

Non-Tariff Measures in CGE Models

Session II: A Basic CGE Model

WTO/ESCAP 12th ARTNeT Capacity Building Workshop for Trade Research
"Empirical Methods in Trade: Analyzing Non-Tariff Measures"
December 12-16, 2016
Bangkok, Thailand

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Introduction

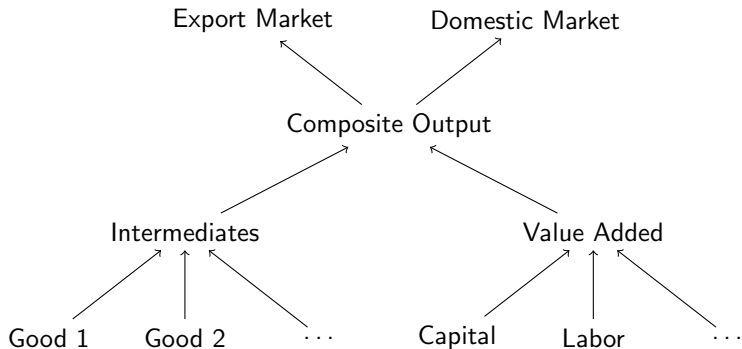
- In this session we will introduce and begin working with a basic CGE model of an economic system.
- The model that we will use model is built in GAMS, is publicly available, and is fully documented in Gilbert and Tower (2013).
- We will talk about the general structure of the model, which is typical of most CGE models, the assumptions of the model, and the data that it requires.
- We will then explore the model code (briefly), and get some hands-on experience running simulations with the model, using an application for Viet Nam's economy.

- There are five basic types of **agent** in the model.
- A **representative household** that owns the resources and generates private final demand.
- **Firms** that hire resources from the household, and produce the final goods, which are then sold to the agents.
- A **government** that spends on public goods, collects taxes and disburses subsidies.
- An **investor** that takes household savings and allocates it to investment.
- A **rest of world** that supplies imports to the economy and acts as a source of demand for exports, and is a potential source of savings.

Theory – Firms

- Industries operate under perfectly competitive market conditions, with a representative firm in each industry.
- Each firm maximizes profits, treating prices of inputs and outputs as given.
- The technology uses primary factors in variable proportions (modeled via CES), combined with intermediate goods used in fixed proportions.
- Each industry produces a differentiated, with one version aimed at foreign markets and another aimed at the domestic market (households, government, investment and intermediates). The transformation function takes the CET form.

Production Structure



Theory – Household

- The representative household has a Cobb-Douglas utility function.
- It maximizes utility subject to its budget constraint.
- Household income is equal to factor payments, less tax payments to the government.

Theory – Government and Investment

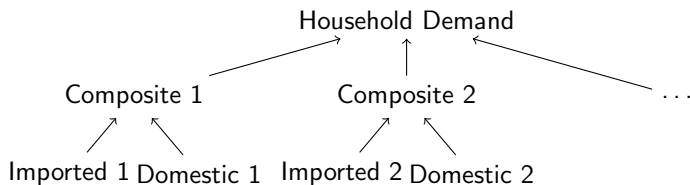
- Government consumption and investment are fixed in quantity terms (they vary in value terms with prices).
- Government revenues are determined endogenously, with all tax rates exogenous.
- Government savings (i.e., the budget deficit or surplus) is variable, financed by (implicit) transfers from the household.
- Household savings varies to match aggregate investment needs.

- The economy is assumed to be small with respect to import markets.
- Foreign demand for exports is modeled using the constant elasticity of demand function.
- The current account balance (i.e., foreign lending or borrowing) is fixed.

Theory – International Trade

- International trade is modeled via the [Armington assumption](#) – horizontal product differentiation by source.
- The Armington assumption is a common method that CGE models use to allow for intra-industry trade.
- A single Armington composite for household, intermediate, government and investment demands.
- The Armington aggregator function is of the CES form.

Structure of Household Consumption



Theory – Factor Market

- By default, the factor market closure is neoclassical.
- This means that all factors of production are available in fixed total supply, mobile across the sectors in which they are used, and that factor prices adjust to maintain full resource use.
- This is a medium-run closure, but it can be easily adjusted if necessary.
- For example, a short-run scenario might assume that capital is specific to each industry.

Data – Flow Structure (SAM)

		Activities		Factors		Taxes	Final Demands				Total
		1	2	K	L	T	H	G	I	X	
Activities	1	40	10				50	12	15	45	172
	2	10	40				110	15	15	15	205
Factors	K	80	20								100
	L	20	80								100
Taxes	T	2	5								7
	H			100	100						200
Final Demands	G					7	20				27
	I						20			10	30
	X	20	50								70
Total		172	205	100	100	7	200	27	30	70	

Data – Required Parameters

- Elasticities of substitution in value-added (by sector).
- Elasticities of substitution in trade (Armington elasticities, by sector).
- Foreign export demand elasticities (by sector).
- Elasticities of transformation between foreign export supply and domestic supply (by sector).

Computing Requirements

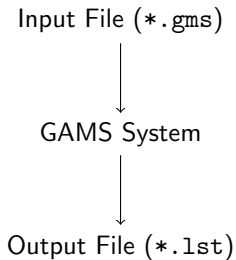
- The model is built using the GAMS language.
- GAMS is an acronym that stands for the General Algebraic Modeling System.
- It is a high level programming language designed for building and solving mathematical models numerically.
- GAMS can solve a wide variety of problems, and is capable of handling very large mathematical systems.
- It is in very widespread use in both the academic and business worlds, and is the most widely used development platform for computable general equilibrium models.

Getting and Installing GAMS

- GAMS Corporation provides a student/demonstration version free of charge, which is suitable for small models (up to 8-10 sectors).
- The latest version can be downloaded for various platforms from <http://www.gams.com/download/>.
- Once the file has downloaded, double click on it to start the installation process. A prompt will appear asking if you wish to copy a license file. You can click no (without the license file GAMS will run in student/demonstration mode).
- Once it has installed, GAMS will ask if you want to launch the IDE, or integrated development environment. This is the main GAMS interface. Click yes and GAMS should appear.

Using GAMS

- We don't have time to cover the complexities of GAMS programming, and will concentrate on how to use this model.
- A GAMS program is a text file that describes the model structure in terms of its component variables, parameters and relationships. The text file is usually given the suffix `gms`.
- To run the program, the text file is submitted to the GAMS system. GAMS then checks for syntax errors, and then translates the model into a form usable by the solution algorithm. This process is invisible to the user.
- The solution algorithm attempts to solve the model, and then reports back to GAMS the result.
- A list file (with the suffix `lst`) is produced that contains information on the solution. If something went wrong in the process, the list file will contain information on where the problem lies.



Program Structure

- Sets
- Flow Data
- Parameter, Variable and Equation Declarations
- Parameter, Variable and Equation Assignments
- Model and Solve Statement
- Review of the Code

Using the Model and Running Simulations

- To use the model for an actual economy, we need to provide appropriate data. We provide an example using Viet Nam.
- The model uses data drawn from the GTAP database – a 5 sector, 3 factor SAM.
- To run a simulation, we need to add a line after the solve changing a parameter value (i.e., introducing a shock), and then execute another solve.
- GAMS will report the solution in the list file.

Examples and Exercises

- **Example 1:** Cutting all tariffs in half. This is accomplished by setting $TM(I)=TM(I)*0.5$ and solving the model.
- **Example 2:** To simulate the impact on the economic system of changes in other countries (market access) you need to shift the demand curves. Try simulating an increase in market demand for textiles through the parameter XI.
- **Example 3:** Suppose that technical cooperation is part of regional agreement. This is expected to increase productivity by 10 percent. What is the economic impact? (The relevant parameter is GAMMA.)

Further Resources

- You can download both the basic model and the version fitted to the Viet Nam economy.
- The structure of this model, along with the detailed code, is described in Gilbert and Tower (2013).
- More detail on GAMS can be found in the GAMS Manual.