Biofuel, the Rural Economy, and Farm Structure

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Transition to a Bioeconomy: Risks, Infrastructure and Industry Evolution
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The Ethanol Explosion

Billion Gallons


2001 2004 2007
Drivers of Feedstock Price

- Processor’s break-even price for corn:

\[ P_{\text{Corn}} = 2.80 \times (P_G \times 0.667 + T_{\text{Credit}} + V_O + V_{\text{DDG}} - C_K - C_O) \]

- $60 per bbl price of crude oil translates into $2.07/gallon price of gasoline ($100 bbl oil is $3.45 P_G and $2.30 P_E)

- Sensitivity to current tax credit of $0.51/gallon ($1.40/bu)

- Long Run Breakeven Corn Price: $4/bu at $60/bbl
Implications for agricultural commodities
prices and food-fuel debate

- Corn and biomass price driven by ethanol price driven by oil price
- Growing global demand for crude oil and livestock products
- Crop and livestock products competing for same domestic and global cropland base – all prices increase (Searchinger, et al)
- Higher commodity prices capitalized into cropland values so growing opportunity cost of land, including land producing biomass
Is biomass ethanol the answer?

- **Biomass Processor’s WTP:**
  
  \[ P_{\text{Biomass}} = (P_{\text{Gas}} \cdot E_V + T_{\text{Credit}} + V_O + V_{BP} - C_K - C_V - C_F - C_E)Y_E \]

  \[ P_{\text{Biomass}} = \text{MWTP} \]

- **Biomass Supplier’s WTA:**
  
  \[ P_{S\text{Biomass}} = C_{NR} + C_{HM} + C_S + C_T \cdot D + (C_{ES} + C_{Opp})/Y_B \]

  \[ P_{S\text{Biomass}} = \text{MWTA} \]

- **Break-even market equilibrium:** \( \text{MWTP} = \text{MWTA} \)
Midwest the Saudi Arabia of Biomass
U.S. Cellulosic Ethanol Plants
New or Under Construction
Current Biomass Ethanol Economics

- Maximum breakeven processor price for biomass is $60/ton with $60/bbl oil; $150/dry ton @ $120/bbl
- Minimum farmer price for delivered biomass is $50-175/ton
- Harvest, transport, and storage costs are $45-100/ton
- Establishment costs are $0-275+/acre
- Opportunity cost of corn land for biomass crop is $200-400/acre
- What is implicit cost/ton of carbon reduced by expanding biofuel?
- Is biofuel an efficient solution to reducing carbon and GHG emissions?
Renewable Fuels Standard

Source: Renewable Fuels Association
Biofuel Policy Approach to Carbon Problem

Impacts of 2007 Energy Independence and Security Act

- 15B gal corn ethanol by 2016 and 20+B gal biomass ethanol by 2022
- Know where we want to go with biomass, residue, and waste biofuels, but how we get there is uncertain
- Life-cycle analyses for new facilities and feedstock create uncertainties
- Implementation of new RFS (e.g., use of waivers) will be critical
- Role of tax credits and tariffs becomes less important
Biofuel Policy Approach to Carbon Problem

Impact of 2008 Food, Conservation and Energy Act

- Lowers VEETC to $.45/gal
- Establishes $1.01 credit for biomass ethanol
- Provides $45/ton payment to producers for HST of biomass to processing plants
Impacts on Rural America of Ethanol Industry?

- Initial plant size was smaller because of capital subsidies leveled playing field and rents captured by local investors: 5 - 40M gal

- Newer plants in era of high oil prices: 50-100M and 275M gal

- Labor-output ratios: 2.0L/1M gal to 0.4L/1M gallons

- Local ownership share decreasing with plant size

- Marginal rural economy impacts of corn ethanol expansion decreasing
Implications of evolving industry structure for the rural economy

- Use a national IO (IMPLAN) model for projections

- Compare 2007 to 2016 CARD baseline ($60/bbl constrained) and LR ($70/bbl unconstrained) equilibrium solutions; 15B and 29B gal ethanol (Searchinger, et al)

- Recognize limitations of IO approach, but indicative of direction and livestock tradeoffs of expansion

- Too early to speculate on biomass feedstock impacts
## Estimated Economic Impacts of U.S. Ethanol Industry

<table>
<thead>
<tr>
<th></th>
<th>Solutions</th>
<th>Direct</th>
<th>Indirect</th>
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<th>Total</th>
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<td><strong>Value Added ($ Millions)</strong></td>
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Composite rural economic impacts

- 2007-2016 baseline crop ($60/bbl oil constrained)
  - E direct and total VA $0.3B and $0.8B
  - LP direct and total VA $1.6B and $15.2B
  - E direct and total labor income $0.1B and $0.6B
  - LP direct and total labor income $1.3B and $9.2B
  - E direct and total jobs 2.4K and 13.5K
  - LP direct and total jobs 34.3K and 268.4K
- 2016 baseline crop ($60/bbl) – LRE crop ($70/bbl)
  - E direct and total VA $0.0B and $2.6B
  - LP direct and total VA -$0.4B and -$4.2B
  - E direct and total labor income $0.3B and $1.8B
  - LP direct and total labor income -$0.4B and -$2.5B
  - E direct and total jobs 6.0K and 37.2K
  - LP direct and total jobs -9.5K and -74.5K
Biofuels and future farm structure

- Corn Belt commodity agriculture will continue current structural trends
  - Larger commercial farms and less operators
  - Corn stover production will not alter trends
  - Harvest window and HST costs
  - Smaller farms will not be players
  - Integrated farming operations and demand for rural labor?
  - Role of corn and corn stover in long run equation
Biofuels and future farm structure

- Major areas of biomass production (e.g., South, SP, NE, PNW) will focus on large scale, contract production (Epplin)
  - Logistics drive biomass fuels to large scale HST service providers (eg, coops, private)
  - Operating between producer and processor (wheat cutters, hay harvesters, cane sugar)
  - Further concentrate operation of land
  - Storage costs may be prohibitive for some regions and feedstocks
Biofuels and future farm structure

- Processing has scale economies and need 1000-4000 dry tons/day for 25-100M gal/year
  - Possibly use multiple biomass feedstocks
  - Technology will reduce enzyme and processing costs, increase yield, expand byproducts, and change fuel platform
  - Just in time deliveries (2 weeks storage?)
  - Contracting and biofuel plant financing issue
Summary and Conclusions

- Ethanol industry structure will continue to evolve as will farm structure.

- Ethanol expansion having a impact on the rural economy, but with decreasing marginal impacts over time.

- Expansion of corn ethanol above 20B gallons may have negative rural economy impacts.

- Is biomass ethanol the answer?
  - MWTP less than MWTA for biomass at 2007 prices.
  - Carbon price necessary to sustain a biomass fuel industry.
  - Will biomass compete with commodities for cropland?
  - Biomass RFS mandates response regardless of cost.
  - Biomass fuels, rural communities, and environment.
Thank you!
Sensitivity of Biorefinery's MWTP

- Oil price ($50, 60, 120)
- EV (0.667, 1)
- Byproduct ($0, 0.09, 0.18)
- Enzyme ($0.5, 0.2, 0.1)
- YE (50, 60, 100)

Break-even Price

- Low
- Baseline
- High
Sensitivity of Corn Stover Supplier's MWTA

- Trans Cost: Low, Baseline, High
- Storage: Low, Baseline, High
- HM ($15,35,55): Low, Baseline, High
- NR ($5,20,30): Low, Baseline, High
- Opp Cost ($50,0,100): Low, Baseline, High

Breakeven Price
Sensitivity of Switchgrass Supplier's MWTA

Breakeven Price

Trans Cost ($10,12,18)  Storage ($5,15,45)  HM ($25,35,45)  NR ($5,15,25)  ES ($100,200,250)  Yield (8,4,2)  Opp Cost ($0,200,400)

Low  Baseline  High
Sensitivity of Miscanthus Supplier's MWTA

- Trans Cost ($10,12,18)
- Storage ($5,15,45)
- HM ($25,35,45)
- NR ($5,15,25)
- ES ($200,275,400)
- Yield (18,9,6)
- Opp Cost ($0,200,400)

Breakeven Price

Low
Baseline
High

IOWA STATE UNIVERSITY
## Range of Breakeven Values for Select Parameters

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