Kosmas Marinakis, Ph.D.

Lecture 24

Natural monopolies & regulation

Industrial Economics

Market failure

- ***Allocative*** efficiency failure
  - ***MB ≠ MC***, due to externalities, market power
- ***Rationing*** efficiency failure
  - ***allocation*** fails to coincide with the ranking of reservation prices
- ***Cost*** efficiency failure
  - output is not produced at min ***opportunity cost***, AC > MES
- ***Product selection*** failure
  - ***selection of products*** does not maximize consumer utility
- Failure to achieve ***optimal investment***
  - due to ***specificity*** or ***information*** asymmetry

Regulation

- Regulation is a ***response*** to market failure
  - Direct government intervention to change ***market outcomes*** (prices, quality, product variety)
  - Changing market institutions to affect ***market concentration***
- Intervention may ***lead to improvement*** in social welfare
  - winners from regulatory intervention could ***compensate*** the losers and still be winners

Regulation in practice

- Regulation is ***designed*** in three acts
  1. ***Identification*** of the failure
  2. ***Assessment*** of feasibility of intervention
  3. ***Cost – benefit analysis*** of the effects / sideefeects
- The usual ***market failure suspects*** that justify price and entry regulation are
  - Natural monopoly
  - Large sunk/specific investments
- ***Examples*** of markets with varying degrees of regulation
  - electricity, telecommunications, airlines, railroads, water, hydrocarbon pipelines

Natural monopoly

- We have a ***natural monopoly*** when
  - *the existence of more than one firms **increases cost** disproportionally to the social benefit*
- This happens when D ***intersects*** with AC curve ***before*** or ***slightly after*** the MES
- In this case, competition may not be ***sustainable***, even if the market ***initially*** has many firms
  - firms would ***merge or exit*** until the remaining firms had enough market power to raise price at least up to AC
- In some natural monopolies ***barriers*** to entry are ***endogenous*** – in some ***others*** they are ***not***

Cost subadditivity

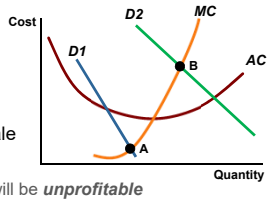
- A ***cost function*** is subadditive at an output level iff

$$C\left(\sum_{i=1}^{N} q_i\right) < \sum_{i=1}^{N} C(q_i), \quad for\ N > 1$$

  - cost functions are subadditive in the range of ***economies of scale***
- Subadditivity **continues** for some range after the range of economies of scale
  - ***With one firm***: $C(q_{MES} + \epsilon)$
  - ***With two firms:*** $C((q_{MES} + \epsilon)/2)$ per firm
  - ***It can be:*** $C(q_{MES} + \epsilon) < 2C((q_{MES} + \epsilon)/2)$
- Natural monopoly ***requires*** subadditivity

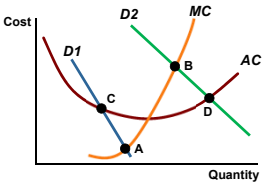
Pricing for efficiency

- Pricing at MC by a natural monopolist <u>can be unprofitable,</u> <u>but need not be</u>
- With D1, economies of scale are ***not exhausted***
  - thus, marginal cost pricing will be ***unprofitable***
- With D2 economies of scale are ***exhausted***, but the industry is still a natural monopoly
  - pricing at marginal cost will be ***profitable***



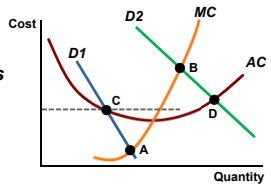
Pricing for sustainability

- Pricing at AC allows the monopoly to ***break even***
- At either D1 or D2 the monopoly can be ***sustained*** with ***no outside funding***
- However, the two cases C and D have ***substantial differences*** concerning the ***barriers to entry***



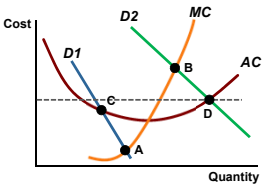
Strong natural monopoly

- With D1, pricing at C, potential entrants will have ***high costs*** and run ***losses***
  - monopoly is ***stable*** and ***breaks even***
- This is a ***strong natural monopoly***
  - does ***not need protection*** from entry under either sustainability pricing (C) or efficiency pricing (A) – barriers are ***endogenous***
- ***Example:*** Routes to remote areas by public airlines



Weak natural monopoly

- With D2, pricing at D, entry will allow for ***cost savings***
- Entrants can ***undercut***
- This is a ***weak natural monopoly***
  - ***cannot be sustainable*** on its own – needs ***regulated barriers*** no matter if pricing targets for sustainability (D) or efficiency (B)
- ***Entry*** is profitable but ***socially suboptimal***
- ***Example:*** Oil industry in some countries



Natural monopoly and regulation

- Regulation cannot be ***perfect***
  1. Efficiency may require ***reallocation*** of resources
     - ***taxpayers*** to pay for state monopoly's ***deficits***
  2. Sustainability is ***not efficient***
     - pricing may be ***distant from MC***
  3. Regulators do not have ***perfect information***
     - cannot completely ***align the objectives*** of the firm and society

Ramsey – Boiteux pricing

- Ramsey pricing is the set of scalar prices that ***maximize the total welfare*** subject to ***profit being zero***

$$\max_{q_1,\dots q_N} \sum_{n=1}^{N} \int_0^{q_n} p_n(q_n)dq_n - C(q_1,\dots q_N)$$
$$s.t. \sum_{n=1}^{N} p_n(q_n)\cdot q_n - C(q_1,\dots q_N) = 0$$

sum of profit and consumer surplus

N is the number of markets; $p_n(q_n)$ is the inverse demands

- Ramsey pricing ***yields***

$$\frac{p_n - \partial C/\partial q_n}{p_n} = \frac{\lambda/(1+\lambda)}{\varepsilon_n}$$

ε_n is the ***elasticity of demand*** in market n and λ is the ***Lagrange multiplier*** of the regulator's problem

Large specific investments

- Regulation will be the ***preferred governance instrument*** when there is:

  uncertainty - information asymmetry - investment specificity

- Regulation as an ***institutional framework*** can address ***holdup***
  - ***Provides a set of rules*** for negotiation and dispute resolution alternative to ***contracting***
  - ***This eliminates*** the incentive of ***renegotiation*** and thus alleviates the potential for ***opportunistic behavior***

Large specific investments (cont'd)

- Regulation minimizes ***transaction costs***
  - ***Replaces private contracting*** under uncertainty, complex performance obligations, and sunk expenditures
  - Relationship between firm and customers is ***administered by the regulator***
- Regulation addresses inefficiencies that arise from ***underinvestment*** in specific assets
  - ***Reduces outside options:*** firms enjoy ***exclusive rights*** in exchange for an ***obligation to invest***
  - ***Controls prices:*** Circumvents contracting rigidities by allowing ***prices to adapt*** in volatile circumstances

Regulatory risk

- Initially, a regulator has an incentive to promise that ***investing*** firms will enjoy ***market power***
- Once investment is ***sunk,*** the regulator has the incentive to regulate ***prices to MC*** or ***allow free entry***

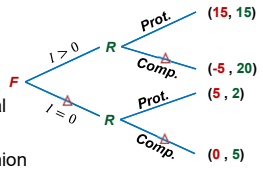
  the regulator -on behalf of consumers- ***expropriates*** the firm's capital investment
- The firm can protect itself by ***underinvesting***

  this will result in a ***loss of efficiency***
- Alternatively, the firm must be ***compensated*** for regulatory risk ex ante through a higher rate of return

  this ***too***, raises the cost of capital and ***reduces efficiency***

Regulatory commitment

- This is a ***two-staged*** game with dynamic inconsistency
- The ***only way*** for the regulator to impose the social optimum is to ***commit*** to not "holdup" firms in this fashion



- Governments have a substantial ***long-run incentive*** to built ***reputations*** of committed regulators

  by ***honoring its promise*** to not expropriate today, the regulator ***encourages investment*** tomorrow

Economic Theory of Regulation (1971)

George Stigler in an influential article on regulation observed:

1. There is ***demand for regulation***

   from ***groups*** who could benefit from its results
2. There is ***supply for regulation***

   politicians have a ***monopoly in regulation*** and ***incentive*** from the political process to provide it in ***return*** for help in attaining and maintaining political power
3. The ***benefits are concentrated and significant***, but the ***costs are small and diffuse***

   often, the benefits to the few ***are less*** than the costs to the many

Full information regulation

- Consider a single-product ***monopolist*** (F) with ***demand*** $q(p)$ and a subadditive ***cost*** function such that

  $$p = MC \quad \Rightarrow \quad \Pi < 0$$
- The ***regulator*** (R) can sustain this monopoly by ***setting*** $p = MC$ and ***subsidize*** it by $S = -[MC \cdot q^* - C(q^*)]$

  where q^* is the output at which $p = MC$
- An alternative way is to set a ***2PT***, so the consumers pay an entry fee of S/N and $p = MC$ (N ***identical*** consumers)
- Suppose now that F can engage in ***cost-reducing effort***, e: $MC = c_o - e$, where $c_o \equiv MC(e = 0)$

  we also assume a ***cost of effort***: $\psi(e)$, $\psi' > 0$ and $\psi'' \geq 0$

First best regulation: p^*

- What are the ***efficient levels*** of p and e?
- We need to assure ***allocative efficiency***
  to maximize the ***gains from trade***
- We need to assure ***productive efficiency***
  that F exerts the ***cost-minimizing*** effort level
- ***2 instruments*** are required to attain both objectives
  the regulator can implement a ***two-part tariff***: (A, p)
- Clearly, ***gains from trade are maximized*** when:

$$p^* = c_0 - e$$

First best regulation: A^* and e^*

- The ***access fee***, A, is a ***subsidy*** on the profits of the firm
- ***Total costs*** are (MC = AC because MC is constant)

$$C\,(q(p^*), e) = (c_0 - e) \cdot q(p^*) + \psi(e)$$

- ***Minimizing*** total cost with respect to e yields

$$q(p^*) = d\psi(e)/de$$

  e^* is the solution to the above FOC

- For exerting e^*, F is allowed to recover $\psi(e^*)$, through A
- 2PT: $T(q) = \frac{\psi(e^*)}{N} + (c_0 - e)q$

  provided that $\psi(e^*)/N < CS(p = p^*)$, (consumers are priced-in)

Thank you!

Kosmas Marinakis
www.kmarinakis.org
kmarinakis@hse.ru