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.
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.

→ We analyze the role of competition in a two-sided market characterized by vertical differentiation.

Competition: Peitz and Valletti (2008), Crampes et al. (2009)

Set up: Individuals

The indirect utility of an individual joining platform $i$ of quality $\theta$ is:

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

where:

- $\theta \in \Theta = [\theta, \bar{\theta}]$ is the quality of platform’s content,
- $\beta$ distributed uniformly on an interval $[\underline{\beta}, \bar{\beta}]$ is the taste for quality
- $\delta a_i$ is the utility loss, where $a_i$ denotes advertising level and $\delta$ 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 ($single-homing$).
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:

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

for $k \neq i$. 
Set up: Advertisers

Advertisers pay the platform $i$ an advertising charge $r_i$ and sell products of quality $\alpha$ distributed on a interval $[0, \bar{\alpha}]$ 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*
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:

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

$K$ 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:

\[
\max_{a_{H}, s_{H}} \Pi_{M} = NB_{M}s_{M} + a_{M}r_{M} - K
\]

\[s.t. a_{M} \geq 0\]

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 \( \delta \).
- 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.

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

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

- 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 $\theta = \frac{(1 - \delta)^2}{4\beta}$, the monopoly platform chooses the maximum quality, $\theta^*_M = \bar{\theta}$. 

Therefore equilibrium profits are: 

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

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

$$\Pi_L (s_H, s_L, a_H, a_L, r_H, r_L, \theta_H, \theta_L) = NB_L s_L + a_L r_L - K$$
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. $\bar{\beta} > 2\beta$

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

2. $\beta \theta_L \geq \frac{(\bar{\beta} - 2\beta)(\theta_H - \theta_L)}{3} - (\rho (a^*_L) - \delta a^*_L)$

   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.
Corollary

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

\[ \rho'(a^*_i) = \delta \quad \text{for} \quad i = H, L, M \]

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: \( B^*_H > B^*_L \).

\[
B^*_H = \frac{2\bar{\beta} - \beta}{3(\bar{\beta} - \beta)} > \frac{\bar{\beta} - 2\beta}{3(\bar{\beta} - \beta)} = B^*_L
\]

- 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, \( \theta^*_L = \theta \).
Corollary

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

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

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

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

- Advertising level is decreasing in the disutility parameter $\delta$,
- Subscription fees $s_L^*$ and $s_H^*$ are increasing in $\delta$. 
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 $s_i^*$, $s_E^*$, $NB_i^*$, $NB_E^*$, $r_i^*$, $r_E^*$, $\Pi_i^*$ and $\Pi_E^*$. 
Competition: Sequential Duopoly (cont’d)

\[ \frac{\partial \Pi^*_E}{\partial \theta_E} \bigg|_{\theta_I} = -N \frac{(\bar{\beta} - 2\beta)^2}{9(\bar{\beta} - \beta)} < 0 \]

\[ \frac{\partial \Pi^*_I}{\partial \theta_I} = N \frac{(2\bar{\beta} - \beta)^2}{9(\bar{\beta} - \beta)} > 0 \]

\( E \) chooses the minimum quality level \( \theta \).
While:

\( I \) chooses the maximum quality.

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

- a potential entrant cannot leapfrog \( I \) with \( \theta_E > \theta_I = \bar{\theta} \)
- but a potential entrant can set \( \theta_E > \bar{\theta} \) 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)
Shaked and Sutton condition holds for two-sided markets:

**Theorem**

Let $2\beta < \bar{\beta} < 4\beta$. 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 $\theta_I^*$ 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 $\tilde{\theta}_I$ and $\tilde{\tilde{\theta}}_I$ are the threshold values driving the entrant profit to zero if it enters with the lowest quality level $\theta$ or $\bar{\theta}$ the highest quality level, respectively.

Corollary

In equilibrium, under the threat of entry the quality differentiation may decrease: $(\theta_I^* - \theta_E^*) \leq (\bar{\theta} - \theta)$
\( \theta_I \) might decrease, while \( \theta_E \) 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
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 \( \tilde{\theta}_1 \) and \( \tilde{\theta}_1 \), if:

- (a) \( \tilde{\theta}_1 < \tilde{\theta}_1 \) monopoly platform cannot prevent entry for \( \theta \in (\underline{\theta}, \bar{\theta}) \), therefore deterrence is an unfeasible strategy;
- (b) \( \tilde{\theta}_1 > \tilde{\theta}_1 \) monopoly platform can prevent entry for \( \theta_1^D = \tilde{\theta}_1 - \varepsilon \), with \( \varepsilon \) 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.

\[ \Pi_M (\text{deterrence}) = \left( \bar{\beta} \theta^D_1 + \left( \frac{1-\delta}{2} \right)^2 \right)^2 - \mathcal{K} \leq \]

\[ \Pi_1 (\text{accommodation}) = \frac{3\bar{\beta}^2 - 3\beta^2}{(\bar{\beta} - 2\beta)^2} \mathcal{K} + \frac{(2\bar{\beta} - \beta)^2}{(\bar{\beta} - 2\beta)^2} \mathcal{F} \]

- There exists a threshold value of the fixed cost of entry \( \mathcal{F} \left( \delta, \bar{\beta}, \beta \right) \) which makes the accommodation and deterrence profits equal
- for \( \mathcal{F} < \mathcal{F} \left( \delta, \bar{\beta}, \beta \right) \) accommodation profits are lower than the deterrence ones, making preemption a profitable strategy.
Figure: Deterrence (solid line) and accommodation (dashed line) profits.
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 $\delta$. 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.
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.