Introduction to CGE

ARTNeT Short Course on CGE Modeling, United Nations ESCAP

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Course Outline

- Brief Introduction to CGE
- GAMS Primer
- Demand
- Firms and Supply
- Trade
- Tariffs and Other Interventions
- The Armington Assumption
- Closure
- Social Accounting Matrices
- Standard CGE Models
- Next Steps

Course Objectives

- By the end of the course you should have a solid understanding of the structure of standard CGE models.
- By working with small scale models, you should have developed a strong understanding of the basic causal mechanisms at play within large-scale models.
- You should have developed enough skill in GAMS programming to begin building your own models and/or modifying existing models to suit your own purposes.

What is CGE?

- Computable general equilibrium (CGE) models are numerical models based on general equilibrium theory. Their objective to turn the abstract models of general equilibrium theory into a practical tool for policy analysis.
- They are multi-sectoral, and in many cases multi-regional, and the behavior of economic agents is modeled explicitly through utility and profit maximizing assumptions.
- Economy-wide constraints are rigorously enforced. In other words, the markets in a CGE model are all linked together.
- CGE models have been widely adopted in the trade policy literature. Recent surveys of their application see Scollay and Gilbert (2000), Gilbert and Wahl (2002), Robinson and Thierfelder (2002), Lloyd and MacLaren (2004) and Hertel and Winters (2005).

What is CGE?

- 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.

Example

- A small example can illustrate the idea.
- 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, we have one of the dominant models of trade theory — the Heckscher-Ohlin-Samuelson model.

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.

CGE Components

- Theory — Specification of behavioral characteristics of the model, and the direction of causality (‘closure’).
- Data — Structural and behavioral.
- Shocks — Changes to the economic system under study.

Data in CGE Models

- 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.
- 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 (although some are more common than others).

Closure

- Closure is the term for the choice of which variables are endogenous and which are endogenous.
- The flow of causality is from exogenous to endogenous, so the choice of closure represents some view of the economic reality.
- Typical choices involve the factor market and the treatment of the savings-investment balance.

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 and may be implemented in terms of changes to any exogenous variable or parameter.

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.

Further Resources

- I will be drawing most of my notes from Gilbert and Tower (2013).
- Other introductory treatments of CGE include Hosoe et al. (2010) and Burfisher (2011).