The gravity model

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References for this lecture

- BBVG
  - Chapter 6, paragraph 6.4

Law of gravity in physics

- **Newton's** law of universal **gravitation**
- The **force** of **attraction** between **two particles** is directly **proportional** to their **masses** (m) and **inversely** proportional to the (square of) their **distance** (r)

$$F = G\frac{m_1 m_2}{r^2}$$

$$\log(F) = \log(G) + \log(m_1) + \log(m_1) - 2\log(r)$$

From physics to economics (trade)

- Jan **Tinbergen** proposed to **adapt** the Law of gravity to the study of **international trade**
- **Size** of 'particles' (countries)
  - **Economic** size
  - Indicator ➜ total **GDP** (or, alternatively, total population)
- **Distance** ➜ **geographical** distance
- **Force** ➜ bilateral **export** from country *i* to country *j*

$$\log(Exp_{ij}) = \alpha \log(GDP_i) + \beta \log(GDP_j) + \delta \log(Dist_{ij}) + X_{ij}'\eta + \varepsilon_{ij}$$

Size in the gravity model

- **GDP** represents **total income** that is distributed to residents in a country
- This income can be spent in **purchasing** either **domestic** or **imported** goods
- The **larger** total **income**, the greater the potential **demand** for **import**

- **GDP** also represents **total production** that takes place in a country
- The **larger total production**, the greater the amount of production that can be **exported**

- Role of **economies of scale** in trade models!

Distance in the gravity model

- **Geographical distance** is strictly connected to **transportation** costs

- Baseline **assumption** ➔ trade costs are proportional to geographical distance

Results for the EU
(my elaboration, period 2007-2014)

Variable	Coefficient
$\log(GDP_i)$	0.663
$\log(GDP_j)$	0.703
$\log(distance)$	-0.846
R squared (share of explained variance)	73.1 percent

Augmenting the gravity model

- **Alternatively** to **GDP**, **population** may be used to account for size

- **GDP per capita** is also likely to influence import and export (and its composition)

- The **distribution** of GDP per capita **within country** has an influence on the level and composition of trade
  - People with different levels of income per capita have different **propensity** to **import**

Augmenting the gravity model

- **Geographical distance** is a rather **crude proxy** of **transportation** costs
  - **Modes** of transport
  - Environmental **barriers** (mountains, sea, etc)
  - **Infrastructure**

- **Other trade costs** need to be taken into account
  - **Tariff** and **non-tariff** barriers
  - Presence (or absence) of **trade agreements**

Augmenting the gravity model

- **Other distances** matter
  - **Cultural** distance
  - **Institutional** distance
  - **Economic** distance

- **Proxy variables** used in gravity models to account for these distances
  - Former **colonial** relationship
  - **Contiguity**
  - **Military** conflicts
  - Common **language**
  - Common **law** vs civil law
  - …

Augmenting the gravity model

- **Trade** and **FDI** are **substitute** strategies for firms that want to **serve foreign markets** or **take advantage** of specific **conditions** in foreign countries

- **Distance** and **size** matter **both** for **trade** and **FDI**

- The **gravity model** has also been **extended** to evaluate the **drivers of FDI**