

The Economics of Climate Change: Appropriateness of Partial and General Equilibrium Approaches

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Climate Change: Mitigation/Adaptation

- CC impact and mitigation
 - Measuring CC impacts
 - GCM/IAM models
 - Global economic models
 - Effects and costs of mitigation strategies
- Adaptation strategies
 - GCM: temp/water taken as given
 - Downscaling of impact analysis
 - Analysis of impacts/costs of adaptation
 - National and sub-national analysis

Climate Change: Agriculture

- Agronomic impacts: temp and H₂O
- Competing demands for crops
 - Food, livestock, industry, energy
- Competing demands for land and water
 - Agriculture, urban, industry, ecosystem services
- Intermediate inputs: energy, chemicals, seeds
- Markets: commercialization, role of trade
 - Shifting geographic patterns of supply and demand

Climate Change: Agriculture

- Transport, communication, marketing
 - Value chains: processing, marketing
- Shifting demand patterns
 - income growth, tastes, and urbanization
- Changing role of developing countries

Long Run Analysis: Drivers

- Climate “shocks”: timing, intensity, duration
- Economic growth: rate, structure, spread
- Demographics
- Resource availability: capital, labor, land, natural resources
- Technical change
- Institutions: national, international

Long Run Analysis

- “Scenarios” versus “forecasts”
 - Given inherent uncertainties about drivers, it is impossible to do long-run forecasts
 - Scenarios: implications of different mixes of drivers.
 - Potential interactions between climate change and the economic system: global and national levels
 - Scenario analysis: consistency of drivers and implications
- Role of simulation models: quantification
 - Empirical framework for scenario analysis

Market Simulation Models

- “Structural” versus “reduced form” models
 - Econometric models: tend to be reduced form
 - Simulation models: structural, “deep” structural
 - Specification of behavior and operation of markets
 - But: econometric models are often used in simulation mode
- Partial versus general equilibrium models
 - Multi-market PE models versus CGE models

Simulation Models: Uncertainty

- Sources of uncertainty
 - Model structure: model uncertainty
 - Model parameters: estimation uncertainty
 - Stochastic processes: e.g., weather/climate
- Deterministic versus stochastic models
 - Most simulation models are deterministic
 - Incorporating uncertainty and stochastic processes
 - Sensitivity analysis: drivers, structure, and parameters
 - Monte Carlo methods: stochastic processes

Multi-Market Models: Impact Model

- IFPRI Impact model: long run model
 - Only agricultural commodities (32)
 - 115 countries, with further sub-regions (FPUs)
 - “Shallow” structural model: supply and demand equations for each crop
 - No detailed specification of crop technology or utility
 - Solves for world and domestic market prices
 - Linked global and national markets. Perfect substitutability

Impact Model and Climate Change

- Linked to a family of models for CC analysis
 - GCMs deliver climate information on temp/H2O
 - Crop models: impact of CC on yields
 - Water models: impacts of CC on water
 - Land supply and use
- Exogenous drivers
 - CC, GDP/income, technology, demographics
- Endogenous
 - Water, land use, yields, supply/demand/prices

PE Models: Advantages

- Flexibility in treatment of sectors
 - Detailed specification in areas of interest
 - Capture emerging phenomena
- Data requirements: focus on target sectors
 - Data system: extensive data available
- Computation: easier to solve
- Policy: focus on detailed specification of agricultural policies

CGE Models

- World Bank ENVISAGE model
 - Close cousin to OECD ENV-LINKAGES model
 - Global CGE trade model: GTAP data set
 - Disaggregation of agriculture, land, energy
 - Deep structural: detailed specification of production technology and demand
 - Dynamics:
 - Endogenous investment and capital accumulation
 - Other exogenous drivers (labor, TFP growth, land)

CGE Models: Advantages

- Economy-wide coverage
 - Capture ag/non-ag linkages and interactions, policies
 - Role of trade: tradeoffs between ag/non-ag
 - Structural change: ag/non-ag, urbanization, etc.
- Data system: GTAP and ancillary data
- Solution: routine, various modeling systems
- Deep structure: technology, behavior
 - Policy impacts on incentives and outcomes

Mitigation versus Adaptation

- Multi-market and CGE models are used for analysis of both mitigation and adaptation strategies
 - Mitigation: global models
 - Adaptation: country models.
- Adaptation
 - Country and sub-region specific impacts
 - National and international policy impacts

Simulation Model Philosophy

- Early models were large and general
 - “Black box” syndrome: cannot explain results
 - Model validation is difficult: many parameters and complex relationships
 - Hard to do sensitivity analysis
 - Difficult to refocus models and issues change
- Current approach: Simulation model “systems”
 - Collection of models organized around a data base
 - Core “standard” model adapted to new uses

Market Simulation Model System

- Data management system: designed to support models and descriptive analysis
 - GTAP data base for global CGE models
 - FAO data for multi-market PE models
- Model system
 - Standard or core model: “state of the practice”
 - Reflects core theory underlying the class of models
 - Starting point for developing new models that focus on new issues and/or are at the research frontier

Choice of Models: Desiderata

- Drivers: long run impact of CC and other trends
- Policy focus and issues
 - Agricultural policy, national and international
 - CC mitigation and/or adaptation strategies
 - Important sectors: agriculture, energy (biofuels)
- Long run market simulation models
 - Multi-market PE versus CGE
 - Global or national

Choice of Models: Desiderata

- Links to other models
 - Crop models: competing demands
 - Micro-focused farm models (agent based models)
 - Land use models: competing demands
 - Water models: hydrology, irrigation/hydropower
 - Energy models (links to biofuels)
 - Ecosystem services: competing needs

Choice of Models: Desiderata

- Adaptation versus mitigation
 - Global versus national models/analysis
- Dynamics
 - Long run
 - Role of expectations and forward-looking behavior
 - Constraints on ability of actors to adjust
 - Investment programs and factor adjustment
 - Institutions and markets: dynamic price signals