COMPARISON OF AVAILABLE MODELLING APPROACHES FOR ILUC ASSESSMENTS RELATED TO BIOFUELS

Peter Witzke
EuroCARE, Bonn, Germany

Outline of the Presentation

- Introduction
- Review of existing methodologies and models
- Critical modelling issues
  - "Available" area definition
  - Calibration issues
  - Elasticities
  - Linking Issues
- Conclusions

Possible cases of ILUC with certificates

- **Immediate effect 1: Import diversion**

  More EU demand for palm oil from certified production of country A

  => Less palm oil exports from A to country C

  => More palm oil exports from non certified production in country B to country C

  => potential loss of tropical forests in B

- **Immediate effect 2: Admissible ILUC**

  More EU demand for palm oil from certified production of A

  => Less exports of other crop products from A to country C

  => More other crop exports from non certified production in country B to country C

  => potential loss of tropical forests in B

- **Immediate effect 3: Yield increase**

  More EU demand for palm oil from certified production of A

  => Yield increases in country A matching increased demand

  Favourable case, but would imply high yield responsiveness relative to area responsiveness

  (Intensification may have other undesirable impacts: N2O, biodiversity…)

Policy Instruments

CAP

- **At the beginning of the production chain**
- **Improved competitiveness of energy crops**
- **Centralized policy (EU level)**
- **Instruments:**
  - *set-aside*
  - ***direct payments***
  - *aid for energy crops*

Regional und Structural Policy

- **In the middle of the production chain**
- **Only in specific support areas**
- **Centralized policy (EU level)**
- **Instruments:**
  - ***Investment aid***

Energy Policy

- **At the end of the production chain**
- **Decentralized policy (strong national influence)**
- **Instruments:**
  - ***tax reduction***
  - ***blending goals***

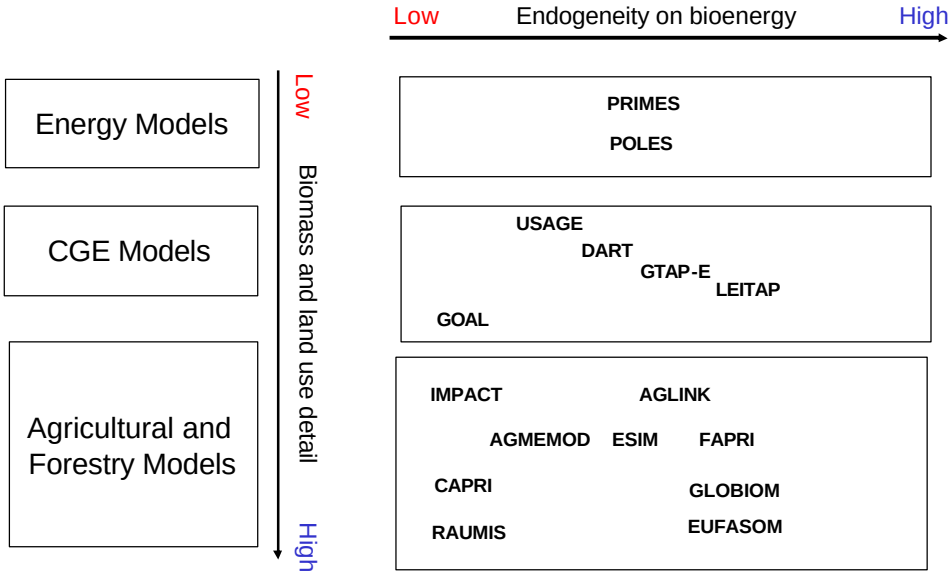
Trade Policy

- **Traditionally: protection for European bioenergy production (raw commodities as well as biofuels)**
- **Centralized policy (EU level)**
- **Instruments: *tariffs, import quotas, certification systems***

Implicit Policy

- **Hypothetical instruments: quantity targets or carbon price**

Review of some economic models



Energy Models

- PRIMES:
  - Independent supply functions for energy crops with capacity constraints
    - No set aside policies or other CAP, no interactions between crops etc.
    - "Available area" is behind capacity contraints
  - Detailed transformation processes in new biomass component (12 biomass energy products)
  - Interaction with demand through bioenergy related prices
  - Demand for bioenergy derived as in general PRIMES:
    - Intertemporal cost minimisation, given demand for energy incl. total transport services, GDP, crude oil price, world markets)
    - non competitive price setting,
    - Detailed vintage approach for whole energy sector (24 energy forms like crude oil, diesel, gasolene, electricity etc., several hundred plant types),
    - capacity expansion and use, learning, adaptive expectations
- POLES:
  - More aggregated than PRIMES, but global
  - Use of biofuels modelled within a technology diffusion module (technological pathways)

CGE models

- LEITAP (ongoing project EURURALIS 2.0):
  - 1st generation of biofuels: standard arable feed stocks (oilseeds, cereals, sugar beet)
  - Nested CES structure: capital-energy → energy → non-electric → non-coal → fuel → diesel & gasoline vs. ethanol → raw inputs
  - 2nd generation of biofuels (planned): new arable crops, forestry, waste
  - Parameter changes to reflect bio-fuel directive, but subsidies and tariffs included
- GTAP-E
  - Less detailed starting point for LEITAP
  - Version with 18 Agro Ecological Zones (AEZ) and explicit by-products
- USAGE (Dixon, Rimmer)
  - Detailed in energy economy and other nonag sectors (about 500),
  - only crop and animal based agriculture
  - Increase in biofuel use modelled through changes in parameters (productivity)
- DART (IfW)
  - GTAP database, dynamic
  - Aggregate on agriculture but links to RAUMIS & CAPRI being developed
- GOAL (Gohin)
  - Strong ag focus (32 ag products), 31 proccessing sectors, 3 non ag sectors (input supply, food retail, other prod & services), only EU15
  - Biofuel directive as additional public demand

Agricultural Equilibrium Models

- AGLINK:
  - Prod of biofuel = f (net prod cost / crude oil price), [cost net of by-products]
  - Shares of feed stocks = CES (net prd cost i / net prd cost j)
  - demand shifters for simulation
  - Capacity utilisation separate from expansion
- ESIM:
  - Prod of biofuel = f (biofuel price, ag raw product prices, prices of by products)
    - Biofuel price = f (fossil price, taxes, tariffs)
  - Shares of feed stocks = CES(net prd cost i / net prd cost j)
  - demand shifters for simulation
  - 2 functions for feed stocks on set aside land and non set aside land (regime switch?)
- FAPRI:
  - Supply = f (ethanol price, corn price, prices of by products, gas price)
  - Demand = f (ethanol price, fossil price, GDP, population, policy)
  - Capacity utilisation separate from expansion
- AGMEMOD:
  - decomposition of demand: food, industrial and biofuel use, details evolving
  - demand shifters for simulation
- IMPACT (IFPRI):
  - Exogenous demand for biofuels is translated into demand for feed stocks

Ag and Forestry Programming Models

- EUFASOM (more aggregated but global: GLOBIOM) :
  - Explicit non-food production lines from agricultural and forestry products
  - Endogenous prices and production levels for renewable products
  - Challenging plan: Extend detailed programming approach to processing stage
  - Permits strong regional disaggregation for linkage to biophysical models for agriculture and forestry
  - Strong responsiveness of LP framework counteracted by disaggregation
  - Calibration problems (observed forests exceed profit max age)
- RAUMIS:
  - Traditional activities plus 'energy maize'.
  - Prices exogenous, no observations in base year
  - Pragmatic calibration: "PMP terms" taken over from cereals
- CAPRI:
  - Exogenous demand for biofuels is translated into demand for feed stocks
  - Linkage to GTAP: price changes adopted
  - Linkage to PRIMES: quantity changes of EU biofuel demand adopted
  - Endogenous response to incentives with behavioural functions under way

Issue 1: "Available area" definition

- **Wide definition of available areas for ILUC modelling**

  All non urban and accessible area suitable for agricultural or forestry production is "available", perhaps after deducting "protected" areas (GTAP-AEZ, LEITAP), but use is determined by prices

  => May neglect natural differences between areas used for forestry, pasture and arable agriculture

- **Narrow definition of available areas for ILUC modelling**

  Forestry (and perhaps permanent pasture) is considered "not available" (ESIM, CAPRI)

  => removes most interesting question for global analysis from consideration

  => Defendable for narrow European analysis

- **Very narrow definition of available area**

  Available is all land currently unused for agriculture and forestry (set aside and fallow land)

  => Key economic problem is turned into purely technical problem for feasibility or potential calculations (IMAGE stand alone application)

- **No check of available area**

  In models with an implicit "other area" (e.g. FAPRI international model)

  => Important plausibility check is missing

Issue 2: Calibration

- Key problem: missing observations
- Parameters transferred from other products (RAUMIS, ESIM, LEITAP)
  - RAUMIS: uses cereal info for energy maize
  - ESIM derives demand parameters for biofuels from food demand
  - LEITAP: uses cereal info for miscanthus
- Base year calibration
  - permits to include current policies
  - increases confidence
  - but base year calibration is easy with free parameters
- Responsiveness matters, not base year reproduction!

Issue 3: Yield and area elasticities

- Econometric problem: how to estimate when state of technology, industry structure and policy framework is changing together with prices?
- Parameters often based on judgement which may be contentious
- Recommendation: Sensitivity analysis, transparent documentation of elasticities
- Possibility of threshold effects (as is typical in programming models)
- Should publicly funded research or technology transfer be factored into elasticities?
  - No, for the sake of transparency
  - No, as linkage is not necessary
- At least equally important: baseline projections for yields as ILUC decreases with yields
  - Long run yield projections (50 years) difficult
    - both for statistical procedures (length of series, stable trend?) as well as
    - technical procedures (observed yields in 2000 probably appeared infeasible in 1950)

Issue 4: Linking models

- Different focus of models may yield complementarities
  - CAPRI – PRIMES: EC4MACS
  - ESIM – LEITAP: Scenar2020…
- Easy if only one way flow of information
  - CAPRI => RAUMIS, GTAP => CAPRI (prices)
  - IMAGE => CLUEs (aggregate areas)
- Iterative calibration if several variable are exchanged, or:
- Response functions or parameters if feasible
  - SENSOR, SEAMLESS, EC4MACS, EDIM
  - CAPRI supply-market interaction: also within model
- Cross checking of key variables (soft linkage)
  - Current status in PRIMES - FASOM – CAPRI interaction
  - Typical in initial phase of model interaction
  - Contradictory results may be inconsistent, but are still illuminating

Conclusions

- Heterogeneity of approaches typical for new area of research
- Minimalist approach to policy:
  - Shock to feedstock demand or carbon price
- Infeasible approach:
  - Explicit policy at all levels: border measures, certification, national energy policy, regional investment support
- Key limitation: data
  - In next years increasingly overcome for first generation biofuels => less excuses for not estimating
  - Bioethanol and biodiesel data on global trade flows?
  - Second generation biofuels? => Calibration problems
- Key limitation: complexity
  - No super model can handle the global economy, product disaggregation, technology disaggregation, regional disaggregation at the same time

Thank you for your attention!