2002 -
6

A Theory of Broadcast Media Concentration and Commercial Advertising

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September 2002

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Executive Summary

We analyze a model in which the interaction of broadcasters, advertisers, and consumers determines the level of non-advertising broadcasting produced and consumed. Our main finding is that an increase in concentration in broadcast media industries may lead to a decrease in the total amount of non-advertising broadcasting. The strength of this inverse relationship depends, in part, on the behavioral response of consumers to changes in advertising intensities. We also present numerical general equilibrium solutions to our model and demonstrate a positive relationship between consumer welfare and the number of firms in the broadcast industry.

I Introduction

The broadcast industry in the United States is unique in that a unit of broadcast firm output is imperfectly related to a firm's revenues. That is, broadcast media output is divided between non-advertising (i.e., programming) and advertising components. The latter generate income for the firm, while the sum of the components jointly determine a firm's costs. Broadcast firms must, on a continuing basis, strike a balance between garnering an audience through the supply of a zero-price output while simultaneously selling different output to a third party. It is this balance that is the central focus of the model we present.

In this paper, we explore how the interaction of broadcasters, advertisers, and consumers determines the level of non-advertising broadcast content produced by broadcast firms. We employ a model of imperfect competition in the advertising market and explore the impact of the number of firms in the broadcast industry on the distribution of broadcasting between non-advertising and advertising content. This model differs from its antecedents in that the broadcast market may be populated by an arbitrary number of firms.[1] We find that the profit-maximizing response of broadcasters to a change in concentration (i.e., the number of firms) depends, in part, upon the behavioral response of consumers to a change in the fraction of broadcast time devoted to advertising.

We consider a full range of values for this response and describe three cases. In the first two cases, the broadcaster's profit-maximizing response to increasing industry concentration is to increase the fraction of broadcasting devoted to advertising. Depending on the precise behavioral response of consumers (captured by a range of elasticities), we find an increase in the

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[1]Moreover, unlike previous work we do not assume that consumers directly dislike advertising.

fraction of broadcast time devoted to advertising leads to a fall (rise) in the overall amount of advertising and an increase (decrease) in the price of a unit of advertising. In both of these cases, we find a reduction in the amount of non-advertising broadcasting consumed and supplied. In the third outcome we explore, we find that an increase in concentration results in a reduction of the fraction of broadcast time devoted to advertising, and a crowding-in of non-advertising broadcasting.

It is important to distinguish between the *amount* of advertising and the *fraction* of broadcast time devoted to advertising. We find that, under plausible conditions, the amount of advertising can fall while the fraction of broadcast time devoted to advertising increases. This result emerges from our assumption of market clearing in the broadcast market combined with a particular behavioral response from consumers that we refer to as "switching-off." Simply put, switching-off may occur as consumers reduce their overall media demand in response to increased advertising/broadcast ratios. If this behavior is strong enough, higher levels of concentration can result in lower levels of advertising, higher prices, and a larger fraction of broadcast time devoted to advertising. In this case, we obtain the "classic" market power result of fewer units sold at a higher price and a crowding-out of programming by advertising.

The importance of our findings reside, in part, in the potential welfare effects associated with broadcast media concentration. Closed-form general equilibrium analysis of these effects is intractable. For this reason, we apply numerical techniques to determine the equilibrium values of the model's key endogenous variables for varying levels of concentration in the broadcast industry. This approach reveals that the reduction in programming associated with industry concentration induces indirect utility losses via higher equilibrium prices. Moreover, increasing

2

concentration induces direct utility losses due to reduced consumption of overall programming.

The remainder of the paper is as follows. In Section II, we review the existing theoretical literature relating to broadcast media and detail how our model is distinct from the existing literature. In Section III, we introduce our model of consumers, advertisers, and broadcasters and present the conditions which characterize optimal behavior in our model. In Section IV, we explore the specific conditions under which variations in concentration may induce a change in the amount of non-advertising broadcasting. In Section V, we specify additional functional forms and present welfare results from numerical solutions to the model. In Section VI we make some concluding remarks and suggest areas for future research.

II Broadcast Literature

There are a handful of important contributions to the broadcast literature. Among the seminal theoretical works on the industry are those of Steiner (1952), Spence and Owen (1977), and Beebe (1977). Recent theoretical work includes that of Anderson and Coate (2001), Nilssen and Sorgard (2000), J. Gabszewicz and Sonnac (2000), and Gal-Or and Dukes (2001).[2]

Steiner's early article demonstrated that under certain (restrictive) conditions a monopoly market structure would provide optimal program diversity. Steiner noted that when viewer preferences were such that a large group of consumers preferred a single program type, and much smaller groups of viewers preferred other types, a monopolist would have the incentive to provide each distinct program type (i.e., the monopolist would internalize the business stealing effect), whereas multiple competing firms would have incentives to provide programming for the largest

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[2]This list is not intended to be exhaustive. Rather, the works cited are among the more influential and detailed extant theoretical studies.

group of viewers only. Beebe (1977) extended the analysis in Steiner (1952) and Rothenberg (1962) to include program costs, differing distributions of viewer preferences, and unlimited channel capacity. Beebe concluded that optimal market structure depends on the structure of viewer preferences and the extent of channel capacity.

Spence and Owen (1977) provide a seminal rigorous analysis of broadcasting. They explore the welfare implications of program provision under alternative market structures (e.g., competitive advertiser supported and pay television). Their results suggest that the fixed costs associated with program production often result in under-provision of certain programming since the broadcast subscription revenues of such programs do not exceed costs. Thus, even in situations where benefits exceed costs, broadcast television is biased against certain programming. This bias is reduced under a pure pay-television framework relative to the competitive advertiser-supported structure, while a monopoly (advertiser supported) market structure exacerbates this bias.

The works of J. Gabszewicz and Sonnac (2000), Nilssen and Sorgard (2000), Anderson and Coate (2001), and Gal-Or and Dukes (2001), collectively represent the horizon of analytical work on the broadcast industry. All four works are similar in that they: (1) adopt a two-firm (broadcasters) location-style approach, with each firm carrying one program with advertising, competing for viewers; and (2) assume consumers dislike advertising.[3] Methodologically these works share an important lineage that stems from the path-breaking work of Hotelling (1929). Hotelling's original work suggested firms would minimally differentiate (locations), while the work of d'Aspremont, Gabszewicz and Thisse (1979) demonstrated, under slightly different as-

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[3]Anderson and Coate (2001) take a relatively novel approach, and assume that there are two types of consumers for broadcasting: advertisers and viewers, and that advertisers impose a negative externality on consumers and other advertisers. This 'externality' is paid for through the pricing of advertising, which Anderson and Coate note is equivalent to a Pigovian tax. The idea that advertisers impose costs on each other is an important innovation, first noted by Berry and Waldfogel (2001).

sumptions, that firms would maximally differentiate.[4, 5]

Our model differs from the recent literature in at least two important ways. First, we do not employ a location-style, stage-game approach. While this methodology is productive in the two-firm context, a specific focus of our work relates to a situation in which the number of broadcast firms is somewhat large. Location models are generally less tractable when the number of firms is large. The case of many firms is important to consider because, in practice, the number of firms is often greater than two. Second, the works cited above generally assume that commercial advertising imposes direct utility costs on consumers. While we also conclude that consumers reduce their amount of broadcast viewing as the level of advertising relative to the total broadcast increases, our approach is based on weaker assumptions than straight-forward disutility, as discussed further below.

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[4]In the case of modern address theory, location refers to product space or, more generally, the degree of product differentiation among firms.

[5]J. Gabszewicz and Sonnac (2000), Anderson and Coate (2001), and Nilssen and Sorgard (2000) are methodologically similar to these works in that they structure stage games in which broadcast firms first choose their programming type, and then each firm chooses a broadcasting/advertising ratio. In contrast, in the work of Nilssen and Sorgard (2000), firms first make the choice of investment in programming and the price of advertising, and then producers choose their level of advertising. Nilssen and Sorgard (2000) suggest that a duopoly market structure reduces the number of viewers and amount of advertising relative to a monopoly market structure. Gal-Or and Dukes (2001) (see also Tirole (1988), p. 293) demonstrate conditions whereby broadcasters minimally differentiate their programming. Minimal differentiation in turn induces a reduction in advertising that reduces consumers overall information. Given reduced information is available to consumers, producers have greater latitude to increase prices. Increased product prices then allow broadcasters to raise the price of advertising, which increases profitability. In direct contrast to Gal-Or and Dukes' finding of broadcast firms maximizing profits via minimal differentiation, Anderson and Coate suggest that minimal differentiation will minimize profits of the broadcast firms. Anderson and Coate's effort highlights the trade-offs inherent in the broadcast industry, and concludes that programming resources and advertising levels may be too high or too low, contingent upon the method of aggregating costs and benefits.

III The Model

In our model, we explore how the interaction of broadcasters, advertisers, and consumers determines the level of non-advertising broadcasting under various levels of market concentration. We assume that broadcasters are also content providers, and that all broadcast content is informational. Broadcasters are only compensated for the informational content provided by advertisers. Broadcasters do not charge their viewers, but they do charge advertisers for delivering their messages to viewers. Additionally, we assume that advertisers are also the producers of the goods that are advertised, and that advertisers are price takers. Finally, we assume consumers maximize utility by their consumption of both non-commercial information and goods produced by advertisers.

A Consumers

We begin by assuming there is a representative consumer that purchases final goods from advertisers, earns a wage, and consumes broadcasting. The following variables are relevant, from the

consumer's perspective:

$$
\begin{aligned}
A &\quad - \text{ total advertising consumed} \\
N &\quad - \text{ total non-advertising consumed} \\
B &\quad - \text{ total broadcast time consumed} \\
Q &\quad - \text{ total quantity of advertised goods consumed} \\
P_Q &\quad - \text{ price per unit of goods} \\
w &\quad - \text{ wage rate} \\
Y &\quad - \text{ consumer's "full" income}
\end{aligned}
\tag{1}
$$

By full income, we mean the level of income which would obtain if all of the consumer's time were spent earning wages. Implicitly, we assume a time endowment in which a unit of time spent consuming broadcasting reduces household income by w.

We assume there is a function, $U(Q,N)$, that maps goods consumption and non-advertising consumption to utility,with the standard property of positive and diminishing marginal utilities. Letting $U_x \equiv \partial U/\partial x$ and $U_{xy} \equiv \partial^2 U/\partial x \partial y$, we assume that $U_x > 0 > U_{xx}$ for $x = Q, N$.

There are m broadcast firms in the market, indexed by $i = 1, \ldots, m$. Variables labelled with an i subscript represent firm-level quantities. Letting α_i represent the fraction of each firm's broadcast time devoted to advertising, we have $N = \sum_{i=1}^m (1 - \alpha_i) B_i$.

The consumer faces a budget constraint that binds the choice of goods consumption and non-advertising consumption: $P_Q Q + wB = Y$. Consumers choose Q and $\{B_i\}_{i=1}^m$ to maximize the LaGrangian:

$$
\mathcal{L} = U(Q, N) + \lambda(Y - wB - P_Q Q)
\tag{2}
$$

with

$$N = \sum_{i=1}^{m} (1 - \alpha_i) B_i \tag{3}$$

and

$$B = \sum_{i=1}^{m} B_i \tag{4}$$

The first-order conditions characterizing the solution to this problem are:

$$U_Q = \lambda P_Q \tag{5}$$

$$(1 - \alpha_i) U_N = \lambda w \text{ for } i = 1, \ldots, m \tag{6}$$

Combining these conditions, we obtain:

$$\frac{U_N}{U_Q} = \frac{w}{(1 - \alpha_i) P_Q} \text{ for } i = 1, \ldots, m. \tag{7}$$

We can see that an increase in α_i will be associated with an increase in the right-hand side of (7). The assumption of diminishing marginal utility implies that consumers will decrease the ratio of non-advertising consumption to goods consumption (N/Q) in response to this increase in α_i.

An increase in the fraction of broadcast time devoted to advertising increases the effective price of non-advertising broadcast consumption. To show this, we re-write the budget constraint to reflect the price of consuming non-advertising broadcasting:

$$P_Q Q + \sum_{i=1}^{m} \frac{w}{1 - \alpha_i} N_i = Y. \tag{8}$$

If an individual broadcaster begins to devote a larger fraction of a unit of broadcasting to advertising, a consumer must spend additional time consuming broadcasting in order to achieve the same level of utility from non-advertising consumption, thereby sacrificing additional wage earnings. Thus, the effective price (or opportunity cost) of non-advertising consumption has increased. In other words, the coefficient on N_i in the budget constraint (8) is increasing in α_i.

We have shown that the consumer will reduce total non-advertising consumption, relative to goods consumption, in response to a rise in α_i. We can also conclude that, given optimal values of Q and N, consumers will devote their media demand to the broadcast firm with the lowest fraction of broadcasting devoted to advertising. This can be seen by inspection of (8), where the total "expenditure" on non-advertising broadcasting is minimized by devoting all media consumption to the firm with the lowest value of α_i, thereby allowing maximum consumption of Q for a given N. Thus, the only outcome in which all m firms face strictly positive demand for their output is one in which each broadcast firm chooses the same α_i. We demonstrate below that this symmetry holds in our model and we label this optimal value α_i^*. When firms choose the same value of α_i, the consumer is indifferent with respect to its distribution of total non-advertising consumption across broadcast firms. Thus, for simplicity, we assume this total is distributed evenly among firms, i.e., $N_i = N/m$.

With these observations, we conclude that (8) becomes

$$P_Q Q + \frac{w}{1 - \alpha_i^*} N = Y. \tag{9}$$

From this expression, we can see that an increase in the fraction of broadcast time devoted to advertising must be matched by a fall in non-advertising consumption. By way of illustration,

suppose this constraint is satisfied for some initial α_i^*. If the advertising share of broadcasting increases to $\tilde{\alpha}_i^*$, the second term on the left-hand side of (9) increases. In this case, the ratio Q/N must also increase. If Q were to increase by itself, the budget constraint would not be satisfied since the left-hand side of (9) would exceed the right-hand side. Thus, N must display an inverse relationship with α_i^*, implying that N_i displays an inverse relationship with α_i. Since $B_i = N_i + A_i$, we can conclude that the demand for total broadcasting is decreasing in the fraction of broadcasting devoted to advertising. Therefore, we write the consumer's demand for broadcasting as a general, decreasing function of the fraction of broadcasting devoted to advertising: $B_i = B(\alpha_i)$ with $B' < 0$. This result will be employed below.

B <u>Advertisers</u>

We assume that there is one advertiser that purchases advertising from the m broadcasters and produces the final good Q. This advertising firm acts in a perfectly competitive manner in all markets.[6] The advertiser's objective is to maximize profits from selling the final good Q. We model the advertiser's revenue function as multiplicative in production of Q and the purchase of a bundle of advertising, $\tilde{A}$, from the m broadcasters. Thus, total revenue for the advertiser is:

$$P_Q Q \tilde{A}^\beta \text{ where } 0 < \beta < 1 \tag{10}$$

The parameter β induces concavity of the firm's revenues with respect to the advertising bundle so that total revenues increase at a decreasing rate with respect to overall advertising.[7] While

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[6]The simplifying assumption of one advertising firm is equivalent to assuming ultra-free entry.

[7]While stylized, this simply assumes that to sell more, firms must advertise more.

revenue scales linearly with production of Q, our assumption of convex production costs ensures the advertiser's problem is well-behaved.

We next specify the manner in which purchases of advertising from individual broadcasters are aggregated into the advertising bundle $\tilde{A}$. As in Blanchard and Giavazzi (2001), we assume a Dixit-Stiglitz aggregator in which the marginal rate of substitution between advertising purchased from different broadcasters, σ, is increasing in the number of broadcasters. Specifically:

$$\tilde{A} = \left[\sum_{i=1}^{m} A_i^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \tag{11}$$

with $\sigma = \overline{\sigma} g(m), g'(m) > 0$. The assumption that σ is rising in the number of firms captures the idea that a broadcast market populated by a larger number of firms is one in which the individual advertising supplies of broadcasters are closer substitutes.

Given these specifications, an advertiser's profits may be written as:

$$\pi_A = P_Q Q \tilde{A}^{\beta} - C_Q(Q) - \sum_{i=1}^{m} P_i A_i \tag{12}$$

We assume positive and increasing marginal costs of production: $C'_Q, C''_Q > 0$ with $C(0) = 0$. The advertiser seeks to maximize profits with respect to production levels and advertising purchases.

There are $m + 1$ first-order conditions which characterize the solution to this maximization problem:

$$P_Q \tilde{A}^{\beta} - C'_Q = 0 \tag{13}$$

$$\beta P_Q \tilde{A}^{\beta-1} \tilde{A}^{1/\sigma} A_i^{-1/\sigma} - P_i = 0 \text{ for } i = 1 \ldots m. \tag{14}$$

11

These two conditions respectively equate the marginal revenue from production/advertising to the relevant marginal cost. Note that (14) implies an inverse relationship between demand for advertising from an individual broadcaster and that broadcaster's price.

If we define the price aggregator as:

$$P \equiv \left[\sum_{i=1}^{m} P_i^{1-\sigma} \right]^{\frac{1}{1-\sigma}}. \tag{15}$$

we can derive a simplified expression for advertising demand that each individual broadcaster will face. Using (15), we see that (14) is equivalent to:

$$P_i = P(\tilde{A}/A_i)^{1/\sigma} \tag{16}$$

Observe that (16) is an inverse demand function for a given broadcaster's advertising, where demand for a given broadcast firm's advertising is decreasing in price.[8]

C   Broadcasters

We begin by defining the following variables for broadcaster i:

$$
\begin{array}{ll}
P_i & - \text{ price per unit of advertising} \\
B_i & - \text{ broadcasting supply} \\
C(B_i) & - \text{ total cost of producing broadcasting}
\end{array} \tag{17}
$$

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[8]It is important to note that this derivation of the inverse demand function illustrates that an individual broadcaster's demand is affected by behavior of other firms in the broadcast industry. For expositional simplicity, we omit industry-level variables from the inverse demand function presented here since we assume that each individual firm is taking the industry-level outcome as independent of its own choices.

We assume the cost function $C(B_i)$ has the standard feature of positive and increasing marginal costs: $C' \equiv \partial C/\partial B > 0, C'' \equiv \partial^2 C/\partial B^2 > 0.$[9] We further assume the broadcaster operates in an imperfectly competitive market in which it considers the inverse demand function (16) when maximizing profits, i.e., $P_i = P(A_i)$. This inverse demand function was derived in (16) and demand was shown to be the level of advertising / broadcast ratio of firm i.

We also assume that the market for broadcasting clears.[10] The market clearing condition allows us to equate supply to the demand function described in Section A: $B_i = B(\alpha_i)$. Finally, it is trivially clear that $A_i = \alpha_i B(\alpha_i)$.

Given these observations, the broadcaster's profit function is as follows:

$$\pi_i = P(\alpha_i B(\alpha_i))\alpha_i B(\alpha_i) - C(B(\alpha_i)). \tag{18}$$

A profit maximizing broadcaster will choose α_i to maximize this expression. The first-order condition characterizing profit maximization is:

$$P_i' \alpha_i B_i^2 + P_i' \alpha_i^2 B_i' B_i + P_i B_i + P_i \alpha_i B_i' = C_i' B_i'. \tag{19}$$

or:

$$P_i \cdot B_i \cdot \left(1 + P_i' \frac{A_i}{P_i} + P_i' \frac{A_i}{P_i} B_i' \frac{\alpha_i}{B_i} + B_i' \frac{\alpha_i}{B_i} \right) = C_i' \cdot B_i' \tag{20}$$

Let the elasticity of advertising price with respect to total advertising supplied be $\eta_{P_i,A_i} \equiv P_i' \frac{A_i}{P_i}$.

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[9]The presence of fixed costs has no qualitative effect on the predictions of the model since fixed costs have no effect on the first-order conditions describing profit maximization.

[10]Market clearing in this model implies that the amount of broadcasting falls either absolutely or relatively, or both. An absolute reduction in broadcasting implies a shortening of the broadcast period. A relative fall in the amount of broadcasting implies that broadcasters produce output where marginal costs are zero, e.g., re-runs.

Let the elasticity of broadcasting supplied and consumed with respect to the fraction of broadcast time devoted to advertising be $\eta_{B_i,\alpha_i} \equiv B_i' \frac{B_i}{\alpha_i}$.

Then (20) becomes

$$P_i \cdot B_i \cdot (1 + \eta_{P_i,A_i} + \eta_{P_i,A_i} \cdot \eta_{B_i,\alpha_i} + \eta_{B_i,\alpha_i}) = C_i' \cdot B_i' \tag{21}$$

Finally, multiplying both sides by α_i/B_i, we find:

$$\alpha_i \cdot P \cdot (1 + \eta_{P_i,A_i} + \eta_{P_i,A_i} \cdot \eta_{B_i,\alpha_i} + \eta_{B_i,\alpha_i}) = C_i' \cdot B_i' \cdot \frac{\alpha_i}{B_i} \tag{22}$$

so that firm i's profit-maximizing share of broadcasting devoted to advertising, α_i^*, satisfies:

$$\alpha_i^* \cdot P(\alpha_i^* \cdot B(\alpha_i^*)) = \frac{1}{\eta_{B_i,\alpha_i}^{-1}(1 + \eta_{P_i,A_i} + \eta_{P_i,A_i} \cdot \eta_{B_i,\alpha_i} + \eta_{B_i,\alpha_i})} C'(B(\alpha_i^*)) \tag{23}$$

Inspection of (23) reveals that the effective price of a unit of broadcasting $(\alpha_i \cdot P_i)$ is optimally set equal to a markup (the fraction on RHS of (23)) over marginal cost. Alternatively, the average revenue from a unit of broadcasting is a markup over marginal cost. In subsequent sections, this expression will be used to assess the impact of market concentration (the level of m) on a broadcaster's optimal advertising share.

IV   Concentration and Broadcast Behavior

We now characterize the manner in which broadcast firms optimally adjust the fraction of broadcast time devoted to advertising as the number of firms in the industry changes. The discussion

in this section is conducted in a partial equilibrium framework, and consideration of indirect, secondary effects of consolidation among broadcast firms is evaluated in a subsequent section. The results of the analysis are presented graphically in Figure 1. From condition (23), it is apparent that the impact of concentration on α_i^* depends upon the values of the elasticities. For this reason, the elasticity values are marked on the axes of Figure 1.

A   The Case of Strong Switching-Off

To begin our analysis of broadcasters' behavioral response to a change in the number of firms, we first describe the effect of α_i (the fraction of broadcast time devoted to advertising) on the average revenue from a unit of broadcasting (i.e., $\alpha_i P_i$ on the left hand side of (23)). In this model, the impact of variations in α_i on average revenues is fundamentally tied to the behavior of consumers, as captured by the value of η_{B_i,α_i}. If the response of broadcast demand to advertising's share is relatively strong, i.e., $\eta_{B_i,\alpha_i} < -1$, we say that consumers are engaging in strong switching-off. In Figure 1, this case corresponds to the unshaded area to the left of the vertical line intersecting the horizontal axis at -1. Given that $\partial(\alpha_i P_i)/\partial \alpha_i = 1 + \eta_{P_i,A_i}(1 + \eta_{B_i,\alpha_i})$ and, per (16), $\eta_{P_i,A_i} < 0$, when consumers engage in strong switching-off the left hand side of (23) is rising in α_i since $\partial(\alpha_i P_i)/\partial \alpha_i > 0$. An increase in the fraction of broadcasting devoted to advertising increases the average revenue from a unit of broadcasting. Note that when strong switching-off occurs, an increase in α_i is associated with a *decrease* in the level of advertising since $\partial A_i/\partial \alpha_i = B_i(1 + \eta_{B_i,\alpha_i}) < 0$.

When η_{B_i,α_i} is less than one, the markup term in (23) is positive if

$$1 + \eta_{P_i,A_i} + \eta_{P_i,A_i} \cdot \eta_{B_i,\alpha_i} + \eta_{B_i,\alpha_i} < 0 \tag{24}$$

15

It can be shown that when (24) holds, $\eta_{P_i,A_i} > -1$. Thus, in the case of strong switching-off, profit-maximizing behavior by an individual broadcaster entails positive values of α_i and P_i when the elasticity of price with respect to advertising volume is greater than negative one but less than zero. This condition ensures that the model's predictions are sensible. Hence, the leftmost shaded region of Figure 1 is the region of elasticity values such that markups are negative (in the strong switching-off case), while the non-shaded region immediately above this area corresponds to the set of elasticities which generate an economically meaningful result (i.e., non-negative mark-ups).

From (16), we can see that if the effect of an individual advertiser's production on the aggregate advertising bundle is negligible, the elasticity of price with respect to an individual advertiser's supply is a function of the elasticity parameter:

$$\eta_{P_i,A_i} = \frac{\partial \ln P_i}{\partial \ln A_i} = -(1/\sigma). \tag{25}$$

If the number of broadcasting firms falls due to consolidation, since $g' > 0$, σ falls and the elasticity of price with respect to advertising supply becomes more negative. Inspection of (23) will confirm that any given broadcast firm will optimally increase its markup in response to this fall in the elasticity of substitution.[11] An increase in α_i^* is clearly the profit-maximizing response to consolidation since such an increase will: (1) increase the average revenue from a unit of broadcasting (the left hand side of (23)), and, (2) reduce the marginal cost of broadcasting (this follows from the combination of switching-off behavior and the assumption of increasing marginal

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[11]This observation follows if η_{B_i,α_i} does not endogenously respond to σ. As discussed above, this assumption will be made for this section and will be loosened in the subsequent section.

costs).

Thus, our model predicts that under strong switching-off, consolidation of the broadcast industry will induce a larger share of broadcasting devoted to advertising, a fall in the amount of advertising supplied, and a fall in the amount of broadcasting consumed. We refer to this result as crowding-out. The elasticity values that generate this outcome are identified in Figure 1.

B The Case of Weak Switching Off

Next, we determine the generality of the result described above by analyzing the effect of broadcast industry consolidation when the demand for broadcasting responds to α_i in a weaker manner: $-1 < \eta_{B_i,\alpha_i} < 0$. We refer to this as the case in which consumers engage in weak switching-off. In this case, the level of advertising rises with α_i. Inspection of (24) confirms that under weak switching-off, the profit-maximizing values of P_i and α_i will be positive only when $\eta_{P_i,A_i} < -1$. The range of elasticities which produce economically meaningful results in the case of weak switching off are contained in the rightmost non-shaded region of Figure 1.

In the case of weak switching-off, the broadcaster's average revenue (the left hand side of (23)) is rising in α_i only when $\eta_{P_i,A_i} < -(1 + \eta_{B_i,\alpha_i})^{-1}$. The right-hand side of this inequality is depicted as a dashed curve in Figure 1. Provided this condition holds, the crowding out of N associated with consolidation in the case of strong switching off continues to emerge in the case of weak switching off. Consolidation still induces larger markups of average revenue over marginal cost; markups that are attained by an increase in the fraction of broadcast time devoted to advertising. The region below the dashed curve in Figure 1 identifies the elasticities that generate this result.

The effects of consolidation on broadcaster behavior are ambiguous when $\eta_{P_i,A_i} > -(1 + \eta_{B_i,\alpha_i})^{-1}$. In this case, average revenue declines as α_i increases. As a result, the rising markups associated with increased concentration in the broadcast industry will require a reduction in α_i^* and a crowding-*in* of non-advertising broadcasting, provided the average-revenue effect of a fall in α_i^* is greater than the the marginal cost effect of such a reduction. This particular result emerges only when $-1 < \eta_{B_i,\alpha_i} < 0$ and $-1 > \eta_{P_i,A_i} > -(1 + \eta_{B_i,\alpha_i})^{-1}$ and corresponds to the region above the dashed curve in Figure 1.

In sum, the behavioral impact of an alteration in the number of broadcast firms depends on a range of elasticity values associated with consumer and advertiser behavior. Inspection of Figure 1 confirms that, if all elasticities in the relevant range are equally likely, crowding-out will be the most frequent outcome. Note that there is an unbounded region of elasticities for which the model predicts an inverse relationship between the number of broadcast firms and the profit-maximizing fraction of broadcast time devoted to advertising. In contrast, since the region above the dashed curve is asymptotically bounded, a direct relationship between these two variables is the least likely prediction of the model.

V   Welfare and Consolidation

As noted above, our model does not admit a simple closed-form solution. In order to assess the general equilibrium and consumer welfare impact of variations in the number of broadcast firms, we utilize numerical solution techniques. To do so, we must first supply specific functional forms for the set of key relationships in the model.

We begin with the consumer utility function. We employ a function that is quasi-linear in

the consumption of the advertised good and non-advertising broadcasting:

$$U = Q + \frac{\gamma}{\gamma - 1} \sum_{i=1}^{m} N_i^{\frac{\gamma-1}{\gamma}} \tag{26}$$

where $\gamma > 1$. The parameter γ captures the curvature of the utility function with respect to each broadcaster's non-advertising content.

We also assume exponential cost functions for the representative advertiser and the m broadcasters:

$$C_Q = K_Q Q^{\mu_Q} \tag{27}$$

$$C_i = K_B B_i^{\mu_B} \tag{28}$$

where $\mu_Q, \mu_B > 1$ and $K_Q, K_B > 0$. These cost functions were initially introduced in (12) and (18). Both (27) and (28) are consistent with positive and rising marginal costs of production for all firms. Finally, we specify a functional form for g, the mapping from the number of firms to the inverse of the elasticity of price with respect to a given advertiser's production level. We choose a linear function:

$$\sigma = \mu_\sigma m - K_\sigma \tag{29}$$

with $\mu_\sigma > 0$ and $K_\sigma > 0$.

Having established a full set of functional forms, we calibrated the exogenous variables to produce a baseline set of results that seem intuitively plausible. These parameter values are listed in Table 1.

The first step in the simulations is to employ the first-order conditions from the consumer's

problem (7) and the functional form for consumer utility (26) to derive an explicit expression for consumer broadcast demand. This expression is provided in the Appendix. Consumer broadcast demand is then combined with the expression for advertiser's demand (16) and the cost function (28) to arrive at a profit function for broadcasters. Maximization of this function with respect to the fraction of broadcast time devoted to advertising, α_i, is carried out numerically.

Simultaneously, the market-clearing price of goods is determined. The first-order condition (14) is combined with advertiser's cost function (27) to arrive at an expression for goods supply. This expression is presented in the Appendix. The consumer's goods demand can easily be derived from the budget constraint and the expression for broadcast demand. Equating goods demand to goods supply yields a market clearing condition which is non-linear in the price of goods, P_Q. In addition, in the symmetric equilibrium in which all broadcast firms adhere to (19) the advertising aggregator (11) implies that $\tilde{A} = A_i$.

This condition, the broadcaster's first-order condition, and the market clearing goods market condition represent three non-linear expressions in three unknowns: α_i, P_Q, and $\tilde{A}$. These three expressions are simultaneously solved and the remainder of the endogenous variables are calculated from the relationships and identities described in Section III.[12] The solution values are calculated for each value of m in the interval $[20, 30]$. The results of this approach are presented in Table 2. We identify the twenty-four firm case as a baseline. The table presents prices, quantities, and consumer utility (the last seven columns) as a percentage of the baseline case.[13] The first three columns represent unaltered values of the respective variable.

The numerical general equilibrium results reported in Table 2 do not contradict the partial-

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[12]The solution is obtained via the *fsolve* routine in Maple 7.00
[13]Note that quantities in this table are industry totals.

equilibrium predictions in Section IV. In the twenty-four firm baseline, the model predicts that broadcasters devote 33% of broadcast time to advertising. When twenty firms operate in the broadcast market, this ratio rises to 42%. The switching-off effect of this higher advertising ratio is evident in the fourth column of the table, where total broadcasting in the twenty firm equilibrium is 25% lower than the baseline case. Simultaneously, in the twenty firm equilibrium, total non-advertising broadcasting is 35% below baseline due to the joint switching-off and crowding-out effects.

Although broadcasters devote a larger share of their output to advertising in the twenty firm case, the switching-off effect implies these firms are essentially creating a larger advertising slice from a shrinking broadcasting pie. The net result is a 7% decline of the total volume of advertising when the pool of broadcast firms shrinks from twenty-four to twenty. As indicated in the eighth column of the table, the relative scarcity of advertising in this situation leads to a 8% increase in advertising relative to the baseline. In column eight, we see that advertisers pass along this price increase in the form of a 7% increase in goods prices.

Along with this increase in the price of the advertised good Q, there is a simultaneous 17% increase in consumption of this good. This is largely a result of the increase in α_i; as described above this increase boosts the price of non-advertising broadcasting for consumers. The income and substitution effects associated with the increase in α_i induces consumers to shift their expenditures away from broadcasters and towards advertisers. While this behavioral change might mitigate some of the impact of consolidation on consumer welfare, the net result of the higher prices and lower quantities in the twenty firm equilibrium is a 10% decline in utility.

In contrast to the twenty firm equilibrium, the thirty firm equilibrium displays the opposite

pattern relative to the baseline. A broadcast sector populated by thirty firms displays a lower fraction of broadcast time devoted to advertising (30%) and higher quantities of broadcasting, advertising, and non-advertising broadcasting. The quantity of goods purchased decreases in the thirty firm equilibrium as consumers shift their expenditures towards broadcasters and away from advertisers. Prices are also lower in the thirty firm equilibrium. The net result of the more competitive equilibrium is increased consumer welfare: utility increases by 8% relative to baseline.

The numerical results reported in Table 2 suggest there is a positive relationship between the number of firms in the broadcast industry and consumer welfare. These results also reveal a diminishing marginal impact of the number of firms on consumer utility. A drop of four firms from the baseline induces an 10% decrease in U while an increase of six firms from the baseline increases U by just 8%. This diminishing impact of m repeats itself across the quantities in columns (4) - (7) and the prices in columns (8) and (9). Thus, this model also predicts a diminishing marginal welfare impact of competition.

VI   Conclusion

This paper presents a positive model in which the interaction of broadcasters, advertisers, and consumers determines the level of non-advertising broadcast content. The model illustrates the effect of market concentration on the broadcast industry's decision to supply non-advertising content. We demonstrated that the profit-maximizing response of broadcasters to increasing concentration depends, in part, upon the behavioral response of consumers to a change in the fraction of broadcast time devoted to advertising.

In the first two cases we examined, the broadcaster's profit-maximizing response to increasing industry concentration was to increase the fraction of broadcasting devoted to advertising. Depending on the precise behavioral response of consumers (captured by a range of elasticities), we found an increase in the fraction of broadcast time devoted to advertising led to a fall (rise) in the overall amount of advertising and an increase (decrease) in the price of a unit of advertising. In both of these cases, we found a reduction in the amount of non-advertising broadcasting consumed. In the third outcome we explored, we found that an increase in concentration results in a reduction of the fraction of broadcast time devoted to advertising, and a crowding-in of non-advertising broadcasting.

This paper also presented the model's welfare predictions. Specifically, to the extent increased concentration in broadcast media does result in higher goods prices and the crowding out of non-advertising broadcasting, welfare losses for consumers may obtain. Empirical work that estimates the values of the key parameters would suggest which of the model's predictions are most relevant, as well as shed light on the robustness of our numerical general equilibrium evidence. Finally, a fully general equilibrium version of the model, in which the merger activity of firms is more explicitly treated, would prove a welcome extension of the current framework.

VII   Appendix

The first component to the numerical analysis contained in Section V is an expression for the consumer's demand for an individual firm's broadcast. Employing the LaGrangian (2) and the utility function (26), the demand expression is:

$$B_i = \left(\frac{P_Q}{w}\right)^\gamma (1 - \alpha_i)^{\gamma-1}. \tag{30}$$

This expression can be derived from the from the first-order condition with respect to broadcasting (B_i).

Moreover, if we combine (13) and (14) and then apply the aggregators (11) and (15) we obtain:

$$P = \beta \mu_Q K_Q Q^{\mu_Q} \tilde{A}^{-1}. \tag{31}$$

If (14) is combined by itself with the aggregators (11) and (15) we find a supply function for the quantity of advertised goods:

$$Q = \frac{P \tilde{A}^{1-\beta}}{P_Q \beta}. \tag{32}$$

When (31) is combined with (32) we obtain a mapping from the price of goods and the aggregate advertising bundle to the aggregate price of advertising:

$$P = \beta (\mu_Q K)^{\frac{1}{1-\mu_Q}} P_Q^{\frac{-\mu_Q}{1-\mu_Q}} \tilde{A}^{\frac{-(1-\mu_Q(1-\beta))}{1-\mu_Q}}. \tag{33}$$

When this expression is then combined with (30), (28) and the identities from Section II we obtain broadcaster's profits as a function of three unknowns: α_i, P_Q and $\tilde{A}$. The first-order

condition associated with maximization of these profits is the first equation in our system.

In order to determine the equilibrium value of the price of goods, the demand for Q is derived from the broadcast demand expression (30) and the consumer's budget constraint. The resulting expression is:

$$Q = \frac{Y}{P_Q} - w^{1-\gamma}P_Q^{\gamma}m(1-\alpha_i) \tag{34}$$

When this expression is combined with (32) we obtain a marking-clearing condition which determines P_Q. This is the second equation in our system. Once combined with (33) the only unknowns in this expression are P_Q and $\tilde{A}$.

The final equation in our system is the equality between the aggregate bundle of advertising and individual advertising levels in the symmetric equilibrium, $\tilde{A} = A_i$. Combining this equality with (30) we obtain an expression whose unknowns are α_i, P_Q and $\tilde{A}$. Given these three unknowns and the three non-linear relationships outlined above, we employ the *fsolve* routine in Maple 7.00 to solve for the numerical value of our unknowns. Our first pass occurs with an assumption of twenty firms.

The remaining endogenous variables are then calculated from identities and other relationships. Once the value of all the endogenous variables has been calculated, a loop is executed in which the number of firms is increased incrementally by one. The *fsolve* routine is called again, the equilibrium is calculated, and the loop repeats until the firm number reaches thirty.

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Table 1: Parameter Values

w	25	K_B	.75
Y	10,000	K_σ	4.95
β	.75	μ_Q	2
γ	3.75	μ_B	2
K_Q	.75	μ_σ	.025

Table 2: Numerical Welfare Results

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
			Relative to Baseline						
m	σ	α_i^*	B	A	N	Q	P	P_Q	U
20	1.050	0.417	0.746	0.935	0.652	1.168	1.085	1.072	0.897
21	1.075	0.381	0.836	0.956	0.776	1.115	1.041	1.043	0.934
22	1.100	0.359	0.902	0.972	0.868	1.071	1.020	1.025	0.961
23	1.125	0.344	0.955	0.986	0.940	1.033	1.008	1.011	0.982
24	1.150	0.333	1.000	1.000	1.000	1.000	1.000	1.000	1.000
25	1.175	0.325	1.039	1.014	1.052	0.970	0.995	0.990	1.016
26	1.200	0.319	1.074	1.027	1.097	0.944	0.990	0.982	1.030
27	1.225	0.314	1.105	1.040	1.138	0.919	0.987	0.974	1.043
28	1.250	0.310	1.134	1.053	1.174	0.896	0.985	0.967	1.055
29	1.275	0.306	1.161	1.066	1.208	0.874	0.983	0.961	1.067
30	1.300	0.303	1.186	1.078	1.239	0.854	0.981	0.954	1.078

Figure 1: Results