

GTAP Modeling Changes Over the Past Year

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1

Steps in Our Analysis

- Introduce the first and second generation of biofuels into version 7 of the GTAP data base (2004).
- Introduce new cellulosic biofuels and their supporting activities into the GTAP-BIO model.
- Make modification in land supply module to support production of dedicated crops on marginal cropland.
- Add greater flexibility in acreage switching among crops.
- Include an endogenous yield adjustment for cropland pasture in response to changes in cropland pasture rent.

2

New GTAP-BIO Database

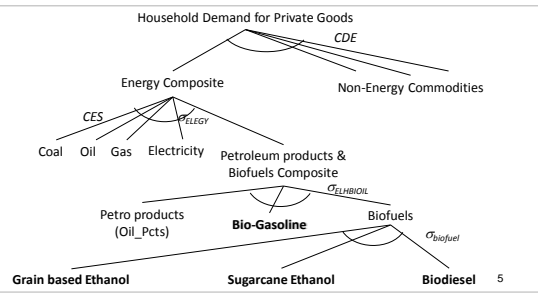
- Introduced 2004 global production, consumption, and trade of the first generation of biofuels including grain ethanol, sugarcane ethanol, and biodiesel into the database following Taheripour et al. (2007).
- Modified the basic GTAP database as was done previously:
 - Split GTAP food industry into food and feed industries,
 - Split GTAP vegetable oil into crude and refined vegetable oil industries.
- Introduced biofuel by-products into the 2004 database.
- Updated land use, land cover, and land rent headers to 2004 following Avetisyan, Baldos, and Hertel (2010).

3

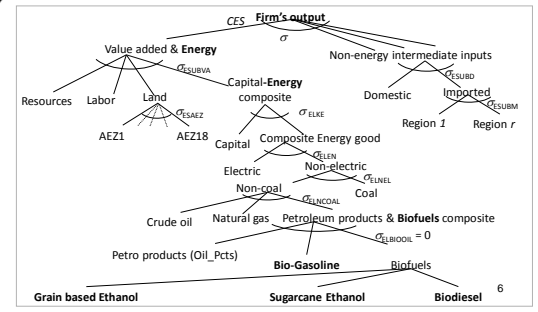
Introduced Cellulosic Feedstock and Biofuels Industries into Version 7

- Corn stover industry which collects corn stover from corn land and delivers it to the cellulosic biofuel industry.
- Dedicated crop industry (miscanthus) produces the feedstock and delivers it to the biofuel industry.
- Introduced a biofuel (bio-gasoline) processing industry for each feedstock with identical cost structures.
- Since none of these industries exist, we relied on the best available data to represent the industries. 4

Household Demand Structure



Firms Input Demand Structure



Add Greater Flexibility in Acreage Switching Among Crops

- In our previous work we and others had observed that GTAP does not seem to have as much acreage responsiveness as we experienced in the decade 2000-09.
- In this analysis, we asked the question of whether there is any difference in farmers reactions to crop price changes in the past decade and earlier periods.

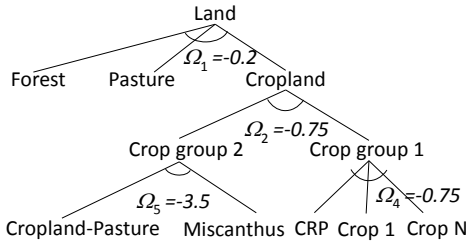
Add Greater Flexibility in Acreage Switching Among Crops

- To answer this question we estimated acreage response to changes in soybean and corn returns per acre over different decades prior to 2000 and for 2000-2009.
- The following regression shows the results for the time period of 2000-2009:
 - $\Delta \text{Harvested corn area (acres)} = 1.388 + 0.084 \Delta \text{Corn revenue/acre}(t-1) - 0.138 \Delta \text{Soybean revenue/acre}(t-1)$,
 - The independent variable t values are 2.9 and 3.0 respectively, and the adjusted R^2 is 0.44.
- We did the same regressions for prior periods and found no significant relationship.

Add Greater Flexibility in Acreage Switching Among Crops

- As the literature suggests, in prior periods, government policy was a major driver, and now it is commodity prices and revenue.
- For these reasons, we increased the supply transformation elasticity among traditional crops that helps govern the response in acreage share to changes in commodity prices from -0.5 to -0.75.
- However, we are still experimenting with this parameter value to make sure it is the best representation of reality possible.

New land supply tree



Endogenous Cropland Pasture Yield Change

- We received comments on our previous work suggesting that the increased use of land for biofuels would lead to investments in increased productivity as land rents increased.
- This led us to introduce an endogenous change in cropland pasture productivity as cropland pasture rent increases due to higher demand for the resource.
- This change in productivity is a function of the change in rent and a new elasticity parameter.¹¹

Endogenous Cropland Pasture Yield Change

$$af_{pasture} = \alpha \left[1 + \beta \left(\frac{A}{A+B} \right) \right] pf$$

- $af_{pasture}$ is the percentage change in the cropland pasture yield,
- A: Area under miscanthus production,
- B: Initial area of cropland pasture,
- pf : Percent change in the cropland pasture rent,
- α : Scalar yield elasticity (0.4),
- β : Scalar yield adjustment factor (10).

Thank you!
Questions and Comments

For more information:

<http://www.ces.purdue.edu/bioenergy>
<http://www.agecon.purdue.edu/directory/details.asp?username=wtynr>
