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Lecture 25

Regulation under asymmetric info

Industrial Economics

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Regulation under asymmetric info

- Under ***full information*** a regulator can potentially achieve both ***allocative efficiency*** and ***cost efficiency***

  provided that she has ***sufficient instruments***
- Typically, the ***firm is better informed*** regarding:
  1. ***Costs*** and ***demand*** (hidden information) – ***incomplete*** info
  2. The choice of cost reducing ***effort*** (hidden action) – ***imperfect*** info
- A sophisticated regulator should be ***aware*** of the ***distortions*** created by the asymmetric information and ***design*** the regulatory regime accordingly

Hidden action – Loeb & Magat (1979)

Assumptions:

- A ***regulator*** *(R)* and ***one firm*** *(F)*
- The ***demand*** function D is common knowledge
- The ***cost*** function $C(q, e) = (c_0 - e)q + \psi(e)$ is private
- The firm ***chooses*** p and e
- R pays F a ***subsidy*** (S) equal to consumer surplus

- The ***payoff*** for the firm is

$$\pi(p) + CS(p) = \int D^{-1} dq - C(q, e)$$

given $S = CS(p)$, F will choose p and e to ***maximize its profits***, and in doing so implement the ***efficient outcome***

- However, the ***firm collects all the gains*** now

Loeb & Magat

Observations – hidden action

1. If the firm was required to ***bid for the monopoly right***, it would end up with zero profits
2. There might be a ***commitment issue*** and ***dynamic inconsistency*** involved in this setting

   hold-up might happen to ***first mover*** (R or F)
3. In a ***repeated setting*** the firm would understand that participating once is enough to ***give away MC*** – R could ***use*** that ***info*** to impose efficient prices in the future

   this creates a ***ratchet effect***

Hidden info – Baron & Myerson (1982)

- The ***regulator knows*** that the firm's cost function is:
  - $c_H = \theta_H \cdot q$ with probability φ
  - $c_L = \theta_L \cdot q$ with probability $1 - \varphi$
- The ***firm knows*** its type; and $\theta_H > \theta_L$
- R seeks to ***minimize the subsidy*** (S) paid to F on equity grounds and offers a ***menu of choices*** to F, (p, S)
- Consider the ***first-best menu*** $(\theta_L, 0)$ and $(\theta_H, 0)$
- The first-best menu is ***not incentive compatible***
  - ***No matter*** its type, F would ***report*** type c_H
  - Eq is ***lower*** because $q(\theta_H) < q(\theta_L)$

An IC mechanism

- The first-best menu results in a ***pooling outcome***
  no incentive to truthfully reveal the type
- Can the regulator induce a ***separating equilibrium***?
  a menu that ***incentivizes*** a potential θ_L to tell the truth
- That is, $\Pi(p_L, S_L | \theta_L) \geq \Pi(p_H, S_H | \theta_L)$

  IC_L: $p(q_L) \cdot q_L - \theta_L \cdot q_L + S_L \geq p(q_H) \cdot q_H - \theta_L \cdot q_H + S_H$

  IC_H is redundant – θ_H has no reason to lie about type
- R must also ensure that a ***high-cost*** firm will produce

  IR_H: $p(q_H) \cdot q_H - \theta_H \cdot q_H + S_H = 0$

  IR_L is redundant – if IR_H holds, θ_L breaks even posing as θ_H

The regulator's problem

- R's problem is to figure a menu that ***satisfies*** both IC_L and IR_H and ***maximizes*** expected total surplus (ETS):
  $ETS = \phi[CS(p_H) - \theta_H \cdot q_H] + (1-\phi)[CS(p_L) - \theta_L \cdot q_L]$
- The solution to R's problem can be ***characterized*** as

	A	B
p	θ_L	θ_H
S	$(\theta_H - \theta_L)q_H$	0

- A high-cost firm will ***pick B*** – needs higher price so forgoes the subsidy, $p = MC$ and profit is zero
- A low-cost firm will ***pick A*** – can afford low price so receives positive subsidy, $p = MC$ and positive profit

Observations – hidden info

- The profits earned by a low-cost firm are **information rents**
- They are equal to the profits the low-cost firm would earn ***had it posed*** as high-cost
- The low-cost firm will always ***be able to earn*** at least that much by pretending to be a high-cost firm
- The result is an instance of the ***revelation principle***
  "If an outcome can be implemented by an arbitrary mechanism, then the same outcome can be implemented by a direct IC mechanism (in which players truthfully report their type)"

Ratchet effects

- If the setting is ***repeating***, the above menu ***may not*** induce θ_L to reveal its true type
  R can ***use*** this information ***against*** θ_L in the ***next*** round
- As R learns more about F, ***tightens*** the regulatory constraint by reducing information rents
- Thus, the menu must ***pay the NPV of the future stream of information rents*** to induce θ_L to reveal its type truthfully
- Alternatively, R must ***commit*** to not use the information revealed to tighten the regulatory constraint
  unlikely, however, to be ***credible***

Systemic distortions

- Assume that S creates a ***distortion cost*** in the economy
  from raising taxes or because of corruption etc.
  $ETS = \phi[CS(p_H) - \theta_H q_H - kS_H] + (1-\phi)[CS(p_L) - \theta_L q_L - kS_L]$
- A high-cost firm can ***charge*** $p_H > \theta_H$ but
  $S_H = -(p_H - \theta_H)q_H$
  price ***exceeds MC*** but all ***profits are taxed back***
- The optimal choice for the low-cost firm ***does not change***
  but S_L will go down because it depends on q_H (and thus p_H)
- Raising p_H above MC ***reduces information rents*** for θ_L and creates a **DWL** in case the firm is θ_H

Baron & Myerson

Observations – systemic distortions

- The extent to which $p_H > MC$ depends on the ***regulator's beliefs*** about φ

  bayesian mechanism
- A lower φ ***results*** to a greater p_H and a smaller S_L
  - As it becomes more possible that the firm is θ_L the ***information rents become lower***
  - R becomes more willing to ***take a chance*** on DWL in case F turns out to be θ_H
  - In fact, it is possible that p_H can be ***greater than the monopoly price***!

In-lecture question

- Open the telegram channel of IE on your phone
- Once you select an answer, tap the appropriate symbol
- You may change your selection within the 60 sec by tapping another symbol
- I will take a screenshot of the app when the 60 sec expire
- Anyone tampering with the process will be penalized with -5 points and will be prosecuted for cheating
- Bonus +1 semester point if
  - Total votes no less than 80, AND
  - Majority votes the correct answer

In-lecture question

The **rachet effect** derives from

(♥) The nature of the IR condition of the incentive problem

(♥) The nature of the IC condition of the incentive problem

(♥) Both the IR and the IC conditions

(♥) The nature of information, which once it becomes available it stays available for all the following periods

VOTE COMPLETED!
PUT PHONES AWAY
LECTURE CONTINUES

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Armstrong – Cowan – Vickers (1994)

- The firm's ***unit cost*** is $c = c_o - e$
- ***Cost of effort*** is $\psi(e) = e^2/2$
- R is able to ***observe*** c but not its composition
  - ***Knows*** that c_o is distributed with density f with μ and σ^2
  - ***Cannot observe*** F's choice on e
- F ***first*** chooses e and ***then*** discovers its c_o
- ***Objective function*** for F is $E(\Pi) - (\gamma/2)V(\Pi)$

  where γ is a ***risk aversion*** coefficient
- For ***simplicity***, we assume that $q(p) = 1$

  demand is perfectly inelastic – ***no*** output choice problem

Armstrong et al.

Timing and instruments

- At <u>stage 1</u>, the regulator sets a ***price rule***

$$p(c) = \bar{p} + (1 - \varrho)c$$

  $\bar{p}$ is the ***max price***, $\varrho \in [0,1]$ is the ***sensitivity*** of price to unit cost
  - $\varrho = 1$ implies a pure ***price cap***
  - $\varrho = 0$ resembles a ***rate-of-return regulation***
- At <u>stage 2</u>, the firm ***chooses*** e to maximize

$$E(\Pi) - (\gamma/2)V(\Pi)$$

Armstrong et al.

R's problem

- R must choose $\bar{p}$ and ϱ to minimize ***expected*** total expenditure on the product

$$E[p(c)] = \bar{p} + (1 - \varrho)\underbrace{(\mu - e)}_{\text{expectation of } c}$$

$$s.t. \quad E(\Pi) - (\gamma/2)V(\Pi) \geq \Pi_o$$

  where Π_o is some ***reservation profit*** for the firm
- The constraint is a ***participation constraint*** (IR) for the firm – it reduces to a ***break-even constraint*** if $\Pi_o = 0$
- Notice that minimizing $E[p(c)]$ is ***equivalent*** to maximizing consumer surplus

  because $q(p) = 1$

Armstrong et al.

Stage 2

* F's ***profit*** is

$$\Pi = p(c)\cdot q - c - \psi(e) \Rightarrow$$
$$\Pi = \bar{p} + (1-\varrho)(c_o - e) - (c_o - e) - e^2/2 \Rightarrow$$
$$\Pi = \bar{p} - \varrho(c_o - e) - e^2/2$$

* ***Expected value*** of profit is: $E(\Pi) = \bar{p} - \varrho(\mu - e) - e^2/2$
* The ***variance of the profit*** is: $V(\Pi) = V(-\varrho\cdot c_o) = \varrho^2\cdot\sigma^2$
* F's ***objective function*** becomes
$$E(\Pi) - (\gamma/2)V(\Pi) = \bar{p} - \varrho(\mu - e) - e^2/2 - \gamma\cdot\varrho^2\cdot\sigma^2/2$$
* ***Maximizing*** w.r.t. e yields FOC:

$$\varrho - e = 0 \quad\Rightarrow\quad e^* = \varrho$$

Armstrong et al.

Stage 1

* R's problem becomes

$$\min_{\bar{p},\varrho} \bar{p} + (1-\varrho)(\mu - \varrho)$$
$$s.t.\quad \bar{p} - \varrho(\mu - \varrho) - \varrho^2/2 - \gamma\cdot\varrho^2\cdot\sigma^2/2 \geq \Pi_o$$

* R will use ϱ to <u>incentivize</u> e and $\bar{p}$ to ensure <u>participation</u>

  thus, $\bar{p}$ will be set to its lowest level so that IR will be ***binding*** with equality

* Solving IR w.r.t $\bar{p}$ and ***substituting*** it into the objective, R's problem ***simplifies*** to

$$\min_{\varrho} \Pi_o + \varrho(\mu - \varrho) + \varrho^2/2 + \gamma\varrho^2\sigma^2/2 + (1-\varrho)(\mu - \varrho)$$

* FOC yields: $\varrho^* = 1/(1+\gamma\sigma^2)$

Armstrong et al.

Tension between $\bar{p}$ and ϱ

Consider the price rule $p(c) = \bar{p} + (1-\varrho)c$

* <u>Increasing $\bar{p}$</u> causes F to choose higher e

  F captures more of the gains, ***productive efficiency*** improves

* <u>Increasing ϱ</u> progressively disconnects price from cost and F is ***uninsured*** against an unfavorable drawing of c_o

  higher risk aversion (γ) or info imperfection (σ^2) ***intensify*** this negative effect

* Regulator has to ***strike a balance*** between $\bar{p}$ and ϱ
  * <u>High</u> $\bar{p}$ and ϱ: Better efficiency but less insurance for F
  * <u>Low</u> $\bar{p}$ and ϱ: worse efficiency but more insurance for F
* The trade-off ϱ vs. $\bar{p}$ ***holds*** with an elastic demand, too

Thank you!

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WARNING

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