Gravity Equation (Introduction)

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Simple model

- Monopolistic competition framework.
- Each country specializes in different varieties.
- Homothetic identical preferences.
- Free trade.
- Symmetry, together with free trade, allows to normalize *all* prices to 1.

Simple model

- C countries, indexed by i or j.
- N varieties (or goods), indexed by k.
- y_k^i: production of good k by country i.
- $Y^i = \sum_{k=1}^{N} y_k^i$: GDP of country i.
- $Y^w = \sum_{i=1}^{C} Y^i$: world GDP.

Simple model

- s^j: share of country j in world expenditure. Under balanced trade, same as share of country j in world GDP:

$$s^j = \frac{Y^j}{Y^w}$$

- If all countries produce different varieties, and preferences are identical and homothetic, the share of country j's expenditure on any good k is equal to country j's share of world expenditure (or of world GDP under balanced trade). Therefore, exports from country i to country j of good k is

$$X_k^{ij} = s^j y_k^i$$

Simple model

- Aggregating up over all goods produced by i, country j buys a share of country i's GDP equal to country j's share of world GDP, i.e.,

$$X^{ij} = s^j Y^i = \frac{Y^j Y^i}{Y^w}$$

- In other words,

$$X^{ij} + X_{ji} = \frac{2 Y^j Y^i}{Y^w}$$

Empirical applications: Helpman (1987)

- Emphasizes role of country asymmetries.
- Previous equation can be re-written as

$$X^{ij} + X_{ji} = 2s^i s^j Y^w$$

- Define $s^i + s^j = s^A$, where $s^A = (Y^i + Y^j)/Y^w$.
- Therefore, $(s^i + s^j)^2 = (s^i)^2 + (s^j)^2 - 2s^i s^j = (s^A)^2$, so that $2s^i s^j = (s^A)^2 - (s^i)^2 - (s^j)^2$. We can thus write

$$\frac{X^{ij} + X_{ji}}{Y^A} = s^A(1 - (s^i)^2 - (s^j)^2)$$

The term in brackets is called a *dispersion index*. For a given size Y^A, the more i and j are similar in size, the more they will trade. Helpman (1987) tests this using data from the OECD.

Empirical applications: McCallum (1995)

- Analyzes the *border effect* within a gravity equation framework.
- In particular, compares intra-country trade and inter-country trade, using data on the U.S. and Canada.
- Estimating equation:

$$\ln X^{ij} = \alpha + \beta_1 \ln Y^i + \beta_2 \ln Y^j + \gamma \delta^{ij} + \rho \ln d^{ij} + \varepsilon^{ij}$$

  where X^{ij} are exports from a Canadian province i to either another Canadian province or a US state j; δ^{ij} is an indicator variable, equal to 1 if trade is between two Canadian provinces and equal to 0 if trade is between Canadian province and US state; and d^{ij} is geographic distance between i and j. (Note: according to theory β_1 and β_2 should be equal to 1.)

Empirical applications: McCallum (1995)

- Coefficient of interest: γ, estimated to be 3.09. Interpretation: $\ln X^{ij}(\delta^{ij} = 1) - \ln X^{ij}(\delta^{ij} = 0) = 3.09$, so that

$$\frac{X^{ij}(\delta^{ij} = 1)}{X^{ij}(\delta^{ij} = 0} = \exp(3.09) = 22$$

- The model thus predicts a *huge* border effect: trade between 2 Canadian provinces is predicted to be 22 times larger than trade between a Canadian province and a US state!

- The importance of the McCallum paper is this huge number: this is what gave rise to an entire literature.

Further empirical and theoretical applications

- Anderson and van Wincoop (2003)
  - Once you have border effect, or less than free trade, prices are no longer the same across countries.
  - This has to be taken into account. If not, the model suffers from omitted variable bias.
- Evenett and Keller (2002)
  Looks at gravity equation within Heckscher-Ohlin framework.
- Helpman, Melitz, Rubenstein (2008)
  Introduces firm heterogeneity, allowing for self-selection of firms into the export, enabling to explain the "zeros" in trade flows.