Module 12: Antitrust in Innovative Industries

Market Organization & Public Policy (Ec 731) · George Georgiadis

- Segal and Whinston (AER, 2007)
- Antitrust policy in industries with continual innovation.

- Insofar, we have assumed that patents have a fixed duration and guarantee monopoly rights.
- In reality,
  - most patents have been superseded by the end of their term, and
  - how protective patents are is a decision that needs to be made.

Model

- Time is discrete.
- Two firms who discount time at rate $\delta \in (0,1)$.
- In each period, one of the firms is the "incumbent" I and the other firm is the "potential entrant" E.
- E chooses its R&D rate $\phi \in [0,1]$ at cost $c(\phi)$, where $c' > 0$ and $c'' > 0$. With probability ϕ:
  - E innovates,
  - receives a patent,
  - competes with the incumbent in the present period,
  - becomes the incumbent in the next period, and
  - the previous incumbent becomes the potential entrant.

- Notation:
  - α: protectionism of the antitrust policy.
  - $\pi_E(\alpha)$: Entrant's profit.
  - $\pi_I(\alpha)$: Incumbent's profit in competition.
  - π_m: Incumbent's profit when he faces no competition.
- Assumptions:
  - $\pi_m \geq \pi_I(\alpha) + \pi_E(\alpha)$ ("efficiency effect")
  - $\pi'_E(\alpha) > 0$ (*i.e.*, higher α represents a policy that is more protective **for the entrant**).

Analysis

- Stationary Markov Perfect equilibria.
- Expected present discounted profit of an incumbent:

$$\begin{aligned} V_I &= (1-\phi)\left[\pi_m + \delta V_l\right] + \phi\left[\pi_I(\alpha) + \delta V_E\right] \\ &= \pi_m + \delta V_l + \phi\left[\pi_I(\alpha) - \pi_m + \delta\left(V_E - V_I\right)\right] \end{aligned} \tag{1}$$

- Expected present discounted profit of an entrant:

$$\begin{aligned} V_E &= (1-\phi)\,\delta V_E + \phi\left[\pi_E(\alpha) + \delta V_I\right] - c(\phi) \\ &= \delta V_E + \phi\left[\pi_E(\alpha) + \delta\left(V_I - V_E\right)\right] - c(\phi) \end{aligned} \tag{2}$$

- Entrant chooses ϕ to maximize the RHS:

$$\Phi(w) = \arg\max_{\phi\in[0,1]} \{\phi w - c(\phi)\} \ ,$$

  where $w = \pi_E(\alpha) + \delta\left(V_I - V_E\right)$ can be interpreted as the "innovation prize".

  - $\Phi(w)$ is increasing in w.
  - $\Phi(w)$ gives us an "Innovation Supply" (IS) curve.

- Subtracting (2) from (1), solving for $(V_I - V_E)$ and substituting into w, we can express the innovation price as $w = W(\phi, \alpha)$, where

$$W(\phi, \alpha) = \frac{[1 - \delta(1-\phi)]\,\pi_E(\alpha) + \delta\,[\phi \pi_I(\alpha) + (1-\phi)\,\pi_m + c(\phi)]}{1 - \delta + 2\delta\phi}$$

  - $W(\phi, \alpha)$ gives us an "Innovation Benefit" (IB) curve.

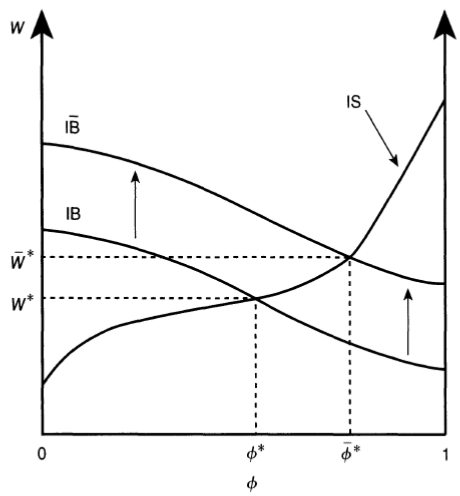

FIGURE 1. COMPARATIVE STATICS

- Can show that (IS) and (IB) intersect once.

- Intersection point pins down the (unique) equilibrium values (ϕ^*, w^*).

Comparative Statics

- How does ϕ^* (*i.e.*, innovation rate) change with α (*i.e.*, entrant protectionism).

- Observe that (IS) does not depend on α.

- *A sufficient condition:* If an increase in α shifts (IB) up at every ϕ, then ϕ^* increases in α.

- Differentiate $W(\phi, \alpha)$ w.r.t α. Protectiveness of antitrust policy increases innovation if for all $\phi \in [0, 1]$:

$$\pi'_E(\alpha) + \frac{\delta\phi}{1 - \delta(1-\phi)}\pi'_I(\alpha) \geq 0$$

  - *First term:* Change in an entrant's profit in the period of entry.
  - *Second term:* Change in the value of a continuing incumbent.

- If $\pi_m'(\alpha) \neq 0$, then the above condition can be re-written as

$$\pi_E'(\alpha) + \frac{\delta}{1 - \delta(1 - \phi)} \left[(1 - \phi)\pi_m'(\alpha) + \phi\pi_I'(\alpha)\right] \geq 0$$

- Because inequality must hold for all ϕ, a more protective antitrust policy raises innovation whenever

$$\pi_E'(\alpha) + \delta\pi_I'(\alpha) \geq 0$$

- The larger δ is, the more likely it is that a more protective policy reduces innovation.
  - (Generally, $\pi_I'(\alpha) \leq 0$)

- A more protective antitrust policy tends to "front-load" an innovative new entrant's profit stream.

- Model extends to
  1. R&D deterring activities
  2. Voluntary deals between the incumbent and a new entrant (*e.g.*, licensing)
  3. Market may grow (or shrink)
  4. Many potential entrants

Application #1: Long-Term Exclusive Contracts

- Incumbent can sign consumers to a long-term contract.
- 2 firms, and a continuum of consumers of measure 1.
- Each consumer may consume a good with production cost $k \geq 0$.
- R&D can improve the quality of the good, and consumers value "generation j" of the good at $v_j = v + j\Delta$.
- In period t:
  - The incumbent possesses a (infinitely-lived) patent on the latest generation j_t.
  - Likewise, there is a patent holder for each of the previous generations $j_t - 1$, $j_t - 2$, ...

  - Only firms other than the incumbent can invest in developing the generation $j_t + 1$ product.

- Long-term contracts:
  - In each period t, the incumbent can offer long-term contracts to a share b_{t+1} of consumers.
  - Contracts specify a sale in period $t + 1$ at price q_{t+1} to be paid upon delivery.
  - Assume $k > \Delta$, so an entrant cannot "steal" a consumer with a long-term contract.

- Antitrust policy α:
  - Proportion of consumers offered a long-term contract cannot exceed $1 - \alpha$.
  - *Idea:* Long-term contracts prevent the ability of an entrant to capture market share.
  - If $\alpha = 1$, then no long-term contracts can be offered. Then the model reduces to a Bertrand competition model between the leading firm and firms further down the ladder.

- Timing within each period t:
  - *Stage* $t.1$*:* Each potential entrant i observes the share of captured consumers B_t and chooses its innovation rate $\phi_{i,t}$. Then innovation is realized.
  - *Stage* $t.2$*:* Firms name prices $p_{i,t}$ to free consumers.
  - *Stage* $t.3$*:* Free consumers accept or reject these offers.
  - *Stage* $t.4$*:* Firm with the leading technology offers to a share $b_{t+1} \leq 1 - \alpha$ of consumers a long-term contract that specifies price q_{t+1}.
  - *Stage* $t.5$*:* Consumers accept or reject these offers.

- Focus on Markov Perfect equilibria (MPE).
  - In stage $t.1$, potential entrants condition their innovation choices only on B_t, and at all other stages, choices are stationary.
  - On the equilibrium path, $B_t = B^*$ in every period.
  - Thus, the value of being an incumbent or an entrant, and the rate of innovation are stationary.

- Suppose that on equilibrium path, the share of consumers signing a long-term contract is B^*.
- Prices offered to "free" consumers in period t:
  - Firm with leading technology offers price $k + \Delta$.
  - Firm with technology $j_t - 1$ offers price k.
  - Assume leading firm "wins" the sale, so it earns $(1 - B^*)\Delta$ from sales to free consumers (in period t).
- Consumers' decision to accept a long-term contract:
  - Probability of entry in the next period is ϕ^*, so a consumer anticipates getting surplus $v + (j_t - 1)\,\Delta - k + \phi^*\Delta$.
  - So he will accept a long-term contract only if

$$\begin{aligned} v + j_t\Delta - q_{t+1} &\geq v + (j_t - 1 + \phi^*)\,\Delta - k \\ \Longrightarrow q_{t+1} &\leq k + (1 - \phi^*)\,\Delta \end{aligned}$$

  - So the incumbent will charge $q^* = k + (1 - \phi^*)\,\Delta$, and earn $B^*(1 - \phi)\,\Delta$ from consumers who sign long-term contracts.
  - Authors show that if the *Innovation Supply* (IS) function $\Phi(\cdot)$ is increasing, then $B^* = 1 - \alpha$.
    - Increasing (IS) function: ea. potential entrant is better off if the innovation prize w increases.
    - *i.e.*, the incumbent will offer as many long-term contracts as permitted.
- Now we can fit this model into the basic model we studied earlier:
  - $\pi_m(\alpha, \phi) = \alpha\Delta + (1 - \alpha)(1 - \phi)\,\Delta$
  - $\pi_I(\alpha, \phi) = (1 - \alpha)(1 - \phi)\,\Delta$
  - $\pi_E(\alpha, \phi) = \alpha\Delta$
- How does a change in the antitrust policy α affect the rate of innovation ϕ?

- We know that ϕ^* increases in α if for all $\phi \in [0,1]$:

$$\begin{aligned} \pi_E'(\alpha) + \frac{\delta}{1-\delta(1-\phi)}\left[(1-\phi)\,\pi_m'(\alpha) + \phi\pi_I'(\alpha)\right] &\geq 0 \\ \Leftrightarrow \Delta + \frac{\delta}{1-\delta(1-\phi)} \underbrace{\left[(1-\phi)\,\phi\Delta - \phi(1-\phi)\,\Delta\right]}_{=0} &\geq 0 \end{aligned}$$

- *Proposition:* In every Markov Perfect equilibrium of this model, the equilibrium rate of innovation ϕ^* increases in α.

- *Implication:* To maximize incentives for innovation, a regulator should prohibit long-term contracts (*i.e.*, set $\alpha = 1$).

- What about aggregate surplus?

  - Consumers' surplus increases in α.
  - Value of entrant V_E increases in α.
  - Value of incumbent V_I is ambiguous.

- *Proposition:* In every Markov Perfect equilibrium of this model, aggregate surplus increases in α.

- *Implication:* Aggregate surplus is maximized when long-term contracts are prohibited.

- *Key observation:* Long-term contracts involve an inefficiency, because when entry occurs, the incumbent sells an old technology to captive consumers.

References

Segal I. and Whinston M.D., (2007), "Antitrust in Innovative Industries", *American Economic Review*, 97 (5), 1703-1730.

Tirole J., (1988), *The Theory of Industrial Organization*, MIT Press.