

# COMPETITION FOR VIEWERS AND ADVERTISERS IN A TV OLIGOPOLY

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# COMPETITION FOR VIEWERS AND ADVERTISERS IN A TV OLIGOPOLY

## Abstract

We consider a model of a TV oligopoly where TV channels transmit advertising and viewers dislike such commercials. We show that advertisers make a lower profit the larger the number of TV channels. If TV channels are sufficiently close substitutes, there will be underprovision of advertising relative to social optimum. We also find that the more viewers dislike ads, the more likely it is that welfare is increasing in the number of advertising financed TV channels. A publicly owned TV channel can partly correct market distortions, in some cases by having a larger amount of advertising than private TV channels. It may even have advertising in cases where advertising is wasteful per se.

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# 1 Introduction

The TV industry is important both in terms of the time people spend watching TV and the amount of advertising it transmits.<sup>1</sup> However, advertising-financed channels are potentially a mixed blessing. On the one hand, TV commercials may be the most efficient way for firms to advertise their products and can generate a surplus both for individual firms and for society as a whole. On the other hand, viewers may dislike being interrupted by commercials.<sup>2</sup> We thus have an ambiguity that raises the questions of whether there is over- or underprovision of advertising on TV and of whether there is a need for some kind of public intervention in the sector. Would it for instance be advantageous to restrict entry of commercial TV channels if consumers dislike ads?

In this paper, we set out to provide answers to these questions with the help of a simple model in which TV stations sell advertising space to advertisers. The basis for the advertisers' willingness to pay for such advertising space is the attention of the TV viewers that the stations attract. And in order to attract viewers, the stations offer TV programs. Thus, the TV industry is an example of a two-sided market: TV stations offer programs to viewers and advertising space to advertisers, with externalities in both directions.<sup>3</sup> We find that there is too little advertising on TV when the channels' programs are close substitutes, and that the scope for such underprovision of advertising increases when the number of TV channels increases. We further show that the more viewers dislike ads, the more likely it is that welfare is *increasing* in the number of advertising financed TV channels.

Well-known discussions of the welfare effects of advertising, such as Dixit and Norman (1978) and Becker and Murphy (1993), do not take into account the role of media firms as transmitters of advertising.<sup>4</sup> An early attempt to do so is in Spence and Owen (1977). However, in their discussion of advertising-financed TV vs. pay TV, the presence of advertising is assumed to have no effect on viewers. Wildman and Owen (1985) extend the Spence-Owen model to take into account that commercials are a nuisance to TV viewers. Our analysis differs from the work of Spence-Owen and Wildman-Owen in that we model strategic interactions between TV stations in an oligopoly, whereas they assume monopolistic competition without any strategic interaction. Moreover, in these model the price of commercials is exogenously determined, whereas we let it be endogenously determined. This is important for understanding strategic interaction

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<sup>1</sup>In 1995, the average adult male American spent 17.3 hours watching TV each week (Robinson and Godbey, 1999). In 2002, TV advertising in the US amounted to approximately USD 50 billion, out of a total of approximately USD 115 billion spent on advertising (see *Advertising Age*, <http://www.adage.com/images/random/lna03.pdf>).

<sup>2</sup>It is documented that viewers try to avoid advertising breaks, see for example Moriarty and Everett (1994) and Danaher (1995). See also Wilbur (2005), who estimates a model of TV competition and finds viewers' disutility from advertising to be significant and positive.

<sup>3</sup>To be precise, advertisers impose negative externalities on viewers, while viewers impose positive externalities on advertisers. For general introductions to the theory of two-sided markets, see Armstrong (2005a) and Rochet and Tirole (2005).

<sup>4</sup>For a survey of the economics literature on advertising, see Bagwell (2005).

in media markets. For example, we show that tougher competition caused by greater substitutability between TV channels leads to higher advertising prices, while tougher competition caused by an increase in the number of TV channels leads to lower advertising prices. In other respects, however, our approach is similar to that of Spence and Owen (1977) and Wildman and Owen (1985). In particular, we follow them in modeling the demand for TV programs by way of a quadratic utility function of a representative viewer.

In recent analyses of the media market, such as Gal-Or and Dukes (2003), Gabszewicz, *et al.* (2004), Anderson and Gabszewicz (2005), and Peitz and Valletti (2005), viewers are located along a Hotelling (1929) line, varying according to their preferences for TV-program content, and TV channels choose positions on that line.<sup>5</sup> Thereby product differentiation is endogenously determined. But this comes at a cost: First, these analyses are limited to discussions of duopoly and have small chances of being generalizable to an oligopoly. Secondly a Hotelling analysis fixes the total size of the market (*i.e.*, the total amount of TV viewing). Thirdly, each viewer is assumed to watch one channel only. We choose a different angle and fix the degree of product differentiation, in line with the earlier work of Spence and Owen (1977) and Wildman and Owen (1985). A major benefit is that we can discuss oligopoly and do not have to limit ourselves to duopoly. This is particularly interesting since most democratic countries have reduced or eliminated regulatory entry barriers for TV channels over the last decades. A major insight from our analysis is that a larger number of advertising-financed TV channels is more likely to have positive welfare effects, the higher is the consumers' disutility from advertising. The intuition for this somewhat paradoxical result is that more competition, in the sense of an increase in the number of TV channels, forces each TV channel to reduce its amount of utility-reducing advertising, and the positive welfare effects of less advertising are greater the more the consumers dislike advertising, other things equal.

Our approach allows for a framework in which the time people spend watching TV is endogenous, depending on the extent of competition. As in most other markets, our model features the appealing property that stronger competition leads to higher output, *i.e.*, to people spending more time watching TV. Finally, our formulation allows a viewer to allocate his time between different channels. This increases the competition in the market for advertising space, as each TV channel can offer advertisers a little of each viewer's attention.

In many European countries there are mixed oligopolies in the TV industry with both publicly and privately owned TV channels.<sup>6</sup> Introducing a welfare-maximizing

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<sup>5</sup>See also the work by Anderson and Coate (2005), who do a welfare analysis in such a Hotelling-style setting. Other contributions in the recent literature on the economic analysis of media industries include Nilssen and Sjørgard (2003), Dukes (2004), Armstrong (2005a), and Crampes, *et al.* (2005). The seminal work is Steiner (1952). For a review of the early literature, see Owen and Wildman (1992). The more recent literature is reviewed by Anderson and Gabszewicz (2005).

<sup>6</sup>See Motta and Polo (1997) for a survey of the media industry in Europe. See Armstrong (2005b) and Armstrong and Weeds (2005) for some recent discussions on public service broadcasting.

publicly owned TV channel into our model, we show that, for sufficiently differentiated TV channels, the public TV channel sells less advertising space than the private channels. Thereby the overprovision of advertising in a system with only privately owned TV channels is mitigated. Conversely, the public TV channel brings more advertising than the private ones if TV programs are sufficiently close substitutes. In fact, we find that a welfare-maximizing public TV channel advertises even in some cases where advertising is *per se* wasteful (*i.e.*, where the disutility of viewers exceeds the surplus that the advertising generates for the advertisers).

This article is organized as follows. The formal model is presented in the next section, and in Section 3 we derive the equilibrium outcomes. In Section 4 we find social optimum, and in Section 5 we compare market equilibrium and social optimum. In Section 6 we introduce a welfare-maximizing TV channel that is owned by the government. Finally, we offer some concluding remarks in Section 7.

## 2 The model

We consider a model with  $m \geq 2$  TV stations and a continuum of identical viewers with measure one. The time that each viewer spends watching TV programs on channel  $i = 1, \dots, m$  is denoted by  $V_i$ . We follow Motta (2004) and assume that consumers' preferences are given by the Shubik-Levitan utility function, originally introduced by Shubik and Levitan (1980):

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

We may interpret  $V_i$  both as the time that each viewer spends watching channel  $i$  and as the number of viewers of channel  $i$ , since we have normalized the population size to 1. The parameter  $s \in [0, 1)$  is a measure of product differentiation: The higher is  $s$ , the closer substitutes are the TV channels from the viewers' point of view. The Shubik-Levitan formulation ensures that the parameter  $s$  only captures product differentiation and has no effect on market size.<sup>7</sup>

We consider TV channels that are financed by advertising and that viewers can watch free of charge. Viewers have a disutility of being interrupted by commercials. To capture this, we assume that viewers' subjective cost of watching channel  $i$  is  $C_i = \gamma A_i V_i$ , where  $A_i$  is the level of advertising on TV channel  $i$  and  $\gamma > 0$  is a parameter that measures the viewers' disutility from advertising. A viewer's consumer surplus is thus given by

$$CS = U - \gamma \sum_{i=1}^m A_i V_i.$$

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<sup>7</sup>Note that this is in contrast to the standard quadratic utility function, where one and the same parameter measures both product differentiation and market size. See Motta (2004) for details.

In a sense, advertising is an indirect price: It has the same function in the market for TV programs as prices have in other markets.

By setting  $\frac{dCS}{dV_i} = 0$ , we find viewers' demand for TV channel  $i$ :

$$V_i = \frac{1}{m} \left[ 1 - \gamma \frac{A_i - s\bar{A}}{1 - s} \right], \quad i = 1, \dots, m, \quad (2)$$

where  $\bar{A} = \frac{1}{m} \sum_{i=1}^m A_i$  is the average level of advertising on the  $m$  channels. The time viewers spend watching channel  $i$  is thus strictly decreasing in the advertising level on that channel, and more so the higher their disutility of being interrupted by commercials (captured by  $\gamma$ ), and increasing in the advertising levels on the competing channels: The more advertising there is on the rival channels, the more attractive is channel  $i$  for the viewers.

TV channel  $i$  charges the price  $R_i$  per advertising slot. Disregarding any production costs, we set the profit of channel  $i$  equal to

$$\Pi_i = R_i A_i, \quad i = 1, \dots, m. \quad (3)$$

Let  $A_{ik}$  denote advertiser  $k$ 's advertising level on channel  $i$ . The advertiser's gross gain from advertising at channel  $i$  is naturally increasing in its advertising level and in the number of viewers exposed to its advertising. We make it simple by assuming that the gross gain equals  $A_{ik} V_i$ . This implies that the net gain for advertiser  $k$  from advertising on TV equals

$$\pi_k = \left( \sum_{i=1}^m A_{ik} V_i \right) - \left( \sum_{i=1}^m A_{ik} R_i \right), \quad k = 1, \dots, n, \quad (4)$$

where  $n$  is the number of advertisers. With a slight abuse of terminology, we label  $\pi_k$  the profit of advertiser  $k$ . The advertisers' aggregate profit equals  $\pi_A \equiv \sum_{k=1}^n \pi_k$ .

Most of the analyses in the literature consider the advertisers to be price takers and derive demand for advertising by way of a zero-profit condition on the marginal advertiser's profit.<sup>8</sup> We find it useful to do this differently, and more in line with models of successive oligopoly, such as Salinger (1988), where producers and retailers set quantities sequentially. We consider the following two-stage game:

Stage 1: TV channels set advertising levels.

Stage 2: The advertisers choose how much advertising to buy.

One noteworthy feature of our set-up is that the TV channels are quantity setters in advertising. If program choice is inflexible in the short run – with a given amount of time between each program – such an assumption is plausible. However, there might

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<sup>8</sup>An exception is Gal-Or and Dukes (2003), who model pairwise negotiations between TV channels and advertisers.

be arguments indicating that TV channels are more flexible concerning the amount of advertising.<sup>9</sup> If so, price setting on advertising is a more natural choice. It can be shown that our main results still hold if we assume price setting rather than quantity setting among TV channels.<sup>10</sup>

Unless stated otherwise, we assume that the TV channels act non-cooperatively.

### 3 Equilibrium outcomes

We solve the game by backward induction. At stage 2, the advertisers simultaneously determine how much to advertise on each of the  $m$  channels, taking advertising prices as given. Solving  $\frac{\partial \pi_k}{\partial A_{ik}} = 0$  simultaneously for the  $n$  advertisers and then using  $A_i = \sum_{k=1}^n A_{ik}$ , we find that demand for advertising at channel  $i$  equals

$$A_i = \frac{1}{\gamma} \frac{n}{n+1} [1 - m(1-s)R_i - ms\bar{R}], \quad i = 1, \dots, m, \quad (5)$$

where  $\bar{R} = \frac{1}{m} \sum_{i=1}^m R_i$  is the average advertising price on the  $m$  channels. As expected, we thus have a downward-sloping demand curve for advertising ( $\frac{dA_i}{dR_i} < 0$ ). More interestingly, we see that demand for advertising on each channel is decreasing also in the other channels' advertising prices ( $\frac{dA_i}{dR_j} < 0, \forall j \neq i$ ). This follows from the viewers' dislike for advertising. To see why, suppose that  $R_j$  increases, so that the advertising level on channel  $j$  falls. This channel thereby becomes more attractive for the viewers, while any channel  $i \neq j$  becomes relatively less attractive. The latter in turn means that channel  $i$  will have a smaller audience, which translates into a lower demand for advertising. As is standard in markets with this property, the TV channels' advertising levels are strategic complements (see Vives, 1999).

Using (5), we can write the inverse aggregate demand curve for advertising on channel  $i$  as

$$R_i = \frac{1}{m} \left[ 1 - \gamma \frac{n+1}{n} \frac{A_i - s\bar{A}}{1-s} \right], \quad i = 1, \dots, m. \quad (6)$$

Note that

$$\frac{dR_i}{ds} = -\frac{\gamma}{m} \frac{n+1}{n} \frac{A_i - \bar{A}}{(1-s)^2}.$$

This means that the marginal willingness to pay for advertising on a channel is increasing in  $s$  if and only if the advertising level on that channel is lower than the average

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<sup>9</sup>When transmitting newscasts or sport events, the TV channels are quite flexible with respect to how much advertising to show. Moreover, to accommodate a low amount of advertising a TV channel can fill in with advertising for its own programs ('tune-ins'). For details concerning tune-ins, see Shachar and Anand (1998).

<sup>10</sup>Barros *et al.* (2004) formulate a model where media firms set prices of advertising rather than quantities. The equilibrium outcomes they find are analogous to the ones we report here. For a more detailed discussion of price versus quantity competition in the market for TV advertising, see Nilssen and Sørsgard (2003).

( $A_i < \bar{A}$ ): The less differentiated the TV programs, the more prone viewers are to shift from a channel with much advertising to channels with little advertising.

The TV channels set their advertising levels non-cooperatively at stage 1. (For the case where TV channels collude on advertising levels, see below.) Solving  $\frac{d\Pi_i}{dA_i} = 0$ ,  $i = 1, \dots, m$ , subject to (6), we find that the equilibrium advertising level at each TV channel equals

$$A_i^M = \frac{1}{\gamma} \frac{n}{n+1} \frac{m(1-s)}{(m-s) + m(1-s)}, \quad i = 1, \dots, m, \quad (7)$$

where the superscript  $M$  denotes market equilibrium. From this equation we see that the advertising level is decreasing in the viewer disutility of advertising ( $\gamma$ ), which is quite natural.<sup>11</sup> Moreover,  $\frac{dA_i^M}{dn} > 0$ : An increase in the number of advertisers increases the demand for advertising, and it becomes optimal for the TV channels to offer more advertising space.

Inserting (7) into (2), we find equilibrium TV viewing on each channel:

$$V_i^M = \frac{(n+1)(m-s) + m(1-s)}{m(n+1)[(m-s) + m(1-s)]}, \quad i = 1, \dots, m. \quad (8)$$

Multiplying this expression by  $m$ , we see that total viewing time ( $mV_i^M$ ) depends on the number and substitutability of TV channels. In other words, total sales vary with the competitive pressure between the firms. This realistic feature of our model is in contrast to the widely used Hotelling framework, where the size of the market by definition is constant.

We note from (8) that TV viewers' equilibrium consumption is unaffected by  $\gamma$ ; the TV channels completely internalize the consumers' disutility of advertising through the level of advertising.

From (7) we find that  $\frac{dA_i^M}{ds} < 0$ , which means that the equilibrium advertising level is lower the less differentiated the TV channels. To understand this result, note that a TV channel attracts viewers by limiting the amount of advertising. The better substitutes the viewers perceive the TV channels to be, the more sensitive they are to differences in levels of advertising. A high  $s$  thus gives each TV channel an incentive to set a relatively low advertising level in order to capture viewers from the other channel. Corresponding to lower levels of advertising when  $s$  increases, TV viewers' consumption increases:  $\frac{dV_i^M}{ds} > 0$ .

Finally, we get the typical effects of an increase in the number of competitors: Each firm's output is reduced ( $\frac{dA_i^M}{dm} < 0$ , and  $\frac{dV_i^M}{dm} < 0$ ), while total output is increased ( $\frac{d(mA_i^M)}{dm} > 0$ , and  $\frac{d(mV_i^M)}{dm} > 0$ ). Again, these are results that cannot be obtained in the Hotelling framework, where  $mV_i^M$  is fixed.

Summarizing our main results so far, we have:

**Proposition 1:** (a) *The larger the number of TV channels*

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<sup>11</sup>See also Anderson and Coate (2005).

- (i) the less time do viewers spend on each individual TV channel, but
- (ii) the more time do they spend on TV viewing in total.
- (b) The equilibrium level of advertising on each channel is smaller
  - (i) the less differentiated the TV channels' programs;
  - (ii) the higher the viewers' disutility of advertising; and
  - (iii) the higher the numbers of TV channels.

At the same time as competition forces the TV channels to reduce their advertising levels, it allows them to charge a higher slotting price  $R_i^M$  and a higher contact price per viewer,  $r_i^M \equiv \frac{R_i^M}{V_i^M}$ :

$$R_i^M = \frac{m-s}{m[(m-s)+m(1-s)]}, \quad \frac{dR_i^M}{ds} > 0; \quad \text{and} \quad (9)$$

$$r_i^M = \frac{(n+1)(m-s)}{(n+1)(m-s)+m(1-s)}, \quad \frac{dr_i^M}{ds} > 0. \quad (10)$$

By insertions into the expressions for profit in (3) and (4), we can now find the equilibrium profit levels of TV stations and advertisers:

$$\Pi_i^M = \frac{1}{\gamma} \frac{n}{n+1} \frac{(m-s)(1-s)}{[(m-s)+m(1-s)]^2}, \quad \text{and} \quad (11)$$

$$\pi_k^M = \frac{1}{\gamma} \left[ \frac{m(1-s)}{(n+1)[(m-s)+m(1-s)]} \right]^2. \quad (12)$$

Differentiations of (11) and (12) show that profits are decreasing in both  $\gamma$  and  $s$ . This is natural, since the level of advertising is lower the larger the consumers' disutility of advertising and the closer substitutes are the TV channels' programs.

Recall that the slotting price is higher the closer substitutes the consumers perceive the TV channels to be. This is because reduced differentiation increases the competitive pressure. If consumers dislike ads, then the TV channels will subsequently have less advertising ( $\frac{dA_i^M}{ds} < 0$ ) and a higher equilibrium price on ads ( $\frac{dR_i^M}{ds} > 0$ ). The same kind of reasoning might lead one to expect that the slotting price also increases in the number of TV channels. This is not true. From equation (9) we find, on the contrary, that  $\frac{dR_i^M}{dm} < 0$ . The intuition is that the market power of each TV channel falls when the number of channels increases. This forces the TV channels to reduce the slotting prices.

The contact price per viewer ( $r_i^M = \frac{R_i^M}{V_i^M}$ ), on the other hand, is unambiguously increasing in the competitive pressure [if  $s \in (0, 1)$ ]. This holds whether the higher pressure is caused by a larger number of competitors or by less product differentiation:  $\frac{dr_i^M}{dm}, \frac{dr_i^M}{ds} > 0$ . It thus becomes more expensive for the advertisers to reach each viewer the larger the number of channels. We therefore get the somewhat surprising result

that the profit level of the advertisers is decreasing in the number of TV channels:  $\frac{d\pi_k^M}{dm} < 0$ .

We summarize our results concerning profits:

**Proposition 2:** *Equilibrium profits for both TV channels and advertisers are higher*

- (i) *the more differentiated the TV channels' programs,*
- (ii) *the lower the viewers' disutility of advertising, and*
- (iii) *the lower the number of TV channels.*

We note that a lower advertising level on each channel is an advantage for consumers. Additionally, consumers gain because an increase in  $m$  means that the diversity of TV channels increases. We thus unambiguously have  $\frac{dCS}{dm} > 0$ .

We end this section with an extension to the case where there is collusion among the TV channels about levels of advertising. When  $s = 0$ , the TV channels' programs are independent, and collusion has no effect at all. At the other extreme, we know that the TV channels compete away (almost) all advertising and have close to zero profits when  $s$  approaches 1. This is a prisoners' dilemma situation, where the firms would have been jointly better off with more advertising on all channels. This suggests that collusion between the TV channels leads to more advertising than in the non-cooperative equilibrium for all  $s \in (0, 1)$ , and more so the less differentiated the TV programs.<sup>12</sup> We derive the first-order conditions for a collusive outcome from the TV channels' joint profit-maximization problem. We find that the equilibrium advertising level for channel  $i$  now equals:

$$A_i^C = \frac{1}{2\gamma} \frac{n}{n+1}, \quad i = 1, \dots, m. \quad (13)$$

where the superscript  $C$  denotes collusion. Note that differentiation as such does not play any role if the TV channels collude. The reason is that a reduction in differentiation has no competitive effect in a collusive outcome, and therefore does not trigger any change in the chosen level of advertising.

By substituting  $A_i^C$  into the expressions for profit in (3) and (4), we find profits for the TV channels and the advertisers, respectively:

$$\Pi_i^C = \frac{1}{8\gamma} \frac{n}{n+1}, \quad \text{and} \quad \pi_k^C = \frac{1}{4\gamma} \frac{1}{(n+1)^2}, \quad i = 1, \dots, m, \quad k = 1, \dots, n.$$

The following can now be established:

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<sup>12</sup>When viewers dislike ads, advertising is like an indirect price of watching TV. Collusion enables TV channels to increase this indirect price and thus have more advertising. Our analysis relates to the informal discussion in Wildman (1998), who points out that introducing viewer disutility of advertising provides a tendency for advertising to be higher when TV channels collude than when they compete. The question is also discussed in Masson, et al. (1990), but their analysis disregards any externalities between viewers and advertisers.

**Proposition 3:** *For any  $s \in (0,1)$ , advertising levels and profits, for both TV channels and advertisers, are higher when the TV channels collude on advertising than when they act non-cooperatively.*

We see from Proposition 3 that also the advertisers gain when the TV channels collude. The reason is that such collusion increases the amount of advertising, and reduces the contact price per viewer.

## 4 Social optimum

We express welfare as the sum of consumers' surplus and TV channels' and advertisers' profits:

$$W = CS + \sum_{i=1}^m \Pi_i + \sum_{k=1}^n \pi_k. \quad (14)$$

With a total of  $\sum_{i=1}^m A_i$  advertising slots on the  $m$  TV channels, the advertisers have an aggregate gross gain from advertising on TV equal to  $\sum_{i=1}^m A_i V_i$ . The money-equivalent consumer disutility from this advertising equals  $\gamma (\sum_{i=1}^m A_i V_i)$ . In order to cultivate the mechanisms that could make the media market underprovide advertising, we assume that no additional consumer surplus is generated by the sales of products triggered by TV advertising. (We could clearly have too little advertising if this extra surplus were assumed to be high.) With this set-up, we thus 'minimize' the social gains from advertising. Accordingly, we can express welfare as

$$W = U + (1 - \gamma) \left( \sum_{i=1}^m A_i V_i \right). \quad (15)$$

From the welfare function, we immediately see that advertising on TV is socially beneficial if and only if  $\gamma < 1$ . In contrast, there will be advertising in market equilibrium even when  $\gamma \geq 1$ . Formally, by solving  $\frac{dW}{dA_i} = 0$ ,  $i = 1, \dots, m$ , subject to viewer behavior in (2), we find that the socially optimal advertising level equals, for  $i = 1, \dots, m$ :

$$A_i^* = \begin{cases} \frac{1-\gamma}{\gamma(2-\gamma)}, & \text{if } 0 < \gamma < 1 \\ 0, & \text{if } \gamma \geq 1 \end{cases} \quad (16)$$

Note that the socially optimal amount of advertising is independent of how close substitutes the TV channels' programs are (*i.e.*, it is independent of  $s$ ). This is natural, since commercials are equally disturbing for the consumers regardless of the extent of horizontal differentiation between the TV channels. The optimal level of advertising is thus only a function of  $\gamma$ , the viewers' disutility parameter. Differentiation of (16) shows the intuitively obvious result that  $A_i^*$  is decreasing in consumers' disutility of advertising for  $\gamma \in (0, 1)$ .

Inserting for  $A_i^*$  shows that welfare in social optimum equals

$$W^* = \begin{cases} \frac{1}{2\gamma(2-\gamma)}, & \text{if } 0 < \gamma < 1 \\ \frac{1}{2}, & \text{if } \gamma \geq 1. \end{cases} \quad (17)$$

From (17) we see that  $\frac{dW^*}{d\gamma} < 0$  for  $\gamma \in (0, 1)$ . The reason for this relationship is two-fold. First, consumer surplus is decreasing in  $\gamma$ . This is a direct effect. Second, there is an indirect effect through the advertising level. We know that higher disutility leads to a lower amount of advertising in social optimum ( $\frac{dA_i^*}{d\gamma} < 0$  for  $\gamma \in (0, 1)$ ). This results in a reduction in society's use of value-enhancing TV commercials.

To sum up, we have:

**Proposition 4:** *In social optimum, advertising levels and welfare are decreasing in viewers' disutility from advertising, and there is no advertising in optimum if this disutility is sufficiently high (i.e., if  $\gamma \geq 1$ ). Optimum advertising and welfare are, however, independent of the degree of product differentiation.*

## 5 A comparison

The equilibrium outcome depends on whether TV channels compete or collude with respect to levels of advertising. We first compare the social optimum with the non-cooperative, or market, equilibrium, and then with the collusive equilibrium.

In market equilibrium there will be advertising for all values of  $\gamma$ , while it is socially optimal to have no advertising if  $\gamma \geq 1$ . The excess level of advertising on each channel in market equilibrium in this case is trivially given by equation (7). The interesting case to consider is therefore  $\gamma < 1$ . Using equations (7) and (16) and suppressing subscripts, we find that the difference between advertising levels in social optimum and in equilibrium can be written as

$$A^* - A^M = \frac{(m-1)(n-1+\gamma) + n\gamma}{\gamma(2-\gamma)(n+1)[m(1-s) + m-s]} (s - \hat{s}), \quad (18)$$

where

$$\hat{s} = \frac{m[\gamma(n+2) - 2] + 2s(1-\gamma)}{(m-1)(n-1+\gamma) + n\gamma}. \quad (19)$$

Both the numerator and the denominator in the first term on the right-hand side of (18) are positive. We therefore see that there is too much advertising in market equilibrium ( $A^M > A^*$ ) if and only if  $s < \hat{s}$ . The driving force behind this result is the fact that TV stations have high market power over their viewers when the channels' program contents are poor substitutes ( $s$  small). The TV channels exploit this market power by selling a larger amount of advertising slots to the advertisers, even though this reduces viewers' utility from watching TV. However, competition for viewers forces the TV channels to reduce their level of advertising, and this competition is stronger the closer substitutes their programs. Indeed, as seen from (7), independent of viewers' disutility of advertising, the equilibrium advertising level goes to zero in the limit as

$s$  approaches one. This is obviously below social optimum if  $\gamma < 1$ . More generally, competition between the TV channels is so tough if  $s > \hat{s}$  that there is underprovision of advertising in equilibrium. Naturally,  $\frac{d\hat{s}}{d\gamma} > 0$ : the higher the viewer's disutility from advertising, the smaller is the range of  $s$  for which there is underprovision of advertising. In addition, we see that  $\frac{d\hat{s}}{dm} < 0$ . This means that the range of  $s$  for which there is too little advertising is an increasing function of  $m$ . This follows from the equilibrium level of advertising on each channel being decreasing in  $m$  (cf. Proposition 1). We have:

**Proposition 5:** (a) *There is too little advertising in equilibrium if the TV channels' programs are close substitutes, in particular if  $s > \hat{s}$ , and too much advertising if  $s < \hat{s}$ .*  
(b) *The range  $(\hat{s}, 1)$  of values for  $s$  for which there is too little advertising gets larger the lower the viewers' disutility from advertising and the larger the number of TV channels.*

By inserting for equilibrium values in (15), we obtain an expression for welfare in market equilibrium:

$$W^M = \frac{[m(1-s) + (n+1)(m-s)] [\gamma(n+1)(m-s) + m(1-s)(\gamma+2n)]}{2\gamma[(m-s) + m(1-s)]^2 (n+1)^2} \quad (20)$$

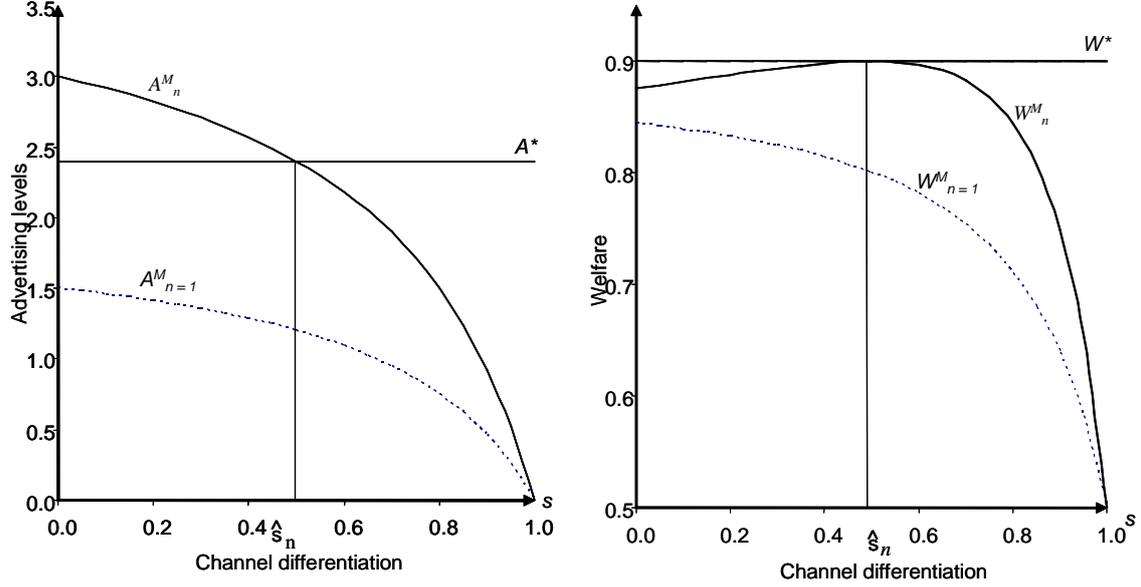
Differentiating (20) with respect to  $s$  and  $n$ , we have:

$$\begin{aligned} \frac{dW^M}{ds} &= -nm \frac{(m-1)[(m-1)(n-1+\gamma) + n\gamma]}{\gamma[(m-s) + m(1-s)]^3 (n+1)^2} (s - \hat{s}), \text{ and} \\ \frac{dW^M}{dn} &= \left(\frac{1-s}{n+1}\right) \frac{m[(m-1)(n-1+\gamma) + n\gamma]}{\gamma[(m-s) + m(1-s)]^2 (n+1)^2} (s - \hat{s}). \end{aligned}$$

There is too much advertising in market equilibrium if  $s < \hat{s}$ . In this case, an increase in  $s$  or a reduction in  $n$  (corresponding to a downward-shift in the demand for advertising) results in higher welfare, since less product differentiation or a smaller number of advertisers would result in less advertising. Likewise, more product differentiation and a larger number of advertisers would be welfare improving if  $s > \hat{s}$ , since in this case there will be too little advertising from a social point of view. Indeed, if the consumers' disutility of advertising is sufficiently low, even a monopoly TV station ( $s = 0$ ) will have too little advertising from a social point of view if  $n$  is small.

The relationship between advertising in market equilibrium and in social optimum is illustrated in the left-hand side panel of Figure 1, where we have set  $m = 2$  and  $\gamma = \frac{1}{3}$ . The curves labelled  $A_{n=1}^M$  and  $A_n^M$  correspond to equilibrium in the case of  $n = 1$  and  $n \rightarrow \infty$  advertisers, respectively. For all  $s < 1$ , the latter curve has the higher values. This is because the equilibrium level of advertising is increasing in  $n$ . The social optimum, on the other hand, is independent of  $n$ . The right-hand side panel of Figure 1 shows the corresponding relationship between channel differentiation and

welfare. Note in particular the inefficiency of the market economy for high values of  $s$ .



**Figure 1:** Comparison between social optimum and market equilibrium ( $m = 2$  and  $\gamma = \frac{1}{3}$ ).

Since an increase in  $m$  means that profits fall and consumer surplus increases, it is clear that the welfare effects of a larger number of TV channels are ambiguous:

$$\frac{dW^M}{dm} = \frac{ns(1-s)[(2m-s(1+n+m))(\gamma-1) + nm(\gamma-s)]}{\gamma[(m-s) + m(1-s)]^3(n+1)^2} \begin{matrix} \geq \\ \leq \end{matrix} 0. \quad (21)$$

More interestingly, by differentiating equation (21) we find

$$\frac{d^2W^M}{dm d\gamma} = \frac{n(1-s)s[ns(m-1) + 2m - s(1+m)]}{\gamma^2[(m-s) + m(1-s)]^3(n+1)^2} > 0. \quad (22)$$

Equation (22) has the non-trivial implication that the welfare effect of a larger number of advertising-financed TV channels is more likely to be positive the higher the viewers' disutility from advertising. The intuition is quite clear: Competition in the form of an extra TV channel forces each of the existing channels to reduce its level of advertising, and the social gain from this is higher the more consumers dislike advertising.

Summing up, we have

**Proposition 6:** *Suppose the number of TV channels increases.*

(i) *The profit levels of both TV channels and advertisers fall, while consumer surplus increases, so that the effect on total welfare is ambiguous.*

(ii) *Aggregate welfare is more likely to increase the larger the viewers' disutility of advertising.*

Finally, let us compare the collusive outcome with the social optimum. When the TV channels collude, they are able to counter the effect of product differentiation. Therefore, advertising levels will be independent of  $s$ . This is true also for social optimum, and by comparing (13) and (16) we find:

**Proposition 7:** *In an equilibrium in which the TV channels collude on advertising, there is too little advertising if  $\gamma < \frac{2}{n+2}$  and too much advertising if  $\gamma > \frac{2}{n+2}$ .*

We know that a shift from competition to collusion leads to more advertising. However, Proposition 7 shows that there can be underprovision of advertising even with collusion. The reason for this is that, for any finite number of  $n$ , the advertisers will have some market power over the TV channels (‘monopsony power’). All else equal, this means that demand for advertising is too small from a social point of view. Only in the limit as  $n \rightarrow \infty$  will it be true that collusion between the TV channels necessarily generates too much advertising.

## 6 Public policy: Mixed duopoly

The analysis above suggests that the level of advertising in market equilibrium may be too high from a social point of view, particularly if the TV channels are poor substitutes. In this case a public regulation that places an upper limit on the level of advertising may be a welfare enhancing policy. Such a policy has been implemented in many countries.<sup>13</sup> Obviously, binding restrictions on the amount of advertising are detrimental to welfare if the market provides too few commercials. Regulation of advertising levels on private TV channels has proven to be increasingly difficult over time. One reason for this is that the regulators are exposed to lobbying pressure. Another reason, which is probably more important (and increases the power of lobbyists), is that technological progress and increased globalization make it increasingly more difficult to enforce an efficient regulation policy towards private TV channels.<sup>14</sup> It is natural to ask, therefore, how governments can affect the equilibrium outcome through ownership of a TV station.

The presence of one public and one or more major private TV channels (mixed

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<sup>13</sup>The EU restricts TV advertising to 9 minutes on average, with a maximum of 12 minutes in any given hour, while some of the member states have stricter limits. See details in Anderson (2005) and Motta and Polo (1997). In the US, the National Association of Broadcasters at one time set an upper limit. In 1981, this was found to violate antitrust laws (see Owen and Wildman, 1992, ch. 5, and Hull, 1990). No restrictions (except for advertising on children’s programs) exist in the US today.

<sup>14</sup>One example of this comes from Norway, where there are restrictions on allowed advertising levels. Even though these restrictions have become less severe over time, the private station TV3, owned by Modern Times Group AB, has chosen to broadcast from the UK to the Norwegian market in order to avoid the Norwegian restrictions on advertising levels. Thus, it is not merely an empty threat when TV stations argue that they will serve the market from abroad if there is a strict regulation of advertising levels.

oligopoly) is common in many European countries.<sup>15</sup> While public TV channels historically have not been financed by advertising, this has gradually changed over time (*e.g.*, by allowing firms to sponsor programs). The main reason for the change is the fact that expensive sport events have made it politically more difficult to finance public TV channels through licenses. However, we will not consider this financial aspect. Instead, we consider a situation where the government owns channel 1 (*TV1*), which maximizes welfare ( $W$ ) with respect to its own level of advertising. The advertising levels on the other channels are assumed to be unregulated.

The TV channels simultaneously set advertising levels at stage 1 and the advertisers decide how much advertising to buy at stage 2. The advertising level at channel 1 is set according to  $A_1 = \arg \max W$ , while for the other channels we solve  $A_i = \arg \max \Pi_i$ ,  $i = 2, \dots, m$ . We consider only the non-cooperative outcome.

Independently of who owns the TV channels, the outcome of stage 2 is given by equation (6). Provided that all TV channels have positive advertising levels, we find that stage 1 yields the following advertising levels (with superscript  $P$  for equilibrium with public channel):<sup>16</sup>

$$A_1^P = m(1-s) \frac{[(m-2) + \gamma] ns + m[2(1+n) - s](1-\gamma)}{\gamma(2-\gamma)(n+1)[m^2(1-s) + (m-s)^2]}, \text{ and} \quad (23)$$

$$A_i^P = m(1-s) \frac{nm(2-\gamma) - s(n+\gamma-1)}{\gamma(2-\gamma)(n+1)[m^2(1-s) + (m-s)^2]}, \quad i = 2, \dots, m. \quad (24)$$

We see that the potential problem of no advertising at all as  $s$  approaches 1 remains unsolved even with a government-owned TV channel. The reason is that, since the TV channels are almost perfect substitutes in this case, imposing advertising on the public channel would make all viewers watch the private channels.

In Section 5 above, we found that there is too little advertising in equilibrium if  $s > \hat{s}$ . Consistent with this, we have

$$A_1^P - A_i^P = m(1-s) \frac{(m-1)(n-1+\gamma) + n\gamma}{\gamma(2-\gamma)(1+n)[m^2(1-s) + (m-s)^2]} (s - \hat{s}).$$

This means that the publicly owned TV channel will advertise more than a private, profit-maximizing TV channel if and only if  $s > \hat{s}$ . This is quite natural, since, by so

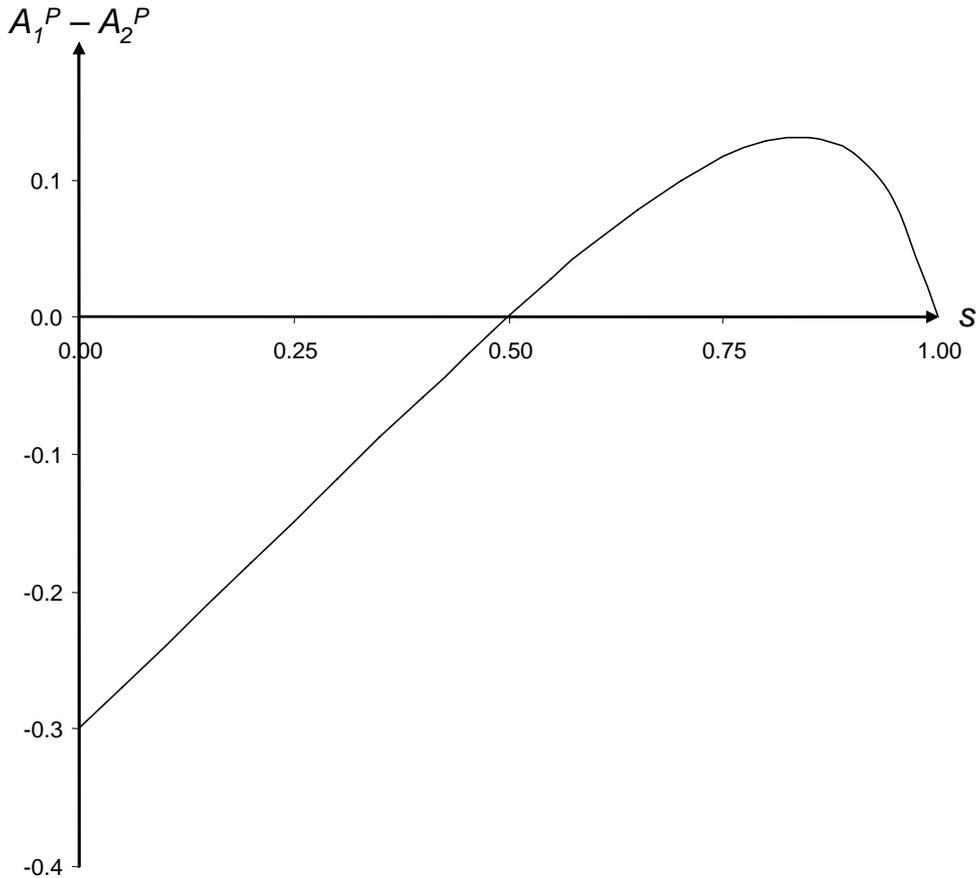
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<sup>15</sup>There are several studies of mixed duopoly, see for example De Fraja and Delbono (1989) and Cremer *et al.* (1991). Nilssen and Sørsgard (2002) present, as far as we know, the only mixed-oligopoly study relating to the media industry. However, their study is a Hotelling model, not capturing consumers' disutility from advertising. In a related study, Nilssen (2000) discusses mixed oligopoly in a payments market where, not unlike the present media context, there are negative externalities among firms in addition to the traditional oligopoly externality.

<sup>16</sup>The only instance where not all TV channels have positive advertising levels for  $s < 1$  is when the expression in (23) is negative so that the public channel's equilibrium level is zero. This turns the industry into an industry with  $(m-1)$  profit-maximizing firms. This happens when  $\gamma > \tilde{\gamma}$ , defined below.

doing, it partly corrects for the underprovision of advertising that would have been the case if all channels had been private, profit-maximizing entities.

Figure 2 illustrates the difference between the advertising levels when  $\gamma = \frac{1}{3}$  and  $m = 2$  for the limit case  $n \rightarrow \infty$ . In the neighborhood of  $s = \frac{1}{2}$ , we see that the public channel advertises increasingly more than the private channel the closer substitutes the TV stations are. However, since the Bertrand-paradox style result that there will be no advertising in the limit as the channels are about to become perfect substitutes is still present, the curve is downward-sloping when  $s$  approaches 1.



**Figure 2:** *The difference in advertising between the public and the private channel (for  $m = 2$ ,  $\gamma = \frac{1}{3}$ , and  $n \rightarrow \infty$ ).*

Suppose that  $\gamma > 1$ , in which case there will be no advertising in social optimum. Does this mean that a public TV channel in a mixed duopoly should carry no advertising? – No, not necessarily. From equation (23) we find that  $A_1 > 0$  if  $\gamma < \tilde{\gamma} \equiv 1 + \frac{ns(m-1)}{n(2m-s)+m(2-s)}$ , where  $\tilde{\gamma}$  is strictly increasing in  $s$ ,  $m$ , and  $n$ . Since  $\tilde{\gamma}$  is greater than 1, we see that the government may find it optimal to allow advertising on its own channel even when advertising is wasteful as such. This is because public-channel advertising has an indirect positive effect on the surplus generated by the private TV channels. To see this, suppose  $\gamma = 1$ , so that advertising has neither a positive nor a

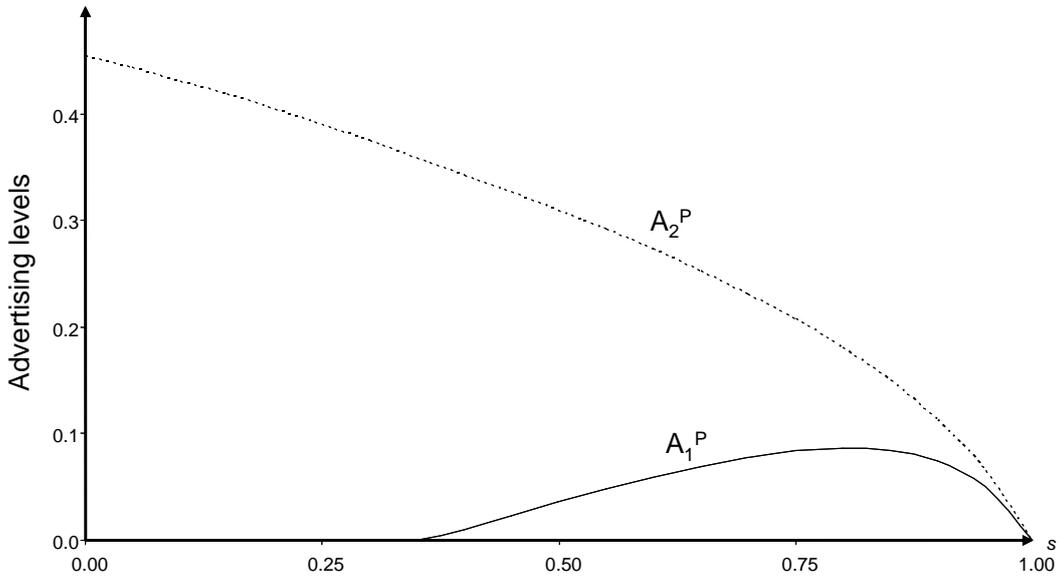
negative social value *per se*. The direct effect of a marginal increase in  $A_1$  is to generate some profit for *TV1* that is exactly matched by a loss in consumer surplus. However, the indirect effect of the increase in  $A_1$  is to make the private channels relatively more attractive for any given advertising level  $A_i$ . Thereby, the private channels will observe a positive shift in its demand for advertising and thus have a non-marginal increase in profits. The net effect of the higher  $A_1$  is thus to improve welfare due to the higher profit level for its rivals. From this, it follows that it must be optimal to set  $A_1$  strictly positive when  $\gamma = 1$ . By continuity, the same must be true also if  $\gamma$  is somewhat larger than 1.<sup>17</sup>

We can summarize our results as follows:

**Proposition 8:** (a) *In a mixed oligopoly the public TV channel has more advertising than the private ones if and only if  $s > \hat{s}$ .*

(b) *The public TV channel may carry advertising even when advertising is socially wasteful, and this happens for  $1 < \gamma < \tilde{\gamma}$ .*

Part (b) of Proposition 8 is illustrated graphically in Figure 3 for  $m = 2$ ,  $\gamma = 1.1$ , and  $n \rightarrow \infty$ . The curve labelled  $A_2^P$  shows the advertising level of the private channel.<sup>18</sup>



**Figure 3:** *Advertising levels when advertising is intrinsically wasteful (for  $m = 2$ ,  $\gamma = 1.1$  and  $n \rightarrow \infty$ ).*

<sup>17</sup>Note that there is no reason to set  $A_1 > 0$  if  $\gamma \geq 1$  and  $s = 0$ . The reason for this is that the TV channels' programs now are completely independent, so that the advertising level on *TV1* does not have any indirect effect on the profit levels of the other channels.

<sup>18</sup>The curve for  $A_2^P$  when  $A_1^P = 0$  ( $\gamma > \tilde{\gamma}$ ) is, in the present two-channel case, given by  $A_2^P = \frac{1}{\gamma} \left( \frac{n}{n+1} \right) \frac{1-s}{2-s}$ . This can be found by using equations (3) and (6).

## 7 Concluding remarks

We have modeled the media firm as an intermediate player that transmits advertising to consumers. Our starting point is that advertising-financed TV is a mixed blessing. Advertising is good for the sales of products because it generates profit, and bad for viewers because they typically dislike being interrupted by commercials on TV. However, we have shown that underprovision of advertising may happen when the TV channels compete to attract viewers for the advertising they bring. In particular, such underprovision is more likely the less differentiated the TV channels' programs.

We also point out that the nature of competition as such may be crucial for whether there is over- or underprovision of advertising on TV. If the TV channels collude on advertising, they will succeed in having a relatively large amount of advertising on TV. However, as shown above, there may be underprovision of advertising even in this case.

From a public-policy point of view, it is important to note that, since advertising is easily observable, there might be scope for collusive behavior between TV channels. If TV channels are observed to advertise a lot even in a situation where their programs appear to be rather close substitutes, this is an indication that there is collusion on advertising.

On the question of whether a policy of removing public barriers to entry for advertising-financed TV channels would be negative from a welfare point of view, we find, somewhat paradoxically, that there may be good reasons to encourage such entry if consumers have a strong distaste for advertising.

Our analysis is based on the notion that the degree of product differentiation, as represented by the parameter  $s$ , is observed and known by everybody, including the social planner. One can certainly envision a richer model where there is uncertainty about this feature of viewers' preferences. This could be an interesting extension, not least from a policy point of view. However, we believe that there will be no qualitative changes in the mechanisms we have highlighted even if such uncertainty is introduced.

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