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Climate Change and Food Security to 2050: A Global Economy-wide Perspective

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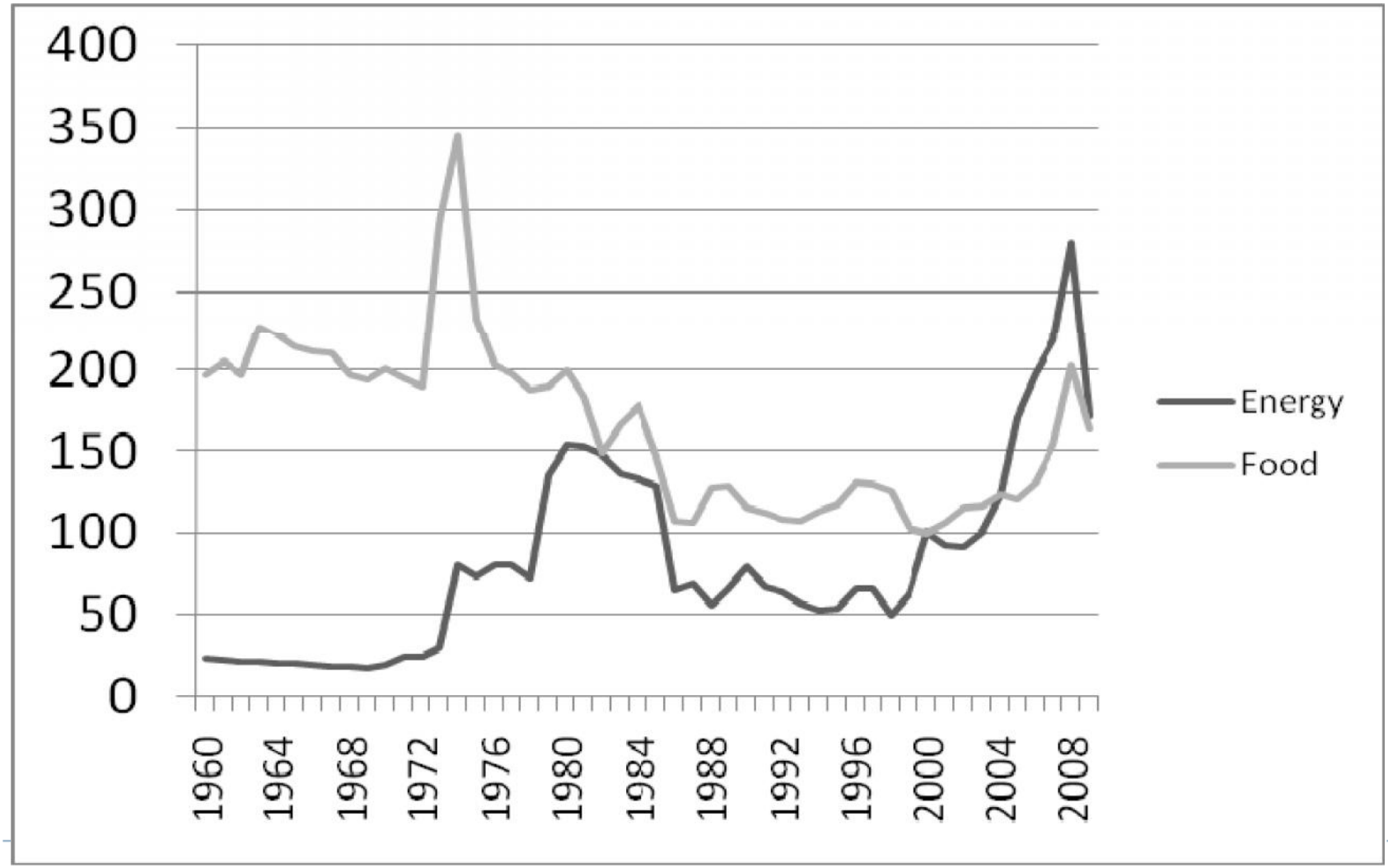
- Climate Change is a complex issue.
- Uncertainty in scientific predictions.
- The role of economists
  - Provide economy-wide projections analysis
  - Assess economic impacts of climate effects (welfare, production and trade patterns)
  - Provide policy advice about mitigation possibilities.

Recent analyses of the possible adverse effects of climate change on agriculture in developing countries have raised food security concerns, especially for farm households whose crop productivity is expected to fall.

International price indexes for food and fossil fuel energy raw materials, 1960 to 2009.

(2000 = 100)



- Fluctuations in agricultural prices are generally larger than those found in other goods
  - Inelastic demand and supply
  - Perishability
  - Variability in supplies induced by random climatic variations, exacerbated by human intervention

- Climate change is expected to have a non-trivial influence on food security even if global mitigation strategies were to be introduced immediately.

- Presence of more-frequent extreme weather events and altered precipitation (thus water availability).

- Crop productivity changes may be:
  - beneficial in cooler temperate regions
  - Expected to reduce farm land and labour productivity in the tropics (Cline 2007, Mendelsohn 2009, Nelson et al 2009).

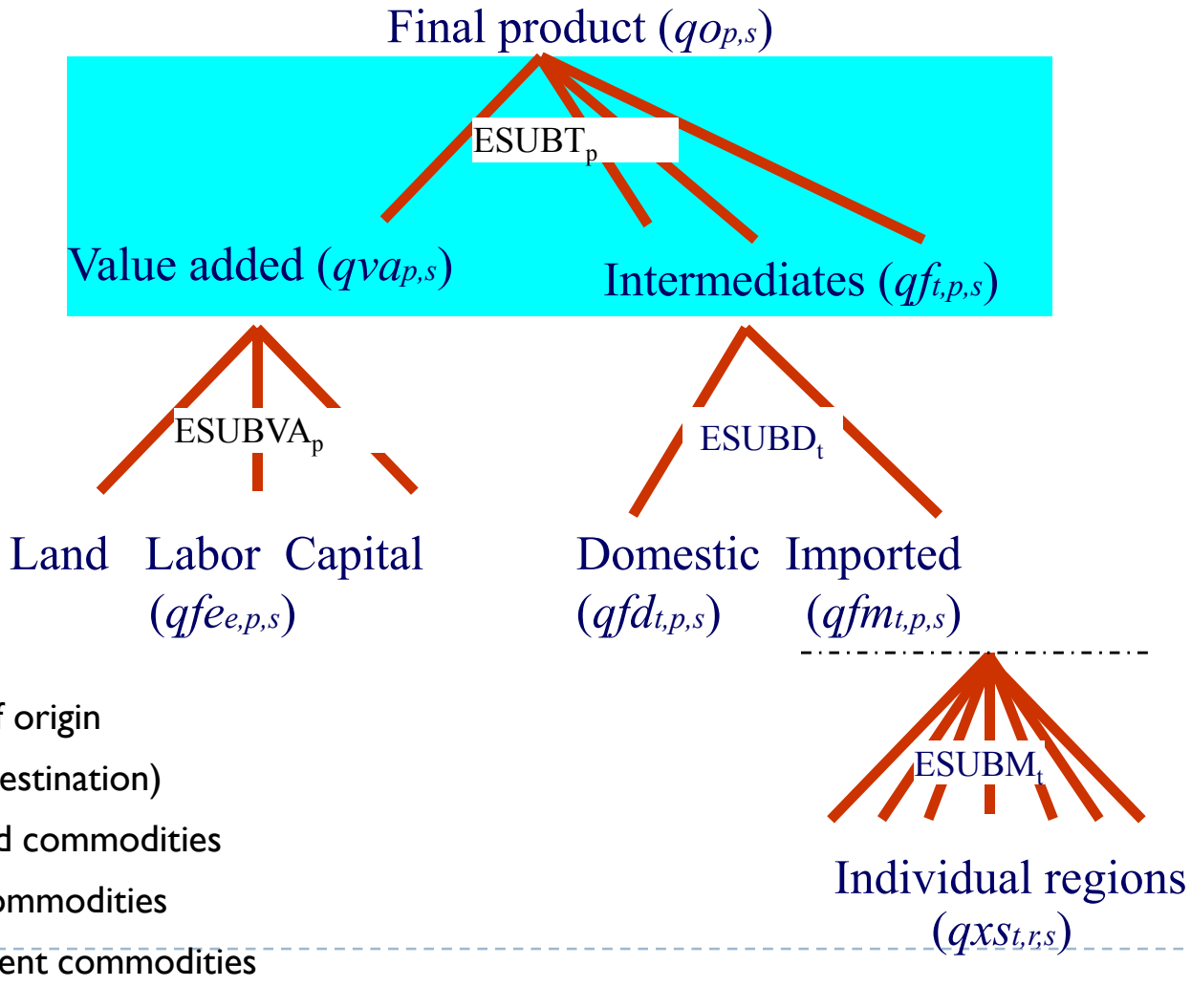
- What would be the market and economic welfare effects of CC effects over productivity of global agricultural resources?

Framework

We use the GTAP (CGE) global economy-wide model to:

- Provide projections of the world economy to 2030 and 2050.
- Compare with projections including assumed impacts of climate change on productivity (based on damage function analysis).
  - -- Crop and land productivity (Hertel et al 2010; adjustments for Australia in line with 2008 Garnaut review).
  - -- Productivity of unskilled labour (van der Mensbrughhe and Rosen 2010).

Nested CES Production Function for commodity *p*, in region *s*



Subscripts:

r – region of origin

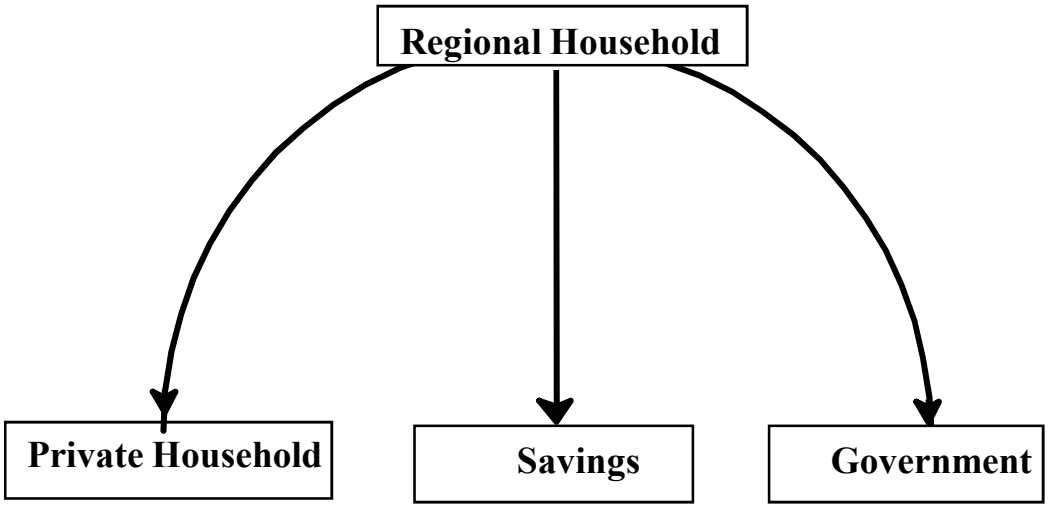
s - region (destination)

p - produced commodities

t - traded commodities

e - endowment commodities

Regional Household
Components of Final Demand



Regional household

-receives all income generated in region

-spends that income according to a Cobb-Douglas utility function

- Advantage:

Welfare indicator offered by regional household utility function

- Disadvantage:

No link between government expenditures and taxes

Framework

- Create *valid* wide-economy projections, 2030 and 2050
  - Endowments projections from UN and World bank
  - Target GDP projections
  - Endogenize TFP, allowing for sectoral and regional differentiation
  - Endogenize price projections

Challenges in providing projections:

- Proper closure in capital markets: flexibility of investment decisions
- Time dimension 2050 and the rate of endowments accumulation in China
- Calibration of price trends and magnitudes
- Feasible structural change in the "new" economies
  - Related to new country and global shares of agriculture, manufacturing and services.

- No single uniform projection is being used. Many different challenges and inconsistencies in current ones.

Shocks

- Yield shocks are generally positive for temperate countries (except for rice, cotton and maize) and fruits and vegetables in Australia.
- Magnitudes are small in relative terms considering time horizon and productivity growth. Land rents are expected to account for less than one-tenth of GDP in even the most agrarian economies.
- No precise predictions of the likely magnitude of unskilled labour productivity in tropical and dessertified developing countries (-3% by 2030 and another -3% by 2050).

Climate Change Effects, Self-sufficiency

	2004	2030	2050	CC-2030	CC-2050
High-income	96	112	127	+0.5	+2.4
Developing	100	93	89	-0.6	-1.6
USA	103	112	122	+0.6	+0.9
Australia	138	152	167	+1.6	+6.1
China	97	90	86	-1.0	-3.2
Indonesia	95	84	79	-0.2	+3.8

Climate Change Effects, % changes

	2030		2050	
	Ag Value added	Exports	Ag Value added	Exports
High-income	-0.9	1.6	-5.1	6.4
Developing	-1.6	-3.5	-4.6	-4.8
USA	-1.2	2.4	-5.1	2.5
Australia	-2.0	2.7	-6.8	9.0
China	-4.0	-23.2	-9.8	-43.6
Indonesia	0.0	8.4	0.1	117

Climate Change Effects, Welfare US $B

	2030	2050
High-income	-8.2 (-0.1)	-40.3 (-0.1)
Developing	-155.9 (-0.9)	-417.6 (-0.6)
World	-164.1 (-0.3)	-457.9 (-0.6)
USA	-0.9 (-0.01)	-5.5 (-0.03)
Australia	-1.2 (-0.1)	-4.6 (-0.3)
China	-46.7 (-0.1)	-154.5 (-1.9)
Indonesia	-5.4 (-0.9)	-9.9 (-1.0)

Caveats

- Only 2 of the many expected impacts (energy demand, water availability, sea level rise, tourism)
- Period 2050-2100 critical, exponential effects
- Offsetting effects of shocks used. Need of more sophisticated land damage functions/changes
- Dynamic model, energy relationship between biofuels and energy
- Extreme weather effects. Long term trend

Conclusions

- Underlines the usefulness of a GE approach to draw implications for agricultural trade and climate change (+ and – shocks, net impact).
- Long term medium trend results are less pessimistic than some earlier studies
  - Nelson et al (2009) +35-70% ag prices
  - Cline (2007) output HIC +8%; DC -8%.
- Need of including stochastic component
  - CC may exacerbate weather variability
  - Most damaging effects result from extreme events

Questions ?

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