To Tell the Truth: Imperfect Information and Optimal Pollution Control

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Introduction

- Self-interested agents will systematically deceive the regulatory authority when asked to reveal their information.

- A necessary condition for designing an optimal pollution control plan is knowledge of both the damages resulting from pollution and the costs of reducing pollution.
- This paper will focus on the policy implications of an asymmetry between the regulatory authority and polluters concerning information about clean-up costs.
- He examines the incentives of firms to deceive the regulatory authority when confronted with two standard pollution control policies, and then propose a new scheme

- There is only one form of pollution, and
- All waste discharged has the same impact on the environment
- These expected damages are denoted by $D(X)$, where X is the total amount of pollution discharged. $D'(X) > 0$ and that $D"(X) > 0$
- There are n firms, and $C_j(X_j)$ describes the cost of clean-up for firm j, where Xj is its output of pollution.
- When there is no government controls: $C_j(X_j) = 0, C_j'(X_j) < 0, C_j''(X_j) > 0$
- At the minimum, $C'(X) = C_j'(X_j)$ for all j. Since $C_j''(X_j) > 0$ for all j, it follows that $C''(X) > 0$.

- The government's objective is to minimize the sum of clean-up costs and expected damages from pollution, $D(\sum_j X_j) + \sum_j C_j(X_j)$.
- Therefore the optimal X_j :

$$D'(\sum_j X_j) + C' \sum_j (X_j) = 0.$$

- the government knows nothing about the aggregate clean-up cost function, $C(X)$
- Suppose the government regulators ask all firms to report their pollution control cost functions. The function reported by firm j is denoted by $\widehat{C}_j(\cdot)$, for all j.
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$$\hat{C}(X) \equiv \min_{\{X_j\}} \sum_{j=1}^{j=n} \hat{C}_j(X_j), \text{ subject to } \sum_{j=1}^{j=n} X_j = X.$$

- **PURE LICENSING:** Let L be the number of licences issued, and p be the market price of a licence. It is assumed that the market for licences is competitive
- **Firm j seeks to minimize:**

$$\min_{\{X_j, L_j\}} C_j(X_j) + pL_j, \text{ subject to } X_j \leq L_j.$$

- Thus, an optimum requires $L_i = X_i$. The first-order condition for a cost minimum is: $C_j'(X_j) + p = 0$
- The market demand for licences: Let L_j be the jth firm's demand for licences, and let $L^d = \sum_j L_j^d$. If the price of a licence is p, each firm chooses X_j so that $-C_j(X_j) = p$ and $L_j^d = X_j$
- When L licences are issued, the aggregate level of pollution will be L, since in equilibrium$\sum_{j=1}^{j=n} X_j = L_d = L$.

- The socially optimal L, is given by the first-order condition, $D'(L) + C'(L) = 0$.
- Each firm j will desire to report a $\widehat{C}_j(\cdot)$ which will minimize p
- Therefore, the government will gain no useful information by asking firms to report their costs of clean-up when firms believe that the information will be used to set L in a pure licensing scheme

- The government regulators plan to set a charge of e per unit of pollution
- Each firm minimizes the sum of its clean-up costs and effluent fees, $C_j(X_j) + eX_j$.
- It does this by choosing X_j such that $-C_j(X_j) = e$.
- The socially optimal e, which minimizes the sum of damages and clean-up costs, is given by the first-order condition

$$D'[X(e)] = -C'[X(e)] = e.$$

Suppose the government asks firms to report their pollution control cost functions, and firms believe that the government will set e such that

$$D'[X(e)] = -\hat{C}'[X(e)] = e.$$

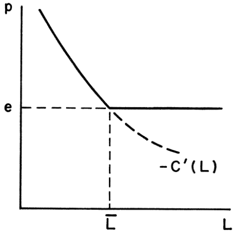
- The firm would have been at least as well off by reporting a clean-up cost function with lower marginal costs for all levels of pollution output

- The plan has two parameters:
- (i) L transferable licences are issued.
- (ii) A subsidy of e per licence in excess of emissions is paid to firms holding such licences
- firm j seeks to minimize the sum of treatment costs plus licence fees minus rebates or

$$C_j(X_j) - e(L_j - X_j) + pL_j = C_j(X_j) + (p-e)L_j + eX_j$$

subject to the constraint that emissions do not exceed licences, i.e. $X_j \leqq L_j$.

- The government asks all firms to report their pollution control cost functions after announcing that it will set the parameters L and e so that $D\prime(L) = -\widehat{C\prime}(L) = e$.
- **Theorem.** Under the mixed effluent charge-licence plan, each firm's total costs are minimized when the government sets the socially optimal effluent subsidy and stock of licences
- Truth telling is a Nash equilibrium
- Given that no firm can do better than when everyone tells the truth, it may be reasonable for each firm to assume that all other firms are telling the truth.



- We might also expect that frequent changes in the tax rate or number of licences issued would imply heavy administrative and enforcement costs for the regulatory authority. Thus, a central desirable feature of the mixed effluent charge-licence plan is its ability to hit the right point once-and-for-all.