Computable General Equilibrium (CGE) Models: A Short Course

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Session Four: EXTENTIONS & APPLICATIONS

Session 4: **Extensions & Applications**

- Extensions
  - Dynamics
  - Uncertainty
  - Financial CGEs
- Applications
  - Development Policy Analysis
  - International Trade
  - Energy-Environment
  - Natural Resources
  - Urban/Regional Analysis

Dynamics

- Single period CGE models are most commonly used to conduct comparative static experiments
- An implicit notion of time even in static models: a long enough time for all markets to clear
- Whether "a long enough time" is short- or long-run depends on the assumptions about the characteristics of factor markets and elasticities
- For example, assuming perfect mobility of factors implies a long-run specification of time

Dynamics

- Many interesting economic questions are inherently dynamic. E.g:
- Analyzing the implications of policies that affect savings and investment decisions, hence the accumulation of capital stock
- Question of depletion of an exhaustible resource

Dynamics

- Two distinct classes of dynamic CGEs:
- Forward-Moving Dynamics
  - Assuming static expectations, essentially solve for a sequence of static equilibria recursively and the notion of inter-temporal equilibrium is not pursued
- Forward Looking Dynamics
  - Incorporate expectations of future outcomes formed by economic agents and solve for an inter-temporal equilibrium

Forward-Moving Dynamics

- First used by Adelman and Robinson (1978), is the most common practice adopted by CGE model builders
- A two-stage approach where in the dynamic stage all the exogenous time-dependent variables are updated and entered into the static stage model. This static model then solves for the next period taking the past solutions as given
- Put differently, the dynamic paths for time-dependent variables are generated by the sequential solution of static CGE models -- "lurching equilibrium."

Forward-Moving Dynamics

- Implicitly assumes that expectations of future events have no effect on today's decisions and that the behavior of economic agents depend only on the past and present outcomes of economic activities
- Advantage:
  - No "terminal condition" problem;
  - Ease of computation
- Drawback:
  - It assumes economic agents are myopic and there is no feedback from the future anticipated paths of dynamic variables;
  - Errors made in each year may quickly compound and lead to unexpected and exaggerated results

Forward-looking Dynamics

- Fully dynamic models in the sense that they capture the impact of the future events and solve for inter temporal equilibrium.
- Events in each period affect the equilibrium of all other periods so that in each instance decisions are made on the basis of past outcomes and expectations of all future events

Forward-looking Dynamics

- Advantage:
  - The correct way of specifying rational behavior
- Drawback:
  - The assumption of perfect foresight substantially complicates empirical implementation
  - A numerical solution of this type of problem rapidly increases the dimensions of the problem

Uncertainty

- Uncertainty, especially about price variations, is very important to policy makers
- With increased ease of computations there are now models that incorporate stochastic elements into CGE models
- E.g.: Adelman, Roland Holst and Harris, 1986

Financial CGEs

- Most CGE models deal with the real side of the economy where only relative prices matter
- There are a growing number of CGE models that incorporate financial markets, including inflation and asset valuation

Applications

- Development Policy Analysis
- International Trade
- Energy-Environment
- Natural Resources
- Urban/Regional Analysis

Development Policy Analysis

- Dervis, K, J de Melo, and S Robinson. 1982. *General equilibrium models for development policy*. Cambridge: Cambridge University Press.
- Development strategies

International Trade

- de Melo, J. 1988. Computable general equilibrium models for trade policy analysis in developing countries: A survey. Journal of Policy Modeling 10: 4. 469-503.

Energy-Environment

- Bergman, Lars. 1988. "Energy policy modeling: A survey of general equilibrium approaches." *Journal of Policy Modeling*, 10:3, pp. 377-99.
- Bhattacharyya, Subhes C. 1996. "Applied general equilibrium models for energy studies: A survey." *Energy Economics*, 18, pp. 145-64.

Energy-Environment

- Energy CGE models:
  - Within sector
  - Energy-economy interaction
- Environment CGE models
- Integrated technology-energy-environment-economy modeling

Natural Resources

- Devarajan, S. 1988. "Natural resources and taxation in computable general equilibrium models of developing countries." *Journal of Policy Modeling*, 10 4, pp. 505-28.
- Devarajan, S. 1997. “Can computable general equilibrium models shed light on the environmental problems of developing countries?” in P. Dasgupta and K.-G. Mahler, eds., *The Environment and Emerging Development Issues*, Cambridge: Cambridge University Press.

Urban/Regional Analysis

- Partridge, Mark D., and Dan S. Rickman. 1998. "Regional computable general equilibrium modeling: A survey and critical appraisal." *International Regional Science Review*, 21:3, pp. 205-48.

Regional CGE models

- Regional CGEs have provided numerous unique policy insights, but not yet as a standard tool for regional economic development analysis
- More needs to be done for CGEs to become more widely used

Regional CGE models

- IOs most widely used in regions but suffer from fixed-price and implicit perfectly elastic supply assumptions
- Fixed price multipliers may lead to overestimation of benefits (empl)
- Econometric models typically lack sufficient structure for complex policy analysis

Regional CGE models

- Regional CGEs are patterned after those used in national and international studies
- Often the same external substitution elasticities are used

Regional CGE Specification

- 1. The structure should be informed by regional location theory than by national or international CGEs
- 2. A better labor market specification, capable of predicting the variety of outcomes of economic development
- 3. Include a time element
- 4. Capture spatial linkages, such as inter-commuting
- 5. Provide greater confidence in the predictions of the model