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The gravity model

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References for this lecture

- **BBVG**
 - Chapter 6, paragraph 6.4

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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)

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

$$\log(F) = \log(G) + \log(m_1) + \log(m_2) - 2\log(r)$$

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

$$\log(\text{Exp}_{ij}) = \alpha \log(\text{GDP}_i) + \beta \log(\text{GDP}_j) + \delta \log(\text{Dist}_{ij}) + X_{ij}'\eta + \varepsilon_{ij}$$

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
$\log(\text{GDP}_i)$	0.663
$\log(\text{GDP}_j)$	0.703
$\log(\text{distance})$	-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**