The Value of Information in Public Decisions

Arvind Magesan and Matthew Turner

University of Toronto

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Motivation

1. Net-Benefit is widely used to rank policies.
   - Executive Order 12866 (1993): mandates agencies to "...adopt regulation only upon a reasoned determination that the benefits... justify its costs"
2. Cost-Benefit analysis is notoriously inaccurate.
   - Public Projects: Demand/Cost mis-measurement (Flyvberg et al)
   - Kyoto: (US) GDP loss estimates range 91 Billion - 311 Billion

Question

- Consider a welfare maximizing regulator, uncertain about costs and benefits of environmental tax regulation.
- Firms can lobby and **possibly** block proposed regulation.
- Given a choice, should the regulator learn about the costs or benefits of regulation before choosing the tax?

Quick Answer

- When regulated firms **can not** effectively lobby, a regulator would prefer information about benefits of regulation.
- When regulated firms **can** effectively lobby to block regulation, a regulator would prefer information about costs.

Literature

- Olson (1964), Stigler (1971), Becker (1985): "Who gets regulated and why?"
- Becker (1985) is the canonical model of regulation. But there is no role for information.
- Lewis (1996): Becker with imperfect information. Optimal policy is inefficient.

Value of Information

- The difference between the expected value of an informed decision and the expected value of an uninformed decision.

Model

- A regulator faces an economy consisting of two firms
- The state of the economy, s is $\{\theta_1, \theta_2, c\}$ where:
  - $\theta_i \in \{\theta_L, \theta_H\}$ is the profitability of firm i, $\theta_H > \theta_L \geq 0$.
  - $c \in \{c_L, c_H\}$ is the social cost of pollution, $c_H > c_L \geq 0$.
- Firm i is **inefficient** if $\theta_i < c$
- Initially the regulator knows only population frequencies.
- We maintain the following assumption:

$$Ec \geq \theta_H \geq c_L \geq \theta_L$$

Model

- There are four "types" of regulator (four types of information):
  1. Fully informed.
  2. Knows (θ_1, θ_2) but not c.
  3. Knows c but not (θ_1, θ_2).
  4. Knows only population frequencies.

Model

- Regulator chooses a tax τ to maximize expected social welfare.
- Given τ, firms choose to exit and pay no tax or stay and pay the tax (binary production decision).
- Aggregate losses L from the tax τ: sum of lost profit from exiting firms and taxes paid by firms remaining.
- The probability of the tax being implemented: $P(L)$, $P'(L) < 0$, $P''(L) < 0$.

Model

- The contribution to social welfare of firm i conditional on implementation of τ, is:

$$W_i = \begin{cases} \theta_i - c & \text{if } \theta_i > \tau \\ 0 & \text{if } \theta_i \leq \tau \end{cases}$$

- Then, in state $s = \{\theta_1, \theta_2, c\}$ social welfare is:

$$\begin{aligned} \mathcal{W}(\tau, s) &= P(L(\tau, s)) \sum_i W_i \\ &+ (1 - P(L(\tau, s))) \sum_i (\theta_i - c) \end{aligned}$$

- Tradeoff between probability of implementation and efficiency.

Model

Observation: When choosing the tax, *any type* of regulator can restrict himself to $\tau \in \{\theta_L, \theta_H\}$:

- A tax of $\tau = \theta_L$ is at least as good as any tax $\tau \in [0, \theta_L)$.
- A tax of θ_H yields the same expected welfare as any tax $\tau \in (\theta_H, \infty)$.
- A tax of θ_L is strictly preferred to any tax $\tau \in (\theta_L, \theta_H)$.

Model

The Regulator's Problem:

- Each type of information induces a probability distribution over the states
- A planner at information set $\mathcal{I}$ solves:

$$G(\mathcal{I}) = \max_{\tau} \mathbf{E}\left[\mathcal{W}(\tau, s)|\mathcal{I}\right]$$

Example: Information Partition

Partition induced by information about firm types $\{\theta_1, \theta_2\}$.

Event ω_θ	Probability $\mu(\omega_\theta)$
$\{\{\theta_L, \theta_L, c_L\}, \{\theta_L, \theta_L, c_H\}\}$	α^2
$\{\{\theta_L, \theta_H, c_L\}, \{\theta_L, \theta_H, c_H\}\}$	$2\alpha(1-\alpha)$
$\{\{\theta_H, \theta_H, c_L\}, \{\theta_H, \theta_H, c_H\}\}$	$(1-\alpha)^2$

Model

Three steps are needed to calculate the value of learning types or cost:

1. For a given type of regulator, for each information set, find the optimal tax and corresponding expected welfare $G(\mathcal{I})$.
2. Compute the expectation over information sets that can be reached with this information, $E[G(\mathcal{I})]$.
3. The value of information is the difference between this expectation and the expected payoff of a regulator who obtains no information.

Example

Consider a regulator who learns the cost of pollution but not the types of firms.

- Regulator will observe $\{\theta_1, \theta_2, c_L\}$ or $\{\theta_1, \theta_2, c_H\}$, and choose the optimal tax in either case. (θ_1, θ_2) remain unknown random variables.
- Compute the expected welfare over these two possible information sets.
- The difference between this expectation and the expected payoff of a regulator who knows nothing but frequencies is the value of information about social cost.

Proposition 1

1. *The value of learning the types of firms is zero if firms' political power is sufficiently small.*
2. *The value of learning social cost of pollution is zero if the firms' political power is sufficiently large.*

Intuition

- A *type* of information has no value iff optimal tax with the information is always the same as optimal tax with no information.
- Observation that $\tau \in \{\theta_L, \theta_H\}$ makes things easy: for each type of information, consider each tax in turn.
- Firm types.
- Social Cost.

Proposition 2

1. *Learning the social cost of pollution yields the expected full information payoff if firms' political power is sufficiently small.*
2. *Learning only the types of firms never yields the expected full information payoff.*

Intuition

- A *type* of information yields full information value iff once you have the information, more information has no value.
- In other words, once regulator has one type of information, optimal tax stays the same regardless of what other information may tell him.
- Learn firm types first.
- Learn social cost first.

Conclusion

- When firms are politically powerful, a welfare maximizing planner prefers information about costs of regulation (firm profit).
- When firms are not politically powerful, a welfare maximizing planner prefers information about benefits (social cost of pollution).
- Learn types in concentrated industries, costs in others.
- Though model is deliberately very simple, intuition generalizes.