Discussion of “Competing Complements”

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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?