Modeling Climate Change Policies Using GTEM

GTEM – a CGE model of the world economy

It is

- Multiregional
- Multisectoral
- Dynamic
- Energy focused

GTEM explicitly models GHG emissions

ABARE
General Equilibrium

- Utility maximisation by households
- Cost minimisation by producers
- Prices determined to ensure supply = demand

Dynamics in GTEM

GTEM contains the following intertemporal relationships:
- Ongoing input efficiency improvement
- Capital accumulation
  - Returns to capital:
    - Myopic (v1)
    - Rational expectation (v2)
- Debt accumulation
- Population and labor supply changes
- Intertemporal optimisation of quota sales
Types of Production Technologies

- Technology-bundle
  - Electricity
  - Iron and steel
- Conventional energy-factor substitution
  - All other sectors

Technology Bundle: Electricity

Electricity TB

- Brown coal
- Steaming coal
- Petroleum
- Gas
- Nuclear
- Other renewables
- Hydro / geothermal
GHG Sources

- **Carbon dioxide**
  - Combustion
  - Fugitive
  - Industrial processes

- **Methane and Nitrous Oxide**
  - Livestock and farming
  - Fugitive
  - Transport
  - Chemical industries

A Possible Kyoto Scenario

- **Targets**
  - Kyoto targets adopted
  - US excluded from emission reductions
  - Tightening targets

- **International quota trading system**
  - CPR
  - Banking (intertemporal optimisation of quota sales)
  - Agriculture emissions excluded
  - Market power (FSU maximises GNP)

- **CDM:** (2010 = 42 Mt; 2015 = 66 Mt CO$_2$-e)
Impacts

• Quota price = Carbon penalty

• Change in competitiveness
  – Emission intensive vs non-emission intensive
  – Annex B vs Non-Annex B
  – Carbon intensive vs Non-carbon intensive energy
  – Domestic abatement vs International abatement

Overall Impacts

• Deadweight losses as industries restructure

• Trade impacts

• Quota revenue transfers
Global Quota Prices With and Without Banking

Projected Russian Federation and the Ukraine GNP Under Different Quota Sales
Global Quota Prices Under Different Policy Assumptions

2002 $US / t carbon equiv.

- Agriculture included
- Agriculture excluded

Kyoto forever
Tightening targets

Change in primary aluminium production and exports Under tightening abatement targets

relative to the reference case

Production
Exports

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Technology-Bundle Industries: Key Assumptions

• TB industries minimise production costs choosing a mix of known technologies

• Inputs in each technology used in fixed proportions
Conventional Technology: Key Features

- Substitution among primary factors
- Substitution among energy inputs
- Substitution between energy- and factor-composites
- No substitution between non-energy material inputs and energy-factor composite