Controlling Policy-Motivated Environmental Regulation Agents under Impact Uncertainty

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Standard Environmental Policy Framework

- Perfect information about marginal damage + marginal abatement costs

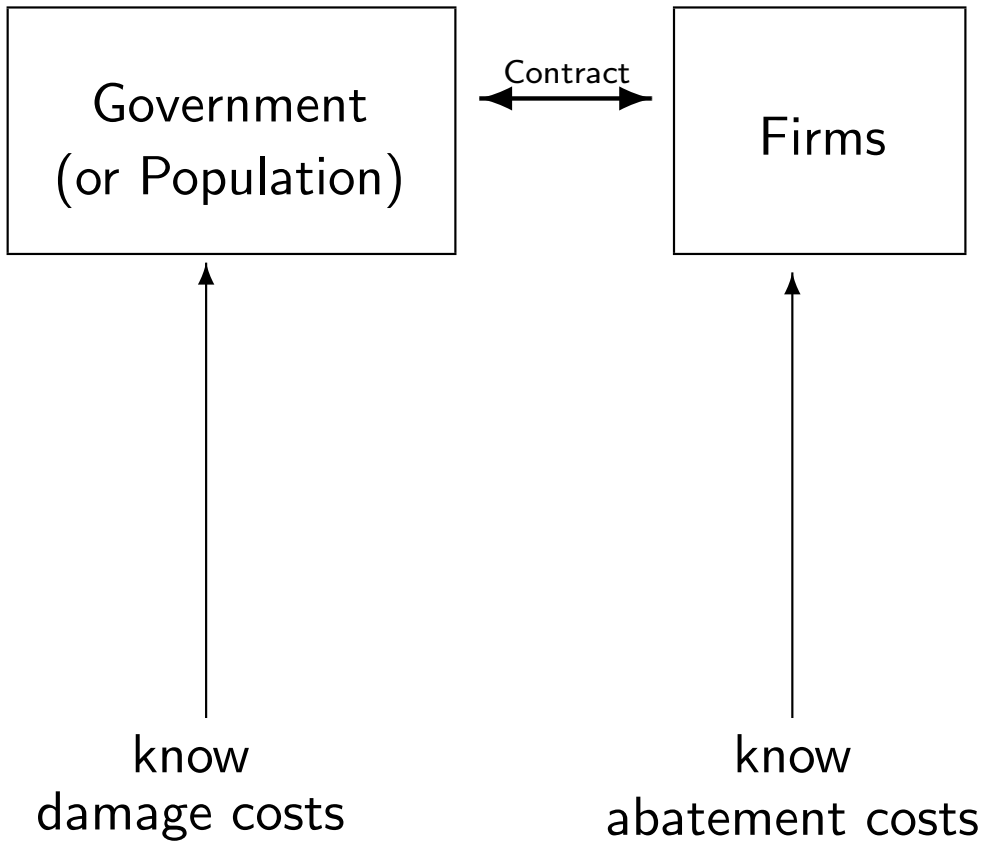
  $\rightarrow$ setting the Pigou tax is easy!
- Real-world: Tax authority (government) probably lacks this information.

Asymmetric Information

- Common assumption in the literature:

  Firms have an informational advantage concerning (marginal) abatement costs
- Examples:
  - Kwerel (1977) REStud, Spulber (1988) JPubE, ...
  - Laffont/Tirole: A Theory of Incentives in Procurement and Regulation

Standard Solution: Principal-Agent Relation



Marginal Damage Costs

- Can the government/voter reliably assess marginal damage costs?
- Probably not. Processes are too complex.
- Government mandates an agency to generate information on the marginal damage.
- The tax (or other policy) decision is then based on this information.

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Marginal Damage Costs: Asymmetry

- Principal-Agent Situation:
  - Principal: government (/median voter)
  - Agent: Environmental agency (or specialists working there).
- This is interesting if there are conflicts of interest:
  - Agent is policy / mission oriented and
  - his 'mission' is different than that of the government ('self-selection', future job prospects in industry...).

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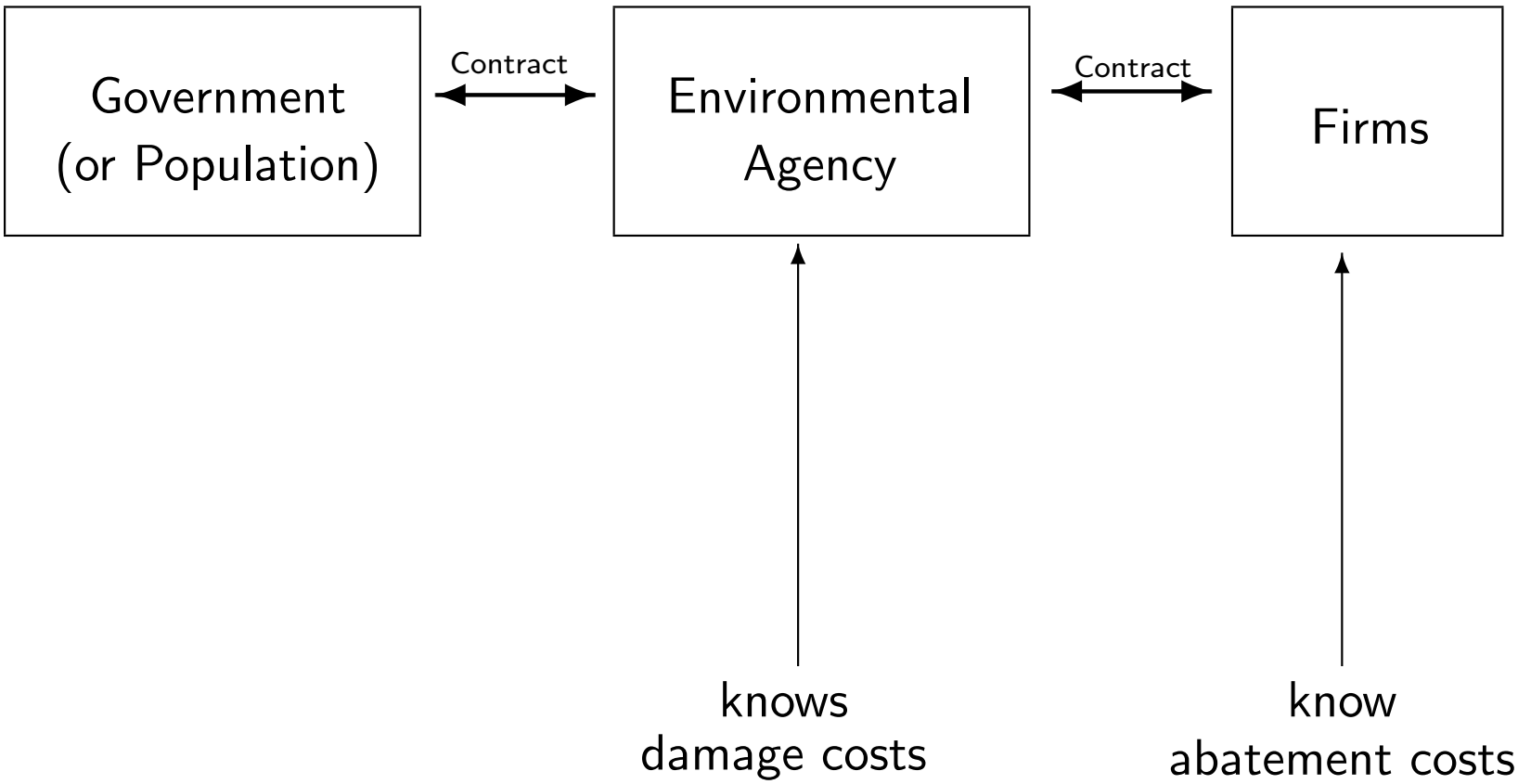
Opening the "Environmental-Agency Black-Box"



Contribution

Our model

- analyzes the Principal-Agent problem,
- solves for the menu of optimal contracts (tax and rewards to agency),
- documents how changes in the underlying damage distribution affect the contract tax.

- Very simple endowment economy that uses imported energy for production.
- Energy use gives rise to an (stochastic) environmental damage that can be internalized by charging a tax τ.
- Government/median voter pays an agency to reveal the true damage, paying r to agency.

Equilibrium

- Equilibrium consumer utility

$$u(\theta, \tau, r) = c(\theta, \tau, r) - \theta E(\tau) \tag{1}$$

- Optimum w/o info asymmetry: $r = 0$, $\tau = \theta$.
- Agent's utility:

$$w(\theta, \tau, r) = u(\theta, \tau, r) + (1 - \gamma)\theta E(\tau) + (1 + \zeta)r \tag{2}$$

where γ reflects the different weight on the environmental damage ($\gamma >, < 1$) and ζ the monetary preferences.

Expected Utility

- When designing the contract, the government does not know the damage.
- Ex-ante probability for some θ is $f(\theta)d\theta$.
- Expected utility of the government (median voter) is

$$\int_{\underline{\theta}}^{\bar{\theta}} f(\theta)\tilde{u}(\theta, \tau, \Delta)d\theta, \tag{3}$$

where Δ denotes the information rent that has to be paid to the agency for revealing the truth.

Tax Schedule

- The government chooses the tax as a function of the marginal damage cost $\tau(\theta)$, subject to restrictions on the form of the information rent.
- the incentive compatibility constraint $\Delta'(\theta) := \frac{\partial \Delta(\theta, \theta' = \theta)}{\partial \theta}$
- and the participation constraint $\Delta \geq 0$.

Optimality Conditions

- Maximizing w.r.t. τ and Δ implies the following focs.

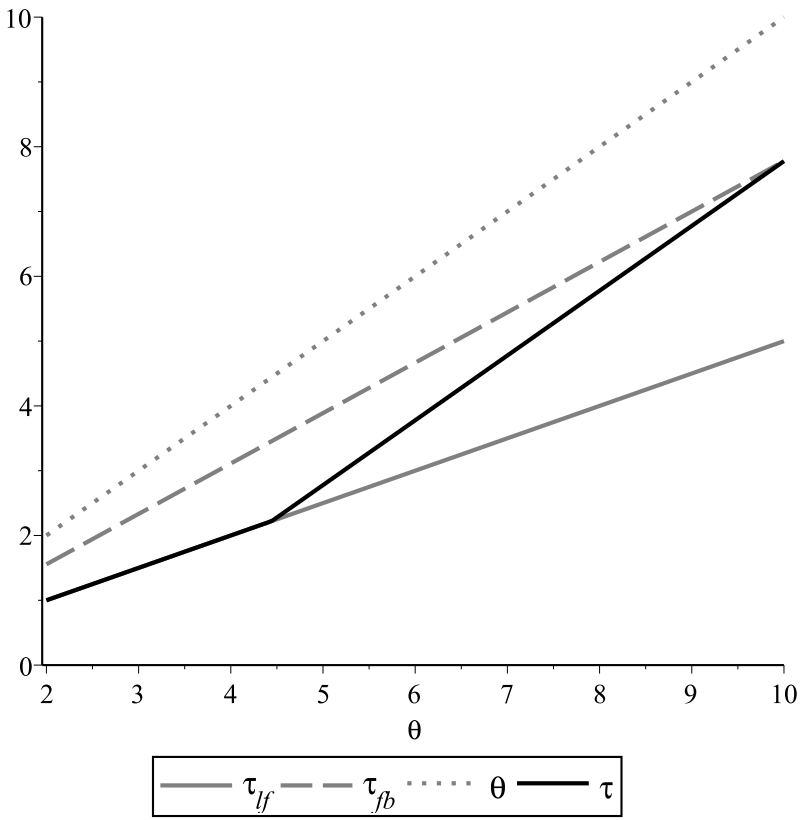
$$\frac{\partial \tilde{u}(\theta, \tau, \Delta)}{\partial \tau} f(\theta) = -\lambda(\theta) \frac{\partial \Delta'(\theta)}{\partial \tau} \tag{4}$$

$$\lambda'(\theta) = \chi f(\theta) - \mu(\theta) \tag{5}$$

$$\mu(\theta)\Delta(\theta) = 0 \tag{6}$$

- Choosing the environmental tax is not only driven by considerations of internalizing an externality, but also by strategic considerations (truthtelling).
- Solving the first-order conditions, we can solve for the equilibrium tax path $\tau(\theta)$ and the equilibrium information rent path $\Delta(\theta)$.
- Following results focus on the equilibrium tax under different parameter situations.

$\gamma < 1$ (Agency has anti-environmentalist bias)



- Low θ: Binding interval, agent's laissez-faire tax, no payment $\rightarrow$ full delegation
- High θ: Information rent, $\tau(\theta) < \tau_{fb}(\theta)$ and payment to avoid understating
- Highest θ: first-best tax, fully compensated by payment

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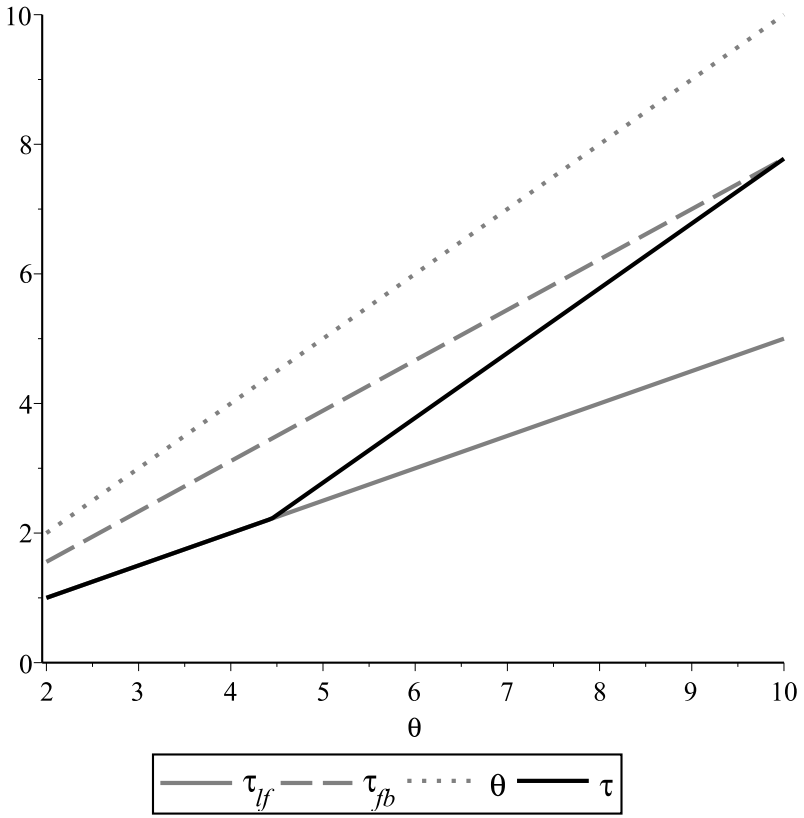

- Why can a binding interval be optimal?
- Getting low-θ types on board would raise the principal's utility for those θ...
- but makes understating more attractive for high θ.

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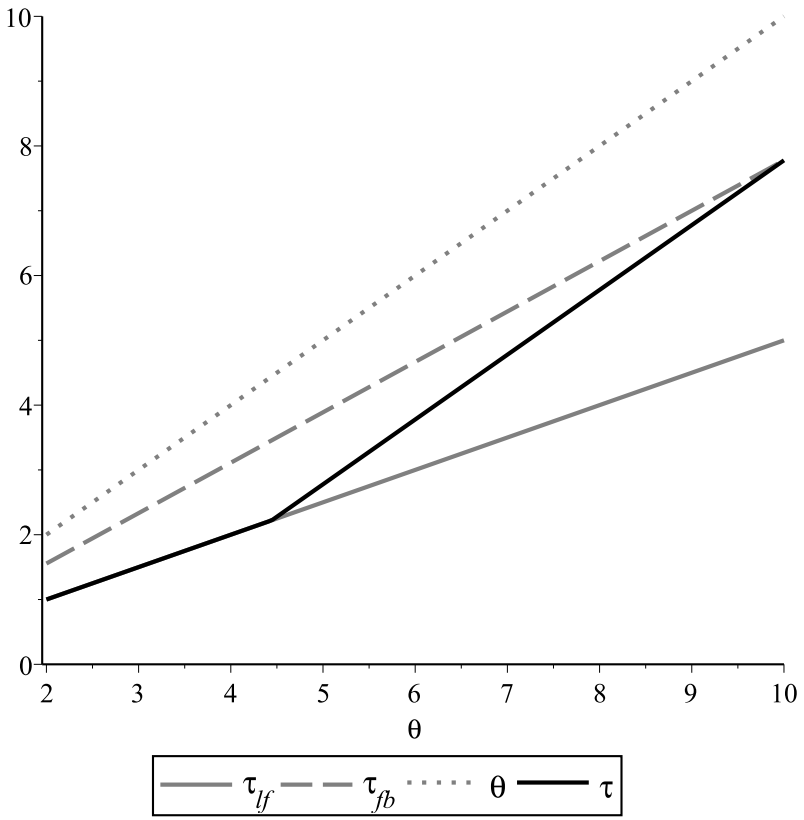
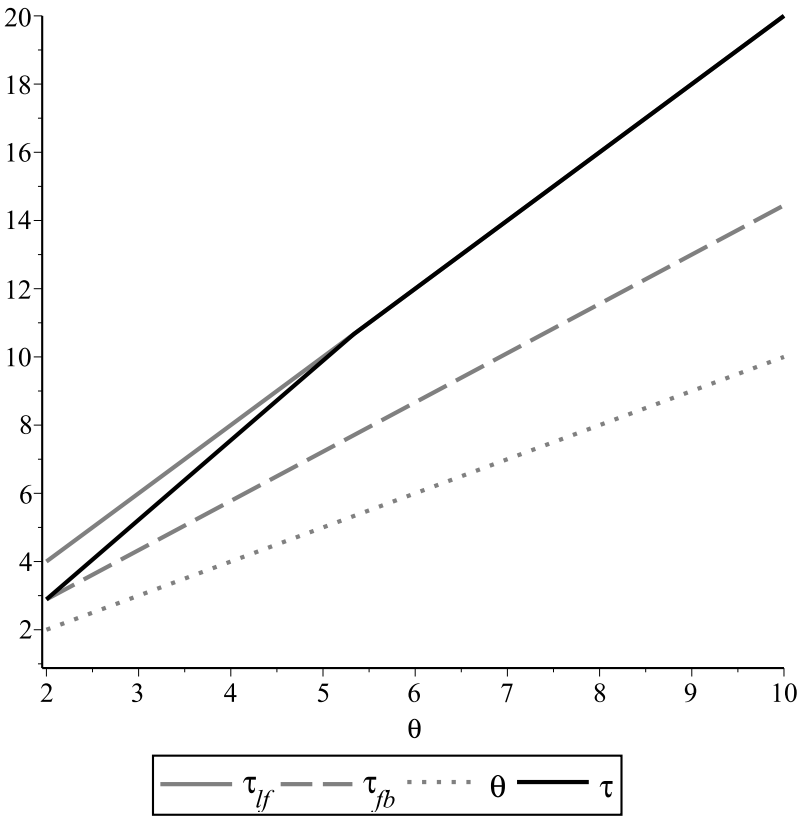


- Cutoff: $\frac{1}{1+\zeta\frac{1-\gamma}{\gamma}}\overline{\theta}$
- decreases in ζ:
  - Less binding types
  - agents are more easily controllable with money
- increases γ:
  - Less binding types
  - Less conflict of interest

$\gamma > 1$ (Agency has pro-environmentalist bias)



- High θ: Binding interval, agent's laissez-faire tax, no payment
- low θ: Information rent, $\tau(\theta) > \tau_{fb}(\theta)$ and payment to avoid overstating
- Lowest θ: first-best tax, fully compensated by payment

Changes in the θ distribution – Expected Damage

- A higher expected damage $\mathbb{E}(\theta)$ decreases the tax independent of the agent's preferences.
- $\gamma < 1$
  - tax decrease implies savings on the information rent.
  - With higher $\mathbb{E}(\theta)$ it becomes more expensive to "buy" the agent.
- $\gamma > 1$,
  - The government save on information rent payments
  - and adjusts the tax more to its preferred level, that is decreasing the tax.

Changes in the θ distribution – Mean Preserving Spread

- A mean-preserving spread decreases (increases) the tax for $\gamma < (>) 1$.
- More uncertain damage distribution $\rightarrow$ in both cases $\gamma \lessgtr 1$, information rents c.p. increase.
- Because compensating the agent is more expensive, he will have more discretion.

Wrap up

- Environmental agency has an informational advantage over the government when it comes to judging the (external) environmental damage caused by economic activity.
- The government offers a contract to the agent conditional on the announced damage, inducing truthful announcements.
- With the environmental agency having discretionary leeway, we find countervailing incentives.
- We solve for the optimal (contract) tax and discuss the implications of various parameter changes on the tax.