

# Discussion of “Competing Complements”

Doh-Shin Jeon (UPF, SP-SP  
(IESE))

# Some overall impressions

- Good motivation with a nice example (Microsoft, Intel and AMD)
- Interesting question
- Complex analysis but well written
- Some expected and unexpected results

# The expected part

- Consider the two monopolists (Microsoft and Intel) selling complementary goods to **one consumer**
- The consumer's valuation of the system (i.e. PC) **is known to be 1**
- Each firm's mc is zero.
- **Multiple equilibria**:  $P_m + P_i = 1$  with  $P_m \geq 0$  and  $P_i \geq 0$
- **Prices are strategic substitutes!!! Source of Conflict**
- Choose the symmetric one:  $P_m = P_i = 1/2$

# The expected part

- Now Intel faces **competition from AMD**.  
The system of M+A gives a value  $f (< 1)$ .
- The consumer prefers the system of M+I if  
 $1 - P_m - P_i \geq f - P_m - P_a$

If  $P_a = 0$ , the inequality becomes  $1 - f \geq P_i$ .

# The expected part

- In addition, assume  $f > 1/2$ .
- Then Intel's maximal profit is  $1-f (< 1/2)$  and Microsoft's minimal profit is  $f (> 1/2)$ .
- Therefore, AMD's presence (and increase in  $f$ ) is good for Microsoft and bad for Intel.

# The model

- A mass 1 of heterogeneous consumers. A consumer's type  $\theta$  is uniformly distributed over  $[0, 1]$
- A  $\theta$ -type consumer gets utility  $\theta$  from M+I system and utility  $\theta f$  from M+A system.
- Simultaneous price choice game
- **Benchmark without AMD**:  $P_m$  and  $P_i$  are **strategic substitutes** and the equilibrium price is  $P^*_m = P^*_i = 1/3$

# No equilibrium in pure strategy

- The system M+A has customers if for some type  $\theta$ ,  
 $\theta f - P_m - P_a \geq \theta - P_m - P_i$

And

$$\theta f - P_m - P_a \geq 0$$

- Consider  $f=1/2$ , when  $P_a=0$ , M+A has customers if  $P_i > P_m$

# No equilibrium in pure strategy: $f=1/2$

- **Stage 1:** No equilibrium in which AMD sells any strictly positive quantity  
:  $P_m=P_i=1/4$  at the equilibrium candidate
- **Stage 2:** No equilibrium at the boundary in which  $P_m=P_i=1/4$   
: Microsoft finds Intel's price too low and has an incentive to charge a  $P_m'(>1/3)$
- **Stage 3:** No equilibrium with  $P^*m=P^*i=1/3$  in which AMD has no demand and no effect on the market  
: Microsoft finds Intel's price too high and has an incentive to charge a lower price to induce AMD into the market in order to sell more windows

## Equilibrium existence with positive sales of AMD when Microsoft has a negative mc

- Then, Microsoft wants to expand Window sales by lowering its price, which in turn induces Intel to increase its price.
- Lower  $P_m$  and higher  $P_i$  facilitates AMD's sales

# Surprising results 1: profits

- **Prop7**: For low  $f$ , Microsoft prefers its own  $mc=0$  to  $mc<0$  such that AMD is not active
- **Prop 8**: For any given  $f$ , Intel always prefers Microsoft to have  $mc<0$  such that AMD is active
- **Intuition**: When AMD is active because Microsoft has a negative  $mc$ , Microsoft charges a very low price but Intel charges a very high price.

## Surprising result 2: social welfare

- When AMD is active, social welfare decreases with  $f$ .
- Intuition: As  $f$  increases, Intel's price decreases but Microsoft's price increases.

# Comments: equilibrium non-existence

- Robustness
- Intuition for stage 1
- A priori, there can be other equilibrium candidates at the boundary since reaction curves may follow the boundary
- Under linear pricing: If customers are homogeneous, multiple equilibria. But if they are heterogeneous, no equilibrium in pure strategy
- **Missing instrument?**: In real world, clients of Microsoft, Intel and AMD are original equipment computer manufacturers (OEMs): then, Microsoft, Intel and AMD would propose **non-linear tariffs**  $\{q(\theta), t(\theta)\}$ . Then, equilibrium is likely to exist

# Comments on negative marginal costs

- **Microfoundation** for the negative marginal cost of Microsoft seems to be useful

Consider a two-period model in which Microsoft sells an original version at  $t=1$  and an upgraded one at  $t=2$ . A consumer who bought the original version at  $t=1$  may get some utility at  $t=2$  even though he does not upgrade it. A consumer who did not buy it at  $t=1$  gets zero utility at  $t=2$  if he does not buy the upgraded one. **Therefore, the profit that Microsoft realizes at  $t=2$  decreases with its sales at  $t=1$ .**

- Microsoft is **unlikely to be able to commit** to its upgrade policy: Ellison and Fudenberg (RJE, 2000)

# Other comments

- The surprising result that “ social welfare decreases with  $f$  ” is contrary to the common wisdom in the literature on vertical relations “the social welfare increases as **double marginalization** decreases”
- What happens with non-linear or two-part tariff?