The Subsidy for Adopting Conservation Tillage: Estimation from Observed Behavior

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Introduction and Objectives

- What does it take for farmers to adopt conservation tillage practices? Or what compensations are needed?
  - Profit loss from switching
  - Reluctance (or premium) due to uncertainty
    - risk aversion, option value (or incentive to learn more)
- New modeling strategy to estimate the two elements based on **observed behavior**
  - The subsidy (**$**) needed for adoption
  - Decomposing the subsidy into profit loss and adoption premium
- Estimate the “supply curve” of conservation tillage
  - The subsidy needed for each level of adoption

Model

Traditional approach (e.g., Soule, Tegene, and Wiebe (2000), Uri (1998))

$$\Pr[adopt] = \Pr[\pi_1 \geq \pi_0 + \sigma_\varepsilon \varepsilon] = \Pr[\pi_1 - \pi_0 \geq \sigma_\varepsilon \varepsilon]$$

$$= \Pr[\delta x \geq \sigma_\varepsilon \varepsilon]$$

$$= \Pr\left[\frac{\delta x}{\sigma_\varepsilon} \geq \varepsilon\right]$$

Pautsch, Kurkalova, Babcock, and Kling (2001)

$$\Pr[adopt] = \Pr[\pi_1 \geq \pi_0 + \sigma_\varepsilon \varepsilon] = \Pr[\pi_1 - \pi_0 \geq \sigma_\varepsilon \varepsilon]$$

$$= \Pr[\beta x - \pi_0 \geq \sigma_\varepsilon \varepsilon]$$

$$= \Pr\left[\frac{\beta x}{\sigma_\varepsilon} - \frac{\pi_0}{\sigma_\varepsilon} \geq \varepsilon\right]$$

Model (continued)

$$\Pr[adopt] = \Pr[\pi_1 \geq \pi_0 + P + \sigma_\varepsilon \varepsilon]$$

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

$$= \Pr\left[\frac{\beta x}{\sigma_\varepsilon} - \frac{\pi_0}{\sigma_\varepsilon} - \frac{\alpha \sigma_{profit}}{\sigma_\varepsilon} \geq \varepsilon\right]$$

Data

- Random sub-sample (1,339 observations) of Iowa 1992 NRI data (soil and tillage) supplemented with Census of Ag. (farmer characteristics) and climate data of NCDA
- 63% of farmers already use conservation till without any subsidy

Model Specification and Data (Continued)

$$\Pr(adopt) = \Pr\left[\frac{\beta x}{\sigma_\varepsilon} - \frac{\pi_0}{\sigma_\varepsilon} - \frac{\alpha\sigma_{profit}}{\sigma_\varepsilon} \geq \varepsilon\right]$$

- Expected profit of conservation tillage (x)
  - Depends on soil characteristics, climate, and farmer characteristics
- Expected profit of conventional tillage (π_0)
  - County level estimates for each crop based on budget estimates
- Adoption premium (σ_{profit})
  - Depends on historical (20 years) precipitation variability
  - Vary by crop, net returns, and farmer characteristics

Results (standard errors in parenthesis)

- Net returns to conservation tillage

$$\pi_1 = \underset{(11)}{41} \cdot I_{corn} + \underset{(0.012)}{0.022} \cdot SLOPE + \underset{(0.31)}{0.63} \cdot PM + \underset{(29)}{73} \cdot AWC + \underset{(0.68)}{2.57} \cdot TMAX$$

$$- \underset{(0.72)}{2.48} \cdot TMIN + \underset{(69)}{76} \cdot PRECIP + \underset{(92)}{194} \cdot TENANT$$

- Premium (corn producers)

$$P_{corn} = \sigma_{precip} \left\{ \underset{(411)}{1400} - \underset{(0.11)}{2.79} \cdot \pi_0 - \underset{(47)}{103} \cdot OFFFARM \right.$$

$$\left. + \underset{(274)}{607} \cdot TENANT - \underset{(1.8)}{5.1} \cdot AGE - \underset{(302)}{763} \cdot MALE \right\}$$

Results

- Average required subsidy and decomposition for current non-adopters

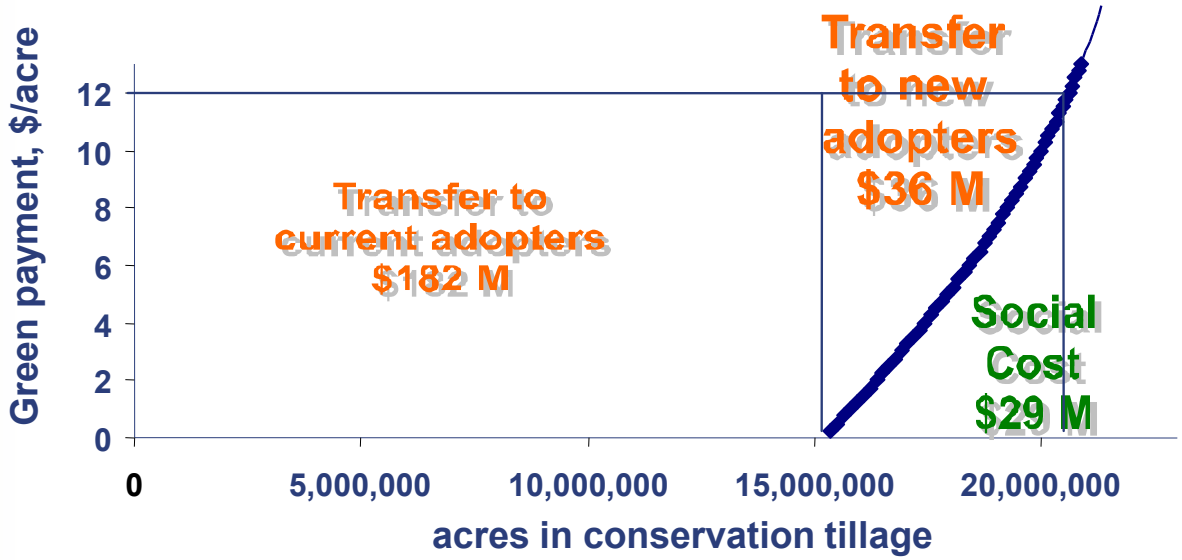
Average/Current non-adopters	Corn ($/acre)	Soybean ($/acre)
Profit loss	-10.6	-34.8
Premium	13.1	38.4
Subsidy	2.5	3.6

Conservation Tillage "Supply Curve"

Total Subsidy to Achieve 90% Adoption

= $247 M

= $29 M + $36 M + $182 M



Conclusions

- The proposed methodology allows for **full recovery of the structural coefficients**
  - Adoption subsidies are computed for a sample of Iowa farmers
- **Income transfer** relative to the adoption cost can be huge
  - May be less important in states with low existing adoption and less heterogeneous adoption costs
- **Adoption premium** plays a significant role in farmers' adoption decisions
  - Future work is needed to understand the source of premium
  - Risk aversion vs. option value require different government responses