Getting Polluters to Tell the Truth

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Introduction

- Pollution is a problem because of the externalities it generates.

- There is the need to regulate polluters, to attain a socially optimal outcome.

- Problems:

  1. Damages arising from pollution are hard to measure.

  2. Polluters know more about their pollution abatement technology than regulators, and they (typically) have an incentive to overstate the costs of abatement.

  3. Even if the right regulation were put in place (i.e. even if damages and abatement costs were known) there is still the problem of enforcement.

This paper

This paper concentrates on how to get polluters to tell the truth.

For the most part, we assume that Damages can be estimated

In our mechanism, the problem of enforcement is \orthogonal" to the problem of setting the right standards.

Motivation

Why another mechanism design paper on regulation?

The problem of pollution has been tackled through regulation and through economic mechanisms (permits, taxes, etc). But:

- Optimal mechanisms in the theory are complicated.
- Actual mechanisms in practice are simple.

Hence, either:

- regulation is not optimal or
- the theory has not given any simple (implementable in practice) optimal mechanisms.

Optimal Mechanisms

Problems with previous papers that implement the ¯rst best levels of emissions:

1. Kwerel, and Dasgupta, Hammond and Maskin (DHM) have unbalanced budgets. Less applicable.

2. Main problem. Kwerel has several equilibria (other than truth telling). Also true of DHM if one requires DHM to have a balanced budget. If lying is an equilibrium that yields higher payo®s for all, it is likely that ¯rms will adopt this other equilibrium.

3. The mechanisms proposed are complicated.

4. They are based on taxes, subsidies and tradeable permits and

4.1 Sometimes regulators are not educated in environmental economics, and don't see the advantages of these instruments over \command and control".

4.2 Sometimes regulators believe it is immoral to let ¯rms pollute \just because" they have paid a tax.

4.3 Policymakers are sometimes reluctant to impose further costs on ¯rms.

Our Mechanism

Advantages

- It is budget balanced
- It's only equilibrium is truth telling
- It is simple. It shares some of the features actually observed in practice.
- It is based on command and control (setting an emissions standard). It can easily be extended for the use of pollution taxes.

Our Mechanism

Main Assumption

There are at least two ¯rms in each industry that share the same abatement cost, and this is common knowledge.

Reasonable assumption: regulation works on a process by process level, so two ¯rms that produce di®erent goods, but (for example) tan leather, will be regulated for their leather tanning process. This process is very basic, and shared by several ¯rms in di®erent industries.

The mechanism can be extended to incorporate industries with one ¯rm.

Our Mechanism

Second Assumption

In our mechanism ¯rms are asked to report their cost functions. We assume that

The regulator can inspect one ¯rm in each industry, and with an arbitrarily small probability it discovers whether the ¯rm has lied.

(it does not discover the true cost function, but only whether the report was false).

We also assume that the regulator can ¯ne a liar with an arbitrarily small ¯ne (large ¯nes may be infeasible, and turn the problem trivial).

Also reasonable: regulation works on small scale. Regulators inspect the abatement technologies of ¯rms to ¯nd out any discrepancies between their declarations and what they have implemented.

The Planner's Problem

There are n^i firms in industry $i = 1; :::; m$:

If all have an abatement technology with the cost function c^i; the regulator wishes to choose the emissions standards $f(c) = x^1; :::; x^m$ for industries $1; :::; m$ in order to minimize the total social cost (damages plus costs of abatement)

$$f(c) = \arg \min_{(x^1;:::;x^m)} \left[D \left(\sum n^i x^i \right) + \sum n^i c^i \left(x^i \right) \right]$$

The regulator must choose a mechanism in which the (hopefully unique) equilibrium is truth telling, and when firms announce their true cost functions c; then the regulator implements standards $f(c)$.

Our Mechanism

1. Firms announce any (convex, di®erentiable) cost function they desire.

2. The regulator:

   2.1 In industry i: identi¯es the ¯rms which announced the cost functions that would lead to the least stringent standard and samples one of them with a high probability, and one other ¯rm with the complementary probability.

   2.2 Fines a ¯rm if and only if: its report is false; it is inspected and the inspection discovers (with probability ") that the report was false. The ¯ne can be as small as one wants.

3. The most sringent emissions standards (consistent with ¯rms in industry i's declarations) are implemented in industry i:

The Theorem

Theorem 1. The efficient (first best, full information) social choice function defined by

$$f(c) = \arg \min_{(x^1,\ldots,x^m)} \left[D - \sum n^i x^i + \sum n^i c^i (x^i) \right]$$

is fully implementable. That is, the unique equilibrium of the direct revelation mechanism, is truth telling.

The Proof

Main idea is very simple:

1. If one other ¯rm in my industry is telling the truth, I am better o® telling the truth (by lying, I can only worsen the standard, and I may get ¯ned).

2. If no other ¯rm is telling the truth, one ¯rm has a chance weakly larger than $1=n^1$ of being inspected. This ¯rm is better o® slightly undercutting the announcement of any other ¯rm. It will only change the standard slightly (and only sometimes, depending on other industries declarations) but reduces the probability of a ¯ne discretely.

Idea is similar to generating \Bertrand like" competition among ¯rms. Generating incentives to undercut each other.

Some assumption is needed

Two ¯rms. If there was only one ¯rm in a certain industry, it could lie like a politician, gain a lot in terms of the standard, and only face a slight probability of a small ¯ne.

Inspection. If there was no chance of being discovered, even if there were many ¯rms, it would still be an equilibrium to overstate the abatement costs. Moreover, this equilibrium would be better for the ¯rms than telling the truth.

Extensions

Unknown Damages. Estimate them as best you can and use the mechanism. Continuity tells us that if the estimation is close to the truth, then the standards are close to the ¯rst best.

Industries with One ¯rm. Estimate the ¯rm's cost function as best you can and use the mechanism. Continuity tells us that if the estimation is close to the truth, then the standards are close to the ¯rst best.