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Regulating Advertising in the Presence of Public Service Broadcasting*

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Abstract

Television advertising levels in Europe are regulated according to the "Audiovisual Service Media Directive", where member states of the European Union usually impose stricter regulation on their Public Service Broadcasting (PSB) channels. The present model evaluates the effects of symmetric and asymmetric regulation of ad levels on competition for viewers and advertisers in a duopoly framework where a public and a private broadcaster compete. If both broadcasters face the same advertising cap, regulation can be profit-increasing for both channels. If the public broadcaster is more strictly regulated, this may benefit the commercial rival if higher revenues in the advertising market outweigh the loss in viewership.

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Keywords: Advertising; Media Markets; Two-Sided Markets.

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1 Introduction

In most European Union countries commercial television and Public Service Broadcasting (PSB) coexist and compete for viewers and advertisers. Most public broadcasters are financed by a mix of advertising income and public funds (often a license fee), though the precise terms of finance vary to a large extent.

The "Audiovisual Media Service Directive",[1] codified in March 2010, regulates television advertising for all broadcasters in the EU. However, member countries may impose stricter regulation. This is done, in particular, for Public Service Broadcasters, who must usually set less advertising than their commercial counterparts. In the UK, the BBC is not permitted to broadcast any advertising. The same holds for Sweden where the two public broadcasters (SVT1 and SVT2) do not air any advertisements. In Germany, ARD and ZDF, the two main public broadcasters, are not allowed to show commercials after 8pm, on Sundays and on Public Holidays; a restriction which does not apply to their private competitors. There are similar rules in the Netherlands. In France, there are plans underway to remove advertising from all public service broadcasting channels. Since 2009 public broadcasters have not been allowed to show commercials after 8pm. Until recently it was planned to remove advertising completely from 2011 on, however, these plans have been postponed and a new debate has started. Similarly, in Spain, tighter advertising caps for public broadcasters are intended. We take this observed asymmetric regulation of public broadcasters as the starting point for our study.

This paper is hence concerned with competition in media markets where public and private broadcasters compete. Our focus lies on the consequences of the asymmetric regulation of advertising. Do private broadcasters benefit if the public service competitor is subject to heavy regulation? Is asymmetric regulation necessarily to the detriment of the more heavily regulated firm? What happens to the overall level of advertising and the price advertisers have to pay to get their message delivered to viewers? Note, however, that the present paper is not concerned with the rationale of such asymmetric regulations nor the existence of public service broadcasters in general, but rather we study the consequences of asymmetric regulation of the type that can be observed.[2]

We try to provide answers to the questions asked above. For this task we set up a simple model of a two-sided broadcasting market following the seminal contribution by Anderson and Coate (2005). Two broadcasters offer differentiated content and choose how much advertisement to air. Viewers—adverse to commercials—choose among the two broadcasters' programs. One central assumption in Anderson and Coate (2005) is that there is no competition in the advertising market, meaning that the broadcasters'

[1]This directive replaces the "Television Without Frontiers Directive" from 1989 to account for further developments and on-demand services in the audiovisual sector.

[2]For a discussion on the rationale of regulating advertising time and content we refer the reader to Anderson (2007); for a discussion on the rationale for public service broadcasting to Armstrong and Weeds (2007b).

advertising price is affected only by its own advertising level, but not by the advertising level chosen by the rival. This assumption is a common one and is used in many papers in media markets.[3] Following Reisinger et al. (2009), in this paper, we depart from this assumption and show that this enables us to explain some features of competition between public and private broadcasters that cannot be explained otherwise.

The key feature of our model is that there is competition for advertisers in the advertising market. If one broadcaster increases the amount of advertising this directly influences the price for advertising slots for all broadcasters. Thus, there is a negative externality between broadcasters in the advertising market. Reisinger et al. (2009) term this externality a 'pecuniary externality'. The impact of competition in the advertising market has been analyzed in recent papers by Kind et al. (2007), Godes et al. (2009), and Dewenter et al. (2011). Yet, neither of these papers considers asymmetric regulation which—as described above—is a widespread characteristic within the EU. Reisinger et al. (2009) focus on symmetric commercial channels and endogenous entry into the market. Dewenter et al. (2011) analyze the effects of collusion over advertising on market outcomes, and Kind et al. (2007) focus on whether there is over- or under-provision of advertising. Godes et al. (2009) analyze the influence of competition on the relative importance of income from the reader/viewer side compared to income from selling advertising slots.

Our model shows that the profit of the private, non-regulated broadcaster may increase if the public broadcaster is regulated in the amount of advertising it can air. This result is consistent with casual evidence. In Germany, the private broadcasters association (VPRT) opposes plans to allow public broadcasters to air commercials after 8pm.[4] This makes sense in light of our model. To grasp the intuition behind our finding consider first the effect of an introduction of a binding asymmetric regulation in a standard model without competition in the advertising market. As viewers dislike advertising this imposes pressure on the non-regulated broadcaster to decrease advertising as well, immediately leading to lower revenues from advertising. This effect is also present in our model, but there is a second, opposing effect which works via the advertising market. Regulating public broadcasters advertising leads to an increase in the price for advertising spots for the private broadcaster, which tends to increase revenues. This effect may overturn the first one, leading to higher profits for the commercial broadcaster.

We also demonstrate that due to asymmetric regulation the level of advertising of the non-regulated broadcaster may increase or decrease. Yet, the total level of advertising in the market is always lower and, hence, the price for adverts is always higher under regulation. Thus, the model shows that regulating advertising is detrimental for the surplus of advertisers. This is consistent with complaints by the German advertising

[3] Among many others, the assumption of competitive bottlenecks has been applied in Armstrong (2006), Armstrong and Weeds (2007a), Peitz and Valletti (2008), and Crampes et al. (2009).

[4] Press release. Verband Privater Rundfunk und Telemedien e.V. (VPRT), 26.09.2003.

industry association (OWM). According to them, advertising prices are higher during times when the public broadcaster is not allowed to show commercials.[5]

In a brief section, we consider symmetric regulation where both broadcasters are subject to the same cap on advertising. We show that in these situations the profits of both broadcasters may increase. The reason for this result is again the externality between broadcasters in the advertising market. When setting the level of advertising a broadcaster does not take the impact on the competitor's profits into account, which in turn can lead to high advertising levels and low advertising prices. The overall level of advertising can be above the one that maximizes joint profits. In this setting, as regulation lowers each broadcaster's advertising level, regulation can lead to higher prices for advertising, and thus to higher profits. Again, this result cannot be reached with the assumption of competitive bottlenecks. Our result is also consistent with Dewenter et al. (2011) who show that semi-collusion over advertising leads to less advertising, higher prices for advertising and higher broadcaster profits.

The rest of the paper is organized as follows: Section 2 presents the basic model with two non-regulated broadcasters. Section 3 considers the impact of regulation. First, we consider symmetric regulation and then turn to asymmetric regulation where only one broadcaster is regulated. Section 4 extends the model to pay-TV. Section 5 provides robustness checks and Section 6 concludes.

2 The Model

We present a model of the media market along the lines of Reisinger et al. (2009). There are two TV channels, called 1 and 2, that compete for viewers and advertisers. These two channels offer differentiated content, thus following Anderson and Coate (2005), we assume the channels to be located at opposite ends of a unit Hotelling-line.[6] Broadcasters are free-to-air, that is, advertising revenues are their only source of income.

Viewer Market

Viewers have preferences about the content of the two channels and are located uniformly along the Hotelling-line. The position on the line is given by x. There are linear transportation costs at a rate t. The transportation cost parameter t can be interpreted as the degree of competition in the viewer market, with lower values corresponding to

[5] OWM: Organisation Werbungtreibende im Markenverband (OWM). Unfortunately, we are not aware of any systematic, empirical evidence on whether the claim is true. A direct comparison may not suffice as there may be other effects driving the results. For instance, advertisers may have different willingness to pay to target viewers of afternoon shows (where in Germany public broadcasters may air commercials) than for targeting prime time viewers (where public broadcasters may not air commercials).

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

tough competition. Advertising annoys viewers, where γ measures the 'nuisance costs' of advertising for viewers.[7] The indirect utility for a viewer, located at x, is then:

$$U = \begin{cases} V - tx - \gamma a_1 & \text{if choosing channel 1} \\ V - t(1-x) - \gamma a_2 & \text{if choosing channel 2,} \end{cases} \tag{1}$$

where a_1 (a_2) denotes the level of advertising at channel 1 (2) and V labels the gross utility of watching TV, which is assumed to be high enough such that every viewer chooses to watch one channel. The marginal viewer ($\bar{x}$), who is indifferent between choosing channel 1 and 2, is then characterized by

$$\bar{x} = \frac{1}{2} + \frac{\gamma(a_2 - a_1)}{2t}. \tag{2}$$

The difference in advertising levels impacts the market shares, that is, advertising levels can be regarded as an implicit price. The market share of channel 1 is $s_1 = \bar{x}$ and the market share of channel 2 is $s_2 = 1 - \bar{x}$.[8]

Advertising Market

In contrast to many existing papers we consider a setup where the price of advertising depends on the total supply of advertising. Following Godes et al. (2009), Kind et al. (2009), and Dewenter et al. (2011) we specify the following linear per-viewer demand function for adverts on channel i, for $i = 1,2$:

$$p = A - a_i - a_j. \tag{3}$$

There is a pecuniary externality among broadcasters. Increasing the amount of adverts on one channel has adverse consequences on the price for adverts on the other channel, as the advertising price is determined by the total supply of advertising.

By offering two alternative microfoundations Reisinger et al. (2009) derive a slightly different advertisers' demand function by weighting the advertising levels with the respective channel's market share.[9] Here, we use a slightly simpler formulation by ignoring market shares which allow for closed-form solutions. However, we show that

[7] Wilbur (2008), Anderson and Gans (2011), and Stühmeier and Wenzel (2011) analyze consumers' reactions to avoiding advertising messages.

[8] We assume that viewers single-home, i.e., only watch one channel. Hence, our model is on competition in time slots, which is standard in the literature, see, e.g., Anderson and Coate (2005) or Crampes et al. (2009).

[9] Reisinger et al. (2009) offer two explanations why the advertising price may be affected by the total supply of advertising: word-of-mouth advertising and increasing marginal costs of production. With word-of-mouth advertising, a viewer of channel i can be informed about the advertising message by a viewer of channel j. Thus, advertising on channel j partly substitutes advertising at channel i and thereby leads to competition between channels over advertisers. With increasing marginal costs of production, selling more products due to advertising on one channel, reduces the willingness to pay for additional

our main results are confirmed if we consider the exact formulation of Reisinger et al. (2009) and focus on the case where the public broadcaster may not advertise at all (see Section 5.1).[10]

As equation (3) states the advertising demand per viewer, total advertising revenues and hence broadcasters' profits are

$$\Pi_i = s_i a_i p. \tag{4}$$

Section 5.2 provides an alternative objective function for the PSB by putting some weight on viewer welfare. At this stage we compare our results to a symmetric benchmark which enables us to provide insights into the basic effects determining the consequences of advertising regulation. Notice, however, that the main results of the paper do not hinge on the exact PSB objective function, but rather rely on the two opposing effects on the viewer and on the advertising market.

Unregulated Scenario

As a benchmark we consider the case when there are no restrictions on the number of adverts a broadcaster may set. Maximization of equation (4) yields the first-order condition of channel i:

$$\frac{\partial \Pi_i}{\partial a_i} = p\left(\frac{\partial s_i}{\partial a_i} a_i + s_i\right) + s_i a_i \frac{\partial p}{\partial a_i} = 0. \tag{5}$$

Increasing the ad level of a channel has three effects. First, it increases ad revenues for a given number of viewers and a given advertising price. Second, it decreases the number of viewers as they dislike ads. Third, more adverts decrease the advertising price. In contrast to existing papers this last effect has an impact on the rival broadcaster as the advertising price is determined by the total supply of advertising. This gives the following best-response function for broadcaster i:

$$a_i = \frac{1}{3\gamma}\left(t + \gamma A - \sqrt{(\gamma(A - a_j))^2 + (\gamma a_j + t)^2 + \gamma(A - a_j)(\gamma a_j + t)}\right). \tag{6}$$

The symmetric equilibrium, leading to equal market shares, can then be characterized as follows:[11]

adverts on the other channel as the costs of production have increased. Hence, more advertising on one channel leads to a lower demand at the other channel.

[10]Solving the model with the advertising demand function of Reisinger et al. (2009) in the general case is analytically not tractable.

[11]For a comparative static analysis of the symmetric equilibrium we refer to Reisinger et al. (2009).

Lemma 1 *In the symmetric equilibrium each broadcaster chooses an advertising level of*

$$a_i^* = \frac{1}{4\gamma}\left(\gamma A + 3t - \kappa\right), \tag{7}$$

where $\kappa = \sqrt{(\gamma A - t)^2 + 8t^2}$.

The resulting advertising price is

$$p^* = \frac{1}{2\gamma}\left(\gamma A - 3t + \kappa\right). \tag{8}$$

Each advertiser earns profits of

$$\Pi_i^* = \frac{1}{16\gamma^2}\left(\gamma A - 3t + \kappa\right)\left(\gamma A + 3t - \kappa\right). \tag{9}$$

In models without competition in the advertising market, advertising levels act as hedonic prices to viewers, affecting only the distribution of viewers over the channels. Then, as in standard Bertrand competition, best-response functions are upward sloping, thus advertising levels are strategic complements. This need not be true if there is an additional pecuniary externality on the advertising price (see Reisinger et al. (2009)). Differentiating equation (6) with respect to a_j yields that advertising levels are strategic complements, i.e. $\frac{da_i}{da_j} > 0$, only if the degree of differentiation in the viewer market is sufficiently small, that is, if

$$t < \bar{t} = \gamma(A - 2a_j). \tag{10}$$

Lemma 2 *Advertising levels are strategic complements if competition in the viewer market is sufficiently intense. Otherwise, they are strategic substitutes.*

In the viewer market, advertising has the property of a strategic complement as consumers dislike advertising (the "market share effect"). In the advertising market, advertising has the property of a strategic substitute as an increase in the advertising level reduces the advertising price at both channels (the "pecuniary effect"). If channels are highly differentiated (large t) the market share effect is small and a change in the advertising level affects the distribution of viewers only to a small extent. Therefore, for large values of t the pecuniary effect dominates and advertising levels have the property of strategic substitutes. We can insert equilibrium advertising levels of equation (7) into equation (10), which yields that in the symmetric equilibrium advertising levels are strategic complements if

$$t < \widetilde{t} = \frac{1}{2}\gamma A. \tag{11}$$

The strategic nature of advertising will essentially determine the way the commercial broadcaster reacts to the introduction of a cap on advertising for the public broadcaster. This will be analyzed in the next section.

3 Regulation

3.1 Symmetric Regulation

Before turning to asymmetric regulation we start by considering the impact of a symmetric advertising cap on broadcasters' profits. Let us say that there is a binding cap on advertising set at $\bar{a}$. We compare the advertising level in the non-regulated scenario a_i^* of Section 2 with the advertising level that maximizes joint profits ($\widehat{a}_i$). The level of advertising that maximizes joint advertising revenues per consumer is

$$\widehat{a}_i = \frac{A}{4}. \tag{12}$$

Note that colluding firms internalize the nuisance costs of advertising (γ). Comparison with the non-cooperatively defined advertising level of equation (7) yields that $a_i^* > \widehat{a}_i$ if

$$t > \frac{1}{2}\gamma A. \tag{13}$$

Thus, in equilibrium, the competitive advertising level may exceed the one that maximizes joint profits and hence broadcasters have a joint interest in reducing advertising. Observe from equation (11) that this holds whenever equilibrium advertising levels are strategic substitutes. Obviously, whenever $a_i^* > \widehat{a}_i$ any cap on advertising between the profit-maximizing level and the competitive one is beneficial for the broadcasters. Thus, regulation might be beneficial to broadcasters as it solves the problem of how to commit to lower advertising levels. However, even tougher caps might be beneficial as broadcasters' profit functions are hump-shaped. Define $a^c < \widehat{a}_i$ as the advertising level that corresponds to the profit in the unregulated equilibrium, such that $\Pi(a^c) = \Pi(a_i^*)$. Now, any cap $\bar{a} \in (a^c, \widehat{a}_i)$ increases profits compared to an unregulated outcome. To summarize:

Proposition 1 *If $t > \frac{1}{2}\gamma A$, the introduction of a symmetric cap on advertising levels $\bar{a} \in (a^c, a_i^*)$ leads to higher broadcaster profits.*

Proposition 1 demonstrates that regulation can benefit broadcasters. Intuitively, a binding advertising cap solves an externality problem between the broadcasters. When deciding how much to advertise broadcasters do not take the impact on the competitor's advertising price into account, the pecuniary externality. And hence, if advertising levels are strategic substitutes, competing broadcasters set advertising levels that are too high from a joint perspective. Then, the cap on advertising helps to overcome the externality problem and broadcaster profits rise. This is more likely to happen if transportation costs (t) are high and advertising causes a small nuisance (low γ). In this case, broadcasters' market shares are less affected by advertising and the impact in the advertising market is more important. Note that Proposition 1 is in contrast to standard models without competition on the advertising market. Without competition in the advertising market advertising levels are strategic complements and the introduction of an advertising cap is necessarily detrimental for profits.

Our result that regulation may be profit-enhancing is in line with Dewenter et al. (2011) where newspapers collude on lower advertising levels to raise the price for adverts. Reisinger et al. (2009) analyze market entry into the broadcasting market. They show that for an intermediate number of broadcasters, additional entry may actually increase profits, as competition on advertising levels may decrease the equilibrium advertising level towards the collusive level. This suggests that advertising ceilings have to be carefully analyzed. Our paper is able to analytically confirm this suggestion and states conditions where broadcasters indeed benefit from a regulation of advertising.

3.2 Asymmetric Regulation

Now let us suppose that only one of the broadcasters is regulated. As mentioned above, usually PSB channels must set advertising levels that are lower than their commercial rival's. We assume that the PSB broadcaster, say broadcaster 2, is restricted to a binding advertising cap $\overline{a}_2$, where $0 \leq \overline{a}_2 < a_i^*$. For simplicity, there is no advertising cap for the commercial broadcaster.

The commercial broadcaster sets its advertising level according to the best-response function, equation (6), given that the advertising level of the PSB is fixed at $\bar{a}_2$:

$$\widetilde{a}_1 = \frac{1}{3\gamma}\left(t + \gamma A - \sqrt{(\gamma(A - \overline{a}_2))^2 + (\gamma\overline{a}_2 + t)^2 + \gamma(A - \overline{a}_2)(\gamma a_2 + t)}\right). \tag{14}$$

We are interested in how the commercial broadcaster reacts to the introduction of a regulation for the PSB broadcaster. Therefore, suppose first that both broadcasters are unregulated and set advertising levels a_i^* according to equation (7). Suppose next that a binding, marginal cap on advertising just below the unregulated equilibrium level is introduced, i.e., $-\frac{\partial\widetilde{a}_1}{\partial\overline{a}_2}|_{a_1=a_2=a^*}$.

From Lemma 2 it then immediately follows that due to the marginal cap on advertising for the PSB, the commercial rival may increase or decrease its advertising level as advertising levels can be either strategic substitutes or complements. In the case of strategic substitutes, the optimal response of the unregulated broadcaster is to increase its advertising level, whereas in the case of strategic complements the best response is to decrease its advertising level.

To explain this reaction intuitively, we decompose the impact of regulation into the effects on the viewer market and on the advertising market. Due to the advertising aversion of viewers, advertising levels are strategic complements in general. If the regulated channel reduces its advertising level so that the advertising cap $\overline{a}_2$ is hence more restrictive, this negatively affects the distribution of viewers for the unregulated channel. Thus,

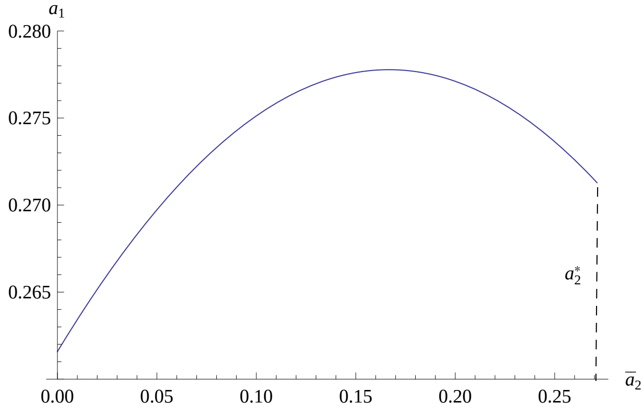

Figure 1: Advertising of commercial broadcaster depending on cap $\bar{a}$.

this effect tends to decrease unregulated broadcaster's advertising level. On the other hand, due to the public broadcaster's reduced advertising, the private broadcaster earns higher advertising revenues per viewer, making it more attractive to increase advertising (the pecuniary effect). These effects oppose each other. The total effect is ambiguous and depends on the strength of the two effects.

The previous section analyzed the impact of asymmetric regulation around the symmetric equilibrium. Similarly, one can analyze the marginal strengthening of regulation for any given level of a cap. The commercial broadcaster increases its advertising level if the following condition is met and advertising serves as a strategic substitute:

$$\bar{a}_2 > \frac{1}{2}\frac{(\gamma A - t)}{\gamma}. \tag{15}$$

Otherwise, the commercial broadcaster decreases the advertising level. It can be shown that the impact need not be monotone if the regulator tightens the cap successively. Figure 1 illustrates this for $A = 1, t = 2$, and $\gamma = 3$.

The resulting advertising price, denoted as $\widetilde{p}$, is affected by regulation:

Lemma 3 *The price for adverts increases monotonically in the degree of regulation. That is,* $-\frac{\partial \widetilde{p}}{\partial \bar{a}_2} > 0$.

Proof See Appendix. ■

Lemma 3 shows that the advertising price increases if the public broadcaster is regulated. Thus, our theory is in line with complaints by the advertising industry that caps on public broadcasters' advertising may hurt them via high access prices to viewers.

Next, we are interested in the impact on the commercial broadcaster's profit. To determine this we analyze the effect of an introduction of a marginal cap on advertising around the equilibrium without regulation, i.e., $-\frac{\partial \widetilde{\Pi}_1}{\partial \bar{a}_2}|_{a_1=a_2=a^*}$. If this is positive (negative) broadcaster 1 earns higher (lower) profits when broadcaster 2 must set less advertising. It can be shown that both is possible.

Proposition 2 *Due to a marginal cap on PSB advertising, the commercial broadcaster earns higher profits if*

$$t > \frac{1}{2}\gamma A. \tag{16}$$

Otherwise, profits fall.

Proof See Appendix. ■

The introduction of the cap has two opposing effects on the profits of the commercial broadcaster. First, due to the cap the regulated broadcaster's advertising is lower and some consumers migrate to the public broadcaster. Thus, the commercial broadcaster suffers from a loss in market share. Second, the price for advertisements per viewer is higher and advertising revenues per viewer are higher. The total effect on profits depends on the strength of these two effects. Note that condition (16) is more easily fulfilled, and hence profits are more likely to increase, if t is large and γ is small. In these cases, the effect on the advertising market is more important than the effect on the viewer market.

We are also able to determine how profits are affected if the cap is successively tightened. Tightening the advertising cap of the regulated broadcaster increases the profit of the unregulated rival, $-\frac{\partial \widetilde{\Pi}_1}{\partial \bar{a}_2} > 0$, if

$$\bar{a}_2 > \frac{1}{2}\frac{\gamma A - t}{\gamma} = \bar{a}^{cr}. \tag{17}$$

The principal trade-off for profits is the same as when considering the introduction of a cap around the symmetric equilibrium: market share effect versus the effect on the advertising market. According to equation (17) it depends on the strength of regulation, $\bar{a}_2$, which of both effects dominate. If $\bar{a}_2 > \bar{a}^{cr}$ the effect in the advertising market dominates and profits increase. However, as regulation becomes successively tougher, the market share effects becomes more important until for $\bar{a}_2 < \bar{a}^{cr}$ it dominates and profits begin to shrink. Note, however, that it is possible to have instances where the advertising market effect is dominant for all values $\bar{a}_2$. In particular, if the differentiation among broadcasters is sufficiently large and nuisance of advertising is sufficiently low,

$$t > \gamma A, \tag{18}$$

and hence, $\bar{a}^{cr} < 0$, the commercial broadcaster always benefits from the tightening of the advertisement cap on its public competitor.

The next proposition collects the previously identified conditions when a commercial broadcaster is more likely to benefit from regulation:

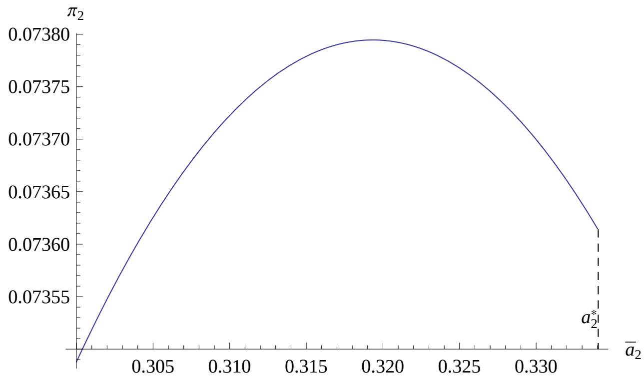

Figure 2: Profits of the regulated public broadcaster depending on cap $\bar{a}_2$.

Proposition 3 *The commercial broadcaster is more likely to benefit from regulation of the public competitor if*

- *broadcasters are sufficiently differentiated (high t),*
- *viewers are not too ad-averse (low γ),*
- *regulation of the public broadcaster is not too strict.*

Proposition 3 is interesting from a political economy perspective as it can be used to assess conditions under which private broadcasters might lobby for regulation of their public competitors. At least in Germany, the private broadcasters association strictly favors regulation on public broadcasting and it can be expected that considerable lobbying efforts are expended.

The effect of regulation on the public broadcaster's advertising revenues is also ambiguous. As the general expressions are rather cumbersome we demonstrate the outcomes for $A = 1, t = 1$, and $\gamma = 1$. Then, the profits of the public broadcaster simplify to

$$\Pi_2 = \left(\frac{5}{6} - \bar{a}_2 - \frac{1}{6}\sqrt{1+3\bar{a}_2^2}\right)\left(\frac{1}{3} + \frac{1}{3}\sqrt{1+3\bar{a}_2^2}\right)\bar{a}_2. \tag{19}$$

Figure 2 shows the profits depending on the cap on advertising $\bar{a}_2$. Observe that for moderate levels of the cap the regulated firm's profits can increase due to regulation. However, as regulation becomes tougher (low levels of $\bar{a}_2$) the effect on profits is clearly negative. We summarize this as follows:

Proposition 4 *If regulation is not too restrictive the advertising revenues of the regulated, public service broadcaster may increase due to the implementation of the regulation.*

4 Pay-TV

In the following section we allow the commercial broadcaster to earn additional revenues from charging a subscription fee k_1.[12] The PSB channel is still restricted to advertising income.

The marginal viewer ($\bar{x}$), who is indifferent between choosing channel 1 or 2, is then characterized by

$$\bar{x} = \frac{1}{2} + \frac{\gamma(a_2 - a_1) - k_1}{2t}. \tag{20}$$

Channel 1 attracts a market share of $s_1 = \bar{x}$ and channel 2 of $s_2 = 1 - \bar{x}$. They earn revenues of

$$\Pi_1 = s_1(a_1 p + k_1) \tag{21}$$

and

$$\Pi_2 = s_2 a_2 p. \tag{22}$$

The pay-TV channel maximizes its profit function of equation (21) with respect to the advertising level and the subscription fee. The PSB channel's advertising level is exogenously set by a regulatory authority and is thus restricted to a binding advertising cap $\overline{a}_2$. The profit-maximizing advertising level and subscription fee of the commercial broadcaster is then:

$$a_1(\overline{a}_2) = \frac{1}{2}(A - \gamma - \overline{a}_2) \tag{23}$$

and

$$k_1(\overline{a}_2) = \frac{1}{2}\left(t - \frac{1}{2}\gamma(A - \gamma - 3\overline{a}_2) - a_1 p\right). \tag{24}$$

Observe that there is a partial pass-through (at a rate of $\frac{1}{2}$) of advertising income $a_1 p$ into the subscription fee k_1, since with higher advertising income viewers are more valuable. Therefore, the channel finds it attractive to attract viewers by charging low subscription fees or even by subsidizing them.

Strengthening regulation makes the commercial broadcaster react in the following way:

$$-\frac{\partial a_1}{\partial \overline{a}_2} = \frac{1}{2} > 0, \tag{25}$$

[12] We allow for negative subscription fees. That is, we allow for subsidies to viewers. This is a common assumption of the literature, see, e.g., Peitz and Valletti (2008). Kind et al. (2009) analyze how competition changes the way media firms raise revenues. They find that more competition in the form of media firms being closer substitutes raises income from advertising but reduces income from subscription. Income from subscription becomes relatively more important vis-a-vis advertising revenues if the number of media firms increases.

$$-\frac{\partial k_1}{\partial \overline{a}_2} = -\frac{1}{2}\gamma - \frac{1}{4}(A+\gamma-\overline{a}_2) < 0 \tag{26}$$

for any $a_1(\overline{a}_2) > 0$ of equation (23).

In contrast to the free-to-air case, the commercial broadcaster reacts unambiguously by increasing its advertising level. In turn, viewers are compensated by a lower subscription fee. Since the advertising price increases due to a lower advertising supply, the commercial channel finds it attractive to increase its advertising level. Possible losses in market share are compensated by a lower subscription fee. Due to the higher advertising revenues viewers become more valuable to the broadcaster, making it attractive to further reduce the subscription fee (the pass-through effect). Thus, with pay-TV the market share effect and the pecuniary effect on the advertising market can be separated. This is in contrast to the free-to-air case studied previously where the commercial broadcaster only had one instrument to handle these two effects.

We are interested in the effect of a tighter regulation of the PSB advertising level on the commercial channel's profit. A tighter regulation has two countervailing effects on the viewer and the advertising market. A tighter regulation of the PSB advertising level, increases the per-viewer advertising income, leading to higher profits from advertising. However, the commercial broadcaster reduces its subscription fee, giving away profit in the viewer market.

Proposition 5 *Tightening the advertising cap of the regulated PSB broadcaster increases the pay-TV broadcaster's profit, i.e.,* $-\frac{\partial \Pi_1}{\partial \overline{a}_2} > 0$*, if*

$$\overline{a}_2 < A - 3\gamma. \tag{27}$$

Hence, the pay-TV broadcaster benefits from regulation if

- *viewers are not too ad-averse and*
- *regulation of the PSB is sufficiently strict.*

Proof See Appendix. ■

In contrast to the free-to-air case, where the commercial broadcaster may benefit if regulation is not too tough, with pay-TV the commercial broadcaster actually benefits if regulation is sufficiently tough. The pay-TV channel can compensate any direct loss in market share due to a lower PSB advertising level by itself lowering the subscription fee. If regulation is sufficiently tough this leads to an increasing market share of the commercial broadcaster, which boosts profits as the returns on the advertising market are high. This holds, in particular, if viewers only weakly respond to advertising (γ is low).

5 Robustness

5.1 Advertising demand

Here we check the robustness of our results and confirm their validity in the setting of Reisinger et al. (2009). By offering two alternative microfoundations they derive an advertisers' demand function of

$$p = A - s_i a_i - s_j a_j, \tag{28}$$

which weights the advertising levels with market shares. To obtain closed-form solutions in our asymmetric model we have used a slightly simpler demand function which omits the direct effect of markets shares on the price of advertising. In this section, we show that the main results do not depend on this simplification. For tractability we provide a comparison of regulation only for the case where the public broadcaster is not allowed to air any advertisements ($\overline{a}_2 = 0$). For brevity, we focus on the free-to air scenario from Section 3.

Let $\Omega = \sqrt{4\gamma^2 A^2 - 4\gamma A t + 9t^2}$. Without regulation each channel chooses an advertising level of

$$a_i^* = \frac{1}{4\gamma}(2\gamma A - 3t - \Omega), \tag{29}$$

which yields a price for advertising of

$$p^* = \frac{1}{4\gamma}(2\gamma A - 3t + \Omega). \tag{30}$$

Each broadcaster earns

$$\Pi_i^* = \frac{1}{32\gamma^2}(2\gamma A + 3t - \Omega)(2\gamma A - 3t + \Omega). \tag{31}$$

Now suppose that the PSB may not air any advertising, i.e., $\overline{a}_2 = 0$. We focus on the more interesting case with low transportation costs, $t < 4\gamma A$.[13] Then, the commercial broadcaster sets an advertising level of

$$\widetilde{a}_1(\overline{a}_2 = 0) = \frac{1}{2}\frac{t}{\gamma}, \tag{32}$$

and earns profits of

$$\widetilde{\Pi}_1(\overline{a}_2 = 0) = \frac{t}{64\gamma^2}(8\gamma A - t). \tag{33}$$

[13] In the case of large transportation, $t > 4\gamma A$, results are unambiguous. The commercial broadcaster's profits always increase due to regulation as with high transportation costs the market share effect is weak.

The resulting advertising price is

$$\widetilde{p}(\overline{a}_2 = 0) = A - \frac{1}{8}\frac{t}{\gamma}. \tag{34}$$

Due to regulation the commercial broadcaster increases its advertising level if $t > \gamma A$, that is, only if the effect on the advertising market is stronger than the effect on the viewer market. Similarly, the commercial broadcaster earns higher profits only if the horizontal differentiation is sufficiently strong, that is, if

$$t > 24\left(\frac{12}{71} - \frac{1}{71}\sqrt{73}\right)\gamma A \approx 1.1682\gamma A. \tag{35}$$

The advertising price always increases if the public broadcaster is not allowed to show advertisements. Thus, we can confirm the results from the main text in the setting of Reisinger et al. (2009): The commercial channel's advertising level may be higher or lower with regulation of the PSB and advertisers always suffer from regulation by paying a higher price to contact viewers. The commercial channel may benefit or suffer from regulation, depending on the extent of the market share effect and the pecuniary effect on the price of advertising.

5.2 PSB objective function

In the main text we have analyzed the effects of tighter PSB advertising regulation around a symmetric benchmark implicitly assuming that the PSB is a profit maximizer (see Prop. 2). This section checks for the robustness of our results if the PSB does not only care about revenues, but also about viewer welfare. We focus on the free-to-air scenario from Section 3. We will show that our main results do hold qualitatively, provided that the weight on viewer welfare is not too large.

In line with Armstrong and Weeds (2007a) this section considers an objective function of the PSB where the PSB puts weight on viewer welfare as well as on advertising income to cover the cost of quality programming. The PSB objective function is denoted as

$$Z = s_2 a_2 p + \alpha\left(s_1(V - \gamma a_1) + s_2(V - \gamma a_2) - \int_0^{\bar{x}} tz dz - \int_{\bar{x}}^1 t(1-z)dz\right), \tag{36}$$

where the first part accounts for advertising income and the second part for viewer welfare. The parameter α parameterizes the importance of viewer welfare. The first-order condition for the PSB is

$$\frac{\partial Z}{\partial a_2} = p\left(\frac{\partial s_2}{\partial a_2}a_2 + s_2\right) + s_2 a_2 \frac{\partial p}{\partial a_2} - \alpha\gamma s_2 = 0. \tag{37}$$

Hence, compared to pure profit maximization the PSB now considers an additional negative nuisance effect of advertising on viewers. As a consequence, the PSB sets a lower advertising level than the commercial channel (see Armstrong and Weeds (2007a)). This effects is stronger the larger the weight on viewer welfare is. The first-order condition of the commercial broadcaster is given by Eq. (6).

Solving for the equilibrium is analytically not tractable. Thus, we have resorted to a numerical analysis to solve for the outcomes with and without regulation. Our main result, that regulation of the public broadcaster can be profitable for the commercial rival, can be confirmed. Consider, for instance, the outcomes with the following parameter values, $A = 1$, $t = 1$, $\gamma = 1.2$, and $\alpha = 0.25$.[14] Without regulation, the equilibrium is given by an advertising level of $a_1^* = 0.302$ for the commercial broadcaster and a level of $a_2^* = 0.164$ for the PSB. In line with intuition, the PSB chooses a lower advertising level than the commercial broadcaster. Then, we can show that for a mild regulation of the PSB, $0.164 > \bar{a}_2 > 0.083$, the commercial broadcaster's profits increase. Profits decrease if the regulation is sufficiently strict, $\bar{a}_2 < 0.083$.[15] This confirms our main result and is in line with Proposition 3 where it is shown that a mild regulation of the PSB can be beneficial for the commercial broadcaster. The effects of regulation do not hinge on the specific PSB objective function we have used in the main model, but rather on the relative magnitude of the effects on the viewer and advertising markets.

The more weight the PSB places on viewer welfare, the lower the advertising level of the PSB and hence, the more pressure is exerted on the commercial broadcaster on the viewer side of the market. Then, if this pressure is sufficiently strong any regulation on the PSB is necessarily detrimental for the commercial rival. In our example, if α exceeds 0.399, the commercial rival is hurt by any regulation, but may benefit otherwise.

6 Conclusion

This paper analyzes the effects of regulating the advertising levels of broadcasters in a duopolistic framework. The "Audiovisual Media Service Directive" regulates advertising levels of all broadcasters to a maximum of 12 minutes per hour. Currently, members of the European Union are debating whether to further restrict the advertising levels on their Public Service Broadcasting channels. In France, it is under debate whether to remove all advertising from PSB broadcasters, as is already the case in the UK. In Germany and Spain, there is a similar debate of whether to restrict advertising completely on the Public Service Broadcasters, which the commercial rivals would also embrace. However, standard models of competition cannot explain this. Advertising is assumed to be a nuisance to viewers, and viewers would migrate to the Public Service channels

[14] We have repeated this analysis for various parameter values and found similar results.

[15] Also, advertising levels of the commercial broadcaster increase for mild regulation, but decrease for strict regulation.

in the case of regulation. With some exceptions, most papers in media economics do not consider competition for advertisers, which leads to the result that a commercial broadcaster suffers from the regulation of the public competitor. By considering competition in the advertising market our framework helps to explain some puzzles that cannot be explained in the models developed so far.

We distinguish two kinds of regulation of advertising levels: With symmetric regulation both channels are regulated to a binding advertising cap and with asymmetric regulation only one of the broadcasters is regulated. This asymmetric regulation accounts for the mixed duopoly structure of many broadcasting markets, where regulated Public Service Broadcasting channels compete with unregulated (or less regulated) commercial broadcasters. We show that both channels can increase profits by the regulation of advertising for sufficiently weak competition in the viewer market. With asymmetric regulation the non-regulated commercial channel faces two countervailing effects. By regulation of the rival's advertising levels it faces the standard negative market share effect, but also a positive pecuniary effect. Due to the reduced advertising level of the PSB, the advertising price rises and the commercial channel gains market power in the advertising market. These two effects determine whether the commercial rival is positively or negatively affected by regulation.

A Appendix

Proof *of Lemma 3*:

We have to show that $\frac{\partial \widetilde{p}}{\partial \bar{a}_2} < 0$. By equation (6) it follows that

$$\frac{\partial \widetilde{p}}{\partial \bar{a}_2} = -\frac{1}{2}\frac{\gamma A - t - 2\gamma \bar{a}_2 + 2(\gamma A + t - \sqrt{\gamma A^2 - t\gamma A + t^2 + 3\gamma \bar{a}_2(t + \gamma \bar{a}_2 - \gamma A)})}{\gamma A + t - \sqrt{\gamma A^2 - t\gamma A + t^2 + 3\gamma \bar{a}_2(t + \gamma \bar{a}_2 - \gamma A)}}.$$

First, consider the boundaries of $\lim_{\bar{a}_2 \to 0}(\frac{\partial \widetilde{p}}{\partial \bar{a}_2})$ and $\lim_{\bar{a}_2 \to \infty}(\frac{\partial \widetilde{p}}{\partial \bar{a}_2})$. Evaluation at the inner boundary of zero yields that

$$\lim_{\bar{a}_2 \to 0}(\frac{\partial \widetilde{p}}{\partial \bar{a}_2}) = \frac{1}{2}\frac{t - \gamma A - 2\sqrt{t^2 - t\gamma A + \gamma^2 A^2}}{\sqrt{t^2 - t\gamma A + \gamma^2 A^2}}.$$

After rearrangement and squaring it follows that $\lim_{\bar{a}_2 \to 0}(\frac{\partial \widetilde{p}}{\partial \bar{a}_2}) < 0$ if $-(2t^2 + 2\gamma^2 A^2 + (\gamma A - t)^2) < 0$, which is always true.

Similarly, evaluation at the outer boundary of $\bar{a}_2 \to \infty$ yields that

$$\lim_{\bar{a}_2 \to \infty}\left(\frac{\partial \widetilde{p}}{\partial \bar{a}_2}\right) = \frac{1}{3}(\sqrt{3} - 3) < 0.$$

In the next step, we show that $\frac{\partial \widetilde{p}}{\partial \overline{a}_2}$ is continuous and monotone. This is done by evaluating the second derivative of

$$\frac{\partial^2 \widetilde{p}}{\partial \overline{a}_2^2} = \frac{1}{4} \frac{\gamma(\gamma A + t)^2}{(\gamma A^2 - t\gamma A + t^2 + 3\gamma \bar{a}_2(t + \gamma \bar{a}_2 - \gamma A))^{\frac{3}{2}}} > 0.$$

As the first derivative is monotone sloping, we can conclude that $\frac{\partial \widetilde{p}}{\partial \overline{a}_2} < 0$ for any $\overline{a}_2 \in (0, \infty)$.

■

Proof *of Proposition 2*:

Profits of the commercial broadcaster are $\Pi_1(\widetilde{a}_1, \overline{a}_2)$. Differentiation with respect to $\overline{a}_2$ yields:

$$\frac{d\Pi_1}{d\overline{a}_2} = \frac{\partial \Pi_1}{\partial a_1}\frac{d\widetilde{a}_1}{d\overline{a}_2} + \frac{\partial \Pi_1}{\partial \overline{a}_2}. \tag{38}$$

As in equilibrium $\frac{\partial \Pi_1}{\partial a_1} = 0$, the expression simplifies to

$$\frac{d\Pi_1}{d\overline{a}_2} = \frac{\partial \Pi_1}{\partial \overline{a}_2} = \frac{\gamma a_1}{2t}(A - a_1 - \overline{a}_2) - a_1\left(\frac{1}{2} + \frac{\gamma(\overline{a}_2 - a_1)}{2t}\right). \tag{39}$$

Evaluating around the symmetric equilibrium $(a_1 = \overline{a}_2 = a_i^*)$ without regulation gives that $-\frac{d\Pi_1}{d\overline{a}_2} \gtrless 0$ iff:

$$a_i^* \gtrless \frac{1}{2\gamma}(\gamma A - t). \tag{40}$$

Using condition (7) this reads

$$-\frac{d\Pi_1}{d\overline{a}_2} \gtrless 0 \Leftrightarrow \gtrless \frac{\gamma A}{2t}. \tag{41}$$

Hence, the introduction of a marginal cap benefits the commercial broadcaster if $t > \frac{1}{2}\gamma A$.

■

Proof *of Proposition 5*:

The derivative of the pay-TV channel's profit function with respect to the PSB advertising cap is

$$-\frac{\partial \Pi_1}{\partial \overline{a}_2} = \frac{1}{32t}\left((A - \overline{a}_2) - 3\gamma\right)\left(4t + (A - \overline{a}_2)^2 + \gamma(\gamma + 6\overline{a}_2 - 2A)\right). \tag{42}$$

We show that the second part of equation (42) is always positive. Denote the second part of equation (42) as $\Omega = 4t + (A - \overline{a}_2)^2 + \gamma(\gamma + 6\overline{a}_2 - 2A)$. Consider a regulation that completely removes advertising from PSB, i.e., $\bar{a}_2 = 0$. In this case, $\Omega = 4t + (A-\gamma)^2 > 0$. From $\frac{\partial \Omega^2}{\partial \bar{a}_2^2} = 2$, it follows that the function is convex, with a minimum of $\tilde{a}_2 = A - 3\gamma$. We only have to consider non-negative advertising levels $\tilde{a}_2 \geq 0$ which is guaranteed if $A \geq 3\gamma$.

We show that even at the minimum Ω is positive, i.e., we consider $\Omega(\tilde{a}_2)$. This gives

$$\Omega(\tilde{a}_2) = 4\gamma(A - 2\gamma) > 0,$$

for any non-negative advertising level.

Since, $\frac{\partial \Omega}{\partial A} > 0$ for any $a_1(a_2) \geq 0$ it follows that the second part is always positive for any a_2.

Hence, we have shown that $\Omega > 0$ and the sign of $-\frac{\partial \Pi_1}{\partial \bar{a}_2}$ is only determined by the first part of equation (42).

■

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