

Media Competition When the Audience Dislikes Advertising: A Theory of Vertical Alliances on the Internet¹

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Abstract: This paper presents a model of media competition in a situation where the media is advertising-financed, but where the media consumers dislike commercials. It is shown that equilibrium prices of advertising are actually higher, and the profit levels lower, the less differentiated the medias are perceived to be. We apply the model to analyze the incentives for Internet portals to form alliances with their advertisers, and find that there exists a prisoners' dilemma where portals that are close substitutes end up in an equilibrium with no vertical alliances and low profit.

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1 Introduction

The media industry has a two-fold role. It is a provider of entertainment and information on the one hand, and a transmitter of advertising for producers in the product market on the other hand. Although media firms are financed by their advertising revenues, their audiences often dislike the presence of this advertising. One example is the TV industry, where viewers may find commercial breaks disturbing.² Another example is portals on the Internet, where surfers typically dislike pop-up ads. Recently, the Internet portals EarthLink and AOL decided to abolish pop-up ads, simply because such ads were a nuisance to surfers on the Internet.³ In the present paper, we set up a simple model of media competition with audience dislike for advertising. We show that this idiosyncratic characteristic of media firms implies that they behave distinctly differently from what we may expect from standard textbook models. We go on to apply this model to an issue of particular interest to the future development of e-commerce: under what circumstances can we expect media firms and advertisers to enter into vertical alliances? In particular, when should we expect portals on the Internet (media firms) to enter into alliances with producers (firms that advertise)?

The media industry plays an important role in society, for example in terms of the time people spend watching TV or surfing on the Internet. Despite this, there are relatively few studies of this particular industry in the economics literature.⁴ With a few notable exceptions, there are no studies that analyze the two-fold role of the media industry - as a provider of entertainment or information and as a transmitter of advertising.⁵ Our model encompasses these two aspects. We assume that a media

²See Nilssen and Sjørgard (2001) for references.

³See Hellweg (2002) and Richtmyer (2002). For a general description of the Internet portals, see Maxwell and Vernet (1999) and Meisel and Sullivan (2000).

⁴For example, the studies that do exist typically focus on how rivalry between TV channels affects program diversity. An early analysis of this question is by Steiner (1952); see Owen and Wildman (1992) for elaborations on Steiner's model. In Nilssen and Sjørgard (1998), program diversity is modelled along two dimensions.

⁵Anderson and Coate (2000), Gabszewicz et al. (2000), and Nilssen and Sjørgard (2001) all study this two-fold role of the TV industry. In contrast to these studies, we consider (i) how the degree

firm, which may be a TV channel or an Internet portal, earns its revenues from selling advertising slots or banners to producers in the product market and attracts an audience for this advertising by offering entertainment or information as such. While entertainment and information are valuable for the audience, advertising is a nuisance to them.

We consider a situation where two media firms offer their differentiated products to the media consumers, and two producers operate in independent product markets and buy advertising from the media firms. We find that a reduction in product differentiation between the media firms' products would lead to *higher* prices on advertising. A higher price on advertising for one media firm would lead to less advertising offered by that media firm. Less advertising, in turn, results in a larger audience for this media firm, and a smaller audience for its rival. This effect is stronger the closer substitutes the two media firms' products are, and such a response dampens the negative effect of a higher own price on advertising. Consequently, the media firms find it profitable to set high prices on advertising if their products are close substitutes.

Even though the media firms charge higher prices the less differentiated they are, we find that the profits for each media firm are low if their products are close substitutes. As explained above, media firms compete for audience by charging a high price on advertising and thereby reducing the amount of advertising. This competition is more intense the closer substitutes the media firms' products are. Hence, the media firms end up with excessively high prices on advertising.

We apply our model to analyze the incentives for vertical alliances, where one media firm can form an alliance with one of the producers and where the alliance maximizes its aggregate profit (as though they were integrated). As shown in Elfenbein and Lerner (2001), such vertical alliances are often observed between a portal

of product differentiation affects the price rivalry on advertising between media firms and (ii) the incentives for vertical alliances in media industries. In a related study, Dukes and Gal-Or (2001) analyze contracts between advertisers and media firms when the media outlets are differentiated. However, the way they model the product differentiation differs from ours, and they assume that all advertisers sell to the same product market, while our advertisers sell to independent product markets.

on the Internet and a producer in the product market. Therefore, we interpret the media firm as a portal on the Internet and advertising as banners on the portal's web page. We find that such kinds of closer vertical links between one producer and one portal lead to foreclosure. The alliance - the portal and the producer - sets so high prices on banners that the independent producer does not buy banners on the alliance's portal. Note, though, that the alliance has incentives to buy a large amount of banners on the competing portal. The reason is that such a behavior would 'degrade' the competing portal, and thereby lead to a shift of visitors from the competing portal to the alliance's portal. This incentive is strong for the alliance, since it earns a larger revenue for each visitor than what is the case for an independent portal. We further find that the independent portal is a free rider on the alliance, in the sense that it benefits from a higher demand for banners from the alliance. To exploit this fact, the independent portal raises its price on banners. This effect is stronger the closer substitutes are the portals, since the alliance then has stronger incentives to 'degrade' the rival portal. One implication of this is that the independent portal earns a higher profit the closer substitutes the portals, the opposite of what was the case with complete separation between portals and producers.

If both portals have formed a vertical alliance, then each alliance will have strong incentives to purchase banners on the competing portal. The reason for this is that it leads to a degrading of the competing portal. The closer substitutes the portals are, the stronger the incentives to do so and the lower the alliance's profit would be.

Finally, we consider the equilibrium outcome. We find that there are two opposing forces at work. On the one hand, the formation of a vertical alliance eliminates a 'double marginalization' problem, since the price of banners to its own producer is set equal to marginal costs. On the other hand, the independent portal can be a free rider on the alliance. As argued above, it would respond to the vertically allied firms by raising the price of banners. It would then exploit the fact that the alliance has incentives to 'degrade' the quality of the competing portal by purchasing a large number of banners. Such a third-party response is disadvantageous for the alliance. The closer substitutes the portals, the more severe is this third party response with

respect to the price of its banner. We find that vertical separation is the equilibrium outcome as long as the portals are sufficiently close substitutes.⁶ Note, though, that vertical separation is a prisoners' dilemma outcome, because firms' joint profit would have been higher if both portals had formed a vertical alliance. In those instances where the industry has most to gain from vertical alliances - when portals are close substitutes - there will be no vertical alliances in equilibrium.

In the next Section, we present a duopoly model of media competition, a crucial feature of which is the specification of consumer benefits and costs of using a medium. We phrase the model in terms of Internet portals, but the model in itself is also applicable to other media. In Section 3, we do the equilibrium analysis. In Section 4, we apply the model to the question of incentives to form vertical alliances among Internet portals and their advertisers. In Section 5 we provide some concluding remarks. All the proofs are given in the Appendix.

2 The model

Consider a media industry where we have two advertising outlets. To fix ideas and facilitate the discussion later on the Internet, we already refer to the two outlets as portals and denote them P and p . By visiting the portals, a representative consumer obtains a (gross) utility level equal to

$$U = V + v - \frac{1}{1+b} \left(\frac{V^2}{2} + \frac{v^2}{2} + bVv \right), \quad (1)$$

where V is the number of visits to portal P , v is the number of visits to portal p , and $b \in [0, 1]$ is a measure of product differentiation: The higher is b , the closer substitutes are the two portals in the consumers' view.⁷ We normalize the number

⁶The driving force is analogous to the one that explains why horizontal mergers can be unprofitable; a disadvantageous third party response. As shown in Salant *et al.* (1983), under certain assumptions a horizontal merger will not be profitable unless 80% of the industry takes part in the merger. The reason for this result is that the non-participating firms increase their sales as a response to a merger.

⁷A more general formulation would be

$$U = V + v - \frac{1+\beta}{1+b} \left(\frac{V^2}{2} + \frac{v^2}{2} + bVv \right).$$

of consumers to 1. Therefore the terms *visits* on each portal and *visitors* on each portal are equivalent, and will be used interchangeably.

Let C and c denote the consumer costs per visit to the two portals. Optimum consumer behavior is such that $\partial U/\partial V = C$ and $\partial U/\partial v = c$, implying

$$\begin{aligned} V &= 1 - \frac{C - bc}{1 - b}, \text{ and} \\ v &= 1 - \frac{c - bC}{1 - b}. \end{aligned} \tag{2}$$

The portals are financed by selling advertising banners to firms that intend to spur sales of their products. Let us call these firms producers (or advertisers). Consumers visit the portals free of charge. However, consumers have a disutility of being interrupted by banners, and their subjective costs of visiting the portals are increasing in the number of advertising banners on a portal. To simplify, we assume that $C = A$ and $c = a$, where A and a are the number of banners on the two portals.

Inserting for C and c into equation (2) we find

$$V = 1 - \frac{A - ba}{1 - b}, \tag{3}$$

and

$$v = 1 - \frac{a - bA}{1 - b}. \tag{4}$$

From (3) and (4), we find that the total number of visitors is equal to $V + v = 2 - A - a$. Note that the total number of visitors is independent of b for any given level of advertisements. We further see that

$$\frac{\partial V}{\partial b} = -\frac{A - a}{(1 - b)^2} = -\frac{\partial v}{\partial b}$$

This means that, if $A > a$, say, then portal p will capture a larger number of visitors at the expense of portal q the higher the value of b . This reflects the fact that an

If $\beta = b$, we have a standard quadratic utility function, where an increase in b both implies that the goods become less differentiated and that the total size of the market increases. With $\beta = 0$, on the other hand, the total size of the market is independent of b . This means that b , in this case, becomes a one-dimensional measure of product differentiation. Since the focus of this paper is competition, we concentrate on the case where $\beta = 0$.

increase in b makes the portals less differentiated, so that the consumers become more prone to shift from one portal to another.

We envisage a two-stage game wherein, at stage 1, the portals set advertising prices and, at stage 2, producers choose how many advertising banners to purchase at each of the two portals.⁸

The portals' profit functions

Let R and r denote the prices that the portals charge from the producers for each advertising banner, and assume that the cost for the portals of inserting a banner is equal to zero. The profit functions of the portals may then be written as

$$\pi_P = RA \tag{5}$$

and

$$\pi_p = ra. \tag{6}$$

The producers' (or advertisers') profit functions

We have two producers, operating in independent markets, that generate sales by advertising on the portals. More specifically, by inserting A_i banners on portal P , producer i will sell A_i units of its goods to each visitor on that portal, $i \in \{1, 2\}$. Banners on portal p generate a similar demand.

For simplicity, we assume there is an inelastic consumer demand for the goods sold by the providers, and that all consumers have the same willingness to pay for each unit of the goods. The producers will therefore charge the consumers a price equal to their reservation price.⁹ Suppose that this gives the producers a profit margin equal to 1 per unit. Producer i faces a demand equal to A_iV from its ads on

⁸We have also explored an alternative model in which the portals set quantities at stage 1 rather than prices, that is, they choose how many banner slots to make available for producers. Propositions 1 and 2 below are not affected by this change of model. However, parts of the subsequent vertical-alliance analysis will have different results in this alternative model. Details are available from the authors.

⁹Since the consumers pay their reservation price for the goods from the producers, we do not need to include these goods in the consumers' utility function. This formulation is analogous to the one used in Anderson and Coate (2000).

portal P and a_iv from its ads on portal p . The profit level of producer i can then be written as

$$\pi_i = (A_iV + a_iv) - RA_i - ra_i, \quad (7)$$

where the producers' costs are set equal to zero.

3 Equilibrium analysis

Suppose first that the whole industry (portals and producers) is owned by one single firm. Since the banner prices are irrelevant in this case, the maximization problem is simply

$$\max_{A,a} \{AV + av\}, \quad (8)$$

where $A = A_1 + A_2$ and $a = a_1 + a_2$. Since the total market size is independent of b , the level of advertisements will also be independent of b . Performing the maximization problem in (8), it is straightforward to show that total advertising on the two portals equals (with an asterisk to denote industry optimum)

$$A^* = a^* = 1/2. \quad (9)$$

Aggregate industry profit is equal to $\Pi^* = 1/2$, and the number of visitors to each portal is $V^* = v^* = 1/2$.

Next, we move to our main case of two independent portals and two independent producers. We are looking for a subgame-perfect equilibrium of our two-stage game and therefore proceed by examining stage 2 first.

Stage 2:

The maximization problem of producer i is

$$\pi_i = \max_{A_i, a_i} \{(A_iV + a_iv) - RA_i - ra_i\},$$

so that its first-order conditions are given by $\partial\pi_i/\partial A_i = \partial\pi_i/\partial a_i = 0$ ($i = 1, 2$).

Setting $\partial\pi_i/\partial A_i = 0$ we find

$$A_i = \frac{1}{2} [(1-b)(1-R) - A_j + b(2a_i + a_j)],$$

This shows that the advertisement level A_i for producer i on portal P is decreasing in A_j (the number of banners by the other producer on portal P) and increasing in the number of banners on the other portal. This latter property reflects the fact that portal P is more attractive for consumers, other things equal, the more they are interrupted by banners on portal p . Finally, we see that A_i is decreasing in the advertisement costs R .

Assuming $R < 1$ and $r < 1$, we solve the four first-order conditions for the producers to find

$$\begin{aligned} A_i(R, r) &= \frac{(1+b) - R - rb}{3(1+b)} \text{ and} \\ a_i(r, R) &= \frac{(1+b) - r - Rb}{3(1+b)}, \end{aligned} \tag{10}$$

so that the level of advertising on each portal depends negatively on the advertisement costs of that portal ($\partial A_i/\partial R = \partial a_i/\partial r < 0$). This means that the portal with the lower banner price will have the larger number of banners. Note, however, that the number of banners on each portal is decreasing also in the costs of advertising on the other portal if $b > 0$; $\partial A_i/\partial r = \partial a_i/\partial R = -b/(3(1+b)) < 0$. In other words, advertising on portal P and advertising on portal p are complementary goods. To see why, suppose that R increases. The direct effect of this is that the producers reduce their advertising on portal P , which consequently becomes more attractive for the consumers. This in turn means that portal p becomes relatively less attractive and will therefore be visited by fewer consumers. Thus, the producers will respond by reducing their advertising on portal p as well, and more so the more equal the portals are perceived to be by consumers. The negative effect of setting a relatively high banner price is therefore smaller the higher the value of b .

One interesting implication is that if $R > r$, say, then the higher attractiveness of portal P means that it will sell more banners at any given pair of prices the more equal the portals are perceived to be, while the opposite is true for portal p (but

the cheaper portal will always sell more banners). This can be seen formally by differentiating equation (10) with respect to b :

$$\frac{\partial A_i}{\partial b} = \frac{R - r}{3(1 + b)^2} = -\frac{\partial a_i}{\partial b} > 0 \text{ iff } R > r. \quad (11)$$

We can summarize our analysis of stage 2 as follows:

Lemma 1: *For a given pair of banner prices,*

i) if the price per banner is the same on the two portals, then the number of banners is independent of b , i.e., if $R = r$, then $A = a = \frac{1-R}{3}$;

ii) if the price per banner differs between the portals, then the cheaper portal will attract more banners.

iii) if the price per banner differs between the portals, then the number of banners on the more expensive portal is higher the less differentiated the portals are perceived to be; likewise, the number of banners on the cheaper portal is smaller the less differentiated the portals are perceived to be.

Stage 1:

At the first stage, portal P maximizes $\pi_P = RA$ with respect to R , subject to the reaction functions A_1 and A_2 from equation (10), taking r as given. Portal p faces a similar problem. Solving this, we find

$$R = r = \frac{1 + b}{2 + b}, \quad (12)$$

from which it follows that the price per banner is increasing in b ($\partial R/\partial b = \partial r/\partial b = 1/(2 + b)^2 > 0$). This is a direct consequence of Lemma 1, where we found that a price increase on banners is less detrimental to the number of visitors on the portal the closer substitutes the two portals. The portals thus compete for visitors by charging a high price on banners, thereby reducing the number of banners and making its own portal attractive for the visitors.

We have the following result:

Proposition 1: *The portals charge a higher price per banner the less differentiated the portals are perceived to be; i.e., $\frac{dR}{db} = \frac{dr}{db} > 0$.*

Since the banner price is increasing in b , it follows that the number of banners is decreasing in b , and inserting for (12) in (10) we find

$$A_i = a_i = \frac{1}{3(2+b)}, \quad i \in \{1, 2\}. \quad (13)$$

Comparing (9) and (13) we find that the number of banners is always higher in the industry optimum than in the market equilibrium. The reason for this is that, in the former case, the producers will advertise until the marginal revenue is equal to zero (which is the marginal cost of inserting a banner), while in the present case, the producers will advertise until the marginal revenue is equal to the price that the portals set per banner (R and r).

In the industry optimum, we always have $A^* = a^* = 1/2$, in which case the consumers are equally much interrupted by banners whether b is high or low. The fact that the number of banners is decreasing in b in the present case implies that the number of visits to the portals is increasing in b . However, the higher banner prices imply that the producers earn a lower profit the less differentiated the portals:

$$\pi_i = \frac{2}{9(2+b)^2}, \quad \frac{\partial \pi_i}{\partial b} < 0. \quad (14)$$

The fact that a higher b allows the portals to charge higher prices for the banners does not mean that their profit is increasing in b . On the contrary, the profit level is decreasing in b :

$$\pi_P = \pi_p = \frac{2(1+b)}{3(2+b)^2}; \quad \frac{d\pi_P}{db} = \frac{d\pi_p}{db} = -\frac{2b}{3(2+b)^3} < 0. \quad (15)$$

To see the intuition for this, suppose that $b = 0$. From equation (12) we then have that $R = r = 1/2$. Since the two portals de facto serve independent markets when $b = 0$, it follows that a banner price equal to $1/2$ would maximize aggregate profit for the portals when $b = 0$. Moreover, since the size of the market is independent of b , it further follows that $R = r = 1/2$ actually maximizes portal profit for all values of b .¹⁰ Thus, an increase in b induces the portals to set higher banner prices to attract visitors, but this is detrimental to their profit.

¹⁰Formally, solving $\max_{R,r} \{RA + ra\}$ s.t. (10) we find $R = r = 1/2$, $\pi_i = 1/18$ and $\pi_P = \pi_p = 1/6$.

To sum up, we have the following:

Proposition 2: *In equilibrium, the portals charge a higher price per banner, and therefore attract a higher number of visitors, the less differentiated the portals are perceived to be, even though this pricing behavior reduces their profit; i.e., $\frac{dR}{db} = \frac{dr}{db} > 0$, $\frac{dV}{db} = \frac{dv}{db} > 0$, and $\frac{d\pi_P}{db} = \frac{d\pi_P}{db} < 0$.*

4 Application: Vertical Alliances on the Internet

In the previous Section the producers and the media firms were by assumption independent firms. We now relax that assumption, and allow a producer and a media firm to form a vertical alliance. Although such alliances are not common in the TV industry, they are regularly observed on the Internet. The portal www.babycenter.com (which offers information on pregnancy and child-upbringing), for instance, has partnered with many of its advertisers. Other examples are discussed in Elfenbein and Lerner (2001), who provide an empirical analysis of different forms of portal alliances between 1995 and 1999. In this section we ask the following question: when should we expect a vertical alliance between a portal and a producer to be the equilibrium outcome? A vertical alliance can be anything in-between a simple linear price and complete vertical integration (see Elfenbein and Lerner (2001)), and to highlight the possible competitive advantages of such partnerships we will model vertical alliances as vertical integration.

We extend our model by introducing a stage 0 in which each of the portals decides whether to enter into an alliance with a producer. This gives rise to essentially three different subgames following stage 0: one in which no vertical alliances are formed, which is the situation analyzed above; one in which one vertical alliance has been formed while the other portal and the other producer continue as independent firms; and one in which we have two vertical alliances. In the following two subsections, we analyze the latter two subgames. Finally, we return to stage 0 to determine what is the equilibrium outcome of this three-stage game.

4.1 One Vertical Alliance (1VA)

Suppose that portal P and producer 1 have formed a vertical alliance and maximize their aggregate profit, while portal p and producer 2 are independent firms. The profit of the alliance equals

$$\Pi_1 = RA_2 + A_1V + a_1v - ra_1. \quad (16)$$

The first term in (16) is the profit from selling banners to the independent producer, the second and third terms downstream profits, and the fourth term the costs of advertising on the independent portal. We maintain the same timing of the game as above, so that banner prices are set at stage 1 and advertising levels at stage 2.

The alliance will obviously advertise more on portal P than will the independent producer (since the latter faces advertisement costs $R > 0$), and in the appendix we show that the outcome of the second stage is characterized by

$$A_1 - A_2 = R/(1 + b). \quad (17)$$

For the first stage we then find that:

$$\frac{\partial \Pi_1}{\partial R} = \underbrace{\left(A_2 - \frac{2}{3(1+b)}R \right)}_{\text{increased income from producer 2}} + \underbrace{\frac{2}{3}A_1}_{\text{increased attractiveness of portal } P}. \quad (18)$$

Equation (18) isolates two effects of a higher R . The term in bracket, which equals $\partial(RA_2)/\partial R$, is the increased income from producer 2 when R increases by one unit. This term appears independent of whether the portal is allied with a downstream firm or not. The term outside the bracket, on the other hand, appears only when the portal is allied with a firm in the downstream market. This term, which equals $\partial(A_1V + a_1v - ra_1)/\partial R$, reflects the fact that portal P will be visited by a larger number of consumers when R increases, since it induces the independent producer to advertise less on portal P and more on portal p . This is a gain for the alliance, which generates most of its downstream sales through its own portal.

Using (17) and (18), we can now write the first-order condition in the first stage as $\partial\Pi_1/\partial R = 5A_2/3$, which means that the alliance will increase R until $A_2 = 0$. We thus find that the alliance forecloses the independent producer, even though the two producers are not competitors in the end-user market.

Above we have seen that, from the industry's point of view, there are too few banners on the portals in the context where all the firms maximize individual profit. The reason for this is that the producers then advertise until the marginal revenue of advertising is equal to R and r rather than zero. This double marginalization problem does not exist on portal P , since the vertical alliance forecloses the other producer. In particular, this means that the vertically allied firm chooses $A_1 = A_1^* = 1/2$ when $b = 0$ (which as shown in the benchmark case is the industry optimum for all values of b).

However, it should be noted that because there is a double marginalization problem on portal p , the number of banners on that portal tends to be relatively low. This has two implications. First, the allied firms cannot maintain the high number of banners when $b > 0$, since that would make portal P too unattractive for the consumers. Thereby we should expect that A_1 is decreasing in b . Second, in order to increase the relative attractiveness of portal P , the allied firms will have stronger incentives to advertise on portal p than the independent producer. This incentive to "degrade" the quality of the competing portal will be stronger the less differentiated the portals, and this indicates that a_1 is increasing in b . The extra incentive for the allied firms to advertise on the independent portal further implies that only the alliance will advertise on portal p when $b = 1$ (in this case one of the portals cannot have a higher level of advertisement than the other without losing all the consumers). In the limit when $b = 1$ the independent producer will thus de facto be foreclosed from both portals. In the appendix we offer a formal proof of the following proposition, which is illustrated graphically in Figure 1.

Proposition 3: *Assume a market structure with one vertical alliance (case 1VA).*

a) The independent producer will be foreclosed from the portal belonging to the

vertical alliance ($A_2 = 0$). In the limit when the portals are homogeneous ($b = 1$), it will also de facto be foreclosed from the independent portal.

b) The vertical alliance will advertise less on its own portal and more on the independent portal the less differentiated the portals are perceived to be; i.e., $\partial A_1/\partial b < 0$ and $\partial a_1/\partial b < 0$.

c) The vertical alliance will advertise more on the independent portal than will the independent producer for all $b > 0$.

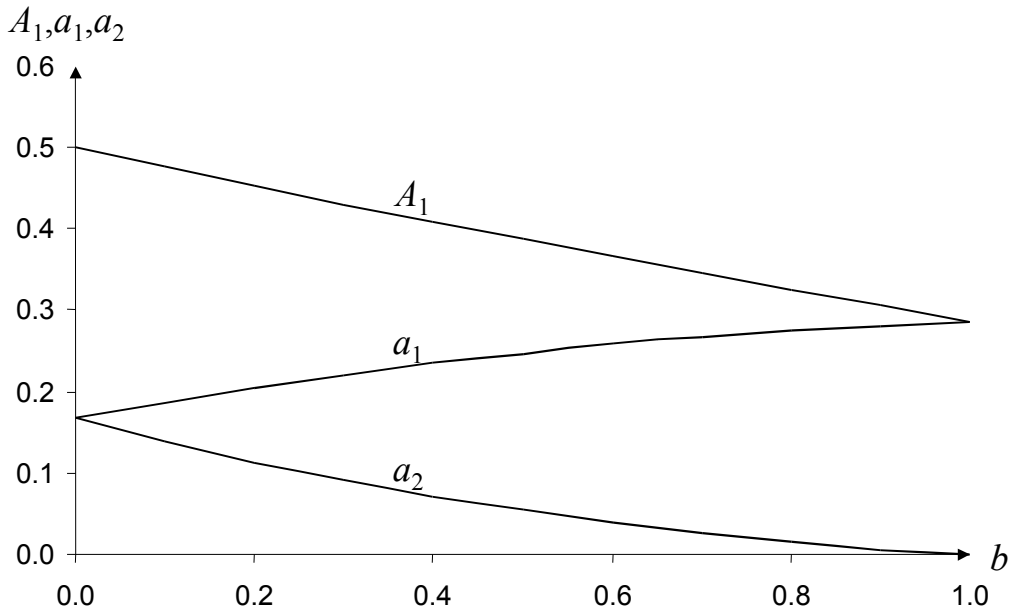


Figure 1: Advertisement levels.

The vertical alliance will earn a relatively high profit when the portals are highly differentiated, and will set $A_1 = A^* = 1/2$ when $b = 0$ as argued above. Additionally, it will also make some profit from its sales through the independent portal. It is thus clear that the alliance will make a higher profit than will the independent firms combined when b is low.

In a traditional market setting we might expect that the alliance would buy few banners on the rival portal when the portals are close substitutes. However, the fact that banners on the two portals are complementary goods implies that the opposite is true. For all $b > 0$ the independent portal imposes a negative externality on the alliance, in the sense that few banners on the independent portal make portal P

less attractive. Thereby, as stated in Proposition 3, the alliance will have stronger incentives to advertise on the independent portal the less differentiated are the portals. Since portal p is aware of these incentives, it will set increasingly higher banner prices the higher is b . As shown in the appendix, this has the following consequences for the profitability of the firms:

Proposition 4: *Assume a market structure with one vertical alliance (case 1VA). There exist some critical values $0 < b_1 < b_2 < 1$ such that*

a) the alliance makes a lower profit than the aggregate profit of the independent firms if $b > b_1$, and

b) the alliance makes a lower profit than the independent portal if $b > b_2$.

Proposition 4 is illustrated in Figure 2. The profit level of the alliance is strictly decreasing in b , similarly to what was the case for all the firms in the context with no alliances. However, the profit level of the independent portal is strictly increasing in b . The independent portal can namely exploit the negative externality that it imposes on the alliance to charge increasingly higher banner prices. Thus, if $b > b_2$ the independent portal will make a higher profit than the alliance.¹¹

Figure 2 indicates that portal P and producer 1 may have limited incentives to form an alliance if b is high. This will be discussed further below.

¹¹Note also that the difference between the curves $\pi_p + \pi_2$ and π_p approaches zero as b approaches 1, reflecting the fact that the independent producer is excluded from the market in the limit when the portals are homogenous.

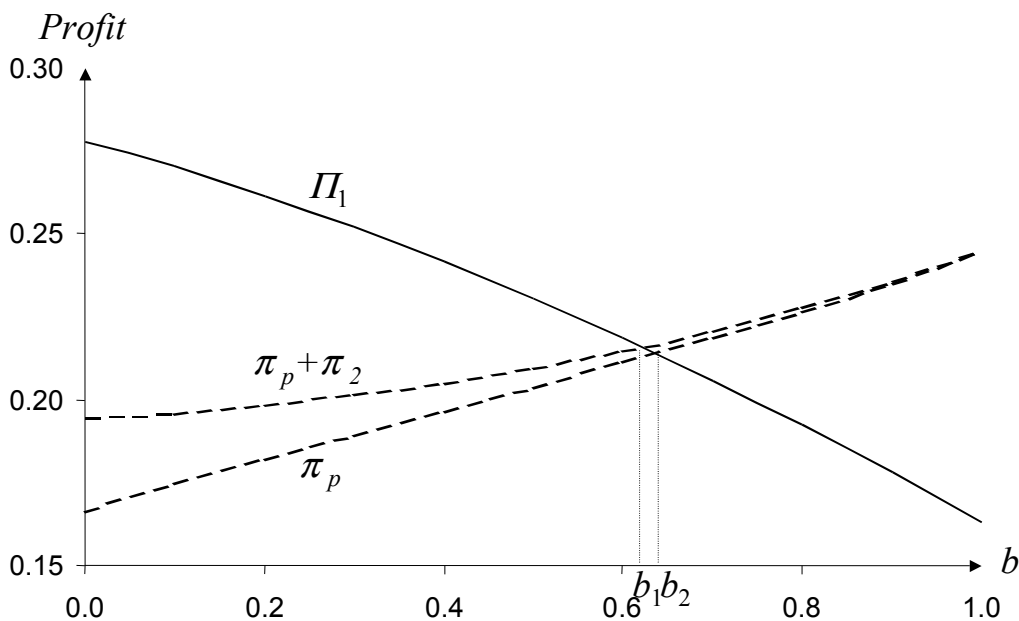


Figure 2: Profits of the alliance and the independent firms.

4.2 Two Vertical Alliances (2VA)

The next and final market structure to consider, is one where portal P has formed an alliance with producer 1 and portal p has formed an alliance with producer 2. The profits of the firms are thus

$$\Pi_1 = RA_2 + A_1V + a_1v - ra_1 \text{ and } \Pi_2 = ra_1 + A_2V + a_2v - RA_2 \quad (19)$$

Maintaining the same timing structure as above, we find that the second stage yields the advertising levels

$$A_1 = \frac{(1+b) + R - 2rb}{3(1+b)} \text{ and } a_2 = \frac{(1+b) + r - 2Rb}{3(1+b)} \quad (20)$$

on the allied firms' own portals, and

$$A_2 = \frac{(1+b) + rb - 2R}{3(1+b)} \text{ and } a_1 = \frac{(1+b) + Rb - 2r}{3(1+b)} \quad (21)$$

on the competing portal. Above we saw that with one vertical alliance, firm 1 (the producer in the alliance) advertised more on the other portal the less differentiated the portals. The same mechanism is the present also in the case where we have

two vertical alliances; an increase in b implies that the firms have an incentive to reduce advertising on its own portal, and increase advertising on the other portal. Formally, we see that

$$\begin{aligned}\frac{\partial A_1}{\partial b} &= -\frac{2r + R}{3(1 + b)^2} \\ \frac{\partial a_1}{\partial b} &= \frac{2r + R}{1(1 + b)^2},\end{aligned}\tag{22}$$

with a similar relationship for the other firm. We thus have:

Lemma 2: *Assume a market structure with two vertical alliances (case 2VA). For any given banner prices, each alliance advertises less on its own portal, and more on the portal of the other firm, the less differentiated the portals are perceived to be.*

Lemma 2 implies that each alliance will observe higher demand for banners from the other firm the less differentiated the portals are perceived to be. The negative externality between the firms thus implies the following (see appendix for proof):

Proposition 5: *Assume a market structure with two vertical alliances (case 2VA). Each alliance advertises less on its own portal and more on the other portal the less differentiated the portals are perceived to be. This implies that profits are decreasing in b .*

Again, the firms compete fiercely when the portals are close substitutes. It is a competition for attracting viewers, and each firm sets a high price on banners to dampen the other firm's incentive to advertise on our portal. The closer substitutes the portals are, the more they compete. This means that prices are high and the number of banners are low when firms compete fiercely.

4.3 The incentives to form alliances

In the previous subsections, we investigated different vertical structures. The curve in Figure 3 measures the difference between aggregate industry profit as a function of b when we have two vertical alliances (Π^{2VA}) and when there are no vertical alliance

(Π^{NA}). We see that total industry profit is always higher with two vertical alliances than with no vertical alliances, and the difference in industry profit is increasing in b . This implies that both portals forming alliances are good for industry profit, and even more so the less differentiated the portals are.

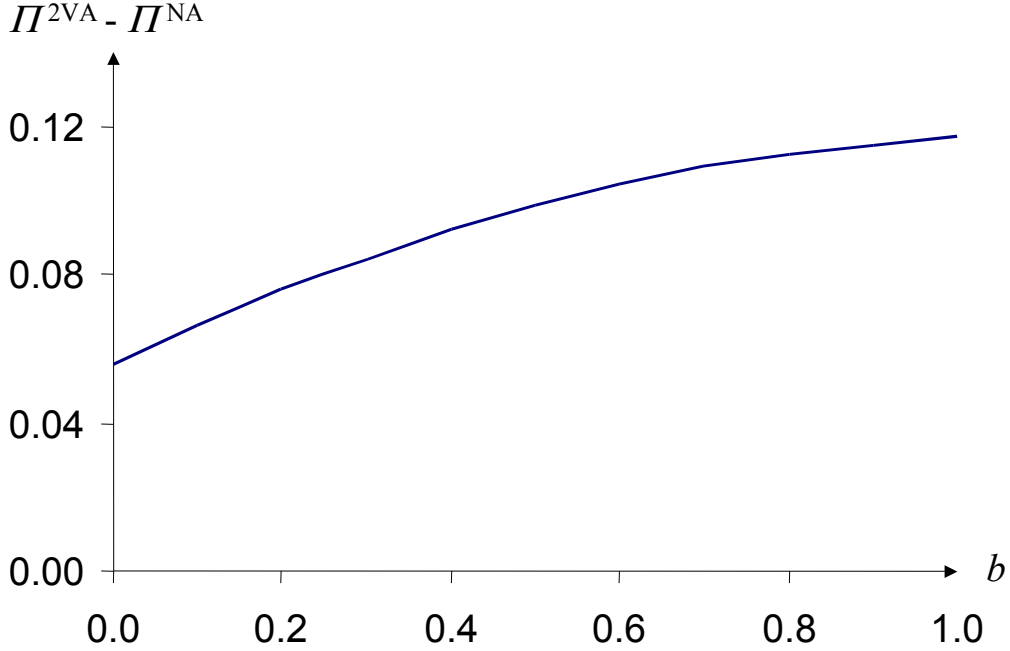


Figure 3: Industry gains from forming two vertical alliances.

Although the industry as a whole benefits from vertical alliances, this is not necessarily the equilibrium vertical structure. The question is whether the firms have incentives to form vertical alliances. Let us therefore introduce a stage 0 of the game. At stage 0 the portals simultaneously decide whether to form a vertical alliance with each their producer (here it does not matter for the outcome whether one of the portals has a first-mover advantage). Stages 1 and 2 are as before.

In Table 1, where the first number is the aggregate profit for portal P and producer 1 and the second number aggregate profit for portal p and producer 2, the outcome of the complete three-stage game is illustrated for the two extreme values $b = 0$ and $b = 1$. The equilibrium when $b = 0$ is that both portals form a vertical alliance, and this outcome maximizes aggregate industry profit. However, each portal prefers that the other portal does not form an alliance. For $b = 1$ we

have the opposite situation; each portal prefers that the other portal enters into a vertical alliance, but will not itself participate in an alliance. We therefore end up in an equilibrium where no vertical alliances will be formed when $b = 1$, and industry profit is minimized. In the appendix we prove the following proposition:

Proposition 6: *Aggregate industry profit is higher if the portals form each their vertical alliance than if they do not, and even more so the closer substitutes the portals are. Nonetheless, if the portals are sufficiently close substitutes, the equilibrium vertical structure will be no vertical alliances.*

$b = 0$	1 and P not allied	1 and P allied	$b = 1$	1 and P not allied	1 and P allied
2 and p not allied	0.22,0.22	0.27,0.19	2 and p not allied	0.17,0.17	0.16,0.24
2 and p allied	0.19,0.27	0.25,0.25	2 and p allied	0.24,0.16	0.23,0.23

Table 1: Equilibrium in the complete game.

We see that, irrespective of the other firms' choices, the best choice is to form a vertical alliance as long as the portals are sufficiently differentiated. On the other hand, the equilibrium vertical structure would be not to form vertical alliances if the portals are sufficiently close substitutes. Comparing with Figure 3, we then see that the firms find it individually rational not to form alliances in those situations where the industry as a whole has much to gain from vertical alliances. Thus, the equilibrium outcome with vertical separation is a prisoners' dilemma.

The intuition for our results is closely related to the intuition we gave in the previous section for how the degree of portal differentiation affects the firms' profits. On the one hand, vertical co-operation between two firms implies that they eliminate a double-marginalization problem. On the other hand, the independent portal can free-ride on the alliance, because it knows that the alliance will have incentives to buy many banners to degrade the quality. This fact triggers a response from the rival portal that is disadvantageous for the alliance, because the rival portal increases

its price on banners to reap the benefit from the higher demand for banners on its portals. This response is more harmful for the alliance, the less differentiated are the portals.

5 Concluding remarks

We have presented a model of media competition when consumers dislike advertising. The model complements previous models in the literature of media economics with the same feature and has the merit of being both simple and based on first principles, i.e., consumer preferences. The model has the robust prediction that advertising prices are higher, the closer substitutes the media channels are in the eyes of the consumers. The simplicity of the model makes it easy to put it to use for intriguing research questions. One such question is analyzed in detail above, namely the incentives for Internet portals, arguably one kind of media in which consumer dislike for advertising is present, to form alliances with their advertisers. We find that the option to form alliances may put the industry into a prisoners'-dilemma kind of situation, in which they do not form any alliances despite this being what maximizes industry profits.

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Appendix

Proof of equation (17)

In the second stage the alliance and the independent producer determine how many banners to insert on the two portals, taking the number of banners of the other firm and the banner prices as given. Solving $\Pi_1 = \max_{A_1, a_1} \{RA_2 + A_1V + a_1v - ra_1\}$ and $\pi_2 = \max_{A_2, a_2} \{A_2V + a_2v - RA_2 - ra_2\}$ simultaneously, we find that equilibrium in the second stage equals

$$\begin{aligned} A_1 &= \frac{(1+b) + R - rb}{3(1+b)}, & A_1 - A_2 &= \frac{R}{1+b} \\ a_1 &= \frac{(1+b) - r + Rb}{3(1+b)}, & a_1 - a_2 &= R\frac{b}{1+b}. \end{aligned} \tag{23}$$

The second-order conditions are satisfied, since $\partial\Pi_1/\partial A_1 = \partial\Pi_1/\partial a_1 = \partial\pi_1/\partial a_1 = \partial\pi_1/\partial a_2 = -2/(1-b) < 0$ for $b < 1$ and

$$\begin{aligned} \left(\frac{\partial^2\Pi_1}{\partial A_1^2}\right) \left(\frac{\partial^2\Pi_1}{\partial a_1^2}\right) - \left(\frac{\partial^2\Pi_1}{\partial A_1\partial a_1}\right)^2 &= \left(\frac{\partial^2\pi_2}{\partial A_2^2}\right) \left(\frac{\partial^2\pi_2}{\partial a_2^2}\right) - \left(\frac{\partial^2\pi_2}{\partial A_2\partial a_2}\right)^2 \\ &= 4\frac{1+b}{1-b} > 0 \text{ for } b < 1. \end{aligned}$$

Proof of Proposition 3

Using (23) we find that

$$\begin{aligned} \frac{\partial\Pi_1}{\partial R} &= \frac{5}{3}A_2 = 0 \\ \frac{\partial\pi_p}{\partial r} &= -\frac{2}{3(b+1)}r + a_1 + a_2 = 0, \end{aligned}$$

which implies that

$$R = 2\frac{(1+b)(2-b)}{8-b^2} \quad (24)$$

and

$$r = \frac{4-b^2+3b}{8-b^2}. \quad (25)$$

The first-order conditions constitute an optimum, since $\partial^2\Pi_1/\partial R^2 = -10/(9(1+b)) < 0$ and $\partial^2\Pi_1/\partial r^2 = -4/(3(1+b)) < 0$.

Inserting for (24) and (25) into (23) we find $A_2 = 0$,

$$A_1 = 2\frac{2-b}{8-b^2}, \quad a_1 = \frac{4+5b-3b^2}{3(8-b^2)} \text{ and } a_2 = \frac{4-7b+3b^2}{3(8-b^2)}. \quad (26)$$

From this we see that $a_2|_{b=1} = 0$, which together with $A_2 = 0$ proves Proposition 3a. Proposition 3b is proved by noting that $\partial A_1/\partial b < 0$ and $\partial a_1 > 0$, while the fact that $a_1 - a_2 = 2b(2-b)/(8-b^2) > 0$ for $b > 0$ proves Proposition 3c.

Proof of Proposition 4

Inserting in the profit function for banner prices in (24) and (25) and the number of banners in (26), we obtain

$$\begin{aligned}\Pi_1 &= \frac{160 - 40b - 75b^2 + 27b^3}{9(8 - b^2)^2}, \\ \pi_p &= 2\frac{(1+b)(4-b)^2}{3(8-b^2)^2} \text{ and} \\ \pi_2 &= \frac{(1-b)(4-3b)^2}{9(8-b^2)^2},\end{aligned}$$

from which it follows that $\Pi_1 < \pi_p$ if $b > b_2 \approx 0.64$ and $\Pi_1 < \pi_p + \pi_2$ if $b > b_1 = 8/5 - (2/5)\sqrt{6} \approx 0.62$.

Proof of Proposition 5

With two vertical alliances the profit levels are given by equation (19). In the second stage the firms choose their advertisement levels, which yield A_i and a_i in equations (20) and (21). Using this, we find that the portals in the first stage choose

$$R = r = 5\frac{1+b}{10+b},$$

which means that

$$A_1 = a_2 = \frac{5-3b}{10+b}; \quad \frac{\partial A_1}{\partial b} = \frac{\partial a_2}{\partial b} = -\frac{35}{(10+b)^2}$$

and

$$a_1 = A_2 = 2\frac{b}{10+b}; \quad \frac{\partial a_1}{\partial b} = \frac{\partial A_2}{\partial b} = \frac{20}{(10+b)^2}$$

The profit level of the firms are then equal to

$$\Pi_1 = \Pi_2 = \frac{(5-b)(5+2b)}{(10+b)^2}; \quad \frac{\partial \Pi_1}{\partial b} = \frac{\partial \Pi_2}{\partial b} = -45\frac{b}{(10+b)^3}.$$

Proof of Proposition 6

Let us assume that portal p and producer 2 have not formed any alliance. Then portal P and producer 1 would find it profitable to form an alliance if:

$$\frac{160 - 40b - 75b^2 + 27b^3}{9(8 - b^2)^2} > \frac{2}{9(2+b)^2} + \frac{2(1+b)}{3(2+b)^2}$$

The left hand side is the profit if alliance, while the right hand side is the profit if no alliance. It can be shown that there exists a $b_Z \in (0, 1)$ such that this is true if $b < b_Z$.

Let us assume that portal P and producer 1 have formed an alliance. Then portal p and producer 2 would also find it profitable to co-operate if:

$$\frac{(5-b)(5+2b)}{(10+b)^2} > 2 \frac{(1+b)(4-b)^2}{3(8-b^2)^2} + \frac{(1-b)(4-3b)^2}{9(8-b^2)^2}$$

The left hand side is the profit if they form an alliance, while the right hand side is the profit if they do not. It can be shown that there exists a $b_Y \in (0, 1)$ such that this is true if $b < b_Y$. It can easily be shown that $b_Z > b_Y$.