Multiple Environmental Externalities Of Conservation Tillage: Empirical Assessment of Practice And Performance Based Targeting

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Research questions

- If a policy that targets conservation tillage is implemented, how much less environmental benefits are obtained than if the benefits were targeted?

- If only one environmental benefits is targeted, what are the associated other environmental benefits?
Data and models

- **Data:** Some 13,000 NRI points located in Iowa

- **Benefits:** Physical processes simulation model EPIC
  - Carbon sequestration
  - Soil erosion
  - Nitrogen runoff

- **Costs:** Model of conservation tillage adoption
  - Econometrically estimated
  - Predicts subsidy needed for adoption
Model of conservation tillage adoption

Traditional approach

\[
Pr[\text{adopt}] = Pr[\pi_1 \geq \pi_0 + \sigma_\varepsilon \varepsilon] = Pr[\pi_1 - \pi_0 \geq \sigma_\varepsilon \varepsilon] \\
= Pr[\delta x \geq \sigma_\varepsilon \varepsilon] \\
= Pr\left[\frac{\delta}{\sigma_\varepsilon} x \geq \varepsilon\right]
\]

Approach of Pautsch, Kurkalova, Babcock, Kling (CEP, 2001)

\[
Pr[\text{adopt}] = Pr[\pi_1 \geq \pi_0 + \sigma_\varepsilon \varepsilon] = Pr[\pi_1 - \pi_0 \geq \sigma_\varepsilon \varepsilon] \\
= Pr[\beta x - \pi_0 \geq \sigma_\varepsilon \varepsilon] \\
= Pr\left[\frac{\beta}{\sigma_\varepsilon} x - \frac{1}{\sigma_\varepsilon} \pi_0 \geq \varepsilon\right]
\]
Model of conservation tillage adoption (continued)

\[
\text{Pr}[\text{adopt}] = \text{Pr}\left[ \pi_1 \geq \pi_0 + P + \sigma_\varepsilon \varepsilon \right]
\]

\[
= \text{Pr}\left[ \beta x \geq \pi_0 + \alpha \sigma_{\text{profit}} + \sigma_\varepsilon \varepsilon \right]
\]

\[
= \text{Pr}\left[ \frac{\beta x}{\sigma_\varepsilon} - \frac{\pi_0}{\sigma_\varepsilon} - \frac{\alpha \sigma_{\text{profit}}}{\sigma_\varepsilon} \geq \varepsilon \right]
\]
Practice and performance based targeting, same budget, $5.7 M

Target conservation tillage

- Carbon, 799,029 tons/year
- Erosion reduction, 45,984,271 tons/year
- N runoff reduction, 6,136,973 tons/year
- Area in CT, 3,181,800 acres

Target carbon
Fraction of maximum possible benefits obtainable under conservation tillage targeting

Cost, 1,000,000 dollars

- Carbon Sequestration
- Erosion Reduction
- Nitrogen Runoff Reduction
Fraction of maximum possible benefits obtainable under carbon targeting

- Erosion reduction
- N runoff reduction

Fraction of benefits vs. policy cost, $1,000,000
Conclusions

- The proposed methodology allows for **comparison of alternative benefit targeting schemes**

- Targeting **conservation tillage** provides high fractions of the maximum possible amounts of the 3 environmental benefits in Iowa

- Targeting a **single benefit** is estimated to provide high fractions of other associated benefits