Modelling Methods for Trade Policy II: Introduction to OLS Regression Analysis

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Outline

A. What is an OLS regression?
B. The interpretation of the regression results: coefficients and the R-square
C. Specification of the OLS regression equation
A. What is an OLS regression?

Given 6 observations on imports and income. What is their relationship?
B. The interpretation of the regression results

- 1 unit increase in GDP will increase imports by $b$ units
- $a =$ imports if GDP = 0

$y' = a' + b' x$

- $R^2 =$ % of variation explained
  - $R^2 = 1$ if $y = y'$
B. The significance of estimated coefficients

- $a'$ and $b'$ are estimated on a sample of observations. A different sample would have given different results.
- Most estimates of $a$ and $b$ will lie within 2 standard deviation from $b$: the confidence interval

![Confidence interval diagram](image)
B. Hypothesis testing

- When we run a regression using a computer, the result will be the value of $a'$ and $b'$ and the result of the test that $b=0$.

- If $b=0$, then $b'$ will fall in the confidence interval with a probability of 95%.

- We will say that imports depend on GDP if the hypothesis is rejected.
C. Specification of the OLS regression equation

- The linear model
- Non-linear relationships

eg. $Y = a + b \ln(X) + u$
C. Specification of the OLS regression equation and the ELASTICITY

- **The linear model**
  \[ y = a + b \, x + u \]
  Elasticity = \( b \, x/y \)

- **Log-log model** often the preferred specification. This is
  \[ \ln(y) = a + b \ln(x) + u \]
  Elasticity = \( b \)
C. Specification of the OLS regression ... (cont’)

- Also implies choosing the explanatory variables (theory, purpose, experience)
- Dummy Variables = 0, 1 variable

Ex. Imports = \( a + b \) GDP + \( c \) D + \( u \)  \( D=\text{island} \)
Modelling Methods for Trade Policy II: Gravity Models

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2.A The theoretical foundations of gravity models: Newton’s Law

- Econometric model (ex-post analysis)
- Initially, NO theoretical foundations.
- Distance and Size determine bilateral trade
2.A The theoretical foundations of gravity models: Newton’s Law

- Specification similar to Newton’s Law

\[ F_{ij} = K \frac{M_i^\alpha M_j^\beta}{D_{ij}^\theta} \]

\[ M = \text{Size (GDP, POP)} \quad D = \text{distance} \]
2.B Estimated gravity equation

...Newton’s Law-based Normal Trade

- Normal trade

\[
\ln (\text{Trade}_{ij}) = C + a \ln(\text{GDP}_i) + b \ln(\text{GDP}_j) + c \ln(\text{distance}_{ij}) + u_{ij}
\]
3.A The theoretical foundations of gravity models

- reduced form of a intra-industry trade model

\[ F_{ij} = \frac{M_i M_j}{M_w} \left( \frac{T_{ij}}{P_i P_j} \right)^{1-\sigma} \]

P = Resistance Term or Remoteness (trade weighted average distances from the rest of the world)

3.A The theoretical foundations of gravity models

- Countries distance from the Rest of the World matters for their bilateral trade
3.B Estimated gravity equation

...Theoretically Founded Normal Trade

- Normal trade with Resistances

$$\ln (\text{Trade}_{ij}) = C + a \ln(\text{GDP}_i) + b \ln(\text{GDP}_j) +$$
$$+ c \ln(\text{distance}_{ij}) + d \ln(\text{Remoteness})_i +$$
$$+ e \ln(\text{Remoteness})_j + u_{ij}$$

Where the Remoteness term is calculated as:

$$\sum_k \text{distance}_{kj}/\text{GDP}_k$$
3.B Estimated gravity equation

...Normal Trade

- Normal trade with fixed effects

\[
\ln (\text{Trade}_{ij}) = C + a \ln(GDP_i) + b \ln(GDP_j) + c \ln(\text{distance}_{ij}) + d \text{ Dummy}_i + e \text{ Dummy}_j + u_{ij}
\]
3.B Estimated gravity equation

...Normal Trade

- Normal trade normalizing for a third country

\[ \ln \left( \frac{\text{Trade}_{ij}}{\text{Trade}_{kj}} \right) = C + a \ln(\frac{\text{GDP}_i}{\text{GDP}_k}) + c \ln(\frac{\text{distance}_{ij}}{\text{distance}_{kj}}) + u_{ij} \]
“Augmenting” the gravity equations

- Income per capita (higher income countries trade more)
- Adjacency
- Common language, colonial links
- Institutions, infrastructures, labour flows,…
- Surprisingly, bilateral tariff barriers often missing!!!
“Augmenting” gravity model

- To evaluate the impact of RTAs: Trade creation and trade diversion

\[
\ln (\text{Trade}_{ij}) = a \ln(\text{GDP}_i) + b \ln(\text{GDP}_j) + \\
+ c \ln(\text{distance}_{ij}, \text{adjacency}, \text{language} ..) + d (\text{Dummy i}) + \\
+ e (\text{Dummy j}) + g (\text{intra-RTA}) + h (\text{extra-RTA}) + u_{ij}
\]

- IMPORTANT the gravity model does not estimate welfare effects