

# Lecture 1:

## Introduction

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Econ 357 - **International Trade (Ph.D.)**

### 1 Some trends

There has been a large increase in world trade since WWII, much faster than GDP growth for most countries. At the same time, there has been a large increase in capital flows. In the last 2 decades, 2/3 of the growth on trade in goods takes place within firms.

### "Two Waves of Globalization"

Baldwin and Martin (1999) describe the massive increase in global trade in goods and in assets that the world experienced in the second half of the 19th century and in the second half of the 20th century.

"What an extraordinary episode in the progress of man that age was which came to an end in August 1914!... The inhabitant of London could order by telephone, sipping his morning tea in bed, the various products of the whole earth... he could at the same time and by the same means adventure his wealth in the natural resources and new enterprise of any quarter of the world... he could secure forthwith, if he wished it, cheap and comfortable means of transit to any country or climate without passport or other formality..." (Keynes, 1919:6, quoted in Sachs and Warner 1995).

The two periods of globalization that the authors describe are 1820-1914, and 1960-present. In each period, there was a large increase in aggregate trade and capital flows, both in absolute terms and as a share of total world income. However, there are fundamental differences between these two waves of globalization. First, unlike the first wave, the

second wave was accompanied by flows of ideas as well as flows in goods. Second, before the initial wave, the whole world was poor and agrarian, and the relative wealth of nations was relatively homogenous. At the start of the second wave, there were already massive disparities in wealth, as well as in industrial structures.

## 2 Gravity Equations

**Gravity equations in trade:** in its simplest form, the gravity equations in trade state that trade between 2 countries  $A$  and  $B$ ,  $X_{AB}$ , with respective size  $GDP_A$  and  $GDP_B$  (in real terms), separated by a geographical distance  $dist_{AB}$ , takes the form,

$$X_{AB} = \lambda \frac{GDP_A^\alpha \times GDP_B^\beta}{dist_{AB}^\gamma} \quad (1)$$

$$\ln X_{AB} = \ln \lambda + \alpha \ln GDP_A + \beta \ln GDP_B + \gamma \ln dist_{AB}$$

Typical empirical estimates give  $\alpha, \beta, \gamma \approx 1$ , and  $\lambda$  is a scaling constant (this constant is in  $km/\$$  units which insures homogeneity). This has been termed "gravity equation", since trade is similar to the gravity force between two object in the sense that it is positively related to the mass of countries (measured in term of GDP), and the distance between them. The first finding of this empirical regularity is due to Tinbergen (1962). The coefficients  $\alpha, \beta$  and  $\gamma$  are surprisingly stable over time and space. This functional form has been widely used to describe international trade between any set of countries/entities.

Interestingly, the pure geographic distance does matter a whole lot. The impact of distance on trade has been extremely stable, basically unresponsive to massive changes in transportation technology and/or in other types of trade barriers (information technology, tariffs and quotas...). A few studies have tried, and to some degree succeeded in explaining the role of distance: more than actual transportation costs, it seems to be related to information costs, and to migrations (another form of information cost in a sense).

### McCallum: Borders Matter

McCallum provides the first crude estimate of how much international borders matter. He looks at trade over the Canada-US border. He finds that trade between Canadian provinces is 22 (2200%!) times higher than trade between Canadian provinces and US states. And this despite the fact that Canada and the US are arguably 2 very integrated countries.

**US-Canada border effect:** McCallum uses data on trade between Canadian provinces, and trade between Canadian provinces and US states. He runs the following gravity type regression,

$$\ln X_{ij} = \ln \lambda + \alpha \ln GDP_i + \beta \ln GDP_j + \gamma \ln dist_{ij} + \delta DUMMY_{ij} + \varepsilon_{ij} \quad (2)$$

where  $DUMMY_{ij}$  is a dummy equal to 1 if both  $i$  and  $j$  are Canadian provinces, and 0 otherwise. Note that he does not have data on trade between US states. The coefficient of interest is  $\delta$ , which measures the importance of the US-Canada border for trade. McCallum finds that  $e^\delta \approx 22$ , meaning that, controlling for size and distance, trade between 2 Canadian provinces is 22 times larger than trade between a Canadian province and a US state.

His estimate has been widely disputed, the current estimate of the border effect is a far lower 44% (still very high), but it remains extremely large. This was a very provocative paper, and the importance of the border effect remains a key puzzle of international trade. We will try during this course to, at least tentatively, explain part of it.

## Gravity with Gravitas

The most important criticism to McCallum's number for the border effect came from Anderson and Van Wincoop (2003). They develop a theoretically founded gravity model of trade, and show that a combination of omitted variable bias, and the small size of the Canadian economy relative to the US leads to such large estimates of the border effect.

**Theoretical gravity equation model:** the model is based on a few simple (and important) assumptions.

- goods are differentiated by country of origin, each country specialized in a single good, and the supply of each good is fixed (this last part may be relaxed).
- Identical homothetic preferences, approximated by CES.
- Multiplicative transportation costs.

Each country  $j$  chooses how much to import from each country  $i$  ( $q_{ij}$ ) by maximizing utility subject to a budget constraint,

$$\begin{aligned} \max_{c_{ij}} & \left( \sum_i q_{ij}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \\ \text{s.t.} & \sum_i p_{ij} q_{ij} = Y_j \end{aligned} \quad (3)$$

where  $\sigma$  is the elasticity of substitution between goods from any two countries. Prices differ between countries because of the existence of transport costs: for each good shipped, exporter pays  $(1 - \tau_{ij})$ , so that if the price of good from country  $i$  is  $p_i$ , it will be sold in country  $j$  at a price  $p_{ij} = \tau_{ij}p_i$ . Exports from  $i$  to  $j$  are therefore  $x_{ij} = p_{ij}q_{ij}$ . Market clearing implies,

$$Y_i = \sum_j X_{ij} \quad (4)$$

Isoelastic demands imply that export from  $i$  to  $j$  are given by,

$$X_{ij} = \left( \frac{\tau_{ij}p_i}{P_j} \right)^{1-\sigma} Y_j \quad (5)$$

$$\text{with } P_j = \left( \sum_i (\tau_{ij}p_i)^{1-\sigma} \right)^{\frac{1}{1-\sigma}} \quad (6)$$

**Proposition 1** *If we further assume that transport costs are symmetric, so that  $\tau_{ij} = \tau_{ji}, \forall (i, j)$ , then the prices  $p_i$ 's that are solution to Eq. 4-6 are such that,*

$$s_i \equiv \frac{Y_i}{Y^W} = (p_i P_i)^{1-\sigma}$$

**Proof.** *If  $\forall i, p_i^{1-\sigma} = s_i / P_i^{1-\sigma}$ , then,*

$$\begin{aligned} \sum_j \left( \frac{\tau_{ij}p_i}{P_j} \right)^{1-\sigma} Y_j &= \sum_j \frac{Y_i}{Y^W P_i^{1-\sigma}} \left( \frac{\tau_{ij}}{P_j} \right)^{1-\sigma} y_j \\ &= \frac{Y_i}{P_i^{1-\sigma}} \sum_j s_j \left( \frac{\tau_{ij}}{P_j} \right)^{1-\sigma} \\ &= \frac{Y_i}{P_i^{1-\sigma}} \sum_j (p_j \tau_{ij})^{1-\sigma} \end{aligned}$$

*by symmetry,  $\tau_{ij} = \tau_{ji}$ , so that,*

$$\begin{aligned} \sum_j \left( \frac{\tau_{ij}p_i}{P_j} \right)^{1-\sigma} Y_j &= \frac{Y_i}{P_i^{1-\sigma}} \sum_j (\tau_{ji}p_j)^{1-\sigma} \\ &= \frac{Y_i}{P_i^{1-\sigma}} P_i^{1-\sigma} \\ &= Y_i \end{aligned}$$

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With this simplification, we get the very simple gravity equation prediction for bilateral trade flows:

$$X_{ij} = \frac{Y_i Y_j}{Y^W} \left( \frac{\tau_{ij}}{P_i P_j} \right)^{1-\sigma} \quad (7)$$

with the price indices solution to,

$$P_j^{1-\sigma} = \sum_i s_i \left( \frac{\tau_{ij}}{P_i} \right)^{1-\sigma}, \quad \forall j. \quad (8)$$

The price indices  $P_i$  and  $P_j$  are measures of bilateral trade resistance. If a country is very isolated from the rest of the world, prices will be high on average, the domestic price index will be high. This country will import relatively little from the rest of the world. More interestingly, given that prices are high in a country, it is relatively easy to capture a large market share in this country: those consumers that only have access to expensive goods are willing to buy more at a given price than consumers in a country where prices are low.

### **Main predictions of the theoretical model:**

- Size matters: larger (richer) countries import more, and they export more.
- Trade barriers matter: the larger bilateral trade barriers between any two countries  $i$  and  $j$  ( $\tau_{ij}$  large), the less they trade with one another.
- Most interesting and novel prediction: for given bilateral trade barriers, more "remote" countries import (and export) less. In other words, the more isolated a country is from the rest of the world, which will be captured by a larger price index, the less this country imports. Alternatively, a country which charges high prices will export relatively little.
- Even more interesting prediction: price indices depend on relative size and relative trade barriers. Next are some interesting implications derived from the determination of price indices (multilateral trade resistance indices).

**Interesting implications of the model**, if we assume that within country trade is frictionless ( $\tau_{ii} = 1, \forall i$ ):

1. Trade barriers reduce (size adjusted) trade between large countries more than between small countries.
2. Trade barriers raise (size-adjusted) trade within small countries more than within large countries.
3. Trade barriers raise the ratio of (size-adjusted) trade within country 1 relative to (size-adjusted) trade between country 1 and country 2 more the smaller is country 1 and the larger is country 2.

The reason for these implications is the following:

There are two effects, loosely speaking, a demand effect and a supply effect. On the demand side: for a very large country, most of what is consumed is produced domestically (the country represents a significant share of the total world production). Therefore, a change in international trade barriers will only affect those goods that are imported, which represent only a small fraction of all the goods consumed in this large country. Hence, changes in international trade barriers have little effects on domestic prices, and therefore on the trade resistance of that country. On the supply side at the same time: remember that each country produces a single differentiated variety. Therefore, the larger this country, the larger the supply of this good in the world, and the smaller the price of that good (relative to the price of a good produced by a smaller country). Hence, larger countries tend to charge lower prices. It follows then that,

1. Consider the extreme case of a world with 2 identical countries (in relative terms, these are 2 "large" countries, since each represent half of the world). If trade barriers fall, all the imported goods become cheaper, while the domestically produced goods' prices are unchanged. Hence, consumers will substitute away from domestic goods towards cheaper imports. In the other extreme case of 2 countries that are a negligible fraction of the total world, a change in trade barriers will change the prices of almost the goods consumed in exactly the same way. Among others, there is no reason to import more from this small country than from any other country, since the relative prices of those exports are exactly unchanged. Trade between those 2 tiny countries is practically unchanged.
2. For similar reasons, when trade barriers go down, a very large country experiences little change in the domestic price index, and therefore consumers substitute relatively little income. In a small

country on the other hand, since most goods consumed are imported goods, an increase in trade barriers raises the price of almost all goods consumed, and therefore the price index goes up almost one for one with trade barriers. Consumers substitute away from expensive foreign imports, towards cheap domestic goods.

3. This last implication is a corollary of the previous two. It once again comes from the fact that price indices are very much affected by changes in trade barriers for small countries, whereas they are relatively immune to changes in trade barriers in large countries. In a small country, most goods are imported. A trade barrier will raise prices of most consumed goods, so that consumers substitute towards domestically produced goods. In a large country on the other hand, trade barriers do not raise the price index much, so that, in general equilibrium, there is not much substitution going on.

### Estimation results:

Anderson and Van Wincoop solve directly for the theoretically grounded gravity equations. This means that they simultaneously solve for the "pure" border effect, and for the price indices in every country/region/state. They assume that trade barriers are made of two part. One part depends on geographic distance. The other part corresponds only to the cost of crossing a border (the "border effect"). Each part is multiplicative, and is applied to each unit shipped. Formally,

$$\tau_{ij} = b_{ij} \times dist_{ij}^{\rho}$$

where  $b_{ii} = 1, \forall i$ , and is equal to one plus the tariff equivalent of the border between country  $i$  and country  $j$  if  $i \neq j$ . They estimate the following equation,

$$\ln \frac{X_{ij}}{Y_i Y_j} = k + (1 - \sigma) \rho \ln dist_{ij} + (1 - \sigma) \ln b_{ij} (1 - DUMMY_{ij}) - \ln P_i^{1-\sigma} - \ln P_j^{1-\sigma} + \varepsilon_{ij}$$

$$\text{subject to } P_j^{1-\sigma} = \sum_i s_i \times dist_{ij}^{\rho(1-\sigma)} b_{ij}^{(1-\sigma)(1-DUMMY_{ij})} \times P_i^{\sigma-1}, \forall j$$

Note that since  $\sigma$  enters multiplicatively in all coefficients estimated, it is not possible to infer a value for  $\sigma$  unless some direct measure of trade barriers is measured in the data. Note also that the more substitutable the goods (the higher  $\sigma$ ), the larger the impact of changes in trade barriers. We will see that this result may not be robust to

introducing heterogeneity within countries, and some selection into the export market.

Taking into account the endogenous determination of price indices dramatically changes some of the estimation results. First, distance plays a much milder role than in the McCallum regression.  $(1 - \sigma) \rho \approx .8$ , instead of 1.5 in McCallum. Second, their estimate of the tariff equivalent of the US-Canada border, for an elasticity of substitution equal to 5, is about 50%, and 10% for  $\sigma = 20$ . Third, their theoretically grounded model allows the authors to perform counterfactual analysis.

Most importantly, they drastically reduce the "border effect" number of McCallum. Canadian provinces trade 10.7 times more between themselves than with US States (instead of the 22 McCallum number), whereas US States trade 2.24 times more among themselves than with Canadian provinces. This is consistent with their theoretical prediction 3. From the point of view of Canadian consumers, the US States represent a large fraction of the world, and of all the goods they consume. For US consumers on the other hand, Canadian provinces represent only a small fraction of the world.

### **3 Trade Barriers**

So we have seen that distance seems to be a key element in trade barriers (in addition to the barriers that are summed up in the "border effect"). A few papers have attempted to explain why distance matters. Looking for direct measures of transportation costs does not do the trick. Including those measures in regressions marginally increases the fit of the regressions, and it barely alters the direct impact of distance. Interestingly, even in some cases where it is very hard to see why distance should play any role, it still has a huge effect, and a large explanatory power. Portes and Rey find that distance matters greatly for cross-border equity flows, when there is literally zero transportation costs related to distance of buying or selling equities across borders. Ali Hortacsu finds that distance has a large impact on the volume of transactions on ebay within the US (controlling for a same city and same state fixed effect, and for actual transportation costs [actual shipping and insurance costs]), when all the relevant information is available online for any one in the US at no cost.

### **Migration and the importance of networks**

On a sometimes anecdotally approach, Rauch in several papers, shows that ethnic networks (and other types of networks) may have a large

positive impact on international trade flows. Combes, Lafourcade and Mayer (2005) try to take this idea more systematically to the data. They use intra-France trade, that is trade between French *Départements* (96 administrative subunits within France). They use as a proxy for the existence of business and social network, the composition of the population, and the composition of firms, in each *Départements*. That is, they look at the flows of migrants between regions, and at the location of French firms, to get proxies for social and business networks. They do find that those networks have a significantly positive impact on trade flows (migrations increase bilateral trade flows by a factor 2, whereas firms' networks by a factor 4). Taking those networks into account also reduces the estimated impact of transportation costs and administration boundaries by a factor 3.

### **3.1 The importance of information**

The only other successful attempt at reducing significantly the direct estimated impact of distance on trade flows is by Portes and Rey (2005). They use a proxy measure for the role of informational barriers. Namely, they have data on the volume of bilateral telephone communications. Including this (obviously endogenous) proxy for informational barriers reduces significantly the impact of distance on bilateral trade flows. The elasticity of trade flows with respect to distance drops from around 1 to around .6 once this proxy is included.

### **Trade in goods and trade in assets**

Portes and Rey (2005)'s main finding is that the same gravity structure applies for (gross) trade in financial assets and for trade in goods. They consider the determinants of cross-border equity flows. They use as a relevant measure of the size of countries their market capitalization (it is somewhat correlated to GDP, but very imperfectly). They find that mass as well as distance matters for explaining the volume of international trade in assets. Including some measures of informational barriers improves the fit of their regressions, and it reduces the direct impact of distance. The measures of information barriers they use are the volume of telephone communications, as well as the number of affiliates of domestic banks in the destination country.

Aviat and Coeurdacier (2006) argue that distance matters for trade in assets only because it matters for trade in goods, because gross trade in goods is highly correlated with gross trade in assets. Using instruments for barriers to trade in goods (shipping costs) and for trade in assets (international affiliates of banks), and estimating trade in goods and in

assets simultaneously, they find that distance has no direct impact on trade in assets.