Energy and Climate Policy and the Economics of U.S. Agriculture

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• Justin Baker, Duke and Texas A&M
• Bruce McCarl, Texas A&M
• Rest of FASOMGHG modeling team (Oregon State, EPRI, USDA, EPA)
• USDA Office of Chief Economist/Global Change Program
Overview

• Current Landscape
  – Agriculture and Energy Markets
  – Climate and Energy Policy

• Overview: Agriculture under Cap-and-Trade
  – Potential costs and benefits of mitigation
  – Review of recent studies

• Focus: Duke/TAMU/OSU study

• Conclusions and caveats
Energy and Agricultural Prices Run Together

*Biofuel expansion, renewable energy policies reinforce this link*

Reported in Abbott et al 2009


*Commodity prices and indices are normalized to equal 1.0, on average, for 2002.*
Policy Interactions and U.S. Agriculture

- Climate Legislation
- Energy Markets
- Bioenergy Mandates
- Agricultural Sector
- Carbon “Offset” Markets

- Direct Revenue
- Indirect Revenue
- Direct Costs
- Indirect Costs
“Cap and Trade”

- **Cap**: An absolute limit on GHG emissions allowed during a period
  - Regulated sectors are capped; others are not
  - The cap creates a new currency: emission allowances
- **Trade**: Capped parties are allowed to bid among themselves for the “allowances”
- **Bidding**
  - Auctioned by the government
  - Allocated for free (“grandfathered”) and traded in a market
- **Advantages**
  - Efficiency
    - Price on GHGs: economic incentive for continued reductions
    - Least cost way to achieve a given emission target
      - Those who can reduce emissions more cheaply will trade their allowances to those for whom it is more expensive
  - Equity: Polluter Pays
Cap-and-Trade: How it Affects U.S. Agriculture

• **Direct Positive (or neutral)**
  – Agriculture/forestry is *exempt from the cap*
    • No direct limits put on farms or livestock
  – Can supply offsets to capped sectors if it is profitable to do so
    • Ag soil management, manure management, afforestation, …
  – A successful climate policy (globally) avoids potentially severe threats to agriculture

• **Direct Negative**
  – Input supply sectors *are* capped
    • Fuels
    • Electric power
    • Ag chemicals
  – This raises input costs
Other Impacts to Consider

- **Indirect: Behavioral/market responses**
  - Modify production/practice decisions in response to input price changes driven by carbon price
  - Engage in offsets to receive carbon payments
  - Increased output prices
  - Costs pass down through the value chain (feed -> livestock -> processed goods -> consumers)
What are the Net Economic Impacts of Federal Cap-and-Trade on Agriculture?

• Initial studies emphasize cost impacts…
  1. Doane Advisory Services (2008)
     – Cost side only
     – Input costs impacts of C&T would cause a loss of $8 billion by 2020
  2. FAPRI
     – Analysis for Missouri production
       • 4-10%/acre increased production costs
  3. USDA (2009) initial study
     – Projects cost increases
       • 2%, 4%, and 10%/acre for short, medium and long term
  4. Texas A&M (Outlaw et al)*
     – Output price effects are measured
     – Farm-level analysis
     – Out of 98 farms:
       • 71 see decreased returns, 27 gain

* Different study than the one discussed below, which also has Texas A&M collaborators
More recent studies incorporate offset suite and output price effects

- **UTENN-25x25 Study**
  - Net returns to agriculture are positive and exceed baseline projections for 8 of 9 crops analyzed
  - No afforestation of major shifts in cropland use for carbon prices up to $27/tCO₂

- **Updated USDA (2009b)**
  - Net returns positive for agriculture
    - Annualized gains of ~$20 billion
    - Offset potential in excess of $30 billion by 2050
“The Effects of Low-Carbon Policies on Net Farm Income”

NI/TAMU et al Modeling Effort
WORKING PAPER*

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Greg Latta
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*Results under review, please do not cite at this time.
Approach

• Full structural economic model of the forest and agriculture sectors
  – FASOMGHG

• Integrated Top-down/Bottom-up look at:
  – Land use decisions
  – Commodity markets
  – Economic “welfare” (producer and consumer surplus)
  – Available at:  
    http://www.nicholas.duke.edu/institute/ni.wp.09.04.pdf
Scenarios Analyzed

- **EISA-RFS biofuel mandates included**
  - 30 Billion Gallons/year from Ag and Forest biomass by 2022
  - Biofuel production locked in at mandated levels beyond 2022

- **To simulate GHG mitigation, CO$_2$e prices are imposed on emissions/sequestration sources**
  - $15$/tCO$_2$e
  - $30$/tCO$_2$e
  - $50$/tCO$_2$e
Cost Implications?

• Energy input cost increases
  – $15/tCO₂e: 2.20%/acre
  – $30/tCO₂e: 2.94%/acre
  – $50/tCO₂e: 5.50%/acre

• Why are our estimates different than USDA and others?
  – Producers can respond to higher energy prices through altered production practices, crop mix strategies
GHG Mitigation Across Scenarios

The more negative, the more mitigation

$15/\text{tCO}_2\text{e}$  $30/\text{tCO}_2\text{e}$  $50/\text{tCO}_2\text{e}$

Annualized Emissions Changes from Baseline (Million tCO2e)

Mitigation Scenarios

Preliminary Results: Subject to Change
Direct and Indirect Revenue Benefits

Preliminary Results: Subject to Change
<table>
<thead>
<tr>
<th>Category</th>
<th>$15/tCO2e</th>
<th>$30/tCO2e</th>
<th>$50/tCO2e</th>
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</thead>
<tbody>
<tr>
<td>Afforestation</td>
<td>2,279</td>
<td>8,048</td>
<td>19,522</td>
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<tr>
<td>Forest Management</td>
<td>2,355</td>
<td>6,761</td>
<td>14,919</td>
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<td>Forest Bioelectricity</td>
<td>351</td>
<td>1,021</td>
<td>2,338</td>
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<td>Agricultural Bioelectricity</td>
<td>4,521</td>
<td>10,523</td>
<td>19,096</td>
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<tr>
<td>Manure Management</td>
<td>48</td>
<td>166</td>
<td>357</td>
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<tr>
<td>Enteric Fermentation</td>
<td>294</td>
<td>958</td>
<td>1,856</td>
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<tr>
<td>N Fertilizer Reductions</td>
<td>6</td>
<td>144</td>
<td>501</td>
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<tr>
<td>Ag Soil Carbon</td>
<td>100</td>
<td>561</td>
<td>1,367</td>
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<tr>
<td>Reduced Rice Cultivation</td>
<td>25</td>
<td>80</td>
<td>195</td>
</tr>
</tbody>
</table>
Total Economic Welfare?

Preliminary Results: Subject to Change
Prices in Context:
Historic, Projected with and w/o $30 carbon price

Wheat

Corn

Beef cattle

Hogs
Implications for Land Use?

- Markets for bioenergy and carbon offsets can shift land use patterns
  1. Less deforestation for agriculture
  2. Afforestation incentives for cropland/pasture
  3. Forest management incentives signal longer harvest periods
  4. Some land moving out of conventional production
General Conclusions

- We model multiple low-carbon futures:
  1. Offsets Dominate
  2. Bioenergy dominates
- Producers/landowners benefit substantially
- Land use competition is important; shifts from agriculture to forestry, or from conventional to bioenergy production are likely
  - Not shown: CRP lands can play an important role
- Price affects can decrease consumer economic welfare
Caveats

• This is an aggregated view
  – Does not consider distributional impacts between small and large operations
  – Regional impacts also important
• We do not model a specific cap-and-trade bill, just a general form of climate policy
  – Offset provisions/protocols might be more stringent
  – Transaction costs matter
• FASOMGHG dynamic optimization procedure provides insight— not predictions
• Risk and uncertainty not accounted for
Thank You!

• Further questions?
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