

Public's Willingness to Pay for Ecosystem Service Improvements From Agriculture

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Introduction

- Agriculture is the world's largest managed ecosystem. Apart from producing food, fiber and fuel, agriculture can provide various other ecosystem services
- Mitigated greenhouse gas (GHG) emission and reduced lake eutrophication are two ecosystem services that the public would get from low input cropping practices. Research at the Long-term Ecological Research site (LTER) in row crop agriculture at the Michigan Kellogg Biological Station has identified several low-input cropping systems that maintain comparable yields to conventional farming practices, yet provide better carbon sequestration, less nitrate leaching, phosphorus retention in soil and less soil erosion.

Rationale

- Payments for Environmental Services (PES) are widely used to provide enhanced ecosystem services from agriculture.
- Most empirical studies of PES programs focus on the supply-side, measuring costs to land owners for changing land management practices.
- Information on public demand is necessary to give a complete picture of the potential market for ecosystem services.

Objective

- Estimate the public's willingness to pay (WTP) for a set of ecosystem service improvements, including GHG reduction and eutrophic lakes reduction.

Method

- A mail survey was conducted in July 2009 with 6000 randomly selected Michigan residents in July yielding a 41% response rate.
- Five contacts were made with respondents using a modified version of Dillman's tailored design method.
- The contingent valuation (CV) question was posed as a dichotomous choice referendum with income taxes as the payment vehicle. The proposed programs provide GHG and eutrophic lake reductions by paying for changes in land management practices.
- Fourteen questionnaire versions were generated from an experimental design with three CV questions per respondent.
- The data were analyzed using the random effects Probit model with a spike in zero willingness to pay.

Proposed model

- Respondents' willingness to pay for ΔX is estimated as a function of 4 sets of explanatory variables: cost of the hypothetical program to be voted on (C), the proposed reductions in eutrophic lakes and GHG (ΔX), people's attitude towards global warming (A), demographics (Z).

$$WTP_i = \exp(\alpha + \beta \Delta X_j + \delta A_i + \varphi \Delta X_i * A_i + \gamma Z_i + \varepsilon_{ij})$$

- The GHG reduction did not pass the scope test in the sample. Therefore an interaction term was added to see whether the scope test would pass for those who cared about global warming.
- The vast majority of the sample were concerned about lakes, but only 67% were "concerned" about global warming. Thus, an interaction term for concern was only included for GHG.

Results

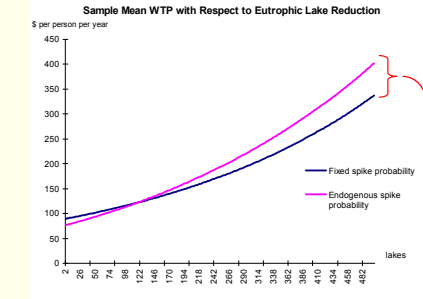
Table 1. Model estimation on the probability of voting yes

Variable Group	Specific variables	coefficient	P> z
C	log of program cost	-1.3	0
ΔX	Reduction in lakes with excess nutrients	0.0033	0
	% reduction in greenhouse gas emission (GHG)	-0.14	0.58
A	Concerned about global warming (=1 if concerned)	1.4	0
$\Delta X * A$	Interaction of Concern & GHG	0.62	0.059
Z	Age	0.026	0.003
	Household pretax income	0.013	0
	Education level	0.19	0.012
	Voter (=1 if yes)	1.5	0.003

Lakes had a significant effect on the WTP of all respondents. The marginal WTP for clean-up of one eutrophic lake was \$0.54 per person per year.

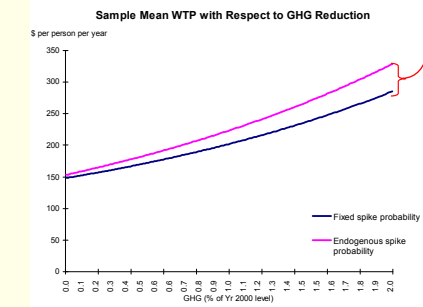
GHG reduction only affected the WTP of those who were concerned about global warming. The marginal WTP for a 1% GHG reduction of the 2000 emission level was \$100 per person.

Comparison of Sample mean WTP as a function of ΔX under fixed spike and endogenous spike probabilities



The probability that a respondent had zero WTP (the spike) was endogenous. As the reduction of lakes and GHG increases, the probability of the spike decreases.

With the endogenous spike, WTP for ΔX increases at a greater rate than with the fixed spike because as ΔX increases, the probability of zero WTP falls.



Conclusions

- Despite the poor economy, an income tax payment vehicle only resulted in an anti-tax protest rate of 10%.
- Ecosystem services of global warming mitigation and eutrophic lake reduction were of value to people. The value depended on the scope of environmental changes, people's attitude towards global warming, age, income, education and whether they are voters.

- Because the probability of a spike response (i.e., zero willingness to pay) decreases as the scope of the policy increases, the results illustrate the importance of modeling the spike as a function of the scope of the policy.
- The results can be coupled with estimates of farmers' willingness to supply these services by adopting low-input cropping practices to see if a "market" for these services exists.

Table 2. Model estimation on the probability of zero WTP (spike probability)

Category	Description of variables	coefficient	P> z
ΔX	Reduction in lakes with excess nutrients	-0.0040	0
	% reduction in GHG	-0.38	0.032
A	Concerned about global warming (=1 if concerned)	-1.3	0
Z	Househd pretax income	-0.0042	0.031

The probability a respondent had zero WTP (the spike) was modeled, and it depended on the scope of the policy (ΔX), annual household pretax income and whether they are concerned about global warming.

