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## The market for fake observations

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# MEMORANDUM

No 25/2011

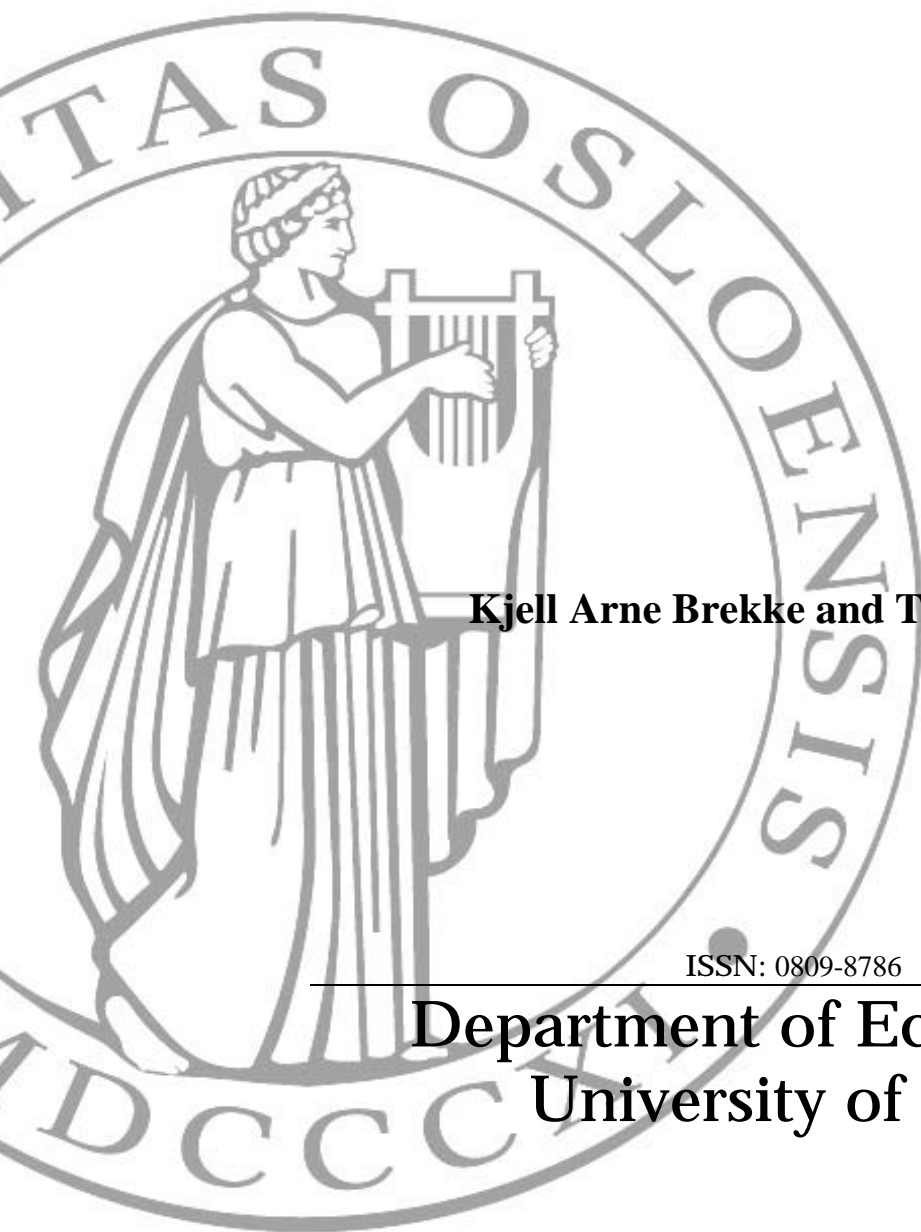
## The Market for Fake Observations

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# The Market for Fake Observations\*

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## Abstract

We show how increased competition in a media market may have implications for the competition between firms that are advertising in that medium. We apply a simple model of a product market with network externalities where firms buy advertising space in a media market and find that there is more entry in the product market, the more competitive the media market is. The paper is the first combining a study of media markets with a behavioral foundation of how advertising affects the demand for the advertised products.

**JEL code:** L82, M37

**Keyword:** Advertising, Media Market, Availability Heuristic, Network Externalities.

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# 1 Introduction

This paper discusses how the media market affects entry into a market with network externalities. Such entry is difficult, even for a firm with a superior product: with network externalities, consumers benefit not only from the quality of the product they consume but also from the presence of other consumers consuming the same product. So unless also others switch to the new product, a consumer may prefer the old product despite the new product's superior quality.

A way to get consumers to switch is through advertising, and advertising space is bought from the media. We show here, by comparing monopoly and duopoly, that more competition in the media market facilitates entry into the market with network externalities. This implies, conversely, that incentives for product development may be severely undermined by a lack of competition in media markets. The reason is that the value from the development of new products ends up in the hands of the media owners to a greater extent when there is little competition between media firms.

In our model, a new firm can make use of advertising in order to allow for entry into the network market. The way the advertising works is through giving the consumers the impression that the firm has many customers (Brekke and Rege, 2006). The argument is that it is easier to imagine someone using a product if you have seen it often in ads, and it is based on Tversky and Kahneman's (1973) theory of the availability heuristic: people judge the prevalence of an event from the ease with which the event can be recalled.

How will the market for advertising space respond to this advertising activity? To answer this question, we incorporate into our model the media industry in which the advertising is placed, along the lines of Kind, *et al.* (2007, 2009) and other studies surveyed by Anderson and Gabszewicz (2006). We find that the market structure in the media industry is important for the possibilities of a new firm to enter a market with network externalities. With monopoly in the media market, the monopolist will extract all the profit from the incumbent but only a fraction of the profit from the entrant. As a consequence, the monopolist will often want the incumbent to be able to defend a lock-in. Thus, competition in the media market makes entry deterrence more difficult.

Like Brekke and Rege, we find that advertising generally favours the entrant. We then introduce imperfect competition in the media industry in the simplest way possible, with a firm having monopoly power in both the market for media content and the market for advertising.

In Bagwell's (2007) recent account of the economics of advertising, he singles out the media in which advertising space is bought on one hand and the behavioral foundations of advertising on the other hand as two aspects of advertising that is in particular need of further analysis. As far as we know, this study is the first to combine the two. Moreover, it is one of very few studies modeling both the media market and the market where the advertisers compete with their products; others who have done the same include Dukes (2004) and Nilssen and Sørsgard (2003).

The paper is organized as follows. In Section 2, we discuss the product market with network externalities. The role of advertising when advertising prices are given is discussed in Section 3. In Section 4, we consider optimal price setting by a media monopolist, while we discuss a media duopoly in Section 5 and compare this case with that of media monopoly. Section 6 presents some points of discussion before our concluding remarks in Section 7. One of our proofs is relegated to an Appendix.

## **2 A market with network externalities**

We present here a simplified version of the model used by Brekke and Rege (2006) in their study of advertising in markets with network externalities. The simplification concerns how network externalities are introduced, where we follow a simple version of the Farrell and Saloner (1985) model along the lines of Tirole (1988, ch. 10).

Consider a set of consumers normalized so that they total 1. Each consumer buys one unit of the product, and consumers are then matched pairwise and randomly. Before any entry, there is only the incumbent firm's product technology available, denoted Old, while in case of an entry, there are two product technologies available, Old and New. A consumer's utility depends on her product's technology and whether or not she is matched with someone having the same technology. The new technology is the most valuable one and has an intrinsic value

$\theta$  to consumers, over and above the intrinsic value of the old technology, which is normalized to 0. The intrinsic value of the new technology varies among consumers, though, and is uniformly distributed on  $[0, 1]$ .<sup>1</sup>

In addition to the intrinsic value of a product technology, there is a match-specific utility. In particular, a consumer with the old technology who switches to the new technology will, in addition to the intrinsic value of that technology, gain  $a$  if matched to someone with the new technology but lose  $b$  if matched to someone with the old technology. We make the following assumption on  $a$  and  $b$ .

**Assumption 1**  $a > b > 1$ .

The condition  $a > b$  is a very natural assumption to make: the biggest jump in utility is obtained when going from the old technology with no match to the new technology with a match. The condition  $b > 1$ , on the other hand, says that network externalities are strong, in the sense that match dominates technology, even for the most technology interested among consumers: even at  $\theta = 1$ , a consumer prefers a match at the old technology to having the new technology without a match.

Our focus is on advertising as a way for the new firm to enter into this market. However, independent of any advertising, there is a fraction  $m$  of consumers who switch to the new technology; we call them *early adopters*; presumably, they have heard about the new product through word of mouth or any channel other than advertising not modelled here.

Due to the network externalities, a technology is more attractive the larger share of the others who choose it. Thus there may be multiple equilibria, unless the share of initial adapters is large. We will focus on equilibria that are stable.<sup>2</sup> Define

$$\bar{m} := \frac{b-1}{a+b} \in \left(0, \frac{1}{2}\right).$$

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<sup>1</sup>To be precise, the intrinsic value is uniformly distributed on  $[0, 1]$  among that fraction  $(1 - m)$  of consumers who are not early adopters; see below.

<sup>2</sup>Note that an equilibrium consists of a share of consumers choosing the new technology such that, given the share, no-one wants to switch. In an unstable equilibrium it would be the case that if one consumer deviates and switches, this would increase the incentives to choose the same technology as the deviator, attracting more individuals to that technology, until all choose the same technology.

**Proposition 1** *It is always a stable equilibrium that all consumers choose the new product. If  $m < \bar{m}$ , then there is also a stable equilibrium where no-one, except the early adopters, chooses the new product. There is no other stable equilibrium.*

The proof is in the Appendix, but the intuition for this result is straightforward. The new product is inherently better, hence with a sufficient market share all consumers prefer the new product. Thus all choosing the new technology is an equilibrium. On the other hand, due to the network externality, all consumers will prefer the old technology if the market share of the new is too low. The lowest possible market share for the new product is  $m$ , the share of early adopters. Thus if  $m$  is sufficiently low, everyone except the early adopters will choose the old technology provided they think everybody else will do so. The inequality is strict since in the limiting case  $m = \bar{m}$  the latter equilibrium will be unstable.

We will further argue that the incumbent, selling the old product, has the advantage in the sense that consumers are used to that product. This leads to:

**Corollary 2** *Assume that, if an equilibrium exists with only the old product present, then this equilibrium will be realized. Then if  $m < \bar{m}$ , all consumers, except early adopters, choose the old product, while if  $m \geq \bar{m}$ , all consumers choose the new product.*

### 3 The market for fake observations

The choices that consumers make depend not on the actual number of early switchers, but on what they *perceive* to be the number of switchers. This creates a scope for advertising to play a role. We assume that consumers form a perception of the share  $m$  from observing  $n$  persons' early choices. Of these  $n$  persons,  $mn$  will be early switchers, while the remaining ones are not. In addition, consumers observe some fake persons from television shows, and these fakes make choices corresponding to the interest of the advertiser paying for them.

We will argue that these fake observations will influence the perceived number of early adopters, almost as if they were real observations. Two related arguments can be made for this assumption. First, we may recall something without knowing the source of the memory. Thus we may know that we have observed a user of a product, without knowing where we

observed him. The advertising thus creates ‘fake observations’ that are later indistinguishable from real observations.

A second justification is the “availability heuristic” suggested by Tversky and Kahneman (1973), who argue that people infer the prevalence of an event from “the ease with which instances or associations could be brought to mind” (p. 208). That is, a person who feels that one product seems more familiar than another infers that he must have seen the familiar product more often. The availability heuristic has been supported by several experimental studies (see Schwartz and Vaughn, 2002), and the impact of TV observations on probability assessments of real-life events is documented in Schrum (1999).

The idea is similar to Cialdini’s (2001) concept of ‘social proof’, that consumers choose the product that the majority of others have chosen, taking their choices as evidence that it is a good product. Similarly, Goldstein and Gigerenzer (2002) find that people choose the most familiar option when they have little information about the alternative,<sup>3</sup> and Gigerenzer (2007) argues that such a strategy is hardwired in terms of a gut feeling, and that this is a good strategy for a consumer with little information about product quality. In the case of network externalities, these effects of advertising are reinforced by the fact that even the well-informed will want to choose the same product as the majority.

Let  $X_N$  denote the number of *fake observations* stemming from advertising for the new technology, and similarly  $X_O$  is the number of fake observations from advertising for the old technology. Then the observations of early switchers, including the fake ones, is  $nm + X_N$  while the total number of observations is  $n + X_O + X_N$ . Thus, the perceived market share of the new technology is

$$\tilde{m}(X_N, X_O) = \frac{mn + X_N}{n + X_O + X_N}$$

Without loss of generality, we normalize variables such that  $n = 1$ . Perceived market share is then

$$\tilde{m}(X_N, X_O) = \frac{m + X_N}{1 + X_O + X_N}.$$

We assume that the number of fake observations is proportional to the number of times a person has been exposed to a certain ad. Assuming the media firm charges a unit price on

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<sup>3</sup>Goldstein and Gigerenzer find that people are better at guessing which is the larger of two cities when they only recognize one of them, as this allows them to apply a heuristic of choosing the known city.

advertising is then equivalent to assuming that it charges a unit price  $R$  on fake observations  $X$ . The media firm's advertising revenue is then

$$\Pi = R(X_N + X_O)$$

In accordance with most models of entry and entry deterrence, we let the firms choose advertising levels sequentially, with the incumbent first choosing its level of advertising and then the entrant choosing its level of advertising. But first the media firm chooses the price  $R$ . Solving the game backwards we first consider the optimal behavior of the entrant for a given level of advertising  $X_O$  from the old firm, and a given unit cost of advertising  $R$ .

Corollary 2 implies that, in equilibrium of this simple model, all consumers, except early adopters, are with either the incumbent firm or the entrant. This feature enables us to have a very simple picture of firms' profits. And just as the new technology is inherently preferable to consumers, it is also more profitable. We capture the difference in a simple way by having the old product earning 1 per unit, gross of advertising expenses, while the new product earns  $h > 1$  per unit.

From the discussion above we know that the economy will be stuck in the equilibrium where all (except early adopters) will choose the old technology, unless  $\tilde{m} \geq \bar{m}$ . In order to focus on the entrant's incentives to take over the market through advertising, we assume that entry involves costs so large that they cannot be covered by serving the early adopters only.

Let  $\tilde{X}_N(X_O)$  denote the level of advertising from the new firm required to reach the level  $\bar{m}$  of perceived market share, for a given level of advertising from the old firm.

**Lemma 3** *Given a level  $X_O$  of advertising from the incumbent firm, the new firm will choose a level of advertising*

$$\tilde{X}_N(X_O) := \frac{(\bar{m} - m) + \bar{m}X_O}{1 - \bar{m}} \quad (1)$$

*if  $R\tilde{X}_N(X_O) < h$ ; otherwise, the new firm will not advertise at all.*

**Proof.** If the entrant chooses to advertise, then he must at least advertise so much that the perceived market share  $\tilde{m}$  reaches  $\bar{m}$ , but there is no need to advertise more. This level is just so that

$$\tilde{m}(\tilde{X}_N, X_O) = \frac{m + \tilde{X}_N}{1 + X_O + \tilde{X}_N} = \bar{m},$$

which gives the stated  $\tilde{X}_N(X_O)$ . The entrant will then take the entire market with a profit  $h$  less the cost of advertising; *i.e.*, the profit is

$$h - R\tilde{X}_N(X_O)$$

and the rest of the lemma follows immediately. ■

Knowing the optimal response from the entrant, we consider the optimal strategy for the old firm, which can choose between an entry-detering strategy and an entry-accommodating one. The optimal entry-detering strategy is to advertise so much that  $R\tilde{X}_N(X_O) \geq h$ , which would make advertising unprofitable for the entrant and thus allow the old firm to retain the whole market. Let the required level be denoted  $\tilde{X}_O$ . From (1), it follows that the old firm keeps the other out if

$$R \frac{(\bar{m} - m) + \bar{m}\tilde{X}_O}{1 - \bar{m}} = h. \quad (2)$$

Since the old firm can only afford this if its advertising costs end up being less than its revenue, rearranging (2) yields:

**Lemma 4** *The incumbent firm chooses a level of advertising*

$$\tilde{X}_O := \frac{1 - \bar{m}}{\bar{m}} \frac{h}{R} - \frac{\bar{m} - m}{\bar{m}}, \quad (3)$$

*if  $R\tilde{X}_O \leq 1$ ; otherwise, it does not advertise.*

Note that, since  $\bar{m} < \frac{1}{2}$ , we have that  $\frac{(1-\bar{m})}{\bar{m}}h > h > 1$ , and so  $R\tilde{X}_O > 1$  whenever  $m \geq \bar{m}$ . Thus, if the incumbent loses the market when not advertising ( $m \geq \bar{m}$ ), then it cannot defend the market by advertising either.

**Corollary 5** *If  $m \geq \bar{m}$ , then the incumbent firm does not advertise.*

Thus, when there are sufficiently many early adopters, the entrant will take over the market with an arbitrarily small level of advertising. We will therefore focus here on the more interesting opposite case and therefore maintain throughout the assumption that  $m < \bar{m}$ .

Whether or not the incumbent will defend the lock-in when  $m < \bar{m}$  depends on the price being such that  $R\tilde{X}_O \leq 1$ . From the expression for  $\tilde{X}_O$  in (3) we see that the cost of the required advertising is decreasing in the unit price of fake observations. The reason is that

the more expensive fake observations are, the more costly it will be for the entrant to buy sufficient advertising and the less is required from the incumbent. Define<sup>4</sup>

$$\hat{R} := \frac{(1 - \bar{m})h - \bar{m}}{\bar{m} - m} > 0. \quad (4)$$

**Proposition 6** *Assume that  $m < \bar{m}$ .*

- (a) *If  $R < \hat{R}$ , then the incumbent loses the market, and  $X_O = 0$ .*
- (b) *If  $R > \hat{R}$ , then the entrant is unable to enter the market, and  $\tilde{X}_N = 0$ .*
- (c) *If  $R = \hat{R}$ , then both these outcomes are feasible.*

**Proof.** Inserting for  $\tilde{X}_O$  from Lemma 4 and rewriting, we have that the condition  $R\tilde{X}_O > 1$  yields  $R < \hat{R}$ . The rest follows immediately. ■

The entrant's level of advertising in case (a) of the Proposition is found by setting  $\tilde{X}_O = 0$  in equation (1):

$$\tilde{X}_N(0) = \frac{\bar{m} - m}{1 - \bar{m}} \quad (5)$$

The old firm will only be able to retain the market when the share of initial switchers is low and the cost of advertising is high. The intuition is that the incumbent benefits from a high initial market share. But the incumbent has no advantage in creating fake observations, and so the incumbent is only able to retain the market share when the cost is sufficiently high to avoid the fake observations to play a large role.

## 4 Media Monopoly

Consider next the optimal pricing by a media monopolist. Summarizing the results above we have the following. If  $R < \hat{R}$ , then only the entrant advertises. Its advertising cost is increasing in  $R$ , and so the media firm's profit is also increasing in  $R$  in this interval. If  $R > \hat{R}$ , then only the old firm advertises and the media firm's profit is declining in  $R$ . If  $R = \hat{R}$ , then both these outcomes may occur. We will make the assumption that the media firm, at  $R = \hat{R}$ , can pick who will be advertising by setting  $R = \hat{R} \pm \varepsilon$  for some  $\varepsilon$  sufficiently

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<sup>4</sup>This expression is relevant only when  $m < \bar{m}$ , so the denominator is positive. The numerator is positive since  $\bar{m} < \frac{1}{2}$  and  $h > 1$ .

small to be ignored. Disregarding any costs to the media firm in providing its services to the advertisers, we can thus write the firm's profit as

$$\Pi_{\text{media firm}} = \begin{cases} R\tilde{X}_N(0) = R\frac{\bar{m}-m}{1-\bar{m}}, & \text{if } R \leq \hat{R} \\ \max[R\tilde{X}_N(0), R\tilde{X}_O] & \text{if } R = \hat{R} \\ R\tilde{X}_O = \frac{1-\bar{m}}{\bar{m}}h - \frac{\bar{m}-m}{\bar{m}}R, & \text{if } \hat{R} > R \end{cases}$$

Define

$$\bar{h} = \frac{1}{1-\bar{m}} = \frac{a+b}{a+1} > 1. \quad (6)$$

Clearly, from the above, the optimal choice must be  $R = \hat{R}$ . We have:

**Proposition 7** *The media monopolist always charges the price  $R = \hat{R}$ .*

- (i) *If  $1 < h \leq \bar{h}$ , then the lock-in is maintained and only the old firm advertises.*
- (ii) *If  $h > \bar{h}$ , then the old firm does not advertise and the new firm advertises to break the lock-in.*

**Proof.** The media firm wants the old firm to advertise if that is what maximizes its profit, *i.e.*, if  $\hat{R}\tilde{X}_O \geq \hat{R}\tilde{X}_N(0)$ , or

$$\tilde{X}_O \geq \tilde{X}_N(0). \quad (7)$$

By putting  $R = \hat{R}$  in (3) and inserting from (3) and (5) in (7), we obtain the condition  $h \leq \bar{h}$ .

■

We thus see that, if the potential profit  $h$  of the new firm is high, or if  $\bar{m} = \frac{b-1}{a+b}$  is small, then the entrant is likely to successfully break the lock-in. Surprisingly, the share  $m$  of early shifters plays no role in this condition! We will return to this observation below.

What about the profit for the two firms? Consider first the case where (6) holds. Now, the entrant has zero profit while the old firm has profit  $1 - \tilde{X}_O\hat{R}$ . After some algebra<sup>5</sup> we find that the incumbent's advertising cost is  $\tilde{X}_O\hat{R} = 1$ , and thus profit is equal to 0.

Consider next the case where (6) does not hold. Now the old firm (again) has zero profit, while the profit of the entrant is<sup>6</sup>  $h - \tilde{X}_N(0)\hat{R} = \bar{h}\bar{m}$ . Note further that, since in this case  $h > \bar{h} > 2\bar{h}\bar{m}$ , where the second inequality follows from  $\bar{m} < \frac{1}{2}$ , the media firm captures more than half the profit from the product market.

<sup>5</sup>Inserting from (3) and (4), we have:  $\tilde{X}_O\hat{R} = \frac{(1-\bar{m})}{\bar{m}}h - \frac{(\bar{m}-m)}{\bar{m}}\hat{R} = \frac{(1-\bar{m})}{\bar{m}}h - \frac{(\bar{m}-m)}{\bar{m}}\frac{(1-\bar{m})h-\bar{m}}{(\bar{m}-m)} = 1$ .

<sup>6</sup>Inserting from (4) and (5), we have:  $\tilde{X}_N(0)\hat{R} = \frac{\bar{m}-m}{1-\bar{m}}\frac{(1-\bar{m})h-\bar{m}}{\bar{m}-m} = h - \frac{\bar{m}}{1-\bar{m}} = h - \bar{h}\bar{m}$ .

**Proposition 8** *A media monopolist will,*

- (i) *if  $1 < h \leq \bar{h}$ , extract all profit from the incumbent firm; and*
- (ii) *if  $h > \bar{h}$ , extract a profit from the entrant equal to  $h - \bar{h}\bar{m}$ ; this profit is larger than the profit that the entrant retains.*

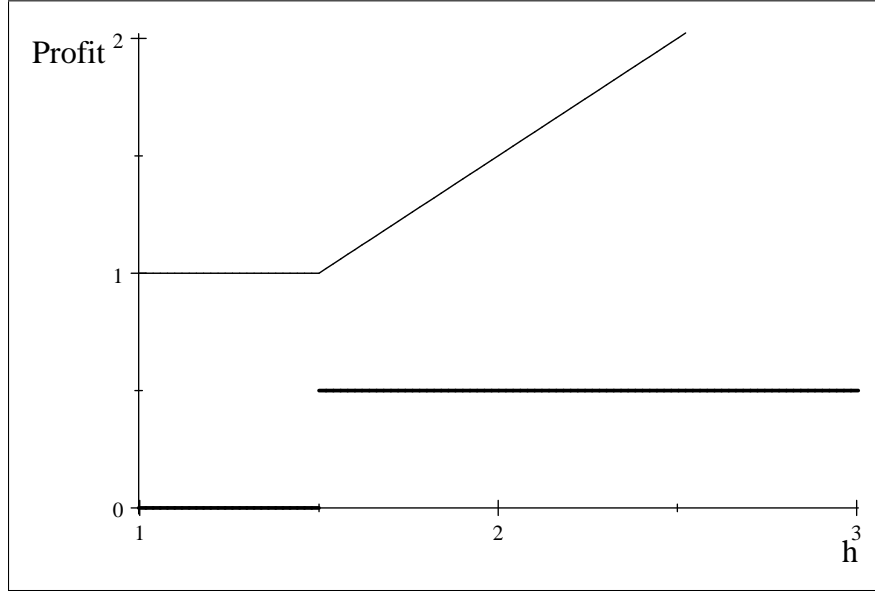


Figure 1. The media monopolist's profit (thin line) and the winning firm's profit (thick line) as a function of  $h$ , for the case  $\bar{h} = 1.5$ ,  $\bar{h}\bar{m} = 0.5$ , *e.g.*, with  $a = 5$  and  $b = 4$ .

The Proposition is illustrated in Figure 1, showing how the media monopolist's and the winning firm's profits vary with  $h$ .

This result is due to the sequential move structure of the game. As long as the old firm is able to defend the lock-in, it will advertise and keep the new firm out. The monopolist will, however, choose the price of advertising so that it can squeeze the last penny out of the old firm. The same does not apply to the entrant who has a higher potential profit  $h > 1$ . To squeeze more of the profit out of the entrant, the media monopolist would have to increase  $R$  but it cannot increase  $R$  beyond the point where the old firm is able to defend the lock-in. Since  $h > 1$ , the media firm will let the new firm enter if it, by allowing this entry, can extract more than the profit it can take from the old, *i.e.*, if  $\tilde{X}_N \hat{R} > 1$ . It follows that the new firm's retained profit must be less than  $h - 1$ .

The profit that the media monopolist is able to extract from the firms is independent of

$m$ . As long as the incumbent wins, the monopolist simply retains the entire profit, which is assumed to be independent of  $m$ . If  $h$  is sufficiently high, so that the media monopolist prefers the entrant to win, the monopolist extracts a profit  $h - \bar{h}\bar{m}$ , which is also independent of  $m$ .

## 5 Media Duopoly

We turn to the case of a media duopoly. The two media firms price fake observations at prices  $R_1$  and  $R_2$ . Note first that, if either one of the two prices is below  $\hat{R}$ , then the entrant will be able to break the lock-in. The advertising firms will buy advertising from the cheaper media firm, and this firm will be able to cover that demand. Hence the outcome in the product market depends only on the lower price. Thus, if either one of the two prices are below  $\hat{R}$ , then the entrant will be able to break the lock-in. The entrant's demand for fake observations will then be constant and equal to  $\tilde{X}_N(0)$ , given in (5). Since either firm is able to cover the entire market, they will each face a residual demand

$$D(R_i) = \begin{cases} \tilde{X}_N(0) & \text{if } R_i < R_j; \\ \frac{1}{2}\tilde{X}_N(0) & \text{if } R_i = R_j; \\ 0 & \text{if } R_i > R_j; \end{cases}$$

*i.e.*, we assume that the two firms split the market evenly when prices are identical. Thus, each firm has incentives to set prices just below that of the competitor, until  $R_1 = R_2 = 0$ . (As above, we disregard the cost of producing fake observation.)

A similar analysis applies when both firms charge prices above  $\hat{R}$ , *i.e.*, when  $\min(R_1, R_2) > \hat{R}$ . Now they face a demand from the old firm which is decreasing in  $\min(R_1, R_2)$ . In this case even the monopolist has incentives to lower the price and duopoly rivals certainly want to lower the price.

Next consider the case where

$$R_1 = R_2 = \hat{R}$$

The two firms then share the demand from the incumbent firm. If one of them lowers the price, then the incumbent will withdraw from the market and they only face demand from the new firm. Now, if they share the market equally at  $R_1 = R_2 = \hat{R}$ , they both face a

demand  $\tilde{X}_O/2$ , while if one media firm slightly lowers its price, then that firm will get the entire market, which is now  $\tilde{X}_N(0)$ . Thus if

$$\tilde{X}_O > 2\tilde{X}_N(0), \quad (8)$$

then there exists an equilibrium with  $R_1 = R_2 = \hat{R}$ .

From footnotes 5 and 6 above, we know that  $\hat{R}\tilde{X}_O = 1$  and  $\hat{R}\tilde{X}_N(0) = h - \bar{h}\bar{m}$ , which imply that condition (8) can be restated as

$$2(h - \bar{h}\bar{m}) < 1,$$

which may be rewritten as

$$1 < h < \frac{1}{2} + \bar{h}\bar{m} < \frac{3}{2},$$

where the first inequality is by assumption and the last one is due to  $\bar{m} \in (0, \frac{1}{2})$ . We note that an  $h$  satisfying the condition will only exist if  $\frac{1}{2} + \bar{h}\bar{m} = \frac{1}{2} + \frac{\bar{m}}{1-\bar{m}} > 1$ , which requires  $\bar{m} \in (\frac{1}{3}, \frac{1}{2})$ .

**Proposition 9** *If*

$$1 < h < \frac{1}{2} + \bar{h}\bar{m}, \quad (9)$$

*then there exists an equilibrium where  $R_1 = R_2 = \hat{R}$ , the lock-in is maintained, and only the old firm advertises; otherwise, the only equilibrium in pure strategies is one where  $R_1 = R_2 = 0$ , the old firm does not advertise, and the new firm advertises to break the lock-in.*

We know from Proposition 7 that, with a media monopolist, the old firm will maintain its lock-in if  $h < \bar{h}$ . But

$$h < \bar{h} = \frac{1}{1-\bar{m}} \iff h < 1 + \frac{\bar{m}}{1-\bar{m}} = 1 + \bar{h}\bar{m},$$

and hence condition (9) is stricter than  $h < \bar{h}$ .

**Corollary 10** *The incumbent firm maintains the lock-in for a wider range of parameters in the case of a media monopoly than in the case of a media duopoly.*

In the above analysis, we assumed that the two firms split the market evenly at equal prices. Any alternative assumption would, in fact, increase the difference between media monopoly and media duopoly. Suppose, say, that the two firms obtain market shares  $s$  and  $1 - s$  when prices are equal, where  $s \in (0, \frac{1}{2}]$ ; the case of  $s = \frac{1}{2}$  is the one discussed above. Then the condition for existence of the high-price duopoly equilibrium would change from (8) to:  $\tilde{X}_O > \frac{1}{s}\tilde{X}_N(0)$ , since the firm less attracted by the high-price equilibrium now would sell  $s\tilde{X}_O$  at that equilibrium. In turn, this implies that condition (9) in Proposition 9 would become:  $h < s + \bar{h}\bar{m}$ , which is stricter than (9) for any  $s < \frac{1}{2}$ .

## 6 Discussion

In the text above, we simply assumed that advertisers can impose a level of advertising on consumers. More realistically, the media firm can only change the number of advertising spots, say on TV. But consumers dislike advertising,<sup>7</sup> and if the TV is too crowded with ads, the consumers will not watch the channel. To reflect this, we assume now that the time people spend watching TV is  $V$  (all people watch TV, but possibly at a lower rate with much advertising), while  $A$  denote the number of advertising slots on the channel. The total advertising pressure is then  $X = AV$ . Moreover,  $V$  is negatively affected by advertising; specifically, we assume<sup>8</sup>

$$V = V(A), \text{ where } V'(A) < 0 \text{ and } \lim_{A \rightarrow \infty} AV(A) = \infty.$$

Since  $\lim_{A \rightarrow \infty} X = \lim_{A \rightarrow \infty} AV(A) = \infty$ , the media firm can sell as many fake observations as it likes. The fact that the firm only controls advertising spots in its channel thus does not affect the analysis above. For any  $X'$  there is a corresponding  $A'$  such that  $X' = A'V(A')$ . Under this assumption, viewer behavior is thus not important for our analysis.

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<sup>7</sup>See, *e.g.*, Wilbur's (2008) empirical study.

<sup>8</sup>This can be derived from somewhat more primitive assumptions. One possibility is to assume that  $\lim_{A \rightarrow \infty} V(A) > 0$ . Alternatively, one could assume that  $V(A) > \nu A^\phi$  for  $A$  sufficiently large, where  $\nu > 0$  and  $\phi < 1$ . In both cases, we would have  $\lim_{A \rightarrow \infty} AV(A) = \infty$ .

## 7 Conclusion

This paper constitutes a first attempt at incorporating behavioral aspects of advertising in a model of a media market. With a simple model, we are able to point out how the market structure in the media industry affects entry behavior in the product market.

Access to advertising is essential to be able to enter a locked-in market, unless the inherent product quality difference is very large (*e.g.*, Brekke and Rege, 2006). In this paper, we have argued that this crucial role of advertising can be exploited by a media monopolist, who is able to extract the major part of the profit in the product market. This undermines the incentives for product development in the product market.

With competition in the market for advertising space, it is easier to enter a locked-in market. The entrant will also retain most of his profit. Competition in the media market – the market for fake observations – is, in other words, crucial in providing incentives for product development in the product market. Our analysis, therefore, points at a mechanism whereby plurality in media, and thus media competition, fosters innovation and economic growth.

## A Appendix

**Proof of Proposition 1:** Let  $p$  denote the probability of being matched with one with the new technology, which also is equal to the probability that a random individual chooses (or have already chosen) the new technology. Now, moving from new to old technology induces a loss  $a$  with probability  $p$  and a gain  $b$  with the remaining value. In addition the intrinsic value of the new technology is lost. Thus

$$\Delta U = EU(\text{old}) - EU(\text{new}) = -ap + (1 - p)b - \theta.$$

Note that, if no-one chooses the new technology, then  $p = m$ . For this to be optimal for everyone, we must have  $\Delta U > 0$  for all, that is

$$\begin{aligned} \Delta U &= -am + (1 - m)b - \theta \geq 0 \text{ for all } \theta \in [0, 1] \iff \\ -m(a + b) + b &\geq 1 \iff \\ m &\leq \frac{b - 1}{a + b} = \bar{m} \end{aligned}$$

On the other hand, if all choose the new technology, then  $p = 1$ . For this to be optimal, we must have  $\Delta U < 0$  for all, and indeed

$$\Delta U = -a - \theta < 0.$$

Finally, with  $m \leq \bar{m}$ , there also exists a probability  $\hat{p} \in (0, 1)$  such that an individual with  $\theta = \hat{\theta}$  is indifferent, i.e.  $-a\hat{p} + (1 - \hat{p})b - \hat{\theta} = 0$  and the share choosing the new technology is indeed  $\hat{p}$ , that is  $m + (1 - m)(1 - \hat{\theta}) = \hat{p}$ . But this equilibrium is unstable; if a few more individuals choose the new technology, that technology will be attractive to more people, a process that will not stop until all adopt the new technology. Note finally that  $\hat{\theta}$  is linear in  $x$ , and since  $\hat{\theta}(0) < 0$ , there can only be one fixed point  $\hat{\theta}(x) = x$  if  $\hat{\theta}(1) \geq 1$ , that is if  $m < \bar{m}$ . In this case

$$\frac{d\hat{\theta}(x)}{dx} = (a + b)(1 - m) > 1 + a > 1,$$

where the first inequality follows from the supposition that  $m < \bar{m} = \frac{b-1}{a+b}$ . Thus, if there is a fixed point  $x^*$ , it follows that this fixed point has the property that

$$\frac{\hat{\theta}(x) - x^*}{x - x^*} > 1.$$

A slight deviation from the equilibrium will therefore induce a reply that moves the economy further away from equilibrium. In a dynamic setting this equilibrium would be unstable, and we rule it out.<sup>9</sup>

Note finally that with  $m = \bar{m}$  then  $\Delta U = 0$  for  $\theta = 0$ , that is  $\hat{\theta} = 0$ . The equilibrium where all, except the early adopters, choose the old technology is thus stable only for  $m < \bar{m}$ . ■

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<sup>9</sup>See also the dynamic analysis in Brekke and Rege (2006).

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