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Financing of Media Firms: Does Competition Matter?

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Financing of Media Firms: Does Competition Matter?

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Abstract: This paper analyses how competition between media firms influences the way they are financed. In a setting where monopoly media firms choose to be completely financed by consumer payments, competition may lead the media firms to be financed by advertising as well. The closer substitutes the media firms' products are, the less they rely on consumer payment and the more they rely on advertising revenues. If media firms can invest in programming, they invest more the less differentiated the media products are perceived to be.

1 Introduction

Media firms can generate revenues in various ways. Some TV channels are for example financed by advertising income, while others rely on direct payment from their viewers. Media firms may also combine different ways to raise revenues, such as when newspapers earn revenues from both advertising and from consumer payment. Why do media firms choose different ways to earn revenues? And why do we often observe purely advertising-financed media firms, even though empirical evidence suggests that their audiences dislike commercials?[1] Why not charge the audience directly, and avoid product-damaging commercials? In answering these questions, we present a simple model showing how competition between media firms can help explain the way they are financed.

To analyze the importance of the rivalry between media firms, we consider a model of a media market where the audience dislikes advertising. The media firms can for instance be TV channels, radio channels, or newspapers (printed or electronic). Each firm is financed by advertising, direct payment from consumers, or both.

In most of the paper, we assume that the advertisers' benefit from advertising is equal to the consumers' disutility of being interrupted by commercials, and show that a monopoly media firm then maximizes profit by having no commercials. Revenue is instead raised by charging consumers directly. In the monopoly case, we therefore end up with a traditional one-sided market. However, in a corresponding duopoly model we demonstrate that competition endogenously creates a two-sided market,

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[1]It is documented that viewers try to escape from advertising breaks on TV, see, *e.g.*, Moriarty and Everett (1994) and Danaher (1995). See also Wilbur (2004), who estimates a model of TV competition and finds viewers' disutility to be significant and positive. For printed newspapers, there are less clear answers as to whether consumers consider advertising as a good or as a bad, and there are some indications that the extent to which people consider commercials as bad varies across countries. For instance, it has been argued that newspaper readers in Europe have a more negative attitude to advertising than those in the USA (Gabszewicz, *et al.*, 2004). Depken and Wilson's (2004) study of US magazines indicates that readers' attitude to advertising is negative in some magazines and positive in others.

where the media firms are financed partly by advertising revenue and partly by consumer payments.[2] The closer substitutes the media products are, the more do the media firms rely on advertising revenues. Indeed, in the limit case where the media firms are perceived to be perfect substitutes, the consumer price equals marginal costs, and the whole profit of the media firms comes from advertising.

In order to understand this result, note that competition in consumer prices is qualitatively different from competition in advertising prices. As is the case in more traditional markets, consumer prices are *strategic complements*: if one media firm reduces the price it charges from its audience, it will be optimal for the other firm to do the same. Advertising prices, on the other hand, are *strategic substitutes;* a price reduction from one firm leads to a price *increase* from the other.[3] To see why, suppose that firm 1 reduces its advertising price. This leads to an increase in its level of advertising, which is bad for its audience. Therefore, there will be a shift of media consumers from firm 1 to firm 2. Since firm 2 will end up with a larger audience, it can respond by increasing its advertising price.

Competition in strategic complements is generally more aggressive than competition in strategic substitutes, and more so the less differentiated the products are (see, *e.g.*, Bulow, *et al.*, 1985, and Vives, 1999). In particular, firms producing identical products at identical costs will make a positive profit if they compete in strategic substitutes, but not if they compete in strategic complements. This explains why we arrive at the result that the media firms raise all their revenues from advertising if their products are perfect substitutes; the profits from consumer prices are competed away with homogenous products.

How will this analysis be affected if the media firms are able to invest in product quality, *i.e.*, undertake investments that make their products more attractive for the consumers? Improving the product quality increases the willingness to pay for the media product, and enlarges the size of the audience. In addition to this market-expansion effect, there is also a business-stealing effect: each media firm has incen-

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[2]For discussions of the notion of two-sided markets, see Armstrong (2004), Evans (2003a), and Rochet and Tirole (2004).

[3]This was first shown by Nilssen and Sørgard (2001).

tives to invest in quality in order to capture part of the rival's audience. Since the audience is more prone to shift from a "low-quality" to a "high-quality" media firm the less (horizontally) differentiated the firms' products are, the business-stealing effect is strongest for media outlets that are close substitutes. The media firms therefore invest more in quality the less differentiated their products are. However, the introduction of quality investments has no effect on the relative merits of consumer payments and advertising revenue: The closer substitutes the media products are, the more the media firms rely on advertising - also when quality investments are available.

The rest of the paper is organized as follows. In the next Section, we relate our study to the existing literature. Section 3 discusses the case of monopoly and shows how the monopoly media firm's choice between advertising and consumer payments depends on the advertisers' benefit from advertising relative to media consumers disutility from it. In Section 4, we introduce a duopoly model and discuss how an increase in competition, in the sense of more similar media products, makes media firms shift from consumer payments to advertising as a source of finance. Section 5 expands on this analysis by considering media firms' incentives to invest in quality as competition increases, and how this affects their choices of source of finance. Some of the basic assumptions of the model are discussed in the concluding Section 6, while the formal analysis of quality investments is relegated to the Appendix.

2 Related literature

The question of why advertising revenue is important to many media firms has received a lot of attention lately. One reason being put forward is that it may be impossible, or at least difficult, to collect money from the public in some cases. This has been used as an explanation for why so few newspapers on the Internet are financed by user payment, and why so many broadcasting firms historically have relied heavily on advertising income. However, as argued by Armstrong (2004), technological progress and new payment systems presumably make this a less important reason now than it was earlier. Another explanation for absence of user

payment may be that the efficiency gains of advertising can be large compared to consumers' disutility of being interrupted by commercials. In such a case, firms may have a relatively high willingness to pay for advertising, and a media firm may find it profitable to sell advertising space even if this should make the media firm's product less attractive for the consumers.

One important strand of the literature on media economics fixes the media firms' financing and discusses implications, particularly for the program content, of the firms being financed by either consumer payments or advertising. This includes the classic study by Spence and Owen (1977) and more recent contributions by Wurf and Cuilenburg (2001) and Peitz and Valletti (2004). In an interesting paper, Chae and Flores (1998) analyze how we should expect pay TV and advertising-financed TV to differ on certain main characteristics of the programmes they offer. Their main result is that pay TV tends to show programs for which there is a relatively small audience, but with a high willingness to pay. Advertising-financed TV, on the other hand, focuses on large markets where the audience has a relatively low willingness to pay. Chae and Flores thus focus purely on the demand side to explain how media firms are financed, while we take into account the two-sidedness of the media industries in our analysis.

The only paper we are aware of, besides ours, that considers media firms which are partly financed by advertising and partly by consumer payments, is Godes, *et al.* (2003). However, they have a different model set-up and focus. In particular, Godes, *et al.* analyze competition between different media industries (*e.g.*, newspaper and TV). Media firms within a given industry are assumed to be homogeneous, and in their main model, consumers are indifferent to the level of advertising.[4] Also Anderson (2003) endogenizes media-firm financing, but firms can only choose between being completely advertising-financed and completely financed by consumer payments. Allowing consumers to differ with respect to their dislike for commercials,

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[4]In an extension, they allow the various media industries to differ with respect to the consumers' disutility of advertising, so that, for instance, commercials on TV are perceived to be more negative than commercials in newspapers. This is an interesting path of research, which we think deserves more attention.

he finds that pay TV and advertising-financed TV may coexist, where the viewers with the greatest dislike for ads watch pay TV.

Our analysis is related to the literature on two-sided markets, and we contribute to this literature by providing a formal analysis of two-way multihoming.[5] Evans (2003b:198) states that multihoming will affect both price level and price structure, but that "theory and empirics are not far enough advanced to say much more". In this paper, we demonstrate how the difference in the kind of competition on the two sides of the market (*i.e.*, strategic complements versus strategic substitutes) determines the pricing schedules. Indeed, we demonstrate that competition by itself creates a two-sided market, since a monopoly firm would have all its revenues from the consumer side.

3   The monopoly case

Consider a monopoly media firm. The firm's product could for instance be a TV program, a printed newspaper, or an Internet newspaper. The media consumers will interchangeably be labelled viewers and audience.

There is a continuum of consumers with measure 1. Denote by V the demand for the product provided by the media firm, and let a consumer's (gross) utility be given by

$$U = V - \frac{V^2}{2}. \tag{1}$$

Each consumer has to make a direct payment equal to $p \geq 0$ per unit of the good (*e.g.*, per copy of a newspaper). The consumer suffers a disutility when being interrupted by commercials, and the presence of advertising can thus be considered an indirect charge for the media product. To capture this, we let the subjective cost of the media product equal $C = (p + \gamma A) V$, where $A \geq 0$ is the advertising level and $\gamma \geq 0$ is a parameter measuring the consumers' marginal disutility of being

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[5]Multihoming means that agents on at least one side of the market use more than one platform (intermediary). In our duopoly model, the audience as well as the advertisers use both TV channels as platforms. See Gabszewicz and Wauthy (2004) for another recent analysis of multihoming in two-sided markets.

interrupted by commercials. Consumer surplus is thus equal to

$$CS = U - (p + \gamma A) V.$$

Setting $\partial CS/\partial V = 0$, we find

$$V = 1 - p - \gamma A. \tag{2}$$

We thus see that the size of the audience is decreasing in the consumer price p, the advertising level A, and the disutility γ of being interrupted by adverting.

For the sake of simplicity, we put the media firm's production costs equal to zero, so that its profit is

$$\Pi = AR + pV. \tag{3}$$

Consumer-good producers advertise with the media firm if the benefit of doing so is larger than the cost. For simplicity we assume that there is only one advertiser, but it can be shown that the qualitative results of the paper hold for any arbitrary number of advertisers. The producer's gross gain from advertising is naturally increasing in its advertising level and in the number of viewers exposed to the commercials. We make it simple by assuming that the gross gain equals ηAV, where $\eta \geq 0$. The net gain for the producer of advertising is then

$$\pi = A(\eta V - R). \tag{4}$$

The producer chooses the advertising level so as to maximize profit. Solving $\partial \pi / \partial A = 0$ and taking account of the non-negativity constraint on advertising, we find that the demand for advertising is

$$A = \max \left\{ 0, \frac{(1-p)\eta - R}{2\eta\gamma} \right\}. \tag{5}$$

The media firm maximizes profit with respect to p and R, subject to (2) and (5). Assuming that the non-negativity constraints are fulfilled ($A \geq 0$ and $p \geq 0$), we find that $\partial \Pi / \partial p = \partial \Pi / \partial R = 0$ yields

$$p = \frac{3\eta \left(\frac{\gamma}{\eta} - \frac{1}{3} \right)}{4\gamma - \eta \left(1 - \frac{\gamma}{\eta} \right)^2} \text{ and } R = \frac{\gamma (\gamma + \eta)}{4\gamma - \eta \left(1 - \frac{\gamma}{\eta} \right)^2}. \tag{6}$$

Inserting for equation (6) in (3) and (5), we further have

$$A = \frac{1 - \frac{\gamma}{\eta}}{4\gamma - \eta \left(1 - \frac{\gamma}{\eta}\right)^2} \text{ and } \Pi = \frac{\gamma}{4\gamma - \eta \left(1 - \frac{\gamma}{\eta}\right)^2}. \tag{7}$$

From equations (6) and (7) it follows that both A and p are non-negative if $\frac{\gamma}{\eta} \in \left(\frac{1}{3}, 1\right)$, in which case

$$\frac{\partial A}{\partial \gamma} < 0, \text{ and } \frac{\partial p}{\partial \gamma} > 0.$$

This shows that the media firm relies less on advertising and more on direct consumer payment the larger the consumers' marginal disutility of being interrupted by advertising. If $\frac{\gamma}{\eta} \geq 1$, profit is maximized by being advertising-free.

We likewise find that we for $\frac{\gamma}{\eta} \in \left(\frac{1}{3}, 1\right)$ have

$$\frac{\partial A}{\partial \eta} > 0, \text{ and } \frac{\partial p}{\partial \eta} < 0.$$

An increase in η means that it becomes relatively more profitable for the media firm to sell advertising space. Therefore, $\frac{\partial A}{\partial \eta} > 0$. However, in order to raise revenue through the advertising market, it is important for the media firm to have a large audience. The optimal consumer price is consequently decreasing in η, and profit is maximized by setting $p = 0$ if $\frac{\gamma}{\eta} < \frac{1}{3}$.

We can now state:

Proposition 1: *The monopoly media firm is financed*
i) purely by advertising ($p = 0$) if $\frac{\gamma}{\eta} \leq \frac{1}{3}$;
ii) by a combination of advertising revenue and consumer payments if $\frac{\gamma}{\eta} \in \left(\frac{1}{3}, 1\right)$;
iii) purely by consumer payments ($A = 0$) if $\frac{\gamma}{\eta} \geq 1$.

4 A duopoly model

Below, we consider a context with two competing media firms. In order to simplify the algebra and highlight the effect of media competition, we put $\gamma = \eta = 1$ in the rest of our analysis. For these parameter values, we know from Proposition 1 that a monopolist would prefer to be advertising-free.

With two media firms, consumers' gross utility is modified to[6]

$$U = V_1 + V_2 - \frac{1}{1+b}\left(\frac{V_1^2}{2} + \frac{V_2^2}{2} + bV_1V_2\right). \tag{8}$$

The new parameter in equation (8) is $b \in [0,1)$, which measures the degree of horizontal differentiation between the products of the two media firms. The products are completely independent if $b = 0$, while there is no horizontal differentiation between them in the limit as $b \to 1$. More generally, the media firms' products are closer substitutes from the consumers' point of view the higher is b.

The consumers' demand for the media products is found by maximizing consumer surplus,

$$CS = U - (p_1 + A_1)V_1 - (p_2 + A_2)V_2, \tag{9}$$

with respect to V_1 and V_2. This yields

$$V_i = 1 - \frac{p_i - p_j b}{1-b} - \frac{A_i - A_j b}{1-b}. \tag{10}$$

Demand for the media product of firm i is thus decreasing in its own price and advertising level, and increasing in those of its rival. This reflects the fact that the consumers perceive the media products as (imperfect) substitutes.

We maintain the assumption that there is only one advertiser, which now has a profit level given by

$$\pi = A_1V_1 + A_2V_2 - A_1R_1 - A_2R_2. \tag{11}$$

To find the demand for advertising, we use equations (10) and (11) to solve $\partial\pi/\partial A_1 = \partial\pi/\partial A_2 = 0$. This yields

$$A_i = \frac{1}{2}\left(1 - p_i - \frac{R_i + bR_j}{1+b}\right), \qquad i,j = 1,2, \quad i \neq j. \tag{12}$$

Equation (12) shows that the demand for advertising facing media firm i is lower the higher its consumer and advertising price. More interesting is the observation that A_i is decreasing also in R_j (for $b > 0$). To see why, suppose that R_j increases.

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[6]This function is a version of a standard quadratic utility function as exposed, *e.g.*, by Vives (1999). Our specification is the same as the one we used in Kind, *et al.* (2003) and Barros, *et al.* (2004).

This causes the advertising level at that media firm to decrease, making it relatively more attractive for the audience. Some viewers will therefore shift to media firm j from media firm i , and more so the closer substitutes the media firms are. Due to a smaller audience, the demand for advertising at media firm i is reduced.[7]

Similarly to the monopoly case, the profit level of media firm i equals

$$\Pi_i = A_i R_i + p_i V_i, \quad i = 1, 2. \tag{13}$$

The two media firms determine simultaneously their advertising and consumer prices. Before discussing the equilibrium outcome, it is useful to note the following:

Proposition 2: *Consumer payments are strategic complements and advertising prices are strategic substitutes.*

This result follows from equations (10), (12) and (13), from which we find that $\frac{\partial^2 \Pi_i}{\partial p_i \partial p_j} = \frac{b}{2(1-b)} > 0$, and $\frac{\partial^2 \Pi_i}{\partial R_i \partial R_j} = -\frac{b}{2(1+b)} < 0$.

Proposition 2 shows that there is an important difference between the two markets in which the media firms operate. In the consumer market, an increase in one firm's price would provide the other firm with incentives to increase its price too. This is in line with the normal textbook depiction of price competition. As argued above, things are quite different in the advertising market. If media firm 1, say, were to increase its advertising price, it would sell less advertising. Since advertising is a nuisance to consumers, this would result in a shift in audience to media firm 1 from media firm 2, which consequently experiences a smaller demand for advertising. Thereby, media firm 2 will have an incentive to *reduce* its advertising price.

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[7]This property is also present with an arbitrary number n of advertisers, in which case we have

$$A_i = \frac{n}{1+n} \left(1 - p_i - \frac{R_i + R_j b}{1 + b} \right).$$

When n is large, each advertiser has a negligible effect on the audience sizes V_1 and V_2, and a single advertiser's demand for advertising at firm 1 is independent of his advertising level at firm 2. *In the aggregate*, however, the two media firms' advertising services are complementary goods. In our simplified setting with a single advertiser, the difference between independent demand individually and complementarity in the aggregate is obscured, but the complementarity is best seen as an effect in the aggregate only.

When $b = 0$, the media firms are monopolists in independent markets and will choose to be advertising-free, as shown in the previous section. The fact that consumer payments are strategic complements and advertising prices strategic substitutes has important implications for how the competition between the media firms works. In particular, competitive forces make the media firms choose to be partly financed by advertising. To show this, we maximize profit (13) subject to the audience function (10) and the demand for advertising (12). Solving $\partial \Pi_i / \partial p_i = \partial \Pi_i / \partial R_i$ simultaneously for the two firms gives rise to a symmetric equilibrium with the following prices (where for convenience we have omitted firm-specific subscripts):

$$R = \frac{1+b}{2+b}, \text{ and } p = \frac{1-b}{2-b}. \tag{14}$$

By insertions in (10) and (12), we find that advertising quantities and audience sizes equal

$$A = \frac{b^2}{2(4-b^2)}, \text{ and } V = \frac{4+2b-b^2}{2(4-b^2)}. \tag{15}$$

Thus, the firms' profits equal

$$\Pi = \frac{4-3b^2}{(4-b^2)^2}. $$

Note that $\frac{d\Pi}{db} < 0$; the more competition the firms face, the lower is profit.

It is now useful to define S as consumer revenue's share of total income:

$$S = \frac{pV}{pV + AR} \tag{16}$$

Using equations (14) and (15), we can express S as a function of b :

$$S(b) = \frac{(1-b)(2+b)(4+2b-b^2)}{2(4-3b^2)}; \ \ S'(b) < 0 \tag{17}$$

with $S(0) = 1$, and $\lim S(b)_{b \to 1} = 0$. We can therefore conclude:

Proposition 3: *Consumer revenue as share of total income is lower the closer substitutes the media firms' products are. At $b = 0$, the media firms are completely financed by consumer payments, while they are completely financed by advertising in the limit as $b \to 1$.*

The intuition for Proposition 3 is that competition in strategic complements is more aggressive than competition in strategic substitutes, and more so the less

differentiated the services are (*e.g.*, Bulow, *et al.*, 1985, and Vives, 1999). Indeed, it is well known from the literature that price is equal to marginal costs if symmetric firms producing homogenous goods compete in strategic complements, but that the same is not true if they compete in strategic substitutes. Since consumer prices are strategic complements while advertising prices are strategic substitutes, this explains why the media firms make profits only in the advertising market as $b \to 1$.

The equilibrium outcome is further illustrated in Figure 1, where we graph advertising revenue (AR) and consumer revenue (pV) as a function of b. The Figure shows clearly that an increase in media competition leads to a shift from consumer payments to advertising as source of revenue.

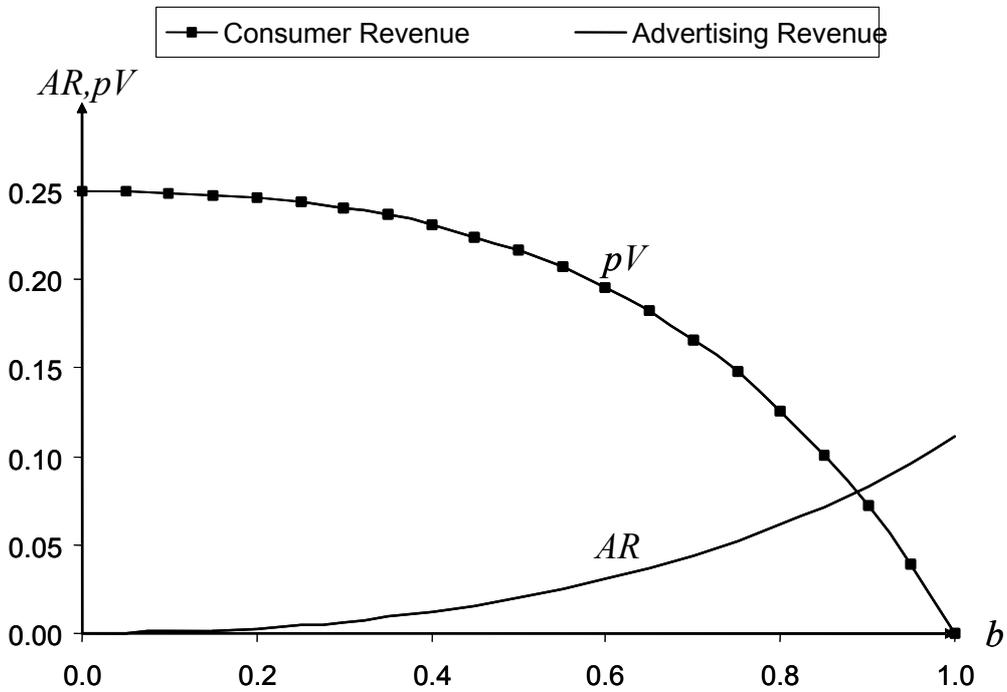**Figure 1:** *Revenue from consumers and advertisers.*

From equation (15), we get another interesting feature of our model:

Proposition 4: *Media firms' audiences are larger the closer substitutes their products are:* $\frac{dV}{db} > 0$.

In combination, the two Propositions above predict that media firms that are mainly advertising financed have relatively large audiences. However, this is not

because they seek a broader public as such. On the contrary, as shown above, a profit-maximizing monopoly would choose to have no advertising, high user payments and a relatively small audience. This fits well with the observation that pay-TV channels (and specialized Internet sites with user payment) typically have relatively few viewers.[8]

5 Investments in quality

In the above analysis, a media firm could affect its attractiveness only through changes in its advertising and consumer price. We now extend our analysis by incorporating the ability of a media firm to invest in content quality (e.g. programming). This extension calls for a respecification of consumer preferences. We accordingly modify the utility function in (8) to:

$$U = V_1 \left(1 + Q_1\right) + V_2 \left(1 + Q_2\right) - \frac{1}{1+b} \left(\frac{V_1^2}{2} + \frac{V_2^2}{2} + b V_1 V_2 \right), \qquad (18)$$

where $Q_i \geq 0$ $(i = 1, 2)$ measures the consumers' perceived quality of the content provided by media firm i.[9] Our earlier analysis corresponds to the special case where quality is fixed at $Q_1 = Q_2 = 0$.

Maximization of consumer surplus now implies that:

$$V_i = 1 - \frac{p_i - p_j b}{1-b} - \frac{A_i - A_j b}{1-b} + \frac{Q_i - Q_j b}{1-b}, \qquad i, j = 1, 2, \quad i \neq j. \qquad (19)$$

This gives rise to the following demand for advertising, where account is taken of the media firms' quality investments:

$$A_i = \frac{1}{2} \left(1 - p_i - \frac{R_i + b R_j}{1+b} + Q_i \right), \qquad i, j = 1, 2, \quad i \neq j. \qquad (20)$$

The profit function of each media firm is as before, except for the costs incurred from investing in content quality:

$$\Pi_i = A_i R_i + p_i V_i - \varphi \left(Q_i \right), \quad i = 1, 2, \qquad (21)$$

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[8]This effect would not show up in a standard Hotelling framework, where the total number of consumers is given. See also discussion in Section 6.

[9]By "quality", we mean anything that make the content more attractive for the consumers. This could, *e.g.*, be a more popular presenter on TV or better paper quality in a newspaper.

where $\varphi(\cdot)$ is assumed to satisfy second-order conditions for an interior solution.[10]

We assume that the firms simultaneously determine how much to invest in quality (*i.e.*, chooses Q_i) at stage 1, while they at stage 2 play the same pricing game as we analyzed above (each firm choosing R_i and p_i). Omitting subscripts, the solution to the last stage in the symmetric equilibrium is given by:

$$R = \frac{1+b}{2+b}(1+Q), \text{ and } p = \frac{1-b}{2-b}(1+Q).$$ (22)

Each firm's advertising quantities and audience sizes then equal

$$A = \frac{b^2}{2(4-b^2)}(1+Q), \text{ and } V = \frac{4+2b-b^2}{2(4-b^2)}(1+Q),$$ (23)

where the optimal quality investment level at stage 1 is implicitly given by (see Appendix)

$$\frac{\varphi'(Q)}{1+Q} = \frac{8+4b-4b^2-b^3}{(4-b^2)^2}.$$ (24)

Note that the expressions for prices and quantities are the same as in our previous analysis without quality investments, except that they are now multiplied by $(1+Q)$. This means that consumer revenue as share of total income, $S(b)$, is independent of whether quality investments are endogenous or fixed at zero. We thus know from Section 3 that $S(0) = 1$ and $S'(b) < 0$.

A higher quality level increases both the consumers' willingness to pay for the media product ($\frac{dp}{dQ} > 0$) and the size of the market ($\frac{dV}{dQ} > 0$). The market-expansion effect implies that demand for advertising increases; this is why $\frac{dA}{dQ} > 0$ and $\frac{dR}{dQ} > 0$. In the Appendix we further show that

$$\frac{dQ}{db} > 0.$$

The closer substitutes the media products, the more the media firms thus invest in quality. This is due to a business-stealing effect: the consumers are more prone to shift from a low-quality to a high-quality media product the less (horizontally) differentiated the products are. Thereby, each media firm's incentive to make quality

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[10]The precise formulation of the second-order conditions, as well as other details of the subsequent analysis, are in the Appendix.

investments is increasing in b.[11] However, since the business-stealing effect implies that both firms invest more in quality the higher is b, the net effect for the media firms of these higher quality investments is to reduce profits.

We can now conclude:

Proposition 5: *In a stable and symmetric equilibrium, the media firms invest more in quality and raise a smaller share of their revenue from consumers the closer substitutes the media products are.*

6   Concluding remarks

The main purpose of this paper is to show that the tougher the competition between media firms, the more important advertising revenues are likely to be. In order to show this, we set up a very simple model where a media firm, when it is a monopolist, maximizes profit by being financed purely by the audience, but where it ends up being purely financed by advertising when it faces competition from a media firm whose product is close to a perfect substitute. We further show that competition between media firms makes them invest more in quality, but that these investments do not change the way they are financed.

A crucial assumption for our result is that the media firms compete in prices. Assuming price competition in the consumer market is hardly controversial, but it could be argued that it is more reasonable to assume that media firm compete in advertising *quantities* than in advertising prices. First, media firms can presumably relatively easily commit themselves with respect to how much space to allocate to commercials. Second, it may be argued that media firms *plan* in terms of quantities: how many pages of advertising should there be in a newspaper, and how often should a television program be interrupted by commercials (see Godes, *et al.*, 2003)? In practice, however, there are no physical limits to how much space media firms can use for advertising. Thus, the firms need to communicate possibly self-imposed

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[11]This implies that competitive media firms have larger audiences and stronger incentives to make quality investments than a monopoly. This is in contrast to results we typically find in Hotelling models.

quantity limits to the market. But what we typically observe is announcement of advertising prices only; it is rather uncommon to see that printed newspapers commit to a maximum number of pages with advertising, or that TV channels commit to a maximum time for commercials per day.[12] Nor do we observe advertisers paying a lower price the more total advertising there is at a media firm, which could be an indirect way of committing to a "low" advertising volume. The advertising-price scheme is rather based on, for instance, the size of the audience and the number of minutes the commercial of a given advertiser is shown.

We have assumed that consumers pay a fixed price per viewing time on TV or per copy of a newspaper, which may be a reasonable approximation to the pricing schedule used on pay-TV and non-subscription newspapers, for instance. It should be noted, though, that many media firms have a fixed monthly or annual fee. An interesting extension of the model would be to consider alternative payment models in order to analyze the robustness of the result that advertising revenue tends to become more important for media firms the higher the competitive pressure.

Another interesting extension would be to incorporate into the analysis the product markets in which advertisers sell their products.[13] In our model, this would possibly affect the advertiser's profit in eq. (11). In the present formulation, there are constant returns to scale in advertising, and an advertiser's demand for advertising at one firm is independent of his advertising at the other (except in the aggregate through advertising's effect on the size of the audience). Adding more structure on the way the advertisers are modelled may open up both for decreasing returns to advertising and for horizontal product differentiation among media firms, also from advertisers' point of view. Future research should, again, establish to what extent our result stands up in such more elaborate settings.

Finally, it should be noted that our model may be considered as a complement to research papers on media economics that build on the Hotelling framework. The

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[12]However, in some European countries, there is an upper, regulatory limit on how much advertising there can be on TV; see Kind, *et al.* (2003).

[13]Earlier studies modelling both the media industry and the product markets of advertisers include Nilssen and Sørgard (2001) and Dukes (2004). These studies do not discuss the financing of media firms.

advantage of the Hotelling framework is that it makes it possible to endogenize the extent of horizontal differentiation between the media products. However, a disadvantage is that the total number of consumers typically is given, such that aggregate output is independent of whether there is any competition. In our framework, competition leads to higher output, and we believe that this is a reasonable prediction both in the media industry and in other markets.[14]

7   References

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[14]For the same reason, we find that competition may lead firms to invest more in quality, while the typical prediction in Hotelling models is that more competition leads to less quality investments, because each firm serves a smaller number of consumers.

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8 Appendix

Quality investments: We solve stage 2 by maximizing Π_i with respect to p_i and R_i $(i = 1, 2)$, subject to (19) and (20). This yields

$$R_i = \frac{1+b}{2+b}\left(1 + \frac{2Q_i - bQ_j}{2-b}\right), \ i,j = 1,2, \ i \neq j, \tag{25}$$

and

$$p_i = \frac{1-b}{2-b}\left(1 + \frac{\left(2-b^2\right)Q_i - bQ_j}{2-b^2-b}\right), \ i,j = 1,2, \ i \neq j. \tag{26}$$

By insertions in (20) and (19), we find that

$$A_i = \frac{b^2}{2\left(4-b^2\right)}\left(1 + Q_i\right), \ i = 1, 2, \tag{27}$$

and

$$V_i = \frac{4 + 2b - b^2}{2\left(4-b^2\right)}\left(1 + \frac{\left(4 - 3b^2\right)Q_i - b\left(2-b^2\right)Q_j}{4 - 3b^2 - b\left(2-b^2\right)}\right), \ i,j = 1,2, \ i \neq j.$$

At stage 1, the two media firms decide on how much to invest in quality. The first-order condition for optimal quality investment by firm i is

$$\frac{\partial \pi_i}{\partial Q_i} = \frac{\left(b^4 + 3b^3 - 8b^2 - 4b + 8\right) + \left(b^4 - 8b^2 + 8\right)Q_i - b\left(4 - 3b^2\right)Q_j}{\left(1-b\right)\left(4-b^2\right)^2} - \phi'(Q_i) = 0, \ i,j = 1,2, \ i \neq j. \tag{28}$$

Solving $\frac{\partial^2 \pi_i}{\partial Q_i^2} < 0$, we find that the second-order condition for an interior solution is satisfied if

$$\phi'' > \frac{8 - 8b^2 + b^4}{(1-b)(4-b^2)^2}. \tag{29}$$

Setting $Q_i = Q_j = Q$ in (28), we arrive at equation (24) in the main text.

A necessary condition for the system to be stable is that $\left|\frac{dQ_i}{dQ_j}\right| < 1, i \neq j$. Differentiation in (28) yields

$$\frac{dQ_i}{dQ_j} = \frac{b\left(4 - 3b^2\right)}{\left(b^4 - 8b^2 + 8\right) - \left(1 - b\right)\left(4 - b^2\right)^2 \phi''(Q_i)}, \ i, j = 1, 2, \ i \neq j,$$

from which it follows that the stability condition requires

$$\phi'' > \hat{\phi} := \frac{\left(1 + b\right)\left(b^3 - 4b^2 - 4b + 8\right)}{\left(1 - b\right)\left(4 - b^2\right)^2}. \tag{30}$$

Comparing the critical values of ϕ'' in (29) and (30), verifies that the second-order condition holds if the system is stable.

To prove that quality investments are increasing in b, we first totally differentiate (28) with respect to Q_i, Q_j and b, and then set $dQ_i = dQ_j = dQ$, and $Q_i = Q_j = Q$. This implies that we in a symmetric equilibrium have

$$\left[\phi'' - B\right]\left.\frac{dQ}{db}\right|_Q = \frac{16 - 8b^3 - b^4}{\left(4 - b^2\right)^3}\left(1 + Q\right), \tag{31}$$

where $B := \frac{8 + 4b - 4b^2 - b^3}{(4 - b^2)^2}$. Since $B - \hat{\phi} = -\frac{2b\left(4 - 3b^2\right)}{(1 - b)(4 - b^2)^2} < 0$, stability implies that the square-bracketed term on the left-hand side of (31) is positive. Since the right-hand side of (31) is positive for all values of b, it follows that $\frac{dQ}{db} > 0$ if the stability condition is satisfied. *Q.E.D.*