Tools to improve trade policymaking with demonstration of gravity online tool

Workshop on "Monitoring and Evaluating Trade Integration Toolkits"
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Good policies need to be based on good analysis

- ESCAP’s Evidence-based trade and investment policymaking for
  - Government officials
  - Researchers / analysts
  - NGOs / journalists / civil society / general public

- Series of reference material (“handbooks”) on “how to..”
  - Trade negotiations
  - Doing empirical research
  - Promote and facilitate investment

- Series of tools and databases – ESCAP Trade Analytics Portal
In this presentation, focus will be on

• ESCAP’s menu of toolkits and databases
  • Asia-Pacific Trade indicators Portal (APTIP) which includes data/indicators from below datasets
  • Asia-Pacific Trade and Investment Agreements Database (APTIAD)
  • ESCAP-World Bank Trade Cost Database
  • Trade Facilitation Score
  • Gravity modeling tool

• If time allows:
  • Gravity online tool demonstration
  • Trade Intelligence Negotiation Adviser (TINA)
APTIAD
Bilateral comprehensive trade costs in the Asia-Pacific, excluding tariff costs of selected economies with China and the United States (2009-2014)

For some landlocked and Pacific island developing economies, comprehensive trade cost is up to 3 times their trade costs with China, which is significantly high compared to other economies.

Expectedly, it is the small islands or landlocked developing countries that incur the highest trade costs with both China and USA.

Trade Facilitation Score

Trade Facilitation and Paperless Trade Implementation Scores
Source: UN Global Survey on Trade Facilitation and Paperless Trade Implementation 2017

- Brunei Darussalam: 55%
- Cambodia: 56%
- Indonesia: 62%
- Lao P.D.R.: 68%
- Malaysia: 81%
- Myanmar: 41%
- Philippines: 70%
- Singapore: 90%
- Thailand: 81%
- Timor-Leste: 22%
Gravity online tool

• Proved to be one of the most used models in empirical trade investigations
• ESCAP has been receiving a continuous stream of requests for capacity building of applied researchers in both government departments and think tanks / institutes
• Most of capacity building materials available through ARTNeT platform
Introduction: Gravity Model of Trade

- Application of **Newton’s theory in Gravitation**: bilateral trade flows are determined by the size of economic mass, measured by GDP of two countries; and distance between two countries

- Model is an **essential tool for policy researchers** in applied international trade

- Model **allows to quantify impacts of trade-related policies**, from traditional tariffs to behind-the-border measures or institutional arrangements
Introduction: Gravity Variables (1/2)

- Dependent variable: bilateral import / export / trade

- Classical gravity-related independent variables:
  - **GDP** of reporting countries and trading partners
  - **Geographical distance** between reporting countries and trading partners
  - Other geographical aspects between two countries: e.g., contiguity, landlockedness
  - **Cultural distance** between two countries e.g., sharing common language, historically being the same country in the past, sharing colonial tie
Introduction: Gravity Variables (2/2)

- Classic policy-related independent variables:
  - Bilateral tariffs
  - Bilateral RTA

- Other policy- or institutional-related independent variables:
  - **Behind-the-border trade facilitation**: e.g., Ease of doing business indicator / ease of trading across border
  - **Quality of cross-border infrastructure**: e.g., Liner shipping connectivity
  - **Quality of institutional arrangements**: e.g., Global competitiveness index
Gravity Model: How to interpret results?

- Basic setup of gravity model:
  \[
  \log(x_{ij}) = \beta_0 + \beta_1 \log(GDP_i) + \beta_2 \log(GDP_j) + \beta_3 \log(dist_{ij}) + \\
  \beta_4 (comcol_{ij}) + \beta_5 \log(tariff_{ij}) + \beta_6 \log(tariff_{ji}) + e_{ij}
  \]

- Interpretation:
  - Log variable: 1% change in independent variable leads to x% change in trade
  - Dummy variable: when a dummy changes from 0 to 1, it leads to \((e^\beta - 1) \times 100\%\) change in trade
Example: How to interpret results? (1/2)

EXAMPLE REGRESSION RESULTS
- Dependent variable: Net exports of i to j
- Reporters / partners: ESCAP member States
- Years: 1995-2016, fixed effects set for years

Distance:
1% change in distance in km leads to 1.469% reduction in exports

Common colonizer:
when two countries used to be under the same colonial power (e.g., Malaysia and India under British colonization), it leads to \((e^{\beta} - 1) \times 100\% = (e^{1.267} - 1) \times 100\% = (3.5502 - 1) \times 100\% = 255.02\%\) change in exports
**Example: How to interpret results? (2/2)**

**EXAMPLE REGRESSION RESULTS**
- Dependent variable: Net exports of i to j
- Reporters / partners: ESCAP member States
- Years: 1995-2016, fixed effects set for years

**Tariff(ji):** Trade-weighted average tariff of country j charging to export of i
1% change in tariff (ji) leads to 2.417% reduction in exports

**Tariff(ij):** Trade-weighted average tariff of country i charging to export of j
1% change in tariff (ij) leads to 1.752% reduction in exports

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<table>
<thead>
<tr>
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<th>t-statistic</th>
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- Author: Ben Shepherd (2016)
- Providing a “hands on” introduction to gravity modeling for applied policy researchers
- To be used in conjunction with a dataset of bilateral trade in services available for free download
- artnet.unescap.org/publications/gravity-book
Demonstration of Portal

How to navigate?
User Step 1: Selection of Dataset

Currently there are 2 available datasets (extended to 4 shortly):

1. **Generic Gravity Model of Trade**
   - Impact analysis on trade flows as a result of the change in policy implications
   - Bilateral trade and policy indicators ranging from tariff, RTA and behind-the-border infrastructure from 1995-2016 on 200+ economies

2. **Gravity Model of Trade with NTMs**
   - Expands policy scope to cover non-tariff measures in impact analysis on imports
   - Indicators ranging from tariff, RTA, non-tariff measures and behind-the-border infrastructure from 2012-2016 on 100+ economies
   - Add-on coverage to conduct an analysis at sectoral level, including agriculture, manufacturing and overall goods sector
User Step 2 & 3: Selection of Reporters & Partners

- Up to 100 reporters and 100 partners can be selected
- Reporters and partners can be quick-selected by region (e.g., Asia-Pacific region) and grouping (e.g., Landlocked Developing Countries)
User Step 4: **Selection of Y and X Parameters**

- Dependent variable typically trade flow (imports or exports)
- Up to 30 independent variables can be selected

**Dependent Variable** (example)

- $\ln(\text{export}_{ij})$

**Independent Variables** (example)

- $\ln(\text{GDP}_i)$
- $\ln(\text{dist})$
- $\ln(\text{tariff}_{ij}^W)$

Net exports of $i$ to $j$

GDP (current USD) of $i$

Simple distance (most populated cities, km)

Weighted average tariff in % of $i$ charging $j$
User Step 5: **Selection of Years & Fixed Effects**

- Fixed effects can be set for years, reporters, partners
- *NTM dataset*: sectoral level (overall goods, agriculture, manufacturing)

![Screenshot of the selection interface for years and fixed effects]

- Ready? Click the button [Run Regression]

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*ArtNet*
Demonstration of Portal

How do the results look?
Result Page: **Regression Parameters & Statistics**

- **Visualization of coefficients** and p-values of independent variables
- **Regression parameters** such as coefficient, standard error, t-statistic and p-value per included variable
- **Regression statistics** such as the r-squared, number of observations and degrees of freedom
- **List of included parameters** on which data was available, as well as a list of missing data
- **Exporting** to CSV, JPEG,..
Result 1: Regression Parameters

- Coefficient, standard error, t-statistic and p-value are displayed
- Information icons in each column name can be clicked for explanation
- A variable can be removed and regression can be re-run by clicking

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Significance codes: * <0.1; ** <0.05; *** <0.001

**Standard error**

The beta value of the independent variable \( k \) (\( b_k \)) is a point estimate of \( \beta_k \). Because of sampling variability, this estimate may be too high or too low. \( \text{SE}(b_k) \), the standard error of \( b_k \), gives us an indication of how much the point estimate is likely to vary from the corresponding population parameter.

\[
\text{SE}(b_k) = \sqrt{\frac{\sum (x_i - \bar{x})^2}{\sum x_i^2 - \frac{1}{n}\sum x_i^2}}
\]

where:
- \( \text{SE}(b_k) \) (Standard Error of Estimate) is the standard deviation of the variation of observations around the regression line
- \( b_k \) is the estimated coefficient
Result 2: Regression Statistics

✓ R-squared, number of observations and degrees of freedom shown

✓ Information icons in each row can be clicked for explanation

Result 3: Info on Included Data

✓ List of included reporters, partners & years

✓ Information about missing data, i.e., reporters, partners & years that were initially selected but insufficient data on these is available
Additional Option A: **Determine Trade Potential**

- Comparing actual figures with predicted figures (based on regression results) to get an **estimated to actual trade ratio**

- For example, compare the estimated export to the actual export of a particular economy to selected economies in a chosen year

Additional Option B: **Generate Trade Simulation**

- Setting specific conditions and assessing their effect on dependent var.

- For example, suppose tariff\textsubscript{ji} is reduced by 5%, what would happen to the export of Lao PDR in a given year?
Option A Example: **Determine Trade Potential**

Trade potential: \( TP_{ij} = \frac{\text{estimated trade}_{ij}}{\text{actual trade}_{ij}} \)

If \( TP_{ij} > 1 \) : potential for trade expansion

If \( TP_{ij} < 1 \) : exceeding trade potential

**Hence:**

There is room for improvement for Lao PDR with Bangladesh and Brunei, for example.
Option B Example: Generate Trade Simulation (1/2)

Suppose tariff$_{ji}$ is reduced by 5%, what would happen to exports of Lao PDR in 2015?
Recall: \( \log(x_2) - \log(x_1) = \log\left(\frac{x_2}{x_1}\right) \approx \frac{x_2}{x_1} - 1 \)

Hence:

The reduction in tariff of Armenia and Bangladesh increases Lao PDR’s exports by 1.1% and 1.7%, respectively.
Thank you
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