Modelling global biofuel impacts

Approach, results and issues

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Global Biofuel Developments: Modeling the Effects on Agriculture
Changing interests in biofuels: Ethanol production and crude oil price

Source: FAOSTAT (non-food only)
Source: F.O. Licht's

Directorate for Trade and Agriculture
Things are moving fast…

Les biocarburants bientôt disponibles dans les stations service

Le plein S.V.P. !

Oui, mais ? Canne à sucre ? Betterave ? Pomme de terre ?

Evh... Choucroute ?
Why do we model biofuels?

- Strong policy engagement in biofuels, other bioenergy
- Knowledge base still fairly weak
  - Contribution to objectives
    - environment, energy, farm income
  - Unintended side-effects
    - market distortions, environment, costs

→ OECD work in its initial phase only
Main problems in biofuel modelling

- Link between crude oil and fossil fuel prices
  - and finally biofuel prices
- Cost and profitability assessment
  - Responsiveness of biofuel industry
- Two fuels, various feedstocks (particularly EU)
  - contribution of each feedstock type
- Link to agricultural markets
- (Link of crude oil prices to agric. production costs)
Modelling scheme (1)

OECD Aglink Model

FAO Cosimo Model

World Agricultural Trade Model
All relevant regions, most commodities covered

World Sugar Model
Modelling scheme (2)

Crude oil prices
Agricultural commodity prices
Biofuel Module
Demand for crops; supply of feed

World Agricultural Trade Model
The Biofuel Module
Main variables and linkages

- Crude oil prices
- Fossil fuel prices
- Fuel taxes
- Net cost ratios
  - Production capacity
  - Capacity use share
  - Biofuel production
  - Feedstock shares
  - Feedstock use
  - By-product output
  - World Agricultural Trade Model
  - By-product prices
Key modelling issues (1)
Profitability of biofuel production

Net production costs of biofuels

\[ NC_{r,t}^{i,j} = \alpha_{r,t}^{i,j} * PP_{r,t}^{i} + \beta_{r,t}^{i,j} * XP_{t}^{OIL} * XR_{r,t} + \gamma_{r,t}^{i,j} - \delta_{r,t}^{i,j,EF} * PP_{r,t}^{CG} - \delta_{r,t}^{i,j,PF} * PP_{r,t}^{OM} - \delta_{r,t}^{i,j,OBP} \]

Fossil fuel prices

\[ CP_{r,t}^{i'} = a_{r,t}^{j'} + b_{r,t}^{j'} * XP_{t}^{OIL} * XR_{r,t} + TAX_{r,t}^{j'} \]

Net cost ratio

\[ CRT_{r,t}^{j} = \frac{NC_{r,t}^{j} * \lambda_{r,t}^{j'}}{CP_{r,t}^{j'}} \]
Key modelling issues (2)

Biofuel production capacity development

\[
\ln(QPC_{r,t}^j) = QPC_{r,t-1}^j + \chi_r^j + \phi_r^j \times \ln \left( \frac{CRT_{r,t-1}^j + CRT_{r,t-2}^j + CRT_{r,t-3}^j}{3} \right) + \ln(R.QPC_{r,t}^j)
\]

Biofuel production capacity use

\[
QPSL_{r,t}^j = QPSL_{r,t}^j + \frac{1 - QPSL_{r,t}^j}{1 + LOGA_r^j \times e^{ \left( LOGB_r^j \times (CRT_{r,t-1}^j) \right)}}
\]
Market impacts

Some results from first study

- Constant biofuels scenario
  - Base of comparison
- Policy-target scenario
- High oil price scenario 60 US$ (instead of 46 – 34 US$)
  - Higher production costs in agriculture
  - Increased biofuel production due to higher fuel prices
Demand growth for biofuels
2004 to 2014, in % of total consumption in 2004
Noticeable impacts on world market prices (2014)

- Oilseeds
- Maize
- Wheat
- Vegetable oils
- Oilseed cakes
- Sugar

Impact on world market prices relative to constant biofuel production at 2004 levels.

-10% 0% 10% 20% 30% 40% 50% 60% 70%
High oil price scenario

*Principal results*

- High crude oil prices have important effects on agricultural markets
  - Higher production costs reduce global crop supply by 1-3% in the medium term
  - Higher biofuel production stimulates crop demand
  - Higher world crop prices: up 12-17% compared to lower oil prices
  - Dominated by ag production cost changes?
High oil price scenario

2014 world price impact of higher crude oil prices relative to policy target scenario

- Wheat
- Coarse grains
- Oilseeds
- Vegetable oils
- Oil meals
- Sugar

Agr. Production Cost Effect
Biofuels Effect

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Concluding remarks:
What needs to be improved?

• Data! Data!! Data!!!
• Regional representation
• Representation of support policies
• Responsiveness of biofuel industries
• Responsiveness of biofuel demand
• Next-generation biofuels
• Other forms of bioenergy
Thank you!

www.oecd.org/tad

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