indicator variables for intra-Canadian and intra-U.S. trade, rather than the border dummy?