# The Role of Program Quality and Publicly-owned Platforms in the Free to Air Broadcasting Industry*

Miguel González-Maestre† Francisco Martínez-Sánchez ‡
Universidad de Murcia Universidad de Murcia

May, 2010

**Abstract**

We consider the role of a publicly-owned platform and program quality in the free to air broadcasting industry. We compare the equilibrium levels of advertising under private and mixed duopoly competition, and show that the connection between program quality and advertising incentives are drastically different between both scenarios. We also consider the welfare implications of our analysis and obtain policy implications regarding the optimal government's intervention in the broadcasting industry.

**Keywords:** program quality, mixed duopoly, advertising, media
**JEL Classification:** L11, L33, L82, M37.

*The first author acknowledges financial support from Fundación Séneca, Agency of Science and Technology of the Region of Murcia, under project 05710/PHCS/07 and the Spanish Ministry of Science and Innovation under project ECO2008-02654/ECON, and the second acknowledges financial support from the Spanish MCYT under the project SEJ2007-62081/ECON and from Junta de Andalucía under the project P08-SEJ-03781.

†Departamento de Fundamentos del Análisis Económico, Universidad de Murcia, 30100 Murcia, Spain. E-mail: mmaestre@um.es

‡Dpto. de Métodos Cuantitativos para la Economía y la Empresa, Universidad de Murcia, 30100 Murcia, Spain. E-mail: fms@um.es

# 1 Introduction

In this paper we consider the role of program quality and a publicly-owned platform in the context of a free-to-air broadcasting industry. The presence of publicly-owned platforms in the broadcasting media industry is prominent in many western countries. The empirical relevance of this presence can be seen in Bel and Domènech (2009, table 1 p. 167). In particular, we point out the existence of one or more national publicly-owned tv-platforms in Italy, Germany, France, United Kingdom, Switzerland and Spain.

The public intervention in the broadcasting industry has been particularly justified where advertising is the only method of commercial provision. As suggested by Coase (1966), in the absence of subscription television, the public policy can increase social welfare by improving the level of quality and diversity of the available programming. A basic ingredient in the justification of this public regulation is usually associated to the need of diminishing the nuisance of excessive advertising. The rapid technological advances in the broadcasting and communication industries, has enhanced the debate about the role of public intervention in broadcasting industries (See, among others, Armstrong, 2005). Moreover, this debate has become particularly relevant, as a result of recent controversial policy decisions within the EU. Particularly remarkable is the decision by the public TV platform in France (more recently followed by its counterpart in Spain) of eliminating advertising as a way of financing.[1]

Despite of the above mentioned evidence, there is a surprising lack of research about the role of publicly-owned platforms in the media industry and its connection with the use of advertising. A remarkable exception is the work by Kind et al. (2007). In a model with horizontal product differentiation, those authors show that a welfare maximizer publicly-owned TV channel brings less advertising than the private ones if TV programs are sufficiently differentiated. In their empirical approach, Alcock and Docwra (2005) develop a stochastic oligopoly model calibrated for the Australian broadcast TV market. They find that the presence of a public platform can simultaneously generate positive outcomes for viewers as well as for other market suppliers because it increases viewers' choice and the total market size. More recently, Bel and Domènech (2009) have undertaken an empirical analysis in

[1] In substitution of this source of financing, the French government has established a tax on the revenues by private TV and telecom platforms, a decision which is currently under investigation by the European Commission.

the Spanish broadcasting industry and have found that advertisers create a negative externality to viewers that tends to be mitigated by the presence of publicly-owned platforms.

The analysis of advertising in broadcasting media industries, with private platforms has been extensively considered in recent literature.[2] In particular, Gabszewicz et al. (2004) consider two private tv-platforms that derive their profits from advertising and show that the platforms profile are closer as advertising aversion becomes stronger. Anderson and Coate (2005) show that advertising levels may be too low or too high with respect to a socially optimal level, depending on the nuisance cost to viewers, the substitutability of programmes and the expected benefits to advertisers from contacting viewers.

However, Gantman and Shy (2007) consider that some viewers are indifferent with respect to the level of advertising and show that if the improvement of advertising quality is profitable for the advertising firms, it is unprofitable for tv-platforms (broadcasters). On the other hand, Peitz and Valletti (2008) analyze and compare two settings: pay-tv, where platforms obtain revenue from advertising and from viewers; and free to air, where platforms obtain all revenues from advertising. They show that if viewers strongly dislike advertising, the advertising intensity is greater under free to air, and that free to air platforms tend to provide less differentiated content whereas pay-tv platforms always maximally differentiate their content.

Crampes et al. (2009) consider the effects of advertising on entry in the media industry. They show that, under constant or increasing returns to scale in the audience, the level of entry is excessive and the level of advertising is insufficient.

Most of these previous contributions focus on the combination of advertising and horizontal product differentiation among private platforms in two-sided markets. In contrast with this previous contributions, our model considers, simultaneously, two relevant aspects of the broadcasting industry:

First, apart from horizontal differentiation, we also assume the presence of differences in the program quality, measured in terms of viewers' utility. In the previous literature, only Armstrong (2005), and Crampes et al. (2009), analyze the role of program quality in the broadcasting industry. In particular, Armstrong compares the equilibrium quality levels between the

[2] See the interesting surveis by Anderson (2007) and Anderson and Gabszewicz (2006) about advertising in the media.

free-to-air duopoly regime and the case of suscription, while Crampes et al. (2009) analyze the effects of endogenous quality improvements. However, these previous contributions assume competition among symmetric private platforms while we consider the role of a publicly-owned platform in the presence of asymmetric quality levels.

Second, our model analyzes the role of a publicly-owned platform in the broadcasting markets. As explained above, only Kind et al. (2007) have analyzed this issue from a theoretical perspective, but in contrast with this previous contribution, focused on horizontal differentiation, our model considers also vertical differentiation among platforms.

Specifically, the aim of our paper is twofold:

1) First, we analyze the optimal advertising decision of the public platform, taking into account two different effects: (i) a direct effect of this decision on welfare, measured in terms of advertising revenues and nuisance costs, and (ii) an indirect effect of advertising in the distribution of the audience among the broadcasting platforms. As we will show, this indirect effect depends on both the degree of product differentiation and the quality differential between platforms.

2) Second, we compare the equilibrium levels of advertising under two different setting: a private duopoly, with two private profit-maximizing platforms, and a mixed duopoly, with a welfare-maximizing publicly-owned platform competing with a private platform.[3] We identify the conditions under which privatization is socially desirable and show that the connection between program quality and advertising incentives are drastically different between both scenarios.

The main insight of our analysis is that the interplay between the social cost of advertising and the quality differential between platforms is crucial in the assessment of both equilibrium level of advertising and the social

[3] There are few papers that consider the existence of a public-owned firm in a model of horizontal product differentiation. Kumar and Saha (2008) show that unless the public ownership exceeds a critical level, maximal differentiation continues to hold and social welfare does not improve with public ownership. Moreover, Sanjo (2009) analyzes simultaneous price choice and sequential price choice and show how the degree of privatization of a publicly-owned firm influences social welfare in a mixed duopoly market. Finally, Martínez-Sánchez (2010) use the same model developed by Sanjo and show that, in the location game in which firms simultaneously set prices, social welfare depends on the degree of privatization and it is only maximized if the partially privatized firm is a fully publicly-owned firm.

desirability of a publicly-owned platform.

The rest of the paper is organized as follows: Section 2 presents a spacial duopoly market with private platforms, Section 3 analyzes the model with a mixed duopoly where one of the competitors is a publicly-owned firm that maximizes welfare, Section 4 considers the advertising and welfare comparisons between both models and Section 5 concludes.

# 2 The private duopoly model

We will assume two private platforms, each located at one extreme of a linear market of length 1. There is a mass of consumers of measure 1 indexed by $x \in [0,1]$ and distributed uniformly along this linear market. Each consumer chooses either one unit of good or zero. The utility of consumer $x$ if he watches platform $i$ is given by the function

$$u(v_i, a_i, x) = \begin{cases} v_1 - \delta a_1 - tx & \text{if } i = 1, \\ v_2 - \delta a_2 - t(1-x) & \text{if } i = 2, \end{cases}$$

where $v_i$ is the gross utility from the chosen platform, $\delta$ is the parameter representing the disutility or nuisance cost per unit of advertising (denoted by $a_i$)[4] and $t$ is the transport cost per unit of the distance of departing from its favorite tv program. Moreover, $t$ can be interpreted as the degree of substitutability, so a higher $t$ means that platforms are least substitutable.

Let us define by $x_1$ as the marginal consumer who is indifferent between watching/listening platform 1 and 2. Thus, $x_1$, is given by the condition:

$v_1 - \delta a_1 - tx_1 = v_2 - \delta a_2 - t(1 - x_1)$.

Also we define $x_2 = 1 - x_1$. Thus, we can obtain the demand for firm $i$, which is:

$$x_i(a_i, a_j) = \frac{v_i - v_j + t - \delta(a_i - a_j)}{2t}, \ i = 1, 2, \ j \neq i. \tag{1}$$

As in Gabszewicz et al. (2004) we consider that the advertising market is perfectly competitive, so advertisers' profits are zero. On the other hand, we assume that the profit obtained by each platform consists of the advertising revenue, so it is given by $\pi_i = \gamma a_i x_i$, where $\gamma$ can be interpreted as the revenue per ad per viewer, which in turn is assumed to be proportional to

[4] Our assumption that $\delta > 0$ is consistent with the empirical evidence shown by Wilbur (2008). This author obtains that viewers dislike advertising in the TV industry.

the level of advertising. By substituting the demand function (1) in the definition of profits, we can obtain:

$$\pi_i(a_i, a_j) = \gamma a_i \frac{v_i - v_j + t - \delta(a_i - a_j)}{2t}, \; i = 1, 2, \; j \neq i. \tag{2}$$

Let $z = (v_1 - v_2)/t$ be the (relative) quality differential between both platforms, so a higher $z$ could be due to a higher quality differential or a higher degree of substitution between platforms. Let $k = \gamma/\delta$ be the relative value between the revenue per ad per viewer and the nuisance cost. Let us obtain the Nash equilibrium (NE) in the levels of advertising. From the first order conditions, we can obtain the reaction function of each firm:

$$a_i^{BR}(a_j) = \frac{v_i - v_j + t}{2\delta} + \frac{a_j}{2}, \; i = 1, 2, \; i \neq j. \tag{3}$$

Which yields the following NE levels of advertising, market shares and profits:

$$a_i^* = \tfrac{v_i - v_j + 3t}{3\delta}; \;\; a^* = a_1^* + a_2^* = \tfrac{2t}{\delta}; \;\; x_i^* = \tfrac{v_i - v_j + 3t}{6t}; \;\; \pi_i^* = \tfrac{k(v_i - v_j + 3t)^2}{18t}. \tag{4}$$

From (4) we have that platforms set higher advertising and obtain a higher audience when its quality is higher, so they increase its profits. This is because a higher quality allows to softening advertising competition since advertising level plays the same role as the price in the well-known Hotelling model as have being shown by Gabszewicz et al. (2004). Proposition 1 summarizes these results.

**Proposition 1** *In the case of competition among private platforms, the following properties hold at the NE of the game:*

*i) The levels of advertising, market share and profit of platform i are increasing in its own quality and decreasing in the quality of its rival.*

*ii) The total level of advertising is independent of quality levels.*

**Proof.** See Appendix. ■

In addition, from (4) the following result holds:

**Proposition 2** *In the case of competition among private platforms, each platform's profit is decreasing in the degree of substitutability among platforms, increasing in the revenue per ad per viewer and decreasing in the nuisance cost of ads.*

**Proof.** See Appendix. ■

According to Proposition 2, a lower substitutability among platforms implies a higher profit for them. This is because competition in ads is softened when platforms are least substitutable and we consider that the market is fully covered. On the other hand, we find that a higher nuisance cost implies a lower profit. This is because viewers' incentive to switch off tv is higher with a high nuisance cost since viewer's utility from watching a tv-platform decreases in the nuisance cost.[5]

Consumer surplus ($CS$) is calculated as:[6]

$$CS = v_1 x_1 - \delta a_1 x_1 - t\int_0^{x_1} x dx + v_2(1-x_1) - \delta a_2(1-x_1) - t\int_{x_1}^{1}(1-x)dx. \quad (5)$$

We now calculate social welfare ($W$), which is defined as the sum of platforms' profits ($\pi = \pi_1 + \pi_2 = \gamma a_1 x_1 + a_2(1-x_1)$) and consumer surplus

$$W = \pi + CS = (\gamma-\delta)a_2 + (v_1 - v_2 + t + (\gamma-\delta)(a_1-a_2))x_1 - tx_1^2 + v_2 - \frac{t}{2}, \quad (6)$$

Taking into account the equilibrium value of advertising and market share by each platform, we obtain the social welfare when both platforms are private, which is:

$$W^* = \frac{9\left(4k-3\right)t^2 + 18\left(v_1 - v_2\right)t + \left(4k+1\right)\left(v_1 - v_2\right)^2}{36t} + v_2 - \frac{t}{2} \quad (7)$$

Notice that the social welfare is increasing in the revenue per ad per viewer. This is because platforms' profits positively depend on the revenue per ad per viewer and consumer surplus do not depend on the revenue per ad per viewer. Moreover, social welfare is decreasing in the nuisance cost because it implies a lower profit by each platform and lower consumer surplus. As we will see in the following section, the result will be very different when one of the platforms is publicly-owned.

[5] These results coincide with that obtained by Peitz and Valletti (2008).

[6] Recall that $x_2 = 1 - x_1$.

# 3 The mixed duopoly model

In this section, we will assume that platform 1 is a publicly-owned firm that maximizes social welfare, while platform 2 is a private firm that maximizes its profits. Substituting (1) in (6) and maximizing the resulting welfare function with respect to $a_1$, we obtain the reaction function of the publicly-owned platform 1, which is:

$$a_1^{BR}(a_2) = a_2 + \frac{k-1}{\delta(2k-1)}(v_1 - v_2 + t) \tag{8}$$

In order to guarantee the second order condition of social welfare maximization by platform 1, we assume that $k > 1/2$. Notice that platform 2's reaction function is the same that the one in the previous section since it continues to be a private firm. Thus, from (3) and (8) we can calculate the NE levels of advertising, market shares and profits in the mixed duopoly:

$$\begin{aligned}
a_1' &= \frac{(4k-3)t-(v_1-v_2)}{\delta(2k-1)};\ a_2' = \frac{(3k-2)t-k(v_1-v_2)}{\delta(2k-1)} \qquad (9)\\
a' &= a_1' + a_2' = \frac{(7k-5)t-(k+1)(v_1-v_2)}{\delta(2k-1)};\\
x_1' &= \frac{k(v_1-v_2+t)}{2(2k-1)t};\ x_2' = \frac{(3k-2)t-k(v_1-v_2)}{2(2k-1)t};\\
\pi_1' &= \frac{k^2\left[(4k-3)t-(v_1-v_2)\right](v_1-v_2+t)}{2(2k-1)^2t};\\
\pi_2' &= \frac{k\left[(3k-2)t-k(v_1-v_2)\right]^2}{2(2k-1)^2t}.
\end{aligned}$$

As in the private duopoly, platform 2 sets higher ads and obtains a higher audience when its quality increases. However, publicly-owned platform 1 operates contrary to a private platform as can be seen in the following proposition.

**Proposition 3** *In the case of competition between a publicly-owned platform and a private platform, the advertising levels of both platforms are decreasing in the quality differential* $(v_1 - v_2)$ *of the publicly-owned platform.*

**Proof.** See Appendix. ■

Surprisingly, in the current debate on the optimal level of advertising in the broadcasting industry the quality levels of the offered programs tend to be ignored. However, as our previous proposition makes clear, this debate is meaningless without taking into account the crucial role of the quality differential between the publicly-owned and private platforms. In particular, our result suggests that, instead of a direct intervention on advertising regulation, the decrease in advertising levels in the broadcasting industry can be achieved by means of the quality improvement of the programs offered by the publicly-owned platform.

From (4) and (9) the following result holds, regarding market shares:

**Proposition 4** *The market share of platform* $1$ *at the NE of both the private and mixed duopoly is increasing in the quality differential* $v_1 - v_2$*, however the sensitivity of market share to this quality differential is greater in the mixed duopoly than in the private one.*

**Proof.** See Appendix. ■

Intuitively, a larger quality differential tends to make socially desirable a larger market share of the high-quality platform. This effect is better captured by the publicly-owned platform because the private platform is interested in increasing its advertising revenues, which tends to decrease its market share.

As in previous section we calculate social welfare which is represented by the expression (6). Thus, taking into account the equilibrium value of advertising and market share in (9), we find the social welfare, which is:

$$W' = \frac{4(k-1)\left[(3k-2)t - k(v_1 - v_2)\right]t + k^2(v_1 - v_2 + t)^2}{4(2k-1)t} + v_2 - \frac{t}{2}. \quad (10)$$

We will focus on the cases where both platforms are active (i.e., having positive market share). By using (9), straightforward calculations show the following result, illustrated in the $(k, z)$ space in Figure 1.

**Proposition 5** *In a NE of the mixed duopoly with both platforms being active, the following properties hold:*

*i) If advertising is socially desirable* ($k > 1$) *then the publicly-owned platform undertakes more advertising than the private platform.(See region (I)).*

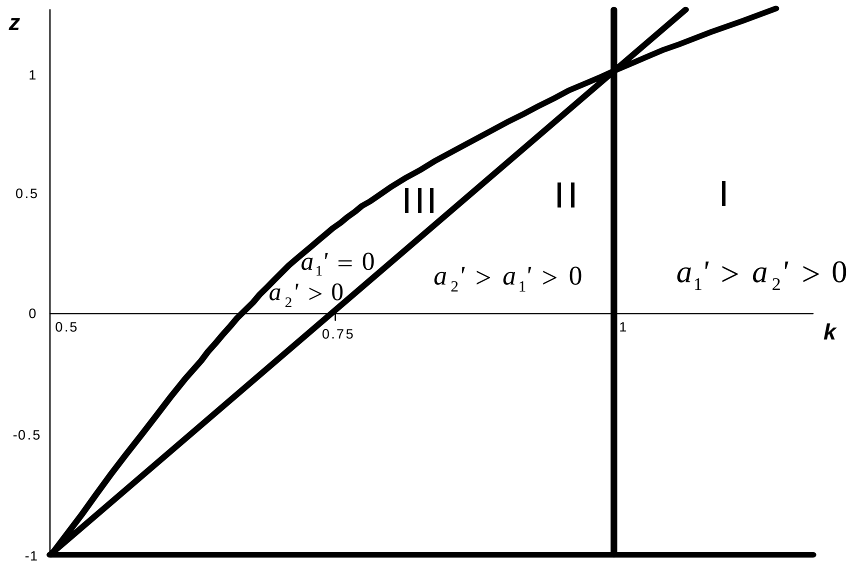


Figure 1: Advertising comparisons in the mixed duopoly

*ii) If advertising is socially harmful ($k < 1$) then the publicly-owned platform undertakes less advertising than the private platform. (See regions (II) and (III)).*

*iii) Moreover, if the quality differential of the public platform is sufficiently large, relative to social preferences for advertising ($z \geq 4k - 3$) then the publicly-owned platform undertakes zero advertising. (See region (III)).*

**Proof.** See Appendix. ■

The previous results is explained by the fact that advertising has two effects on welfare: On the one hand, there is a direct effect, captured by $k$, which depends on the private profits associated to advertising (measured by $\gamma$) and the nuisance costs (measured by $\delta$), but, on the other hand, there is also an indirect effect of advertising on welfare by affecting the distribution of audience shares between both platforms. In particular, this explains why advertising by the publicly-owned platform is positive in region (II), despite of the harmful direct effect in this region. The reason is that the negative direct impact of advertising on welfare is outweighed by the positive effect associated with the fact that this positive advertising by the publicly-owned platform increases the audience of the private platform, which is socially profitable if the quality differential of the publicly-owned platform is small (compared with $k$).

Interestingly, region (III) helps to identify the cases where an "advertising-free" public platform is actually an optimal decision (in terms of a NE of the game). We remark this result in the following

**Corollary 6** *If advertising is socially harmful and the quality differential of the public platform is sufficiently large, relative to social preferences for advertising, then the NE of the mixed duopoly implies an "advertising-free" publicly-owned platform. (See region (III)).*

Intuitively, a necessary condition for this result is that advertising is harmful as a direct effect ($k < 1$) but, in addition, region (III) requires the quality differential of the publicly-owned platform being sufficiently large. Thus, a policy implication of our model is that the case for an "advertising-free" publicly-owned" platform implies a sufficiently large quality of the publicly-owned platform, compared with its rival. Otherwise the recent policies mentioned in the introduction, followed by some EU countries could not be necessarily welfare-enhancing, even if advertising is harmful as a direct effect.

# 4 Private versus Mixed Duopoly

Straightforward computations give the following auxiliary result:

**Lemma 7** *The existence of a NE with both platforms having positive market share and advertising in both models, is satisfied if and only if*

$$z \in \left[-1, \min\left\{4k-3, \frac{3k-2}{k}\right\}\right].$$

**Proof.** See Appendix. ■

In the following analysis we will restrict our attention to the set or parameters satisfying the previous lemma.

Now let us consider the comparison between the NE levels for advertising in each of the previous models. Again, easy computations show the following:

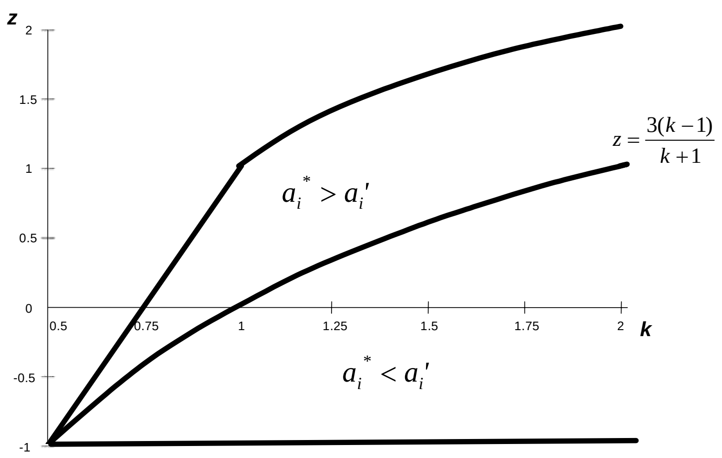


Figure 2: Advertising comparisons between mixed and private duopoly

**Proposition 8** *Individual and total advertising levels in the mixed duopoly are greater than in the private duopoly if and only if*

$$z < \frac{3(k-1)}{k+1}.$$

**Proof.** See Appendix. ■

Lemma 7 and Proposition 8 are reflected in Figure 2, where there are two relevant regions: Above the function $z = \frac{3(k-1)}{k+1}$, advertising levels under a mixed duopoly are smaller than under a private duopoly. The intuition of Proposition 8 is as follows: the incentive to undertake advertising by a publicly-owned platform is decreasing in both the nuisance cost (which is inversely related to $k \equiv \gamma/\delta$) and in the quality differential $z$. As a result, the larger is $k$ and the smaller is $z$, the more likely is that the market is in the region where the mixed duopoly involves more advertising (note that the function $z = \frac{3(k-1)}{k+1}$ is strictly increasing).

We are interested in knowing what setting, private or mixed duopoly, is better from a social perspective. Thereby, we calculate the difference in social welfare between private and mixed duopoly, which is:

$$W' - W^* = \frac{45\,(k-1)^2\,t^2 - 18\,(k^2-1)\,(v_1-v_2)\,t + (k+1)^2\,(v_1-v_2)^2}{36\,(2k-1)\,t} \quad (11)$$

Dividing the difference in social welfare (11) by $t$, taking into account that $z = (v_1 - v_2)/t$ and rearranging we have that:

$$\frac{W' - W^*}{t} = \frac{45\,(k-1)^2 - 18\,(k^2-1)\,x + (k+1)^2\,x^2}{36\,(2k-1)}. \quad (12)$$

Given that $k > 1/2$ and $t > 0$, the sign of the difference in social welfare is the same that the sign of the numerator of the expression (12). By using the condition $\frac{W'-W^*}{t} = 0$, we obtain the following pair of solutions:

$$z = \frac{3(k-1)}{k+1};\ z = \frac{15(k-1)}{k+1}$$

From these two functions, shown in Figure 3, it is easy to obtain the sign of $\frac{W'-W^*}{t}$ in each of the four regions illustrated in Figure 3 (A, B, C and D). Thus, we find that the socially optimal setting depends on the interplay between parameters $z$ and $k$, as illustrated in the following proposition and in Figure 3.

**Proposition 9** *A private duopoly can be socially preferred to a mixed duopoly only in the following cases: i) when advertising is socially harmful (k<1) and quality differential (z) is negative (region D) and ii) when advertising is socially beneficial (k>1) and quality differential is positive (region B). Otherwise, a mixed duopoly is socially preferred to a private duopoly, which is ensured by either socially harmful advertising combined with positive quality differential (region A) or socially beneficial advertising combined with low quality differential (region C).*

In order to understand the intuition of the previous result let us combine this proposition with the following facts, easily obtained: First, in the private duopoly $a_1^* \gtreqless a_2^* \leftrightarrow v_1 \gtreqless v_2$ and second, in the mixed duopoly $a_1' \gtreqless a_2' \leftrightarrow k \gtreqless 1$. From these facts and the previous proposition, the following result holds:

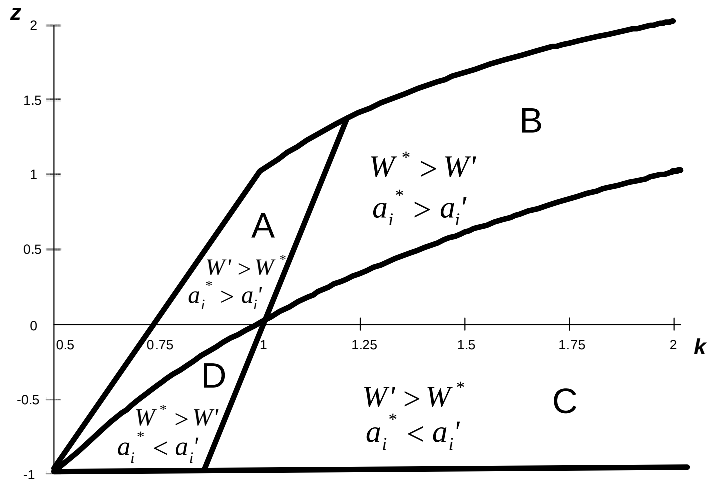


Figure 3: Social welfare comparisons between mixed and private duopoly

**Corollary 10** *The regions represented in Figure 3, are characterized as follows: In regions A and C the socially optimal market is a mixed duopoly while in regions B and D the socially optimal market is a private duopoly. Moreover, in regions A and B the mixed duopoly undertakes less advertising than the private duopoly while in regions C and D it undertakes more.*

The intuition of the previous corollary is as follows:

i) In regions B and D the optimal strategy for the government is to choose a private duopoly, but the underlying explanation is different. In region B a publicly-owned platform undertakes lower level of advertising than a private firm. Intuitively, in this region advertising is socially profitable ($k$ is large) and the government chooses the market structure with higher level of advertising. However, in region D advertising is socially harmful ($k$ is small) and the mixed duopoly undertakes more advertising than a private one. Thus privatization is the optimal policy.

ii) In regions A and C the optimal government's strategy is a mixed duopoly but, again, for different reasons. In region A the government chooses a mixed duopoly because the publicly-owned platform undertakes less advertising than the private firm and advertising is relatively harmful, compared with the social desirability of large market share of a high-quality platform. However, in region C the publicly-owned platform undertakes more advertising than the private duopoly, which is socially profitable given that in this region $z$ is relatively small compared with $k$.

It is interesting to look at cases D and B in terms of the taxonomy by Fundenberg and Tirole (1984). In case D the optimal government's choice can be interpreted as an example of the so called "Lean and Hungry Look": By choosing a private duopoly, the government makes a credible commitment to "underinvest" in advertising (which hurts its rival) . However, in case B the same privatization strategy is an example of the so called "Fat Cat" effect: The government chooses a private duopoly as a commitment to "overinvest" in advertising (which is beneficial for its rival).

Note that under the particular assumption (most usual in the previous literature) that platforms provide the same quality but different content (there is only horizontal differentiation), the difference in social welfare between private and mixed duopoly (equation (11)) is reduced to the following expression:

$$W' - W^* = \frac{5\,(k-1)^2\,t}{4\,(2k-1)} > 0, \tag{13}$$

which is positive since we assume that $k > 1/2$. Therefore, when platforms are only horizontally differentiated, a publicly-owned platform must exist.

However, according to our results, this is a very particular case and the optimal government's intervention in the broadcasting industry depends, crucially, on the interactions between the quality differential of platforms and the relationship between the social value of advertising and nuisance cost.

# 5 Conclusions

In this paper we develop a model where a publicly-owned platform compete with a private one in a free-to-air broadcasting industry where programs are differentiated in two dimensions, content (horizontal differentiation) and quality (vertical differentiation). In this context, we consider the publicly-owned firm's optimal level of advertising and identify the conditions under which the recently adopted policy of an "advertising-free" public platform is actually an optimal choice, from the social welfare point of view.

We also analyze the social profitability of the presence of a publicly-owned platform and show that the optimal government's intervention in the broadcasting industry depends, crucially, on the interactions between the quality differential of platforms and the relationship between the social value of advertising and nuisance cost. In particular, we find that the existence of publicly-owned platform can be a social optimum even if it provides lower quality than the private platform.

# 6 Appendix

**Proof of Proposition 1:** From (4) we have $\frac{\partial a_i^*}{\partial(v_i-v_j)} = \frac{1}{3\delta} > 0$, $\frac{\partial x_i^*}{\partial(v_i-v_j)} = \frac{1}{6t} > 0$ and $\frac{\partial \pi_i^*}{\partial(v_i-v_j)} = \frac{k(v_i-v_j+3t)}{9t} > 0$, which is ensured by $x_i^* \geq 0$.

**Proof of Proposition 2:** From (4) it follows that and $\frac{\partial \pi_i^*}{\partial t} = \frac{k(v_i-v_j+3t)(v_j-v_i+3t)}{18t^2} > 0$, which is ensured by $x_i^* \geq 0$. Also, $\frac{\partial \pi_i^*}{\partial k} = \frac{(v_i-v_j+3t)^2}{18t^2} > 0$ (recall that $k = \gamma/\delta$).

**Proof of Proposition 3:** From (9) we have $\frac{\partial a_1'}{\partial(v_1-v_2)} = -\frac{1}{\delta(2k-1)} < 0$ and $\frac{\partial a_2'}{\partial(v_1-v_2)} = -\frac{k}{\delta(2k-1)} < 0$, which are ensured by the second order conditions of welfare maximization by platform 2 ($k > 1/2$).

**Proof of Proposition 4:** From (4) and (9) we obtain $\frac{\partial x_1^*}{\partial(v_1-v_2)} = \frac{1}{6t} < \frac{\partial x_1'}{\partial(v_1-v_2)} = \frac{k}{2(2k-1)t}$, which is ensured by $k > 1/2$.

**Proof of Proposition 5:** From (9) it follows that $x_1' \geq 0 \longleftrightarrow k > -1$ and $x_2' \geq 0 \longleftrightarrow z < 3-\frac{2}{k}$. Therefore, both platforms are active if and only if $z \in \left[-1, 3-\frac{2}{k}\right]$, which includes regions (I), (II) and (III) in Figure 1. Thus, parts (i) and (ii) follows from noticing that $a_1' \gtreqqless a_2' \longleftrightarrow k \gtreqqless 1$ and part (iii) comes from the fact that $a_1' > 0 \longleftrightarrow z < 4k-3$, which implies that in region (III) we have $a_1' = 0$.

**Proof of Lemma 7:** Note, first that $a_i^* > 0 \longleftrightarrow x_i^* > 0 \longleftrightarrow z \in [-3, 3]$. Also, from the proof of Proposition 5 it follows that if $a_1' > 0$, $x_1' > 0$ and $x_1' > 0$ then $z \in \left[-1, \min\left\{4k-3, \frac{3k-2}{k}\right\}\right]$.

**Proof of Proposition 8:** By using (4) and (9) it follows that $a_i' > a_i^* \longleftrightarrow a' > a^* \longleftrightarrow z < \frac{3(k-1)}{k+1}$.

# References


[1] Alcock, J. and G. Docwra, 2005, A Simulation Analysis of the Market Effect of the Australian Broadcasting Corporation, *Information Economics and Policy*, 17 (4), 407-427.

[2] Anderson, S. P., 2007, Regulation of Television Advertising, in Paul Seabright and Jurgen Von Hagen, Editors, *The Economic Regulation of Broadcasting Markets*, Cambridge University Press.

[3] Anderson, S. P. and S. Coate, 2005, Market Provision of Broadcasting: A Welfare Analysis, *Review of Economic Studies*, 72, 947-972.

[4] Anderson, S. P. and J. J. Gabszewicz, 2006, The Media and Advertising: A Tale of Two-sided Markets, in Victor A. Ginsburgh and David Throsby, Editors, *Handbook of the Economics of Art and Culture*, Volume 1, Elsevier B.V.

[5] Armstrong, M., 2005, Public Service Broadcasting, *Fiscal Studies*, 26 (3), 281-299.

[6] Bel, G. and L. Domènech, 2009, What Influences Advertising Price in Television Channels?: An Empirical Analysis on the Spanish Market, *Journal of Media Economics*, 22 (3), 164-183.

[7] Coase, R., 1966, The economics of broadcasting and government policy, *American Economic Review*, 56, 440-447.

[8] Crampes, C., C. Haritchabalet and B. Jullien, 2009, Advertising, Competition and Entry in Media Industries, *The Journal of Industrial Economics*, 57 (1), 7-31.

[9] Gabszewicz, J. J., D. Laussel and N. Sonnac, 2004, Programming and Advertising Competition in the Broadcasting Industry, *Journal of Economics and Management Strategy*, 13 (4), 657-669.

[10] Fundenberg, D. and J. Tirole, 1984, The Fat-Cat Effect, the Puppy-Dog Ploy, and the Lean and Hungry Look, *American Economic Review*, 74, 361-66.

[11] Gantman, N. and O. Shy, 2007, Broadcasting Competition and Advertising Quality: A Two-sided Market Approach, *mimeo*.

[12] Kind, H. J., T. Nilssen and L. Sørgard, 2007, Competition for Viewers and Advertisers in a TV Oligopoly, *Journal of Media Economics*, 20 (3), 211-233.

[13] Kumar, A. and B. Saha, 2008, Spatial Competition in a Mixed Duopoly with one Partially Nationalized Firm, *Journal of Comparative Economics*, 36 (2), 326-341.

[14] Martínez-Sánchez, F., in press, Bertrand Competition in a Mixed Duopoly Market: A Note, *The Manchester School*.

[15] Peitz, M. and T. M. Valletti, 2008, Content and Advertising in the Media: Pay-tv versus Free-to-air, *International Journal of Industrial Organization*, 26, 949-965.

[16] Sanjo, Y., 2009, Bertrand Competition in a Mixed Duopoly Market, *The Manchester School*, 77 (3), 373-397.

[17] Wilbur, K. C. (2008), A Two-Sided, Empirical Model of Television Advertising and Viewing Markets, *Marketing Science*, 27 (3), 356-378.