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Getting Beer During Commercials: Adverse Effects of Ad-Avoidance*

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Abstract

This paper studies the impact of ad-avoidance behavior in media markets. We consider a situation where viewers can avoid advertisement messages. As the media market is a two-sided market, increased ad-avoidance reduces advertisers' value of placing an ad. We contrast two financing regimes, free-to-air and pay-TV. We find that a higher viewer responsiveness to advertising decreases revenues and entry in the free-to-air regime. In contrast, in the pay-TV regime, lower income from advertisements is compensated by higher subscription income leaving revenues and the number of channels unaffected for a fixed total viewership.

Keywords: Media Markets; Ad-avoidance; Two-Sided Markets.
JEL-Classification: L11, L13

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1 Introduction

Media markets are frequently modeled as two-sided markets. In the TV market, broadcasters act as platforms and serve two types of customers: advertisers and viewers. Typically, advertisers are interested in placing their adverts in media platforms with many viewers; that is, there is a positive network externality from viewers on advertisers. Contrary, to viewers - who want to enjoy media content - advertisement is often a nuisance. They are interested in media with few commercials. Thus, the externality from advertisers on viewers is negative.[1]

If advertising is such a nuisance to viewers, viewers may try to avoid advertising messages placed on the platform. As documented, for instance in Wilbur (2008), there are many ways for viewers to avoid advertisements: for example, change the channel, divert attention to other things, leave the room and get a beer, mute or turn off the TV, fast-forward through recorded programs, or make use of ad-avoidance technologies such as TiVo. In addition, if the number of adverts is too large, viewers may switch off completely or reduce the amount of TV consumption. Wilbur et al. (2009) show that a 10 % increase in advertising time reduces the audience size by 15 %. As media markets are two-sided markets, this avoidance behavior by viewers has immediate, adverse consequences on the other side of the market, the advertising industry: placing an ad with a media platform has a much lower value for advertisers if viewers avoid this advert. This, in turn, has consequences for the media platform when deciding about pricing its media product to viewers and advertisers.

Since the opportunities to reach viewers via classical advertising spots are reduced, broadcasters and the advertising industry have to find new ways to get advertising messages delivered to viewers. Broadcasters increasingly use the instrument of placing products in its content to account for viewers' avoidance of traditional advertising breaks. Wilbur et al. (2009) find empirical evidence that broadcasters in the US have responded to ad-avoidance technologies such as TiVo and digital video recorders by increasing product placements in their shows by about 40% during the years 2005 to 2008. The

[1] Advertising may not always be perceived as a nuisance. There is empirical evidence that magazine readers may value advertising positively (Kaiser and Wright, 2006; Kaiser and Song, 2009).

same can be expected for Europe, where the EU Commission recently defined rules on product placements in the new "Audiovisual Media Services Directive" in March 2010. Until 2010 product placement where subject to several restrictions. However, this new directive defines several exceptions, so product placements are generally allowed on commercial broadcasters. The effect on broadcasters and viewers is still debated. Balasubramanian et al. (2006) review the behavioral literature on product placement which shows difficulties of reproducing significant effects of product placement on consumers in laboratory settings. This seems to be in line with Ephron (2003) who states a conjecture about product placement: "If you notice, it's bad. But if you don't, it's worthless." Our model contributes to the discussion and analyzes the effect of bypassing opportunities on broadcasters' profit in a free-to-air and pay-TV regime.

To study the issues raised above we develop a two-sided market model of the broadcasting industry where broadcasters compete for viewers and advertisers. We follow Anderson and Coate (2005) and Peitz and Valletti (2008) in considering broadcasters which are horizontally differentiated à la Hotelling or Salop. In our base model, we consider two broadcasters and analyze the outcomes under free-to-air and under pay-TV. Later, we extend our model to an arbitrary number of broadcasters to analyze entry behavior. The main innovation of the paper is to incorporate ad-avoidance behavior by viewers into the analysis, as is empirically analyzed by Wilbur et al. (2009). We model this by specifying a function that maps the amount of advertising at a channel into demand for TV consumption. In line with the above discussion, viewers' demand for TV consumption is the lower the more commercials are placed on a channel.

We find that the impact of ad-avoidance differs in the financing regime. In the free-to-air regime, if viewers can avoid commercials more easily this may lead to an increase or decrease in the level of advertising. Revenues decrease unambiguously. In the pay-TV regime, the advertising level decreases. However, the loss in revenues from advertising can be compensated by an increase in revenues from subscription. In our model with fixed total viewership, total revenues in the pay-TV regime are independent of any ad-avoidance behavior. However, if we introduce elastic subscription, profits may decrease. This difference between free-to-air and pay-TV has also implications concerning diversity in the TV market. An increase in ad-avoidance decreases the level of entry in the free-to-air regime but has a smaller impact in a pay-TV market.

There is a large literature analyzing the broadcasting industry from a two-sided market perspective. Many papers are based on spatial models of product differentiation such as the Hotelling model, see, for instance, the contributions by Gabszewicz et al. (2004), Anderson and Coate (2005), Choi (2006), Armstrong and Weeds (2007), Peitz and Valletti (2008), Crampes et al. (2009) or Reisinger et al. (2009). In these models, advertising typically affects viewers adversely, but the viewers' only possible reaction to high advertising levels is to switch among channels. In contrast, in this paper, we introduce another margin by which viewers can react to advertising as we allow viewers to avoid commercials.

There are several recent papers that analyze ad-avoidance behavior. Closest in spirit of the present paper is the contribution by Anderson and Gans (2009). The authors study a specific consumer reaction to high advertising levels. In their paper, viewers can bypass advertisement by investing in an ad-avoidance technology such as TiVo. Viewers are heterogenous in their disutility from advertising. Compared to the case of no ad-avoidance technology the adoption of such a technology leads to higher advertising levels. The reason is that only viewers with lower disutility from advertising remain without the ad-avoidance technology leading broadcasters to increase advertising levels. Our base model differs in two aspects: i) our model introduces a demand function which captures various sorts of advertising avoidance behavior, and ii) our focus lies on competition between duopolists while Anderson and Gans (2009) consider a monopolistic broadcaster.[2] We provide two alternative extensions of the base model, where we discuss channels' entry decisions and the effects of elastic subscription for television.

Related are also papers that compare business models where firms can offer a version of a product with and without advertisement. Offering a version without adverts may serve as a device of price discrimination to separate consumers with low and high nuisance to advertising. These issues are analyzed by Prasad et al. (2003) and Tag (2009).

[2]In an extension, Anderson and Gans (2009) consider a duopoly version of their model under free-to-air.

The paper proceeds as follows. Section 2 sets up the base model with two broadcasters. In Section 3 we study free-to-air broadcasting while in Section 4 we turn to pay-TV. Section 5 provides two extensions of the base model, where we consider market entry and the effects of elastic subscription. Finally, Section 6 concludes.

2 The model

This section describes our model setup.

2.1 TV stations

In our base model, there are two TV stations, called A and B, competing for viewers and advertisers.[3] These two stations offer differentiated content, thus, following Anderson and Coate (2005), we assume the stations to be located at opposite ends of a unit Hotelling line.[4]

We compare two distinct financing regimes: free-to-air and pay-TV. In the free-to-air regime, TV stations cannot charge viewers directly. Revenues from advertising are the only income source. In the pay-TV regime, TV stations are additionally able to charge viewers directly for TV consumption. In this case, stations have two income sources: subscription fees and advertising revenues.

2.2 Viewers

Advertising annoys viewers. Viewers may avoid advertising. To formalize this, we assume that there exists a function $q(a, k)$ which maps the amount of advertising at a channel (a) into a demand for TV consumption.[5] This

[3] In Section 5.1, we will extend the setup to an arbitrary number of stations using the Salop formulation in order to study entry decisions.

[4] Peitz and Valletti (2008) study the broadcasters' incentives to offer differentiated content in pay-TV and free-to-air regimes.

[5] Technically, we follow Gu and Wenzel (2009a,b) who introduce a price-dependent demand function into the Salop model.

function is identical for all consumers.[6] In line with our previous discussion $\frac{dq(a,k)}{da} < 0$, that is, the higher the advertising level on the channel the less attention is paid to adverts. Hence, advertising levels have the same impact on viewers' demand for TV consumption as prices in other product markets. The parameter k is a shift parameter in the demand for TV consumption with $\frac{dq(a,k)}{dk} < 0$ and $\frac{d^2q(a,k)}{dadk} \leq 0$. The parameter k can be interpreted as viewers' responsiveness to advertising, where higher values of k lead viewers to switch off more quickly.

Denote the absolute value of the avoidance elasticity with respect to advertising[7] as

$$\epsilon = -\frac{dq(a,k)}{da}\frac{a}{q(a,k)}. \tag{1}$$

We now introduce the following assumption:

Assumption 1. The absolute value of the advertising elasticity ϵ is strictly increasing in $a \in (0, \hat{a})$ and $\lim_{a\to\hat{a}} \epsilon(a) \geq 1$,

where $\hat{a}$ denotes the level of advertising that reduces the demand for TV consumption to zero, thus $q(\hat{a}, k) = 0$. This assumption is needed to ensure equilibrium existence. Note that our setup so far implies that $\frac{d\epsilon}{dk} > 0$.

As an example, assumption 1 is satisfied if advertising has a linear influence on the demand for TV consumption, e.g. $q(a, k) = A - B \cdot a \cdot k$, where both A and B are suitable positive constants.

Such a demand function for TV consumption can be derived as follows: Suppose viewers can divide their time between two activities, TV consumption (q) and all other leisure activities (d). Utility is given by: $U = u(q, k) + d$, where $u(q, k)$ gives the utility from TV consumption and all other activities enter linearly. Now assume that advertising annoys consumers, that

[6] In this aspect, our model differs from Anderson and Gans (2009) who assume that viewers differ in their intensity of advertising nuisance. Note, however, that the function $q(a, k)$ could be interpreted as the result of aggregating over a mass of heterogenous viewers.

[7] Since advertising levels act as hedonic prices, this can be regarded as a "price elasticity" of advertising.

is, it incurs a psychic cost to viewers. Optimization then leads to the demand function $q(a, k)$ for TV consumption. The associated indirect utility to this demand is given by $V(a, k)$. Under the assumption of quasi-linearity, indirect utility can be written as:

$$V(a, k) = \int_{a}^{\hat{a}} q(a, k)da. \tag{2}$$

Viewers have preferences about the content of the two channels and are located uniformly along the Hotelling-line. The position on the line is given by x. There are linear transportation costs at a rate t. The transportation cost parameter t can be interpreted as the degree of competition. The indirect utility for a viewer, located at x, is then:

$$U = \begin{cases} \int_{a_A}^{\hat{a}} q(a, k)da - tx - s_A & \text{if choosing channel A} \\ \int_{a_B}^{\hat{a}} q(a, k)da - t(1 - x) - s_B & \text{if choosing channel B,} \end{cases} \tag{3}$$

where a_A (a_B) denotes the level of advertising at channel A (B) and s_A (s_B) denotes the subscription price at channel A (B). The marginal viewer ($\bar{x}$), who is indifferent between choosing station A or B, is then characterized by

$$\int_{a_A}^{\hat{a}} q(a, k)da - t\bar{x} - s_A = \int_{a_B}^{\hat{a}} q(a, k)da - t(1 - \bar{x}) - s_B. \tag{4}$$

This can be reformulated as:

$$\bar{x} = \frac{1}{2} + \frac{1}{2t} \int_{a_A}^{a_B} q(a, k)da + \frac{s_B - s_A}{2t}. \tag{5}$$

Hence, the difference in advertising levels impacts the market shares, that is, advertising levels can be regarded as hedonic prices. The same holds for the subscription price.

2.3 Demand for advertising space

The advertisers' demand for placing advertisement with a channel depends positively on the number of viewers watching this channel. However, the advertisers' willingness to pay is reduced when viewers avoid advertisement. We assume the following per-viewer revenue function:

$$\Omega(a) = [R \cdot q(a,k)] \cdot a. \tag{6}$$

A channel's advertising revenue depends on the number of spots (a) and the viewers' demand ($q(a,k)$). When viewers avoid advertisement the advertisers' value of a spot is reduced. We capture this by assuming that advertisers pay an amount of $R \cdot q(a,k)$ per customer for each spot. This price per spot depends on the demand for TV consumption. If $q(a,k)$ is high and the viewers pay attention to advertisement messages, TV channels receive a high price per spot. If, on the other hand, the viewers avoid advertisements ($q(a,k)$ is low), TV channels receive a low price per spot. The parameter R can be interpreted as the price for actual or effective ad consumption per spot and per viewer.[8]

The assumed revenue function can be derived as follows. Suppose there is a unit mass of homogenous advertisers. Each of them makes a revenue of R whenever a viewer happens to receive its advertisement message. The broadcasters hold monopoly power over access to their viewers, that means, in the terminology of the two-sided market literature they act as a competitive bottleneck (Armstrong, 2006). Thus, the advertisers can only sell their product to those viewers, who have seen the ad. Whether a viewer receives the ad depends on the demand for TV consumption. If q is large there is a high probability that the viewer watches the message. If, however, viewers avoid advertising, that is, q is small, there is a rather low chance that the viewer receives a certain advertising message. Assume that $\phi(q)$ with $\frac{d\phi}{dq} > 0$ measures the probability of watching an ad. For simplicity, we set $\phi(q) = q$. Hence, an advertiser's willingness to target a viewer is $R \cdot \phi(q)$. Assuming that advertisers are price-takers, this willingness to pay coincides with the advertising revenue per viewer, and hence $\Omega(a) = [R \cdot q(a,k)] \cdot a$.

[8] Here we follow Mangani (2003) and Gabszewicz et al. (2004) who assume that TV channels receive a fixed price per ad. This might be motivated by the assumption that the channels are too small to influence the overall advertising market. Anderson and Coate (2005), Armstrong and Weeds (2007) and Peitz and Valletti (2008) assume that the advertising revenues are a concave function in the number of adverts.

3 Free-to-air

We start our analysis with the free-to-air regime. In the free-to-air regime, there are no subscription fees and the TV channels' only source of income is the advertising revenue. Hence, $s_A = s_B = 0$. The marginal consumer can then be expressed as:

$$\bar{x} = \frac{1}{2} + \frac{1}{2t}\int_{a_A}^{a_B} q(a,k)da. \tag{7}$$

The revenues of the TV channels are:

$$\Pi_A = \left[\frac{1}{2} + \frac{1}{2t}\int_{a_A}^{a_B} q(a,k)da\right] R \cdot q(a_A,k) \cdot a_A, \tag{8}$$

and

$$\Pi_B = \left[\frac{1}{2} - \frac{1}{2t}\int_{a_A}^{a_B} q(a,k)da\right] R \cdot q(a_B,k) \cdot a_B, \tag{9}$$

where we abstract from any fixed and variable costs.

The first-order condition of a symmetric equilibrium with respect to the optimal level of advertising is given by:

$$\frac{1}{2}q(a,k)R - \frac{1}{2t}[q(a,k)]^2 aR + \frac{1}{2}\frac{dq(a,q)}{da}aR = 0 \tag{10}$$

An increase in the level of advertising has three effects on revenues. First, it increases advertising revenues for a given number of viewers and for a given level of ad-avoidance (first term in equation (10)). But it also has adverse consequences for revenues. An increase in advertising at one channel leads to a loss in the market share of this channel as well as to a lower demand for TV consumption. The second term measures the loss in market share while the third term reflects the decrease in demand of TV consumption. Note, that this third effect is not present in models without endogenous ad-avoidance behavior.

Our equilibrium condition can be rewritten as:

$$t[1 - \epsilon(a^*,k)] = q(a^*,k)a^*, \tag{11}$$

where $\epsilon(a^*, k) = -\frac{dq(a,k)}{da}\frac{a}{q(a,k)}|_{a=a^*}$ denotes the individual elasticity of advertising evaluated at the equilibrium level of advertising. Note that in equilibrium the demand elasticity ($\epsilon(a^*, k)$) is smaller than one.[9]

We can now study the properties of the equilibrium. We are particularly interested in the impact of a higher responsiveness of viewers to advertising on the equilibrium level of advertising. Total differentiation of equation (11) with respect to k yields:

Proposition 1. In the free-to-air regime, an increasing responsiveness to advertising, as measured by k, has an ambiguous effect on equilibrium advertising. That is, $\frac{da^*}{dk} \gtrless 0$.

Proof: See Appendix.

The reason is that an increase in k affects the factors that determine the equilibrium advertising level in different ways. To see this, divide equation (10) by $\frac{R \cdot q(a,k)}{2}$ to get:

$$1 - \frac{1}{t} a q(a, k) - \epsilon = 0 \tag{12}$$

Equation (12) shows the relative importance of the three effects. Note first that an increase in k has no impact on the relative importance of the direct effect of an increase in a. The second effect, the loss in market share decreases in k, meaning that this raises the incentives to increase the level of advertising. Intuitively, when viewers avoid averts anyway (k is high), a marginal increase of advertising does rarely impact the distribution of viewers. Otherwise, if k is low, broadcasters have more incentives to compete for an additional viewer by holding advertising at a low level. Thus, this effect is due to a decreased level of competition. Finally, the demand elasticity increases with k leading to a lower demand for TV consumption.[10] This tends to reduce advertising. The overall effect is thus determined by the relative strength of the competition effect and the ad-avoidance effect. To demonstrate the possibility that an increase in k can both increase and decrease equilibrium advertising, suppose $q(a, k) = 1 - 0.1a - k$ and $t = 1$. We

[9] The proof for the existence of a unique equilibrium is provided in the appendix.

[10] Hence, in equilibrium TV consumption decreases in k.

solve for equilibrium advertising numerically. The result is shown in Figure 1.

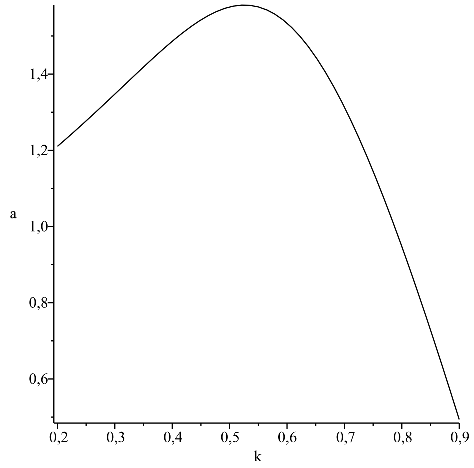


Figure 1: Equilibrium advertising in the free-to-air regime for $q(a, k) = 1 - 0.1a - k$ and $t = 1$.

Our results complement those from Anderson and Gans (2009). While in Anderson and Gans (2009) the introduction of TiVo increases equilibrium advertising unambiguously, in our model equilibrium advertising may increase or decrease. The reason in their model is that the viewers who adopt TiVo are those with a high nuisance to advertising. Thus, only those with low nuisance remain and in consequence, advertising is high. We introduce a new effect which may lead to an decrease in advertising, namely the competition effect. Broadcasters compete on advertising levels to gain market shares from the rival.

Inserting the equilibrium advertising level into the revenue function we get the revenues earned by each of the two channels:

$$\Pi^* = \frac{1}{2}tR[1 - \epsilon(a^*, k)] \tag{13}$$

Proposition 2. In the free-to-air regime, a higher responsiveness to advertising decreases broadcasters' equilibrium revenues.

Proof: See Appendix.

The impact on revenues is strictly negative. The opportunity to avoid advertising messages, measured by the demand function $q(a, k)$, unambiguously leads to lower profits in the free-to-air scenario. Consequently, advertisers and broadcasters have to find less obvious and nuisance advertising methods, such as product placements. The European Commission recently announced a new "Audiovisual Media Services Directive" in 2010, which among others defines conditions under which product placement is permitted. Generally, product placements are liberalized compared to previous legislation.[11] Broadcasters may use the instrument of placing products in their content to account for viewers' avoidance of traditional advertising breaks. Broadcasters in the US have responded to ad-avoidance technologies such as TiVo and digital video recorders by increasing product placements in their shows by about 40 % during the years 2005 to 2008 (Wilbur et al., 2009). It is presumed that viewers are less able to avoid this instrument of advertising, as advertising becomes less obvious and thus harder to skip. Although, the effect of product placements on profits and viewers is yet unclear. Products are placed in the editorial content, so that viewers should not really be aware of the new kind of advertising and do not skip. Although, if they are not aware of it, it is an open question, whether product placement is an effective method of advertising (Balasubramanian et al., 2006).

4 Pay-TV

In the pay-TV regime, TV channels have subscription fees as an additional source of income. Advertising is still possible. We allow for negative subscription prices, that is, subsidies to viewers. These subsidies might be program decoders the viewers are offered for free or at a lower charge.[12]

[11] Article 11 (2) of the directive states that product placements are generally forbidden. It defines several exception, though. According to Article 11 (3,a) product placement shall be admissible in cinematographic works, films and series made for audiovisual media services, sports programmes and light entertainment programmes, which certainly includes much of the television content.

[12] This is common in other markets, too, for instance, in the mobile telecommunication industry where the customers' handsets are often subsidized by the operators.

The revenues of the broadcasters are now given by:

$$\Pi_A = \left[\frac{1}{2} + \frac{1}{2t}\int_{a_A}^{a_B} q(a,k)da + \frac{s_B - s_A}{2t}\right][R \cdot q(a_A,k) \cdot a_A + s_A], \tag{14}$$

and

$$\Pi_B = \left[\frac{1}{2} - \frac{1}{2t}\int_{a_A}^{a_B} q(a,k)da + \frac{s_A - s_B}{2t}\right][R \cdot q(a_B,k) \cdot a_B + s_B]. \tag{15}$$

Solving for a symmetric equilibrium, we obtain the following conditions for a broadcaster's advertising level and subscription price:

$$R[1 - \epsilon(a^{\#},k)] = 1, \tag{16}$$

and

$$s^{\#} = t - R \cdot q(a^{\#},k) \cdot a^{\#}. \tag{17}$$

The first condition implicitly defines the level of advertising in equilibrium. Note that the level of advertising does only depend on the revenue parameter R and the shape of the function $q(a,k)$. The intensity of competition, measured by t, does not play a role for equilibrium advertising. The second condition determines the subscription price charged to customers. The price depends largely on the intensity of competition and advertising revenues $(R \cdot q(a^{\#},k) \cdot a^{\#})$. Higher advertising revenues reduce the subscription price as viewers are now more valuable to broadcasters. As in the models by Choi (2006) and Peitz and Valletti (2008) there is a full pass-through of advertising revenues into the subscription price. By introducing elastic subscription for pay-TV in section 5.2 this pass-through effect is reduced.

Differentiating the equilibrium conditions for advertising and the subscription price with respect to k, we obtain:

Proposition 3. In the pay-TV regime, equilibrium advertising decreases in the responsiveness to advertising while the subscription price increases. That is, $\frac{da^{\#}}{dk} < 0$ and $\frac{ds^{\#}}{dk} > 0$.

Proof: See Appendix.

Notice that in the pay-TV regime an increase in k has an unambiguous negative impact on the level of advertising. The reason is that in contrast to free-to-air the effect of relaxed competition is not present. With increasing values of k advertising levels are decreasing, subscription prices are increasing.

The equilibrium revenues of broadcasters from advertising ($R_a^{\#}$) and subscription ($R_s^{\#}$) are:

$$R_a^{\#} = \frac{1}{2} R \cdot q(a^{\#}, k) a^{\#}, \tag{18}$$

and

$$R_s^{\#} = \frac{1}{2}[t - R \cdot q(a^{\#}, k) a^{\#}] = \frac{1}{2} s^{\#}. \tag{19}$$

Total income is then the sum of the income sources:

$$\Pi^{\#} = \frac{t}{2}, \tag{20}$$

which solely depends on the degree of competition in the media market. This is an immediate implication of the full pass-through of advertising revenues into the subscription price, confirming the "profit neutrality" result of Peitz and Valletti (2008). Thus, a larger responsiveness to advertising leaves total revenues constant but changes the composition of the two revenue sources. While the revenues from advertising decrease there are higher revenues from subscription. We summarize this in the following proposition:

Proposition 4. In the pay-TV regime, equilibrium revenues are unaffected by the viewers' responsiveness to advertising, but the composition of revenues is altered: income from advertising decreases while income from subscription increases.

Proof: See Appendix.

5 Extensions

We discuss two extensions of the base model: Entry decisions and effects of elastic subscription.

5.1 Entry

We can generalize our model to the case with more than two competitors. Instead of the Hotelling setup we now turn to the Salop framework (Salop, 1979) which enables us to analyze entry decisions. There is a unit mass of viewers distributed uniformly on the unit circle. The n channels are located equidistantly on this circle. There is a fixed cost of f for entering the market. We assume that competition follows a two-stage game. In the first stage, channels decide whether to enter. In the second stage, firms decide on the number of adverts and, in the pay-TV regime, on the subscription price. We are interested in determining the impact of ad-avoidance on the number of channels that enter in a free-entry equilibrium.

Consider a situation with a given number of channels n in the market and seek for a symmetric equilibrium. Thus, we consider the situation of a representative channel i. Let a_i (s_i) denote the advertising level (subscription price) at this channel while all remaining channels set advertising (subscription prices) at a_o (s_o). The revenue of a representative channel can then be written as:

$$\Pi_i = \left[\frac{1}{n} + \frac{1}{t} \int_{a_i}^{a_o} q(a,k)da + \frac{s_o - s_i}{2t} \right] [R \cdot q(a_i,k)a_i + s_i] - f. \tag{21}$$

First consider free-to-air broadcasting, i.e. $s_i = 0$. Solving for a symmetric advertising level, we get

$$q(a^*,k) \cdot a^* = \frac{t}{n} \left[1 - \epsilon(a^*,k) \right]. \tag{22}$$

Again, an increase in k may lead to more or less advertising. A larger number of channels decreases the equilibrium advertising level. Inserting equation (22) into equation (21) gives the equilibrium revenues for a given number of firms:

$$\Pi^* = \frac{t}{n^2} R[1 - \epsilon(a^*,k)] - f. \tag{23}$$

The impact on revenues is unambiguous. A higher responsiveness to advertising ($\frac{d\Pi^*}{dk} < 0$) and a larger number of competitors ($\frac{d\Pi^*}{dn} < 0$) decrease revenues.

By a zero profit condition we seek to determine the number of firms entering the market, which implicitly defines the free-entry number of firms:

$$\frac{t}{n^2} R[1 - \epsilon(a^*, k)] - f = 0. \tag{24}$$

In general, it is not possible to explicitly express the number of entrants since the equilibrium demand elasticity $\epsilon(a^*, k)$ depends on the number of competitors. However, we know that revenues decrease monotonically in the number of firms. Hence, we know that a unique solution to equation (24) exists.[13] As a larger value of k decreases revenues, it follows immediately that an increasing responsiveness to advertising, measured by k, decreases entry and hence reduces diversity.

Consider now additional revenues from subscription. We get the following conditions for the revenue maximizing levels of advertising and subscription fees:

$$R[1 - \epsilon(a^{\#}, k)] = 1, \tag{25}$$

and

$$s^{\#} = \frac{t}{n} - R \cdot q(a^{\#}, k) a^{\#}. \tag{26}$$

Note that the equilibrium level of advertising is identical to our solution in the duopoly model and hence advertising is independent of the number of channels. The reason is the full pass-through of advertising revenues into the subscription fee leading to a profit-neutrality result (see Section 4). Only the subscription price is affected by the number of competing channels. The more channels are in the market, the lower is the subscription price. Revenues decrease in the number of channels competing in the market. However, the two income sources are affected differently by a rising number of competitors. While revenues from advertising are constant, revenues from subscription decrease. Thus, with a larger number of channels revenues from advertising gain relative importance.

Due to the profit neutrality result, equilibrium revenues are independent of the possibilities to avoid advertising and the number of entering channels co-

[13] We assume that the market is viable for at least two firms. This can be ensured assuming that transportation costs are sufficiently large or fixed costs of entry are sufficiently small.

incides with entry in a standard Salop model, and hence $n^{\#} = \sqrt{t/f}$. Thus, diversity in the media market is not affected by ad-avoidance behavior.[14]

Proposition 5. A rising responsiveness to advertising reduces diversity in the free-to-air regime and has no impact on diversity in the pay-TV regime.

Allowing for elastic subscription of pay-TV in section 5.2 the level of entry in the pay-TV regime will be affected, although to a lower extent than in the free-to-air regime.

5.2 Elastic subscription

A limitation of the base model is that the market size is exogenously fixed. The number of television viewers is normalized to one. In this extension, we discuss the implications of incorporating elastic subscription. That is channels may increase total viewership by charging low subscription prices and sending fewer adverts. In this section, we show that the result that pay-TV profits are unaffected by ad-avoidance relies on the previous assumption of a fixed market size. Accounting for elastic subscription profits are no longer constant but decrease with an increasing responsiveness towards advertising. However, pay-TV profits are affected to a much smaller extent than profits in the free-to-air regime. The reason for this result lies in the fact that with elastic subscription there is only a partial pass-through of advertising revenues into the subscription price.

Following Armstrong and Wright (2009) we use a tractable variant of the Hotelling model with hinterlands. We assume that demand at firm i is now given by:

$$d_i = \frac{1}{2} + \frac{1}{2t}\int_{a_i}^{a_j} q(a,k)da + \frac{s_j - s_i}{2t} + \lambda\left[\int_{a_i}^{\hat{a}} q(a,k)da - s_i\right]. \qquad (27)$$

[14] For a discussion of welfare optimal advertising levels, subscription prices and entry in the distinct regimes we refer to the paper by Choi (2006). He shows that with pay-TV the equilibrium advertising is less than the social optimal level, while the extent of entry is excessive. However, in the free-to-air regime, advertising levels and entry can be excessive or insufficient.

In a symmetric equilibrium, the total market size is then given by:

$$D = 1 + 2\lambda \left[\int_{a}^{\hat{a}} q(a,k)da - s \right]. \tag{28}$$

The total size of the market is no longer constant, but decreases with the subscription price and the advertising level. The parameter $\lambda > 0$ serves as a measure for the importance of elastic subscription.[15]

Equilibrium advertising in the free-to-air regime is characterized by:

$$t[1 - \epsilon(a^*, k)] \left[1 + 2\lambda \int_{a^*}^{\hat{a}} q(a,k)da \right] = q(a^*, k)a^*(1 + 2t\lambda). \tag{29}$$

As in the base model, the advertising level may increase or decrease with the responsiveness towards advertising. Additionally, when subscription becomes more elastic (λ increases), the advertising level is lower. Corresponding equilibrium profits are given by:

$$\Pi = \frac{1}{2} tR[1 - \epsilon(a^*, k)] \frac{[1 + 2\lambda \int_{a^*}^{\hat{a}} q(a,k)da]^2}{1 + 2t\lambda}. \tag{30}$$

Under pay-TV equilibrium advertising and the equilibrium subscription price are characterized by:

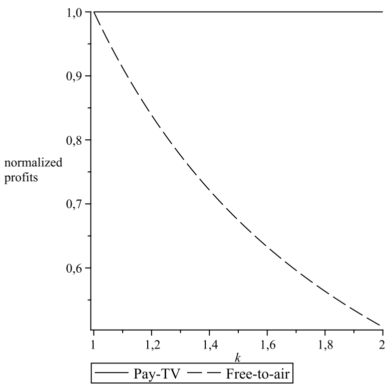
$$R[1 - \epsilon(a^{\#}, k)] = 1 + 2t\lambda, \tag{31}$$

and

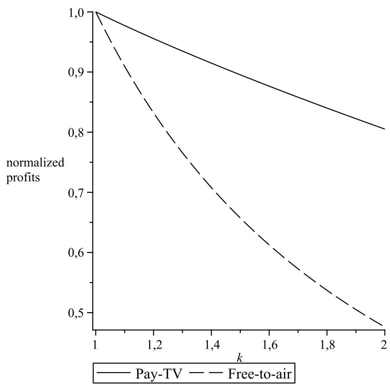
$$s^{\#} = \frac{t - R \cdot q(a^{\#}, k)a^{\#} + 2t\lambda \int_{a^{\#}}^{\hat{a}} q(a,k)da}{1 + 2t\lambda}. \tag{32}$$

When introducing elastic subscription the pass-through of advertising revenues is only partial. As can be seen from equation (32) only a fraction $\frac{1}{1+2t\lambda}$ of the advertising revenues is passed over. The more important elastic subscription is (larger λ), the lower is the pass-through. In equilibrium, each

[15]Setting $\lambda = 0$ reproduces the base model.



(a) base model ($\lambda = 0$)



(b) elastic subscription ($\lambda = 0.1$)

Figure 2: Relative profits in free-to-air and in pay-TV regime for $q(a, k) = 1 - ak$, $t = 1$, $R = 2$.

channel earns profits of

$$\Pi^{\#} = \frac{1}{2t}(s^{\#} + R \cdot q(a^{\#}, k)a^{\#})^2. \tag{33}$$

In contrast to the base model with a fixed total viewership, also profits of pay-TV channels decrease when consumers become more averse towards advertising (larger k). A decrease in advertising revenues cannot be fully compensated by an increase in revenues from subscription. However, profits in the pay-TV regime are affected to a smaller extent than profits in the free-to-air regime. This difference due to elastic subscription is demonstrated in Figure 2 where we compare free-to-air and pay-TV profits for $q(a, k) = 1 - ak$. In each regime, we normalize profits at $k = 1$ to one so that deviations can be interpreted as percentage changes in profits. Figure 2(a) shows profits in our base model with fixed viewership where pay-TV profits are unaffected by ad-avoidance behavior (k). In contrast, pay-TV profits are affected if we introduce elastic subscription. Figure 2(b) shows that an increase in viewers' responsiveness towards advertising from $k = 1$ to $k = 2$ reduces profits in the free-to-air regime by about 50%, but only by roughly 20% in the pay-TV case.

The effect on broadcasters' profits directly translates into an effect on market entry. An increase in ad-avoidance opportunities will decrease entry to a larger extent in the free-to-air regime than in the pay-TV regime.

6 Conclusion

This papers considers the impact of ad-avoidance behavior on media markets. As media markets are two-sided markets, the avoidance behavior of viewers has an impact on the other side of the market, namely on the advertising industry. If advertisement messages are avoided by viewers, the value of placing adverts is reduced to a large extent.

We consider two alternative schemes in which media channels are financed: free-to-air and pay-TV. We show that ad-avoidance behavior of viewers has a very different impact in these two regimes. In the free-to-air regime, channels rely exclusively on advertisements as the only source of revenue. Then, channels are hurt if viewers have better opportunities to avoid advertisement messages. This, in turn, leads to a fewer number of channels that can survive in the market. Channels in the pay-TV regime also face lower revenues from advertising. However, as revenues from subscription increase at the same level, total revenues are not affected by viewers' avoidance behavior. In the free-entry version of our model this leads immediately to an unchanged number of channels. However, when subscription for pay-TV is elastic, a higher responsiveness to advertising decreases broadcasters' profits.

Viewers always had the opportunity to bypass advertisement messages. However, due to technological advances, such as the digital video recorder, these avoidance possibilities have become more comfortable. In the light of our analysis, these increased bypassing possibilities will have an impact on the financing structure of television and broadcasting. Business models that rely exclusively on advertising revenues will become relatively unattractive while pay-TV will become a more attractive business model. Furthermore, due to opportunities to bypass advertisement messages broadcasters might replace traditional advertising spots by product placements, which are more difficult to bypass. Our model contributes to the discussion on the effects of ad-avoidance technologies and the advertising industry, broadcasters, and viewers. The EU Commission recently allowed for product placements on commercial broadcasters to account for decreasing abilities to reach viewers via classical advertising breaks. The effect of product placement is yet unclear. Some arguments state that product placements will likely have no effect if viewers do not notice it as advertising. Others fear an excrescence of placing products. This may lead to an adverse effect of ad-avoidance. Due to the avoidance of classical advertising breaks, viewers may be annoyed to an even larger extent by new ways of advertising, which are even harder to avoid.

A Appendix

A.1 Equilibrium existence

Here we provide the proof for the existence of a symmetric equilibrium in the free-to-air regime. We provide the proof for the entry version of our model. The proof follows the one in Gu and Wenzel (2009b).

First, we show that in equilibrium $\epsilon < 1$. Note when $\epsilon \geq 1$, i.e. $\frac{dq(a)}{da}\frac{a}{q(a)} \leq -1$, the first-order derivative is

$$\frac{d\Pi_i}{da_i} = \underbrace{-\left[q\left(a_i\right)\right]^2 a_i \frac{1}{t}}_{\text{negative}} + \underbrace{\left[\frac{1}{n} + \frac{1}{t}\int_{a_i}^{a_o} q\left(a\right) da\right] q\left(a_i\right)}_{\text{positive}} \underbrace{\left[1 + \frac{a_i}{q\left(a_i\right)} \frac{dq\left(a\right)}{da}\Big|_{a=a_i}\right]}_{\text{non-positive}} \quad (34)$$

and obtains a strictly negative value. The middle part on the right-hand side of Equation (34) is positive because we are interested in symmetric equilibrium ($a_i = a_o$). With $\frac{d\Pi_i}{da_i}$ being negative, whenever demand elasticity exceeds or is equal to 1, a firm wants to reduce the amount of advertising. In equilibrium, however, the first-order condition (22) holds,

$$\begin{aligned} & 1 + \frac{a^*}{q\left(a^*\right)} \frac{dq\left(a\right)}{da}\Big|_{a=a^*} > 0 \\ \Longrightarrow\ & \frac{a^*}{q\left(a^*\right)} \frac{dq\left(a\right)}{da}\Big|_{a=a^*} > -1 \\ \Longrightarrow\ & \epsilon^* < 1. \end{aligned}$$

In the next step, we show that the first-order condition admits a unique solution. Define $\Delta(a) = q\left(a\right)a - \frac{t}{n}\left[1 - \epsilon(a)\right]$. The functions $q(a)$ and $\epsilon(a)$ are continuous and differentiable. Hence, $\Delta(a)$ is continuous. Note that

$$\lim_{a\to 0} \Delta(a) = 0 - \frac{t}{n}\left[1 - \lim_{a\to 0}\epsilon(a)\right] = 0 - \frac{t}{n} < 0.$$

From assumption 1 follows that $\mu(a) = aq(a)$ is unimodal, which means it has a unique global maximum $\widetilde{a}$ in $(0, \hat{a})$. Then,

$$\Delta(\widetilde{a}) = q\left(\widetilde{a}\right)\widetilde{a} > 0.$$

Because of continuity, $\Delta(a) = 0$ obtains solution(s) for $a \in (0, \widetilde{a})$. Take the derivative of $\Delta(a)$,

$$\frac{d\Delta(a)}{da} = \frac{d\mu(a)}{da} + \frac{t}{n}\frac{d\epsilon(a)}{da}.$$

Following Assumption 1, $\frac{d\epsilon(a)}{da} > 0$; since $\mu(a)$ is strictly unimodal, for $a \in (0, \widetilde{a})$, $\frac{d\mu(a)}{da} > 0$ as well. Hence, we conclude $\frac{d\Delta(a)}{da} > 0$. Because of this monotonicity, $\Delta(a) = 0$ obtains a unique solution in $(0, \widetilde{a})$. When $a \in [\widetilde{a}, \hat{a})$, we know $\epsilon(a) \geq 1$ which means $\Delta(a) > 0$ for $[\widetilde{a}, \hat{a})$. So the solution given by $q\left(a\right)a = \frac{t}{n}\left[1 - \epsilon(a)\right]$ for $a \in (0, \widetilde{a})$ has a unique solution.

A.2 Derivations of Section 3

To obtain proposition 1, take the total differential of equation (11) with respect to k:

$$\begin{aligned}
&\frac{dq}{dk}a^* + \frac{dq}{da}\frac{da^*}{dk}a^* + \frac{da^*}{dk}q = -t\left(\frac{d\epsilon}{dk} + \frac{d\epsilon}{da}\frac{da^*}{dk}\right) \\
\Longrightarrow &\frac{da^*}{dk} = -\frac{t\frac{d\epsilon}{dk} + \frac{dq}{dk}a^*}{q^*(1-\epsilon^*) + t\frac{d\epsilon}{da}} \gtreqless 0.
\end{aligned}$$

The denominator is positive as $\epsilon^* < 1$ and $\frac{d\epsilon}{da} > 0$. The nominator can be positive or negative as $\frac{d\epsilon}{dk} > 0$ and $\frac{dq}{dk} < 0$.

To obtain proposition 2, differentiate equation (13) with respect to k:

$$\begin{aligned}
\frac{d\Pi^*}{dk} &= -\frac{1}{2}Rt\left[\frac{d\epsilon}{dk} + \frac{d\epsilon}{da}\frac{da^*}{dk}\right] \\
&= -\frac{1}{2}Rt\left[\frac{q^*(1-\epsilon^*)\frac{d\epsilon}{dk} - \frac{d\epsilon}{da}\frac{dq}{dk}a^*}{q^*(1-\epsilon^*) + \frac{d\epsilon}{da}t}\right] < 0.
\end{aligned}$$

Numerator and denominator are both positive, so $\frac{d\Pi^*}{dk} < 0$.

A.3 Derivations of Section 4

To obtain proposition 3, take the total differential of equation (16) with respect to k:

$$0 = -R\left(\frac{d\epsilon}{dk} + \frac{d\epsilon}{da}\frac{da^{\#}}{dk}\right)$$
$$\Longrightarrow \frac{da^{\#}}{dk} = -R\frac{\frac{d\epsilon}{dk}}{\frac{d\epsilon}{da}} < 0.$$

Since $\frac{d\epsilon}{da} > 0$ and $\frac{d\epsilon}{dk} > 0$, $\frac{da^{\#}}{dk} < 0$.

Take total differential of equation (17) with respect to k:

$$\begin{aligned}\frac{ds^{\#}}{dk} &= -R\left(\frac{da^{\#}}{dk}q^{\#} + \frac{dq}{dk}a^{\#} + \frac{dq}{da}\frac{da^{\#}}{dk}a^{\#}\right)\\ &= -R\left(\frac{da^{\#}}{dk}q^{\#}(1-\epsilon^{\#}) + \frac{dq}{dk}a^{\#}\right) > 0.\end{aligned}$$

Since $\frac{da^{\#}}{dk} < 0$ and $\frac{dq}{dk} > 0$, it follows that $\frac{ds^{\#}}{dk} < 0$.

Take total differential of equation (18) with respect to k:

$$\frac{dR_a^{\#}}{dk} = -\frac{1}{2}\frac{ds^{\#}}{dk} < 0.$$

Take total differential of equation (19) with respect to k:

$$\frac{dR_s^{\#}}{dk} = \frac{1}{2}\frac{ds^{\#}}{dk} > 0.$$

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