Module 12: Antitrust in Innovative Industries

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- 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  - most patents have been superseded by the end of their term, and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 \( \phi \):
  - \( E \) 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:
  - $\alpha$: protectionism of the antitrust policy.
  - $\pi_E(\alpha)$: Entrant’s profit.
  - $\pi_I(\alpha)$: Incumbent’s profit in competition.
  - $\pi_m$: 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 $\alpha$ represents a policy that is more protective for the entrant).

**Analysis**

○ Stationary Markov Perfect equilibria.

○ Expected present discounted profit of an incumbent:

$$V_I = (1 - \phi) [\pi_m + \delta V_I] + \phi [\pi_I(\alpha) + \delta V_E]$$
$$= \pi_m + \delta V_I + \phi [\pi_I(\alpha) - \pi_m + \delta (V_E - V_I)]$$

(1)

○ Expected present discounted profit of an entrant:

$$V_E = (1 - \phi) \delta V_E + \phi [\pi_E(\alpha) + \delta V_I] - c(\phi)$$
$$= \delta V_E + \phi [\pi_E(\alpha) + \delta (V_I - V_E)] - c(\phi)$$

(2)

○ Entrant chooses $\phi$ to maximize the RHS:

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

where $w = \pi_E(\alpha) + \delta (V_I - V_E)$ 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.

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

Intersection point pins down the (unique) equilibrium values \((\phi^*, w^*)\).

**Comparative Statics**

- How does \(\phi^*\) (i.e., innovation rate) change with \(\alpha\) (i.e., entrant protectionism).
- Observe that (IS) does not depend on \(\alpha\).
- A sufficient condition: If an increase in \(\alpha\) shifts (IB) up at every \(\phi\), then \(\phi^*\) increases in \(\alpha\).
- Differentiate \(W(\phi, \alpha)\) w.r.t \(\alpha\). 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

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

- Because inequality must hold for all \( \phi \), a more protective antitrust policy raises innovation whenever

\[
\pi'_E(\alpha) + \delta \pi'_I(\alpha) \geq 0
\]

- The larger \( \delta \) 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 \( j_t - 1, j_t - 2, \ldots \)
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 $\alpha$:
  - 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 $\phi^*$, so a consumer anticipates getting surplus $v + (j_t - 1)\Delta - k + \phi^*\Delta$.
- So he will accept a long-term contract only if
  \[ v + j_t\Delta - q_{t+1} \geq v + (j_t - 1 + \phi^*)\Delta - k \]
  \[ \implies q_{t+1} \leq k + (1 - \phi^*)\Delta \]
- 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 $\alpha$ affect the rate of innovation $\phi$?
We know that $\phi^*$ increases in $\alpha$ if for all $\phi \in [0, 1]$:

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

$$\equiv \Delta + \frac{\delta}{1 - \delta (1 - \phi)} [(1 - \phi) \phi \Delta - \phi (1 - \phi) \Delta] \geq 0$$

- **Proposition:** In every Markov Perfect equilibrium of this model, the equilibrium rate of innovation $\phi^*$ increases in $\alpha$.

- **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 $\alpha$.
  - Value of entrant $V_E$ increases in $\alpha$.
  - Value of incumbent $V_I$ is ambiguous.

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

- **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**
