Quality Competition among Platforms: a Media Market Case

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Introduction and Motivation

- Quality is a relevant feature of media markets.

  What is quality?

  - *Broadcasting*: (content) not only entertainment, but also education, learning, cultural excellence, niche interests ... ; (technology) e.g. high definition, interactive services

  - *Press*: truth, impartiality and immediacy of information, expressing different and minority voices and performing the watchdog role for public interest ...

- Quality issue affects the policy debate: free-to-air, pay-TVs, public broadcasters and newspapers subsidization.

Introduction and Motivation (cont'd)

- Platforms in media markets compete for audience and advertisers to maximize profits. Therefore competition has a broader meaning with respect to a standard IO literature.

$\Longrightarrow$ **We analyze the role of competition in a two-sided market characterized by vertical differentiation**

Literature

- Endogenous quality provision: Armstrong (2005), Armstrong, Weeds (2007), Lin (2011), Gonzales-Mestre and Martinez-Sanchez (2013); also Roger (2010), Ribeiro (2012).
- Competition: Peitz and Valletti (2008), Crampes et al. (2009)
- Vertical differentiation: Shaked and Sutton (1982, 1983).

Set up: Individuals

The indirect utility of an individual joining platform i of quality θ is:

$$V - \delta a_i + \beta\theta_i - s_i$$

where:

- $\theta \in \Theta = [\underline{\theta}, \overline{\theta}]$ is the quality of platform's content,
- β distributed uniformly on an interval $[\underline{\beta}, \overline{\beta}]$ is the taste for quality
- δa_i is the utility loss, where a_i denotes advertising level and δ the disutility parameter for being exposed to advertising.
- s_i the price to access the platform i (subscription fee)
- There is a continuum of individuals of mass N.
- They can access at most one platform (*single-homing*).

Set up: Individuals (cont'd)

The individual indifferent between assessing a platform i or not assessing at all is characterized by:

$$\beta_{0i} = \frac{\delta a_i - V}{\theta_i} + \frac{s_i}{\theta_i}$$

While the individual indifferent between two platforms is described as follows:

$$\beta_{ik} = \frac{\delta\left(a_i - a_k\right)}{\left(\theta_i - \theta_k\right)} + \frac{\left(s_i - s_k\right)}{\left(\theta_i - \theta_k\right)}$$

for $k \neq i$.

Set up: Advertisers

Advertisers pay the platform i an advertising charge r_i and sell products of quality α distributed on a interval $[0, \overline{\alpha}]$ according to a distribution function F. Advertisers' profits on platform i are:

$$\Pi_a = \alpha_i NB_i - r_i$$

where NB_i is the individuals' demand for platform i. Under the assumption that marginal advertiser get zero profit, the amount of advertising for each platform becomes:

$$a_i = 1 - F\left(\frac{r_i}{NB_i}\right)$$

- advertisers are *multi-homing*

Set up: Platforms

- Platforms are financed both by advertising and subscription fees.
- Platforms set advertising space and subscription prices (positive or negative) and qualities.

For any platform i the objective function takes the form:

$$\Pi_i\left(s_i, a_i, r_i, \theta_i\right) = NB_i s_i + a_i r_i - K$$

- K is a fixed cost for quality

Set up: Timing

Three-stage game.

1. First stage - platforms choose quality levels of their contents.
2. Second stage - subscription fees and advertising spaces are set.
3. Third stage - viewers and advertisers simultaneously decide whether to join a platform or not. Viewers might join one platform (single-homing) while advertisers might join more than one (multi-homing).

Monopoly

Monopoly platform maximizes profit subject to a positivity constraint on the advertising level:

$$\begin{cases} \max_{a_H, s_H} \Pi_M = NB_M s_M + a_M r_M - K \\ s.t. a_M \geq 0 \end{cases}$$

Defining the advertising revenues per viewer as $\rho(a_i)$

$$\rho(a_i) = \frac{a_i r_i}{NB_i}$$

Assuming $\rho(a_i)$ to be concave in the interval $a \in [0, 1]$. Then, given that $\rho(a_i) = 0$ for $a_i = 0$ and $a_i = 1$, the function is single-peaked.

Monopoly (cont'd)

Theorem

The optimal advertising level of monopoly media platform is:

$$\rho'(a_M) = \delta$$

- The best reply is to set a fixed advertising space just depending on the disutility of the viewers, as measured by parameter δ.
- However, the monopoly platform does not set the maximum amount of advertising.
- Different from Peitz and Valletti (2008), where the market is covered and the monopoly advertising space would be $\rho'(a_M) = 0$

Monopoly (cont'd)

Theorem

With $\rho(a_M)$ concave, we obtain the equilibrium price s_M^* and demand B_M^* as function of quality, revenues per viewer and advertising level.

$$s_M^* = \frac{\overline{\beta}\theta_M - \rho\left(a_M^*\right) - \delta a_M^*}{2}$$

$$B_M^* = \frac{\overline{\beta}\theta_M + \rho\left(a_M^*\right) - \delta a_M^*}{2\theta_M}$$

- Partial "Profit neutrality" result
- A sort of substitutability between advertising and quality.

Monopoly (cont'd)

Under the assumption of p.d.f. of advertisers F uniform on $[0, 1]$:

Theorem

In equilibrium, under the technological constraint $\theta \in (\underline{\theta}, \bar{\theta})$ with $\underline{\theta} = \dfrac{(1-\delta)^2}{4\overline{\beta}}$, the monopoly platform chooses the maximum quality, $\theta_M^* = \bar{\theta}$.

Therefore equilibrium profits are:

$$\Pi_M^* = \frac{\left(\overline{\beta}\bar{\theta} + \left(\frac{1-\delta}{2}\right)^2\right)^2}{4\bar{\theta}} - K$$

Duopoly

We consider two platforms, namely $i = L, H$.
Analogously, we calculate demand functions for the high-quality NB_H and for the low-quality NB_L, the amount of advertising for each platform a_L and a_H, and profit function respectively for the high-quality platform and for the low-one:

$$\Pi_H\left(s_H, s_L, a_H, a_L, r_H, r_L, \theta_H, \theta_L\right) = NB_H s_H + a_H r_H - K$$

$$\Pi_L\left(s_H, s_L, a_H, a_L, r_H, r_L, \theta_H, \theta_L\right) = NB_L s_L + a_L r_L - K$$

Duopoly (cont'd)

We consider a market structure where both firms are active (individuals' demands for platform H and L are positive) and we look for an equilibrium in the covered market.

1. $$\overline{\beta} > 2\underline{\beta}$$

   with $\beta \in [\underline{\beta}, \overline{\beta}]$. It rules out the possibility of zero-demand for the low-quality platform.

2. $$\underline{\beta}\theta_L \geq \frac{\left(\overline{\beta} - 2\underline{\beta}\right)(\theta_H - \theta_L)}{3} - \left(\rho\left(a_L^*\right) - \delta a_L^*\right)$$

   it guarantees that the market is covered; i.e. even the consumer with the lowest taste for quality, gets some positive utility joining the low-quality platform.

Duopoly (cont'd)

Theorem

For each platform i, if the profit maximizing advertising level is positive, then it is constant and it is determined by

$$\rho'(a_i) = \delta$$

- For both platforms, a fixed advertising space is the best reply.
- The equilibrium level of advertising depends on the advertising disutility of the viewers.
- Replicate the outcome of Armstrong and Weeds (2007) in a context of vertical differentiation but with quadratic costs.

Duopoly (cont'd)

Corollary

The strategic advertising choice is the same, regardless the market structure:

$$\rho'(a_i^*) = \delta \quad \textit{for} \quad i = H, L, M$$

However, in the duopoly structure, the total amount of advertising doubles the monopoly level. In particular in the uniform case,

$$a_L^* + a_H^* = 1 - \delta = 2a_M^*$$

- Individual platform's strategic advertising choice is neutral with respect to competitive market structure.

Duopoly (cont'd)

Theorem

Platform H set a higher subscription fee and a lower advertising price, with respect to platform L: $s_H^*(\theta_H, \theta_L) > s_L^*(\theta_H, \theta_L)$ *and* $r_L^*(a, \rho) > r_H^*(a, \rho)$. *They also share the market in a fixed proportion:* $B_H^* > B_L^*$.

$$B_H^* = \frac{2\overline{\beta} - \underline{\beta}}{3\left(\overline{\beta} - \underline{\beta}\right)} > \frac{\overline{\beta} - 2\underline{\beta}}{3\left(\overline{\beta} - \underline{\beta}\right)} = B_L^*$$

- Full "profit neutrality" result

Theorem

In equilibrium the high quality platform chooses a quality level, $\theta_H^* = \bar{\theta}$ *and the low quality platform chooses the minimum quality level,* $\theta_L^* = \underline{\theta}$

Duopoly (cont'd)

Corollary

In the special case where the p.d.f. of advertisers F is uniform on $[0,1]$ equilibrium values are:

$$a_L^* = a_H^* = a^* = \frac{1-\delta}{2}$$

$$s_H^*(\theta_H, \theta_L, \delta) = \frac{(2\overline{\beta}-\underline{\beta})(\overline{\theta}-\underline{\theta})}{3} - \frac{1-\delta}{2}\left(\frac{1+\delta}{2}\right)$$

$$s_L^*(\theta_H, \theta_L, \delta) = \frac{(\overline{\beta}-2\underline{\beta})(\overline{\theta}-\underline{\theta})}{3} - \frac{1-\delta}{2}\left(\frac{1+\delta}{2}\right)$$

- Advertising level is decreasing in the disutility parameter δ,
- Subscription fees s_L^* and s_H^* are increasing in δ.

Competition: Sequential Duopoly

Quality differentiation in a framework of sequential entry.

- Slight change of timing: in Stage 1 (quality choice) the Incumbent platform (I) sets quality first, followed by the Entrant platform (E).
- Same technology structure and profit function, but entry cost F.
- Incumbent platform exploits its advantage behaving as the high-quality platform (higher profit), just living a room to entry as a low-quality platform.

We calculate s_I^*, s_E^*, NB_I^*, NB_E^*, r_I^*, r_E^*, Π_I^* and Π_E^*.

Competition: Sequential Duopoly (cont'd)

$$\frac{\partial \Pi_E^*}{\partial \theta_E}|_{\theta_I} = -N\frac{\left(\overline{\beta} - 2\underline{\beta}\right)^2}{9\left(\overline{\beta} - \underline{\beta}\right)} < 0$$

E chooses the minimum quality level $\underline{\theta}$.
While:

$$\frac{\partial \Pi_I^*}{\partial \theta_I} = N\frac{\left(2\overline{\beta} - \underline{\beta}\right)^2}{9\left(\overline{\beta} - \underline{\beta}\right)} > 0$$

I chooses the maximum quality.

- Maximal differentiation

Competition: Threat of Entry

The Incumbent behaves as a high-quality platform, therefore:

- a potential entrant cannot leapfrog I with $\theta_E > \theta_I = \overline{\theta}$
- but a potential entrant can set $\theta_E > \underline{\theta}$ and catch the low-quality demand (with positive profit)

In a traditional model of vertical differentiation: "...*there are at most two firms having positive market share and covering the entire market with different qualities, for a convenient heterogeneity of the viewers*" (Shaked and Sutton, 1982)

Competition: Threat of Entry (cont'd)

Shaked and Sutton condition holds for two-sided markets:

Theorem

Let $2\underline{\beta} < \overline{\beta} < 4\underline{\beta}$. Then of any n platforms offering distinct qualities, exactly two will have positive market shares on the buyers' side (audience) at equilibrium. Moreover at equilibrium the market is covered.

- In equilibrium the market is covered by the two highest quality platforms
- A survival strategy for the low quality platform would be to drive profit to zero in case of potential entry.

Competition: Threat of Entry (cont'd)

Theorem

Under the "threat of entry" the equilibrium quality of the Incumbent platform θ_I^* lies in the interval $[\max(\tilde{\theta}_I, \tilde{\tilde{\theta}}_I), \bar{\theta}]$ while the product quality choice of the entrant firm is such that $\theta_E^* < \theta_I^*$.

Where $\widetilde{\theta}_I$ and $\tilde{\tilde{\theta}}_I$ are the threshold values driving the entrant profit to zero if it enters with the lowest quality level $\underline{\theta}$ or $\bar{\theta}$ the highest quality level, respectively.

Corollary

In equilibrium, under the threat of entry the quality differentiation may decrease: $(\theta_I^* - \theta_E^*) \leq (\bar{\theta} - \underline{\theta})$

Competition: Threat of Entry (cont'd)

- θ_I might decrease, while θ_E might increase. Therefore quality differentiation may shrink.
- No evidence that increasing competition positively affects the high quality of the Incumbent platform
- While increasing competition, namely the threat of entry, can boosts the quality of the Entrant from a minimum level

Competition: Entry Deterrence

Could a quality investment be a successful deterrence strategy?

- Timing: a new stage of the game where the entrant (2) picks up the choice of entering the market or staying out.
- The incumbent platform (1) could accommodate the entry (duopoly profits) or deter the entry (threatened monopoly)
- We state the conditions such that incumbent platform prevents entry in the market.

Theorem

Given $\widetilde{\theta}_1$ and $\widetilde{\widetilde{\theta}}_1$, if: (a) $\widetilde{\theta}_1 < \widetilde{\widetilde{\theta}}_1$ monopoly platform cannot prevent entry for $\theta \in (\underline{\theta}, \bar{\theta})$, therefore deterrence is an unfeasible strategy; (b) $\widetilde{\theta}_1 > \widetilde{\widetilde{\theta}}_1$ monopoly platform can prevent entry for $\theta_1^D = \widetilde{\theta}_1 - \varepsilon$, with ε enough close to zero, therefore deterrence is a feasible strategy

Competition: Entry Deterrence (cont'd)

We should check whether the entry deterrence strategy is profitable with respect to the accommodation one.

$$\Pi_M(\text{deterrence}) = \frac{\left(\overline{\beta}\theta_1^D + \left(\frac{1-\delta}{2}\right)^2\right)^2}{4\theta_1^D} - K$$

$$\lesseqgtr$$

$$\Pi_1\left(\text{accommodation}\right) = \frac{3\overline{\beta}^2 - 3\underline{\beta}^2}{\left(\overline{\beta} - 2\underline{\beta}\right)^2} K + \frac{\left(2\overline{\beta} - \underline{\beta}\right)^2}{\left(\overline{\beta} - 2\underline{\beta}\right)^2} F$$

- There exists a threshold value of the fixed cost of entry $\underline{F}\left(\delta, \overline{\beta}, \underline{\beta}\right)$ which makes the accommodation and deterrence profits equal
- for $F < \underline{F}\left(\delta, \overline{\beta}, \underline{\beta}\right)$ accommodation profits are lower then the deterrence ones, making preemption a profitable strategy.

Entry Deterrence: Numerical Simulation

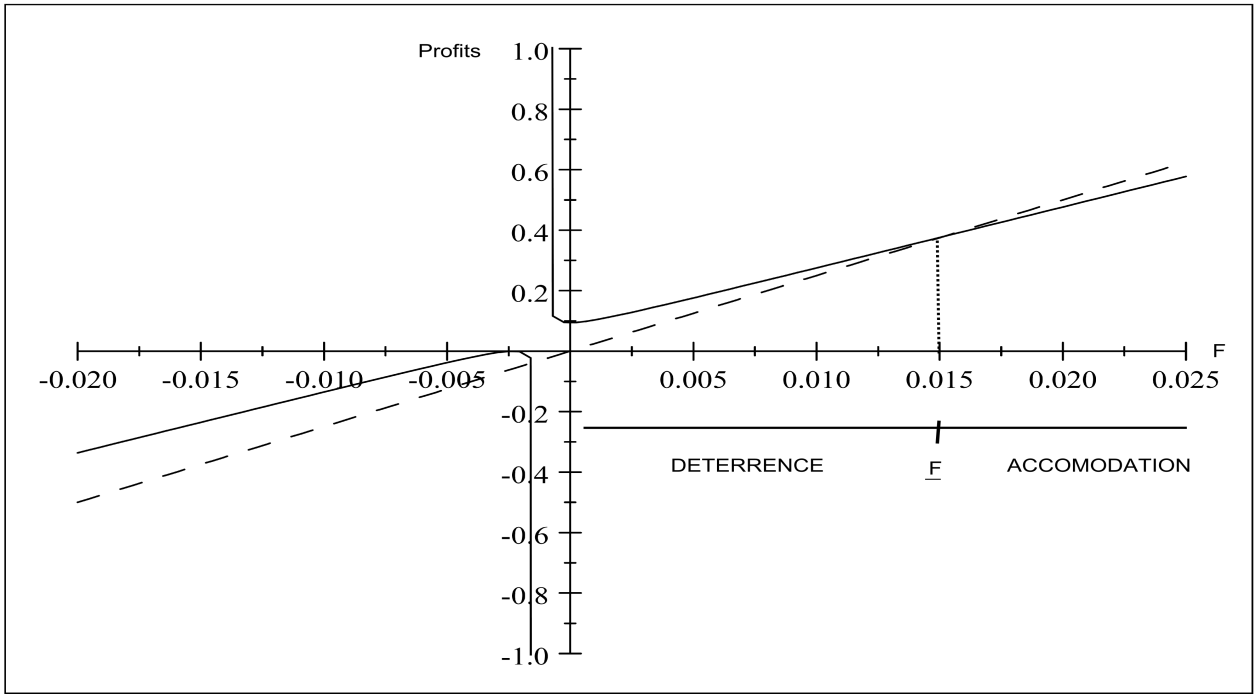

Figure: Deterrence (solid line) and accomodation (dashed line) profits.

Conclusions

This paper provides a two-sided model with endogenous quality provision, where competition prevails on the individuals side of the market.

- We provide a full characterization of the equilibrium for what concerns advertising, subscription fees, market shares and qualities, both in duopoly as well as in monopoly market structure.
- Comparison between Monopoly and Duopoly:

- For each platform, if the profit maximizing advertising level is positive, then it is constant and it is determined just by the disutility parameter δ. This means that the strategic advertising choice is the same, regardless the market structure. However, in the duopoly structure, the total amount of advertising doubles the monopoly level.

Conclusions (cont'd)

- In duopoly there is a full profit neutrality effect, while his effect is reduced in the monopoly case. This result is strongly related to the issue of competitive bottleneck and prevailing competition on consumers' side.

- Monopoly platform chooses the maximum quality while Duopoly platforms choose maximal differentiation

- Competition, "threat of entry":

- We extend the Shaked and Sutton (1982) result to a two-sided setting: under some conditions on individuals' heterogeneity, we show that of any n platforms offering distinct qualities, exactly two will have positive market shares on the buyers' side (audience) at equilibrium, covering the market.

- Incumbent quality might decrease, while Entrant quality might increase. Quality differentiation might decrease.

Conclusions (cont'd)

- Competition: quality can be a barrier to entry. In fact for some range of the parameter values deterrence strategy is feasible and profitable for the Incumbent platform.