

General Equilibrium Analysis Part I

Introduction to CGE

Capacity Building Workshop
"Enhancing Capacity on Trade Policies and Negotiations in Laos"
May 8-10, 2017
Vientienne, Lao PDR

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Introduction

- In the next set of sessions we will learn about using a computable general equilibrium (CGE) model of a complete economic system to analyze trade policy.
- We will begin in this session with an introduction to CGE models in general.
- After that, we will consider a CGE model of the economy of Lao PDR, and applications.

What Is General Equilibrium?

- **General equilibrium analysis** is the branch of economics concerned with the simultaneous determination of prices and quantities in multiple inter-connected markets.
- It contrasts with **partial equilibrium analysis** – models that consider only a single sector.
- The key characteristic of general equilibrium models is that they are economy-wide – constraints apply at both the individual and the system level.
- It is used extensively in many branches of economics, most notably in macroeconomics and in international trade theory.

Why Is General Equilibrium Important?

- Often a change in an economic system will have repercussions far beyond the sector in which the change occurs.
- General equilibrium models are designed to help us understand those repercussions. Thinking in general equilibrium terms helps us to see the full consequences of policy changes.
- **Thought Experiment:** What is the effect of a increase in the import tariff applied to steel?

What Is Computable General Equilibrium?

- **Computable general equilibrium** (CGE) models attempt to take the general equilibrium theory and turn it into a practical tool for policy analysis.
- They do so by building computer models of real economic systems using some software, fitting the models to real data on the economic structure of those systems, and simulating the effects of policy changes inside the models.
- CGE models are used widely in international trade, public finance, regional economics, and environmental economics.
- CGE models have been particularly widely adopted in the trade policy literature. Recent surveys of their application are Scollay and Gilbert (2000), Gilbert and Wahl (2002), Robinson and Thierfelder (2002), Lloyd and MacLaren (2004) and Hertel and Winters (2005), Gilbert, Furusawa and Scollay (2016).

Advantages of CGE

- High degree of theoretical consistency.
- The ability to highlight the importance of linkages between sectors.
- The ability to incorporate unique features of an economic system.
- The ability to predict values for many economic variables in the system.

Limitations of CGE

- The data requirements of CGE models are substantial.
- The human capital investment required in building/using these models is very high.
- There is often uncertainty over parameters, specification, and experimental design.
- By covering all sectors in an economy, a CGE model may miss key features of critical sectors.
- It can be difficult to know what is driving the results (the 'blackbox' critique).

When is CGE Appropriate?

- CGE is *not* an appropriate method for all types of question, though it can be very helpful for some.
- The policy question involves large changes that are well outside of historical experiences. This suggests the need to use simulation techniques of some kind.
- The policy question involves multiple countries and/or multiple sectors. This suggests that we need general equilibrium rather than partial equilibrium techniques.
- Or, the policy question involves only one sector directly, but that sector is large enough to have an impact on the overall economy.
- Answering the policy question requires detailed information on the economic system and not just broad economic aggregates.

How Does CGE Work?

- As a practical matter, a CGE model consists of a set of behavioral relationships drawn from economic theory.
- The relationships are implemented using specific functions in the form of a computer program (usually written in either GAMS or GEMPACK, but sometimes other languages).
- The model will also consist of a set of data that represents the economic system, and data specifying the nature of behavioral relationships.
- Together, these form a quasi-experimental setting where different policy scenarios can be considered before setting them loose.

The Basic Components of CGE

Data

What does the economy look like now?

How will agents respond to changes?

Theory

What process generated the data we observe?

How are the parts of the economy connected?

What is the direction of causality?

Shocks

What is going to change?

- Data in CGE models is of two basic types - structural and behavioral.
- **Structural data** describes the features of the economic system under study. It will generally cover production, consumption, trade and interventions, including NTMs (in principle, in practice we usually need to add).
- The data will generally be organized in a **Social Accounting Matrix** (SAM).
- **Behavioral data** describes how the system responds to changes. It will usually take the form of elasticities (of demand, production, trade, etc.) It is usually obtained from previous econometric work.

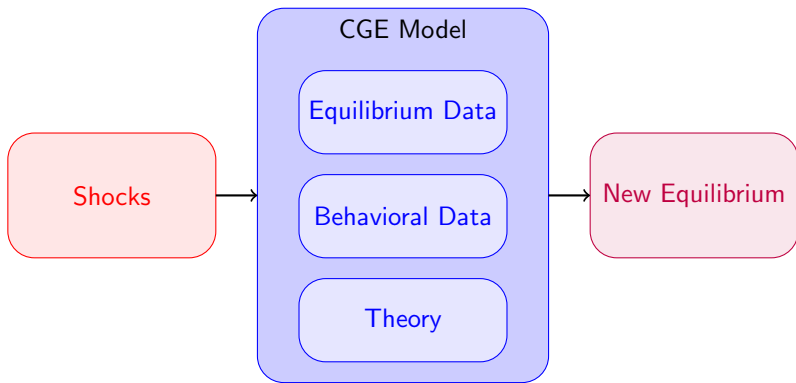
Theory in CGE Models

- Numerical simulation models are all based on an explicit underlying theoretical specification.
- Because there are many theoretical specifications that are consistent with an observed set of base data, there are in principle many different ways of designing a CGE model.
- Part of the theory of a model is the **closure** – the choice of which variables are endogenous and which are exogenous.
- The flow of causality is from exogenous to endogenous, so the choice of closure represents some view of the economic reality.

Shocks in CGE Models

- In CGE terminology a **shock** is a change to the underlying economic system.
- The shocks are meant to represent the policy change under study and may be implemented in terms of changes to any exogenous variable or parameter.
- Examples include technology changes or endowment growth, and changes in taxes, or trade policies.

CGE Simulations



Interpreting CGE Results

- Data, theory, and shocks are the three basic elements of a CGE study, and combined they *determine* the results.
- The results of a CGE analysis are numerical 'predictions' of the changes in the economic system.
- Exactly how we interpret the results will depend to a degree on how the model is constructed, but generally the numbers represent how the base economic system would look under alternative policy scenarios *holding all other factors constant*.
- The last point is important - CGE models are not forecasting tools as much as they are isolating tools.
- Typical results will include measures of welfare, changes in output, trade and other variables.

Example

- A small example can illustrate the idea.
- For this purpose we will use a CGE model built in Excel.
- The demonstration model features a single economy producing two goods.
- The economy uses two factors of production with constant returns to scale technology.
- Assuming full employment and perfect mobility of factors across production, along with competitive markets, we have one of the dominant models of trade theory — the Heckscher-Ohlin-Samuelson model.

- An introduction to CGE can be found in Gilbert and Tower (2013).
- Other introductory treatments of CGE include Hosoe et al. (2010) and Burfisher (2011).
- A very well-known CGE model is GTAP, which is described in Hertel (1997).