Thoughts on using national or international CGE approaches

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Multi-sectoral models

- Computable General Equilibrium (CGE) models are members of a family of modelling approaches which includes:
  - Input-Output (IO)models
  - TIMES (Linear programming models)
- IO
  - Demand driven model
  - Fixed coefficients in production and consumption
  - No supply-side constraints
- TIMES
  - Linear programming (cost minimising) model
  - Choices between linear discrete techniques
  - Long-term perspective
- In all the energy-environment versions of these models typically no feedback from environment.
- They are complements, rather than competitors

Broad structure of CGE models

- CGE models attempt to capture the way in which a decentralised system operates to organise production and consumption
  - Incentives
  - Co-ordination
- Role of the profit, utility maximisation and market mechanism
- Allocation of scarce resources, but not necessarily strict neo-classical approach
- Incorporate state taxes, subsidies and regulation
  - To supply/control public goods and public bads (emissions)

CGE model as a numerical aid to conceptual thought

- All models abstract/simplify
- CGE models take a complex system whose individual elements are well understood but whose interaction, following a disturbance, may be difficult to predict
  - Sign
    - Competing forces
  - Magnitude
- Strength
  - Theoretical rigour
  - Flexibility
  - Calibrated on actual data (IO accounts)
  - Ability to surprise
    - Backfire

Is big always beautiful? (1)

- In early days our CGE modelling restricted
  - computing power
  - programming skills/packages
    - 3 sectors, single period, 5 minutes to solve
  - data
    - IO data limited and incompatible
- Much extended computing and data processing power
- Scotland and International data more frequent and timely

Is big always beautiful? (2)

- A 1 to 1 map is not useful
  - "To think is to ignore (or forget) differences, to generalise, to abstract" ("Funes and his memory, Borges).
- Need to suppress information for focus
  - Physically/conceptually dealing with results
    - 20 sectors, 20 periods
      - 5 pollutants per sector
      - 5 economic variables per sector
    - Do the math: each simulation gives 20x20x10=4,000 results
- Large number of parameter values
- Difficult to maintain large model

Regional, National or Global?

- We began with a Scottish stand-alone model:
  - Model economic activity, wages, prices, employment, unemployment and sectoral output in small open region
  - explicitly (endogenously) model trade (RUK, ROW) and migration (RUK)
  - implicitly model capital flows
  - However, no inter-action across regions/nations
- Regional Government with:
  - supply-side policies
  - targets
  - limited fiscal powers

Scotland/RUK Model

- Economic activity, modelled simultaneously in both regions
  - Impacts inter-regional trade and migration
  - ROW still “passive”
- National macro-economic closures/constraints
  - national/regional fiscal policy
  - balance of payments/exchange rate

Strengths and weaknesses of multi-regional approach

- Strength
  - Feedback
  - Modelling the regional effect of a national policy
    - 50% of negative impact on Scotland of the UK leaving EU comes from the RUK
    - Simultaneous operation of policy
  - Modelling the national effects of region-specific policy
  - Identifying possible spatial policy co-ordination and conflict
- Weaknesses
  - Data
    - Compatibility
    - Timeliness
- Question
  - Is the geographic disaggregation appropriate?

Global economic models

- Limited knowledge of global models
  - GEM-E3
  - ZEW
  - Reviewing RHOMOLO

- The issues similar to those raised as move from regional to multi-regional/national, writ large.

- Specific Issues
  - Increased focus specific resource constraints/supply-side issues
  - More focus on distribution of costs
  - Complex issue of appropriate spatial disaggregation

Global energy-environment-economy model

- Global problem/national targets
  - Do global models help?
- Consumption accounting/ Environmental footprints
  - But policy usually expressed in production /territorial accounting
- Pollution leakage
  - Potentially problematic, especially where costs imposed on emissions
  - Examples with tax and energy efficiency policy

Regional/national/global

- Ideally:
  - suite of compatible models
  - different levels of sectoral and geographic disaggregation.
- Model adopted would be the one that best matched the problem
- National models would inform the global models: global models would augment and validate national models.

Takeaway

- Primary aim of CGE modelling is comprehension not “black-box”
  - tension with politicians with policy makers caught in the middle
- Key environmental issues are global and involve demand-composition and supply-side issues: need global CGE models
- Ideally want suite of compatible multi-sectoral models
- Although we have made incredible modelling progress over last 25 years, ultimately you always face trade-offs.