

Business models for media firms: Does competition matter for how they raise revenue?

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Abstract: The purpose of this article is to analyze how competitive forces may influence the way media firms like TV channels raise revenue. A media firm can either be financed by advertising revenue, by direct payment from the viewers (or the readers, if we consider newspapers), or by both. We show that the scope for raising revenues from consumer payment is constrained by other media firms offering close substitutes. This implies that the less differentiated the media firms' content, the larger is the fraction of their revenue coming from advertising. A media firm's scope for raising revenues from ads, on the other hand, is constrained by how many competitors it faces. We should thus expect that direct payment from the media consumers becomes more important the larger the number of competing media products.

1 Introduction

In December 2005, after years of planning and months of testing, *CNN* launched its *Pipeline* service where viewers could subscribe to live breaking news online at a price of \$ 24.95 a year (\$ 2.95 a month, \$ 0.99 a day). One and a half years later, *CNN* removed its subscription fee on *Pipeline* and replaced it with a free ad-supported service.¹ In September 2005, *New York Times* introduced *TimesSelect*, which charged \$ 49.95 a year or \$ 7.95 a month for online access to its columnists and news archive. Two years later, the fee was removed. Vivian L. Schiller, general manager of the site explained the change in strategy as follows: ‘*our projections for growth in the subscription base were low, compared to the growth in online advertising*’ (New York Times, 2007). These, and many other examples, indicate that business models with revenues from subscription fees have become increasingly less viable on the Internet. However, in the traditional TV industry we observe the opposite trend. In 2003, subscription revenues were larger than advertising revenues for the first time in the UK TV market (Ofcom, 2005). By 2007, the same was true in the USA.²

How can we explain that financing seems to shift from subscription to advertising in one media market, and in the opposite direction in another media market? The purpose of this article is to introduce a theory that can help us to resolve this puzzle. We show that competition and strategic interactions between media firms may be decisive for their choice of financing. To capture the role of competition, we allow both the degree of content differentiation between the media firms’ products and the number of media firms to vary (e.g. the number of newspapers or TV channels). It turns out that these two competitive forces are qualitatively different. On the

¹See http://en.wikipedia.org/wiki/CNN_Pipeline.

²According to TNS Media Intelligence, the revenues from advertising on TV in the US rose from \$ 54.4 bn in 2003 to \$ 63.8 bn in 2007, see for example <http://www.tns-mi.com/news/03252008.htm> concerning the figures for 2007. The revenues from subscriptions and license fees increased from \$ 49.5 bn in 2003 to \$ 66.6 bn in 2007 according to PwC (see <http://www.marketingcharts.com/television/global-entertainment-media-to-reach-22t-in-2012-driven-by-digital-mobile-5012/pwc-outlook-global-tv-subscription-license-fee-market-by-regionjpg/>).

one hand, the scope for raising revenues from consumer payment is constrained by other media firms offering close substitutes. On the other hand, the scope for raising revenues from ads is constrained by the number of media firms.

To understand our results, consider two or more TV channels which are so differentiated that they have (close to) monopoly power in their own viewer segments. This market power can be utilized to set high consumer prices. However, if the differentiation between the TV channels is reduced, each will have incentives to lower its consumer price in order to attract viewers from its rivals (demand becomes more elastic). Better substitutability between the channels thereby puts a downward pressure on viewer charges. Actually, the channels will not be able to set consumer prices higher than marginal costs if the viewers perceive the channels as perfect substitutes (and the firms have equal marginal costs). We therefore arrive at the standard textbook result that revenue from consumer payments is monotonically decreasing in the substitutability between the products.

The same is not true with regard to revenue from the advertising market. The reason is that when consumers dislike advertising, competition in advertising prices is distinctively different from competition in consumer prices. As we should expect from more traditional markets, a firm that lowers its advertising price will sell more advertising space. However, since advertising on the margin is a nuisance for the audience, this will make the other media firms' products *more attractive* for the consumers. All else equal, media firms will consequently be reluctant to compete by setting low advertising prices. More technically, we show that it is a fundamental characteristic of the media market that advertising prices are strategic substitutes while consumer prices are strategic complements. From the literature it is well known that competition is tougher on strategic complements than on strategic substitutes. Contrary to what is the case with consumer payments, a smaller channel differentiation will therefore not reduce advertising revenue. Indeed, we show that the opposite is true; the less differentiated the media products are from the audience' point of view, the higher is the revenue from advertising.

Next, suppose that the number of TV channels increases. The viewers will then be spread over a larger number of channels. This, in turn, reduces any individual TV

channel's market power in the advertising market. As the number of TV channels increases, the price each can charge for ads approaches marginal costs. But if the consumers consider the new channels as different from those which are already in the market, each channel will still have some market power in the viewer market, and will therefore always be able to make a positive profit from direct consumer payments. Our model thereby predicts that consumer payments are relatively more important as a source of revenue the greater the number of TV channels.

Our predictions are consistent with casual observations from several media markets. The total number of printed newspapers has gone down the last couple of decades, while at the same time we have witnessed an increase in the number of purely advertising-financed newspapers. This indicates that a reduction in the number of printed newspapers has led to a larger fraction of their revenues being generated by advertising.³ In the TV market we observe the opposite. The number of commercial TV channels has increased, and direct payments from the viewers have become more and more important relative to advertising revenues. Casual observations also indicate that the newspapers and TV channels which are most differentiated from their rivals, are the ones that are best able to charge the consumers. This is most obvious on the internet; a high reliance on ad revenue seems to be the only viable business model for electronic newspapers which cannot offer unique content.

Finally, our model predicts that media products that are mainly advertising-financed have relatively large audiences. Again, competition is the driving force. To see why, note that media products which the consumers perceive to be good substitutes will have low market power. Such media products must therefore be sold on relatively favorable terms to the consumers. Thus, the size of the audience increases. This is not because the media firms seek a broad audience as such, but because the competitive pressure forces them to behave so that they attract a larger audience. This prediction is consistent with the observation that pay-TV channels and newspapers with few close substitutes typically have high prices and

³As pointed out by one of the referees, the drop in the number of printed newspapers might be due to a negative demand shock on the reader side of the market.

small audiences.

Several studies of the media industry focus on program scheduling and, in particular, on the well-known 'lead-in' effect (see, for example, Rust and Eechambadi, 1989, and Shachar and Emerson, 2000).⁴ Other studies are concerned with the choice of programming, *i.e.*, what programs to produce (see, for example, Liu *et al.*, 2004).⁵ However, none of these studies models the choice of advertising by media firms. More recently, there have been some studies that analyze advertising decisions by media firms.⁶ The choice of financing - advertising versus direct payment - has not been an issue in any of these articles.

The only paper we are aware of, besides our own, that considers media firms financed partly by advertising and partly by consumer payments, is Godes *et al.* (2009).⁷ One of the novelties of their work is to analyze competition between firms in different media industries, for instance between a newspaper and a TV channel, an issue not raised here. They also analyze duopolistic competition between media firms in the same industry, highlighting the impact of competition on media firms' incentives to underprice (e.g. to sell newspapers at prices below marginal costs in order to attract readers and earn higher advertising revenue). In contrast, we provide a systematic discussion of how competition affects media firms' sources of revenue by distinguishing between product differentiation in the content market and the number of firms as sources of increased competition. The model of Godes *et al* is not equally suitable for this exercise, since they use a framework where the equilibrium advertising level is independent of the competitive pressure on the

⁴'Lead-in' refers to TV stations that air popular programs early in the evening to attract viewers who then continue to watch their channels for the rest of the evening. This topic is also studied in Goettler and Shachar (2001) and Rust and Alpert (1984). See also Nilssen and Sørsgard (1998), where the program scheduling of news for two competing TV channels is analyzed.

⁵For a debate concerning their results, see Chou and Wu (2006) and Liu *et al.* (2006). Programming has been an issue in the media-economics literature for a long time, see for example Steiner (1952), Beebe (1977) and Spence and Owen (1977).

⁶See Dukes and Gal-Or (2003), Barros *et al.* (2004), Gabszewicz *et al.* (2004b), Anderson and Coate (2005), Gal-Or and Dukes (2006) and Kind *et al.* (2007).

⁷Peitz and Valletti (2008) analyze competition between pay-TV and pure free-to-air TV in a setting where they assume that the latter cannot charge the viewers.

consumer side, and they limit their analysis to monopoly and duopoly. Besides, they do not have a unique measure of the differentiation between media products.

We would like to emphasize that our analysis should not be confused with the standard theory of two goods being complements in consumption. Complements are used to describe a situation where an increase in the price of one good causes a consumer to reduce consumption of both goods, as measured by the change in his or her compensated demand (see e.g. Kreps 1990, p. 61). A two-sided market, in contrast, consists of two distinct groups of customers, and the groups may respond differently to changes in output on the other side of the market (see Rochet and Tirole (2003, 2006) for a general discussion). The price of a newspaper, for instance, is irrelevant for advertisers per se, as are advertising prices for the readers. However, to the extent that a higher newspaper price translates into reduced sales of newspapers, demand for ads will typically fall. A lower advertising volume (e.g. due to higher advertising prices), on the other hand, increases demand for newspapers if the readers perceive ads as a bad.

The rest of the paper is organized as follows. In Section 2 we present our model, and we report our equilibrium outcomes in Section 3. In Section 4 we analyze how competition affects the media firms' source of financing. We first show that while price competition is a harsh form of competition in the consumer market, it is relatively weak in the advertising market. Secondly, we discuss the role of product differentiation and the number of firms in explaining the financing of media firms. In Section 5 we provide some empirical examples that illustrate how the competitive forces at work in our model play out in specific cases. Finally, in Section 6, we conclude and discuss the managerial implications of our results.

2 The model

We consider a media industry where the media firms choose to earn revenue solely from the advertising market (traditional free-to-air TV and free newspapers), solely from consumer payments (e.g. pure pay-TV), or from a combination of these two sources. There are $m \geq 2$ competing media firms, and each media firm is offering

one media product. The advertising level in media product $i = 1, \dots, m$ is denoted A_i , and consumer demand is denoted C_i . The advertisers and consumers are charged unit prices equal to r_i and p_i , respectively. We disregard any production costs, such that the profit level of media firm i is

$$\Pi_i = p_i C_i + r_i A_i, \quad i = 1, \dots, m. \quad (1)$$

We follow Kind et al. (2007) in assuming that consumer preferences are given by the following quadratic utility function:

$$U = \sum_{i=1}^m C_i - \frac{1}{2} \left[m(1-s) \sum_{i=1}^m (C_i)^2 + s \left(\sum_{i=1}^m C_i \right)^2 \right]. \quad (2)$$

The parameter $s \in [0, 1)$ is a measure of product differentiation: The higher s , the closer substitutes the media products are from the consumers' point of view (and the higher is the elasticity of substitution between any pair of goods). We normalize the population size to one, and may thus interpret C_i as, for example, both the time that each viewer spends watching channel i and as the number of viewers of channel i .

The specification in (2) is due to Shubik and Levitan (1980) and is a modification of the standard quadratic utility function (SQU). The reason why we use the modified version, is that the SQU poses two problems which make it less suitable for our purpose. First, under SQU a change in the parameter s would affect both the substitutability between the goods and the size of the market. Secondly, the elasticity of substitution would depend on both s and m , making comparative statics with respect to those two parameters problematic. These problems are not present in the Shubik-Levitan utility function; with such consumer preferences the size of the market is independent of s , and the elasticity of substitution between any pair of goods is independent of m (for any given prices).⁸ This is important in the present paper, since our main contribution is to show why a higher substitutability between

⁸The Shubik-Levitan utility function has consequently been applied in studies where the number of products varies. See Davidson and Deneckere (1985) and Shaffer (1991) for two specific applications, and Motta (2004) for a general discussion of the virtues of the Shubik-Levitan utility function over SQU.

media products could make media firms more dependent on advertising revenue, while an increase in the number of media products has the opposite effect. We thus need a utility function where it is possible to isolate the effects of changing s and m , respectively, but except for this we believe that our qualitative results are robust to the exact specification of the consumer preferences.⁹

Consumer surplus depends on the price p_i that the consumers are charged for the media product (e.g. per copy of a newspaper). In addition it depends on the level of advertising, unless the consumers are indifferent to ads. To capture this dependency, we let the subjective consumer cost for each unit consumed of media product i be $(p_i + \gamma_i A_i)$, where γ_i measures the consumers' disutility of the ads. Consumer surplus is thus given by

$$CS = U - \sum_{i=1}^m (p_i + \gamma_i A_i) C_i.$$

This formulation implies that a consumer's disutility from ads in a given media product is higher the more he consumes of that media product. This captures the notion that increased consumption of a media product also exposes the consumer to more of the advertising that the media product carries.

In principle, the parameter γ_i might itself be a function of the advertising level in media product i . We could for instance assume that consumers have positive utility of ads ($\gamma_i < 0$) for relatively small advertising levels (e.g. because ads inform newspaper readers about retail prices at local stores), but that they perceive ads to be a nuisance if the advertising level becomes sufficiently large. In the former case $\gamma_i A_i$ may be perceived as a negative indirect price for media product i , and in the latter case as a positive indirect price. For the majority of media products it is reasonable to assume that consumers perceive ads as a bad on the margin.¹⁰ In order to highlight the fact that the media firms' choice of direct prices (p_i) and indirect

⁹In an appendix available upon request we show a possible way of reinterpreting the parameters under SQU such that the elasticity of substitution between the goods is independent of m , and where our main results hold for $m \geq 3$.

¹⁰It is well documented that viewers try to avoid advertising breaks on TV, see Moriarty and Everett (1994), Danaher (1995) and Wilbur (2008). For printed newspapers, there are less clear answers as to whether consumers consider advertising as a good or a bad, see e.g. Gabszewicz *et*

prices ($\gamma_i A_i$) depends crucially on the competitive pressure, we let γ_i be positive and constant, and with the same value for each media product in the industry we consider; $\gamma_i \equiv \gamma \forall i$. By setting $\partial CS / \partial C_i = 0$, we then find that consumer demand for media product i equals

$$C_i = \frac{1}{m} \left[1 - \gamma \frac{A_i - s\bar{A}}{1 - s} - \frac{p_i - s\bar{p}}{1 - s} \right], \quad i = 1, \dots, m, \quad (3)$$

where $\bar{A} = \frac{1}{m} \sum_{j=1}^m A_j$ is the average level of advertising in the m media products, and $\bar{p} = \frac{1}{m} \sum_{j=1}^m p_j$ is the average (direct) consumer price. Demand for media product i is thus decreasing in its own price and advertising level, and increasing in those of its rivals if $s > 0$. This reflects the fact that the consumers then perceive the media products as (imperfect) substitutes.

Note that $\partial C_i / \partial (\gamma A_i) = \partial C_i / \partial p_i < 0$; other things equal, sales of media product i fall by the same amount whether the indirect price (γA_i) or the direct price (p_i) increases by one unit. We nevertheless show that increased competition between media firms affects their choices of direct and indirect prices qualitatively differently. Without loss of generality, we choose the unit size of advertising A_i such that we can put $\gamma = 1$.

The media firms can raise advertising revenue by selling advertising space to producers of consumer goods. There are n potential advertisers, and we let $A_{ki} \geq 0$ denote producer k 's advertising level in media product i . A producer's gross gain from advertising is naturally increasing in its advertising level and in the number of media consumers exposed to its advertising. In particular, the benefit to an advertiser from a marginal increase in its advertising level in a given media product should be larger the more consumers that media firm has. Similarly, the benefit to the advertiser from increased consumption of a media product should be greater the more advertising he has in that media product. We catch this interaction between the levels of advertising and media consumption in the simplest possible way by assuming that advertiser k 's gross gain from advertising in media product i equals $\eta A_{ki} C_i$, where $\eta > 0$ measures the strength of the advertiser's benefit from advertis-

al. (2004a) and Depken and Wilson (2004). Note that this is not inconsistent with our assumption that *on the margin*, consumers dislike advertising.

ing. This implies that the net gain for advertiser k from advertising in the m media product equals

$$\pi_k = \left(\eta \sum_{i=1}^m A_{ki} C_i \right) - \left(\sum_{i=1}^m A_{ki} r_i \right), \quad k = 1, \dots, n. \quad (4)$$

Below, we consider a three-stage game. At stage 1, the media firms non-cooperatively set advertising prices (r_i) and consumer prices (p_i). At stage 2 the advertisers choose how much advertising space to buy. At stage 3 the consumers decide how much to buy of each media product.

We solve the game by backward induction, and the solution to the final stage is given by equation (3). Proceeding to the second stage, the first-order condition for the advertising level of advertiser $k = 1, \dots, n$ in media product i can be written as

$$\frac{\partial \pi_k}{\partial A_{ki}} = 0 \Rightarrow \eta C_i + \eta \left(A_{ki} \frac{\partial C_i}{\partial A_{ki}} + \sum_{j \neq i} A_{kj} \frac{\partial C_j}{\partial A_{ki}} \right) = r_i. \quad (5)$$

Solving $\partial \pi_k / \partial A_{ki} = 0$ simultaneously for $k = 1, \dots, n$ and $i = 1, \dots, m$ we find a unique equilibrium where $A_{ki} = A_i/n$ and $A_{kj} = A_j/n$. This allows us to rewrite the equilibrium characterization in (5) as

$$\eta C_i + \frac{\eta}{n} \left(A_i \frac{\partial C_i}{\partial A_{ki}} + \sum_{j \neq i} A_j \frac{\partial C_j}{\partial A_{ki}} \right) = r_i. \quad (6)$$

To see the intuition for (6), suppose first that $n \rightarrow \infty$, so that $r_i \rightarrow \eta C_i$. In the limit, as n approaches infinity, an advertiser's willingness to pay for an extra ad in media product i is thus proportional to the consumption level of that media product. However, in general each advertiser must take into account the fact that by increasing the advertising level in media product i , that media product will become less attractive for the consumers (since the consumers dislike ads) and the other media products will become more attractive. These effects are captured by the terms $\frac{\partial C_i}{\partial A_{ki}} < 0$ and $\frac{\partial C_j}{\partial A_{ki}} > 0$ in the brackets of (5) and (6), but they are weaker the smaller each advertiser's share of total advertising in the media products is (and vanish in the limit as $n \rightarrow \infty$).

Using (3) and (6) we find that demand for advertising in media product i equals

$$A_i = \frac{n}{n+1} \frac{m}{\eta} \left[(1-p_i) \frac{\eta}{m} - (1-s)r_i - s\bar{r} \right], \quad i = 1, \dots, m, \quad (7)$$

where $\bar{r} = \frac{1}{m} \sum_{j=1}^m r_j$ is the average advertising price at the m outlets.

Equation (7) shows that advertising demand at each outlet is decreasing in its own price: $\frac{\partial A_i}{\partial r_i} < 0$. Interestingly, it is also decreasing in the other firms' advertising prices: $\frac{\partial A_i}{\partial r_j} < 0$, $j \neq i$. To see the intuition for this, suppose that the advertising price in one of the media products increases. That media product will then contain less advertising. Thereby it attracts media consumers from the other firms, which consequently will observe smaller demand for advertising.

Media consumers and advertisers constitute two different groups of customers (this is one reason why the analysis of two-sided markets differs from that of complementary goods, as noted in the Introduction). Other things equal, the advertising price r_i is thus irrelevant for the media consumers, as is the consumer price p_i for the advertisers. Equation (7) nonetheless shows that advertising demand at media firm i is decreasing in its consumer price; $\frac{\partial A_i}{\partial p_i} < 0$. However, this is an indirect effect, which follows from consumers having downward-sloping demand for each media product: A higher p_i reduces consumption of media product i , making it less interesting to advertise in this product.

2.1 The nature of competition

An important insight from the model is that competition in advertising prices is qualitatively different from competition in consumer prices. This difference is nicely spelled out by use of the notions of strategic substitutes and strategic complements, due to Bulow, *et al.* (1985). In essence, firms' strategic variables are *strategic substitutes* if an increase in one firm's variable entails a decrease in the other firms' variables, while they are *strategic complements* if an increase in one firm's variable entails an increase also in the other firms' variables; see, *e.g.*, Vives (1999) for further discussion. We have:

Lemma 1: *Advertising prices are strategic substitutes, whereas consumer prices are strategic complements.*

Proof. By inserting for (3) and (7) into (1), we have

$$\frac{d^2\Pi_i}{dr_i dr_j} = -\frac{n}{n+1} \frac{s}{\eta} < 0, \quad \forall j \neq i.$$

and

$$\frac{d^2\Pi_i}{dp_i dp_j} = \frac{1}{n+1} \frac{1}{m^2} \frac{s}{1-s} > 0, \quad \forall j \neq i.$$

■

Lemma 1 shows that there is a fundamental 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 firms with incentives to increase their prices too. This is in accordance with the normal textbook depiction of price competition. As argued above, things are quite different in the advertising market. If media firm i sets a higher advertising price, it will naturally sell less advertising. However, since advertising is a nuisance to consumers, consumer demand for media product i will increase while consumer demand for rival media products will fall. The rivals will consequently experience a smaller demand for advertising, and thus have incentives to *lower* their advertising prices. This effect seems to be relatively robust, as it appears in a number of different frameworks. See e.g. Nilssen and Sørsgard (2001) and Gabszewicz et al. (2004b).

It could be argued that it is more reasonable to assume that media firms set advertising quantities rather than advertising prices. First, media firms can presumably relatively easily decide how much space to allocate to commercials. Godes *et al.* (2009), who analyze competition in advertising quantities, provide some examples where media firms signal that their advertising volume will be relatively low. Second, media firms may *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?

In practice, however, there are no strict physical limits to how much space media firms can use for advertising. Separate leaflets can for example easily be included in newspapers and thereby increase the space for ads quite substantially. Another example is that TV channels can replace tune-ins with ads to expand the

volume of commercials (or vice versa). Thus, the firms need to communicate possibly self-imposed quantity limits to the market. But what we typically observe is announcement of advertising prices only; it is not common for printed newspapers to commit to a maximum number of pages with advertising, or for TV channels to commit to a maximum amount of time for commercials per day. Nor do we observe that advertisers pay a lower price the more advertising there is in a media product, 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.

What if the media firms were able to compete in advertising quantities instead of advertising prices, *i.e.* if, in contrast to our argumentation, they could make credible ad quantity commitments? Then they would compete in strategic complements also on the advertising side of the market. But since this is harsher than competition in strategic substitutes, they have - not surprisingly - no incentives to make such commitments (see the Appendix for a proof with $m = 2$). On the contrary, it is a dominant strategy for each firm to compete in advertising prices. This indicates that not only would it be difficult to commit to setting quantities; it would also be unprofitable. In line with this, we find it reasonable to assume that the media firms set prices on advertising.

3 Equilibrium

The outcome of the two last stages of the game is given by equations (3) and (7), and we are now ready to find the solution to the first stage. In order to simplify the algebra we make the following assumption:

Assumption 1: *Let $\eta = 1$.*

The consequences of relaxing this assumption are discussed below.

At stage 1, each media firm sets its two prices; one for advertisers and one for consumers. Solving $\partial \Pi_i / \partial p_i = \partial \Pi_i / \partial r_i = 0$ simultaneously for the m media firms, subject to consumer demand in (3) and advertising demand in (7), gives rise to a

unique, symmetric equilibrium. By setting $r_i = r$ and $p_i = p \forall i$, we find:

$$r = \frac{1}{m(2-s) + s}; \quad (8)$$

$$p = \frac{m(1-s)}{m(2-s) - s}. \quad (9)$$

Let A and C denote advertising and consumption levels at each media firm in the symmetric equilibrium. Inserting from (8) and (9) into (3) and (7) yields:

$$A = \frac{n}{n+1} s^2 \frac{m-1}{[m(2-s) - s][m(2-s) + s]}; \quad (10)$$

$$C = \frac{(m-s)[m(2-s) + s] - \frac{n}{n+1} s^2 (m-1)}{m[m(2-s) - s][m(2-s) + s]}. \quad (11)$$

Equilibrium profit for each media firm can now be shown to equal

$$\Pi = \frac{s^3 (m-1)^2 (2-s) \frac{n}{n+1} + (1-s)(m-s)[m(2-s) + s]^2}{[m(2-s) + s]^2 [m(2-s) - s]^2}. \quad (12)$$

From (10) - (12) we can now easily verify the following result:

Lemma 2: *A larger number of advertisers (higher n) leads to*

- (i) *more advertising ($dA/dn > 0$),*
- (ii) *reduction in output of each media product ($dC/dn < 0$), and*
- (iii) *higher profits for each media firm ($d\Pi/dn > 0$).*

A larger number of advertisers implies that the demand for ads increases. This leads to a higher advertising volume in equilibrium, such that consumption of each media product falls. Despite this, the media firms earn higher profits. The reason is that the increase in revenues from ads is greater than the reduction in revenues from consumer payment.

4 Competition and sources of revenue

The parameters s and m can be interpreted as measures of competition among the TV stations. If s increases, competition becomes tougher because the media products are less differentiated, while an increase in m implies that competition

becomes tougher due to a larger number of media firms. It is therefore not surprising that each media firm's profit is decreasing in both of these parameters ($d\Pi/ds < 0$ and $d\Pi/dm < 0$; see Appendix for a proof). However, the relative importance of advertising revenue compared to consumer payments depends crucially on whether competition increases due to an increase in s or in m . To see this it is useful first to define S as the share of consumer payments in each media firm's total revenue:

$$S = \frac{pC}{pC + rA}. \quad (13)$$

The algebra becomes quite complex if we have an arbitrary number of advertisers. In the main text we shall therefore focus on the limit case where n approaches infinity:

Assumption 2: *Let $n \rightarrow \infty$.*

Assumption 2 *de facto* implies that the advertisers are price takers in the advertising market (they take r_i as given). It further implies that each advertiser's advertising volume is so small that he rationally disregards the possibility that his advertising volume has any effect on the attractiveness of each media product. We believe that the latter is a reasonable approximation for most advertisers in most media markets. In the Appendix we nonetheless show that Assumption 2 does not significantly affect our main results.

Inserting for (8) - (11) into (13) and taking the limit value as $n \rightarrow \infty$, the share of consumer payments in each media firm's total revenue can be written as

$$S = \frac{(1-s)m[m(2-s)+s]}{[m(1-s)+s][m(2-s)-s]}. \quad (14)$$

4.1 The role of product differentiation

Lemma 1 showed that consumer payments are strategic complements, and advertising prices are strategic substitutes. This has important implications for how competition between media firms works. Competition in strategic complements is more aggressive than competition in strategic substitutes, and more so the less differentiated the services are (see, for example Bulow *et al.* (1985) and Vives (1999)).

Intuitively, we should therefore expect the media firms to rely more on advertising revenue and less on consumer payments the closer substitutes the consumers perceive the media products to be (the higher is s).

To understand the mechanisms at work, let us first point out a direct link between the content market and the advertising market:

$$\frac{dA}{ds} = \frac{4s(m-1)m^2(2-s)}{[m(s-2)-s]^2[m(s-2)+s]^2} > 0. \quad (15)$$

We have the following result:

Lemma 3: *The less differentiated the media products (the higher s), the larger the volume of advertising.*

We thus see that the advertising volume increases if the media products become closer substitutes. This is a consequence of the existence of a two-sided market and the nature of competition in those two markets. Tougher competition in the content market implies that the media firms must rely more on the advertising market for raising revenue.

Godes et al. (2009) also analyze the financing of media firms, but they use a framework which is very different from ours. In particular, they assume that the advertisers have a per se preference for spreading the ads over the different media outlets. Their modeling approach has the advantage that it allows them to analyze competition in the advertising market even between media products which the consumers consider as completely unrelated, but has the disadvantage that the competitive pressure in the content market has no effect on the advertising volume. More specifically, this means that Godes et al. (in our notation) have $dA/ds = 0$.¹¹

Now we are ready to look more closely at the sources of revenues:

$$\frac{d(pC)}{ds} = -\frac{ms(m^2-1)(2-s)}{[m(2-s)-s]^2[m(2-s)+s]^2} < 0. \quad (16)$$

¹¹Their modelling approach further implies that total advertising revenue is proportional to the size of the audience. Holding the size of the audience fixed, Godes et al thus arrive at the result that a greater substitutability between the media products (from the consumer' point of view) leaves advertising revenue unchanged, but reduces consumer revenue.

$$\frac{d(rA)}{ds} = \frac{s(m-1)[m^2(8-2s-s^2)+s^2-2ms]}{[m(2-s)-s]^2[m(2-s)+s]^3} > 0. \quad (17)$$

We can state our first main results:

Proposition 1:

The less differentiated the media products (the higher s),

(i) the higher are the revenues from ads ($d(rA)/ds > 0$), and

(ii) the lower are the revenues from consumer payment ($d(pC)/ds < 0$).

Figure 1 illustrates Proposition 1 for $m = 2$. With our assumption that $\eta = 1$, the gains from selling advertising space are so low compared to the consumers' distaste for ads that a monopoly media firm would prefer to be advertising-free. At $s = 0$ the media firms thus raise all their revenue from consumer payments ($A = 0$ from equation (10)). However, the closer substitutes the media products are, the more fiercely they compete to capture an audience. Since this will make it difficult to raise revenues from consumer payment, the media firms will have to rely more on the advertising market to raise revenue. If $s \approx 1$ the media products are perceived as (almost) perfect substitutes. At this extreme, they are unable to charge a price that is higher than marginal costs on the consumer side of the market ($p = 0$ from equation (9)). This follows directly from the result that consumer prices are strategic complements (and the assumption that all media firms have the same marginal costs, which we have set equal to zero).

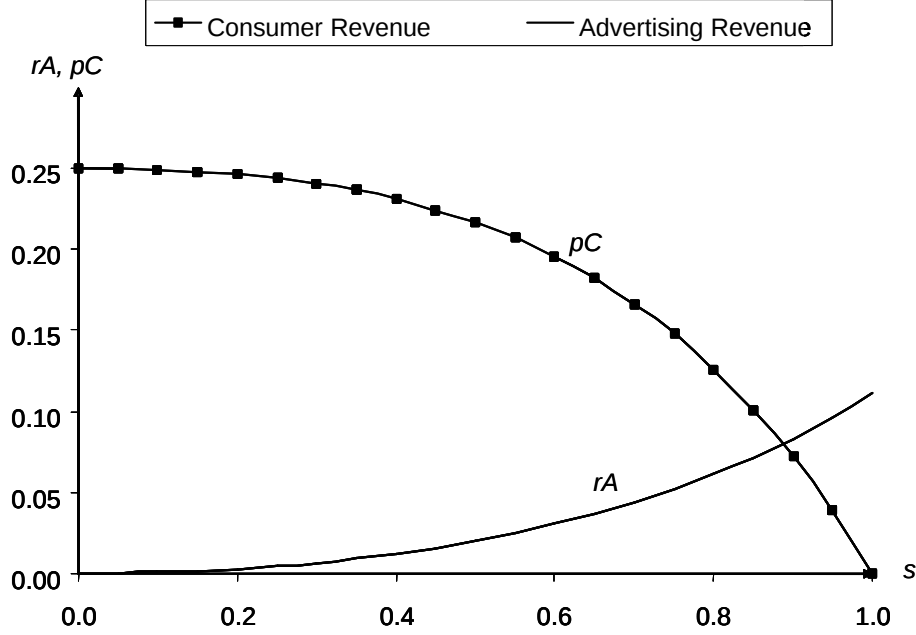


Figure 1: *Revenue from consumers and advertisers ($m = 2$).*

In contrast to our result, Godes et al (2009) find that it is ambiguous how differentiation on contents affects ad revenues and revenues from consumer payment. This is due to their application of a standard quadratic utility function, where one and the same parameter captures both product differentiation and market size. In their framework it is thus not possible to isolate the effects of a change in product differentiation on the media firms' revenue. Technically, an increase in their parameter γ implies both that the products become less differentiated and that the size of the market falls.¹²

Note that equation (14) yields

$$\frac{dS}{ds} = -\frac{ms(m-1)[m(4-3s)+s]}{[m(1-s)+s]^2[m(2-s)-s]^2} < 0. \quad (18)$$

We can state:

Corollary 1: *The share of consumer payment in the media firms' total revenue is smaller the less differentiated the media products are ($dS/ds < 0$).*

¹²See the explanation Godes et al. (2009) provide for their Result 4. This explanation is also relevant for understanding their Result 3 and in particular their Result 3 (ii).

Corollary 1 is directly related to Proposition 1, which shows that advertising revenue is higher and consumer payments lower the less differentiated the media products are (as in Godes et al, 2009). In the Appendix we prove that Corollary 1 is valid for an arbitrary number of n .

From equation (11) we find

$$dC/ds = \frac{m-1}{[m(2-s)+s]^2} > 0.$$

This implies:

Corollary 2: *Other things equal, consumption of each media product is larger the closer substitutes they are: $dC/ds > 0$.*

To understand the intuition for Corollary 2, note that consumption of each media product is affected in two opposing ways as s increases: Consumer prices go down, and this has a positive impact on the size of the audiences. At the same time, the amount of advertising goes up. In isolation, this tends to reduce the sales of the media products. However, the former effect dominates. The reason for this is simply that an increase in s means that competition increases, such that the media firms' ability to utilize their market power over the consumer is reduced. Thereby the size of the audiences is unambiguously higher the closer substitutes the media firms deliver, as stated in Corollary 2. Other things equal, this result is similar to what we typically find in one-sided markets.

In combination, Corollary 1 and Corollary 2 predict that media firms that are mainly advertising financed have relatively large audiences. However, this is not because they seek a broader audience as such. On the contrary, a media firm with large market power would in our model choose high user payments and accept a relatively small audience. This fits well with the observation that pay-TV channels and newspapers with few close substitutes typically have high prices and small audiences. By the same token, one observes that electronic newspapers with unique contents are able to charge their visitors directly, but that this reduces the number of readers.

A few words on how Assumptions 1 and 2 affect our results may be warranted. First, the smaller is η , the less profitable is clearly the advertising market for the media firms. Secondly, it should be noted that n (the number of advertisers) can be interpreted as a proxy for the media firms' market power over the advertisers - the smaller is n , the less able the media firms are to extract the profit that advertising generates. Both a lower value of η and a smaller n thus reduce advertising revenue for the media firms. It nonetheless remains true that as s approaches one, the media firms can make a profit only from the ad market. Letting $\eta < 1$ and $n < \infty$ would thus neither change the result that the media firms prefer to be advertising free as monopolies nor that they must rely solely on ad revenue if they are perceived as perfect substitutes.

With $\eta > 1$, we must distinguish between two cases. If η is above a critical value η^{crit} , we reach a corner solution where the media firms raise all their revenues from advertising, no matter how poor substitutes the media products are. This corresponds to the underpricing result in Godes *et al.* (2009).¹³ If $1 < \eta < \eta^{crit}$, on the other hand, the media firms will make profits from both the advertising and the consumer side of the market for any $s \in [0, 1)$. Proposition 1 still holds, though - advertising revenue is more important and consumer payments less important for the media firms the higher s is. In this respect, Assumptions 1 and 2 are innocent for our qualitative results.

In our model the advertising prices are determined by the media firms. Alternatively, the prices of advertising could be set in negotiations between advertisers and media firms.¹⁴ This is most relevant in the case with a limited number of advertisers. In the Appendix we consider a Nash bargaining game between one advertiser and two media firms.¹⁵ Not surprisingly, we find that the more bargaining power given to the advertiser, the lower the price of advertising. We further verify that independent of the distribution of the bargaining power, the media firms will rely

¹³This was discussed in detail in an earlier version of the paper, see Kind *et al.* (2005). In the Appendix we show that, if $m = n = 1$, then we have underpricing if $3 < \frac{\eta}{\gamma} < 3 + 2\sqrt{2}$.

¹⁴We would like to thank one of the referees for suggesting this possibility.

¹⁵See Dukes and Gal-Or (2003) and Gal-Or and Dukes (2003) for an alternative setup of bargaining between advertisers and media firms.

solely on consumer payments at $s = 0$ and solely on advertising revenue at $s = 1$.

Based on intuition from one-sided markets, one might expect that each media firm will have less advertising revenue the smaller its bargaining power. However, this is not necessarily the case. On the contrary, the media firms' advertising revenue, both absolutely and relative to consumer payments, might be increasing in the advertiser's bargaining power (see Appendix). The reason for this is that each media firm will partly internalize the fact that a higher advertising volume reduces the consumers' willingness to pay for the media product; in general the media firms will therefore prefer to have fewer ads than the volume which maximizes advertising revenue. The media firms' ability to internalize this effect is higher the greater is their market power (i.e., the smaller is s and the higher is their bargaining power over the advertiser). The advertiser will not take this effect into account. If he has the power to do so, he therefore sets advertising prices which are so low that the advertising volume becomes unduly high from the media firms' point of view. This might generate higher advertising revenue for the media firms, but the gain is more than outweighed by reduced consumer payments (it is straight forward to show that the media firms' profit is decreasing in the advertiser's bargaining power). Put differently, more bargaining power to the advertiser leads to a lower price of ads, which in turn causes the advertising levels and possibly the media firms' advertising revenue to increase. However, more ads lead to a reduction in the consumption of the media product, and thereby to less revenues from consumer payment.

4.2 The role of the number of media products

In this section we analyze how the financing of media firms depends on the number of competitors. First, let us consider a shift from monopoly ($m = 1$) to duopoly ($m = 2$). From equation (14) we find

$$S(m = 2) - S(m = 1) = -\frac{s^2}{(4 - 3s)(2 - s)} < 0 \text{ for } s > 0. \quad (19)$$

We can state:

Corollary 3: *If the market structure changes from monopoly to duopoly, then the relative importance of advertising revenue increases.*

Note that $S(m = 2) - S(m = 1) = 0$ if $s = 0$. Whether we have one or two media firms thus does not matter *per se* for the choice of business model. What matters is instead whether there is competition between the media firms. If there are two media firms in the market, then advertising revenue will be a more important source of income if these firms compete ($s > 0$) than if each of them has monopoly power in its own market segment ($s = 0$).¹⁶ This is nothing but a special case of Corollary 1. Not surprisingly, we therefore cannot generalize from this how the relative importance of advertising revenue depends on the number of competing media firms.

Let us thus consider the effects of changing the number of media firms, holding the differentiation between the media products fixed. It is easily verified that both advertising prices and consumer prices are decreasing in m . The effects of an increase in m on each of those two sources of revenues are as follows:

$$\frac{d(pC)}{dm} = -\frac{(1-s)[m^2(4(1-s) + s^2) + s^2]}{[m(2-s) - s]^2[m(2-s) + s]^2} < 0 \quad (20)$$

$$\frac{d(rA)}{dm} = -2s^2 \frac{m(2-s)[(2-s)m - (3-s)] + s}{[m(2-s) - s]^2[m(2-s) + s]^3} < 0 \text{ (for } m \geq 2) \quad (21)$$

We have the following result:

Proposition 2: *Assume that $m \geq 2$ and $s \in (0, 1)$. An increase in the number of media firms will then lead to lower revenues from both advertising and consumer payment; $d(pC)/dm < 0$ and $d(rA)/dm < 0$.*

Note the asymmetry between Proposition 1 and Proposition 2. If the competitive pressure increases due to greater substitutability between the goods, one source of revenue will increase (advertising) and the other will decrease (consumer payments).

¹⁶In the latter case $S = 0$, given Assumption 1.

If the higher competitive pressure is caused by a larger number of rivals, on the other hand, then both sources of revenue will fall for each firm. Godes et al (2009) also analyse financing of media firms, but they do not address this question, since their analysis is limited to cases of monopoly and duopoly.

Proposition 2 does not say anything about the relative importance of the two revenue sources when the number of competitors increases. To focus on this issue, suppose that new TV channels enter the market. Then the advertisers can reach each viewer on a larger number of channels. Thereby each channel's market power in the advertising market falls, and the advertising price will approach marginal costs as the number of TV channels increases. In the limit we find from equation (8) that

$$\lim_{m \rightarrow \infty} r = 0. \quad (22)$$

In contrast, the consumers perceive the media products as imperfect substitutes as long as $s < 1$. The media firms will therefore have some market power over the consumers, no matter how many media products there are on the market. This is formally verified from equation (9):

$$\lim_{m \rightarrow \infty} p = \frac{1-s}{2-s} > 0 \text{ for } s < 1. \quad (23)$$

Equations (22) and (23) suggest that as the number of media firms grows, they will to an increasingly large extent have to rely on direct charges from the consumers. We can state the following result:

Proposition 3: *Assume that $m \geq 2$ and $s \in (0, 1)$. Then the share of consumer payment in each media firm's total revenue is higher the larger the number of rivals; $dS/dm > 0$.*

Proof. From equation (14) we find

$$\frac{dS}{dm} = \frac{s^2 (1-s) [m(m-2)(2-s) - s]}{[m(1-s) + s]^2 [m(2-s) - s]^2} > 0,$$

where the inequality can be shown to hold for all $s \in (0, 1)$ and $m \geq 3$. Inserting for $m = 2$ and $m = 3$ into (14) we further have

$$S(m=3) - S(m=2) = \frac{s^2 (1-s)^2}{(3-2s)^2 (2-s) (4-3s)} > 0 \text{ for } s \in (0, 1).$$

■

In combination, Corollary 3 and Proposition 3 state that consumer payments' share of media firms' revenues is non-monotonically related to the number of firms: As we move from monopoly to duopoly, consumer payments' share decreases. However, as the number of firms is increased beyond duopoly, consumer payments' share increases. This shows that one should be careful with drawing conclusions about the effects of increased competition merely from a comparison of monopoly and duopoly.

Figure 2, which measures s on the horizontal axis and S on the vertical axis, illustrates how the share of consumer payments in each media firm's revenue (S) depends on the number (m) and the substitutability (s) between the media products. The upper and lower curves in the Figure are found by setting $m = 10$ and $m = 2$, respectively, into equation (14). From Corollary 1 we know that $dS/ds < 0$. Both curves are therefore downward-sloping. Consistent with Proposition 3 we further see that $S(m = 10) > S(m = 2)$ for all $s \in (0, 1)$. Increased competition in the form of higher substitutability versus a large number of competing media products thus has opposite consequences for the relative importance of the two sources of revenue for each media firm.

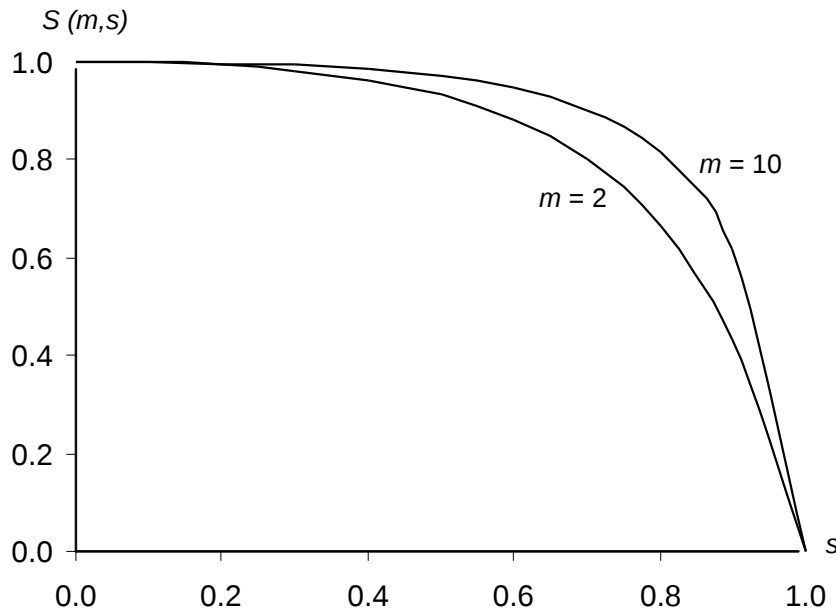


Figure 2: *Revenue sources*

In the Appendix we prove that except for Proposition 3, all the propositions

and corollaries hold also for any value of n . The qualification we must make on Proposition 3, is that $dS/dm > 0$ if $m \geq 3$ if $n < \infty$; the difference $S(m = 3) - S(m = 2)$ is then negative if s is below a critical value (this critical value is lower the smaller is n , and reaches a minimum at $s = 0.83$ for $n = 1$). However, this observation is of limited value, since it is hard to imagine a media industry where the number of media competitors is lower than three. For all practical purposes, the model therefore predicts that $dS/dm > 0$ independent of the number of advertisers.

Although our model is simple, we believe that our main result is quite robust. When the number of media firms approaches infinity, we predict that there is a very limited scope for the media firms to earn revenues from advertising. This is simply because the market power of each media firm in the advertising market then becomes insignificant. In the consumer market, on the other hand, each media firm will still have some market power as long as it produces a media product which is differentiated from those of the rivals.

5 Some empirical observations

According to our theoretical predictions, media firms face two qualitatively different competitive constraints. On the one hand, the scope for raising revenues from consumer payment is constrained by other media firms offering close substitutes. On the other hand, the scope for raising revenues from ads is constrained by the number of media firms. Let us provide some examples, which we claim indicate that the driving forces at work in our model are indeed present in media markets.

Media firms on the Internet have to consider the trade-off between consumer payments and ads, and we have seen various business models being used. As mentioned in the introduction, in December 2005 *CNN* launched *CNN Pipeline* as an online video news product financed purely by consumer payments and not by ads. The business model was then totally reversed in June 2007. Consumer payments were removed, and the service became financed purely by ads. Some commentators have indicated that the change in business model was due to the fact that other close

substitutes were launched.¹⁷ Such a change in business model is consistent with our theory, since closer substitutes for the consumers should lead to less reliance on subscription.

There seems to be a trend on the Internet towards less reliance on consumer payments, but there are exceptions. *CNN*'s experience can be contrasted with *TV2 Sumo*. The latter is a web page for the Norwegian broadcaster *TV2*, where consumers can pay for watching various video programs.¹⁸ The most important content on *TV2 Sumo* is live soccer matches from the Norwegian Premier League ("Tippeligaen"). *TV2* has the exclusive right to broadcast these matches, which implies that there are no close substitutes on the Internet. A business model based on consumer payments is thus viable according to our results.

On the Internet we also have more traditional news web pages, where typically printed newspapers launch an online version of the printed news. Also in this case we observe different business models. *New York Times* had a similar experience as *CNN Pipeline*. They launched a subscription service called *TimesSelect* in September 2005, and removed the subscription in September 2007. *Wall Street Journal*, on the other hand, continues to offer online subscription.¹⁹ If you subscribe, you not only receive updated online news, but you also have access to an online market data center. This suggests that *Wall Street Journal* might offer more unique content than what *TimesSelect* did, *i.e.*, that *Wall Street Journal*'s online service does not have as close substitutes seen from the consumer's perspective. A business model with subscription for online *Wall Street Journal*, but not for *TimesSelect*, is then consistent with our predictions.

It could be argued that technological progress is the main reason why TV chan-

¹⁷See the description of *CNN Pipeline* on Wikipedia: http://en.wikipedia.org/wiki/CNN_Pipeline. According to *CNN*, the subscription model was abandoned because there were too few subscribers; see <http://behindthescenes.blogs.cnn.com/2007/06/25/a-special-note-for-our-cnn-pipeline-subscribers/>.

¹⁸*TV2 Sumo* offers a menu of tariffs, where you can subscribe either weekly, monthly or annually or simply pay for watching one particular program. For details, see <http://webtv.tv2.no/webtv/>.

¹⁹The subscription fee is \$ 1.99 per week for online service or \$ 2.49 per week for online service + print journal, see <https://order.wsj.com/sub/f2>

nels now rely more on consumer payments than they used to do. We certainly agree with this claim; it is only with the advent of encrypted digital signals that it has become possible for TV channels to charge their viewers directly (and it is digital transmission technologies which have allowed the large increase in the number of TV channels). However, our model suggests that digitalization of TV signals and fundamental economic forces might be complementary factors in explaining the growth of pay-TV. As noted in the introduction, in the UK and the US we have witnessed both a shift towards raising revenues through subscription and large technological changes in this industry during the last few years. Similar developments have taken place in other countries, for example through the replacement of analogue terrestrial networks with digital terrestrial networks. This makes it possible for consumers to watch a much larger number of TV channels. Such structural changes in the industry will according to our predictions undermine each TV channel's prospects of raising revenues from advertising. No surprise, then, that we observe a shift towards more reliance on user payment than on revenues from advertising.

Clearly, there is reason to believe that the growth in internet newspapers has reduced the demand for printed newspapers. In this sense it is not surprising that the number of printed newspapers has declined, raising their dependence on advertising revenue in accordance with our model. Furthermore, the mechanisms we have highlighted suggest that their tendency to rely on advertising revenue should increase the better substitutes the readers consider printed and electronic newspapers to be. However, a further analysis of this issue requires a more elaborate model, which takes into consideration the specific characteristics of the two kinds of newspapers, and the competitive forces within and between these two market segments. There is also a need for empirical work to analyze how the internet has reduced the willingness to pay for ads in traditional newspapers relative to the readers' willingness to pay for printed media.

6 Concluding remarks

The main purpose of this paper is to show how competitive forces may affect the way media firms raise revenue. It turns out that competition has an ambiguous effect on the choice of business model. Tougher competition in the sense of closer substitutability between the media products makes advertising revenue relatively more important, while a larger number of media products (e.g. a larger number of TV channels) increases the relative importance of direct payment from the audience.

Our analysis demonstrates that competition in media markets differs from what we observe in most other industries. More specifically, the two-sided nature of media markets implies 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 firms to do the same. Advertising prices, on the other hand, are strategic substitutes; a price reduction by one firm leads to a price *increase* by the others. Competition in strategic complements is generally more aggressive than competition in strategic substitutes, and more so the less differentiated the products (see Bulow et al., 1985, and Vives, 1999). This explains why we arrive at the result that the closer substitutes the competing media firms' products are, the larger is the fraction of their revenue that comes from advertising.

We argue that it is difficult for media firms to commit to quantity of advertising. Moreover, since competition in strategic substitutes is weaker than competition in strategic complements, in our model it is a dominant strategy for the media firms to compete in advertising prices rather than advertising quantities. Thus, the firms do not have incentives to make nonreversible commitments with respect to advertising quantities. Future empirical and theoretical research should analyze how robust this conclusion is. The observation that internet newspapers (and tv channels) which are very close substitutes manage to raise significant advertising revenue supports our argument that they compete in strategic substitutes on the advertising side.

The predictions from our theory have clear cut managerial implications. Media

firms should watch carefully the competitive constraints they are facing when they make a strategic choice concerning financing. In particular, they should determine whether the main competitive constraint is (i) another media product that is viewed on as a close substitute by the consumers or (ii) many other media firms that are good alternatives for the advertisers. In the former case it is difficult for the media firm to raise revenues from consumer payment, simply because consumers would then switch to another media product. In the latter case it is difficult for the media firm to raise revenues from advertisers, because the advertisers would then switch to other media firms with a lower price on ads. As illustrated by the change in business model for *CNN Pipeline*, it is very important for the media firm to anticipate the changing environment they will be facing in the near future. If *CNN* had anticipated that quite soon after the introduction of their new service they would be challenged by new rivals offering close substitutes, they would have realized that financing the service by subscription could not be a viable business model. In the same manner, TV channels should anticipate that the technological change will make more TV channels available to the viewers and thereby reduce the prospects of raising revenues from commercial breaks. Fortunately, the TV channels in the UK and the US seem to have adapted better to such a change in the competitive constraint than what was the case with *CNN*, as they have gradually shifted their financing from advertising towards subscription fees.

Our model may be considered as a complement to research papers on media economics that build on Hotelling and Salop frameworks.²⁰ The 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 of both Hotelling and Salop is that the size of the market is typically given, such that aggregate output is independent of whether there is any competition. In our framework, competition leads to higher aggregate output, and we believe that this is a reasonable prediction both in the media industry and in other markets. The main motivation for our choice of framework, however, is that it allows us to analyze the consequences of increasing the number of rivals in the market.

²⁰See e.g. Anderson and Coate (2005), Gabszewicz *et al* (2004a, 2004b), and Liu *et al* (2004).

In this study, we predict how some fundamental economic forces in the media industry affect media firms' financing. There should be scope for testing empirically the validity of our model, compare this with the validity of other relevant models, and in particular that of Godes *et al* (2009). One way to discriminate between the two models is to test whether there is any relationship between the advertising volume in a media outlet and the extent to which the competitors produce close substitutes. According to Godes *et al* there should be no relationship, while our model indicates a positive relationship. However, such a test must take into account idiosyncratic institutional features of the media industry. For example, one should control for the fact that some countries have upper limits on the amount of advertising on TV, that contracts often are more complex than simple linear prices, and that list prices on advertising can differ significantly from actual prices. Empirical analyses must further take into account the fact that some media firms are vertically as well as horizontally integrated, and that ownership concentration has increased over time.

7 Appendix

A) *Equilibrium with an arbitrary number of advertisers*

Define $N \equiv \frac{n}{n+1}$. Note that N is monotonically increasing in n , varying from $N = 1/2$ for $n = 1$ to $N \rightarrow 1$ as $n \rightarrow \infty$.

A1) *Proof that $\frac{d\Pi}{ds} < 0$ and $\frac{d\Pi}{dm} < 0$ for any n*

Differentiating equation (12) with respect to s yields

$$\frac{d\Pi}{ds} = s(m-1)^2 \frac{2s [3m^2(2-s)^2 + s^2] N - [m(2-s) + s]^3}{[m(2-s) + s]^3 ([m(2-s) - s])^3},$$

where we note that $d\Pi/ds$ is more likely to be positive the larger N is. Setting $N = 1$ we find $d\Pi/ds = -s(m-1)^2 [m(2-s) + s]^{-3} < 0$, from which it follows that $d\Pi/ds < 0$ for all feasible values of N . Q.E.D.

Differentiating equation (12) with respect to m yields

$$\frac{d\Pi}{dm} = -\frac{2s^3(2-s)(m-1)NT_1 + (1-s)[m(2-s) + s]^3 T_2}{[m(2-s) + s]^3 [m(2-s) - s]^3},$$

where $T_1 \equiv 4m(1-s)(m-2) + s^2(m-1)^2 > 0$ and $T_2 \equiv (2-s)(m-1) + 2(1-s)^2 > 0$. Since all the terms both in the numerator and the denominator are positive, it follows that $d\Pi/dm < 0$ for any value of N . Q.E.D.

A2) *Proof of Proposition 1 for arbitrary values of n ($d(rA)/ds > 0$ and $d(pC)/ds < 0$)*

From equations (8) and (10) we find

$$\frac{dr}{ds} = \frac{m-1}{[m(2-s)+s]^2} > 0 \text{ and } \frac{dA}{ds} = \frac{4Nm^2s(m-1)(2-s)}{[m(2-s)-s]^2[m(2-s)+s]^2} > 0, \quad (24)$$

which proves Proposition 1 (i), that $d(rA)/ds > 0$.

Equations (9) and (11) yield

$$C \frac{dp}{ds} + p \frac{dC}{ds} = - \frac{\overbrace{[(m-1)(m(2-s)+s)^2]}^{\Delta_{s1}} + \overbrace{[(4-5s)(2-s)m^2 + 2ms(1-s) + s^2]}^{\Delta_{s2}} N}{[m(2-s)+s]^2 [m(2-s)-s]^3 s^{-1} (m-1)^{-1}} \quad (25)$$

The term Δ_{s1} is always positive for $m \geq 2$, while Δ_{s2} might be negative for $s > 4/5$. The absolute value of Δ_{s2} is increasing in N , such that we must have $(\Delta_{s1} + \Delta_{s2}) > 0$ for any $N \leq 1$ if $(\Delta_{s1} + \Delta_{s2})$ is positive for $N = 1$. Suppose that $N = 1$. We then find

$$\Delta_{s1} + \Delta_{s2} = m(2-s)(m+1)[m(2-s)-s] > 0, \quad (26)$$

which implies that $d(pC)/ds = C \frac{dp}{ds} + p \frac{dC}{ds} < 0$. This proves Proposition 1 (ii).

A3) *Proof of Corollary 1 for arbitrary values of n ($dS/ds < 0$)*

Totally differentiating (13) with respect to s and simplifying, we have

$$\frac{dS}{ds} = \frac{[C \frac{\partial p}{\partial s} + p \frac{\partial C}{\partial s}] rA + [-A \frac{\partial r}{\partial s} - r \frac{\partial A}{\partial s}] pC}{(pC + rA)^2}. \quad (27)$$

From the proof of Proposition it follows that

$$\frac{dS}{ds} = \frac{\overbrace{\left[C \frac{\partial p}{\partial s} + p \frac{\partial C}{\partial s} \right]}^{\text{positive}} rA + \overbrace{\left[-A \frac{\partial r}{\partial s} - r \frac{\partial A}{\partial s} \right]}^{\text{negative}} pC}{(pC + rA)^2} < 0. \quad Q.E.D.$$

A4) Negotiations between one advertiser and two media firms

Consider a context where we have two TV channels and one advertiser, and where the advertiser bargains simultaneously with each of the tv channels over the advertising price. We assume the same timing structure as in the main body of the paper.

Subgame after bargaining breakdown: Suppose bargaining broke down between channel 1 and the advertiser. Firms set consumer prices p_1 and p_2 . Channel 2 and the advertiser agree on advertising price r_2 . Channel 1 is without advertising. With no advertising in channel 1, consumers' demand for content in the two channels is:

$$\begin{aligned} C_1 &= \frac{1}{2} \left[1 + \frac{1}{2} \frac{s}{1-s} A_2 - \frac{p_1 - s(p_1 + p_2)/2}{1-s} \right] \\ C_2 &= \frac{1}{2} \left[1 - \frac{1}{2} \frac{2-s}{1-s} A_2 - \frac{p_2 - s(p_1 + p_2)/2}{1-s} \right] \end{aligned}$$

This implies the following demand for advertising at channel 2:

$$A_2 = \frac{1-s}{2-s} - \frac{1}{2} p_2 + \frac{1}{2} \frac{s}{2-s} p_1 - 2 \frac{1-s}{2-s} r_2.$$

Thus, the profit of the advertiser, in case of a breakdown at channel 1, is:

$$\pi_{1t} = \frac{[2(1-s) - (2-s)p_2 + sp_1 - 4(1-s)r_2]^2}{16(2-s)(1-s)}$$

TV channel 1, in case of a breakdown, has revenue only from consumers. Using expressions for C_1 and A_2 above, we find TV channel 1's profit in case of breakdown as:

$$\Pi_{1t} = p_1 \left[\frac{2(4-s)}{2-s} + \frac{s}{1-s} p_2 - \frac{(s^2 - 8s + 8)}{(2-s)(1-s)} p_1 - \frac{4}{2-s} r_2 \right]$$

These are the threat points for the bargaining between TV channel 1 and the advertiser. Similarly, we find the threat points for the bargaining between TV channel 2 and the advertiser:

$$\begin{aligned}\pi_{2t} &= \frac{[2(1-s) - (2-s)p_1 + sp_2 - 4(1-s)r_1]^2}{16(2-s)(1-s)} \\ \Pi_{2t} &= p_2 \left[\frac{2(4-s)}{2-s} + \frac{s}{1-s}p_1 - \frac{(s^2-8s+8)}{(2-s)(1-s)}p_2 - \frac{4}{2-s}r_1 \right]\end{aligned}$$

Subgame after successful bargaining: When bargaining does not break down in either channel, there is advertising in both channels. We have the following demand for content ($i, j = 1, 2; i \neq j$):

$$C_i = \frac{1}{2} \left(1 - \frac{A_i - s(A_i + A_j)/2}{1-s} - \frac{p_i - s(p_i + p_j)/2}{1-s} \right) \quad (28)$$

This gives

$$A_i = \frac{1}{2} [1 - p_i - (2-s)r_i - sr_j] \quad (29)$$

Now we need to find expressions for profits. Following prices (p_1, p_2, r_1, r_2) set in stage 1, the advertiser will earn:

$$\begin{aligned}\pi &= \frac{1}{4} + \frac{2-s}{4} (r_1^2 + r_2^2) - \frac{1}{2} (r_1 + r_2) + \frac{s}{2} r_1 r_2 + \frac{1}{16} \frac{2-s}{1-s} (p_1^2 + p_2^2) \\ &\quad - \frac{1}{4} (p_1 + p_2) - \frac{1}{8} \frac{s}{1-s} p_1 p_2 + \frac{1}{2} (r_1 p_1 + r_2 p_2)\end{aligned}$$

TV channel i will earn:

$$\Pi_i = \frac{1}{2} \left\{ r_i [1 - (2-s)r_i - sr_j] + \frac{p_i}{2} \left[1 - \frac{1}{2} \frac{2-s}{1-s} p_i + \frac{1}{2} \frac{s}{1-s} p_j \right] \right\}$$

Let $\alpha \in [0, 1)$ denote the bargaining power of the advertiser, such that the bargaining power of the advertiser is increasing in α (the second-order conditions do not hold in the limit $\alpha = 1$). In the main body of the paper we have treated the case where $\alpha = 0$, such that each media firm sets the advertising price in order to maximize its own profit.

The Nash product for the bargaining between TV channel i and the advertiser for an arbitrary value of α is:

$$NP_i = (\Pi_i - \Pi_{it})^{1-\alpha} (\pi - \pi_{it})^\alpha$$

Solving $\partial \Pi_i / \partial p_i = \partial NP_i / \partial r_i = 0$ simultaneously for $i = 1, 2$ we find a unique, symmetric equilibrium. Letting $p \equiv p_1 = p_2$ and $r \equiv r_1 = r_2$ we have:

$$p = \frac{2(1-s)}{4-3s} \quad (30)$$

$$r = \frac{4 - (3 + \alpha)s}{(4 - 3s)[4 - (1 + \alpha)s]} \quad (31)$$

Because of symmetry we also have $A = A_1 = A_2$ and $C = C_1 = C_2$. Using equations (29) and (30) we have for $s > 0$ that

$$\begin{aligned} \frac{dA}{d\alpha} &= \frac{2s^2}{(4-3s)[4-(1+\alpha)s]^2} > 0 \text{ and} \\ \frac{dr}{d\alpha} &= -\frac{2s^2}{(4-3s)[4-(1+\alpha)s]^2} < 0. \end{aligned}$$

This means that the higher the advertiser's bargaining power, the higher the advertising volume and the lower the price of advertising. The higher advertising level in turn implies that consumption falls:

$$\frac{dC}{d\alpha} = -\frac{s^2}{(4-3s)[4-(1+\alpha)s]^2} < 0.$$

Concerning each media firm's revenue on the two sides of the market we further have

$$\frac{d(pC)}{d\alpha} = -\frac{(1-s)2s^2}{(4-3s)^2[4-(1+\alpha)s]^2} < 0 \text{ and } \frac{d(rA)}{d\alpha} = s^2 \frac{(8-s^2-6s)-s(2+s)\alpha}{(4-3s)^2[4-(1+\alpha)s]^3} \gtrless 0.$$

We thus see that revenue from consumer payments unambiguously is decreasing in the advertiser's bargaining power. However, the media firms' revenue from the advertising market is increasing in the bargaining power of the advertiser unless both α and s are sufficiently large (in which case the media firms have little ability to internalize the externalities between the two sides of the market). Figure A1 thus illustrates that the share of consumer payments in the media firms' revenue is smaller for $\alpha = 0.5$ than for $\alpha = 0$, where $\alpha = 0$ is the case studied in the main text.

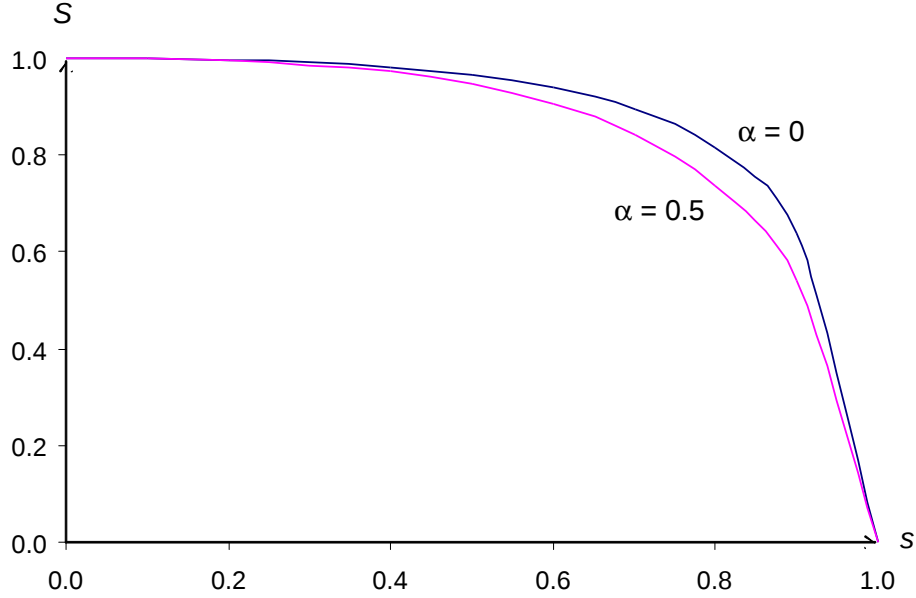


Figure A1: *The share of consumer payments in the media firms' revenue under bargaining.*

A5) *Proof of Corollary 2 for arbitrary values of n ($dC/ds > 0$)*

Differentiating (11) with respect to s we find

$$\frac{dC}{ds} = (m-1) \frac{[m(2-s) + s]^2 - 4ms(2-s)N}{[m(2-s) + s]^2 [m(2-s) - s]^2} \quad (32)$$

Equation (32) is less likely to be positive the larger is N . Setting $N = 1$, which is its highest possible value, we find that

$$N = 1 : \frac{\partial C}{\partial s} = \frac{m-1}{(m(2-s) + s)^2} > 0.$$

It follows that $\frac{\partial C}{\partial s} > 0$ for all feasible values of N . Q.E.D.

A6) *Proof of Proposition 2 for arbitrary values of n ($d(rA)/dm < 0$ and $d(pC)/dm < 0$)*

From (8) and (9) we have

$$\frac{dp}{dm} = -\frac{s(1-s)}{(m(2-s) - s)^2} < 0 \text{ and } \frac{dr}{dm} = -\frac{2-s}{(m(2-s) + s)^2} < 0.$$

For the advertising volume in each media outlet we have from equation (10) that

$$\frac{dA}{dm} = -Ns^2 \frac{4m(1-s)(m-2) + s^2(m-1)^2}{[m(2-s) - s]^2 [m(2-s) + s]^2} < 0.$$

Using equation (11) we find

$$\frac{dC}{dm} = - \frac{[m(2-s)(m-2s) + s^2][m(2-s) + s]^2 - s^2[m^2(2-s)^2(2m-3) + s^2]N}{m^2[m(2-s) - s]^2[m(2-s) + s]^2},$$

which is more likely to be positive the larger is N . It is straight forward to show that $\frac{dC}{dm} < 0$ for $N = 1$. Thus, $\frac{dC}{dm} < 0$ for all feasible values of N .

Since each media firm's output and prices are decreasing in m , it follows that $d(rA)/dm < 0$ and $d(pC)/dm < 0$. Q.E.D.

A7) Proof of Corollary 3 for arbitrary values of n (change from monopoly to duopoly)

Using equations (8) - (13) we find

$$S(m=2) - S(m=1) = - \frac{Ns^2(4-3s)}{(2-s)[(4-3s)^2 + s^3(N-1)]} < 0. \text{ Q.E.D.}$$

A8) The validity of Proposition 3 for arbitrary values of n ($dS/dm > 0$ for $m \geq 2$)

By inserting for (8) - (11) into (13) and differentiating with respect to m we find

$$\frac{dS}{dm} = Ns^2(1-s) \frac{2s^3(m-1)^2(2-s)N + [m(2-s) + s]\phi}{D^2}, \quad (33)$$

where

$$\begin{aligned} D &\equiv s^3(m-1)^2(2-s)N + (1-s)(m-s)[m(2-s) + s]^2 > 0 \text{ and} \\ \phi &\equiv (2-s)^2m^3 - m^2(2-s)(4+s) + s(2-s)(5+2s)m - s^2(5-2s). \end{aligned}$$

The first term in the numerator of (33) is positive for all $m \geq 2$ and increasing in N . Since $N \in [\frac{1}{2}, 1)$, a sufficient condition for dS/dm being positive is that the numerator of (33) is positive for $N = 1/2$. Setting $N = 1/2$ we can rewrite the numerator of (33) to

$$T = T_1(2-s)m^2 + T_2, \quad (34)$$

where

$$T_1 \equiv (2-s)^2m^2 - 4(2-s)m + s(6-2s-s^2) \text{ and } T_2 \equiv 2s^3(2-s)m - s^3(3-s).$$

The term T_2 is positive for all $m \geq 1$. A sufficient condition for T being positive is therefore that $T_1 > 0$. Factorization of T_1 yields

$$T_1 = (2 - s)^2 (m - t_1) (m - t_2),$$

where

$$t_1 = \frac{2 - \sqrt{2(1-s)(2-s) + s^3}}{2-s} \text{ and } t_2 = \frac{2 + \sqrt{2(1-s)(2-s) + s^3}}{2-s}.$$

Since $s \in [0, 1)$ we have $t_1 \in [0, 1)$ and $t_2 \in [2, 3)$. We thus see that a sufficient (but not necessary) condition for $dS/dm > 0$ is that $m \geq 3$.

Inserting for $m = 3$ and $m = 2$ into S shows that $S(m = 3) - S(m = 2)$ is increasing in N , with $S(m = 3) - S(m = 2) > 0$ for $s > 0.83$ with $N = 1/2$ and $S(m = 3) - S(m = 2) > 0$ for all s as $N \rightarrow \infty$.

B) On underpricing of the media products

If the ratio (η/γ) is sufficiently large it is optimal for the media firms to set the consumer price below marginal costs (while it is optimal to have no advertising if the ratio (η/γ) is sufficiently small). This is true for any $m \geq 1$ and $n \geq 1$, but to simplify the algebra we consider only the case $m = n = 1$. From equation (3) we then find that consumer demand for the media product equals

$$C = 1 - \gamma A - p. \quad (35)$$

As in the main text, we assume that the advertiser's profit equals (with $m = n = 1$) $\pi = \eta AC - Ar$. Solving $\partial\pi/\partial A = 0$ s.t. (35), taking account of the non-negativity constraint on advertising, we find the following demand for advertising:

$$A = \max \left\{ 0, \frac{(1-p)\eta - r}{2\eta\gamma} \right\}. \quad (36)$$

The media firm's profit function is given by equation $\Pi = (p - c)C + rA$, which corresponds to equation (1) in the main text except that we allow for positive marginal costs ($c > 0$). The firm maximizes profit with respect to p and R , subject to (35) and (36). The second-order conditions read

$$\begin{aligned} \left(\frac{\partial^2 \Pi}{\partial p^2} \right) &= -1 < 0; \quad \left(\frac{\partial^2 \Pi}{\partial r^2} \right) = -\frac{1}{\gamma\eta} < 0 \\ \left(\frac{\partial^2 \Pi}{\partial p^2} \right) \left(\frac{\partial^2 \Pi}{\partial r^2} \right) - \left(\frac{\partial^2 \Pi}{\partial p \partial r} \right)^2 &= \frac{6\eta/\gamma - 1 - (\eta/\gamma)^2}{4\eta^2} > 0 \text{ for } 3 - 2\sqrt{2} < \frac{\eta}{\gamma} < 3 + 2\sqrt{2}. \end{aligned}$$

Solving $\partial\Pi/\partial p = \partial\Pi/\partial r = 0$ yields the first-order conditions

$$p = \frac{(3\eta/\gamma - 1)c - (\eta/\gamma)^2 + 3\eta/\gamma}{6\eta/\gamma - 1 - (\eta/\gamma)^2} \text{ and } r = \frac{(1-c)(\gamma + \eta)\eta/\gamma}{6\eta/\gamma - 1 - (\eta/\gamma)^2}. \quad (37)$$

Output is now given by

$$A = \frac{1}{\gamma} \left(\frac{\eta}{\gamma} - 1 \right) \frac{1-c}{6\eta/\gamma - 1 - (\eta/\gamma)^2} > 0 \text{ if } \frac{\eta}{\gamma} > 1$$

and $C = 2\frac{\eta}{\gamma} \frac{1-c}{6\eta/\gamma - 1 - (\eta/\gamma)^2}.$

From (37) we find that

$$p - c = \frac{\eta}{\gamma} \left(3 - \frac{\eta}{\gamma} \right) \frac{1-c}{6\eta/\gamma - 1 - (\eta/\gamma)^2},$$

which means that the second-order conditions are satisfied with $p - c < 0$ if $3 < \frac{\eta}{\gamma} < 3 + 2\sqrt{2}$.

C) On competing in advertising prices as a dominant strategy

It seems unreasonable to assume that the media firms compete in quantities on the consumer side. We will thus prove that it is a dominant strategy for the media firms to compete in advertising prices instead of advertising quantities, given that they compete in prices on the consumer side.

Assume that there are two media firms; $m = 2$. If both compete in advertising prices, we find from equation (12) that the profit level of each firm is equal to (with superscripts indicating the media firms' choice variables on the ad side of the market)

$$\Pi_i^{r_1, r_2} = \frac{2-s}{(4-s)^2}. \quad (38)$$

Suppose that media firm 1 deviates, and chooses advertising quantity as strategic variable (the results would be symmetric if instead we assumed that the rival deviated). Solving $\{p_1, A_1\} = \arg \max \Pi_1$ and $\{p_2, r_2\} = \arg \max \Pi_2$ we find $p_1 = p_2 = \frac{2(1-s)}{4-3s}$, $r_2 = \frac{4-3s}{16(1-s)+s^2}$ and $A_1 = \frac{4s^2(1-s)}{(4-3s)(16(1-s)+s^2)}$. The media firms will then have the following profit levels:

$$\Pi_1^{A_1, r_2} = \frac{4(1-s)^2(4-s)^2}{(2-s)[16(1-s)+s^2]^2} \text{ and } \Pi_2^{A_1, r_2} = \frac{4(1-s)(4-3s)^2}{(2-s)[16(1-s)+s^2]^2}. \quad (39)$$

Since

$$\Pi_1^{A_1, r_2} - \Pi_1^{r_1, r_2} = -s^3 \frac{4(4-3s)^2 - 3s^3}{(2-s)(4-s)^2(16(1-s) + s^2)^2} < 0 \text{ for } s > 0,$$

it is not profitable for media firm 1 to deviate from an outcome where both firms compete in advertising prices.

Suppose next that both firms compete in advertising quantities. Solving $\{p_1, A_1\} = \arg \max \Pi_1$ and $\{p_2, A_2\} = \arg \max \Pi_2$ implies that neither of the media firms will have any advertising, and that $p_1 = p_2 = \frac{2(1-s)}{4-3s}$.²¹ The firms then make profits equal to

$$\Pi_i^{A_1, A_2} = \frac{(1-s)(2-s)}{(4-3s)^2}.$$

If media firm 2 deviates and chooses advertising price as strategic variable, we can solve $\{p_1, A_1\} = \arg \max \Pi_1$ and $\{p_2, r_2\} = \arg \max \Pi_2$ to find that $\Pi_1^{A_1, r_2}$ and $\Pi_2^{r_2, A_1}$ are given by equation (39). Since $\Pi_2^{A_1, r_2} - \Pi_2^{A_1, A_2} > 0$, it is profitable for media firm 2 to deviate.

Summing up, it follows that it is a dominant strategy for both firms to choose price rather than quantity as the strategic variable in the advertising market. Q.E.D.

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²¹With η sufficiently larger than γ we will have $A_i > 0$, but this does not change the result that it is less profitable to compete in advertising quantities than in advertising prices.

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