Broadcasting Competition and Advertising Quality: A Two-sided Market Approach*

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Abstract

We compare the equilibrium levels of advertising to the socially optimal levels in the broadcasting industry. Three types of agents are analyzed: Viewers who differ in their aversion towards advertising, firms that place ads, and broadcasters who sell advertising slots and compete on viewers. We identify the conditions on the proportion of ad-averse viewers under which the number of ads exceeds or falls below the optimal level. Finally, the paper investigates firms' incentives to improve the quality of their broadcasted ads, and demonstrates that if quality improvement is profitable for the advertising firms, it is unprofitable for broadcasters.

Keywords: Advertising, Ad-averse viewers, Rating, Advertising quality, Two-sided markets.

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1. Introduction

The past three decades followed a continual deregulation of broadcasting industries. As a result, we observe a sharp increase in the number of commercial broadcasting stations all over the world. In addition, the competition on viewers among broadcasting stations was intensified with the increased availability of cable television and hence the demand for advertising airtime by producers and service providers. Television, radio, and most recently the Internet, constitute the main media for spreading information, providing entertainment, and cultural life. Therefore, most people allocate significant parts of the day (and night) to watching television and listening to radio stations.

In most countries, regulators limit the amount of broadcasted advertising. Advertising is limited to an average of six minutes per hour in France, seven minutes in England, and nine minutes in Germany, see Motta and Polo (1997). In the United States, broadcasters are generally free to set the number of commercial breaks as well as the lengths of these breaks. However, in 1990 Congress has passed a law that limits commercial breaks in kids' channels to twelve minutes per broadcasting hour during weekdays, and to ten minutes during weekends.

In view of these observations, the present paper investigates whether advertising airtime exceeds the socially-optimal level (and hence whether it should be regulated) in a model consisting of the following features. (a) Viewers are heterogeneous with respect to their attitude towards commercial interruptions. (b) Broadcasters compete in two dimensions: On the number of viewers, as well as on the number of firms which they advertise for. Profit is made by selling airtime to firms whose willingness to pay depends on the number of viewers. The number of viewers is also negatively affected by the number of advertisements. Therefore, the profit maximizing advertising prices are determined by *balancing* the endogenously-determined number of viewers with the endogenously-determined number of advertising firms. In this respect, the role played by broadcasters in the environment described in this paper resembles very much firms that operate in two-sided market, see Rochet and Tirole (2003).

In the literature, Masson, Mudambi, and Reynolds (1990) examine how the competition on rating affects advertising prices assuming two identical channels with a homogeneous viewer population. They find that greater competition generally leads to a less-than-expected decline in advertising prices. Epstein (1998) examines both theoretically and empirically the timing and length of broadcasted advertisements, and demonstrates that broadcasting networks tend to schedule advertising at similar time periods. Gabszewicz, Laussel and Sonnac (2004) analyze channels that first select their profiles (program mixes) and then their advertising ratios, and show that these ratios play the same role as prices in usual horizontal differentiation models. Zhou (2004) investigates the length and timing of advertising under monopoly and duopoly, and demonstrates that channels choose equal lengths of commercial breaks.

Anderson and Coate (2005) explore the nature of market failure by modeling how well commercial broadcasting fulfils its two-sided role of providing programming to viewers/listeners and permitting advertisers to contact potential customers. Their paper ties the products' markets to advertising as a marketing tool and analyze the tradeoff between the disutility stemming from commercial interruption during broadcasts and the informational gains generated by the content of these ads. Gal-or and Dukes (2003) model commercial media (stations) that compete for audiences with their choice of programming variety in order to attract advertising revenues from advertisers, and show that media have incentives to minimize the extent of differentiation between them. Dukes and Gal-Or (2003) model the bargaining process between stations and advertisers. Dukes (2004) shows that less product differentiation or more media differentiation leads to a higher market level of advertising. In the case of sufficiently high media differentiation, levels of advertising are in excess of the social optimum. Kinds, Sørgard, and Nilssen (forthcoming) find that the less differentiated the TV channels' programs are, the lower is the amount of advertising in equilibrium, and that relative to the social optimum, there is underprovision of advertising if TV channels are sufficiently close substitutes. Dukes (2006) investigates how competition in the media market affects choices of advertising and program quality. Finally, Gal-Or and others (2006) explore the extent to which an advertiser should allocate resources to increase the quality of its targeting.

The present paper differs from the above literature in two major aspects. Firstly, it analyzes heterogeneous viewers who differ in their attitudes toward advertising.[1] All our results are tied to the parameter measuring the proportion of the viewer population who are advertising-averse (as opposed to advertising indifferent or even advertising-lover viewers). Secondly, we also model viewers who have preference for the quality of the advertisements and not only for the quality of the aired programs. Analyzing the endogenous determination of advertising quality is important since it serves as a tool by which advertising firms can mitigate the negative effect of advertising on the number of viewers who watch their ads on TV. Thirdly, the number of advertising firms is endogenously determined in a two-sided market environment. None of the investigations cited above offers these kinds of comparisons in a single model.

The paper is organized as follows. Section 2 constructs a model with three types of agents: Viewers, firms that place ads, and broadcasters that sell advertising slots and compete on rating. Section 3 solves for the equilibrium number of firms that advertise. Section 4 compares the equilibrium number of advertising firms with the socially-optimal level. Section 5 presents a model where the quality of advertising becomes a choice variable to the advertising firms. Section 6 concludes.

2. A Model of Broadcasters, Viewers, and Advertisers

Consider an economy with two broadcasting networks (labeled α and β) competing simultaneously in two markets: (a) On the number of viewers (rating, in what follows), and (b) On selling advertising airtime to a wide variety of producers whose profit levels are enhanced with an increase in the number of viewers who watch their product or service being advertised on television.

2.1 Viewers

First, it should be pointed out although we use the term “viewers,” our model also applies to radio and newspaper advertising. Suppose that there are N viewers who can choose between

[1] Heterogeneous ad readers were assumed in some papers analyzing advertising in the press industry, see for example Gabszewicz, Laussel, Sonnac (2005).

watching the broadcasting aired by α or β. Viewers are heterogeneous in two dimensions: (a) They differ with respect to their preferences for watching α and β. This means that we assume that α and β broadcast different contents. (b) They differ with respect to their attitude toward advertising. More precisely, the utility of γN viewers, called *ad-averse*, declines with an increase in the number of broadcasted advertisements, where $0 \leq \gamma \leq 1$. In contrast, the utility of $(1-\gamma)N$ viewers, called *ad-indifferent*, is unaffected by the number of advertisements they are exposed to.

Ad-averse viewers include viewers who are not concerned with obtaining information about products and services. Alternatively, ad-averse consumers simply cannot obtain useful information concerning their commerce. For these viewers, watching ads on TV is time costly. Thus, ad-averse consumers view ads on TV as persuasive advertising and not as informative advertising. In contrast, ad-indifferent consumers may have a low value of time, or may appreciate some of the content transmitted by the aired advertising which offsets the loss of value of time. Section 5 below analyzes ad-lover viewers who actually benefit from the information transmitted via aired ads.

Let A_α and A_β denote the number of ads broadcasted by α and β, respectively. We restrict advertising levels to satisfy $0 \leq A_i \leq 1$, $i = \alpha, \beta$, meaning that A_i also measures the fraction of broadcasting time allocated to advertising. Hence, $A_i = 0$ implies no advertising, whereas $A_i = 1$ implies that broadcaster i airs only advertisements and no other content.

The γN ad-averse viewers are uniformly distributed on the unit interval $[0,1]$ according to increased preference for broadcaster β. Formally, the utility of an ad-averse viewer indexed by y $(0 \leq y \leq 1)$ is defined by

$$U_{AA} \stackrel{\text{def}}{=} \begin{cases} v(1-A_\alpha) - \mu y & \text{if watching } \alpha \\ v(1-A_\beta) - \mu(1-y) & \text{if watching } \beta, \end{cases} \tag{1}$$

where the parameter $\mu > 0$ measures the degree of taste heterogeneity of viewers associated with the different contents broadcasted on α and β. Inspecting (1) reveals that each viewer gains a basic utility of v from watching television without advertising, and that this basic utility is reduced with the amount of advertising on the relevant channel. The $(1-\gamma)N$ ad-indifferent viewers are also uniformly distributed on the unit interval $[0, 1]$. The utility of an ad-indifferent viewer indexed by z ($0 \le z \le 1$) is defined by

$$U_{AI} \stackrel{\text{def}}{=} \begin{cases} v - \mu z & \text{if watching } \alpha \\ v - \mu(1-z) & \text{if watching } \beta. \end{cases} \tag{2}$$

Comparing (2) with (1) reveals that the utility *AI*-viewers is unaffected by the number of broadcasted ads.

Let $\hat{y}$ denote an ad-averse viewer and $\hat{z}$ denote an ad-indifferent viewer who are both indifferent between watching α and β. The utility functions (1) and (2) imply that

$$\hat{y} = \frac{1}{2} + \frac{v(A_\beta - A_\alpha)}{2\mu} \quad \text{and} \quad \hat{z} = \frac{1}{2}. \tag{3}$$

Therefore, all viewers indexed by $y \le \hat{y}$ and $z \le \hat{z}$ watch α, and all others watch β. Equation (3) shows that the difference in advertising levels affects the fraction of ad-averse viewers of α and β, but does not affect ad-indifferent viewers. Hence, ad-indifferent viewers are equally divided between the broadcasters. Figure 1 illustrates how the two groups of viewers are divided between the two broadcasters.

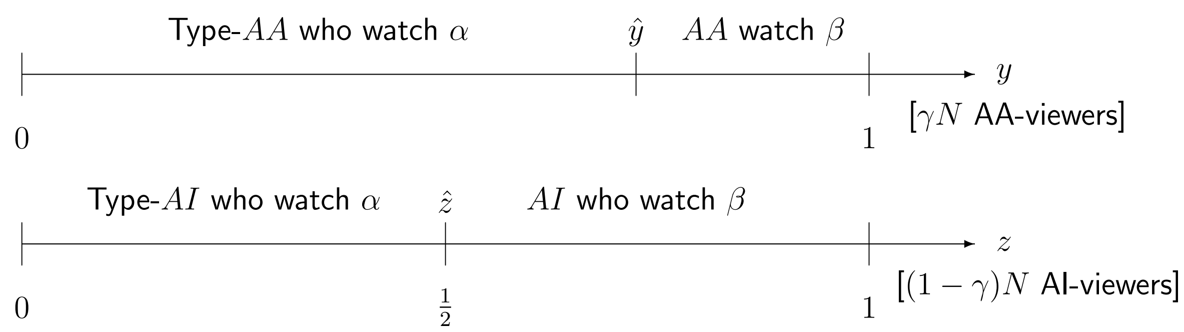

Figure 1: Viewers' choice of broadcasting. *Top:* Ad-averse viewers. *Bottom:* Ad-indifferent viewers. *Note:* For the sake of illustration only, the figure assumes $A_\beta > A_\alpha$.

In view of (3) and Figure 1, the endogenously-determined total number of viewers (rating, in what follows) who watch α and β are given by

$$n_\alpha = [\gamma\hat{y} + (1-\gamma)\hat{z}]\, N = \frac{N}{2} + \frac{N\gamma v(A_\beta - A_\alpha)}{2\mu} \quad \text{and,} \tag{4a}$$

$$n_\beta = [\gamma(1-\hat{y}) + (1-\gamma)(1-\hat{z})]\, N = \frac{N}{2} + \frac{N\gamma v(A_\alpha - A_\beta)}{2\mu}. \tag{4b}$$

2.2 Advertising firms

There is a continuum of firms indexed by x on the interval $[0,1]$, with unit density. Each firm airs at most one ad either in network α or in β but not both.[2] Let p_α and p_β denote the prices that broadcasters α and β charge the advertising firms for placing an ad. Given these prices, and given the number of viewers n_α and n_β, each firm chooses whether to advertise in α or β as to maximize their profit given by

$$\pi(x) \stackrel{\text{def}}{=} \begin{cases} \phi n_\alpha - \tau x - p_\alpha & \text{advertises in } \alpha \\ \phi n_\beta - \tau(1-x) - p_\beta & \text{advertises in } \beta \\ 0 & \text{does not advertise.} \end{cases} \tag{5}$$

The profit functions (5) reveal that the choice where to advertise is influenced negatively by the prices charged by broadcasters, p_α and p_β, and positively by the *rating* of each broadcaster n_α and n_β given by (4a) and (4b), and magnified by the parameter $\phi > 0$.

The profit functions (5) imply that firms indexed by a "low" x tend to advertise in α, whereas firms indexed by a "high" x tend to advertising in β. The differentiation variable x, magnified by the parameter $\tau > 0$, reflects the importance of the difference in the contents broadcasted by α and β in relation to the type of products or services sold by an advertising firm x. For example, investment banks would find it more profitable to advertise in news channels; diaper producers would advertise in family programs, whereas toy producers would find it more profitable to advertise in kids' channels.[3] Therefore, if all firms advertise (fully-served market, in what

[2]Thus, this model is confined to single-homing advertising. A more general formulation would include an endogenous determination of whether advertising firms should choose single-homing or multi-homing advertising which means placing ads in more than one channel, see Dukes and Gal-Or (2003).

[3]In view of the previous footnote, with some loss of generality the present model rules out business that may benefit from advertising in both channels. In a more general setup, advertising firms indexed near $x = \frac{1}{2}$ would seek to multihome, whereas advertising firms near the extremes, $x = 0$ and $x = 1$ would seek single homing.

follows), there exists a firm $\hat{x}$ that earns the same profit whether it places an advertisement in α or β, which is given by

$$\hat{x} = \frac{1}{2} + \frac{\phi(n_\alpha - n_\beta) + p_\beta - p_\alpha}{2\tau}. \tag{6}$$

However, if some firms do not find it profitable to advertise (partially-served market) then there exist firms $\hat{x}_\alpha$ and $\hat{x}_\beta$ which earn zero profits whether they choose not to advertise at all or whether to advertise in α or β, respectively. In view of (5),

$$\hat{x}_\alpha = \frac{\phi n_\alpha - p_\alpha}{\tau} \quad \text{and} \quad \hat{x}_\beta = \frac{\tau - \phi n_\beta + p_\beta}{\tau}. \tag{7}$$

Figure 2 illustrates the two possible market configurations.

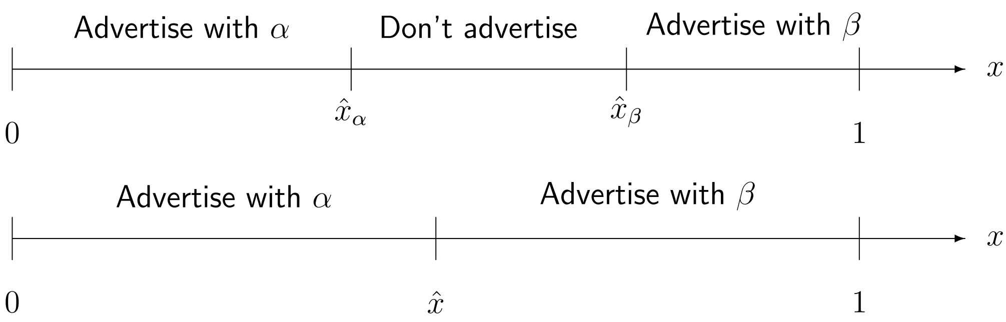

Figure 2: Firms' choice of advertising. *Bottom:* Fully-served market. *Top:* Partially-served market.

2.3 Broadcasters

Broadcasters α and β are commercial networks that air programs and advertisements and have no ability to charge viewers for their programs. Thus, the only source of revenue of each broadcaster comes from advertising firms who pay p_α and p_β for placing advertisements. Therefore, broadcasters' revenues are defined by

$$\pi_\alpha \overset{\text{def}}{=} p_\alpha \tilde{x}_\alpha \quad \text{and} \quad \pi_\beta \overset{\text{def}}{=} p_\beta(1 - \tilde{x}_\beta), \tag{8}$$

where $\tilde{x}_\alpha = \tilde{x}_\beta = \hat{x}$ if the market is fully served, and $\tilde{x}_\alpha = \hat{x}_\alpha < \tilde{x}_\beta = \hat{x}_\beta$ if the market is only partially served.

3. Equilibrium Advertising Levels

This model has three types of agents: Broadcasters, viewers, and advertising firms. We assume that these agents interact according to the following three stages:

I. Broadcasters α and β set advertising prices, p_α and p_β, to maximize advertising revenues given in (8).

II. Each advertising firm $x \in [0,1]$, correctly anticipating the ratings n_α and n_β, determines whether to advertising in α or β as to maximize (5).[4]

III. Each viewer of type y and type z takes broadcasters' advertising levels as given and determines which channel to watch as to maximize (1) and (2).

3.1 Fully-served market

Suppose that each producer places an ad in one of the networks [see bottom of Figure 2 and equation (6)]. The equilibrium of Stage III has already been characterized in (4a) and (4b). Next, the *key* observation that must be made for solving Stage II is that $A_\alpha = \hat{x}$ and $A_\beta = 1 - \hat{x}$, where $\hat{x}$ is given in (6). That is, the advertising level of each broadcaster equals to the number of firms that advertise with the broadcaster. Substituting $A_\alpha = \hat{x}$ and $A_\beta = 1 - \hat{x}$ into (4a) and (4b), and then substituting (4a) and (4b) into (6) yields

$$\hat{x}(p_\alpha, p_\beta) = \frac{1}{2} + \frac{\mu(p_\beta - p_\alpha)}{2(N\gamma\phi v + \mu\tau)}. \tag{9}$$

In Stage I, broadcasters choose prices to maximize (8) where $\tilde{x}_\alpha = \tilde{x}_\beta = \hat{x}(p_\alpha, p_\beta)$ is given in (6). The unique Nash equilibrium advertising prices and the resulting broadcasters' profit levels are

$$p_\alpha = p_\beta = \tau + \frac{N\gamma\phi v}{\mu} \quad \text{and} \quad \pi_\alpha = \pi_\beta = \frac{\tau}{2} + \frac{N\gamma\phi v}{2\mu}. \tag{10}$$

[4]Whereas many papers assume that media firms set levels of advertising instead of prices (though some demonstrate that the choice of strategic variable does not affect equilibrium) we view price setting as a more realistic assumption.

Clearly, broadcasters' profit levels are enhanced with an increase in the number of viewers N, the parameter measuring the profit that each producing firm makes from placing ads ϕ, and viewers' valuation of content parameter v. More interestingly, (10) implies that

Result 1. *Given that the market is fully served, an increase in the proportion of ad-averse viewers will increase advertising prices paid by advertising firms and enhance broadcasters' profit levels. Formally, π_i and p_i increase when γ increases, for each broadcaster $i = \alpha, \beta$.*

Thus, an increase in the number of ad-averse viewers decreases viewers' benefit from watching TV, which induces broadcasters to raise prices. The assumption that the market for advertising is fully served is crucial (compare with Result 2 below) since when *both* broadcasters raise their advertising prices they do not decrease the demand for advertising. Hence, as long as all firms place advertisements, an increase in the number of ad-averse viewers weakens price competition between the broadcasters.

Clearly, in this symmetric equilibrium viewers are equally-distributed between the two broadcasters so that $n_\alpha = n_\beta = N/2$. However, for the market of advertisers to be fully-served (see Figure 2) the profit of firm $x = 1/2$ must be nonnegative. Substituting the equilibrium prices (10) into (5) for $x = 0.5$ we obtain the condition

$$\pi(0.5) \geq 0 \quad \text{if and only if} \quad \gamma \leq \frac{\mu(N\phi - 3\tau)}{2N\phi v}, \tag{11}$$

which ensures that the market is fully served. Condition (11) is satisfied for sufficiently high values of N or ϕ, and for γ sufficiently low.

3.2 Partially-served market

Suppose now that condition (11) is reversed, meaning that some firms do not advertise [see top of Figure 2 and equation (7)]. Substituting (4a) and (4b) into (7), noting that $A_\alpha = \hat{x}_\alpha$ and $A_\beta = 1 - \hat{x}_\beta$, and then solving simultaneously yields

$$\hat{x}_\alpha(p_\alpha, p_\beta) = \frac{N^2\gamma\phi^2 v + N\phi[\mu\tau - \gamma v(p_\alpha + p_\beta)] - 2\mu\tau p_\alpha}{2\tau(N\gamma\phi v + \mu\tau)}. \tag{12}$$

It is interesting to note that although the market for advertisements is not fully served, the market shares $\hat{x}_\alpha(p_\alpha, p_\beta)$ and $\hat{x}_\beta(p_\alpha, p_\beta)$ depend on both prices p_α and p_β. This happens since viewers pick which channel to watch based on the amount of advertising which is affected by all advertising prices, a direct consequence of modeling a two-side market. Broadcaster α takes p_β as given and chooses p_α to maximize $\pi_\alpha = p_\alpha \hat{x}_\alpha(p_\alpha, p_\beta)$. Substituting $p_\beta = p_\alpha$ into the first-order condition, the symmetric equilibrium broadcasters' prices and profit levels are

$$p_\alpha = p_\beta = \frac{N\phi(N\gamma\phi v + \mu\tau)}{3N\gamma\phi v + 4\mu\tau} \quad \text{and} \quad \pi_\alpha = \pi_\beta = \frac{N^2\phi^2(N\gamma\phi v + 2\mu\tau)(N\gamma\phi v + \mu\tau)}{2\tau(3N\gamma\phi v + 4\mu\tau)^2}. \tag{13}$$

Substituting the equilibrium prices p_α and p_β into (12) yields that the number of firms placing ads at α and β are

$$\hat{x}_\alpha = 1 - \hat{x}_\beta = \frac{N\phi(N\gamma\phi v + 2\mu\tau)}{2\tau(3N\gamma\phi v + 4\mu\tau)}. \tag{14}$$

Differentiating (13) and (14) with respect to γ yields the following result.

Result 2. *When the advertising market is only partially served so that condition (11) is reversed, an increase in the proportion of ad-averse viewers will increase advertising prices, decrease the number of advertising firms, and will result in lower profits to broadcasters. Formally for $i = \alpha, \beta$,*

$$\frac{\mathrm{d}p_i}{\mathrm{d}\gamma} > 0, \quad \frac{\mathrm{d}\hat{x}_\alpha}{\mathrm{d}\gamma} = \frac{\mathrm{d}(1-\hat{x}_\beta)}{\mathrm{d}\gamma} < 0, \quad \text{and} \quad \frac{\mathrm{d}\hat{\pi}_i}{\mathrm{d}\gamma} < 0.$$

As in Result 1, more ad-averse viewers imply higher prices for advertisers. However, in contrast to Result 1, here the resulting decline in the number of advertising firms leads to a reduction in broadcasters' revenue from advertising.

4. Welfare Analysis

This section computes the socially-optimal level of advertising and compares it to the equilibrium levels. In this model, the advertising levels equal the number of firms advertising in α and β, as measured by $A_\alpha = \hat{x}_\alpha$ and $A_\beta = 1 - \hat{x}_\beta$.

Using (1) and (2), aggregate consumer surplus CS, as a function of the advertising levels $\hat{x}_\alpha$ and $\hat{x}_\beta$, is calculated by

$$\begin{aligned} CS(\hat{x}_\alpha, \hat{x}_\beta) &= \gamma N \int_0^{0.5} [v(1-\hat{x}_\alpha) - \mu y] dy + \gamma N \int_{0.5}^{1} [v\hat{x}_\beta - \mu(1-y)] dy \\ &+ (1-\gamma) N \int_0^{0.5} (v - \mu z) dz + (1-\gamma) N \int_{0.5}^{1} [v - \mu(1-z)] dz \\ &= \frac{N}{4} \left[2\gamma v (x_\alpha + x_\beta) + \mu - 4v \right]. \end{aligned} \tag{15}$$

Next, the economy's aggregate profit level is the sum of broadcasters' profit and the profit made by advertising firms. Hence,

$$\begin{aligned} \Pi(\hat{x}_\alpha, \hat{x}_\beta) = \pi_\alpha + \pi_\beta + \int_0^{\hat{x}_\alpha} \pi(x) dx + \int_{\hat{x}_\beta}^{1} \pi(x) dx \\ = \frac{1}{2} \left[N\phi(\hat{x}_\alpha + 1 - \hat{x}_\beta) - \tau(\hat{x}_\alpha^2 + \hat{x}_\beta^2) + 2\hat{x}_\beta \tau - \tau \right]. \end{aligned} \tag{16}$$

The social planner's problem is to choose the advertising levels (number of advertising firms) to maximize social welfare given by $W(\hat{x}_\alpha, \hat{x}_\beta) = CS(\hat{x}_\alpha, \hat{x}_\beta) + \Pi(\hat{x}_\alpha, \hat{x}_\beta)$. Hence,

$$A_\alpha^* = x_\alpha^* = \frac{N(\phi - \gamma v)}{2\tau} = 1 - x_\beta^* = A_\beta^*. \tag{17}$$

In order to determine whether advertising is excessive (or deficient) from a social perspective, we compare (17) with (14). Figure 3 compares the socially-optimal advertising level of broadcaster α, $A_\alpha^* = x_\alpha^*$ given in (17), with the equilibrium level, $\hat{x}_\alpha$ given in (14), both as functions of the parameter γ (the proportion of ad-averse viewers), where $\tilde{\gamma}$ denotes the particular value of γ evaluated at $x_\alpha^* = \hat{x}_\alpha$. Figure 3 illustrates the following result.

Result 3. *Equilibrium advertising levels are excessive from a social viewpoint when the proportion of ad-averse viewers among the entire viewer population is significant ($\gamma \geq \tilde{\gamma}$). In particular, if $\gamma \geq \phi/v$, no advertising is socially efficient whereas the equilibrium advertising levels are strictly positive (and hence not socially optimal).*

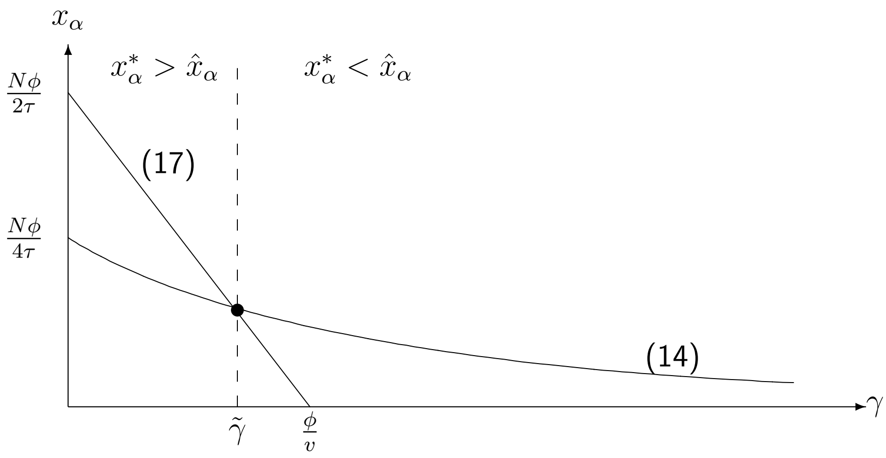

Figure 3: Socially-optimal advertising x^*_α vs. equilibrium advertising level $\hat{x}_\alpha$.

It follows from Result 3 and Figure 3 that the relative magnitudes of the three parameters γ, v, and ϕ determine the (in)efficiency of the equilibrium advertising levels. Recall that the ratio ϕ/v is a firm's profit from placing an advertisement divided by a viewer's utility from watching the content without advertising. If this ratio is low, then the range of excessive advertising $x^*_\alpha < \hat{x}_\alpha$ will always exist. In contrast, if this ratio is high it means that viewers do not value the programs relative to the firms' profit generated by placing advertisements, which means that for "most" values of γ the equilibrium number of ads is inefficiently low.

Finally, it should be noted that the extreme case characterized by Result 3 where no advertising is socially efficient could be mitigated assuming that advertising often finances programming.

5. Quality of Advertising

The model has so far focused on ad-averse and ad-indifferent viewers, and therefore neglected viewers whose decision which channel to watch is influenced by the quality of the advertisements themselves. When such viewers exist, advertising firms find it profitable to enhance the quality of their ads in order to increase the number of viewers thereby increasing the business generated from placing an ad.

The quality of advertisement can be manifested in several aspects. Firstly, ads can be more informative and less persuasive. Secondly, advertising firms can shoot their ads in more exotic places, thereby turning ads into geography lessons. Thirdly, advertising firms can include celebrities as actors which may please some viewers, who may view these ads as part of their daily entertainment.

To demonstrate our argument, let us replace the γN ad-averse (*AA*) viewers with ad-lovers (*AL*) whose utility is enhanced with the quality of the ads.[5] Thus, we replace the utility (1) with

$$U_{AL} \stackrel{\text{def}}{=} \begin{cases} v(1+q_\alpha) - \mu y & \text{if watching } \alpha \\ v(1+q_\beta) - \mu(1-y) & \text{if watching } \beta, \end{cases} \tag{18}$$

where q_α and q_β are the quality of the ads broadcasted by α and β, respectively. The utility of the $(1-\gamma)N$ ad-indifferent viewers (2) remains unchanged. The utility functions (18) and (2) imply that (3) is now given by

$$\hat{y} = \frac{1}{2} + \frac{v(q_\alpha - q_\beta)}{2\mu} \quad \text{and} \quad \hat{z} = \frac{1}{2}. \tag{19}$$

Substituting (19) into (4a) and (4b) yields

$$n_\alpha = \frac{N}{2} + \frac{N\gamma v(q_\alpha - q_\beta)}{2\mu} \quad \text{and,} \tag{20a}$$

$$n_\beta = \frac{N}{2} + \frac{N\gamma v(q_\beta - q_\alpha)}{2\mu}. \tag{20b}$$

Thus, as expected, the number of viewers of each broadcaster is influenced by the relative quality, $q_i - q_j$, of broadcasted ads and magnified by the proportion of ad-lovers, γ, among all viewers.

Instead of modeling a continuum of firms, we assume that there are only two firms: Firm A that places an ad with broadcaster α, and firm B that places an ad with broadcaster β.[6] Each

[5] Ad-averse viewers are not modeled in this section for the sake of convenience only, as the number of consumer groups is reduced to two groups only, instead of three consumer groups. It should be pointed out that there is no contradiction between having ad-averse viewers and the possibility of improving ad quality since quality enhancement can be used to mitigate ad aversion.

[6] Modeling only two advertising firms who exert monopsony power over their broadcasting channels is a clear limitation this model. However, continuing to assume a continuum of advertising firms would eliminate their incentive to enhance the quality of their ads because of the free-rider effect.

firm can invest in the quality of the ad it places with its broadcaster. Thus, the profit of each advertising firm is assumed to be

$$\pi_A = \max\left\{\phi n_\alpha - p_\alpha - q_\alpha^2; 0\right\} \quad \text{and} \quad \pi_B = \max\left\{\phi n_\beta - p_\beta - q_\beta^2; 0\right\}, \tag{21}$$

where q_i^2 is the cost of improving the quality of the ad, which is assumed to be quadratic.

Consider the following three-stage game.

I. Broadcaster α and broadcaster β set their prices for placing an ad, p_α and p_β, respectively, to maximize $\pi_\alpha = p_\alpha$ and $\pi_\beta = p_\beta$.

II. Firm A and firm B take p_α and p_β as given and choose how much to invest in the quality of their ads, q_α and q_β, to maximize their profit (21), anticipating the rating of each broadcaster according to (20a) and (20b).

III. Viewers take the quality of ads, q_α and q_β, as given, and choose whether to watch α or β as to maximize (18) and (2), respectively.

The solution to Stage III is already summarized in (19). To solve Stage II, substitute (20a) and (20b) into (21), then maximizing π_A with respect to q_α and π_B with respect to q_β yields

$$q_\alpha = q_\beta = \frac{N\gamma\phi v}{4\mu}. \tag{22}$$

We can now state the following result.

Result 4. *Firms increase their investment in the quality of their ads when that are more ad-lover viewers (an increase in γN), and when rating becomes more effective, (an increase in ϕ).*

In other words, since advertising firms earn higher profits when the rating of their broadcasts is enhanced, it is profitable for them to invest in higher quality of their submitted ads.

To solve Stage I, observe that since in this section we have already assumed that advertising firms cannot switch broadcasters, each broadcaster raises its ad broadcasting price until firms make zero profits. Substituting $n_\alpha = n_\beta = N/2$ and (22), into (21) yields the broadcasters' profit-maximizing price of advertising given by

$$p_\alpha = p_\beta = \frac{N\phi}{2} - \frac{N^2\gamma^2\phi^2 v^2}{16\mu^2}. \tag{23}$$

We summarize our analysis of advertising quality with the following statement.

Result 5. *An increase in the proportion of ad-lover viewers, γ, reduces broadcasters' profits.*

Result 5 identifies some *monopsony power* of advertising firms over their broadcasting networks. In fact, this result demonstrates that this monopsony power is intensified with an increase in the advertising firms' investment in the quality of their ads. This means that advertising firms tend to invest in quality not only to attract more viewers but also to be able to reduce the price of ads paid to broadcasters. Finally, this result demonstrates that advertising firms' monopsony power intensifies with an increase in the proportion of viewers who are ad- (quality) lovers.

Results 4 and 5 together imply the following result.

Result 6. *If investing in quality of advertising is profitable to the advertising firms, then it is unprofitable to broadcasters.*

In other words, Result 6 identifies a conflict of interest between broadcasters and advertising firms with respect to the quality of ads, because an increase in the quality of advertising results in lower equilibrium prices charged by broadcasters due to increased monopsony power of the advertising firms.

6. Conclusions

The novelty of our approach is that it identifies the exact tradeoff between *three* parameters characterizing heterogeneous viewers and heterogeneous advertising firms: The utility from watching ad-free content, v; the proportion of ad-averse viewers, γ; and firms' profit from advertising, ϕ. An increase in the proportion of ad-averse viewers will raise the price of placing ads because it makes broadcasters' ratings more sensitive the the number of ads. The effect on profit depends on whether the market is fully or only partially served.

The above-mentioned parameters also determine whether advertising is excessive or deficient from a social-welfare point of view, see Figure 3. An increase in the number of ad-averse viewers, or a decrease in firms' profit from advertising relative to viewers' utility from ad-free content, increase the parameter range where advertising is excessive (and the other way around). Since most countries place restrictions on the number of ads, one may conclude that regulators are convinced that most viewers are ad-averse. Therefore, advertising firms must respond by investing in making higher-quality advertisements thereby increasing the rating of the channel they advertise through.

When the quality of broadcasted advertising becomes a choice variable of the advertising firms, we identify an interesting conflict between broadcasters and advertising firms. When increasing quality enhances the profit of advertising firms, it also reduces the profit of broadcasters. Thus, broadcasters have the incentives to block quality improvements, thereby enhancing their monopoly power over firms placing ads (alternatively, reducing advertising firms' monopsony power over the broadcasting networks).

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