

**ARTNeT- KRI Capacity Building Workshop on Trade Policy Analysis:
Evidence-based Policy Making and Gravity Modelling for Trade Analysis
18-20 August 2015, Kuala Lumpur**

Session 1 Evidence-based policy making and tools

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Overview of the workshop

Day 1 AM: Introduction to evidence-based policy making (EBPM) and tools

Day 1 PM: Introduction to gravity model for trade analysis

- Its concepts, applications, weakness, and development

Day 2 AM: Estimating the gravity models in STATA

- Estimating intuitive gravity models
- Estimating trade potential using a gravity model
- Problems of intuitive gravity models

Day 2 PM: Theoretical gravity models

- Theoretical gravity models
- Econometric approaches to estimating theoretical gravity models

Day 3: Advanced issues and consolidation

- Recent development in gravity techniques
- Group exercises and presentation
- Workshop wrap-up

Outline

- The role of evidence for policymaking
- Tools for applied analysis
- How could ESCAP/TID/ARTNeT help?

Policymaking approaches

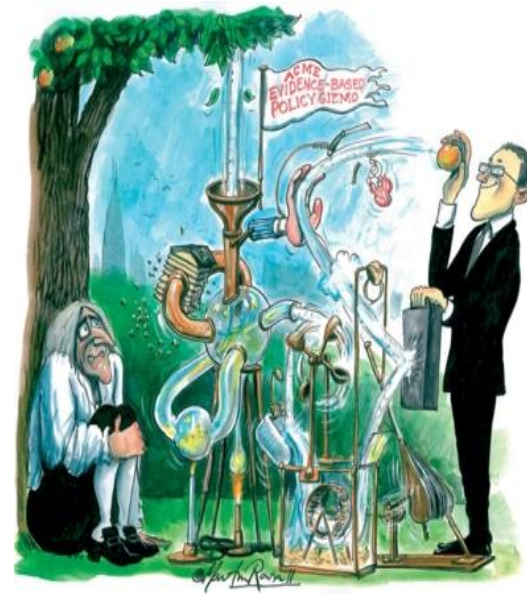
Opinion-based Policy Making

- Anecdote
- Experts
- Seniors
- Gut feeling

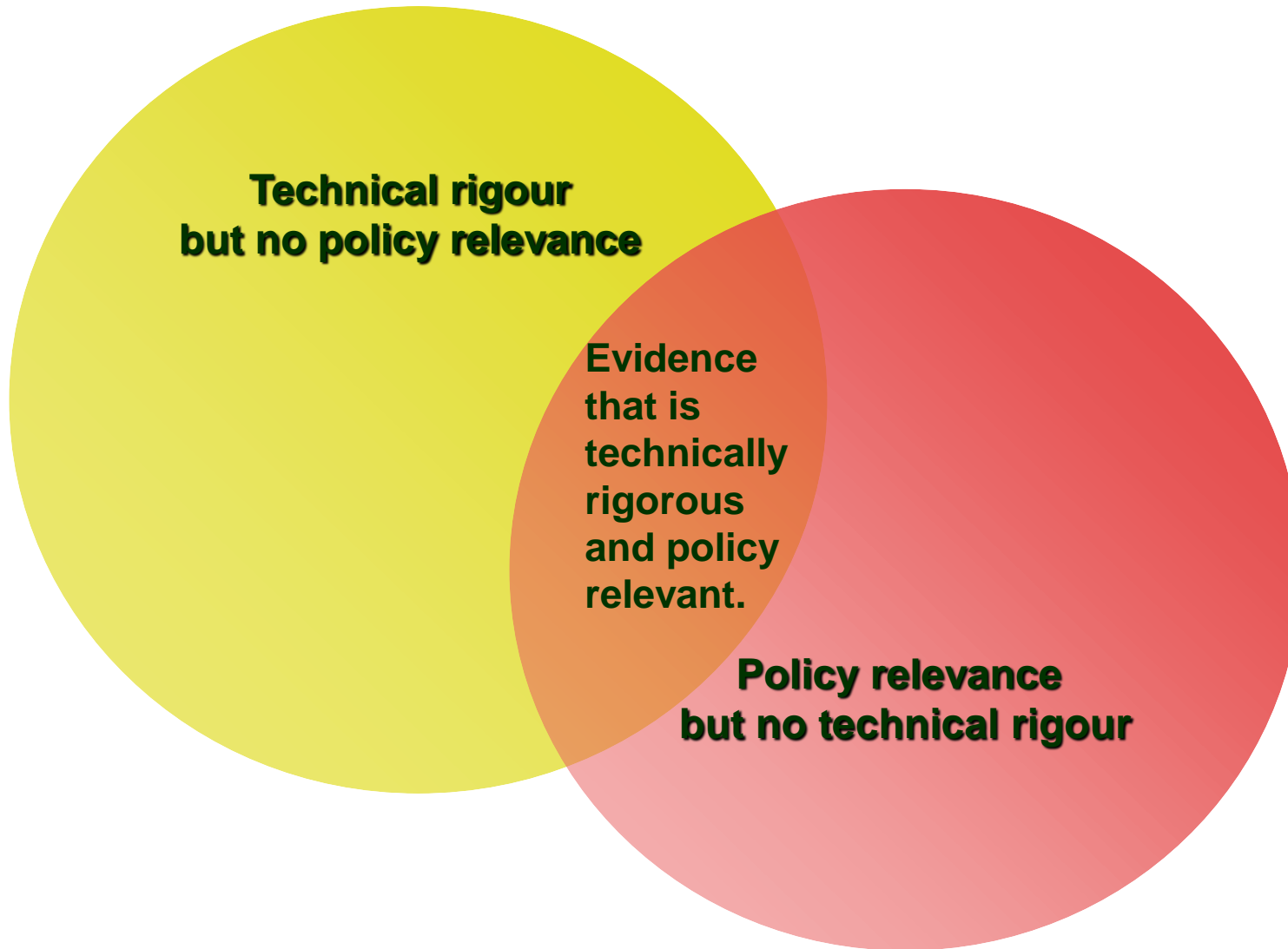


Evidence-based Policy (EBP) Making

- Best available research evidence
- Evidence from collected data (empirical evidence)
 - Theory
 - Data
 - Tools for data analysis
- Gains
 - Transparency
 - Accountability



The “quality” challenge: How to match technical rigour and policy relevance?



What do we need for policy analysis?

- Data

- Statistical data on trade of goods and services flows, FDI, etc. (labour mobility, energy, ...)
- Data on tariffs and other types of direct and indirect trade barriers (trade costs, wages, etc...)

- Tools for analysis

- Access to expert advice and guidance

- Access to stakeholders (for feedback/check on the “reality check”)

The role of research for policy making

- Tracking, monitoring and evaluation of the results of policies that have been put in place
 - Ex-post analysis
- Making decisions in public area (including on issues recognition, policy choice and sequencing, or forecasting future developments)
 - Ex-ante analysis

Policy questions at different stages of policymaking

- Before negotiation of an FTA: An analysis of potential costs and benefits (ex-ante)
 - What a country can supply to its FTA partners? What it can source from the partners?
 - What are expected impacts on production and employment level and composition, welfare, fiscal balance, etc.
 - What are the costs of necessary adjustment policies for the adversely affected sectors?
- After its implementation: An impact assessment (ex-post)
 - Whether the impacts are within the expected range?
 - Whether the expected benefits are fully materialized?
 - Whether further adjustment policies are necessary?

Tools for policy analysis

- Simple indicators (descriptive statistics)
- (Sophisticated) econometric models (including gravity models, etc.)
- Simulation techniques
 - A partial equilibrium model: sectoral analysis
 - A general equilibrium model: economy-wide analysis
- They are complementary with different strengths/weaknesses and different (explicit and/or implicit) assumptions

Context of the questions and availability of resources dictate the choice of methodology

- Whether the focus is the impacts at macroeconomic level or industry level ?
- Whether ex-post questions or ex-ante questions are being asked?
- Whether the required data are available?
- How much time and resources (technology, human capital, and money) are available?

Points to be raised (for researchers)

- Researchers must understand what kinds of information are needed by policymakers in terms of what policy questions they face
- The second stage is choosing the right tool(s) from the menu
 - Often, there is more than one alternative
 - The choice should be dictated by policy questions
 - Questions requiring ex-ante and ex-post analyses require different tools
- Problems would arise if researchers choose the tools that are not appropriate to answer your questions
 - Researchers need to understand the advantages and disadvantages (limitations) of each tool

Points to be raised (for policymakers)

- Researchers could use economic models to help policy makers foreseeing where the gains and losses of a policy change will come from.

For example, quantitative approach could help identify the potential impacts of joining an FTA through

- Revenue losses such as tariff revenues transferred to partners in the PTA
 - Costs of (temporary) unemployment of labor, capital
 - Other transfers such as increased IP royalties, fees
 - Gains from trade
 - Static gains such as consumer welfare (surplus) gains
 - Dynamic gains such as productivity improvements
- DON'T be fooled by the numbers. The precise results are less important than the scale and origin of the changes.

Ex. Modelling tactics for pro- and anti- FTAs

- Static gains from trade
 - full employment
 - Perfect competition
- Small tariff cuts
- Dynamic gains from trade
 - scale economies and monopolistic competition
 - Employment effects
 - learning and productivity growth
 - Capital accumulation (Investment gains)
- Large tariff cuts
- Emphasizing impacts on trade rather than welfare (or GDP)

The bottom line:

- Shall we look at the short-term and long-term impacts of an FTA?
- Numerical estimates always come with a large margins of error

AN OVERVIEW OF TOOLS FOR TRADE-POLICY ANALYSIS

Tools for ex-ante policy analysis

Ex. what will be the potential effects of an FTA?

Tools:

1. Making inferences from trade indicators
2. Partial Equilibrium Analysis (PE)
 - Estimating the potential effects on an individual product
3. General Equilibrium Analysis (GE)
 - Estimating the potential effects on the whole economy

They are complementary with different strength/weakness and different (explicit and/or implicit) assumptions.

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Trade indicators

- Inferences can be made from the “picture” of trade performance and trade-policy stance
 - How much does a country trade?
 - What does it trade? With whom?
 - How open is a country’s trade policy?

Trade indicators

- **Trade openness**: trade-to-GDP, import penetration, export propensity....
- **Trade performance**: growth , trade balance, market shares, growth decomposition
- **Geographical orientation of trade**: regional intensity, regional trade share..
- **Characteristics of trade**: export diversification, intra-industry trade, import-content of exports, revealed technology content
- **Trade opportunity/competitiveness**: RCA, complementarity

Note: The list is not exhaustive.

Trade-policy indicators

- Tariff profiles: average tariffs, dispersion, effective protection
- Non-tariffs: price gap, frequency ratio

Note: The list is not exhaustive.

Example of applications

Ex. what will be the potential effects of an FTA?

- How much of trade is intraregional?
 - Will the proposed FTA promote trade between trading partners? Are they then “natural” trading partners?
- What is the comparative advantage of each member?
 - Which sectors are likely to have export (import) potential?
- Is export of a particular good regionally oriented?
 - How strong is a regional bias (if there is one)?
- How complementary is trade between a given pair of FTA members?
 - To what extent the export pattern of a country matches the import pattern of a region?
- What is a degree of similarity between partners' exports?
 - To what extent a country's export profile overlaps with other FTA members?

Ex. trade indicators

$$\text{Intraregional Trade Share}_i = \frac{T_{ii}}{T_i}$$

$$\text{Regional Orientation}_{cgr} = \frac{\left(\frac{X_{cgr}}{X_{cr}} \right)}{\left(\frac{X_{cg-r}}{X_{c-r}} \right)}$$

$$\text{Intraregional Trade Intensity}_i = \frac{\left(\frac{T_{ii}}{T_i} \right)}{\left(\frac{T_i}{T_w} \right)}$$

$$\text{Complementarity}_{cgr} = 1 - \left\{ \frac{\sum_{\vartheta} \text{abs} \left[\left(\frac{M_{rg}}{M_r} \right) - \left(\frac{X_{cg}}{X_c} \right) \right]}{2} \right\}$$

$$\text{Revealed Comparative Advantage}_{cg} = \frac{\left(\frac{X_{cg}}{X_c} \right)}{\left(\frac{X_{wg}}{X_w} \right)}$$

$$\text{Export Similarity}_{cgr} = \sum_{\vartheta} \min \left[\left(\frac{X_{rg}}{X_r} \right), \left(\frac{X_{cg}}{X_c} \right) \right]$$

Note: The list is not exhaustive.

where

T_{ii} = exports of region i to region i plus imports of region i from region i

T_i = total exports of region i to the world plus total imports of region i from the world

T_w = total world exports plus total world imports, which can be twice the value of world exports or twice the value of world imports since the value of world exports should equal world imports

T_{oi} = exports of region i to outsiders plus imports of region i from outsiders

T_o = total exports of outsiders plus total imports of outsiders

X_{cg} = exports of good g by country c

X_c = total exports of country c

X_{wg} = world exports of good g

X_w = total world exports

X_{cr} = total exports of country c to region r

X_{cg-r} = exports of good g by country c to countries outside region r

X_{c-r} = total exports of good g to countries outside region r

X_{rg} = exports of good g by region r

X_r = total exports of region r

M_{rg} = imports of good g by region r

M_r = total imports of region r

Steps

1. Asking a policy question
2. Translating (1) into relevant analytical questions
3. Getting indicators to answer (2)
4. Making inferences from (3) to answer (1)

Limitations

- They cannot provide precise numbers that quantify the effect of an FTA on trade, production, consumption, or welfare
- They can be meaningless or misleading if data are unsuitably classified
 - Trade classifications do not match a country's production structure
 - Data are too aggregated

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Application of Partial Equilibrium Analysis (PE)

- PE is a tool for looking at the potential impact of a policy change on an individual product.

Ex. what will be the potential effects of an FTA?

- How a tariff cut in the FTA will affect production, consumption, and trade flows in the domestic market for a single commodity?
 - What will be an import increase?
 - What will be an export increase of FTA partners?
 - What will be an export decrease of non-member countries?
 - What will be a fall in tariff revenue?

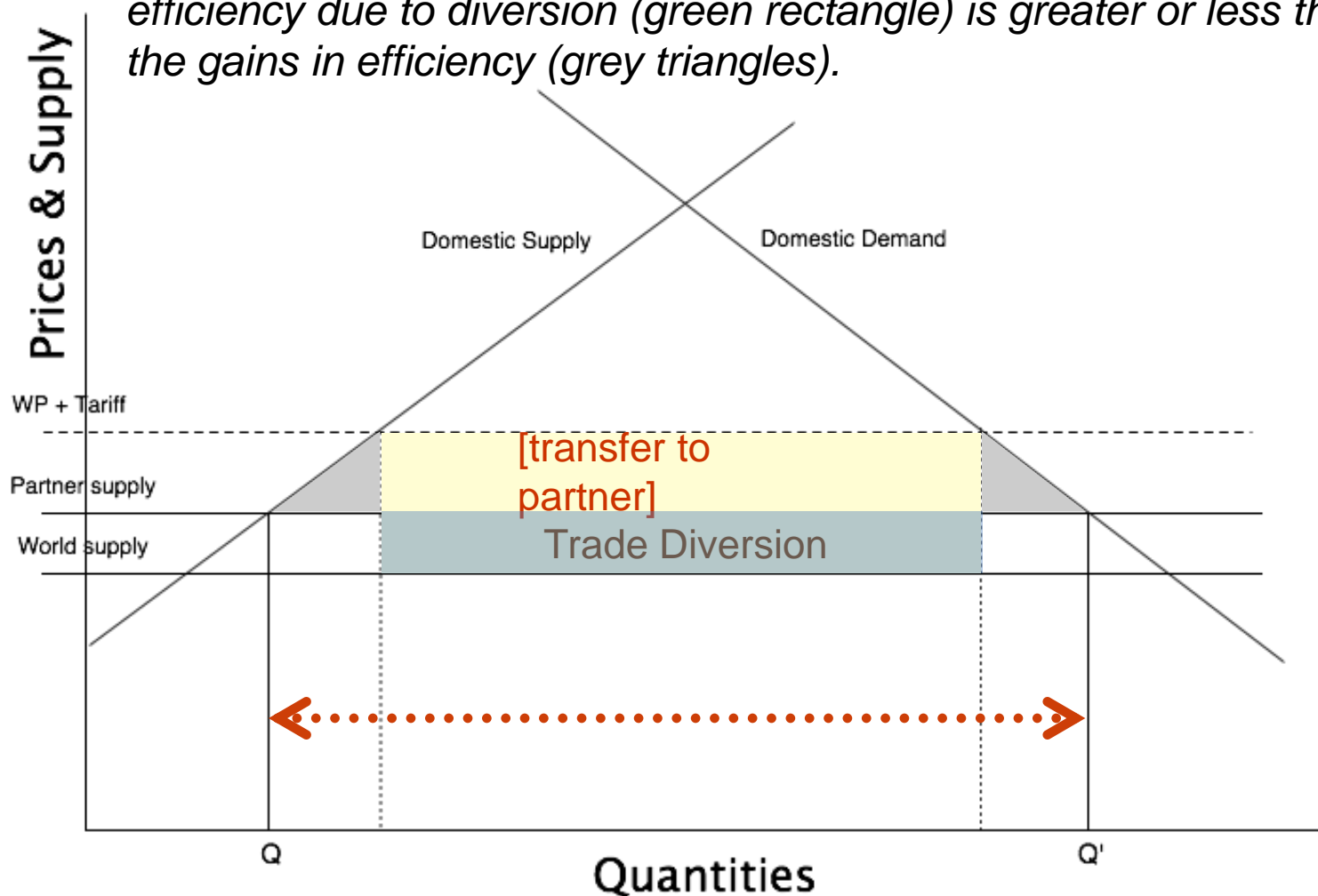
Potential impacts on an individual product

- How an FTA will affect production, consumption, and trade flows in the domestic market for a single commodity?
- Reasons for focusing on an individual product:
 - Its trade is significant in the country's trade balance
 - It generates substantial tariff revenue,
 - It employs a large share of the country's workforce
 - Its output contributes significantly to GDP
 - Firms in the sector may be important political players
 - It may be located in an important region of a country
- The in-depth analysis at the level of individual industry or product makes partial equilibrium (PE) approach more appropriate

PE (Viner) model for FTA analysis

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Summary: *the net trade effect depends on whether the loss of efficiency due to diversion (green rectangle) is greater or less than the gains in efficiency (grey triangles).*



PE for analyzing trade policies

- Feed the model with a policy shock (and see what will be a result?)
- Analysis of own trade-policy change impact
 - Price (consumers and producers)
 - Quantity imported (diversion and creation)
 - Tariff revenues
- Analysis of change market access impact
 - Quantity exported
 - Producers price

What is Partial Equilibrium (PE) analysis?

- The effects of policy actions are examined only in the markets that are directly affected (apples not oranges).
- General Assumptions:
 - Country is relatively small
 - Sector in question is small
 - No adjustment – short- term impact analysis
 - Consumer preferences are fixed
- Some technical assumptions:
 - NO substitution between different products... (modeling one market at a time)
 - Armington assumption: Imperfect substitution between imports of product i from trading partners A, B, C, (varieties)...
 - Modeling based on elasticities (percentage changes)
- **No long-term effects** (dynamic effects): reallocation of production factors is not taken into account, no market entry of new trading partners.

What is Partial Equilibrium (PE) analysis? (Ct'd)

- Supply and demand curves are used to depict the price effects of policies.
- Producer and consumer surplus is used to measure the welfare effects on participants in the market.
- Ignores spillover effects on other industries /countries.

Advantages of using PE Analysis

- PE models can be used to compute trade impacts of trade policy at a very disaggregated level of statistical product classification.
 - This detailed level is very often the level at which trade liberalization and rule of origin in trade agreements are negotiated.
- Easier to implement than general equilibrium
- Less of a black box than general equilibrium
- Less intensive on data requirements
- Easy to change parameters and check for robustness to different assumptions

Limitations

- It ignores the inter-industry effects and the feedback effects of a trade policy change
 - One way to look at it is the short-run impacts of a policy change on a particular industry

Software for PE analysis

SMART – *UNCTAD/World Bank WITS*

TRIST – *World Bank website – Excel*

GSIM – *UNCTAD/World Bank WITS*

Software limitations

- Results depends on pre-defined elasticities
 - But these can be adjusted into the software
- Trade policy restricted to tariffs (taxes)
- Not well suited to assess policy related to other trade policies or costs
 - Non-tariff measures
 - Cost of compliance
 - Behind-the-border issues
 - Trade facilitations

Tools for ex-ante policy analysis

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Potential economy-wide impacts of an FTA

- What are the macro-level impacts of an FTA (when interactions between all markets are accounted for)?
 - real GDP
 - trade balance
 - terms of trade
 - import and export prices in a particular sector
 - output and trade in different sectors within the country
 - national welfare (and where will these welfare effects come from?)
- The multi-sectoral trade liberalization makes CGE (Computable General Equilibrium) approach may be more appropriate
 - The direct effects of tariff reductions in individual markets
 - The indirect changes in related markets

CGE Modelling

Computable General Equilibrium.

General Equilibrium → “Economy-wide”, enough time to achieve “equilibrium”.

Computable → Solution can be computed.

Also called Applied GE.

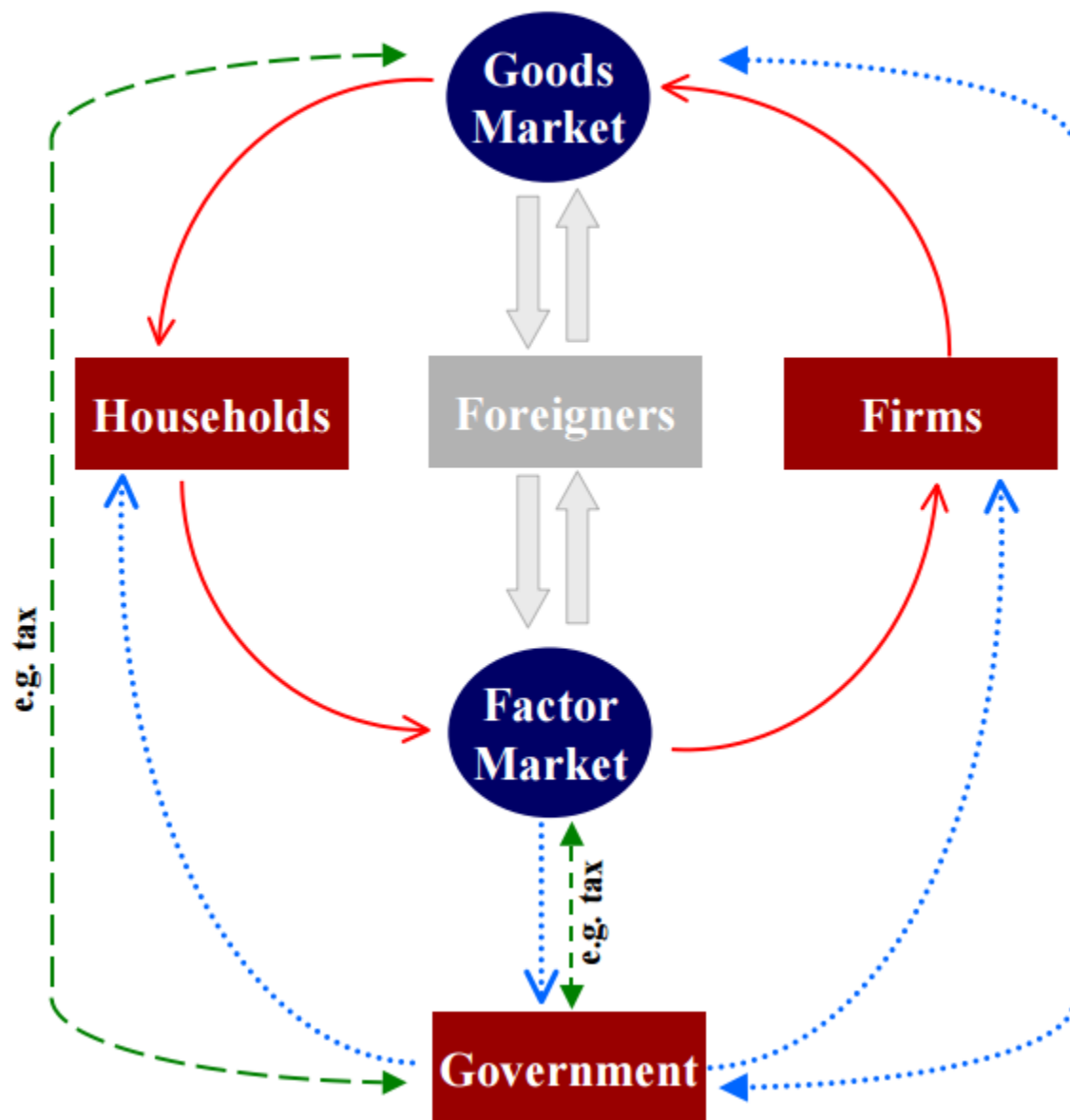
What is CGE? (1)

- CGE is a GE model that use the power of today computers to calculate **NUMERICALLY** the effects of changes in exogenous and/or policy variables, in setting with many goods and factors and countries.
- CGE provide a precise numerical answer to the question “what is the impact of(a numerically specified trade policy)?”

What is CGE? (2)

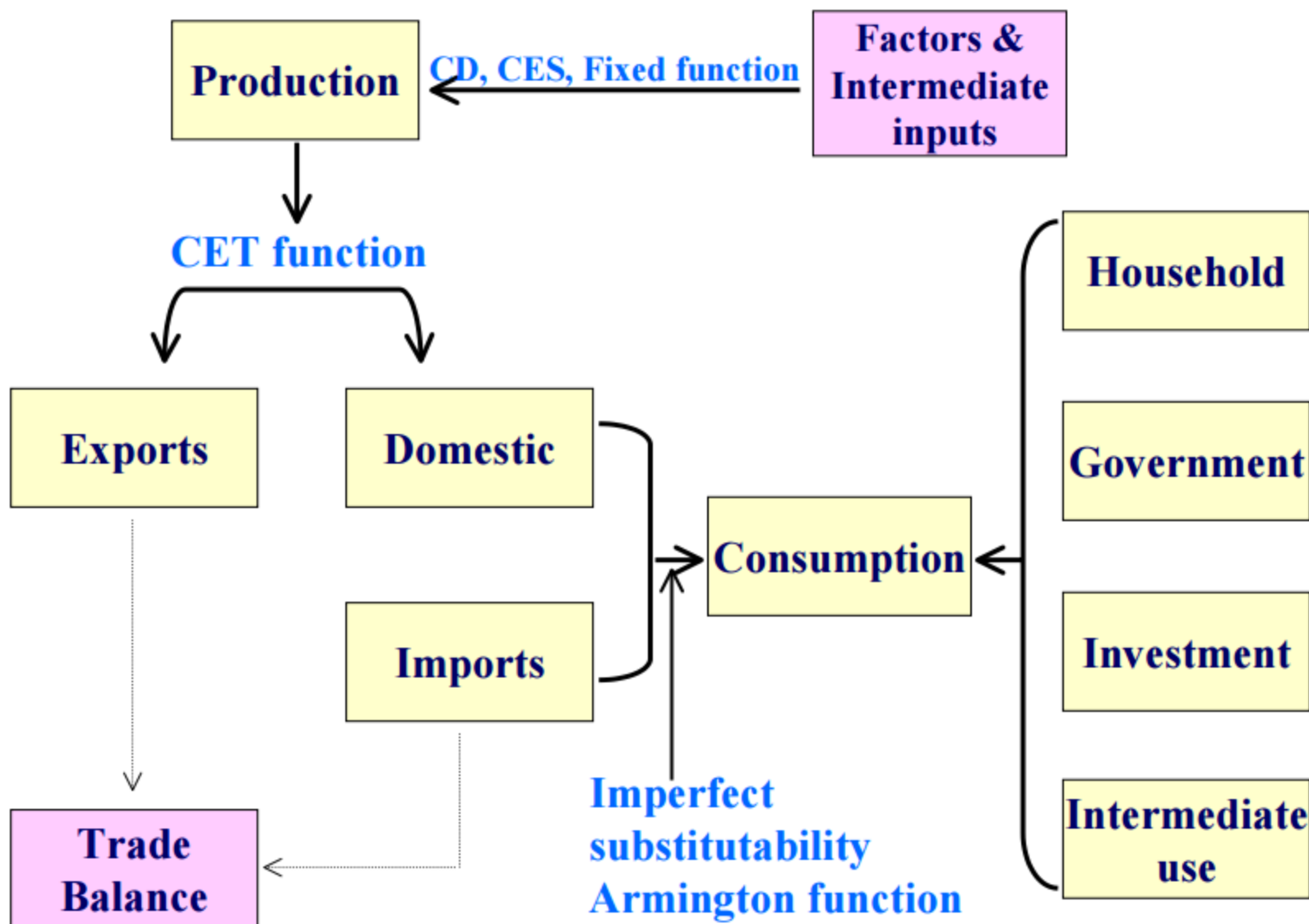
- CGE models are based on the fact that the different markets in a given economy are linked, and changes that take place in one market affects other markets; these changes must be accounted for as they can have back and forth impacts
- CGE models use Social Accounting Matrix (SAM) to capture these various linkages
 - SAM is built upon the circular flow conception of the economic system where each expenditure must be matched by a corresponding receipt or income.
- They take into account cross-sectoral reallocation of factors of production

CGE Overview -- Economy Representation



Adapted from
Krauss, M. B.
and H. G.
Johnson.
"General
Equilibrium
Analysis: A
Micro-
Economic
Tex." Figure
1.2, page 27,
1974

CGE Overview -- Commodity Flow



Reference: Lofgren, H., R. L. Harris, S. Robinson, M. Thomas, and M. El-Said. "A Standard computable general equilibrium (CGE) model in GAMS, IFPRI, Washington, D.C.

Step1: Introducing assumptions

- market structure (im/perfect competition)
- production function (two-level: final and Intermediates)
- representative household behaviour
- government behaviour
- substitutability between domestic and foreign products (Armington assumption)
- Investment and dynamics
- Model closure (unemployment?)
- Social Welfare = Welfare of the representative household

Step 2: social accounting matrix

- SAM provide CGE with the data
- SAM builds on the circular flow
- Uses information from I-O tables, national accounts, government fiscal account, trade data
- Need to be collected, standardized (same base year and currency) and combined

Step 3 elasticities

- substitution between factor of productions
- household price elasticities of demand
- Household income elasticity
- substitution between domestic and foreign products (Armington elasticities)

IMPORTANT: PE and GE approach are complementary. In many cases (e.g. in GTAP), CGE models borrows parameter estimates from PE econometric studies

Step 4: Calibrate

- Calculate a subset of parameters that together with the SAM and inputted values for the elasticities can replicate the data of the reference year (baseline)

A CGE Model: GTAP

<https://www.gtap.agecon.purdue.edu/>

- Multi-region model (Policy Relevance)
 - GATT/WTO multilateral liberalization
 - Regional Trading Blocks
 - Environmental Policy
 - Labour migration
- Global database (Timeless)
 - Input-output data
 - Bilateral trade flow data
 - Bilateral duty collection data
 - The current release, the GTAP 9 Data Base, boasts dual reference years of 2004, 2007 and 2011 reference years as well as 140 regions for all 57 GTAP commodities.
- Standard modeling framework (Transparency)
- Global network of researchers (Evaluation and Validation, Diversity of Approaches to some extent)

When to use CGE?

- They are useful when sectors interact
 - through intermediate consumption, or
 - their competition for factors of production or for consumers
- ...when the focus is economy- wide impacts of a policy change
- ...when the focus is identifying winners and losers under a policy change

Note:

If the scope of a study is limited to a small sector or short-term impacts, building a partial equilibrium model may be more relevant

- It will be simpler and will allow entering into more details
- Price rigidity may play an important role (impact of a devaluation, short-term impact of trade policy on current accounts)

When not to use CGE?

- NOT to use CGE
 - Small sector/region/issue with rich data on particular aspects: impossible to incorporate into a CGE model, e.g., time-series/survey data.
 - Complex model capturing structural details of a region/sector that cannot be *fed* into a CGE framework.
 - Where one requires statistical significance of the results (although there is a way of doing a similar thing in CGE)

PE vs. CGE

	CGE	PE
Capturing economy wide linkages	X	
Consistency wrt budget constraints	X	
Capturing disaggregated effects		X
Capturing complicated policy mechanisms		X
Use of timely data		X
Capturing short and med. term effects		X
Capturing long-term effects	X	

How to get the best of both worlds?

- ***Feeding*** the results from “structurally rich” PE model into CGE
- Using econometric estimates to calibrate the parameters in CGE
- Linking a specialized PE model to CGE
- Feeding the CGE results into a PE/econometric model

Tools for ex-post policy analysis

Tools:

1. Making inferences from trade indicators
2. Econometric analysis
3. Case studies and firm/industrial surveys

Ex-post policy questions

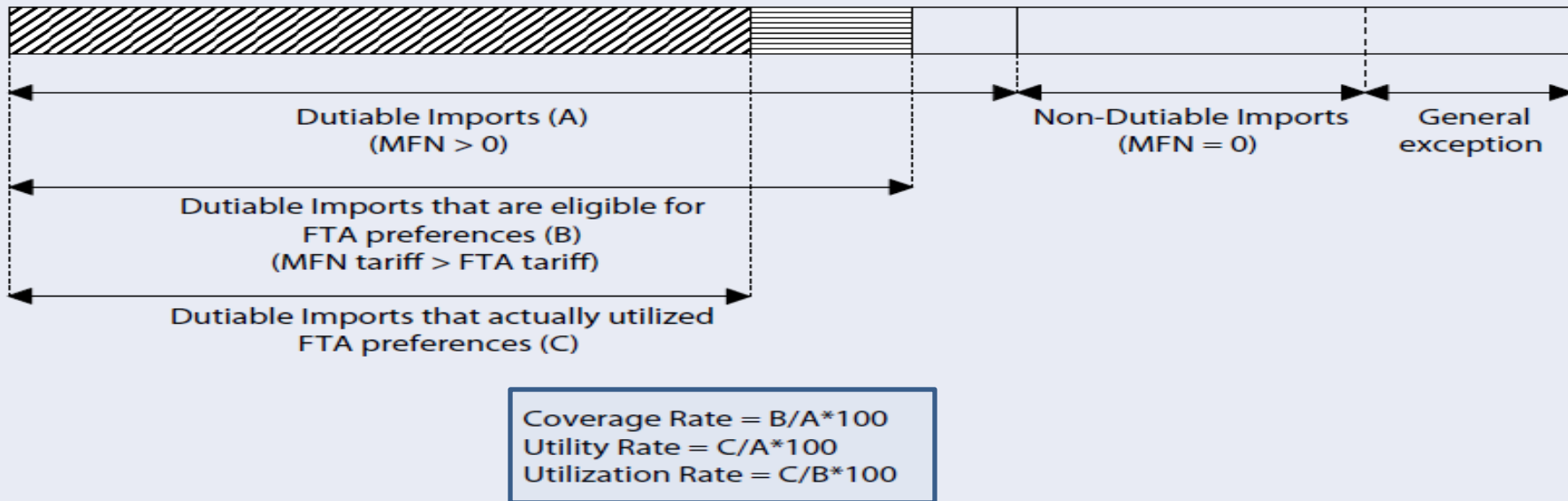
Ex. After an FTA is ratified and implemented.

- Were the preferences utilized?
- Did the FTA raise welfare of the country in question?
- What were the channels of transmission of FTA-triggered trade flows changes to households' welfare?

Indicators

- Preference margin – also known as MOP- (the attractiveness of a preferential regime relative to MFN treatment)
 - MFN-FTA tariff
 - The compliance cost has to be lower than the preference margin for exporters to utilize the preferences.

Figure 3.1 Structure of Imports and Formulas for Free Trade Agreement Preference Indicators



FTA = free trade agreement, MFN = most favored nation.

Advantages and Limitations

- Useful summary measures
- Calculation is simple provided customs data is made available

But

- They do not identify the reasons behind the results

Thus,

- Firm survey may be used to fill the gap

Did the FTA raised welfare of the country?

- Qualitative evaluation
 - Based on Viner's concept of trade creation and trade diversion
- Quantitative evaluation
 - Econometric approach(such as gravity model of trade)

Did the FTA raised welfare of the country?

- **Qualitative evaluation:** Changes in domestic production and trade affect welfare (based on the Viner concept)
 - + inefficient domestic production is replaced by efficient imports from FTA members.
 - efficient imports from the rest of the world are replaced by inefficient imports from FTA members.

Gravity Model of Trade

- The gravity model is an econometric method of estimating trade flows.
 - Tinbergen (1962) compared the size of bilateral trade flows between any two countries to the gravitational force in physics between two objects.
 - Since then, many theoretical models that yield the gravity equation for trade has been produced.
- It was used to analyze the impact of FTAs, GATT- WTO membership, TBTs, NTBs, currency unions, etc. on trade flows.
- The main advantage is that it can control for the effects of other trade determinants besides the FTA, and can therefore isolate the effects of the FTA on trade.

Gravity Model of Trade

The basic gravity model of trade relates the imports of country i from country j (M_{ij}) positively to the sizes of the two countries (Y_i and Y_j), but negatively to the geographical distance between them (D_{ij}):

$$M_{ij} = G \frac{Y_i Y_j}{D_{ij}}$$

$$\ln M_{ij} = G + \beta_1 \ln Y_i + \beta_2 \ln Y_j + \beta_3 \ln D_{ij} + u_{ij}$$

The theoretical work on the gravity equation has emphasized that bilateral trade is not only a function of distance, but also the relative trade costs of the pair from other countries.

- Anderson and van Wincoop (2003) concept of “**Multilateral Trade Resistance (MTR)**”. The higher the MTR, the more the pair of countries should trade with each other and vice versa.

$$\ln M_{ij} = G + \beta_1 \ln Y_i + \beta_2 \ln Y_j + \beta_3 \ln D_{ij} + \text{MTR}_i + \text{MTR}_j + u_{ij}$$

Gravity Model of Trade

$$\ln M_{ij} = G + \beta_1 \ln Y_i + \beta_2 \ln Y_j + \beta_3 \ln D_{ij} + MTR_i + MTR_j + u_{ij}$$

Several approaches to proxy the MTR:

- One is to use iterative methods to construct the estimates of the price-raising effects of barriers to multilateral trade (Anderson and van Wincoop, 2003).
- A simpler alternative is to control for each country's "remoteness" by using a formula that measures its average distance to trading partners.
- An even simpler –and widely used– method consists of using country fixed effects for importers and exporters (Rose and van Wincoop, 2001).

Using the gravity model for an FTA analysis

- At the aggregated level, gravity equations have been used extensively to assess, ex post, the effect of FTAs.
 - One of the seminal contributions in this area being Frankel, Stein and Wei (1995).
- The crudest way to do so is to include a “dummy” (zero/one) variable marking pairs of countries linked by the FTA in the set of gravity regressors.

An example

$$\ln M_{ij}^t = G + \beta_1 \ln Y_i^t + \beta_2 \ln Y_j^t + \beta_3 \ln D_{ij} + TradeCreate + TradeDivert + MTR_i + MTR_j + YEARS + u_{ij}^t$$

$TradeCreate = 1$ when both the importing and exporting countries are members of the FTA in year t (Otherwise, $TradeCreate = 0$)

$TradeDivert = 1$ when the importing country is a member of the FTA in year t , but the exporting country is not.
($TradeDivert = 0$)

Note:
 $TradeCreate$ measures trade creation, while $TradeDivert$ measures trade diversion.

Advantages

- Data for the gravity model is widely available.
- The model has a high level of explanatory power.
- Although a theoretical gravity model could be complicated, there are established standard practices that facilitate the work of researchers.
- It allows controlling for other trade-related variables and quantify any changes in a country's trade due to the FTA.
- These quantitative estimates may then be used in welfare calculations.

Cautions and Limitations

Quantitative results should not be over-sold because the econometric technique has its own limitations.

- The model may yield misleading results if the data is inaccurate, or important variables are omitted from the estimation.
- The fact that FTA membership are likely to be endogenous to trade flows make the estimation is prone to endogeneity problem
 - Natural trading partners are more likely to form FTAs if governments decide to form them on welfare grounds.
- Results may differ depending on whether or not zero trade flows are included in the dataset.
 - Potential solutions are increasingly discovered by the literature

Case Studies

- Describe the experience of a specific country case/ specific industry
- Analysis of the facts without a single, rigorous working framework
- Often the only tool for lack of data
- Difficult to generalize

Conclusions

- A tour d'horizon of some of widely used tools for EBPM.
- There is more than one answer to a policy question. The choice is dictated by:
 - Policy questions
 - Data availability
 - Technical capability of research institutes
 - Time and resources
- Alternative model, sometimes, give conflicting results, but they are actually complementary.
 - Understanding underlying assumptions the tools is the key to properly interpret the research results

How TID/ESCAP could help?



- Communities of knowledge
- Toolkits
- Datasets
- Courses for all stakeholders
- Advisory teams
- Evaluation (especially for adjustment purposes)
- Networking with donors, subregional and national institutions

⇒ All of the above with developmental focus

Asia-Pacific Research and Training Network on Trade (ARTNeT)

- Open regional network of trade research institutions across the ESCAP region.
- Over 60 Institutional Members and associate partners from across the region
- Objective: increasing the amount of quality and relevant trade research in the region
 - harnessing the research capacity already available
 - developing additional capacity through regional team research projects
 - enhanced research dissemination mechanisms
 - increased interactions between policymakers and researchers
 - and specific capacity building activities catering to researchers and research institutions from least developed countries.
- Examples of workshops:
 - Capacity Building Workshop for Trade Research, June
 - CGE, Gravity modeling
 - Tailored national workshops



Useful readings

- Andriamanananjara, Cadot, and Grether (2013). [Tools for Applied Goods Trade Policy Analysis: An Introduction](#), in Arvid Lukauskas, Robert M. Stern, and Gianni Zanini (eds), Handbook of Trade Policy for Development. Oxford University Press.
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Thank you