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GTAP Modeling Changes Over the Past Year

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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.

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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).

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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.

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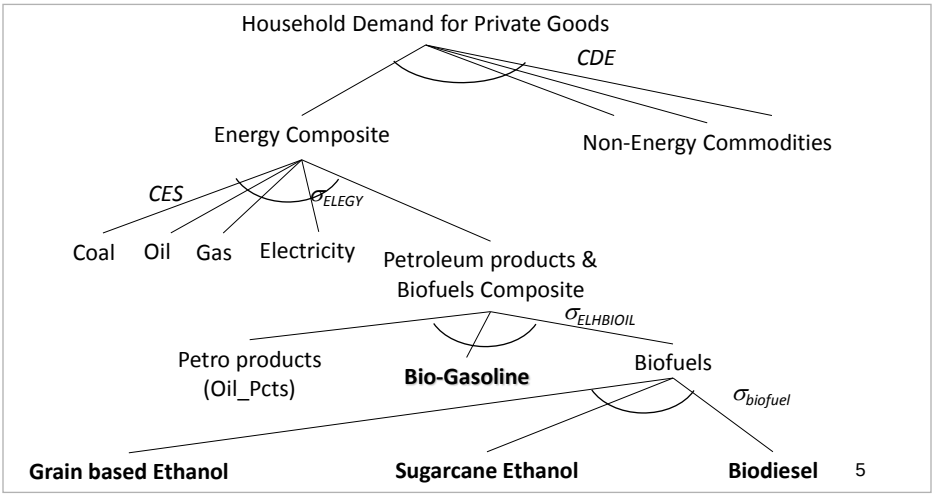
Household Demand Structure



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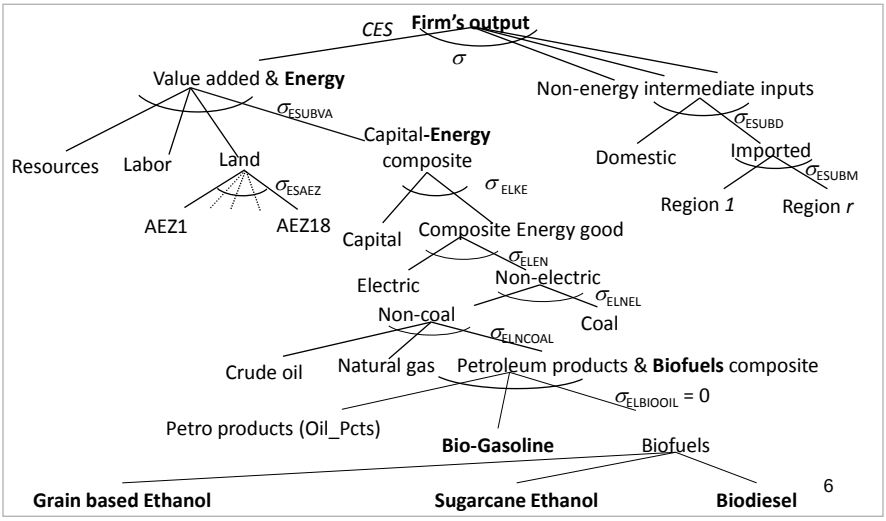
Firms Input Demand Structure



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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.

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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:
  - ΔHarvested corn area (acres) = 1.388 + 0.084 ΔCorn revenue/acre(t-1) – 0.138 ΔSoybean 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.

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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.

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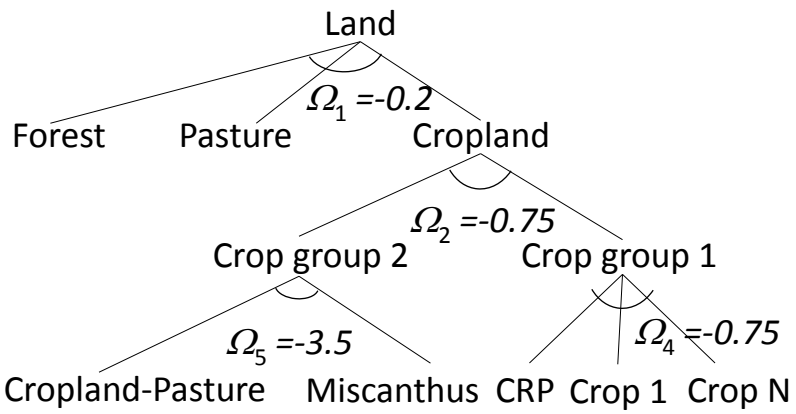
New land supply tree



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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.

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Endogenous Cropland Pasture Yield Change

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

- $af_{pasture}$ 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).

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Thank you!

Questions and Comments

For more information:

http://www.ces.purdue.edu/bioenergy

http://www.agecon.purdue.edu/directory/details.asp?username=wtyner