The Entry-Deterring Effects of Inflexible Regulation

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- But limit pricing does not occur in a vacuum!
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- Our question: These agencies may facilitate (or hinder) the transmission of information to potential entrants, thus affecting entry patterns.
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  - the incumbent’s output level, as in standard ED games, AND
  - the emission fee set by the regulator.
Model

Incumbent’s costs are high or low, $K = \{H, L\}$, thus maximizing

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- Social welfare ($SW$) is
  \[ CS(Q) + PS(Q) + T - EnvD(Q) \]
  where $EnvD(Q) \equiv d \times Q^2$. 
Complete Information

- **Low costs?** No entry. Therefore the regulator sets a constant fee $t^{L,NE}$ that induces efficient output levels in both periods.

- **High costs?** Entry. The regulator hence wants set:
  - a lax fee on the 1st period monopoly, but
  - a more stringent fee on the 2nd period duopolists.

But he must choose a single tax!! (Not readjusted upon entry).

- Hence, any constant fee $t$ produces inefficiencies in one or both periods.
- The regulator selects a fee that minimizes the sum of these inefficiencies.
Complete Information - Example

- When $\delta = 1$, the reg. selects $t_{HE}^H = \frac{9}{25} t_1^H + \frac{16}{25} t_2^{HE}$. 

- Hence, under Complete info. fees cannot be used to deter entry.

- What about Incomplete info? Yes! Emission fees can help conceal info., thus deterring entry.
When $\delta = 1$, the reg. selects $t^{H,E} = \frac{9}{25} t_H^1 + \frac{16}{25} t_{2}^{H,E}$:

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- What about Incomplete info?
- Yes! Emission fees can help conceal info., thus deterring entry.
Incumbent and regulator are privately informed about the incumbent’s marginal costs: either $c^H_{inc}$ or $c^L_{inc}$.
Incomplete information - Time structure

1. Incumbent and regulator are privately informed about the incumbent’s marginal costs: either $c_{\text{inc}}^H$ or $c_{\text{inc}}^L$.

2. The reg sets emission fee $t$ and the inc. responds choosing its first-period output $q(t)$.
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3. A potential entrant observes the pair $(t, q(t))$, forms beliefs, and decides whether to enter/stay out.
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4. **Second period:**
Incumbent and regulator are privately informed about the incumbent’s marginal costs: either $c_{inc}^H$ or $c_{inc}^L$.

The reg sets emission fee $t$ and the inc. responds choosing its first-period output $q(t)$.

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**Second period:**

1. If entry does not occur ($NE$), the incumbent responds producing a monopoly output $x_{inc}^{K,NE}(t)$. 

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**Incomplete Information - Time Structure**

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An **informative PBE** can be sustained when priors $p$ are sufficiently high, where:

- The regulator selects type-dependent fees, and
- The incumbent chooses $q^H(t)$ and $q^A(t)$ when her costs are high and low, respectively,
  - where $q^A(t_1) > q^L(t_1)$. 
Informative equilibrium - Welfare comparisons

1. Relative to Complete information:
   - Under complete info.: since entry does not occur, the reg. can induce $q^{SO}$ in both periods.
   - Under incomplete info: the inc. produces a different output in the first and second period, but the reg. selects a single $t$ (\(\rightarrow\) inefficiencies).
     - Hence, $W^{L,R}_{CI} > W^{L,R}_{IE}$.

2. Relative to ED models in which the regulator is Absent:
   - When the reg. is absent: overproduction emerging in the IE induces additional pollution.
   - When the reg. is present: Despite not inducing $q^{SO}$, he ameliorates such overproduction (second best).
     - yielding that $W^{L,R}_{IE} > W^{L, NR}_{IE}$.
An uninformative equilibrium can be sustained when priors $p$ are low, in which:

- The regulator selects a type-independent fee $t^{L,NE}$, and
- Both types of incumbent choose output function $q^L(t)$.

Hence, the high-cost incumbent “over-produces,” while the regulator “over-taxes.”

- They conceal information from the entrant,
- and entry is deterred.
When considering ED, the reg. faces a trade-off:

- **Costs:** overtaxing emphasizes the inefficiencies of $t^{L,NE}$ (which was already a second-best policy under CI), but
- **Benefits:** it entails savings in the fixed entry cost $F$.
  - When those savings are sufficiently large, i.e., $F > F^{\text{Inflex}}(d)$, deterring entry becomes welfare improving.

Hence, the reg. overtaxes (facilitating ED) when doing so is welfare improving.
Uninformative equilibrium - Welfare comparisons

1. Relative to Complete information:
   - Under complete info: Inefficient regulation, both under CI and UE.
   - Under incomplete info: Since the reg. is willing to overtax, \( W_{UE}^{H,R} > W_{CI}^{H,R} \).
     hence, if the UE exists, it must be welfare improving.

2. Relative to ED models in which the regulator is Absent:
   - When the reg. is absent: overproduction emerging in the UE induces additional pollution, i.e., \( W_{UE}^{H,NR} \) is low.
   - When the reg. is present: Despite not inducing \( q^{SO} \), he ameliorates such overproduction (second best).
     hence, \( W_{UE}^{H,R} > W_{UE}^{H,NR} \).
What if, instead, the regulator is capable of rapidly readjusting emission fees if market conditions change?

- Some environmental policies are changed upon entry,
- while other policies remain rigid along time,

Examples:
- California timber taxes (unaffected since 1976),
- Electricity tax in Spain (unaffected during 1998-2003),
- Tax on aviation noise pollution in France (constant since 2003).
Flexible vs. Inflexible regimes

- **Flexible regime:** The reg. is less attracted to the UE, since the alternative (IE) yields optimal outcomes.

- **Inflexible regime:** The reg. is more attracted to the UE, since the alternative (IE) yields suboptimal outcomes.
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  - UE can be sustained only in region $III$.

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  - UE can be supported in regions $III + II$. 

![Graph showing flexible and inflexible regimes](image-url)
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![Graph showing regions III, II, and I with functions $F^{Flex}(d)$ and $F^{Inflex}(d)$](image)
Discussion

- **More responsive environmental agencies:**
  - Environmental protection agencies that rapidly adjust to market conditions can *hinder* firms’ ED practices.
  - While rigid agencies (e.g., in developing countries) would actually *facilitate* firms’ ED.

- **Why not just publicize the incumbent’s costs?**
  - Not necessarily optimal for the reg:
    - Playing the UE can entail a larger SW than the CI outcome.
  - Otherwise, SW is larger under CI than UE.
Related literature

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  - They abstract from the regulatory context in which the firm operates.

- Contributions:
  - The presence of the regulator can promote/hinder information transmission, entailing welfare improvements.
  - Regulator can anticipate the incumbent's actions, and successfully conceal information, but only if it is welfare improving.
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