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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 increased avoidance opportunities decrease profits and entry in the free-to-air regime. In contrast, in the pay-TV regime, lower income from advertisements are compensated by higher subscription income leaving profits and the number of channels unaffected. Bypassing advertising messages affects welfare ambiguously.

Keywords: Media Markets; Two-Sided Markets; Ad-avoidance.
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 to place 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 adverts. Thus, the externality from advertisers on viewers is negative.

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: 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, make use of ad-avoidance technologies such as TiVo. Also, if the advert ratio is too large, viewers may switch off completely or reduce the amount of TV consumption. 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 advert with a media platform has a much lower value for advertisers if viewers can avoid this advert. In the extreme case, that viewers do not any pay attention to adverts, the value to the advertisers is zero. This, in turn, has consequences for the media platform when deciding about pricing its media product to viewers and advertisers. It is the aim of the present paper to analyze these consequences on platform behavior if viewers can avoid advertisement.

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. We model this by specifying a function that maps the amount of advertising at a channel into consumers' avoiding behavior. In line with the above discussion, consumers' bypassing of adverts is the higher the more adverts are placed on a channel.

We find that the possibility of ad-avoidance by viewers has a very different impact depending on the financing regime. In the free-to-air regime, an increase in ad-avoidance possibilities may lead to an increase or decrease in the level of advertising. Profits 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, total profits in the pay-TV regime are independent of any ad-avoidance behavior. 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 free-to-air but has no 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 Gabsczewicz et al. (2004), Anderson and Coate (2005), Choi (2006), Armstrong and Weeds (2007), Peitz and Valletti (2008) or Crampes et al. (2009). In these models, advertising typically affects viewers adversely, but viewers' only possible reaction to high advertising levels is to change the channel. In contrast, in this paper, we introduce another margin by which viewers can react to advertising as we allow viewers to avoid advertisement messages.

There are several recent papers that analyze ad-avoidance behavior. Closest in spirit to the present paper is the contribution by Anderson and Gans (2006). 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 in the model of Anderson and Gans (2006) to higher advertising levels. The reason is that only viewers with lower disutility from advertising remain without the ad-avoidance technology leading stations to increase advertising levels. Our model differs in three aspects: i) Our model is more general in the sense that it encompasses all possible sorts of ad-avoidance behavior. ii) Our focus lies on competition between duopolists while Anderson and Gans (2006) consider a monopolistic broadcaster.[1] iii) We consider channels' entry decisions, and thus study diversity in media market in the presence of ad-avoidance.

Related to our work are also papers that compare business models where firms can offer a version of a product with advertisement and another version with removed 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 (2007).

From a methodological point of view our paper is related to Gu and Wenzel (2009a,b) who introduce price-dependent demand into the Salop model and show that the classic excess entry result need not hold. We use their framework to model ad-avoidance behavior by TV viewers.

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 extends the model to more than two firms and considers entry decisions. Section 6 studies the welfare outcomes. Finally, Section 7 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, that compete for viewers and advertisers.[2] 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.[3]

[1] In an extension, Anderson and Gans (2006) consider a duopoly version of their model under free-to-air.

[2] In Section 5, we will extend the setup to an arbitrary number of stations using the Salop formulation in order to study entry decisions.

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

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. Consumer avoid advertising by switching off, paying less attention, etc. To formalize this, we assume a function $q(a, k)$ which maps the amount of advertising at a channel (a) into consumer's bypassing behavior of adverts.[4] The function can be interpreted broadly, measuring all possible sorts of ad-avoidance behavior, e.g. mute off, leave the room, buy TiVo. This function is identical for all consumers.[5] 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. The parameter k is a shift parameter in the ad-avoidance behavior with $\frac{dq(a,k)}{dk} < 0$ and $\frac{d^2q(a,k)}{dadk} \geq 0$. The parameter k can be interpreted in two ways. On the one hand, an increase in k measures a rise in viewers' responsiveness to advertising (e.g. muting off more quickly). On the other hand, the availability of ad-avoidance technologies (such as TiVo, Sky+) can be modeled by an increase in k as these make bypassing adverts more comfortable and hence decrease the costs associated with avoiding adverts. Additionally, a rise in k might reflect a rise in the penetration of these technologies, for instance, due to lower prices.

Denote the absolute value of the elasticity of demand with respect to advertising as

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

We now introduce the following assumption:

[4]Here we follow Gu and Wenzel (2009a,b) who introduce a price-dependent demand function into the Salop model. We assume that $q(a, k)$ is continuous and two time differentiable.

[5]In this aspect, our model differs from Anderson and Gans (2006) who assume that viewers differ in their intensity of advertising nuisance.

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

where $\hat{a}$ denotes the level of advertising that reduces TV consumption to zero, thus $q(\hat{a}, k) = 0$. This assumption is needed to ensure equilibrium existence.

As an example, this assumption is satisfied if advertising has a linear influence on viewing behavior, e.g. $q(a, k) = A - B \cdot a \cdot k$, where both A and B are suitable positive constants.

The function $q(a, k)$ can then be seen as demand for TV consumption depending on the level of advertising. 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 is, it incurs a psychic cost to viewers. Optimization then leads to demand function $q(a, k)$ for TV consumption. There is an associated indirect utility to this demand 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 two stations 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:

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

where a_A (a_B) denotes the level of advertising at channel A (B) and s_A (s_B) 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

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

This can be reformulated as:

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

Hence, the difference in advertising levels impact 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

Advertisers' demand for placing advertisement with a channel depends positively on the number of viewers associated with a certain channel. However, advertisers' willingness to pay is reduced if viewers avoid advertisement by not paying attention to the spots, switching off or leaving the room. We assume the following per-viewer revenue function:

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

A channel's advertising revenues depends on the number of spots (a) and viewer avoidance behavior ($q(a,k)$). If viewers avoid advertisement advertisers' value of sending 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. The price per spot depends on viewer behavior. If $q(a,k)$ is high and viewers pay attention to advertisement messages, TV stations receive a high price per spot. If, on the other hand, viewers avoid advertisements ($q(a,k)$ is low), TV stations 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.[6]

[6] Here we follow Gabszewicz et al. (2004) and Mangani (2003) who assume that TV channels receive a fixed price per ad, which might be motivated by the assumption, that the channels are too small to influence the overall advertising market. Anderson and

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

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 TV stations' only source of income is 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 profits of 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

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

Coate (2005), Peitz and Valletti (2008), and Armstrong and Weeds (2007) assume that advertising revenues are concave function in the number of adverts.

The first-order condition of a symmetric equilibrium is given by:

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

An increase in the amount of advertising has three effects on profits. 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 profits, a loss in market share and a rise in ad-avoidance. The second term measures the loss in market share while the third term is the increase in ad-avoidance. 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 equilibrium advertising. Note that in equilibrium the demand elasticity ($\epsilon(a^*, k)$) is smaller than one.[7]

We can now study the properties of the equilibrium. We are particularly interested in the impact of advertising-avoidance possibilities on the equilibrium level of advertising. Thus, we are interested in the impact of an increase of k on a^*. Total differentiation of equation (11) with respect to k yields:

Result 1. In the free-to-air regime, increased avoidance possibilities, as measured by k, have an ambiguous effect on equilibrium advertising. It may increase or decrease equilibrium advertising. That is, $\frac{da^*}{dk} \gtrless 0$.

Proof: see appendix.

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

[7]The proof for the existence of a unique equilibrium is provided in the Appendix.

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

This equation 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, is weaker when k rises, meaning that this raises the incentives to increase advertising. At an intuitive level, if viewers avoid averts anyway (k is high), there is less loss in market share if a channel increases advertising level. Thus, this effect is due to decreases level of competition. Finally, the demand elasticity increases with k leading to a larger effect ad-avoidance which tends to reduce advertising. The overall effect is thus determined by the relative strength of the competition effect and the ad-avoidance effect.

Our results complement those from Anderson and Gans (2006). While in Anderson and Gans (2006) the introduction of Tivo increases equilibrium advertising unambiguously, in our model equilibrium advertising may increase or decrease. The reason in their model is that viewers that adopt TiVo are those with a high nuisance to advertising, and so only those with low nuisance remain and so in consequence, advertising is high. We introduce a new effect which may lead to an increase in advertising, namely the competition effect. In the appendix, we provide an example for this result using a specific functional form.

Inserting equilibrium advertising into the profit function we get the profits earned by each of the two channels:

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

Comparative statics show that increases ad-avoidance opportunities reduce profits in the free-to-air regime.

Result 2. In the free-to-air regime, increased consumer avoidance of advertising decreases equilibrium profits.

Proof: see appendix.

Even though, advertising may increase due to a rise in k, the impact on profits is strictly negative.

4 Pay-TV

In the pay-TV regime, TV channels have an additional source of income, subscription fees. 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.[8]

The profit of a broadcaster is now:

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

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 the advertising level and the 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 defines implicitly equilibrium advertising. 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 enter the equation for equilibrium advertising. The second condition determines the subscription price charged to viewers. 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

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

as viewers are now more valuable to broadcasters due to the associated higher advertising revenues. As in the models by Peitz and Valletti (2008) and Choi (2006) there is a full pass-through of advertising revenues into the subscription price.

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

Result 3. In the pay-TV regime, equilibrium advertising decreases in ad-avoidance opportunities while the subscription price increases.

Proof: see appendix.

Notice that in the pay-TV regime an increase in k has an unambiguous impact on the level of advertising. An increase in k decreases advertising. The reason is that in contrast to free-to-air the effect of relaxed competition is not present. Due to the full-pass through of advertising revenues into subscription prices, an increase in k yields a higher subscription fee.

The equilibrium income streams to 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 depend 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. Thus, an increase in ad-avoidance opportunities leaves total profits constant, but changes the composition of the two revenue sources. Income from advertising reduces, but there is more income from subscription. We summarize this in the following result:

Result 4. In the pay-TV regime, equilibrium profits are unaffected by increased ad-avoidance opportunities, but the composition of profits is altered: income from advertising decreases and income from subscription increases.

Proof: see appendix.

5 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 along the circumference of a unit circle. Channels, whose number is denoted by n, 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 on the subscription price (in the pay-TV regime). We are interested in determining the impact of ad-avoidance opportunities on the number of channels that enter in a free-entry equilibrium.

5.1 Free-to-air

Consider first the free-to-air regime. We start by considering the situation with a given number of channels n in the market. We seek for a symmetric equilibrium. Thus, we consider the situation of a representative channel i. Let a_i denote the advertising level at this channel while all remaining channels set advertising at a_o. The profit of a representative channel can then be written as:

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

Solving for a symmetric advertising level, we get

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

The comparative statics of increased avoidance opportunities (measured by k) has the same impact on the equilibrium outcome as in the duopoly case. A larger k may lead to more or less advertising. A larger number of channels decreases the equilibrium advertising level.

Inserting equation (22) into equation (23) gives the equilibrium profits for a given number of firms:

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

The impact on profits is unambiguous. More avoidance possibilities decrease profits, $\frac{d\Pi}{dk} < 0$. A larger number of competitors reduces profits.

In the next step, we seek to determine the number of firms entering the market. This number is determined by setting equation (23) equal to zero 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 express the number of entrants explicitly as the equilibrium demand elasticity ($\epsilon(a^*, k)$) depends on the number of competitors. However, we know that profits decrease monotonically in the number of firms. Hence, we know that a solution to equation (24) exists and is unique.[9] As a larger value of k decreases profits, it follows immediately:

Result 5. In the free-to-air regime, more ad-avoidance opportunities, as measured by k, decreases entry.

In the free-to-air regime, increased ad-avoidance opportunities lead to a reduced number of channels in the market, and hence to less diversity.

5.2 Pay-TV

Now we turn to the pay-TV regime. Let a_i and s_i denote advertising level and subscription fee, respectively, at the representative channel i while ad-

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

vertising and subscription fee at all remaining channels is denoted by a_o and s_o. The profit of channel i is:

$$\Pi_i = \left[\frac{1}{n} + \frac{1}{t}\int_{a_i}^{a_o} q(a,k)da + \frac{s_o - s_i}{2t}\right][R \cdot q(a_i,k)a_i + s_i] - f. \tag{25}$$

Solving for a symmetric equilibrium, we get the following conditions for advertising and subscription:

$$R[1 - \epsilon(a^{\#},k)] = 1, \tag{26}$$

and

$$s^{\#} = \frac{t}{n} - R \cdot q(a^{\#},k)a^{\#}. \tag{27}$$

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. As in the duopoly case the reason is again the full pass-through of advertising revenues into the subscription fee. The subscription price is affected by the number of competing channels. The more channels are in the market, the lower is the subscription price. The comparative statics concerning increased avoidance opportunities are the same as in the duopoly case. A higher k decreases advertising and increases subscription prices.

As in the duopoly case, equilibrium profits are independent of the possibilities to avoid advertising, and hence of k:

$$\Pi^{\#} = \frac{t}{n^2} - f, \tag{28}$$

As can be seen directly, profits 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, income from subscription shrinks. Thus, with a larger number of channels income from advertising gains relative importance.

The number of channels entering in a free-entry equilibrium follows from setting equation (28) equal to zero:

$$n = \sqrt{\frac{t}{f}}. \tag{29}$$

As profits are independent from the possibility of ad-avoidance, so is the number of channels that enter in a free-entry equilibrium.[10] Thus, diversity in the media market is not affected by ad-avoidance behavior.

5.3 Comparison

As the analysis above has shown, ad-avoidance behavior has a very different impact on the market structure in the two financing regimes. This difference is summarized in the following result:

Result 6. Increased ad-avoidance opportunities reduce diversity in the free-to-air regime and has no impact in the case of pay-TV.

In the free-to-air regime, a rise in ad-avoidance decreases the number of channels and decreases diversity. This is not the case in the pay-TV regime. Here, the decline in advertising revenues can be compensated by an increase in subscription prices, and thus profits are unaffected by ad-avoidance, and so is the number of channels that enter. The analysis sheds light on possible changes in the composition of the broadcasting sector. Due to increased technological advances, such as TiVo or other digital video recorder, it is likely that viewers will have increased opportunities to avoid advertisement messages. In the light of the present analysis this should make TV channels more likely to adopt a business strategy with subscription prices.

6 Welfare

This section derives the welfare properties of our model. We compare the optimal allocation with the equilibrium outcome in the two financing regimes. In the duopoly model, the only relevant factor for welfare is the level of advertising. In the entry model, welfare is additionally affected by the number of channels. In the setup of our model it suffices to define social welfare as the sum consumer utility and channels' profits. Profits of the advertisers are zero.

[10]Note that the number of firms entering in the pay-TV regime coincides with entry in the standard Salop model. Thus, the standard welfare properties apply.

6.1 Duopoly model

In the duopoly version of our model, the level of advertising enters into social welfare as follows:

$$W^d(a) = \int_a^{\hat{a}} q(\tilde{a}, k) d\tilde{a} + R \cdot q(a, k)a. \tag{30}$$

The first term in the welfare function is the impact of advertising on consumers utility. The second term are the joint advertising revenues of all channels. Maximization with respect to a yields the socially optimal amount of advertising:

$$1 = R[1 - \epsilon(a^d, k)]. \tag{31}$$

The optimal advertising level depends on $q(a, k)$ and R. The optimality condition coincides with equilibrium condition in the pay-TV regime. Thus, advertising in the pay-TV regime is at the welfare optimal level.

In the free-to-air regime, equilibrium and optimal advertising are more difficult to compare. Both, equilibrium and optimal advertising, depend on the shape of $q(a, k)$, but equilibrium advertising depends on the degree of competition in market (t) while optimal does not. On the other hand, optimal depends on R while equilibrium does not. We find equilibrium advertising can be excessive or insufficient. The result depends on the relative magnitude of transportation costs and revenues. Advertising is too few if

$$\frac{t}{R} < q(a^*, k)a^*. \tag{32}$$

As transportation costs are relatively low, that is, competition limits advertising level. The opposite is if

$$\frac{t}{R} > q(a^*, k)a^*. \tag{33}$$

6.2 Entry model

In the entry model, there are two factors that impact on welfare: the advertising intensity and the number of channels. Welfare can be expressed as:

$$W^e(a,n) = \int_a^{\hat{a}} q(\tilde{a},k)d\tilde{a} - 2n\int_0^{\frac{1}{2n}} txdx + R[q(a,k)a] - fn. \quad (34)$$

The first term represent the impact of advertising on consumer welfare. The second term is the sum of transport costs due to the mismatch between content offered by channels and consumers' preferences. The third term are advertising revenues to the channels. And the fourth term are fixed costs associated with operating a channel.

Maximization with respect to advertising and the number of channels, we obtain:

$$1 = R(1 - \epsilon^e), \quad (35)$$

and

$$n^e = \sqrt{\frac{t}{4f}}. \quad (36)$$

The first expression denotes the optimality condition for advertising. The second expression denotes the optimal number of channels. Note that optimal advertising and entry are governed by different factors. While optimal advertising depends on R and $q(a,k)$, optimal entry depends on fixed costs f and transportation costs t. This separating result is due to the additivity in the welfare function.[11]

Comparing outcome in the pay-TV market, we find that the advertising level is at the optimal level. However, there is excessive entry into the market—the classic excess entry theorem in the Salop model. While in the pay-TV market we have unambiguous results, in the free-to-air regime virtually anything is possible. There can be excessive or insufficient entry. The amount of advertising may be too low or too high. In this respect our model provides no new insight compared to a model without ad-avoidance. Thus, for a discussion of the welfare properties we refer to the paper by Choi (2006).

[11] See also Choi (2006).

7 Conclusion

This papers considers the impact of ad-avoidance behavior in 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 largely 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 income. Channels are then 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 income from advertising. However, as income from subscription increases at the same level, total income is not affected by viewers' avoidance behavior. In the free-entry version of our model this leads immediately to an unchanged number of channels.

Viewer always had the opportunities 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.

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 $\varepsilon < 1$. Note when $\varepsilon \geq 1$ i.e., $\frac{dq(a)}{da}\frac{a}{q(a)} \leq -1$, the first-order derivative is

$$\frac{d\Pi_i}{da_i} = \underbrace{-\left[q\left(a_i\right)\right]^2 a_i \frac{1}{t}}_{\text{negative}} + \underbrace{\left[\frac{1}{n} + \frac{1}{t}\int_{a_i}^{a_o} q\left(a\right) da\right] q\left(a_i\right)}_{\text{positive}} \underbrace{\left[1 + \frac{a_i}{q\left(a_i\right)}\frac{dq\left(a\right)}{da}\Big|_{a=a_i}\right]}_{\text{non-positive}} \tag{37}$$

and obtains a strictly negative value. The middle part in the right-hand side of (37) 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,

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

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

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

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 $\Delta(a)$,

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

Following Assumption 1, $\frac{d\varepsilon(a)}{da} > 0$; 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 $\varepsilon(a) \geq 1$ which means $\Delta(a) > 0$ for $[\widetilde{a}, \hat{a})$. So the solution given by

$q\left(a\right)a = \frac{t}{n}\left[1-\varepsilon(a)\right]$ for $a \in (0, \widetilde{a})$ has a unique solution.

A.2 Derivations of Section 3

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

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

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 demonstrate the possibility that an increase in k can increase or decrease equilibrium advertising, suppose $q(a,k) = 1 - 0.1a - k$ and $t = 1$. We solve for equilibrium advertising numerically. The result is shown in Figure 1.

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

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

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

A.3 Derivations of Section 4

To obtain result 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 $\frac{d\epsilon}{dk} > 0$, $\frac{da^{\#}}{dk} < 0$.

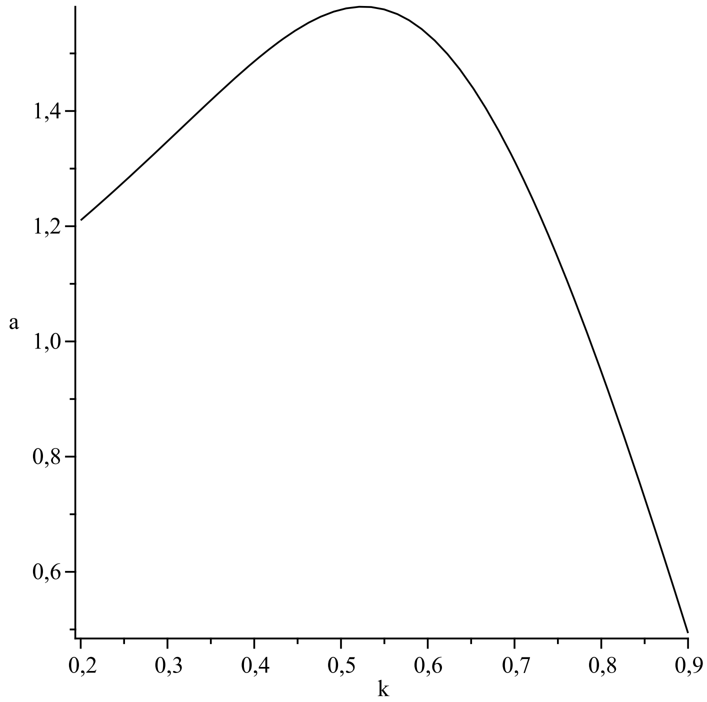

Figure 1: Equilibrium advertising in the free-to-air regime

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 $\frac{dq}{dk} > 0$, $\frac{ds^{\#}}{dk} < 0$.

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:

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

A.4 Derivations of Section 5

To show that $\frac{da^*}{dk} \gtrless 0$ follows the same steps as in the duopoly model in section 3. So we refer the reader to this section.

To derive the impact of the number of firms on advertising, differentiate equation (22) with respect to n:

$$\begin{aligned}
&\frac{dq}{da}\frac{da^*}{dn}a^* + q^*\frac{da^*}{dn} = \frac{t}{n}\left(-\frac{d\varepsilon}{da}\frac{da^*}{dn}\right) - (1-\varepsilon^*)\frac{t}{n^2} \\
\Longrightarrow &\left(\frac{dq}{da}a^* + q^*\right)\frac{da^*}{dn} = -\frac{t}{n}\frac{d\varepsilon}{da}\frac{da^*}{dn} - \frac{t}{n^2}(1-\varepsilon^*) \\
\Longrightarrow &\frac{da^*}{dn}\left(q^*(1-\varepsilon) + \frac{t}{n}\frac{d\varepsilon^*}{da}\right) = -\frac{t}{n^2}(1-\varepsilon^*) \\
\Longrightarrow &\frac{da^*}{dn} = \frac{-\frac{t}{n^2}(1-\varepsilon^*)}{q(1-\varepsilon^*) + \frac{t}{n}\frac{d\varepsilon^*}{da}} < 0.
\end{aligned}$$

Since $(1-\varepsilon^*) > 0$ and $\frac{d\varepsilon^*}{da} > 0$, in equilibrium $\frac{da^*}{dn} < 0$.

The derivation $\frac{d\Pi^*}{dk} < 0$ follows the same steps as in the duopoly model in section 3.

Differentiate equation (23) with respect to n:

$$\begin{aligned}
\frac{d\Pi^*}{dn} &= -\frac{2t}{n^3}(1-\varepsilon^*) - \frac{t}{n^2}\frac{d\varepsilon^*}{dn} \\
&= -\frac{t}{n^3}(1-\varepsilon^*)\left[2 - \frac{t}{n}\frac{d\varepsilon^*}{da}\left(\frac{1}{q^*(1-\varepsilon^*) + \frac{t}{n}\frac{d\varepsilon^*}{da}}\right)\right] \\
&= -\frac{t}{n^3}(1-\varepsilon^*)\frac{2q^*(1-\varepsilon^*) + \frac{t}{n}\frac{d\varepsilon^*}{da}}{q^*(1-\varepsilon^*) + \frac{t}{n}\frac{d\varepsilon^*}{da}} < 0.
\end{aligned}$$

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