Policy Models: Design, Implementation, and Use
Sherman Robinson
IFPRI
July 2001
Model Design: Issues

• Growth and structural change
  – Investment/education
  – Role of trade
  – Productivity growth
  – Agriculture
  – Industrialization
Model Design: Issues

- Macro shocks and structural adjustment
- Income distribution
  - Long run: poverty and growth
  - Short run: impact of macro adjustment
- Fiscal policy
  - Tax system design and/or reform
  - Government expenditure policy
Model Design: Issues

• Globalization
  – Trade policy reform: GATT/WTO
  – Technical change
    • Production: agriculture and industry
    • Transport and communications
  – Institutional change
    • Role of developing countries in WTO
  – Domestic policy reforms
Model Design: Aggregation

• Macro
  – Structural adjustment
  – Asset markets and financial variables

• Micro
  – Household/firm/farm analysis

• Mezzo
  – Sectoral structural change and adjustment
Model Design: Theory

• Walras-Neoclassical-Structuralist-Keynes
  – Role of product and factor markets
  – Role of assets and financial markets

• Dynamic vs static
  – Time horizon: short, medium, long
  – Notion of equilibrium: Flows and stocks
    • Rational expectations, forward looking, etc.
Model Design: Theory

• Structural models
  – Specify agents, markets, institutions, signals, motivation, and behavior.

• Reduced form models
  – Vague theoretical specification of relationships among variables.
  – Unidentified/unidentifiable underlying structural model.
Implementation: Construction

• Explicit mathematical statement of theoretical model
  – Specify functional forms, endogenous variables, parameters, and exogenous variables.
  – Transforms inputs to outputs.
• Computer code
  – Modeling language such as GAMS
Implementation: Parameter Estimation

• Role of statistics/econometrics.
• Nature of prior information.
• Reduced form models.
  – Very little prior information about parameters. Not enough theory.
  – Need lots of data.
  – Appropriate use of standard econometric methods for parameter estimation.
Implementation: Parameter Estimation

• Structural model
  – Much more prior information about parameter values, based on theory and knowledge of model structure.
  – Usually more parameters to estimate, and data are scarce.
  – Appropriate setting for Bayesian and maximum entropy econometric methods.
Implementation: Parameter Estimation

• CGE model has mostly two kinds of parameters to be estimated:
  – Share parameters, which can be estimated from SAM data.
  – Elasticity parameters describing curvature of various structural functions. These cannot be estimated from the SAM.
Implementation: Parameter Estimation

• “Benchmark” estimation. Model parameters are estimated so that the base data (SAM) are an exact solution to the CGE model.
  – Assumption of base equilibrium imposes much prior knowledge on estimation.
  – Elasticities, however, are not constrained by assumption of base equilibrium.
Implementation: Validation

• Validation is linked to issues to be analyzed—the purpose of the model.
• Must consider “domain of applicability” of the model.
• Need to “test” the model with historical data relevant to its domain of applicability. How well does the model “explain” past events?
Implementation: Validation

• Econometric methods
  – Tend to combine parameter estimation and model validation in the same analysis.
    • Should estimate model over time period relevant for model’s domain of applicability.
  – McClosky criticism. Confusion between economic and statistical “significance.”
    • Parameter values are important, but only in relation to model structure.
Implementation: Validation

- Heuristic validation
  - Given lack of extensive time series data, must rely on analysis of particular historical shocks. Compare available data.
  - Using simulation methods, map out the model’s “response” functions for relevant shocks. Compare to “stylized facts” from historical experience or from experience of comparable countries.
Model Use: “Explain” History

- Do controlled experiments in simulation mode.
- Historical shocks tend to be complex and multifaceted. Can use model to change one exogenous variable at a time.
  - Decomposition analysis.
Model Use: Policy Analysis

• Impact of existing policies
  – Decomposition analysis
  – Policy design in stable environment

• Impact of policy response to external and internal shocks.
  – Structural adjustment
  – Bad, good, and optimal policies.
Model Use: Policy Analysis

• Forecasting
  – Difficult to do. Must project ALL exogenous variables and parameter values.

• Counterfactual history
  – Similar to forecasting, but historical.
  – “What if” experiments.
  – Must know relationship among exogenous variables. May not all be exogenous.
Model Use: Policy Analysis

• Map out “policy response” relationships using controlled simulations.
• Looking for empirically important effects and indirect (general equilibrium) links.
  – Synergy between various policies.
• Search for “good” policies in various environments.
  – Usually operating in a “second best” world.
Analyzing Results

• Structural simulation model acts as the “real world” for domain of applicability.
  – Compare to flight simulators. Pilot does not care how the simulator works.

• Model should disappear. Analyze results using standard economic methods.
  – CGE model produces all price/quantity results. Just need to print them out.
Analyzing Results

- Model is not a “black box”. All results are explainable, usually with simple economics.
- Complex results can be explained by using controlled experiments to decompose effects.
  - Synergy among changes is often important, and can be analyzed by decomposition experiments.