Additionality and the Adoption of Farm Conservation Practices

(forthcoming in *Land Economics*)

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Farm Conservation Programs

USDA has invested $24 billion in 2002-2007 on conservation programs (e.g. CRP, CSP, EQIP)

Federal conservation programs are designed to provide incentives for farmers to voluntarily adopt conservation practices (e.g. no till, filter strips, cover crops)

Additionality & Policy implications

- Additionality:

  The increase in conservation effort by enrolled farmers relative to what they would have done without funding.

- If additionality is low, then the government is wasting its money. It's paying farmers to adopt practices they would have likely adopted anyway.

Goals of this paper

1. Estimate the additional use of six conservation practices *caused* by enrollment in federal conservation programs using data from a survey of Ohio farmers
2. Decompose the additionality between two groups: new adopters and prior adopters.

Additionality Defined as Average Treatment Effect on the Treated (ATT)

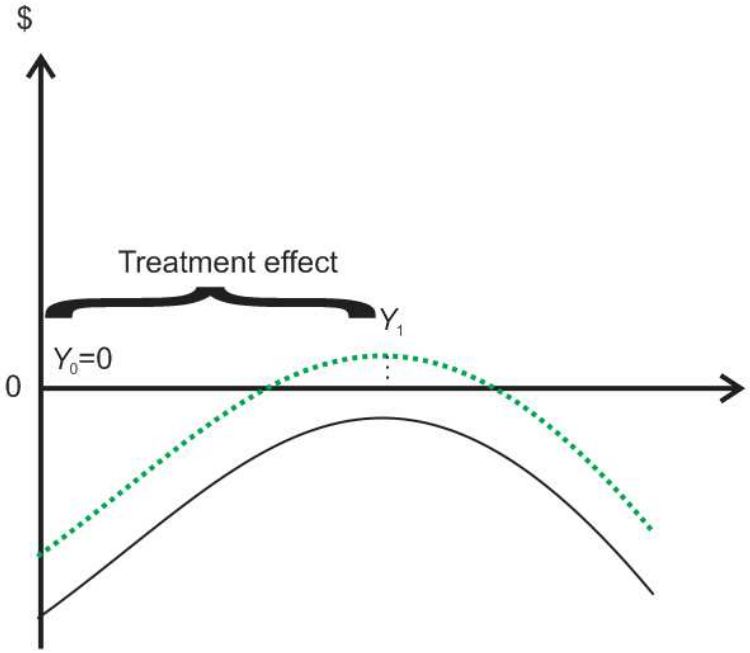
$$ATT = E\left[Y_1 \mid D=1\right] - E\left[Y_0 \mid D=1\right].$$

Practice use with funding

Practice use without funding

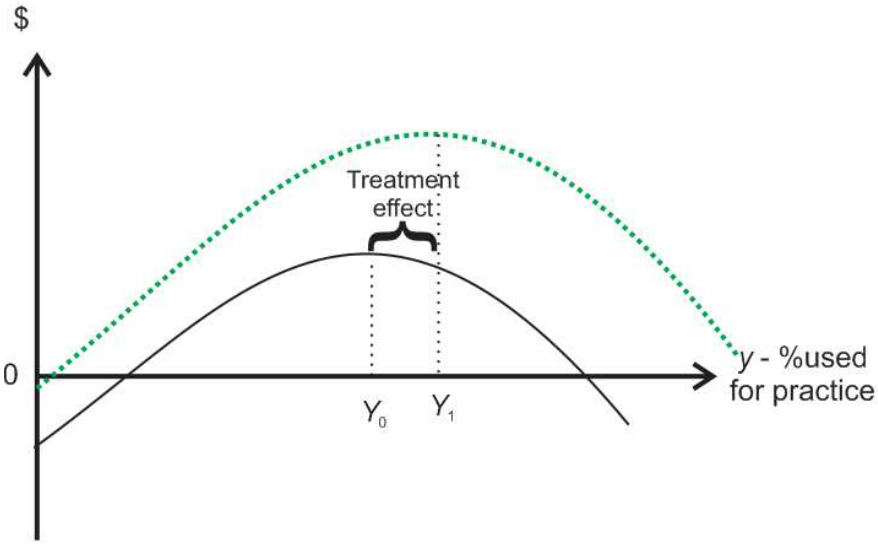
We are only interested in those subjects who were treated

Decomposing Additionality



New Adopters

$Y_0 = 0$



Prior Adopters

$Y_0 > 0$

Decomposition of the ATT

We decompose ATT into relative contributions from

New adopters: Farmers who would NOT adopt without payment
Prior adopters: Farmers who would adopt even without payment

$$ATT = P_n \cdot ATT_n + P_p \cdot ATT_p$$

New Adopter: $Y_0=0$

$$P_n = P\left(Y_0 = 0 \mid D = 1\right)$$

$$ATT_n = E\left[Y_1 - Y_0 \mid Y_0 = 0, D = 1\right]$$

Prior Adopter: $Y_0>0$

$$P_p = P\left(Y_0 > 0 \mid D = 1\right)$$

$$ATT_p = E\left[Y_1 - Y_0 \mid Y_0 > 0, D = 1\right]$$

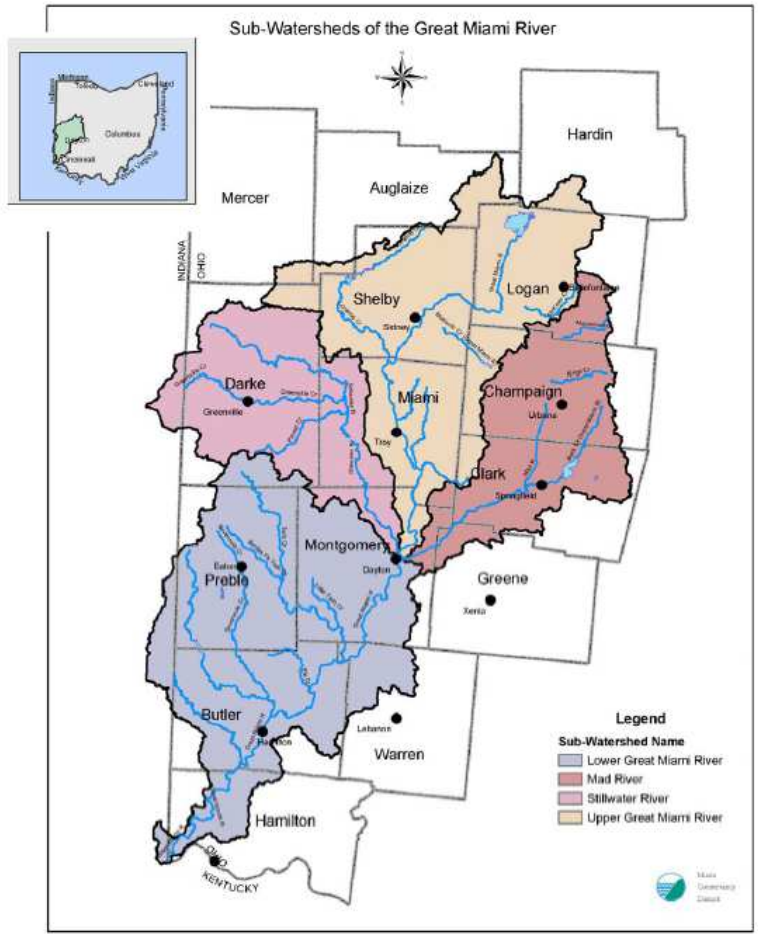
Farmer Survey

Study Region

- 25 counties in southwest Ohio

Survey

- 2009
- Administered through NASS
- Mailed to 2000 farmers with follow-up phone calls
- 771 respondents

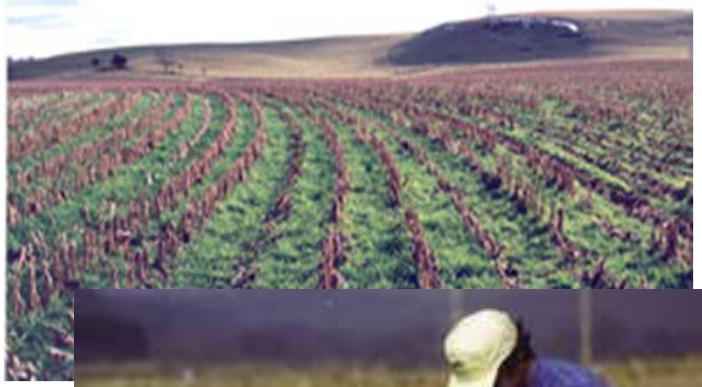


Key variables

- Proportion of farm used for conservation practice in 2009
  - Whole field practices
    - conservation tillage
    - cover crops
    - hayfields or grasslands
    - grid sampling
  - Practices for environmentally sensitive areas
    - grass waterways
    - filter strips
- Received cost-share payment for that practice from ANY program
  CRP, CREP, CSP, EQIP, WQTP, and Other

Whole field practices

Conservation tillage



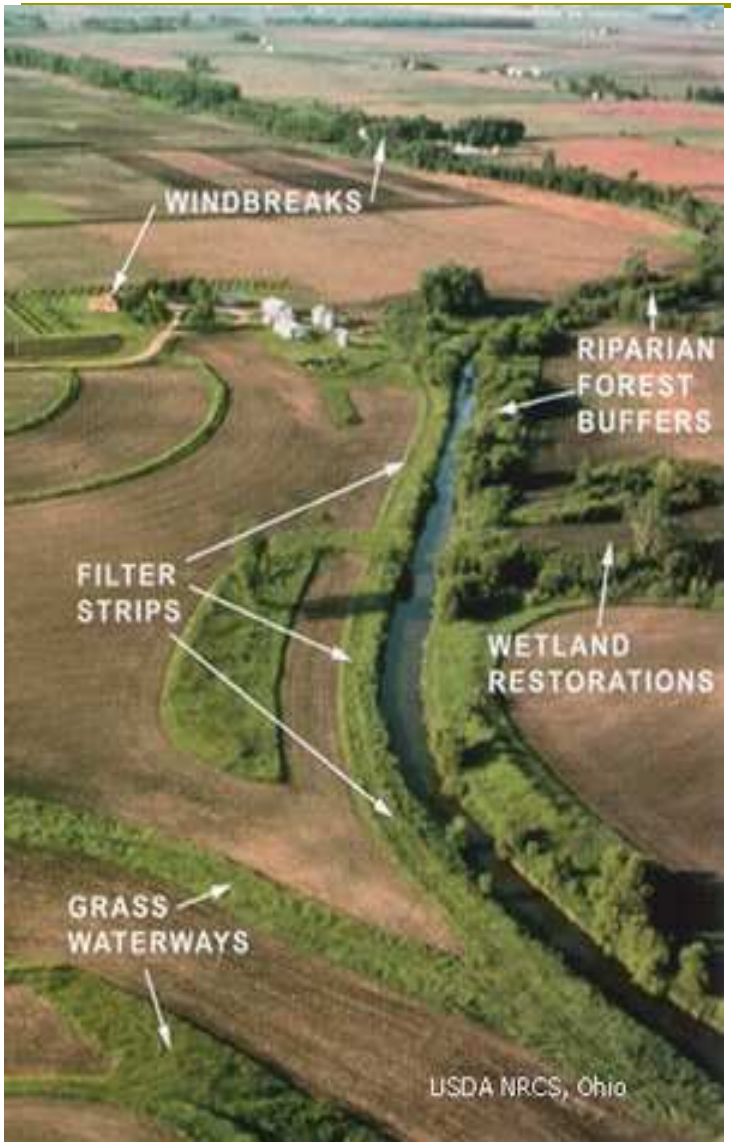
Grid Sampling

Cover Crops

Hayfield establishment

Images from http://zedxinc.blogspot.com/2010/06/conservation-tillage-bmps.html & https://shoreacres.wordpress.com/2012/04/10/a-little-nash-ramble/

Practices for environmentally sensitive areas



Summary Statistics: Conservation practices and enrollment

Practice Type	No Adoption	Adoption without Enrollment	Adoption with Enrollment	Total[a]
Conservation Tillage	97	379	87	563
Cover Crops	513	68	24	605
Hayfield Establishment	522	53	19	594
Grid Sampling	323	161	55	539
Grass Waterways	243	137	146	526
Filter Strips	395	56	93	544

[a]. The number of useable observations varies by practice type due to missing or incomplete survey information.

Summary Statistics: Conservation practices and enrollment

Practice Type	Average Proportion for Non-Enrolled[b]	Average Proportion for Enrolled
Conservation Tillage	0.554	0.779
Cover Crops	0.023	0.262
Hayfield Establishment	0.014	0.287
Grid Sampling	0.212	0.749
Grass Waterways	0.007	0.018
Filter Strips	0.001	0.011

[a]. The number of useable observations varies by practice type due to missing or incomplete survey information.

Matching Estimators: key choices

Propensity Score Matching

- Propensity to enroll in cost-share program using probit

Matching specifications

- Kernel and local linear matching
- Gaussian and Epan kernel
- Bandwidth = 0.02, 0.06, 0.2

Covariates for Matching Estimation

Farmer characteristics

- Age
- Education
- Household income

Farm management

- Farm size
- Farm revenue
- Percent of farm rented
- Percent of acreage in grain (corn, soybean, wheat)
- Livestock

Land characteristics

- Stream on property
- Soil type
- Slope

Balancing test (grass waterways):
Difference in means pre & post matching

Variable	Pre-	Post-
Farm Rev. > $250k	0.108*	0.007
Farm Planning Horizon	0.036	0.000
Age	-0.963	0.132
Education>HS	0.076	0.025
Soil type = clay	0.063	0.010
Soil type = loam or sandy	-0.063	-0.010
Highly Erodible Land	0.293**	0.010
HH inc 0 - 10% from farming	0.033	-0.008
10 - 50% from farming	-0.020	0.002
>50% from farming	-0.013	0.006

Variable	Pre-	Post-
Prop. of farm rented	0.053	0.003
Prop. of farm in grain crops	0.090**	0.009
Prop. of farm w/ slope 0%-2%	-0.138**	-0.027
Prop. of farm w/ slope 2%-6%	0.120**	0.020
Prop. of farm w/ > 6% slope	0.018	0.007
log of total farm acreage	0.435**	0.080
Stream borders or on property	0.123**	0.028
Livestock on farm	-0.098*	0.009

Results on ATT and % ATT

Average treatment effect on the treated (ATT)

$$ATT = E\left[Y_1 - Y_0 \mid D = 1\right]$$

$$\%\ ATT = \frac{E\left[Y_1 - Y_0 \mid D = 1\right]}{E\left[Y_1 \mid D = 1\right]} \cdot 100$$

Results: Measures of additionality by practice

$$\%ATT = \frac{ATT}{E\left[Y_1 \mid D=1\right]} \cdot 100\,\%$$

	ATT*		% ATT*	
Whole field practices	Estimate	95% CI	Estimate	95% CI
Conservation tillage	0.160	[0.091, 0.216]	20.5	[12.3, 26.5]
Cover crops	0.233	[0.145, 0.327]	88.9	[76.5, 94.3]
Hayfield establishment	0.227	[0.074, 0.344]	92.9	[78.3, 96.4]
Grid sampling	0.503	[0.378, 0.583]	66.3	[54.8, 72.9]
Practices for environmentally sensitive areas				
Grass waterways	0.012	[0.008, 0.017]	65.0	[51.3, 75.1]
Filter strips	0.010	[0.007, 0.014]	89.1	[75.8, 95.7]

*ATT and %ATT for all practices are significantly different from zero at the 95% level based on bootstrapped confidence intervals.

Results: $ATT = P_n \cdot ATT_n + P_p \cdot ATT_p$
Decomposition of additionality

	New Adopters		Prior Adopters		Overall	
	Proportion	ATT_n	Proportion	ATT_p	ATT	% ATT
Whole field practices						
Conservation tillage	**0.14**	0.745	**0.86**	0.065	0.160	20.5
Cover crops	0.87	0.262	0.13	0.040	0.233	88.9
Hayfield establishment	**0.90**	0.240	**0.10**	0.112	0.227	92.9
Grid sampling	0.60	0.756	0.40	0.124	0.503	66.3
Practices for environmentally sensitive areas						
Grass waterways	0.58	0.019	0.42	0.003	0.012	65.0
Filter strips	**0.83**	0.011	**0.17**	0.004	0.010	89.1

Conclusions

Additionality is statistically significant for all practices

%ATT varies considerably between practice types

- Highest for filter strips (89.1%), hayfields (92.9%), and cover crops (88.9%)
- Moderate for grid sampling (66.3%) and grass waterways (65.0%)
- Lowest for conservation tillage (20.5%).

ATT_p for prior adopters is small

- Prior adopters are not contributing much to the expansion of conservation acreage
- Practices with a larger fraction of prior adopters have smaller values for % ATT

The End