The Waxman-Markey approach to offsets: Application to Nitrogen fertilizer on wheat

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Waxman-Markey specifications for offsets were uniquely detailed and rigorous.

- Leakage
- Additionality
- Permanence
- Verification that practices are implemented
- Somewhat unclear about whether offsets would be crop-by-crop and practice-by-practice or more encompassing.

Of course, it is unclear how well we would have been able to accommodate these elements in practice.
Analysis of offset rules for reducing Nitrogen fertilizer use on wheat

Farmers who grow wheat would be eligible for offset payment for agreeing to apply N below the baseline rate.

• Simulate rules to address each* of the W-M issues.
• Focus on low-transactions cost approaches.
• Analysis assumes that contracts to apply a specific N rate can be verified.
• Payment is based on N application rate, not measured N\textsubscript{2}O.**
• Linear quantification: 1 kg N = 0.01 kg N2O
Procedure

1. Assign field-specific baselines using prevailing practices based on 2009 Agricultural Resource Management Survey data (non-irrigated wheat.) \( n = 1,605 \) in 17 states.

2. Introduce a safety-margin a la Waxman-Markey. Several approaches considered.

3. Payment is for an agreement to apply N below the baseline.

4. Use cost estimates to predict new, additional participants. Farmer costs are reduced production minus fertilizer savings.
Baseline rates

Assign field-specific baselines equal to *prevailing application rate* for each Major Land Resource Area (MLRA), state, soil, climate, and wheat productivity index, minus a safety margin.

- Farmer and broker can both look these up.
- Not based on farm records.
- Close to MSU/EPRI proposed protocol.
- Easy to update annually as wheat or fertilizer prices change and as climate changes.
- Results not much changed if instead base the baseline on “best practice” application.
Additionality

Additionality =

Emissions under farm’s business-as-usual application rate minus Emissions under new, contracted application rate.

• By simulating participation as if an offset market were operating in 2009, we can observe “business-as-usual” application rates.

• Careful with terminology! *Baselines ≠ Business-as-usual*
Additionality

• By using actual application rates, we can also estimate farm-specific costs & predict which farms would have found it advantageous to reduce N further, thereby providing reductions that were *additional*.

• Some farms have $B > N_{2009}$ and do not reduce further – they provide offsets that are *non-additional*.

• Why this focus on additionality?
  • Non-additional credits raise costs, in terms of overall emissions.
  • Leakage only occurs when credits are additional. No change in behavior = no leakage.
Safety Margin

• Analysis uses a safety margin that is proportional to the variance in Nitrogen application rates.
  • More variable rates == Larger safety margin

• Other safety margins also analyzed.
  • E.g., only farms in “low variability” regions are eligible for offsets.
  • E.g., safety margin proportional to negative skewness. Greater negative skewness == larger safety margin.
Table 1. Results

<table>
<thead>
<tr>
<th></th>
<th>Safety margin (standard deviations below mean)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Participants – proportion</td>
<td>0.53</td>
</tr>
<tr>
<td>Participating acres (million acres)</td>
<td>21.5</td>
</tr>
<tr>
<td>Non-additional credits (million lbs. N)</td>
<td>395.2</td>
</tr>
<tr>
<td>Additional N reduction</td>
<td>117.5</td>
</tr>
<tr>
<td>Offsets</td>
<td>506.0</td>
</tr>
<tr>
<td>Additional/Non-additional</td>
<td>0.30</td>
</tr>
</tbody>
</table>
Results

• Nitrogen reduction is about half as expensive as reducing greenhouse gas emissions from point sources.

• We project a substantial quantity of non-additional credits.
  • Additional reductions are about 30-40 percent as large as non-additional credits.
  • This occurs because N application rates are highly variable in the cross-section.
  • We need a ratio of Additional/Non-additional $\approx 2$ to pass a standard benefit cost test.
  • Higher safety margins reduce non-additionality but not by enough. Low participation rates.
Different approaches to the safety margin can help but don’t dramatically change the results.

Similar results for Yes-No practices such as No-Till or Fall application.

- Again, cross-sectional variability is high even within region/soil/climate/NCCPI.

What are our options for improving additionality?

- Can previous practices on the farm be used to condition the baseline and improve additionality?
Substantial conceptual and empirical issues arise when previous farming practices are used to condition the baseline.

- **MORAL HAZARD.** Farmers change behavior just to qualify.
- **COMPLEXITY.**
  - Costs of keeping and interpreting farm records. Regulation needed to define for eligible farm records?
  - No longer a simple transaction between farmer and broker.
  - How to deal with ownership changes or incomplete records? If farm records not available, use the “prevailing practices” approach? Yikes!
Using previous farm practices to condition the baseline, cont.

• To avoid moral hazard, use a base year rather than preceding year.

• How well do past practices predict future practices?
  – This problem especially keen when the policy uses a base year.
  – **ADVERSE SELECTION.** Farms for which prediction overestimates N application rates (etc.) are more likely to enter. In other words, *non-additionality.*
Concluding comments

Remaining issues:

• Leaves unclear how policy would treat other practices that might accompany reduced N application rates.
• Leaves unclear how to deal with fields that might shift into or out of wheat as a result of offset opportunities.
• Would offset rules be issued one-by-one or would we have to wait until an entire body of offset rules was ready to issued?

Economic analysis of these alternatives would be complex.