Network effects, switching costs and competition policy

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with credit to
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But what do we know about the relationship between switching costs and network effects?

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"To grasp what HP has in mind, one has to understand the two main currents in the IT industry. First, nearly any new technology quickly becomes a commodity that is easily copied and hence not very profitable.... Second, the biggest IT firms typically control what is known as a "platform": a digital foundation on which others build their products, such as Microsoft's Windows."

The simplest possible models

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  - ➥ One incumbent;
  - ➥ Free entry;
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$$\begin{aligned} \text{price} &= \sigma, \\ \text{profit} &= \alpha\sigma. \end{aligned}$$

Efficient.

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$$\text{price} = \sigma,$$
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  Efficient.
- Network effects

$$\text{price} = \alpha\nu,$$
$$\text{profit} = \alpha^2\nu.$$

  Efficient.

Efficiency issues revisited

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➥ Note that we can have inefficiency without discrimination.

Hal Varian in Berkeley lectures

"network effects lead to substantial collective switching costs and lock-in",
which are
"even worse than individual switching costs due to coordination costs".

Four themes

How do switching cost models and network models differ?

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How do we model inertia and incumbency advantage in networks?

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How do switching cost and network effects mix?

No two sidedness!

Elementary repeated games with homogeneous consumers

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You do not become rich on switching costs (or network effects) alone.

Heterogeneity of consumers: static model

Some consumers with switching costs/network effects equal to zero (or with no value for network effect).

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Remark: With heterogeneous consumers a no discrimination rule can be costly in terms of social welfare.

Dynamics
with
heterogeneous consumers

With an ∞ horizon, the profit is not equal to the one period profit.

$$\Pi = \alpha_H(-\delta\Pi + \sigma) + \delta\Pi$$
$$\implies \Pi = \frac{\alpha_H\sigma}{1 + \alpha\delta - \delta}.$$

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Profit is smaller than discounted flow of one period profit.

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Adding zero switching cost/network effects customers increase the profit of the incumbent.

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When $\delta \rightarrow 1$, $\Pi \rightarrow$ 1 period profit.

$$\sigma_L > 0$$

is different from

$$\nu_L > 0.$$

Two periods: $\sigma_L > 0$ and $\alpha\sigma_H > \sigma_L$

☞ In 1st period,

1. incumbent charges $(1 - \alpha\delta)\sigma_H$ (this requires some work);
2. entrants charge $-\delta\sigma_L$
   and attract all the “low switching costs” consumers.

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a proportion strictly between 0 and 1 of σ_H consumers will purchase from an entrant.

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  High switching cost customers try to "hide" among low swithching cost customers.

  $$(-\delta\sigma$$

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- Becaus

  Requires lots of rationality from consumers, who need to be able to predict path of prices.

  $(-\delta\sigma$

  $$< (1 - \alpha\delta)\sigma_H + \delta\sigma_H = (1 + \delta - \alpha\delta)\sigma_H$$

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Network effects

Puzzles

- ☞ Two networks; a mass α of consumers. Utility of consumers is equal to

$$\nu \times \text{mass of consumers in same network.}$$

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- ☞ What prices will the network charge at equilibrium?

Modeling coordination failures in network effects

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- Crémer, Rey, Tirole: a mass of "trapped" consumers.
- Caillaud, Jullien: coordination on worse equilibrium for the entrant.
- Weyl: Insulated Tariffs
- Cabral: differentiated consumers compete for new consumer
- Ambrus and Argenziano: Coalitional Rationalizability
- Trying to say things about the whole set of equilibria.

- Our solution: strong non-coordination.

The model

- ☞ α_H consumers of type H and α_L consumers of type L.
- ☞ Within group network effects are either V_H or V_L, with $\alpha_H V_H > \alpha_L V_L$.

⟹ Utility of consumer of type H who belongs to network n is

$$V_H \times (\gamma_{nH} + \lambda_H \gamma_{nL})$$

where γ_{nH} is mass of consumers of type H belonging to network n and $0 \leq \lambda_H < 1$.

- ☞ Utility of consumer who belongs to no network: $-\infty$.

Nomadic consumers equilibria

$$\begin{aligned} &V_H(\gamma_{nH} + \lambda_H \gamma_{nL}) - p_n \stackrel{\text{def}}{=} u_H && \text{if } \gamma_{nH} > 0, \\ &V_H(\lambda_H \gamma_{nL}) - p_i \leq u_H && \text{if } \gamma_{nH} = 0, \end{aligned}$$

Same thing for L consumers.

This is the standard definition of equilibrium for networks.

Sedentary consumers equilibria

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Sedentary consumers equilibria

An allocation of consumers among networks is a “sedentary consumers” (SC) equilibrium if it is a nomadic consumers equilibrium and we can find a sequence of moves of “small” masses of consumers which converge to a nomadic consumers equilibrium, where at each stage it is the consumers gaining the most who move.

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Dynamic model

Period 1 starts with one incumbent

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Each period $t > 1$ starts
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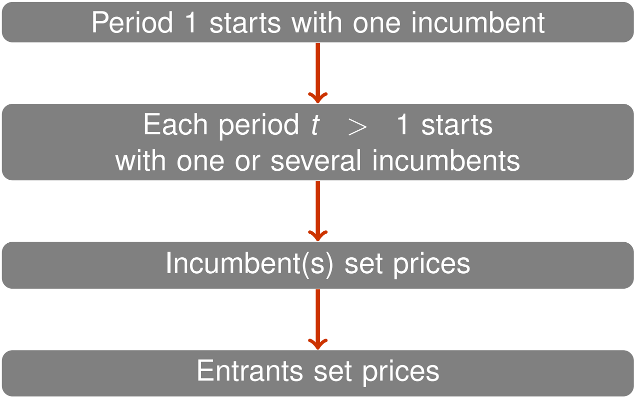
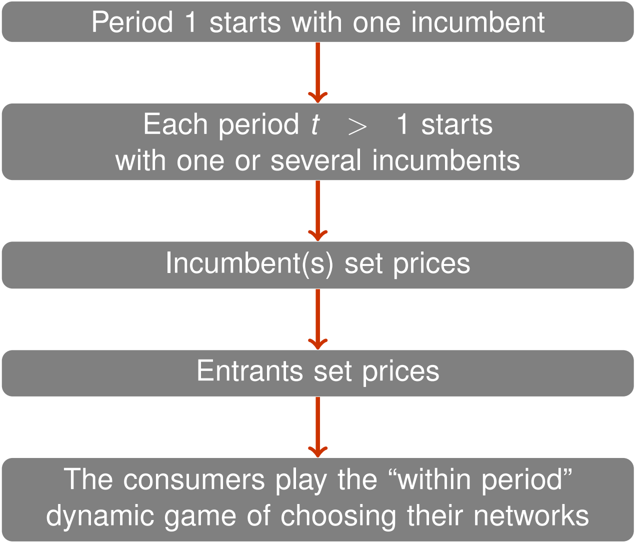
Incumbent(s) set prices

Dynamic model



Nash timing works also.

Dynamic model



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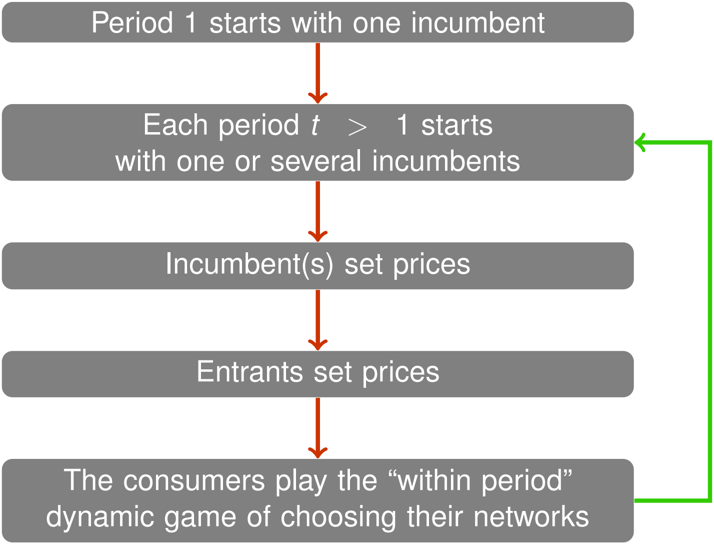

The myopia principle

Lemma (Myopia principle)

In the continuation game played by the consumers in each period, the set of equilibria is the same as if the game was a one period game.

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Really different from network effects model! Consumers can be short sighted.

Under which conditions can we have two networks?

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Necessary condition:

$$\alpha_H \lambda_L V_L + \alpha_L \lambda_H V_H < \alpha_H V_H - \alpha_L V_L.$$

Small cross-effects.

Under which conditions can we have two networks? (2)

Necessary and sufficient condition:

$$\frac{[(1-\delta)\alpha_L + \alpha_H\lambda_L]\,[(1-\delta)\alpha_L + \alpha_H]}{\alpha_H(1-\delta)(\alpha_H - \alpha_L\lambda_H)} \leq \frac{V_H}{V_L},$$

☞ Incumbent only keeps *H* consumers.

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- ☞ Incumbent only keeps *H* consumers.
- ☞ If $\lambda_L = 0$, then can hold for δ close to 1.
- ☞ If $\lambda_L > 0$, then as $\delta \to 1$, it cannot hold.
- ☞ Given any δ, there exists V_H/V_L such that a two network equilibrium exists.

Profits of the incumbent

$$\Pi_H = \frac{\alpha_H(\alpha_L + \alpha_H)(\alpha_H - \alpha_L \lambda_H) V_H}{\alpha_L(1-\delta) + \alpha_H}.$$

The profits of the incumbent ...

... are greater than the one period profit;

... are smaller than the value of a flow of one period profit;

... are increasing in V_H;

... are independent of V_L;

... are increasing in α_H;

... can be increasing or decreasing in α_L (decreasing when $\delta \to 0$.)

Network effects
+
switching costs

σ and ν — static

- ☞ In static model with only network effects, incumbent charges $\alpha\nu$;
- ☞ In static model with only switching costs, incumbent charges σ.

σ and ν — static

- In static model with only network effects, incumbent charges $\alpha\nu$;
- In static model with only switching costs, incumbent charges σ.
- Focal equilibrium with both effects: incumbent charges $\sigma + \alpha\nu$.
- Profits are the sum of the profits in the pure network model and in the pure switching cost model.

More interesting

- ☞ $1/2$ consumers have switching cost 0 and $1/2$ switching cost σ. Assume also

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- Then, the σ switching cost customers will also switch.

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- ☞ With both effects present, if the incumbent charges $\alpha\nu + \varepsilon$, the 0 switching cost customers switch.
- ☞ Then, the σ switching cost customers will also switch.

$\Longrightarrow$ The focal equilibrium has the incumbent charge $\alpha\nu$. *Additivity disappears.*

An illustrative story

Steve Jobs

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"Some have argued that once a consumer purchases a body of music from one of the proprietary music stores, they are forever locked into only using music players from that one company. Some have argued that once a consumer purchases a body of music from one of the proprietary music stores, they are forever locked into only using music players from that one company. Or, if they buy a specific player, they are locked into buying music only from that company's music store…

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It's hard to believe that just 3% of the music on the average iPod is enough to lock users into buying only iPods in the future."

John Lech Johansen

“Many iPod owners have never bought anything from the iTunes Store. Some have bought hundreds of songs. Some have bought thousands. At the 2004 Macworld Expo, Steve revealed that one customer had bought $29,500 worth of music.

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If you’ve only bought 10 songs, the lock-in is obviously not very strong. However, if you’ve bought 100 songs ($99), 10 TV-shows ($19.90) and 5 movies ($49.95), you’ll think twice about upgrading to a non-Apple portable player or set-top box.

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If you've only bought 10 songs, the lock-in is obviously not very strong. However, if you've bought 100 songs ($99), 10 TV-shows ($19.90) and 5 movies ($49.95), you'll think twice about upgrading to a non-Apple portable player or set-top box. In effect, it's the customers who would be the most valuable to an Apple competitor that get locked in. The kind of customers who would spend $300 on a set-top box."

Conclusions

- ☞ Distribution of switching costs/network effects is important.
- ☞ Even consumers to which the incumbent/dominant firm does not sell can influence the outcome.
- ☞ There are still many things we do not understand at the fundamental theoretical level about the dynamics of markets with switching costs and/or network effects.
- ☞ Identifying anti-competitive behavior requires close attention to the specificities of the cases.