Price Coordination in Two-Sided Markets: Competition in the TV Industry

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Abstract

The TV industry is a two-sided market where both advertisers and viewers buy access to the programs offered by competing TV channels. Under the current market structure advertising prices are typically set by TV channels while viewer prices are set by distributors (e.g. cable operators). The latter implies that the distributors partly internalize the competition between the TV channels, since they take into account the fact that a lower viewer price at one channel will harm rival channels. We nonetheless find that a shift to a market structure where both advertising prices and viewer prices are set competitively by the TV channels might increase joint industry profits. The reason is that this market structure, in contrast to the one we observe today, directly addresses the two-sidedness of the market. We also show that this is to the benefit for the viewers.

JEL-Code: D40, D62, L10, L82.

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1 Introduction

It is well known that firms which sell competing products can raise profits by delegating pricing decisions to a third party that partly or fully internalizes competition. It is quite intuitive that firms in traditional one-sided markets can benefit from such horizontal price coordination, but we show that one should be careful in applying similar arrangements in two-sided markets. Indeed, that might be counterproductive, since it undermines the firms' abilities to choose efficient price structures.

Firms in two-sided markets cater to two distinct groups of customers that are connected through quantity spillovers, and the firms maximize profit by facilitating value-creating interactions between the two groups. Two-sided platforms operate in many economically significant industries, such as the media sector, the financial sector (payment card systems), real-estate brokerage, and the computing industry (computer operating systems, software, game consoles etc.). The price structure in two-sided markets must account for interactions between the demands of different customer groups and the externalities that arise in these relationships.[2] For instance, in the media industry, advertising may be perceived as a nuisance (a negative externality) by readers/viewers, while advertisers benefit from an increase in readers/viewers of the media outlet. In the credit card industry there are positive quantity spillovers between merchants and cardholders. Merchants who accept a credit card welcome an increase in the number of households joining the credit card system, and vice versa.

This paper is motivated by the TV industry, a two-sided market that serves both advertisers and viewers. Previously, free-to-air channels dominated the market, and the channels competed fiercly in the advertising markets to raise revenue. However, partly due to technological progresses which make it possible to exclude non-paying viewers, the industry now raises a large share of its revenue directly from the audience. Nonetheless, we do not see fierce price competition between the channels in the end-user market. The reason for this is that the viewers must buy access to the TV channels through a distributor, and under the current market structure it is the

[2] Evans (2003a,b) provides examples and classifications of two-sided markets.

distributor - and not the TV channels - who sets viewer prices. In this sense the distributor acts as a price coordinator for the TV channels.

Obviously, such horizontal coordination of prices tends to increase prices and thus profits compared to a situation where the prices are set in a competitive environment.[3] The problem is that the distributor does not internalize the fact that high end-user prices have a negative impact on advertising revenue for the TV channels through reducing the size of the audiences. An alternative market structure is one where the TV channels non-cooperatively set both advertising and viewer prices. Then each channel will take into account the interdependence between the two sides of the market, and thus coordinate the prices vertically. We show that such a shift from horizontal to vertical coordination of prices can be beneficial for the industry as well as for the viewers. This market structure, which we label open network, is expected to become more common in the future.[4]

To understand the benefits of an open network - *i.e.* vertical coordination of prices - consider the special case where the two products are independent in viewers' demand (unrelated). Then there is no horizontal coordination problem, since the TV channels are monopolies in each their market segment. Therefore individual profit maximization coincides with industry optimum when each TV channel sets both end-user and advertising prices. If the distributor sets end-user prices, on the other hand, there is no vertical coordination. The distributor sets higher end-user prices than those that maximize joint profits, because it does not take into account the negative effect of high end-user prices on the advertising revenues.

If the viewers perceive the TV channels as substitutes rather than as unrelated products, an open network will no longer lead to the optimal outcome for the industry. With no horizontal coordination of end-user prices, competition forces those prices down. This implies that joint profits for the TV channels and the distributor

[3] Note that this holds independent of whether a distributor sells channels a-la carte or offers different channel packages (which we abstract from).

[4] One reason is the growth in broadband internet connections for private households that makes it possible for TV channels to bypass the traditional distributor. In some countries, for example in Norway and Denmark, we have also seen a debate about whether TV channels should have direct access to the viewers in the existing networks and set end-user prices for their own products.

are lower the closer substitutes the TV channels' products are. Interestingly, with the present market structure - where the distributor sets the end-user prices to the viewers - the opposite is true. Tougher competition forces the TV channels to limit their amount of advertising (it is well documented that viewers dislike ads). Such a competitive pressure dampens the negative externality from the advertiser market to the viewer market. Since a smaller amount of advertising makes each TV channel more attractive for the viewers, it enables the industry to achieve higher joint profits through higher revenues from the end-users. The closer substitutes the TV channels' products are, the higher aggregate profits can be achieved.

Vertical coordination is thus most important for the industry if TV channels are very differentiated, while horizontal coordination is most important if the viewers perceive the channels as close substitutes. No surprise, then, that we find that an open network is superior to the present market structure if the TV channels' products are sufficiently differentiated. More surprisingly, we show that an open network might lead to the highest aggregate profits even when the TV channels are close substitutes. The reason for this is that an open network, in contrast to the present market structure, directly addresses the two-sidedness of the market.

The rest of the paper is organized as follows. In the next section we relate our study to the existing literature. In section 3 we present the rules of the game and our model. In Section 4 we solve the game for the market structure where the distributor sets end-user prices, while we in Section 5 solve the game for the market structure with open networks. The outcome in those two market structures are compared in Section 6, and in Section 7 we offer some concluding remarks.

2 Related literature

Media industries in general, and the TV industry in particular, have been the subject of a number of important studies. The earlier studies were mostly concerned about how the market structure affected the program profile.[5] More recent studies - such

[5] In Steiner (1952), which was extended in Beebe (1977), it is discussed how a change from monopoly to oligopoly could change the program profile. Spence and Owen (1977) discuss how the

as Gabszewicz, et al. (2004), Anderson and Coate (2005), and Kind, *et al.* (2007, 2009) - have emphasized how important it is to take the view that these industries are two-sided markets, serving both content consumers and advertisers, two groups that exert externalities on each other. In the present paper, we bring this discussion a step further, by taking into account the fact that TV viewers are served through distribution of TV signals to the households.[6] What we find is that the industry's two-sidedness creates a need for coordinating viewer prices and advertising prices that is not present in one-sided industries. Accordingly, there is less scope for the distributor, or retailer, to keep control of prices to consumers when the industry is two-sided.

We are, of course, not the first to discuss vertical relations between TV channels and TV distributors.[7] One strand of the literature focuses mainly on the effects of exclusive distribution of premium content, and there is no or very little discussion of the role played by advertising on the issue of exclusive distribution; see Armstrong (1999), Stennek (2007), Hagiu and Lee (2009), and Weeds (2009). In a slightly different vein, Crawford and Cullen (2007) and Crawford and Yurukoglu (2009) discuss a TV distributor's bundling of TV channels; again, the role of advertising on TV is not studied.

In two-sided markets where distribution plays a key role, as is the case in most media industries, it is crucial to understand the interplay between the externalities between user groups on the one hand and the way the services are delivered and priced on the other. The only other paper we know of that discusses the role of distribution in a two-sided market is Bel, *et al.* (2007). In contrast to us, however, they focus on a situation where one firm is vertically integrated, controlling both the distribution and the program production. They do not compare regimes where either distributors or TV channels set end-user prices, as we do here.

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financing of a TV channel - by user payment (pay TV) or advertising - affects the program profile.

[6] The distribution is through either digital terrestrial TV, direct broadcast satellites, or cables. Since the recent digitization of the TV industry, analogue free-to-air transmission has declined.

[7] Incidentally, vertical relations are an issue also in Barros, et al. (2004), but they focus on relations between media firms and advertisers, rather than between media firms and distributors, as we do here.

With our focus on relations between producers and their distributor, we contribute to the more general literature on vertical relations by taking up an issue particularly pertinent to two-sided markets: a firm in a two-sided market should coordinate its prices to its two user groups.[8] Such coordination is difficult if control over end-user prices for consumers is with the distributor.

3 The model

We consider a setting with two competing TV channels earning revenues from advertising and consumer payments. The level of advertising in TV channel i is denoted A_i, and consumer demand is denoted C_i, $i = 1, 2$. The TV channels transmit their contents through a distributor, *i.e.*, a downstream firm that the upstream TV channels must go through in order to reach the viewers.

We compare two different market structures. In market structure D, the distributor is the price setter in the end-user market, receiving a price $p_i \geq 0$ from each viewer. At the same time, TV channel i receives a price $f_i \gtreqless 0$ for each viewer in addition to a fixed fee $F_i \gtreqless 0$ from the distributor. TV channel i sets a price of advertising r_i on its own channel. This market structure mirrors the one which is presently observed in most TV markets, where the distributor sets prices to end-users.

In market structure T, the distributor has no price-setting role. Instead, TV channel i sets both the price it charges from its viewers (p_i) and the advertising price, r_i. The payment from TV channel i to the distributor is equal to $w_i \gtreqless 0$ per viewer plus a fixed fee $W_i \gtreqless 0$. We label this setting an *open network* market structure.

Below, we consider a three-stage game. The access prices, F (or W) and f (or w), are presumably the least flexible of the prices we consider. We therefore assume that these are determined jointly by the distributor and the TV channels at stage 1. It further seems reasonable to assume that viewer prices are fixed in the short

[8] See e.g. Katz (1989) and Rey and Tirole (2007) for surveys of vertical relations in one-sided markets.

run, since end-users typically sign contracts with a distributor for a certain period of time. Advertising prices, on the other hand, are quite flexible, since these can easily be changed by the TV channels. In line with this, we assume that end-user prices and advertising prices are set at stages 2 and 3, respectively.

We follow Kind *et al.* (2007, 2009) and let consumer preferences be given by the following quadratic utility function:

$$U = C_1 + C_2 - \left[(1-s) \left(C_1^2 + C_2^2 \right) + \frac{s}{2} \left(C_1 + C_2 \right)^2 \right]. \tag{1}$$

The parameter $s \in [0, 1)$ is a measure of product differentiation; the viewers perceive the TV channels' products as completely unrelated if $s = 0$ and as perfect substitutes in the limit as $s \to 1$.[9]

Consumer surplus depends not only on the price that the consumers are charged for the TV channels, but also on the level of advertising. To capture this dependency, we let the generalized price for watching channel i be given by $G_i \equiv p_i + \gamma A_i$, where γ measures the consumers' disutility of being interrupted by ads.[10] Consumer surplus can thus be written as

$$CS = U - (G_1 C_1 + G_2 C_2).$$

We choose the unit size of advertising A_i such that we can set $\gamma = 1$. From the consumer surplus we can then derive demand for each media product by solving $\frac{\partial CS}{\partial C_i} = 0$:

$$C_i = \frac{1}{2} - \frac{(2-s)(A_i + p_i)}{4(1-s)} + \frac{s(A_j + p_j)}{4(1-s)}, \; i, j = 1, 2, \; i \neq j. \tag{2}$$

There is a total of n advertisers interested in buying advertising space on the two TV channels. Let A_{ik} denote advertiser k's advertising level on channel i (such

[9] Utility function (1) is due to Shubik and Levitan (1980). The merit of using this utility function is that market size does not vary with s. Our qualitative results would go through also with a standard quadratic utility function, but then an increase in s would both reduce the size of the market and increase the substitutability between the TV channels. See Motta (2004) for further discussion.

[10] It is well documented that viewers try to avoid advertising breaks on TV, see Moriarty and Everett (1994), Danaher (1995), and Wilbur (2008).

that $A_i = \sum_{k=1}^{n} A_{ik}$). The advertiser's gross gain from advertising at channel i is naturally increasing in its advertising level and in the number of viewers exposed to its advertising. We make it simple by assuming that the gross gain equals $\eta A_{ik} C_i$, where $\eta > 0$. This implies that the net gain for advertiser k from advertising on TV equals

$$\pi_k = \eta \left(A_{1k} C_1 + A_{2k} C_2 \right) - \left(r_1 A_{1k} + r_2 A_{2k} \right), \tag{3}$$

where r_i is the advertising price charged by TV channel i for one unit of advertising.

Maximizing (3) with respect to A_{1k} and A_{2k}, subject to (2), we find demand for advertising at TV channel i:

$$A_i = \frac{n}{n+1} \left[(1 - p_i) - \frac{2r_i - s(r_i - r_j)}{\eta} \right] \tag{4}$$

As this expression shows, the number of advertisers merely serves to scale total advertising demand. As a simplification, we therefore set $n = 1$.

We abstract from any costs for the TV channels and the distributor (except for the access charges, which are only internal transfers). Joint profits for these firms are thus equal to the sum of advertising revenue and consumer payment:

$$\Pi^z = \sum_{i=1}^{2} \left(r_i A_i + p_i C_i \right),$$

where $z = D, T$.

To simplify the algebra we make the following assumption:

Assumption 1: $\eta = 1$.

The following can now be verified:

Remark 1: *Joint profits for the distributor and the TV channels are maximized for* $p = p^{opt} \equiv \frac{1}{2}$ *and* $A = A^{opt} \equiv 0$ *(such that* $G^{opt} = \frac{1}{2}$*) for any* $s \in [0, 1)$.

With $\eta = 1$ (or $\eta < 1$, for that matter) we thus find that joint profits are maximized by being advertising-free, and instead charge the viewers directly. A higher value of η would imply a greater demand for ads (since the benefit of advertising would be higher), such that $A^{opt} > 0$ and $p^{opt} < \frac{1}{2}$. Except for this, the value of η does not matter for the qualitative results.

3.1 The distributor sets end-user prices

In case D, the distributor sets end-user prices. With this market structure, the profits of the distributor (Π) and TV channel i (π_i) are given by

$$\Pi = \sum_{i=1}^{2} (p_i - f)C_i - 2F \text{ and } \pi_i = r_i A_i + fC_i + F, \ i = 1, 2, \tag{5}$$

where $f \gtrless 0$ and $F \gtrless 0$ are the per-viewer fee and the fixed fee, respectively, that a TV channel receives from the distributor.

At stage 3, each TV channel chooses its advertising price. Solving $\frac{\partial \pi_i}{\partial r_i} = 0$ gives rise to the reaction function

$$r_i(r_j) = \frac{1 + f - p_i - sr_j}{2(2-s)}, \ i, j = 1, 2, \ i \neq j. \tag{6}$$

Note that $\frac{dr_i(r_j)}{dp_i} < 0$: an increase in p_i reduces the audience and thus the advertising demand on channel i, which in turn necessitates a lower advertising price. Secondly, we have $\frac{dr_i(r_j)}{dr_j} < 0$: a higher advertising price on channel j implies that it will have less advertising, and thus become more attractive to the viewers. This makes the rival (channel i) relatively less attractive, such that it will have to reduce its advertising price. Thereby
advertising prices are strategic substitutes.[11]

Solving (6) simultaneously for the two TV channels we find that advertising prices are given by

$$r_i = \frac{(4-3s)(1+f) - 2(2-s)p_i + sp_j}{(4-s)(4-3s)}, \ i, j = 1, 2, \ i \neq j. \tag{7}$$

Equation (7) shows that channel i's advertising price is decreasing in p_i ($\frac{dr_i}{dp_i} < 0$), as we should expect from the reaction function $r_i(r_j)$. Furthermore, we see that $\frac{dr_i}{dp_j} > 0$ for $s > 0$: an increase in p_j reduces channel j's audience and therefore its advertising price r_j. With advertising prices being strategic substitutes, this increases r_i.

Finally, note that $\frac{dr_i}{df} > 0$. The reason for this is that the higher the per-viewer price that the channel receives from the distributor, the more it gains from having

[11] This is a mechanism that is present in other models of the media market, see for example Nilssen and Sørgard (2001), Gabszewicz *et al.* (2004), and Kind *et al.* (2009).

a large audience. If f increases, it will thus charge a higher advertising price and sell less advertising space ($\frac{dA_i}{df} < 0$) in order to attract a larger viewership. In the continuation, we will put a cap on f to ensure that advertising is not brought down to zero. In particular, we assume that $f < \overline{f} := \frac{(2-s)(6-s)}{(10-s)(4-s)}$. Below, we verify that this in fact holds in equilibrium if f is set at its optimal value (despite the fact that $A^{opt} = 0$).

At stage 2, the distributor chooses those p_1 and p_2 that maximize Π, taking (7) into account. Our problem has a unique symmetric solution, so we can omit subscripts. The end-user price can be written as

$$p = \frac{1}{2} + \frac{8-s}{2(6-s)}f. \tag{8}$$

Combining (2), (4), (7) and (8), we have

$$r = \frac{1}{2(4-s)} + \frac{1}{2(6-s)}f; A = \frac{2-s}{4(4-s)} - \frac{10-s}{4(6-s)}f;\ C = \frac{6-s}{8(4-s)} - \frac{1}{8}f. \tag{9}$$

The mere fact that the advertising volume is decreasing in the per-viewer fee ($\frac{dA}{df} < 0$) allows the distributor to set an end-user price that is increasing in f. Additionally, a higher f means that the distributor's perceived marginal costs increase. This magnifies the positive relationship between p and f. Not surprisingly, we therefore find that the generalized viewer price, $G = p + A = \frac{1}{2} + \frac{2-s}{4(4-s)} + \frac{1}{4}f$, is higher than the one maximizing joint profits ($G^{opt} = p^{opt} = 1/2$), unless f is sufficiently negative.

At stage 1, f is set such as to maximize aggregate profits for the distributor and the TV channels. However, it might be argued that a per-viewer fee $f \neq 0$ is difficult to sustain because of problems of commitment: if the distributor and the TV channels have agreed on a particular f, the distributor may have incentives to meet with one of the channels in order to renegotiate the agreed-upon fee; see, e.g., Rey and Vergé (2008, Sec. 9.3.4) for a general discussion, and Armstrong (1999) and Stennek (2007) for analyses of TV distribution with no per-viewer fees. We therefore start out with considering the case where f is fixed at zero.

Remark 2: *Suppose that the wholesale contracts consist of a fixed fee only ($f = 0$). Then advertising volumes are decreasing in s ($\frac{dA}{ds} < 0$), while end-user prices are independent of s ($\frac{dp}{ds} = 0$).*

The intuition for the results in Remark 2 is that the closer substitutes the TV channels are, the more they will compete in having few advertising slots (and the higher the advertising will prices be).[12] This explains why $\frac{dA}{ds} < 0$. The distributor, on the other hand, internalizes the competition between the TV channels, and therefore sets end-user prices which are independent of the substitutability between the channels; $\frac{dp}{ds} = 0$.[13]

We now turn to the case where the firms pick f in order to maximize joint profits. As noted in Remark 1, joint profits are maximized if there is no advertising ($A = A^{opt} = 0$) and $p = p^{opt} = 1/2$. This outcome is in general not achievable since firms are not allowed to collude on prices. However, at stage 1, they can influence subsequent decisions on both advertising levels and end-user prices through their choice of f. It should be noted, though, that the firms face a trade-off when they set f: Equations (8) and (9) make it clear that a positive f will move the end-user price in the wrong direction and the advertising volume in the correct direction compared to first-best industry-optimum, and vice versa for a negative f. At the outset the optimal sign of f is therefore not clear.

Intuition might nonetheless lead us to expect that f should be positive. The reason for this is that a positive f has both a harmful and a beneficial effect on the distributor's profit; on the one hand it tends to reduce his profit margin, which is bad, but on the other hand it also reduces the advertising volume, which is beneficial for the distributor. At the same time a slightly positive f is unambiguously positive

[12] This result was first shown in Barros *et al.* (2004).

[13] The distributor could utilize the fact that $\frac{dA}{ds} < 0$ to let end-user prices be increasing in s ($\frac{dp}{ds} > 0$). However, this would excessively reduce the size of the audiences (recall that $G > G^{opt}$).

for the TV channels.[14] Setting $d\left(\Pi+\pi_1+\pi_2\right)/df=0$, we find

$$f=f^{*}\equiv\frac{2\left(6-s\right)\left(2-s\right)}{\left(4-s\right)\left[4+\left(8-s\right)^{2}\right]}\in\left(0,\overline{f}\right);\quad\frac{df^{*}}{ds}<0. \tag{10}$$

By inserting for (10) into (8) and (9), we have:

Proposition 1. *Suppose that $f=f^{*}$, such that it maximizes joint profits for the distributor and the TV channels.*

a) End-user prices and advertising levels are above industry optimum ($p>p^{opt}$ and $A>A^{opt}$)

b) The closer substitutes the TV channels are

- the lower are end-user prices ($\frac{dp}{ds}<0$)

- the lower are advertising levels ($\frac{dA}{ds}<0$).

Proposition 1 shows that end-user prices and advertising levels are closer to first-best industry optimum the higher s is. This has the following interesting implication:

Corollary 1. *Suppose that $f=f^{*}$. The closer substitutes the TV channels are, the higher are joint profits ($\frac{d\Pi^{D}}{ds}>0$) and the larger is the size of the audiences ($\frac{dC}{ds}>0$).*

The property that $\frac{dC}{ds}>0$ is well known from one-sided markets; a closer substitutability between goods increases the competitive pressure, and thus also consumption. However, the result that joint profits are increasing in the substitutability between the media products is in stark contrast to what we typically find in one-sided markets. The intuition is that the distributor partly internalizes the competition between the TV channels, since it sets the end-user prices for both channels. The distributor cannot control advertising volumes, though, and these are too high from the industry's point of view. The reason is that each TV channel sells the amount of advertising space that maximizes its own operating profits, without taking into

[14] To see these effects for the two groups of agents, we differentiate their profits with respect to f to find $\frac{d\Pi}{df}=\frac{4-s}{4(6-s)}f-\frac{1}{4}$, and $\frac{d(\pi_1+\pi_2)}{df}=\frac{1}{4}+\frac{2-s}{2(6-s)(4-s)}-\frac{46-13s+s^2}{2(6-s)^2}f$. From these expressions we immediately see that it must be optimal to set f positive; a small increase in f from $f=0$ yields a net increase in industry profit equal to $\frac{2-s}{2(6-s)(4-s)}$.

account how this reduces income for the distributor (and the rival TV channel). This is a negative vertical externality, but the stronger is the competition between the TV channels, the less advertising will they carry. Tougher competition between the TV channels thereby reduces the strength of the negative vertical externality, and increases aggregate profits.

3.2 The TV channels set end-user prices

In case T, where the TV channels set end-user prices, joint profits of the distributor and the TV channels equal

$$\Pi = w(C_1 + C_2) - 2W \text{ and } \pi_i = (p_i - w)C_i + r_i A_i + W, \tag{11}$$

where w is the price that the distributor receives from each TV channel per viewer. Note that the access price w is modeled as a variable cost for the TV channels, while the per-viewer fee f in the previous section is modeled as a variable cost for the distributor.

At stage 3, each TV channel chooses its advertising price. Setting $\frac{\partial \pi_i}{\partial r_i} = 0$ yields the reaction function

$$r_i(r_j) = \frac{1 - w - sr_j}{2(2-s)}, \; i, j = 1, 2, \; i \neq j, \tag{12}$$

where we again note that advertising prices are strategic substitutes ($\frac{dr_i(r_j)}{dr_j} < 0$). Solving the first-order conditions for the two TV channels simultaneously implies that

$$r_i = \frac{1-w}{4-s}, \; i = 1, 2. \tag{13}$$

At stage 2, the TV channels set viewer fees. The reaction function is now given by

$$p_i = \frac{2(1-s) + (2-s)w + sp_j}{2(2-s)}, \; i, j = 1, 2, \; i \neq j. \tag{14}$$

We thus have the standard result that end-user prices are strategic complements ($\frac{dp_i(p_j)}{dp_j} > 0$).

Solving (14) simultaneously for $i = 1, 2$, and dropping subscripts because of symmetry, we find that the outcome of the second stage is

$$p = \frac{2(1-s)}{4-3s} + \frac{2-s}{4-3s}w \tag{15}$$

which further implies that

$$r = \frac{1}{4-s}(1-w); \; A = \frac{s^2}{2(4-3s)(4-s)}(1-w); \text{ and } C = \frac{16-12s+s^2}{4(4-3s)(4-s)}(1-w). \tag{16}$$

The end-user prices that the TV channels set at stage 2 are thus increasing in the access price w. With higher end-user price, there is also naturally a smaller audience, and thus a lower demand for advertising and a lower price of advertising.

Let us again, as we did in the analysis of market structure D, consider the case without per-viewer fees, *i.e.*, where $w = 0$. We have:

Remark 3: *Suppose that the wholesale contracts consist of a fixed fee only ($w = 0$). Then advertising volumes are increasing in s ($\frac{dA}{ds} > 0$), while end-user prices are decreasing in s ($\frac{dp}{ds} < 0$). In the limit $s \to 1$ we have $p = 0$, in which case the industry raises revenue only from the advertising market.*

With $w = 0$, advertising becomes a more important source of revenue the closer substitutes the TV channels are, while the opposite is true for viewer payments. Note in particular that $p = 0$ if $s = 1$; competition presses end-user prices down to zero if the consumers perceive the TV channels to be perfect substitutes. In this case the industry earns profits solely from the advertising market. The reason why the advertising market is profitable for the industry even if the channels are perfect substitutes in the eyes of the viewers, is (as noted above) that advertising prices are strategic substitutes. This is a relatively mild form of competition (see Kind *et al.*, 2009, for a thorough discussion). As a digression, it should be mentioned that this can shed light on observations on the internet: arguably, readers perceive the majority of online newspapers as having rivals which offer close substitutes ($s \approx 1$), and such newspapers are thus only able to raise revenue from the advertising market.

Competition between the TV channels implies that end-user prices are too low ($p < p^{opt}$) and advertising levels too high ($A > A^{opt}$) compared to industry optimum when $w = 0$ and $s > 0$. Since $\frac{dp}{dw} > 0$ and $\frac{dA}{dw} < 0$ we should expect that w must be positive in order to maximize joint profits. This is confirmed by solving $\max(\Pi + \pi_1 + \pi_2)$, which yields

$$w = w^* \equiv Ms\left\{4\left[(4-3s)^2 + 2(2-s)s\right] - s^3\right\} > 0; \quad \frac{dw^*}{ds} > 0, \tag{17}$$

where

$$M := \frac{1}{2\left[4(2-s)(4-3s)(4-s) + s^4\right]}.$$

Inserting for (17) into (15) and (16) we further find that

$$p = \frac{1}{2} - 2Ms^2(4-3s); \quad r = M\left[4(4-3s) + s^2\right](4-3s); \tag{18}$$

$$A = \frac{1}{2}Ms^2\left[4(4-3s) + s^2\right]; \text{ and } C = \frac{1}{4}M\left[4(4-3s) + s^2\right]^2. \tag{19}$$

Using equations (17)-(19), we can state:

Proposition 2. *Suppose that $w = w^*$, such that it maximizes joint profits for the distributor and the TV channels.*

a) End-user prices are too low and advertising levels too high compared to industry optimum (i.e., $p < p^{opt}$ and $A > A^{opt}$) for $s > 0$.

b) The closer substitutes the TV channels are

- the lower are end-user prices: $\frac{dp}{ds} < 0$.

- the higher are advertising levels: $\frac{dA}{ds} > 0$.

Independent of the value of w, the TV channels will compete so harshly if $s \to 1$ that end-user prices are equal to TV channels' marginal costs ($p = w$). However, since $w^* > 0$ for all $s > 0$, the industry as a whole makes a positive profit from viewer charges no matter how close substitutes the TV channels are.

Note from equation (17) that $w = 0$ at $s = 0$. Each TV channel is in this case a monopolist in its own market segment, and chooses end-user prices and advertising prices that maximize both individual and aggregate industry profits ($p = p^{opt} = 1/2$ and $A = A^{opt} = 0$). For higher values of s there will be a deviation between equilibrium prices and equilibrium advertising levels compared to industry optimum, and more so the higher s is. It can thus be shown that:

Corollary 2: *Suppose that $w = w^*$. The closer substitutes the TV channels are, the lower are joint profits ($\frac{d\Pi^T}{ds} < 0$) and the smaller is the size of the audiences ($\frac{dC}{ds} < 0$).*

It might seem surprising that w is set so low that $p < p^{opt}$ for $s \in (0,1)$; by having w somewhat higher than w^*, the TV channels would set end-user prices closer to industry optimum. The same would be true for advertising levels, since $A > A^{opt}$ and $dA/dw < 0$. However, the larger s is, the lower the TV channels' profit margin $(p-w)$ will be. This in turn gives the TV channels incentives to sell more advertising space even though this reduces the size of the audiences. Setting w such that we always have $p = p^{opt}$ would therefore excessively increase viewers' generalized price and excessively reduce the number of viewers. It is therefore optimal to set w such that $p < p^{opt}$. It should be noted, though, that this does not prevent the generalized price from being an increasing function of s:

$$\frac{dG}{ds} = M^2 s^3 (8 - 3s) \left[4(4-3s) + s^2\right] > 0. \tag{20}$$

In contrast to market structure D (and to what we typically expect from analysis of one-sided markets), the size of the audiences is thus smaller the better substitutes are the TV channels.

4 A comparison

Let us now compare the two market structures. In market structure D, the distributor sets the end-user prices. Thereby the two TV channels' viewer prices become coordinated, but at the cost of not being coordinated with advertising prices. This market structure thus exhibits horizontal — but not vertical — price coordination. In market structure T, each TV channel coordinates the prices it charges from the viewers and the advertisers, but at the cost of viewer prices being uncoordinated across the channels. We might say this market structure exhibits vertical — but not horizontal — price coordination. These differences in price coordination lead to large differences in outcomes in the two market structures.

We first consider the case where the contract between the distributor and the TV channels only specifies fixed fees, with variable fees being equal to zero ($f = w = 0$). The curves Π^D and Π^T in Figure 1 show joint profits under the two market structures in this case. At $s = 0$, each TV channel is a monopolist in its own market segment, and there do not exist any horizontal externalities. The market structure where each TV channel sets both end user and advertising prices must then necessarily be the most profitable one, and ensures that individual profit-maximization coincides with industry optimum. If s is close to 1, on the other hand, end-user prices are pressed down to marginal costs if they are controlled by the channels. So if the TV channels are sufficiently close substitutes, the market structure where end-user prices are coordinated by the distributor is superior from the industry's point of view.

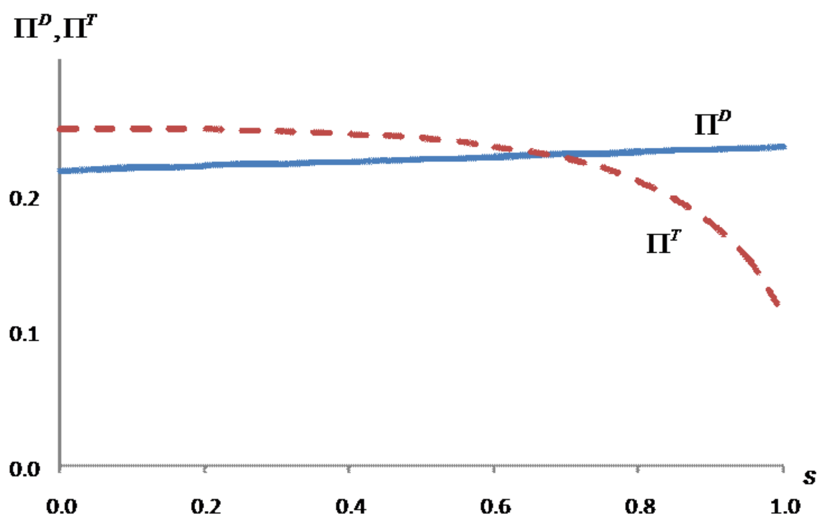

Figure 1: *Joint profits if no variable access fees.*

Let us now consider how the relative profitability of the two market structures changes if the variable fees are set at their optimal levels. In market structure D, where TV channels control advertising prices only, they do not take properly into account that a high advertising volume reduces the consumers' willingness to pay for watching TV. In Section 3 we thus showed that it is optimal (from the industry's point of view) to give the TV channels a positive variable income per viewer ($f > 0$) and thus induce them to carry less adverting. The extent to which there is excessive advertising is, however, smaller the tougher is the competition between the TV channels. We therefore found that $\frac{df}{ds} < 0$, as shown by the downward-sloping curve in the left-hand-side panel of Figure 2.

In market structure T, where TV channels set end-user prices, competition forces the TV channels to set the end-user prices closer to the (perceived) marginal costs the better substitutes they are. In order to reduce the extent to which competition more or less eliminates profits from the viewer side of the market, the variable access price w — which is the per unit access price the TV channels pay to the distributor — should therefore be increasing in s: $\frac{dw}{ds} > 0$. This is illustrated by the upward-sloping curve in the left-hand-side panel of Figure 2.

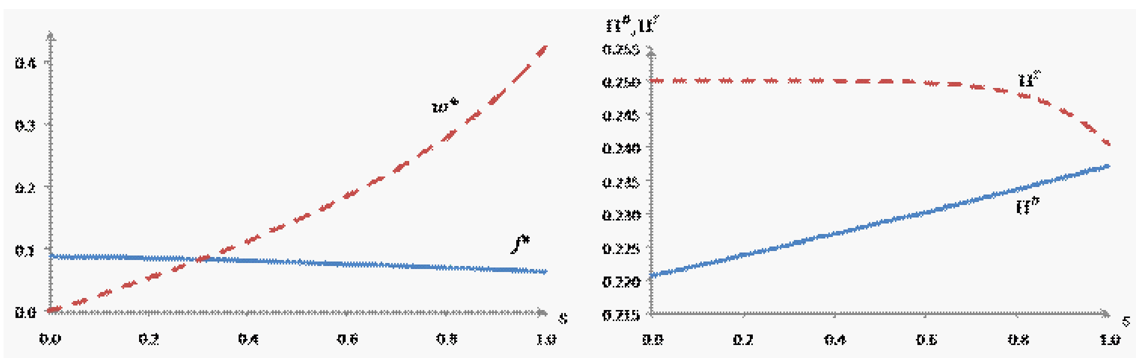

Figure 2: *Access prices and joint profits.*

So which market structure performs better if the variable fees are set at their optimal levels? Bargaining between the distributor and the TV channels could make it possible to set w such that the end-user prices are identical in those two market structures ($p^T = p^D$). However, recall from Section 3.1 that $p^{opt} < p^D$. Not surprisingly, it can therefore be shown that $p^T < p^D$ when w is optimally chosen.[15] Thereby, excessively high end-user prices are avoided, with the result that $\Pi^D > \Pi^T$, no matter how close substitutes the TV channels are.[16] The main reason for this result is that the market structure where each TV channel sets prices in

[15]It is straightforward to show that $p^T < p^D$ by inserting for f^* in (8) and for w^* in (15).

[16]Note that there are no negative vertical externalities with open networks, and that the negative horizontal externalities are partly internalized under efficient bargaining. Under market structure D, on the other hand, there will always exist negative horizontal as well as vertical externalities.

both markets directly addresses the two-sidedness of the market. The right-hand-side panel of Figure 2 illustrates this by showing total industry profit always being higher in market structure T than in market structure D.

Also the consumers would gain from a shift to an open network. This is not surprising, since end-user prices are then set competitively instead of by a price-coordinating distributor. We can state:

Proposition 3: *A shift from market structure D (distributor setting end-user prices) to market structure T (TV channels setting end user prices) increases both total industry profit and consumer surplus.*

Both consumer surplus and total industry profit are increasing in s when the distributor sets end-user prices (see Corollary 1), while the opposite is true when the TV channels set end user prices (see Corollary 2). Both the industry and the viewers thus have less to gain from a shift to open access the closer substitutes the TV channels are.

When the distributor sets end-user prices, the TV channels' only choice variable is the advertising price. Stronger competition between the TV channels therefore implies that they must adjust advertising prices so as to reduce advertising levels. Proposition 1 consequently shows that the advertising volume is decreasing in s. Under market structure T, on the other hand, the TV channels compete both in end-user prices and advertising prices. Since competition in advertising prices is weaker than competition in end-user prices, Proposition 2 shows that the advertising volume is increasing in s in this case. Additionally, the generalized price is lower — and thus the number of viewers higher — when end-user prices are set by the TV channels rather than by the distributor. This explains why the advertising volume is higher under market structure T than under market structure D if the TV channels' products are sufficiently close substitutes (see the left-hand-side panel of Figure 3).

As a final comparison of the two market structures, the right-hand-side panel of Figure 3 shows the relative importance of viewer payments for the industry,

$$\omega := \frac{pC}{pC + rA}.$$

If the TV channels' products are completely unrelated ($s = 0$), then there will be no advertising in market structure T: all revenue will be earned from the end-user market. However, the stronger the competition between the channels, the less important consumer payments will be as a source of revenue. It is worth stressing once more, though, that if the variable access price were fixed at zero ($w = 0$), then competition between the TV channels would drive revenue from the consumer side of the market down to zero in the limit as s approaches 1; the only reason why the industry is able to make the larger part of its revenue directly from the viewers even for high values of s is that w has a positive value.

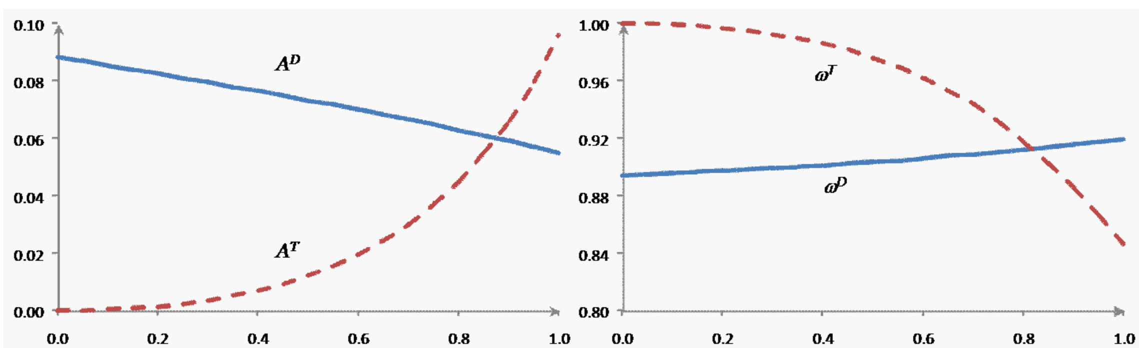

Figure 3: *Advertising levels and revenue shares.*

When the distributor sets end-user prices, we have the opposite picture; the end-user prices are coordinated by the distributor and become increasingly more important as a source of revenue as s increases, since the TV channels then compete away most of their potential advertising revenues. If the TV channels' products are sufficiently close substitutes, consumer payments will therefore be relatively more important in this market structure than in the market structure where the TV channels set end-user prices.

Summarizing, we have:

Proposition 4: *If the TV channels' products are sufficiently differentiated, a shift from market structure D (distributor setting end-user prices) to market structure T (TV channels setting end-user prices) reduces the advertising volume and the relative dependence on advertising revenue.*

5 Concluding remarks

In this paper we have compared two ways of organizing pricing of TV distribution to end-users. One of our findings is that a market structure where TV channels set end-user prices might be favorable for both the industry and the viewers relative to one in which the distributor sets end-user prices.[17] Leaving the setting of viewer prices to the distributor means that the TV channels' viewer prices are coordinated, but this approach does not solve the problem associated with the coordination of viewer prices and advertising prices. As our analysis shows, the latter coordination is of paramount importance for both the industry and the viewers.

The driving force behind our result is the two-sidedness of the TV industry, which by now has been discussed in a number of theoretical and empirical analyses.[18] As stressed by Rochet and Tirole (2003), efficiency in two-sided markets requires that the firms choose the correct price structures. This cannot be achieved if prices are set by different agents. Due to the externalities that viewers and advertisers exert on each other, there is thus a gain from coordinating the prices that these two customer groups are charged. It should be noted, though, that from the industry's point of view the present market structure has the advantage that it hinders direct price competition between the TV channels in the end-user market. This horizontal coordination problem with an open network can to some extent be resolved by having high unit access prices, which the TV channels will partly pass on to the end-users through higher viewer prices. This is why we arrive at the result that open networks yield the highest joint industry profit even if the consumers perceive the TV channels as close substitutes.

[17] It might be argued that it is a violation of competition law to allow the TV channels to determine the viewer prices charged by the distributors; this could be regarded as a retail price maintenance (RPM) system. Many countries have had a restrictive policy towards RPM, but this is gradually changing. For example, RPM is now treated with a rule of reason approach in the US (see Blair, 2008). This suggests that the TV industry might be allowed to use RPM by arguing that this is to the benefit of both the industry and the viewers.

[18] See Gabszewicz, et al. (2004), Anderson and Coate (2005), Kind, et al. (2007, 2009), and Wilbur (2008), as well as the survey by Anderson and Gabszewicz (2006).

However, lack of commitment might make it impossible to set a markup on access prices. If so, it is not possible for the industry to use the per unit access price to influence the end-user and the advertising prices. The per unit access price will then be equal to marginal costs, and there is no scope for even an imperfect horizontal coordination in an open network. In that case the present market structure, where the distributor coordinates end-user prices, leads to higher profits for the industry if the TV channels' products are sufficiently close substitutes.

The industry's mix of revenue raised from the advertising and viewer markets is distinctly different in the two market structures we discuss. This is easily seen if we consider the consequences of TV channels' products becoming closer substitutes. In the present system this would imply that the TV channels compete tougher by having fewer advertising slots. Since the distributor can prevent competition on end-user prices, the result would be that a larger fraction of the revenues would come from the end-user market. In an open network, the opposite is true. Tougher competition leads to lower end-user prices. The industry must then rely more on the revenues from the advertising market.

Our vision of TV distribution in this analysis has been as an intermediary between content consumers on the one side and the two-sided TV industry on the other. An alternative picture has the distribution industry itself as a two-sided market, with consumers gaining from the presence of more content providers in a distributor's portfolio, and content providers gaining from an increase in a distributor's customer base. An example of this latter approach, applied to the internet industry, is the work of Economides and Tåg (2009). They view internet service provision as a two-sided market and find arguments in favour of net neutrality on the internet. Our work can be related to theirs by noting that also on the internet content provision is a two-sided market, with advertisers exerting a negative externality on content consumers, while the consumers exert a positive externality on the advertisers. In this setting our results can be interpreted as arguing against net neutrality, exactly because of these externalities between advertisers and content consumers. By giving up on net neutrality, content providers and internet service providers are better able to internalize these externalities.

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