Mimicking vs. Counter-programming Strategies for Television Programs

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Abstract

In this paper, I analyze the trade-off between mimicking and counter-programming strategies in the pay- and the advertiser-supported television industries. Two channels compete with respect to both program profile and program quality. I show that profile differentiation is higher under pay-support than under advertiser-support, as a consequence of the inability of channels to compete in price under advertiser-support. I also show that program quality is higher under advertiser-support than under pay-support if advertising revenues are sufficiently high. Finally, I compare the market provision to the socially optimum provision of programs.

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1 Introduction

Does competition lead television channels to provide differentiated or similar programs? This question has been widely debated both by economists and practitioners. For some authors, competition forces television channels to adopt *mimicking strategies*, i.e., to provide similar programs. For instance, Greenberg and Barnett (1971) and Levin (1971) state that an increase in the number of channels does not necessarily increase program variety, as new channels can merely mimick incumbent channels. On the other hand, television channels have used *counter-programming strategies* for a long time to differentiate from their rivals.

In this paper, I provide a formal framework to analyze the trade-off between mimicking and counter-programming strategies for two television channels, both in the pay-television and the advertiser-supported television industries. I show that profile differentiation is higher under pay-support than under advertiser-support, as a consequence of the inability of channels to compete in price under advertiser-support. I also show that program quality is higher under advertiser-support than under pay-support if advertising revenues are sufficiently high.

Compared to the social optimum, with pay-supported television, there are too many channels, program variety is too high and program quality is too low. When channels are advertiser-supported, the distortions depend on the advertising revenue per viewer. On the one hand, if the advertising revenue is low, there may be too few channels and program variety and program quality may be too low. One the other hand, if it is high, there may be too many channels and program variety and program quality may be too high.

In the literature, program diversity has been studied from two different angles.[1] A first approach, initiated by Steiner (1952) and extended by Rothenberg (1962), Wiles (1963) and Beebe (1977) among others, compares the program choice made in a monopoly and an oligopoly television market. Channels are assumed to maximize their audience. There are different types of programs and viewers are divided into groups according to which program type they prefer. Steiner shows that program variety is larger when programs are provided by a monopoly than by competing channels. The intuition of this result is as follows. Assume that there are two channels and that a majority of viewers prefer a popular program, whereas a minority of viewers prefer a specialized program. If two channels compete for viewers, it may be more profitable for each channel to capture a share of the audience of the popular program

[1] For a survey of the program choice literature, see Owen and Wildman (1992).

than to serve all the audience of the specialized program. On the other hand, a monopolist who operates both channels finds it profitable to provide the two programs to maximize its total audience. Hence, this model provides an explanation for the incentives to mimic rivals' programs.[2] However, it does not explain why counter-programming strategies are used in the television industry.

Another branch of the literature, initiated by Waterman (1990) and extended by Papandrea (1997), adapts the model of circular differentiation of Salop (1979) to the television industry. Waterman assumes that channels are differentiated along a circle and that they have to decide on program quality. He shows that pay-television and advertiser-supported television yield the same level of program variety. Besides, program quality is higher under pay-television than under advertiser-supported television if the equilibrium subscription price is higher than the fixed advertising price. In this circular model of program differentiation, Waterman assumes that channels maximize differentiation. Therefore, he cannot account for the tendencies to mimic rival programs.

In the present paper, I propose a framework that takes into account both mimicking and counter-programming incentives in a duopoly. I assume that two television channels provide programs which are horizontally and vertically differentiated. Horizontal differentiation corresponds to the choice of a program profile. For instance, the profile of a news program might be the proportion of politics compared to other news. Vertical differentiation arises because program production costs, and hence program quality, can vary. For instance, for a sport program, quality increases with the number of cameras and hence, with the production cost. In this setting, I study mimicking and counter-programming incentives with both pay support and advertiser support.

The paper is structured as follows. In Section 2, I introduce the model. The equilibrium for pay-television and advertiser-supported television are derived and discussed in Section 3. In Section 4, I compare the market provision of programs to the socially optimal provision. Some concluding remarks are presented in Section 5.

2 The Model

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[2] Beebe (1977) develops a more general model in line with Steiner's. He shows that when viewers will watch other than their first program choice, they may prefer competition to monopoly.

2.1 TV Channels

There are two channels, indexed by $i \in \{1,2\}$, each of which can carry one program. Each channel has to decide on the profile of the program it supplies and its quality. *Program profile* is a continuous choice, between 0 and 1. For instance, the profile of a news program could be the proportion of politics with respect to other news. For a sport program, it could be the proportion of soccer news with respect to other sports. The program profile of channel 1 is θ_1 and the program profile of channel 2 is $1-\theta_2$. Without loss of generality, I assume that $\theta_1 < 1-\theta_2$. *Profile differentiation* is $\lambda = 1-\theta_1-\theta_2$.

Program quality depends on production cost. Indeed, studies have shown that there is a strong correlation between the audience of a program and its production cost.[3] To simplify the analysis, I assume that it costs αK^2 to produce a program of quality K, where $\alpha > 0$. However, the results obtained in this paper would be similar with a more general program production cost function, as soon at it is convex with respect to quality. The convexity of the cost of quality function seems reasonable, because quality inputs –in particular, "talents" – grow rare as quality increases. Program quality of channel $i \in \{1,2\}$ is denoted K_i and its audience share is $a_i \in [0,1]$.

Channels derive revenues either from advertising or subscriptions. If channels are advertiser-supported, advertising revenue per viewer, r^*_{adv}, is fixed.[4] I also assume that consumers derive no utility or disutility from watching advertisements on TV.[5] If channels derive revenues from subscription, they compete with respect to subscription prices.

2.2 Viewers

There are A potential viewers. Viewers are distributed uniformly on the interval [0,1], which represents viewers' profiles. Each viewer is characterized by a variable θ, where θ represents

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[3] In particular, this has been shown for the movie picture industry. For instance, see Litman (1984), Litman and Kohl (1989) and Ravid (1999).

[4] This assumption is consistent with the literature (for instance, see Crandall (1972), Fournier (1985), Waterman (1990), Nilssen and Sørgard (1998a, 2000)). It states that the television industry is competitive with other industries and therefore cannot influence advertising rates.

[5] See Anderson and Coates (2000) and Nilssen and Sørgard (2000) for a formalisation of the advertising market. In particular, they take into account the nuisance cost of advertising for viewers.

its preferred program profile. When a consumer watches a program which does not correspond to its preferred profile, he incurs a loss of utility which is proportional to the distance between his preferred profile and the program's profile. I call this loss of utility the *transportation cost* and I assume that it is quadratic and equal to $t > 0$ per unit of length.

An increase of one unit of quality pushes up utility for the program by one unit. Notice that quality is valued equally by viewers, while they differ in their preferences with respect to program profile. Let R denote a consumer's gross benefit from watching a program with its favorite profile and with minimum quality (0). When it watches the program of channel i, a viewer of type θ gets net benefit

$$U = \begin{cases} R + K_1 - t(\theta - \theta_1)^2 - p_1 & \text{if } i = 1 \\ R + K_2 - t(\theta - (1 - \theta_2))^2 - p_2 & \text{if } i = 2 \end{cases},$$

where p_i represents the subscription price of channel i. If channels are advertiser-supported, viewers do not pay for the right to view a program, hence $p_i = 0$.

I assume that viewers always watch a program, which is satisfied if $R \geq 5t/4$.[6] This assumption implies that the total audience is fixed. However, in reality, the total audience can vary according to the programs offered by TV channels. In particular, counter-programming strategies can attract minority audiences and hence, increase total audience. This aspect is not covered in the present setting.

Finally, I assume that $\alpha t \in (A/18, A/9)$, which ensures that there is an equilibrium when channels charge subscription prices.

2.3 The Timing

The timing of the game is as follows.

1. The channels choose program profiles simultaneously.
2. The channels choose program quality simultaneously.
3. I distinguish two possible cases.
    a. *Advertiser-supported TV*: channels receive a constant per capita revenue equal to r^*_{adv}.
    b. *Pay TV*: channels choose subscription prices simultaneously.

One reasonable interpretation of the sequence of decisions is that channels will generally define program profile in the schedule of conditions before the actual production of the program, and keep the same profile within a time slot, even when they introduce a new program.

I search for the subgame-perfect equilibrium in both games under consideration and solve the games by backward induction.

3 Pay TV vs. Advertiser-supported TV

3.1 Pay TV

In this subsection, viewers pay an amount for the right to view a channel. The present model is similar to the one solved by Economides (1989), except that in my setting, transportation costs are quadratic.[7] I solve the game backwards and start by the last stage of the game.

3.1.1 Stage 3: Price Competition

Let p_i denote the subscription price of channel $i \in \{1,2\}$. The marginal consumer is defined by

$$K_1 - \left[p_1 + t(\theta - \theta_1)^2\right] = K_2 - \left[p_2 + t(\theta - (1-\theta_2))^2\right],$$

hence

$$\theta^* = \theta_1 + \frac{1-\theta_1-\theta_2}{2} + \frac{K_1 - K_2}{2t(1-\theta_1-\theta_2)} + \frac{p_2 - p_1}{2t(1-\theta_1-\theta_2)}.$$

If $\theta^* \in [0,1]$, the audience shares of channels 1 and 2 are $a_1 = \theta^*$ and $a_2 = 1-\theta^*$, respectively. Each channel i maximizes

$$\Pi_i = p_i A a_i - \alpha K_i^2$$

with respect to p_i.

The reaction functions are

$$p_1 = R_1^p(p_2) = \left(p_2 + K_1 - K_2 + t\cdot(1-\theta_1-\theta_2)\cdot(1+\theta_1-\theta_2)\right)/2,$$

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[6] This is a necessary and sufficient condition for all viewers to watch a program at the pay-TV equilibrium. It also implies that all viewers watch a program at the advertiser-supported TV equilibrium.

[7] A quadratic transportation cost function leads to more interesting results than a linear transportation cost function when channels are advertiser-supported. I discuss this point in Remark 2, at the end of section 3.2.

and

$$p_2 = R_2^p(p_1) = \left(p_1 + K_2 - K_1 + t\cdot(1-\theta_1-\theta_2)\cdot(1+\theta_2-\theta_1)\right)/2 .$$

The Nash equilibrium of the subgame satisfies $p_i^* = R_i^p\left(p_j^*\right)$, which implies that

$$p_1^* = \frac{K_1 - K_2 + t(1-\theta_1-\theta_2)(3+\theta_1-\theta_2)}{3}, \tag{1}$$

and

$$p_2^* = \frac{K_2 - K_1 + t(1-\theta_1-\theta_2)(3+\theta_2-\theta_1)}{3}. \tag{2}$$

Second-order conditions for maximization are always satisfied.

3.1.2 Stage 2: Quality Competition

Substituting equilibrium prices given by (1) and (2) in the profit functions, I derive the profit functions of the quality stage. The reaction functions at the quality stage are defined by the first-order conditions, which yield

$$R_1^K(K_2) = A\times\frac{K_2 - t(1-\theta_1-\theta_2)\cdot(3+\theta_1-\theta_2)}{A-18\alpha t(1-\theta_1-\theta_2)},$$

and

$$R_2^K(K_1) = A\times\frac{K_1 - t(1-\theta_1-\theta_2)\cdot(3+\theta_2-\theta_1)}{A-18\alpha t(1-\theta_1-\theta_2)}.$$

Solving for the Nash equilibrium of the subgame, I obtain

$$K_1^* = A\times\frac{A-3\alpha t(1-\theta_1-\theta_2)(3+\theta_1-\theta_2)}{6\alpha\left[A-9\alpha t(1-\theta_1-\theta_2)\right]}, \tag{3}$$

and

$$K_2^* = A\times\frac{A-3\alpha t(1-\theta_1-\theta_2)(3+\theta_2-\theta_1)}{6\alpha\left[A-9\alpha t(1-\theta_1-\theta_2)\right]}. \tag{4}$$

The second-order conditions for profit maximization are satisfied if and only if

$$18\alpha t(1-\theta_1-\theta_2) > A .$$

3.1.3 Stage 1: Location

The objective functions of the location stage are the equilibrium profits of the quality stage. In the following proposition, I establish that the two channels locate at the two extremes of the profile interval and derive equilibrium prices and program quality levels.

Proposition 1 *If the channels charge subscription rates, quality differentiation is minimum ($K_1^* = K_2^* = A/(6\alpha) = K_{pay}^*$), profile differentiation is maximum ($\lambda_{pay}^* = 1$),and channels charge $p_{pay}^* = t$ for subscription.*

Proof. See the Appendix. ■

This proposition shows that at the equilibrium channels choose two extreme profiles for their programs. This is a familiar result in the product differentiation literature (for instance, see Economides (1989) or Tirole (1988, Chapter 7) for a survey). The intuition is that channels differentiate their programs to soften competition with respect to subscription prices. In this setting, price competition dominates quality competition. To understand why, assume that the two channels are symmetrically located, i.e., $\theta_1 = \theta_2$. In that case, Equations (3) and (4) yield that $K_1^*(\theta_1, \theta_2) = K_2^*(\theta_1, \theta_2) = A/(6\alpha)$. Hence, program quality is the same whether channels choose similar or differentiated program profiles. On the other hand, Equations (1) and (2) show that $p_1^*(\theta_1, \theta_2) = p_2^*(\theta_1, \theta_2) = t\lambda$. Hence, subscription prices decrease as channels choose more similar profiles.[8] Therefore, channels adopt counter-programming strategies to raise prices and increase profits.

Equilibrium profits are given by

$$\Pi_{pay}^* = \frac{tA}{2} - \frac{A^2}{36\alpha}. \tag{5}$$

Equation (5) shows that the channels obtain higher profits when the transportation cost, t, is higher and when the cost of quality, α, is higher. Indeed, a high transportation cost means that viewers are reluctant to switch to the rival channel, hence providing channels with market power on their respective audiences. Besides, a high cost for quality softens competition with respect to quality and hence, drives up profits. Equation (5) also states that the larger the audience, A, the lower the profits. This is because a larger audience leads to more intense quality competition, hence to profit dissipation in program quality.

Finally, Equation (5) implies that there is room for two channels on the pay-TV market if and only if $\Pi_{pay}^* \geq 0$, or

[8] This reasoning holds for the equilibria of the quality stage with symmetric locations. Remark that this property of the equilibrium holds even though the further apart the programs, the lower tends to be the marginal benefit of the producer of increasing quality, as the reaction functions of the quality stage show.

$$\alpha t \geq \frac{A}{18}, \tag{6}$$

which is always satisfied by assumption.

3.2 Advertiser-supported TV

In this subsection, the channels derive revenues from advertising. I solve the game backwards and start by the last stage.[9]

3.2.1 Stage 2: Quality Competition

Channels do not charge any subscription prices, hence $p_1 = p_2 = 0$. The marginal consumer is defined by

$$K_1 - t(\theta - \theta_1)^2 = K_2 - t(\theta - (1 - \theta_2))^2,$$

which yields

$$\theta^* = \theta_1 + \frac{1 - \theta_1 - \theta_2}{2} + \frac{K_1 - K_2}{2t(1 - \theta_1 - \theta_2)}.$$

If $\theta^* \in [0,1]$, the audience shares of channels 1 and 2 are $a_1 = \theta^*$ and $a_2 = 1 - \theta^*$, respectively. The profit function of channel i is

$$\Pi_i = r^*_{adv} A a_i - \alpha K_i^2.$$

First-order conditions for profit maximization in quality are solved to derive equilibrium program quality levels. I find that

$$K_1^* = K_2^* = \frac{r^*_{adv} A}{4\alpha t \lambda}.$$

Second-order conditions are satisfied.

Contrary to pay television, here program quality at the subgame equilibrium depends only on profile differentiation, λ. Besides, program quality is higher when the channels are less differentiated. The intuition is that when the channels choose nearer program profiles, quality competition intensifies. Notice also that program quality increases with r^*_{adv} and A and decreases with α and t.

3.2.2 Stage 1: Location

Now, I consider the first stage of the game, in which the two channels choose program profiles. The profit function of channel i can be written as

$$\Pi_i(\theta_1,\theta_2)=r_{adv}^* A\times a_i\left[\theta_1,\theta_2,K_1^*(\theta_1,\theta_2),K_2^*(\theta_1,\theta_2)\right]-\alpha\times\left[K_i^*(\theta_1,\theta_2)\right]^2 .$$

Without any loss of generality, I consider channel 1. Channel 1 maximizes its profit, $\Pi_1(\theta_1,\theta_2)$, with respect to θ_1, taking θ_2 as given. The envelop theorem states that $\partial\Pi_1/\partial K_1=0$, as in stage 2 channel 1 maximizes its profit with respect to program quality. Therefore, first-order condition for channel 1 is

$$\frac{d\Pi_1}{d\theta_1}=r_{adv}^* A\times\left[\frac{\partial a_1}{\partial\theta_1}+\frac{\partial a_1}{\partial K_2}\frac{\partial K_2^*}{\partial\theta_1}\right]. \tag{7}$$

In Equation (7), $\partial a_1/\partial\theta_1$ represents a *direct effect*: as it approaches its rival, channel 1 increases its audience share. The second term, $\partial a_1/\partial K_2\times\partial K_2^*/\partial\theta_1$, represents an indirect or *strategic effect* that influences the program quality chosen by channel 2 in stage 2. If the program profile of channel 1 approaches that of channel 2, channel 2 increases its program quality in stage 2 and hence, captures a proportion of the audience of channel 1. Indeed, computations show that

$$\frac{\partial a_1}{\partial\theta_1}=\frac{1}{2}>0, \tag{8}$$

and

$$\frac{\partial a_1}{\partial K_2}\frac{\partial K_2^*}{\partial\theta_1}=\left(\frac{-1}{2t\lambda}\right)\left(\frac{r_{adv}^* A}{4\alpha t\lambda^2}\right). \tag{9}$$

Equation (8) shows that channel 1 increases its audience by mimicking channel 2's profile. This direct effect represents an *incentive to mimic* the program choice of the rival channel. Equation (9) shows that as it approaches its rival's program profile, channel 1 makes its rival more aggressive in the quality stage: its rival increases its program quality, which ends up diminishing the audience share of channel 1. This strategic effect represents an incentive for channels to adopt a *counter-programming* strategy.

Substituting Equations (8) and (9) in Equation (7) yields the following equilibrium condition:

[9] This subsection is based on an earlier joint work with Laurent Benzoni (see Benzoni and Bourreau, 2001).

$$\frac{1}{2} - \frac{r^*_{adv} A}{8\alpha t^2 \lambda^3} = 0,$$

or

$$\lambda = \left(\frac{r^*_{adv} A}{4\alpha t^2} \right)^{1/3}. \qquad (10)$$

I find the same equilibrium condition for channel 2. Second-order conditions are satisfied. Let $\rho = \sqrt[3]{r^*_{adv} A / (4\alpha t^2)}$. Since $\lambda \in [0,1]$, Equation (10) has a solution if and only if $\rho \in [0,1]$. If $\rho > 1$, Equation (10) has no solution, and $d\Pi_i / d\theta_i < 0$ for $i \in \{1,2\}$.

Proposition 2 *If the channels are advertiser-supported, quality differentiation is minimum ($K_1^* = K_2^* = K^*_{adv}$) and profile differentiation depends on ρ.*

(i) If $\rho > 1$, profile differentiation is maximum, i.e., $\lambda^*_{adv} = 1$. The channels locate at the two extremes of the profile interval.

(ii) If $\rho \in (0,1)$, there is an infinite number of equilibria (θ_1^*, θ_2^*), such that profile differentiation is $\lambda^*_{adv} = \rho$ and $\theta_i^* \in [1/2 - \rho, 1/2]$.

(iii) When ρ goes to 0, there is a unique equilibrium such that profile differentiation is minimum, i.e., $\lambda^*_{adv} = 0$. Channels locate at the middle of the profile interval.

Proof. See the Appendix. ■

When $\lambda^*_{adv} \in (0,1)$, there is an infinite number of equilibria. Since in the present setting the two channels are symmetric, in the rest of this paper I will focus on the symmetric equilibrium of the game.

Proposition 2 states that profile differentiation depends both on mimicking and counter-programming incentives. When quality is very costly (i.e., α is high), mimicking incentives dominate and profile differentiation is minimum. I find here the same result as Tirole (1988) and Gabszewicz and Thisse (1992).

When quality is not too costly (i.e., α is low), the two channels differentiate their program profiles to soften quality competition. Therefore, program quality plays a similar role as subscription prices for pay-television. However, profile differentiation is not always maximum. At the equilibrium, profile differentiation depends on the parameters that characterize quality competition. More precisely, mimicking incentives are constant (they are equal to 1/2), whereas counter-programming incentives depend on the parameters of the model. Equation (10) shows that counter-programming incentives are stronger when total advertising revenues ($r^*_{adv} A$) are higher and when the cost of quality (α) or the transportation cost (t) is lower.

This result contrasts with traditional models of program choice (i.e., Steiner-type models). These models show that if channels are advertiser-supported and viewers want the same type of programs (i.e., t is low), channels are likely to adopt mimicking strategies. In the present model, when t is low, channels are likely to adopt counter-programming strategies, as quality competition is intense. This effect was missing in Steiner-type models, because they assumed fixed program quality.

Proposition 2 and Equation (10) yield that when $\lambda^*_{adv} \in (0,1)$, program quality at the equilibrium is

$$K^*_{adv} = \frac{r^*_{adv} A}{4\alpha t \lambda^*_{adv}} = t\left(\lambda^*_{adv}\right)^2 . \tag{11}$$

The vertical differentiation literature shows that in this type of setting, outcomes are generally asymmetric (e.g., see Tirole, 1988). However, this standard result hinges not only on vertical differentiation of products but also on the heterogeneity of consumers' tastes. As in the present setting, consumers have the same taste for quality, I end up logically with a symmetric equilibrium, with respect to quality.

Equation (11) shows that the further apart the programs, i.e. the higher λ^*_{adv}, the higher the program quality levels. Inversely, the nearer the programs, the lower the quality levels. The intuition is that channels differentiate their program profiles to soften quality competition when quality competition is intense. Hence, if quality competition is soft, channels choose low quality levels and their incentives to differentiate are low. On the other hand, if quality competition is intense, program quality levels are high and channels have strong incentives to differentiate.

Quality competition leads the channels to dissipate profits in program production. Since the channels differentiate their programs only when quality competition is intense, profits are likely to be lower when the programs are differentiated and higher when the programs are similar. Indeed, at the equilibrium the profit of channel i is

$$\Pi^*_{adv} = \frac{r^*_{adv} A}{2} - t\left(\lambda^*_{adv}\right)^2 .$$

Substituting λ^*_{adv} by its value yields

$$\Pi^*_{adv} = \frac{r^*_{adv} A}{2} - \left(\frac{r^*_{adv} A}{4\alpha}\right)^{2/3} \times \frac{1}{t^{1/3}}.$$

As for pay-TV, profits increase with the cost of quality, α, and the transportation cost, t. Profits may either increase or decrease with total advertising revenues, $r^*_{adv} A$. Finally, there is room for two channels on the advertiser-supported television market if and only if $\Pi^*_{adv} \geq 0$, i.e., if and only if

$$r^*_{adv} A \geq \frac{1}{2\alpha^2 t}. \tag{12}$$

Remark 1 *In this model, channels are assumed to be symmetric. If channels are asymmetric, there is no pure strategy equilibrium to the game. For instance, one channel could earn higher advertising revenues per viewer than its rival. In this case, I find two different equilibrium conditions. These conditions yield two equilibrium distances,* λ_1^* *and* λ_2^**, for channels 1 and 2, respectively, with* $\lambda_1^* \neq \lambda_2^*$*. For instance, assume that* $\lambda_1^* > \lambda_2^*$*. If the channels locate at a distance of* λ_1^**, the mimicking incentives of channel 1 compensate its counter-programming incentives. However, for channel 2, mimicking incentives dominate counter-programming incentives. Therefore, channel 2 has an incentive to approach the profile of channel 1. This analysis shows that there can be no equilibrium in pure strategies.*

Remark 2 *In the present setting, the transportation cost function is quadratic. If it is linear, I find that advertiser-supported TV channels choose the same program profiles at the equilibrium, i.e., differentiation is minimum. This is because, when transportation costs are linear, the quality term in the expression of the marginal consumer does not depend on the distance between the two channels. Hence, channels have mimicking incentives, but no counter-programming incentives. With a quadratic transportation cost function, the two advertiser-supported TV channels have to trade off between their mimicking incentives and their counter-programming incentives. The present paper focuses on this latter case, as it seems more interesting.*

3.3 Pay TV and Advertiser-supported TV Compared

I have determined above the equilibrium both for pay-television and advertiser-supported television. I can now compare program variety and program quality in these two settings.

Proposition 3 *Program variety is always higher under pay-TV than under advertiser-supported TV. Program quality is higher under advertiser-support if the advertising revenue is sufficiently high.*

Proof. The result derives directly from the comparison of profile differentiation and program quality for pay-TV and advertiser-supported TV. Firstly, program variety is always higher under pay-TV than under advertiser-supported TV, as $\lambda^*_{pay} = 1$ and $\lambda^*_{adv} \leq 1$. Secondly, the program quality levels for pay-TV and advertiser-supported TV are

$$K^*_{pay} = \frac{A}{6\alpha},$$

and

$$K^*_{adv} = \begin{cases} \left(\dfrac{r^*_{adv} A}{4\alpha}\right)^{2/3} \times \dfrac{1}{t^{1/3}} & \text{if } \lambda^*_{adv} < 1 \\ \dfrac{r^*_{adv} A}{4\alpha t} & \text{if } \lambda^*_{adv} = 1 \end{cases},$$

respectively. To begin with, assume that $\lambda^*_{adv} < 1$. I compare K^*_{pay} to K^*_{adv}, which shows that $K^*_{adv} \geq K^*_{pay}$ if and only if

$$r^*_{adv} \geq \sqrt{\frac{2At}{27\alpha}}.$$

Now, assume that $\lambda^*_{adv} = 1$. In this case, $K^*_{adv} \geq K^*_{pay}$ if and only if

$$r^*_{adv} \geq 2t/3.$$

Since $A > 9\alpha t$ by assumption, $r^*_{adv} \geq 2t/3$ implies that $r^*_{adv} A > 6\alpha t^2$. Moreover, $\lambda^*_{adv} = 1$ if and only if $r^*_{adv} A \geq 4\alpha t^2$. Therefore, $r^*_{adv} \geq 2t/3$ implies that $\lambda^*_{adv} = 1$ and $K^*_{adv} \geq K^*_{pay}$. Hence, program quality is higher under advertiser support if the advertising price is sufficiently high.
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The intuition of this result is as follows. First, in advertiser-supported television, channels do not compete with respect to prices. Hence, mimicking tendencies are stronger, compared to pay-television. It follows that variety is higher in pay-TV than in advertiser-supported TV. However, notice that these mimicking tendencies are partially compensated by intense quality competition. This result is consistent with the program choice literature. In particular, Spence and Owen (1977) show that an advertiser-supported TV industry is more likely to broadcast programs that attract large audiences than a pay-TV industry. However, in

Spence and Owen's model, the costs of programs are fixed, hence channels do not compete with respect to program quality. The present model shows that this result is still valid when quality competition is assumed in both pay and advertiser support.

Waterman (1990) also assumes that channels compete with respect to program quality. He finds that program variety is the same under pay-TV and advertiser-supported TV. However, in his model, program differentiation is assumed to be maximum. In the present setting, program differentiation is determined endogenously. In this case, TV channels may have stronger mimicking tendencies with advertiser support than with pay support, as shown above. Hence, variety may be higher under pay-TV than under advertiser-supported TV.

Second, in pay-TV, program quality depends only on the cost of quality and on the total audience, whereas in advertiser-supported TV, program quality depends also on the fixed advertising revenue. In particular, if advertisers' valuation for audience is very high, program quality will be higher under advertiser-supported television. If advertisers' valuation for audience is very low, program quality will be lower. This second result is qualitatively similar to the one found by Waterman (1990), though quantitatively different.[10]

4 The Social Optimum

In this section, I compare the market provision of programs to the optimal provision. Welfare is defined as the sum of consumers' surplus less the cost of producing the programs. The optimality problem is to choose program profile and program quality. I distinguish two cases, depending on whether it is optimal to provide one program or two programs. Indeed, providing two programs instead of one introduces a social trade-off: on the one hand, it increases program variety, hence decreases total transportation costs, but on the other hand, it leads to program duplication and hence, increases total production costs.

Intuition suggests that when transportation cost (t) and quality cost (α) are low, total transportation costs are negligible compared to the gross benefits viewers derive from watching high-quality programs. Hence, it should be optimal to provide only one channel. Similarly, when transportation cost (t) and quality cost (α) are high, it should be optimal to provide two channels.

First, assume that only one program is provided. Welfare is given by

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[10] Waterman finds that program quality is higher under pay-TV if and only if $p_{pay}^{*} > r_{adv}^{*}$.

$$W = A \cdot \int_0^1 \left(R + K^w - t \cdot \left(\theta - \theta^w\right)^2 \right) \cdot d\theta - \alpha \left(K^w\right)^2,$$

where θ^w is the profile of the program and K^w, its quality. The program profile and program quality level that maximize social welfare are

$$\theta^w = 1/2,$$

and

$$K_{1c}^w = \frac{A}{2\alpha}.$$

Now, assume that two programs are provided. Welfare is

$$W = AR + A \cdot \left(\int_0^{\theta^*} \left(K_1^w - t\left(\theta - \theta_1^w\right)^2 \right) \cdot d\theta + \int_{\theta^*}^1 \left(K_2^w - t\left(\theta - \left(1 - \theta_2^w\right)^2\right) \right) \cdot d\theta \right) - \alpha \cdot \left(\left(K_1^w\right)^2 + \left(K_2^w\right)^2 \right),$$

where θ^* is the marginal consumer. Total transportation costs are minimized for $\theta_1^w = \theta_2^w = 1/4$, hence the socially optimal profile differentiation is $\lambda_{2c}^w = 1/2$. As channels are symmetric, program quality levels are also symmetric. Hence, starting from socially optimal program profiles, it is possible to increase or decrease program qualities, keeping total transportation costs as constant. The first-order condition with respect to program quality yields

$$K_{2c}^w = \frac{A}{4\alpha}.$$

I can now compare social welfare with only one program to social welfare with two programs.

Lemma 1 *It is optimal to provide only one program when* $t < 2A/\alpha$ *and two programs when* $t > 2A/\alpha$.

Proof. When there is only one program, optimal social welfare is

$$W_{1c}^* = A \times \left(R - \frac{t}{12} + \frac{A}{4\alpha} \right), \tag{13}$$

whereas, when there are two programs, it is equal to

$$W_{2c}^* = A \times \left(R - \frac{t}{48} + \frac{A}{8\alpha} \right). \tag{14}$$

Comparing Equations (13) and (14) shows that it is optimal to provide only one program when $t < 2A/\alpha$ and two programs when $t > 2A/\alpha$. ■

I now compare the unregulated outcome and the regulated outcome with respect to the number of channels, program variety and program quality.

Proposition 4 *From a social point of view,*

(i) with pay TV, there are too many channels, program variety is too high and program quality is too low;

(ii) with advertiser-supported TV, there may be too few channels and program variety and program quality may be too low if the advertising revenue is sufficiently low, whereas there may be too many channels and program variety and program quality may be too high if the advertising revenue is sufficiently high.

Proof. See the Appendix.

The distortions introduced by pay-support are similar to the ones found by Waterman (1990). Indeed, as in the present setting, Waterman finds that there is under investment in quality and over production in variety (i.e., in the number of channels).[11]

The distortions which arise under advertiser-support are linked to the inability of channels to charge viewers. If advertising revenues are sufficiently low, channels have low incentives to provide programs, because they expect low revenues. Hence, there might be only one program, whereas it would socially desirable to have two. Similarly, when advertising revenues are sufficiently low, channels have low incentive to provide program quality, which also implies that counter-programming are low. The same reasoning explains why there may be too many channels and program variety and program quality may be too high when the fixed advertising revenue is sufficiently high. This result is in contrast with Waterman (1990), where program variety is always too high and does not depend on the advertising price, r^*_{adv}.

5 Conclusion

This paper provides a formal framework to analyze the trade-off between mimicking and counter-programming strategies for two competing channels, when the channels are allowed to select the degree of differentiation from other programs. While pay-television channels

[11] In his circular model, variety is defined as the number of channels, whereas in the present model, variety is defined as the difference in program profile.

adopt counter-programming strategies to soften price competition, advertiser-supported television channels trade off between their mimicking and their counter-programming incentives. The degree of program differentiation at the equilibrium depends on the intensity of quality competition. Hence, program variety under pay-support is higher than under advertiser-support, even though quality competition is assumed in both.

The present model suggests that the inability of advertiser-supported channels to compete with respect to prices may have a strong impact on their programming strategies. First, mimicking strategies are stronger under advertiser-support than under pay support. In particular, this is true when advertising revenues are low or when the cost of quality is high. Second, pro-competitive factors may lead to intense quality competition under advertiser support, as channels do not compete in price. For instance, when viewers have low preferences for program profiles (i.e., a low transportation cost), program quality is higher under advertiser-support than under pay-support.

The results obtained in this paper depend to some extent on the model specification and are not necessarily generalizeable. First, I analyze programming strategies under a duopoly. As Waterman (1990) shows, results might differ for an oligopoly with free entry, when channels cannot choose the profile of their programs. Second, alternative versions of the utility function might lead to different results. In particular, recall that the impact of advertisements on the utility of viewers is ignored.

This model could be extended in various directions. For instance, it could be interesting to analyse programming strategies with two successive time slots. Indeed, a key issue for television channels – and in particular, for advertiser-supported channels – is to attract large audiences at prime time. When viewers have some reluctance to switch from one channel to another (i.e., when viewers have switching costs), competition for the audience will be more intense at the first time slot (the access prime time) than at the second time slot (the prime time). Therefore, as channels differentiate their programs to soften competition, program variety is likely to be higher at the access prime time than at the prime time.

Competition between a commercial profit-maximizing channel and a public welfare-maximizing channel could also be explored. This is an important issue in the European Union as European public channels have high audience shares. An interesting question is whether public channels can address minority tastes even though they have to compete with private channels. Nilssen and Sørgard [1998b] study competition between a public channel and a private channel for the scheduling of a program (for instance, a news program). They show that the optimal welfare maximizing strategy of the public channel could be to mimic its rival channel's time schedule – hence, a public channel does not increase variety. However, Nilssen and Sørgard focus on the scheduling strategy of TV channels, and therefore do not exactly study the variety-quality issue.

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Appendix

Proof of Proposition 1. For channel 1, the relocation tendencies are given by

$$\frac{d\Pi_1}{d\theta_1}=\frac{-\alpha t}{(A-9\alpha t\lambda)^2}\times K_1^*(\theta_1,\theta_2)\times\Psi(\theta_1,\theta_2),$$

where $\Psi(\theta_1,\theta_2)=81\alpha^2t^2\lambda^2(3\theta_1+\theta_2+1)+2A^2(1+\theta_1)-27A\alpha t\lambda(1+2\theta_1)$ and $K_1^*\geq 0$. Since $\alpha t<A/9$, $d\Pi_1/d\theta_1$ is defined for all λ. Note that the first term in the equation above is negative and assume that $K_1^*(\theta_1,\theta_2)>0$. I am going to show that $\Psi(\theta_1,\theta_2)>0$ for all θ_1 and θ_2, which implies that $d\Pi_1/d\theta_1<0$.

To show that $\Psi(\theta_1,\theta_2)>0$, I proceed in four steps.

1. I find that $\partial^3\Psi/\partial\theta_1^3=1458\alpha^2t^2$, hence $\partial^2\Psi/\partial\theta_1^2$ increases with θ_1.
2. I find that $\partial^2\Psi/\partial\theta_1^2(\theta_1=0)=54\alpha t(-15\alpha t+21\alpha t\theta_2+2A)$. The latter expression is minimum when $\theta_2=0$. At its minimum, it is positive if and only if $-15\alpha t+2A>0$ or $\alpha t<2A/15$. As $\alpha t<A/9$ and $1/9<2/15$, then $\alpha t<2A/15$. Hence, $\partial^2\Psi/\partial\theta_1^2(\theta_1=0)>0$ for all θ_2. As $\partial^2\Psi/\partial\theta_1^2$ increases with θ_1, then $\partial^2\Psi/\partial\theta_1^2>0$ for all θ_1 and θ_2. Therefore, $\partial\Psi/\partial\theta_1$ increases with θ_1.
3. I compute $\partial\Psi/\partial\theta_1$ for $\theta_1=0$. Let $B(\theta_2)\equiv\partial\Psi/\partial\theta_1(\theta_1=0)$. I find that
   $$B(\theta_2)=81\alpha^2t^2(1-\theta_2)(1-5\theta_2)+A\times(54\alpha t\theta_2-27\alpha t+2A).$$
   Deriving this expression with respect to θ_2 yields
   $$B'(\theta_2)=54\alpha t(-9\alpha t+15\alpha t\theta_2+A).$$
   As $9\alpha t<A$ and $\theta_2\geq 0$, then $B'(\theta_2)>0$ for all θ_2, which implies that $B(\theta_2)$ increases with θ_2. Besides, as $B(0)=(9\alpha t-A)\cdot(9\alpha t-2A)$, then $B(0)>0$ holds for $\alpha t<A/9$. Therefore, $B(\theta_2)>0$ for all θ_2. Since $B(\theta_2)=\partial\Psi/\partial\theta_1(\theta_1=0)$ and $\partial\Psi/\partial\theta_1$ increases with θ_1, it follows that $\partial\Psi/\partial\theta_1>0$ for all θ_1 and θ_2.
4. Finally, I show that $\Psi(0,\theta_2)>0$ for all θ_2, which implies that $\Psi(\theta_1,\theta_2)>0$ for all θ_1 and θ_2, as $\partial\Psi/\partial\theta_1>0$ for all θ_1 and θ_2. I find that
   $$\Psi(0,\theta_2)=81\alpha^2t^2(1-\theta_2)^2(1+\theta_2)+2A^2-27A\alpha t(1-\theta_2)\equiv C(\theta_2).$$
   Computing the above expression for $\theta_2=0$ yields $C(0)=81\alpha^2t^2+2A^2-27A\alpha t$. As $\alpha t<A/9$, then $C(0)>0$. Besides, $C'(\theta_2)=81\alpha^2t^2(\theta_2-1)(1+3\theta_2)+27A\alpha t$. This expression is minimized at $\theta_2=1/3$ and $C'(1/3)=27\alpha t(A-4\alpha t)$. As $9\alpha t<A$, then $4\alpha t<A$, which implies that $C'(1/3)>0$. Therefore, $C'(\theta_2)>0$ for all θ_2. Since

$C(0) > 0$ and $C(\theta_2)$ increases with θ_2, then $\Psi(0,\theta_2) > 0$ for all θ_2, hence $d\Pi_1 / d\theta_1 < 0$.

A similar analysis shows that $d\Pi_2 / d\theta_2 < 0$. Therefore, $K_i^* > 0$ implies that $d\Pi_i / d\theta_i < 0$ for $i \in \{1,2\}$. Since $K_i^* \geq 0$ and that we cannot have simultaneously $K_1^* = 0$ and $K_2^* = 0$, it follows that at the equilibrium the two channels choose the most extreme program profiles, i.e. $\theta_1^* = \theta_2^* = 0$. Hence, $K_1^* = K_2^* = A/(6\alpha)$, if the second-order conditions for maximization with respect to quality levels are satisfied. This is the case if and only if $\alpha t > A/18$. Therefore, the equilibrium exists if $\alpha t \in (A/18, A/9)$, which is satisfied by assumption. At the equilibrium, subscription prices are $p_1^* = p_2^* = t$. ■

Proof of Proposition 2. The outcome of the game depends on ρ. I distinguish three different cases.

Case 1 $\rho > 1$. In this case, equation (10) has no solution. We have $d\Pi_1 / d\theta_1 < 0$ and $d\Pi_2 / d\theta_2 < 0$. There is a unique Nash equilibrium, in which the channels choose extreme program profiles, $\theta_1^* = 0$ and $\theta_2^* = 0$. Profile differentiation is maximum ($\lambda_{adv}^* = 1$) and at the equilibrium program quality is

$$K_{adv}^* = \frac{r_{adv}^* A}{4\alpha t}.$$

Case 2 $\rho \in (0,1)$. Equation (10) is equivalent to $\theta_1 + \theta_2 = 1 - \rho$. There is an infinite number of couples (θ_1, θ_2) which satisfy this condition. Nonetheless, assume that $\rho < 1/2$. The couple $(0, \rho)$ satisfies condition (10) but it is not a Nash equilibrium. Indeed, channel 1 increases its profit if it chooses 2ρ as program profile. More generally, (θ_1^*, θ_2^*) is a Nash equilibrium if it satisfies condition (10) and if $\rho < \theta_i^* < 1/2 + \rho$ for $i \in \{1,2\}$. When $\rho \geq 1/2$, every couple (θ_1^*, θ_2^*) which satisfies condition (10) is a Nash equilibrium. From this, it follows that if (θ_1^*, θ_2^*) is a Nash equilibrium such that $\theta_1^* < 1 - \theta_2^*$, then $\theta_i^* \in [1/2 - \rho, 1/2]$ for $i \in \{1,2\}$. At the equilibrium, profile differentiation is $\lambda_{adv}^* = \rho$.

Case 3 When ρ goes to 0, Equation (10) is equivalent to $\theta_1 = 1 - \theta_2$. We know that $\theta_i^* \in [1/2 - \rho, 1/2]$. Therefore, when ρ goes to 0, program profiles go to 1/2. Hence, profile differentiation is minimum ($\lambda_{adv}^* = 0$) and program quality is also minimum ($K_{adv}^* = 0$).

■

Proof of Proposition 4. I proceed in two steps. Firstly, I compare the market provision to the optimal provision of programs for pay TV. Secondly, I proceed with advertiser-supported TV.

Pay TV: It is optimal to provide two programs if and only if $t > t^w$, where $t^w = 2A/\alpha$. Since $t \in (A/(18\alpha), A/(9\alpha))$ by assumption and $1/9 < 2$, the unregulated outcome yields too many channels. As for program quality, since $A/(6\alpha) < A/(4\alpha) < A/(2\alpha)$, then $K_{pay}^* < K_{2c}^w < K_{1c}^w$. Hence, program quality is always too low with pay-TV. Finally, program variety is too high, as $\lambda_{adv}^* = 1 > \lambda_{2c}^w$.

Advertiser-supported TV: For advertiser-supported TV, two competing channels are viable if and only if condition (12) is satisfied, i.e., if $t \geq t^{adv}$, where $t^{adv} = 1/(2r_{adv}^* A\alpha^2)$. We have $t^w > t^{adv}$ if and only if $r_{adv}^* > 1/(4\alpha A^2)$. If $r_{adv}^* > 1/(4\alpha A^2)$ and $t \in [t^{adv}, t^w)$, two channels are viable in the advertiser-TV market while it would be socially optimal to provide only one. Therefore, the unregulated outcome may yield too many channels if r_{adv}^* is high. If $r_{adv}^* < 1/(4\alpha A^2)$ and $t \in (t^w, t^{adv})$, two channels are not viable in the advertiser-supported TV market while it would be socially optimal to have two. Therefore, the unregulated outcome may yield too few channels if r_{adv}^* is low.

As for program quality, it is too high if and only if $K_{adv}^* > K_{2c}^w$, i.e., if and only if $t < A/(4\alpha\lambda_{adv}^*)$. Substituting for λ_{adv}^*, I find that $K_{adv}^* > K_{2c}^w$ if and only if $r_{adv}^* > \sqrt{At/(4\alpha)}$. Therefore, program quality is too high when r_{adv}^* is high and too low when r_{adv}^* is low.

Finally, as $\lambda_{adv}^* = (r_{adv}^* A/(4\alpha t^2))^{1/3}$, program variety is too high when r_{adv}^* is sufficiently high and too low when r_{adv}^* is sufficiently low.

■