

Asymmetric Information and Contract Design for Payments for Environmental Services

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PES programs

(1) Participation is voluntary

(2) Use contracts between conservation agents and the landowners.

“Conservation Agent” →

any entity that wishes to encourage landowners to supply environmental services

“Landowner” →

any entity that is in the position (de jure or de facto) to supply environmental services through its influence on an ecosystem

Asymmetric information

***Hidden Information* (adverse selection):
arises when negotiating the contract**

Landowners have better information than the conservation agent about the opportunity costs of supplying environmental services.

Landowners extract informational rents from the conservation agent in the form of a higher than necessary payment to induce them to participate in the PES program.

Hidden Information

- (1) PES programs are often funded by taxes**
(So what? Why should we care about these deadweight loss informational rents?)
- (2) Private agents are budget-constrained;**
- (3) Environmental services are generally public goods subject to free riding. Maximizing the environmental services secured with available budgets is socially desirable; and**
- (4) Informational rents relax landowner's budget constraint and can induce ecosystem conversion, thus lowering environmental benefits from contract.**

Asymmetric information

***Hidden Action* (moral hazard): arises after a contract has been negotiated**

When monitoring contract compliance is costly, landowner has an incentive to avoid fulfilling his or her contractual responsibilities (extracts informational rents from payments for actions never taken)

Asymmetric information

Hidden information is a problem in all PES contracting settings.

Hidden action is only a problem to the degree that the actions specified by the contract are costly to monitor.

Hidden Information

**Conservation contracts with
landowners for habitat quality: $0 \leq h \leq 100$**

**Two types of landowners: H (high-opportunity costs) and
L (low-opportunity costs).**

$$\text{Cost}_H = 2h^2$$

$$\text{Cost}_L = 2h$$

Conservation agent desires $h = 100$.

**Perfect information world: offer \$200 if the landowner
is type L and \$20,000 if the landowner is type H**

Hidden Information

When type is private information, all landowners would claim they were type H in order to receive a larger payment.

- (1) gather more information on landowners in the form of costly-to-fake signals ;**
- (2) rely on screening contracts (self-selection mechanisms);**
- (3) harnessing competitive forces through procurement auctions**
- (2) and (3) design the contracting system to induce landowners to reveal their hidden information**

Gathering Information from Costly-to-Fake Signals

Simplest and coarsest approach

**Gather information on observable landowner attributes
that are correlated with opportunity costs AND
difficult to fake**

Use these attributes to establish contract prices

Costly information acquisition.

**Ability of this information to reduce information rents
without distorting the conservation outcome will only
be as good as the strength of the correlations between
the characteristics and landowner types.**

Screening Contracts

Offer a contract for each of the different landowner “types.” Contracts are designed so each type will pick the contract that is meant for that type.

Two types of landowners: H (high-opportunity costs) and L (low-opportunity costs).

$$\text{Cost}_H = 2h^2$$

$$\text{Cost}_L = 2h$$

$$0 \leq h \leq 100$$

Screening Contracts

- (1) payments at least cover landowners' opportunity costs (i.e., "participation constraints" are satisfied),**
- (2) landowners pick the contract intended for their type (i.e., the "incentive compatibility constraints" are satisfied)**

(i) \$382 for $h = 100$; and (ii) \$201 for $h = 10$

Type H landowner prefers contract (ii) and a type L landowner prefers contract (i).

Thus their contract choices reveal their types.

Revelation Comes at a Cost

(1) To encourage the type L landowners to reveal their type, the conservation agent must compensate them at a level above their opportunity costs.

Through the use of screening contracts, the conservation agent reduces the informational rents paid to the low-cost landowners, but cannot eliminate them.

Revelation Comes at a Cost

(2) in order to reduce the attractiveness of low-cost landowners claiming to be high-cost, the contracts aimed at high-cost landowners require a lower level of habitat quality.

This distortion in the contracted output of environmental services (and the informational rent paid to the low-cost landowners) grows with the difference in costs between the low-cost and high-cost landowners and the proportion of landowners who are low-cost.

Screening Contracts with **Consistency Constraints**

Informational rents obtained by low-cost landowners can relax landowners' budget constraints and induce more ecosystem conversion, thereby lowering environmental benefits from PES contracts (Motte et al.).

Consistency constraint requires landowners to set aside within the contract at least as much forested land as they would have without the contract

Screening Contracts

Does anyone use them in conservation field? No.

Designing a menu of screening contracts requires knowledge about the distribution of landowner types and sophisticated calculations by conservation practitioners.

The administration of a large menu of contracts may also be expensive and unwieldy.

Procurement Auctions for PES

Contracts

- Through competitive bidding, reduce informational rents to landowners with smaller trade distortions.
- Solicit wide range of bids simultaneously. Thus can assist multiple buyers of environmental services to coordinate contracting activities
- Use transparent rules: reduces the influence of political power in the distribution of contracts.
- Can encourage innovations that reduce contract costs.
- Can be used as research tool to make ex ante estimates of the distribution of landowner willing-to-accept land use changes in return for payments.

Auctions vs Screening Contracts

Auctions do not require the conservation agent to specify the distribution of landowner types; landowners reveal this distribution

Auctions reduce informational rents with fewer distortions to the supply of environmental services

Conservation practitioners may find auctions easier to apply in the field despite their higher administrative costs.

Auctions in Practice

U.S. Conservation Reserve Program (not a great example)

**Flint River Drought Protection Act auction
(Georgia, USA)**

Australia Bush Tender auction.

Auctions vs Fixed-Price

Informational rents to low-cost landowners are smaller under auctions.

With the same budget, the buyer can accept some high-cost landowners into the program via the cost savings provided by the low cost participants.

The efficiency gains increase with the degree of heterogeneity of the landowners.

Auction Disadvantages

- **More administratively complex than fixed prices (but no more complex than bilateral bargaining).**
- **May reduce participation in the PES program (cognitive burden or mistrust).**
- **Require competition to be effective; market power from large landowners or collusion might be a problem.**

PES Auction Design

Characteristics of PES auctions violate the standard assumptions in auction theory (e.g., multiple heterogeneous units, fixed buyer budgets or maximum acceptable offer prices).

Extant theory will often not give unambiguous answers about the appropriate rules for a PES auction.

Laboratory and field experiments are necessary.

Pricing Rules

Discriminative-price auctions: landowners receive their offer prices

Revealing one's true reservation price is not in a landowner's best interest.

Behavior in these auctions will be sensitive to the seller's risk preferences and beliefs about other sellers' offers.

Pricing Rules

Uniform-price auctions: landowners receive the same price (last rejected offer price).

Increases the incentive to reveal true opportunity costs compared to the discriminative-price auction: in simple settings, a seller can do no better than telling the truth because the price paid is not determined by an accepted offer.

Informational rents are higher.

Pricing Rules

Expenditures(discriminative) < ? > Expenditures(uniform)

Fairness(discriminative) < ? > Fairness(uniform)

Transparency(discriminative) < ? > Transparency(uniform)

Targeted PES Auctions

Landowners vary not only in their opportunity costs, but also in the quality of the environmental services they can supply

If opportunity costs and environmental benefits are strongly negatively correlated or if the relative spatial variability of costs is much higher than that of benefits, an auction that ignores benefits will secure much of the environmental benefits that could be secured through a targeted auction

Targeted PES Auctions

- (1) Separate bidders into different auctions where bidders are roughly homogenous with respect to the ecological values of their land (also eligibility requirements).**

- (2) Assign an environmental benefit value to each contract**
 - scoring indices**
 - nonparametric efficiency scores (Ferraro 2004)**

Targeted PES Auctions

- How to measure value of a contract?**
- Should benefit valuation rules be shared with landowners?**
- How to incorporate the value of contiguity and thresholds?**

Other Design Issues

- **Repeated contracting implies dynamic game with more complex strategic behavior.**
 - **Power to reduce informational rents dissipates over time.**
 - **This dissipation can be delayed or eliminated through the use of a targeted auction.**
- **Should budget be publicly revealed?**
- **Sealed or open bidding?**
- **Multiple and divisible contracts make predictions of bidding behavior more complicated,**
- **Enforcement environment affects bidding behavior.**

Hidden Information: Other Relevant Issues

- **Dynamic adverse selection**
- **Adverse selection with multidimensional types.**
- **Incomplete contracts.**