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Discussion paper

# Inter-Firm Price Coordination in a Two-Sided Market

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# Inter-Firm Price Coordination in a Two-Sided Market \*

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## Abstract

In many two-sided markets we observe that there is a common distributor on one side of the market. One example is the TV industry, where TV channels choose advertising prices to maximize own profit and typically delegate determination of viewer prices to independent distributors. We show that in such a market structure the stronger the competition between the TV channels, the greater will joint profits in the TV industry be. We also show that joint profits might be higher if the wholesale contract between each TV channel and the distributor consists of a simple fixed fee rather than a two-part tariff.

JEL: L11, L82, M31, M37

*Keywords:* Vertical relations, advertising, media economics

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# 1 Introduction

The most widespread business model in the TV industry is that the TV channels use a common distributor to reach the viewers. The TV channels set advertising prices on their own, but delegate to the distributor to determine the prices that the viewers have to pay. This delegation has the benefit that there will be no price competition between the TV channels in the viewer market; any business-stealing effects will be internalized by the distributor. In a traditional (“one-sided”) market, such inter-firm price coordination would always be beneficial to the firms. Other things equal, it would generate the same joint profit as would be obtainable in a perfect cartel. We show that this logic does not apply in a two-sided market such as the TV industry.<sup>1</sup>

To understand this, note that the distributor does not fully internalize the impact that high viewer prices have on revenues from the advertising side of the market. Likewise, the TV stations, in setting their prices to advertisers, do not fully internalize the effect that the advertising volume has on viewers’ willingness to pay for watching TV. Due to these shortcomings, inter-firm coordination can lead to some seemingly counter-intuitive results. We find that when products are becoming less differentiated, then TV channels compete more fiercely and joint industry profits is increasing. The reason for this surprising result is that the lack of internalization becomes less serious if the competitive pressure increases. In particular, tougher competition for viewers leads to a lower advertising volume.

In our analysis, we allow at the outset the distributor and each TV channel to bargain over a two-part wholesale contract that consists of a fixed fee and a unit wholesale price. Since the viewer price is increasing in the unit wholesale price, one might expect that the contract could be used to induce firms to set optimal end-user prices. The problem, however, is that the unit wholesale price affects the

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<sup>1</sup>For a definition of two-sided markets, see Weyl (2010). Examples, in addition to the TV industry, are other media industries, the payment-card industry, real-estate brokerage, and the computing industry (computer operating systems, software, game consoles etc.). See Wright (2004) for a general discussion of the problems associated with applying a one-sided logic to a two-sided market. Note, however, that he is not discussing the point we are making.

relative profitability between the two sides of the market, and therefore changes both the viewer price and the advertising price. It follows that a two-part tariff does not solve the coordination problems. Indeed, we show that joint profits are higher if the industry can commit to a simple fixed fee rather than a two-part wholesale contract. To see why, note that if a channel receives a higher unit wholesale price from the distributor, it will optimally reduce the ad volume in order to attract a larger audience. But then the rival channels are forced to reduce their ad levels too, and their profits fall. This profit effect is not internalized in a non-cooperative equilibrium, so unit wholesale prices - and thus viewer prices - are distorted upwards. Two-part tariffs consequently lead to inefficiently high prices. Both the industry and the consumers would be better off if the wholesale contracts instead consisted of a simple fixed fee.

The focus on the TV industry is a timely one, since business models in this industry are about to change. The presence of the Internet has made it possible for TV channels to bypass independent distributors and instead sell directly to viewers. Following up on this technological development, we contrast the market structure with a common distributor on one side of the market with one where the TV stations bypass this distributor. In such a situation TV stations set prices non-cooperatively in both markets. Now, each firm takes into account the interdependence between the two sides of the market, and thus coordinates its prices (intra-firm coordination). In other words, a TV station uses both viewer prices and advertising prices in order to account for the externalities involved between its two groups of consumers. On the other hand, there is no longer any inter-firm coordination of prices on one side of the market, since the distributor has disappeared. We show that if TV stations' products are sufficiently differentiated in viewers' demand, so that competition for viewers is sufficiently lax, then a regime with intra-firm coordination of prices leads to higher industry profit than one with inter-firm coordination through the distributor.

Early studies of media markets, such as Steiner (1952), were mostly concerned with how competition for raising advertising revenue affects media plurality.<sup>2</sup> More

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<sup>2</sup>Steiner (1952) and Beebe (1977) discuss how competition affects content, while Spence and Owen (1977) discuss how financing of TV stations affects content.

recent studies – such as Rochet and Tirole, (2003, 2006), Caillaud and Jullien (2003), Anderson and Coate (2005), Armstrong, 2006, Kind *et al.* (2007, 2009), and Peitz and Valletti (2008) – emphasize how important it is to take the view that these industries are two-sided markets, serving both content consumers and advertisers. However, the media-economics literature does not analyze the kind of coordination problems that we focus on in this paper. Most models on competition between TV stations in two-sided markets, for example, either abstract from the role of distributors, or implicitly assume that these distributors are passive firms with no influence on end-user prices. This does not seem to fit well with how the TV industry typically is organized in most countries.

We are not the first to model a distributor in a media industry, though. Notably, Crawford and Cullen (2007) and Crawford and Yurukoglu (2012) discuss a TV distributor’s bundling of TV stations. However, the role of advertising on TV is not studied and therefore the two-sidedness of the TV industry is not taken into account.

Bel, *et al.* (2007) is the only other paper we are aware of that discusses the presence of retailers in a two-sided TV market.<sup>3</sup> They focus on a situation where a firm is vertically integrated, controlling both the distribution and the program production. They do not compare regimes where either distributors or TV stations set end-user prices, as we do here.

In the next section we present a model of the TV industry. In Section 3 we solve this model for the situation where the distributor sets viewer prices, and in Section 4 we solve it for the situation where a TV station sets both its prices. The outcomes in those situations are compared in Sections 5. In Section 6 we offer some concluding remarks.

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<sup>3</sup>Vertical integration in a two-sided media market is discussed in Barros, *et al.* (2004), though. But there the interest is with respect to integration between platforms and consumers, in particular between Internet portals and advertisers.

## 2 A model of the TV industry

We consider a setting with two TV stations that earn revenues from advertisers and viewers. The advertising level in the programs provided by TV station  $i$  (hereafter  $TVi$ ) is denoted  $A_i$ , and the level of viewers' consumption of program content is denoted  $C_i$ ,  $i = 1, 2$ . Advertisers pay  $r_i$  per unit of advertising on  $TVi$ , while consumers pay  $p_i$  per unit of program content.

The preferences of a representative viewer is given by the following quadratic utility function:

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

where  $s \in [0, 1)$  measures product differentiation: viewers perceive the TV stations' content as independent if  $s = 0$  and as perfect substitutes as  $s \rightarrow 1$ .

This formulation of viewer preferences has two realistic features. First, viewers do not choose one TV station to watch, but rather consume content from both TV stations; this is called multihoming and is a feature of consumer behavior common in the TV industry that distinguishes it from many other two-sided markets. Secondly, viewers' total demand across TV stations is not fixed, which allows for viewers to respond to lower prices with an increase in total demand. Neither of these features is present in the Hotelling-line approach to viewer demand, which is widely used in analyses of media markets.<sup>4</sup>

Viewers' consumer surplus from watching  $TVi$  depends both on the viewer price  $p_i$  and on the advertising level  $A_i$ . To capture this dependency, we let the *generalized price* for watching content on  $TVi$  be given by

$$G_i = p_i + \gamma A_i,$$

where  $\gamma > 0$  measures viewers' disutility of being interrupted by ads.<sup>5</sup> Consumer

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<sup>4</sup>The merit of using the particular utility function in (1), which is due to Shubik and Levitan (1980), is that market size does not vary with  $s$ ; see Motta (2004) for further discussion. Our qualitative results are invariant to the choice of utility function, though.

<sup>5</sup>While advertisers obviously benefit from the presence of viewers, empirical studies like that of Wilbur (2008) indicate that the typical viewer has a disutility from the presence of advertising.

surplus can thus be written as

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

We choose the unit size of advertising such that  $\gamma = 1$  and derive viewers' demand for each media product by solving  $\frac{\partial CS}{\partial C_i} = 0$ ,  $i = 1, 2$ , to obtain:

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

There are 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  $TVi$ , such that  $A_i = \sum_{k=1}^n A_{ik}$ . His gross gain from advertising on  $TVi$  is naturally increasing in his 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

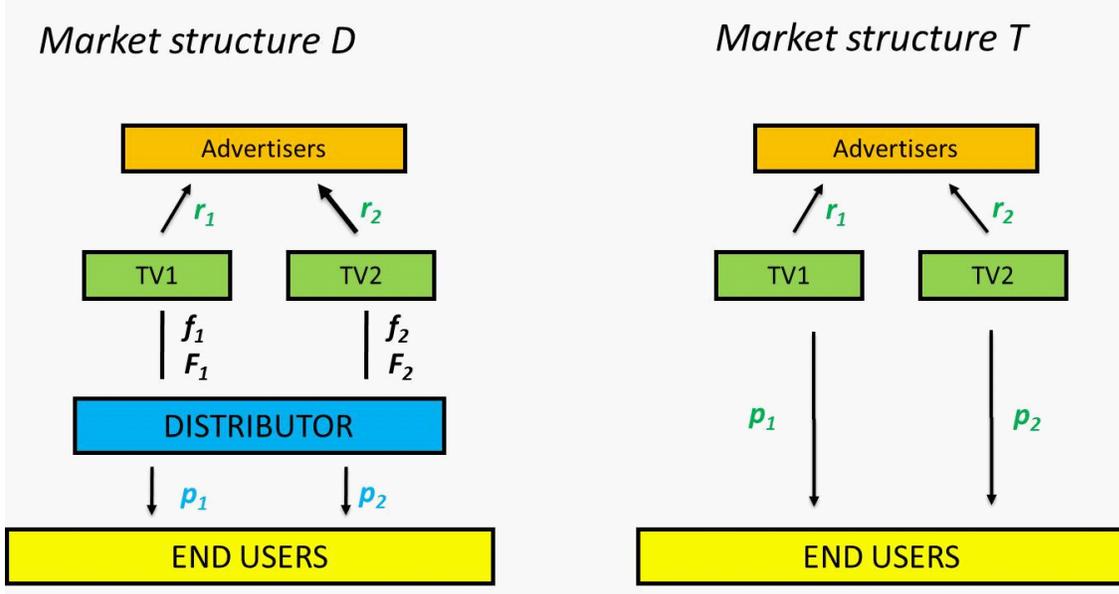
$$\pi_k = \eta (A_{1k} C_1 + A_{2k} C_2) - (r_1 A_{1k} + r_2 A_{2k}), \quad (3)$$

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

Simultaneous maximization of (3) with respect to  $A_{1k}$  and  $A_{2k}$  for each  $k$ , subject to (2), yields the demand for advertising at TV channel  $i$ :

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

Our interest is in a situation where a downstream distributor buys the right to transmit programs to viewers. For this he pays  $TVi$  a fixed fee  $F_i$  and a variable fee  $f_i$  per unit of program content that viewers watch,  $i = 1, 2$ . The distributor subsequently sets the viewer price  $p_i$ , while  $TVi$  sets the advertising price  $r_i$ ; see the left panel of Figure 1, where we denote this situation  $D$ . Subsequently, we will compare this with another situation, denoted  $T$ , where the TV stations bypass the distributor and offer their content directly to the consumers, *i.e.*,  $TVi$  sets both  $p_i$  and  $r_i$ ; see the right panel of Figure 1.



**Figure 1:** Market structure with and without distributor.

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

$$\Pi_J = \sum_{i=1}^2 (r_i A_i + p_i C_i). \quad (5)$$

We make the following assumption to simplify the analysis.

**Assumption 1** (i)  $\eta = 1$ ; (ii)  $n = 1$ .

With  $\eta = n = 1$ , joint profits in (5) are maximized at  $p = p^{opt} \equiv \frac{1}{2}$  and  $A = A^{opt} \equiv 0$  (implying a generalized price  $G^{opt} = \frac{1}{2}$ ), for any  $s \in [0, 1)$ . With  $\eta = 1$  (or  $\eta < 1$ , for that matter), joint profits are thus maximized when TV is free of advertising and viewers instead are charged directly through a high  $p$ . A larger  $\eta$  would imply a greater demand for advertising space, since the benefit of advertising now would be higher, implying  $A^{opt} > 0$  and  $p^{opt} < \frac{1}{2}$ .

A similar effect would come from an increase in the number of advertisers  $n$ ; total demand for advertising space goes up, as equation (4) shows. Apart from that, our qualitative results do not hinge on the simplification introduced in Assumption 1.

### 3 With distributor

As already indicated, our main focus is on situation  $D$ , where a distributor buys the rights to transmit the channels' contents. Specifically, it signs contracts  $(f_1, F_1)$  and  $(f_2, F_2)$  with the two TV stations;  $f_i$  is a variable fee that  $TVi$  charges the distributor per unit of content a viewer watches, and  $F_i$  is a fixed fee. The size of these fees are determined at stage 1, and at stage 2 the distributor sets viewer prices and the TV channels set advertising prices.

Profits of the distributor and of  $TVi$  are now given, respectively, by:

$$\Pi = \sum_{j=1}^2 [(p_j - f_j) C_j - F_j], \text{ and} \quad (6)$$

$$\pi_i = r_i A_i + f_i C_i + F_i, \quad i = 1, 2. \quad (7)$$

We start out with stage 2 and solve first  $\frac{d\pi_i}{dr_i} = 0, i = 1, 2$ , to find  $TVi$ 's best response:

$$r_i = \frac{1 - p_i + f_i - sr_j}{2(2 - s)}, \quad i, j = 1, 2, \quad i \neq j. \quad (8)$$

Equation (8) shows that  $\frac{dr_i}{dp_i} < 0$ . This is essentially because an increase in  $p_i$  reduces the viewing time at  $TVi$  and thus the willingness among advertisers to pay for an ad. We also have  $\frac{dr_i}{dr_j} < 0$ . This is because channel  $j$  will have less ads if it increases its advertising price, and will thus become more attractive to the viewers. Thereby channel  $i$  becomes relatively less attractive, making it optimal to charge a lower advertising price. Advertising prices are consequently strategic substitutes, in contrast to what is typically the case with prices in one-sided markets.<sup>6</sup>

Next, let us consider the distributor's maximization problem. Holding advertising prices fixed, and solving  $\{p_1, p_2\} = \arg \max \Pi$ , we find

$$p_i = \frac{1}{2} + \frac{f_i + (2 - s)r_i + sr_j}{2}. \quad (9)$$

Viewer prices are naturally increasing in the distributor's marginal costs, so that we have  $\frac{dp_i}{df_i} > 0$ . We further see that viewer prices are increasing in the TV stations'

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<sup>6</sup>This is a mechanism that is present also in other models of media markets, see for example Nilssen and Sørsgard (2001), Gabszewicz *et al.* (2004), and Kind *et al.* (2009).

advertising prices:  $\frac{dp_i}{dr_i} > 0$  and  $\frac{dp_i}{dr_j} > 0$ . This is so because the higher the advertising prices, the less ads the TV stations will show, and the more attractive they will be for viewers. Therefore the distributor finds it optimal to charge higher prices.

Equilibrium prices are, from (8) and (9), as follows:<sup>7</sup>

$$p_i = \frac{1}{2} + \frac{1 + (6 - s)f_i}{2(5 - s)} - \frac{s(2 - s)}{4(5 - 4s)(5 - s)}(f_i - f_j), \text{ and} \quad (10)$$

$$r_i = \frac{1 + f_i}{2(5 - s)} + \frac{3s}{4(5 - 4s)(5 - s)}(f_i - f_j). \quad (11)$$

### 3.1 Symmetric, exogenous wholesale prices

Below we shall endogenize the wholesale prices, but to see the mechanisms as clearly as possible it is useful first to fix them at some exogenous values, with  $f_1 = f_2 = f$  and  $F_1 = F_2 = F$ . In order to ensure non-negative prices and quantities, we assume that

$$-1 < f \leq \frac{2 - s}{8 - s}. \quad (12)$$

We shall later see that this holds when contract terms are endogenized.

Equations (10) and (11) yield

$$p = \frac{1}{2} + \frac{1 + (6 - s)f}{2(5 - s)}, \text{ and } r = \frac{1 + f}{2(5 - s)}, \quad (13)$$

where we for simplicity have skipped subscripts. We further have

$$C = \frac{6 - s - (4 - s)f}{8(5 - s)}, \text{ and } A = \frac{2 - s - (8 - s)f}{4(5 - s)}. \quad (14)$$

The fact that the advertising volume decreases in  $f$  induces the distributor to set a viewer price that increases in  $f$ : the higher  $f$  is, the less advertising there is on TV, and the more are viewers willing to pay for TV. Additionally, a higher  $f$

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<sup>7</sup>Note that this holds only when the expression for advertising prices is positive, which requires that variable fees  $f_1$  and  $f_2$  are not too different, in particular that

$$\frac{3s}{5(2 - s)} < \frac{1 + f_1}{1 + f_2} < \frac{5(2 - s)}{3s}.$$

means an increase in the distributor's marginal cost. This magnifies the positive relationship between  $p$  and  $f$  further. We therefore have  $\frac{dp}{df} > 0$ .

The distributor chooses viewer prices without taking into consideration that, since a higher such price reduces viewing time, advertising revenue will fall. The TV stations likewise choose advertising levels without taking into consideration that more advertising reduces viewers' willingness to pay for watching TV. These neglections have the important implication that the generalized viewer price,  $G = p + A = \frac{1}{2} + \frac{4-s}{4(5-s)}(1+f)$ , is higher than the one maximizing joint profits:  $G > G^{opt} = p^{opt} = 1/2$ ; recall the restriction  $f > -1$ .

It is now straightforward to verify the following:<sup>8</sup>

**Lemma 1** *With distributor. Suppose that wholesale prices are fixed and symmetric ( $f_1 = f_2 = f$ ). The generalized viewer price and the advertising level are inefficiently high, but decrease in  $s$  ( $\frac{dG}{ds} < 0$ ,  $\frac{dA}{ds} < 0$ ). The advertising price and the viewer price increase in  $s$  ( $\frac{dr}{ds} > 0$ ,  $\frac{dp}{ds} > 0$ ).*

The closer substitutes the TV stations' contents, the more fiercely will the stations compete in having few advertising slots (and the higher will the advertising prices be).<sup>9</sup> This explains why  $\frac{dA}{ds} < 0$  and  $\frac{dr}{ds} > 0$ . The lower advertising volume in turn allows the distributor to charge higher viewer prices:  $\frac{dp}{ds} > 0$ . However, since the generalized price is excessively high ( $G > G^{opt}$ ), the distributor increases the monetary price by less than what the reduced advertising volume would allow for. Thus, the generalized price decreases in  $s$ :  $\frac{dG}{ds} < 0$ .

The distributor's profit is found from equations (6), (13), and (14):

$$\Pi = 2[(p-f)C - F] = \frac{1}{8} \left( \frac{6-s-f(4-s)}{5-s} \right)^2 - 2F, \quad (15)$$

while each TV station's profit is

$$\pi = rA + fC + F = \frac{(1+f)[(4-s)(10-s)(1-f) - 2fs]}{16(5-s)^2} + F. \quad (16)$$

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<sup>8</sup>We have  $\frac{dA}{ds} = 3\frac{dG}{ds} = -\frac{1+f}{4(5-s)^2} < 0$ , and  $\frac{dr}{ds} = \frac{dp}{ds} = \frac{1+f}{2(5-s)^2} > 0$ .

<sup>9</sup>This is a core result on the effect of utility-reducing advertising in two-sided markets, see e.g. Barros *et al.* (2004) and Anderson and Coate (2005).

Joint profits thus equal

$$\Pi^D = \Pi + 2\pi = \frac{(1+f)[(40-12s+s^2)(1-f)-2s]}{8(5-s)^2}. \quad (17)$$

We can now show the following:<sup>10</sup>

**Lemma 2** *With distributor. Suppose that wholesale prices are fixed and symmetric ( $f_1 = f_2 = f$ ). Joint industry profits increase in  $s$ :  $\frac{d\Pi^D}{ds} > 0$ .*

Technically, it is not surprising that joint profits increase in  $s$ , since  $G > G^{opt}$  and  $\frac{dG}{ds} < 0$ . It is nonetheless remarkable that stronger competition between the TV stations benefits both the industry and consumers (the latter following trivially from the fact that consumer surplus is higher the lower is the generalized viewer price).

### 3.2 Endogenous wholesale prices

At stage 1 the distributor and the TV stations bargain over the wholesale contracts  $(f_1, F_1)$  and  $(f_2, F_2)$ . This bargaining is done simultaneously and independently between the distributor and each TV station. Since the two parties in each negotiation bargain over two-part tariffs, this bargaining will be efficient, in the sense that the distributor and TV station  $i$  will agree on that variable fee  $f_i$  that maximizes their joint profits, taking  $f_j$  as given. The distributor and  $TVi$  thus seek to maximize

$$\begin{aligned} \Pi + \pi_i &= [(p_i - f_i)C_i + (p_j - f_j)C_j - F_i - F_j] + [f_iC_i + r_iA_i + F_i] \\ &= p_iC_i + r_iA_i + (p_j - f_j)C_j - F_j \end{aligned} \quad (18)$$

with respect to  $f_i$ .

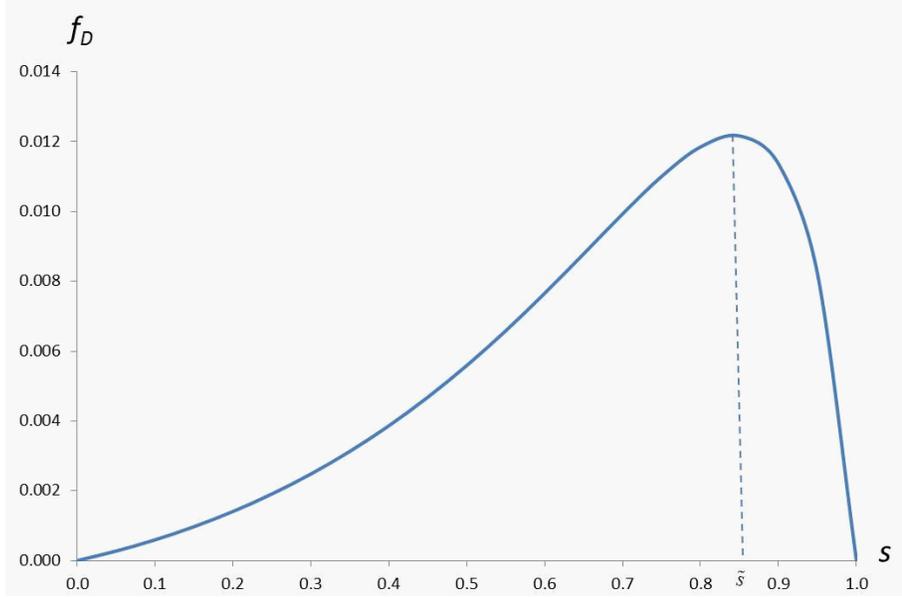
Simultaneous maximization of (18) for each  $i$  gives rise to a symmetric equilibrium in which the two variable fees are the same and equal to

$$f_D := \frac{s(1-s^2)}{2[100(1-s)^2 + s(18-s)(1-s^2) + 4s]} > 0 \text{ for } s \in (0, 1). \quad (19)$$

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<sup>10</sup>Using (15) and (16) yields  $\frac{d\Pi^D}{ds} = \frac{(1+f)[11-3s+2fs-14f]}{4(5-s)^3} > 0$ , as long as (12) holds.

From equation (19) we see that  $f_D \rightarrow 0$  as  $s \rightarrow 0$  or  $s \rightarrow 1$ . More generally,  $f_D$  is a hump-shaped function of  $s$  ( $\frac{df_D}{ds} > 0$  for  $s < \tilde{s}$  and  $\frac{df_D}{ds} < 0$  for  $s > \tilde{s}$ ), as shown in Figure 2. And  $f_D$  satisfies our assumption in (12).



**Figure 2:** *Variabel fees from the distributor to the TV channels.*

From Lemma 1 we know that  $A$  decreases in  $s$  and that  $p$  increases in  $s$  if the wholesale price is constant. This relationship is even stronger when  $\frac{df_D}{ds} > 0$ , but it does not necessarily hold when  $\frac{df_D}{ds} < 0$ . The reason is that a lower wholesale price tends to make it more profitable for a TV station to sell ads and for the distributor to reduce the viewer price. However, by inserting for (19) into (13) and (14), we can nonetheless state:

**Proposition 1:** *With distributor. Suppose that  $f$  is endogenous.*

- a) *The generalized viewer price monotonically decreases in  $s$ , with  $G > G^{opt}$  for all  $s$ .*
- b) *The advertising level is lower in the neighbourhood of  $s = 1$  than at  $s = 0$ :  $A_{s \rightarrow 1} < A_{s=0}$ .*
- c) *Both the viewer price and the advertising price are higher in the neighbourhood of  $s = 1$  than at  $s = 0$ :  $p_{s \rightarrow 1} > p_{s=0}$ , and  $r_{s \rightarrow 1} > r_{s=0}$ .*

By inserting for (19) into (17) we find joint profits. Since the generalized price is inefficiently high, but decreasing in the substitutability between the channels, we find, analogously to Lemma 2, that aggregate industry profits are higher the less differentiated are the TV stations' contents:

**Proposition 2:** *With distributor. Suppose that  $f$  is endogenous. Joint industry profits increase in  $s$ :  $\frac{d\Pi^D}{ds} > 0$ .*

The finding that  $f_D > 0$  is somewhat surprising. The fact that  $G > G^{opt}$  indicates that the wholesale price should optimally be negative in order to press down the generalized price. It can be verified that this actually is true: if the distributor and the two TV stations could negotiate jointly, then they would set  $f^{opt} < 0$ . The reason why  $f_D$  nonetheless is positive, is the inefficiency that arises in the negotiations because the parties do not take into account how a change in  $f_i$  affects profits for  $TVj$ . More specifically, a higher  $f_i$  increases the relative profitability of the viewer market compared to the advertising market for  $TVi$ , making it optimal to reduce its advertising volume (through a higher advertising price). This is negative for TV station  $j$ , who consequently responds by reducing its own advertising volume. Therefore also  $TVj$  loses advertising revenue when  $f_i$  increases.

So  $f = f^{opt} < 0$  is not a Nash equilibrium. If the distributor and  $TV1$ , say, agreed on setting  $f_1 = f^{opt}$ , then the distributor and  $TV2$  would increase their joint profit by setting  $f_2 > f^{opt}$ . But even if  $f = f^{opt}$  is not implementable, we might imagine that the industry is able to commit to using only a fixed fee and not a two-part tariff in the wholesale contracts. Putting  $f = 0$  in equation (17) we find that aggregate industry profit now is equal to

$$\Pi_{f=0}^D = \frac{(10-s)(4-s)}{8(5-s)^2}. \quad (20)$$

As under a two-part tariff, the fixed fees ( $F_1$  and  $F_2$ ) will be used to distribute profits according to the parties' bargaining power. Comparing joint profits in this case with what the industry achieves with an arbitrary wholesale price, we find<sup>11</sup>

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<sup>11</sup>We have  $\Pi_{f=0}^D - \Pi^D = \frac{f[(40-12s+s^2)f+2s]}{8(5-s)^2} > 0$ , for  $f > 0$ . Since  $f_D > 0$  for  $s \in (0,1)$ , the result follows.

**Proposition 3:** *With distributor. Joint profits are higher in an equilibrium with a simple fixed-fee wholesale contracts ( $f_i = 0$ ) than in a Nash equilibrium with two-part wholesale tariffs ( $f_i = f_D$ ).*

## 4 No distributor

Now, let us look at the alternative situation, where the TV channels sell directly to viewers. As argued in the Introduction, this is a scenario that is of increasing relevance as technological developments allow TV stations to use the Internet in order to bypass distributors. This means that the TV stations decide both advertising and viewer prices, and that they do not have to pay any distribution fees to downstream firms ( $f_i \equiv 0, F_i \equiv 0$ ). The profit level of  $TVi$  is then simply equal to

$$\pi_i = p_i C_i + r_i A_i. \quad (21)$$

Solving  $\frac{\partial \pi_i}{\partial r_i} = 0$  and  $\frac{\partial \pi_i}{\partial p_i} = 0$ , we find  $TVi$ 's best responses to  $TVj$ 's prices:

$$r_i = \frac{1 - sr_j}{2(2 - s)}, \text{ and} \quad (22)$$

$$p_i = \frac{2(1 - s) + sp_j}{2(2 - s)}. \quad (23)$$

Note that advertising prices are strategic substitutes also in this case; best-response function (22) is qualitatively similar to the one in the previous case, equation (16). Equation (23) reveals a new aspect, though: the channels compete in viewer prices when they bypass the distributor, and these prices are strategic complements:  $\frac{dp_i}{dp_j} > 0$ .

Solving the system of equations in (22) and (23), we obtain equilibrium prices:

$$r = \frac{1}{4 - s}, \text{ and} \quad (24)$$

$$p = \frac{2(1 - s)}{4 - 3s}, \quad (25)$$

where subscripts are disregarded for simplicity.

Equations (2), (4), (24), and (25) further imply:

$$A = \frac{s^2}{2(4-3s)(4-s)}, \text{ and} \quad (26)$$

$$C = \frac{4(4-3s) + s^2}{4(4-3s)(4-s)}. \quad (27)$$

From equations (24) through (27) we can derive:

**Proposition 4:** *No distributor. The monetary and generalized viewer prices decrease in  $s$  ( $\frac{dp}{ds} < 0$ ,  $\frac{dG}{ds} < 0$ ), while the advertising volume and the advertising price increase in  $s$  ( $\frac{dA}{ds} > 0$ ,  $\frac{dr}{ds} > 0$ ).*

Proposition 4 implies that advertising becomes a more important source of revenue the closer substitutes the TV stations are, while the opposite is true for viewer payments. Note in particular that  $p \rightarrow 0$  in the limit as  $s \rightarrow 1$ , in which case the industry is unable to raise revenue from the viewer market. This reflects the fact that viewer prices are strategic complements, resulting in marginal-cost pricing in the limit when the consumers perceive the stations' contents as being perfect substitutes. The explanation for why the advertising market is still profitable even as  $s \rightarrow 1$ , 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.

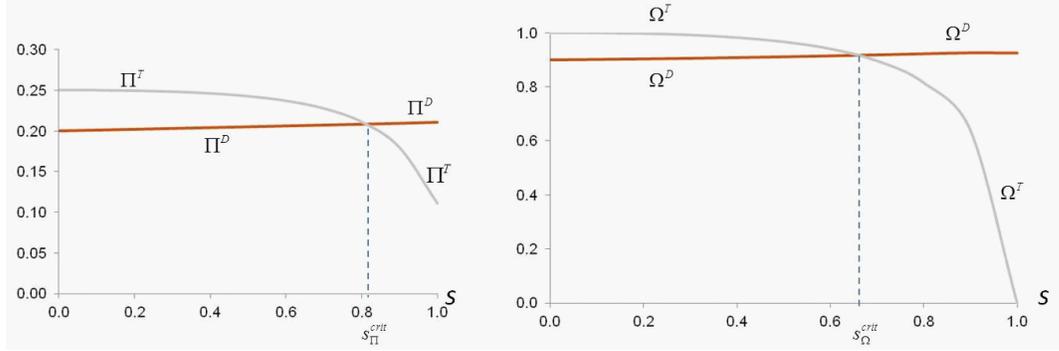
Joint industry profits, called  $\Pi^T$ , are now simply equal to aggregate profits for the TV stations:

$$\Pi^T = 2\pi = \frac{[16(1-s) + s^2](2-s)^2}{(4-3s)^2(4-s)^2}.$$

## 5 A comparison

Let us now compare the performance of the two market structures, with and without a distributor. They behave quite differently, depending on the similarity of the TV stations' contents. This is illustrated in Figure 3. The left-hand-side panel of the figure measures industry profit, and we see that bypassing the distributor yields highest joint profit if and only if  $s$  is sufficiently low ( $s < s_{\Pi}^{crit}$ ). To see why, suppose

first that  $s = 0$ . Then each TV channel behaves like a monopolist, and it perfectly balances the externalities across the two sides of the market when the distributor is not there. Thus, individual profit maximization coincides with industry optimum. This is not the case when the distributor is there: now the generalized price – as noted above – will be too high, since different firms set prices on the two sides of the market.



**Figure 3:** *Comparison of market structures.*

The problem with the situation without a distributor is the lack of inter-firm price coordination. Competition between the TV channels will press down viewer prices, and more so the better substitutes the viewers perceive the channels' contents to be. Indeed, as  $s$  approaches 1, any attempt to charge the viewers for watching TV will induce the rival to undercut in a Bertrand manner. The same is not true in the other case, when the distributor is present. Now the distributor internalizes price effects, taking into account that a lower  $p_1$  will reduce the revenue it can raise from  $TV_2$ , and vice versa. The advantage for the industry of internalizing these competitive externalities is greater than the disadvantage of not being able to internalize the two-sidedness of the market (the externalities between advertisers and viewers) if  $s > s_{\Pi}^{crit}$ . In other words, when competition for viewers is sufficiently strong, the need for intra-firm price coordination is dominated by the need for inter-firm price coordination.

From these reflections it also follows that the relative importance of viewer payments,  $\Omega = \frac{pC}{pC+rA}$ , necessarily must be lower without a distributor than with one, if  $s$  is above a critical value. In the right-hand-side panel of Figure 3 we consequently have  $\Omega^T < \Omega^D$  for  $s > s_{\Omega}^{crit}$ .

If  $s > s_{II}^{crit}$ , then total industry profits are higher if the TV stations use a distributor, even if this intermediate firm does not have any value *per se*. We have illustrated this by using a very specific model. However, we believe that our findings are quite robust to alternative assumptions both on the supply and the demand side. Specifically, no matter how complex the contracts between distributors and TV channels, a market structure where different firms set prices on the two sides of the market can hardly be more efficient than one where the two-sidedness is fully internalized if we consider a TV channel that offers unique content (which in our context should be interpreted as  $s$  being close to zero). Likewise, it is difficult to see how channels with non-unique content (high  $s$ ) should be able to raise higher profits if they compete head-to-head than if they delegate the pricing decision to a firm that internalizes the competitive externalities on the viewer side of the market.

## 6 Concluding remarks

Our analysis illustrates the challenge firms face when they try to coordinate prices in a two-sided market. It might seem appropriate to let an independent distributor set viewer prices in order to reduce competition between TV channels in the viewer market. This could lead to a cartel-like outcome in a one-sided market, but not in a two-sided market. The problem is that inter-firm price coordination on just one side of the market prevents intra-firm price coordination. In this paper we show that this might lead to inefficiently high generalized prices, and possibly more so if the wholesale contracts between a distributor and a TV channel consist of a two-part tariff rather than a simple fixed fee.

An alternative could be to combine an independent distributor that coordinates viewer prices with other ways to take the two-sidedness into account. For example, the distributors' payment to the TV channels could depend on the TV channels' advertising revenues. However, this does not seem to be a common business model, at least not in the UK or Scandinavia.<sup>12</sup> An interesting research question is why

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<sup>12</sup>See Ofcom (2010), who write the following concerning regulation of the pay TV industry: ‘... we proposed to put in place linear, per subscriber prices such that a retailer’s payments for the

this is so; could it for instance be due to contractual problems that arise when each distributor bargains with a large number of TV channels?

Since the generalized viewer prices tends to be too high when the distributor sets viewer prices, one might imagine that the coordination problem could be overcome by employing resale price maintenance (RPM), where the TV stations set a maximum price that the distributor can charge from the viewers.<sup>13</sup> But if RPM is enforced and viewer prices are reduced, this would in turn change the the rivalry between the TV channels in the advertising market. In that respect the consequences of RPM is more complex in a two-sided than in a corresponding one-sided market. We leave this issue for future research.

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*wholesale channels would increase linearly with the number of subscribers. Our proposed approach is the current industry norm*' (paragraph 10.36, p. 521), and '*... The Three Parties (BT, Top UP TV and Virgin Media) agreed with our proposed approach to set linear, per subscriber charges in recognition of the fact that this is the current industry norm*' (paragraph 10.37, p. 521). Although linear prices are the industry norm, both the Three Parties and Sky argue that they should be able to negotiate two-part tariffs. However, this would not solve the problems related to the two-sidedness of the market that we focus on.

<sup>13</sup>This is discussed in an earlier version of the paper. See also Gabrielsen *et al.* (2013), who discuss incentives for imposing RPM in two-sided markets.

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