Tutorial 1 – Introduction to trade

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1 The gravity model

This exercise is based on Head and Mayer (2014) and the third chapter of Bacchetta et al (2012) (see references at the end).

1. Figures 1 and 2 below are taken from Head and Mayer (2014). Comment on these figures and how they illustrate the gravity equation.

Figure 1: Trade is proportional to size

(a) Japan's exports to EU, 2006 (b) Japan's imports from EU, 2006

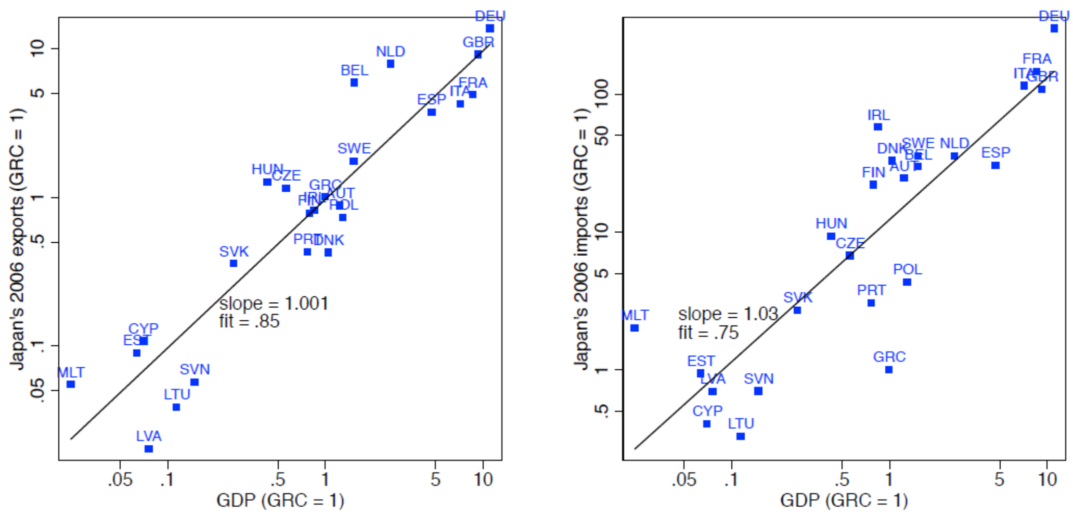
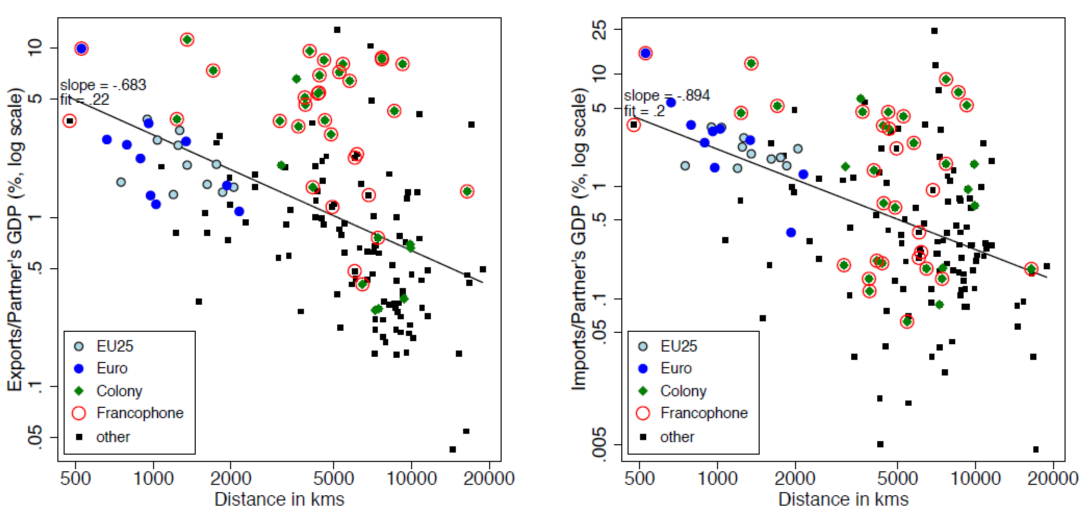


Figure 2: Trade is inversely proportional to distance

(a) France's exports (2006) (b) France's imports (2006)



2. Equation (3.2) from Bacchetta et al (2012) presents Anderson and van Wincoop's gravity equation:

$$X_{ij} = \frac{Y_i Y_j}{Y} \left(\frac{t_{ij}}{\Pi_i P_j} \right)^{1-\sigma}$$

   with X_{ij} the monetary value of exports from i to j, Y_i and Y_j the GDP of countries i and j, Y the world's GDP, t_{ij} the cost of importing a good from i to j, and Π_i and P_j the exporter's and importer's ease of market access (multilateral resistance terms). Show how this relates to the linear regression in equation (3.4):

$$lnX_{ij} = \alpha_0 + \alpha_1 lnY_i + \alpha_2 lnY_j + \alpha_3 lnt_{ij} + \alpha_4 ln\Pi_i + \alpha_5 lnP_j + \epsilon_{ij}$$

3. If equation (3.2) was a realistic model of trade flows, what values should we expect to find empirically for the coefficients α_0 to α_5? From Figure 1, do the values of α_1 and α_2 seem credible to you?

4. Let's assume one can proxy importation costs t_{ij} with distance, such that:

$$lnX_{ij} = \beta_0 + \beta_1 lnY_i + \beta_2 lnY_j + \beta_3 lnd_{ij} + \beta_4 ln\Pi_i + \beta_5 lnP_j + \mu ij$$

   with d_{ij} the distance between country i and country j. Do you see any reason why the coefficient β_3 in the previous equation may be a biased estimate of the effect of distance on import flows?

5. Use equation (3.6) to substitute for t_{ij} in equation (3.4).

$$(3.6) \quad t_{ij} = d_{ij}^{\delta_1} exp(\delta_2 cont_{ij} + \delta_3 lang_{ij} + \delta_4 ccol_{ij} + \delta_5 col_{ij} + \delta_6 landlock_{ij} + \delta_7 RTA_{ij})$$

   Looking at Figure 2, do you expect these control variables to improve the estimation of the effect of distance? Justify.

2 Monopolistic competition

This exercise is based on Dixit & Stiglitz (1977) and Krugman (1980). The elements presented here are essential to understand the Melitz model (Lecture 2).

2.1 Assumptions

(a) We assume consumers enjoy the consumption of many different goods. These goods enter symmetrically into their utility function. We also assume all consumers have the same preferences, so that the representative agent utility function can be expressed as:

$$U = \sum_{i=1}^{n} c_i^{\theta} \qquad 0 < \theta < 1$$

with c_i the consumption of good i.

(b) Labor is the only input to production, and all firms face the same cost function. For any firm i, the amount of labor necessary to produce x_i units of output is:

$$l_i = \alpha + \beta x_i \qquad \alpha, \beta > 0$$

and each unit of labor is paid at wage w.

(c) There are L agents in the economy who work one unit (paid w) and consume. Because all agents are identical, aggregate demand for any good i is Lc_i. In equilibrium, it is equal to aggregate supply x_i.

(d) We assume full employment so the labor market clearing condition implies:

$$L = \sum_{i=1}^{n} l_i$$

(e) Firms are assumed to maximize profits. Because there is free entry and exit, the equilibrium number of firms will be determined by the zero profit condition.

(f) Because of increasing returns to scale, it can be shown that each firm specialize in one good: there is a unique firm i producing good i.

(g) We assume that the total number of goods produced n is large, so that the pricing decision of a given firm has a negligible impact on other firms.

2.2 Questions

1. Write down the representative agent problem as a Lagrangian.

2. Derive the first order conditions of this Lagrangian with respect to c_i and c_j and show that at the optimum:

$$\frac{c_i}{c_j} = \left(\frac{p_i}{p_j}\right)^{\frac{1}{\theta-1}}$$

3. Using the representative agent's budget constraint, show that the demand for good j can be expressed as:

$$c_j = \frac{w p_j^{\frac{1}{\theta-1}}}{\sum_i p_i^{\frac{\theta}{\theta-1}}}$$

4. Let's define the parameter $\sigma = \frac{1}{1-\theta}$ and the price aggregator $P = \left(\sum_i p_i^{1-\sigma}\right)^{\frac{1}{1-\sigma}}$. From the previous expression of c_j, show that the demand for good j can be written as:

$$c_j = \left(\frac{p_j}{P}\right)^{-\sigma} \frac{w}{P}$$

5. Draw a graph to represent firms' total, marginal, and average costs as a function of output, assuming (arbitrarily) $\alpha = 5$ and $\beta = 1$. Explain why firms in this model display increasing returns to scale.

6. Write down the problem of firm i. Show that its pricing decision is determined by the following equation:

$$p_i = \beta w - \frac{x_i}{\frac{\partial x_i}{\partial p_i}}$$

7. Going back to the demand function of the representative agent, and recalling that $x_i = Lc_i$, show that the equilibrium price is:

$$p_i = \beta w \theta^{-1}$$

8. Using the zero-profit condition, determine the equilibrium number of firms n on the market.

9. From Krugman (1980), explain how this model can be useful to understand trade between similar countries.

References

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