Modelling Economy-Energy-Environment Interactions

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Outline

- Modelling
- Demographic Model – long-term driver
- HERMES – ISUS
- TIMES 2
- TIMES 3

Modelling - 1

- Demographics
- Structural Model
  - Based on economic theory
  - Estimated based on behaviour
  - Includes dynamics
  - Equilibrium specification?
- Computable General Equilibrium Model
  - Based on theory
  - Calibrated
  - No dynamics
  - Equilibrium specification

Modelling - 2

- Different approaches:
- Economic Theory
  - Consumption a function of income, wealth etc.
  - Firms maximise profits. Hence when input prices go up output should go down
- Atheoretical
  - Time series – don't specify precise relation
  - Let the data speak.
  - However, they may be mute or results wrong
- Calibration

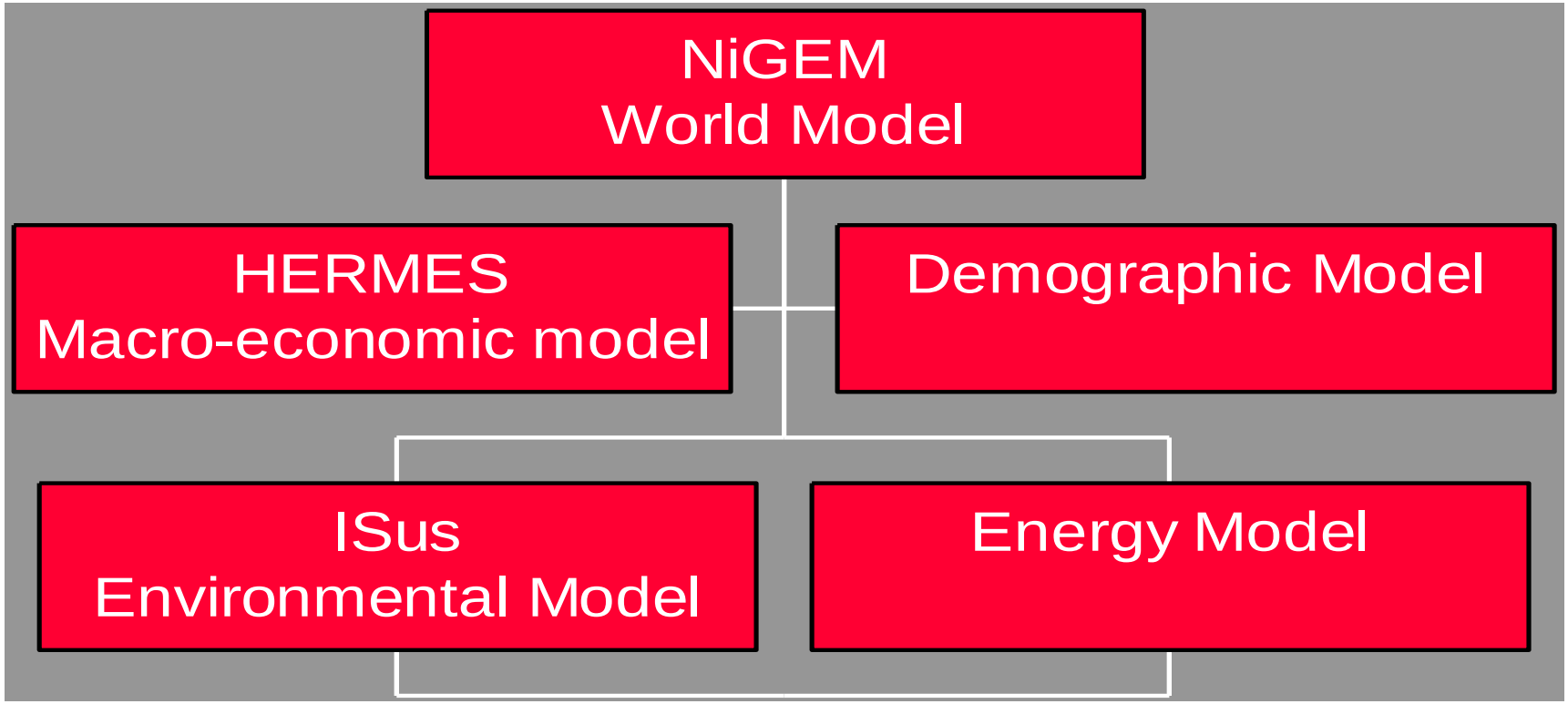
Demographic Model

- Population P at age i P_i at time t is P_{it}
  - $P_{it} = P_{i-1t-1} - M_{i-1t-1} - D_{i-1t-1}$
- M= migration; D= deaths
- Forecast by level of education affects behaviour
- Migration estimates from HERMES
- Labour force participation: education, age and gender
- Households: headship rates: education, age and gender
- Fertility
- Forecast labour force, population, households, births
- Feed back into HERMES - TIMES

HERMES - ISUS

- Macro-Economic Models
  - World
  - Ireland – HERMES
  - Links to energy and Environment – ISUS
  - Max 20 year time horizon
- Limited attention to agriculture
- How to handle technical change?
- Energy and Environment post-recursive
- Uncertainty

Modelling Structure



HERMES - ISUS: Applications

- Medium-Term macro-economic scenarios
  - Related impact on energy, waste, water, emissions
- Effects of external shocks
  - Oil prices, world growth etc.
- Effects of Fiscal Policy
  - e.g. carbon tax, structural budget deficit
- Effects of Public Investment etc. etc.
- Limitations:
  - Medium-term focus, technical change (structural)

TIMES 2

- Long Term Modelling
- Bottom up energy sector
  - Important because it allows for new technologies
  - Problems of technologies yet to be invented
  - Ratchet effect of new technologies
  - Long implementation cycle on mech. engineering
  - Dynamics very uncertain
  - Need simpler macro-economic structure
  - Problems of adding “behaviour” to engineering

TIMES 2

- Demographic Model: key driver of economy
- Macro-Economics: Production Function
  - Relates capital and labour to output
  - Productivity & technical change applied to labour force
  - Structure of demand and output assumed unchanging from 2025 / 2030
  - Simple drivers of energy / environment scenarios
  - Calibration- priors: not based on past behaviour

TIMES 3

- Model feedback from energy / environment to the economy
  - Cost of technical change affects economy
  - Investment?
  - External macro-economic environment?
  - Competitiveness matters
- Behaviour and technical change
  - How will engineering innovations be implemented by real people and companies?
  - Elasticities of demand and substitution?

Conclude

World Model

- Take forecasts from another source
- Needed to answer some questions
  - e.g. what happens if oil prices rise?
  - Will affect world output and inflation
  - Inflation affects monetary policy – interest rates
- Need an external environment on which to hang a model of Ireland
- Simplest – assume growth in world GDP of x%
  - Link Irish growth to world growth

Model of the Irish Economy

- HERMES – annual data
- Capture main relationships:
  - Drivers of Output
  - Output drives income
  - Prices and wages
  - Labour market – equilibrium, full employment?
  - Public finances – equilibrium?
  - External account - equilibrium?
- What happens when shock the model?
  - Multiple equilibria?
- Solution algorithm - simultaneous equations
  - non-linear model but not very non-linear
  - Energy largely post-recursive

Energy Model

- Use “hooks” in Hermes macro-economic model
- Annual data
  - Price and volume data
  - What would quarterly data bring to the table?
- 5 sectors
  - Households, Industry, Services, Agriculture, Transport
- Different fuels:
  - Electricity (separable?), gas, oil, coal, peat, renewable
- Energy use driven by:
  - Economic activity, relative prices, **technical progress**
- Model energy shares
  - Assumptions – separability etc. (does “energy” exist as an aggregate?)
- Output: energy demand and price and emissions
- Feedback to economy?

Economics and engineering

- Differences in approach
- Example of energy efficiency
- Study efficiency gains from insulating houses
  - Technical improvement
  - What will happen in practise?
  - Dealing with humans, not just molecules
  - However, economics must deal with molecules too
- Improved insulation:
  - Some saving in energy
  - Changes in behaviour: some improvement in quality of life
  - Income distribution effects?

Economics and engineering

- Example of electricity
- Modelling energy used in electricity generation
- Begin with engineering
- Assume system minimises cost
- Short run marginal cost v long run marginal cost
- Modelling SEM v modelling GB electricity system