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# Channel Coordination in the Presence of a Dominant Retailer

## **Abstract**

The retail trade today is increasingly dominated by large, centrally managed “power retailers.” In this paper, we develop a channel model in the presence of a dominant retailer to examine how a manufacturer can best coordinate such a channel.

We show that such a channel can be coordinated to the benefit of the manufacturer through either quantity discounts or a menu of two-part tariffs. Both pricing mechanisms allow the manufacturer to charge different effective prices and extract different surpluses from the two different types of retailers, even though they both have the appearance of being “fair.” However, quantity discounts and two-part tariffs are not equally efficient from the manufacturer’s perspective as a channel coordination mechanism. Therefore, the manufacturer must judiciously select its channel coordination mechanism.

Our analysis also sheds light on the role of “street money” in channel coordination. We show that such a practice can arise from a manufacturer’s effort to mete out minimum incentives to engage the dominant retailer in channel coordination. From this perspective, we derive testable implications with regard to the practice of street money.

## **Keywords**

distribution channels, channel power, channel coordination

## **Disciplines**

Business | Business Administration, Management, and Operations | Marketing | Operations and Supply Chain Management | Organizational Behavior and Theory

# **Channel Coordination in the Presence of a Dominant Retailer**

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## Technical Note: Alternative Model Specification

Consider a dominant-retailer channel characterized by the following demand functions:

$$Q_d = \gamma(\alpha - \beta p) + s, \quad (1)$$

$$Q_c = (1 - \gamma)(\alpha - \beta p), \quad (2)$$

$$Q_m = \alpha - \beta p + s. \quad (3)$$

Relative to the model specified in our paper, this specification essentially increases the incentive for the dominant retailer to provide  $s$  at any given cost  $f$ , since the dominant retailer's demand can be written as  $Q_d = \gamma(\alpha - \beta p + s) + (1 - \gamma)s$ , and eliminates any free-riding on  $s$  by fringe retailers.

### 1. Integrated Channel

As the channel demand remains the same under this alternative model specification, the price and profit for the integrated channel are the same as in our paper. We have for the integrated channel:

$$\Pi^*(s, f) = \frac{(\alpha - \beta c + s)^2}{4\beta} - f, \quad (4)$$

$$p^* = \frac{\alpha + \beta c + s}{2\beta}, \quad Q_m^* = \frac{\alpha - \beta c + s}{2}, \quad (5)$$

where  $c$  is the marginal cost of production.

### 2. Channel Conflict

By following the same procedures as in our paper, we can derive the equilibrium for this alternative model when the channel is not coordinated. Toward that end, we assume  $\gamma > \frac{1}{2}$ ,  $c > (\frac{1}{\gamma} - 1)s$ ,  $\alpha > \beta c + 2(2n + 1)s$ ,  $n \geq 2$ , and  $f < f_c$ . We maintain these assumptions throughout this technical note. Further to simplify our notation, define

$$f_a = \frac{s[\gamma(\alpha - \beta c) + 2(1 - \gamma)s]}{4\beta\gamma}, \quad (6)$$

$$f_b = \frac{s[\alpha\gamma - \beta c\gamma + 2s - 2\gamma s + \sqrt{(2\gamma - 1)s(2\alpha\gamma - 2\beta c\gamma - s + 2\gamma s)}]}{4\beta\gamma}, \quad (7)$$

Table 1: Equilibrium for Decentralized Channel

	<b>Merchandising</b> ( $0 \leq f \leq f_a$ )	<b>Merchandising</b> ( $f_a < f \leq f_b$ )
$\tilde{p}$	$\frac{\gamma(3\alpha+\beta c+2s)+s}{4\beta\gamma}$	$\frac{4\alpha\gamma s+3s^2-4\beta\gamma f}{4\beta\gamma s}$
$\tilde{w}$	$\frac{\gamma(\alpha+\beta c+2s)-s}{2\beta\gamma}$	$\frac{s(2\alpha\gamma+s)-4\beta\gamma f}{2\beta\gamma s}$
$\tilde{\pi}_m$	$\frac{(\alpha\gamma-\beta c\gamma+2\gamma s-s)^2}{8\beta\gamma^2}$	$\frac{[4\beta f\gamma+(4\gamma-3)s^2][s(2\alpha\gamma+s)-2\beta\gamma(2f+cs)]}{8\beta(\gamma s)^2}$
$\tilde{\pi}_d$	$\frac{[\gamma(\alpha-\beta c)+(3-2\gamma)s]^2}{16\beta\gamma} - f$	$\frac{(s^2-4\beta\gamma f)^2}{16\beta\gamma s^2}$
$\tilde{\pi}_c$	$\frac{(1-\gamma)[\gamma(\alpha-\beta c-2s)-s][r(a-\beta c)+(3-2\gamma)s]}{16\beta\gamma^2}$	$\frac{(1-\gamma)(4\beta\gamma f-3s^2)(4\beta f\gamma+s^2)}{16\beta(\gamma s)^2}$

$$f_c = \frac{s(2\alpha\gamma - 2\beta c\gamma + s)}{4\beta\gamma}, \quad (8)$$

$$f_d = \frac{s[\gamma(\alpha - \beta c) + (1 - \gamma)s]}{4\beta\gamma}. \quad (9)$$

Our analysis shows that when  $f_b < f < f_c$ , the equilibrium is such that  $s$  is not provided. In this case, we have (using the same notation as in our paper)

$$\begin{aligned} \tilde{p} &= \frac{3\alpha + \beta c}{4\beta}, \quad \tilde{w} = \frac{\alpha + \beta c}{2\beta}, \quad \tilde{\pi}_m = \frac{(\alpha - \beta c)^2}{8\beta}, \\ \tilde{\pi}_d &= \frac{\gamma(\alpha - \beta c)^2}{16\beta}, \quad \tilde{\pi}_c = \frac{(1 - \gamma)[\gamma^2(\alpha - \beta c)^2 - 4s^2]}{16\beta r^2}. \end{aligned}$$

The equilibrium where  $s$  is provided is summarized in Table 1. As is the case in our paper, the decentralized channel does not achieve the maximum profit that the channel can potentially generate due to the fact that the retail price is always higher than the channel profit optimizing price  $p^*$ .

### 3. Quantity Discount and Channel Coordination

The channel-coordinating quantity discount schedule can be easily derived in the same way as in our paper. It is given by

$$t^*(q) = \left( \frac{\alpha}{\beta} - \frac{q-s}{\beta\gamma} \right) \left( 1 - \frac{k_1^*}{\gamma} + \frac{k_1^*(1-\gamma)s}{q\gamma} \right) + \frac{k_1^*c}{\gamma} \left( 1 - \frac{(1-\gamma)s}{q} \right) - \frac{1-k_2^*}{q}f. \quad (10)$$

We determine  $k_1^*$  and  $k_2^*$  in the above schedule following the same steps detailed in our paper (Appendix A), and they are

$$k_1^* = \frac{\gamma(\alpha - \beta c - s)[(N\gamma + \gamma - 1)(\alpha - \beta c - s) + 2Ns]}{(\alpha - \beta c - s - 2Ns)[(2Nr + r - 1)(\alpha - \beta c) + (1 + 2N - \gamma)s]}, \quad (11)$$

$$k_2^* = \begin{cases} 1 & \text{if } 0 \leq f \leq k_1^* \frac{s(2\alpha - 2\beta c + s)}{4\beta} \\ k_1^* \frac{s(2\alpha - 2\beta c + s)}{4\beta f} & \text{if } k_1^* \frac{s(2\alpha - 2\beta c + s)}{4\beta} < f \leq f_c. \end{cases} \quad (12)$$

Note that the optimal quantity discount schedule in equation (10) is nonlinear in  $q$  here, more complex than the corresponding schedule in our paper. This is due to the fact that our paper specifies a simple relationship between  $Q_d$  and  $Q_m$  or  $Q_m = Q_d/\gamma$ . That relationship is more complex here, given by  $Q_m = s + (Q_d - s)/\gamma$ . However, it is straightforward to verify that the qualitative nature of this schedule has not changed. Given our assumption about  $\alpha$ , we can show  $0 < k_1^* < \gamma$  and  $\frac{dt^*(q)}{dq} |_{f=0} < 0$ .

The payoff for the manufacturer under this quantity discount schedule is given by

$$\pi_m^d = \begin{cases} \frac{(1-k_1^*)(\alpha - \beta c + s)^2}{4\beta} & \text{if } 0 \leq f \leq k_1^* \frac{s(2\alpha - 2\beta c + s)}{4\beta} \\ \frac{(1-k_1^*)(\alpha - \beta c + s)^2}{4\beta} - (1 - k_2^*)f & \text{if } k_1^* \frac{s(2\alpha - 2\beta c + s)}{4\beta} < f \leq f_c. \end{cases} \quad (13)$$

### 4. Two-Part Tariffs and Channel Coordination

The derivation of the channel coordinating menu of two-part tariffs follows the same process as described in Section 4 of our paper (and also Appendix B). Again, the key to coordinating this dominant retailer channel is to motivate the retailer to set its price at  $p^*$  and the manufacturer can do so only if it sets  $w_d^* = \frac{\beta\gamma c - (1-\gamma)s}{\beta\gamma}$ . Under the new specification, the dominant retailer has more

an incentive to mark-up on the wholesale price when  $s$  is provided so that the manufacturer must lower its wholesale price to motivate the provision of  $s$ . Then, to determine  $F_d$ ,  $F_c$ , and  $w_c$ , the manufacturer solves the following optimization problem:

$$\max_{(F_d, F_c, w_c)} \frac{\beta\gamma(1-\gamma)(\alpha-\beta c-s)(w_c-c) - (1-\gamma)s(\alpha\gamma-\beta c\gamma+(2-\gamma)s)}{2\beta\gamma} + F_d + NF_c \quad (1)$$

$$F_d \leq \frac{[\gamma(\alpha-\beta c) + (2-\gamma)s]^2}{4\beta\gamma} - f, \quad (2)$$

$$F_c \leq (1-\gamma)\frac{(\alpha-\beta c-s)[\alpha+s+\beta(c-2w_c)]}{4\beta N}, \quad (3)$$

$$F_d - F_c \geq (1-\gamma)\frac{(\alpha-\beta c-s)[(1-\gamma)s + \beta r(w_c-c)]}{2\beta N\gamma} \quad (4)$$

$$F_d - F_c \leq \frac{[\beta\gamma(w_c-c) + (1-\gamma)s][2\alpha\gamma + (3-\gamma)s - \beta\gamma(w_c+c)]}{4\beta\gamma}. \quad (5)$$

It can be shown that the optimal solution requires that constraints (3) and (5) are both binding and constraint (2) is not. In other words, the manufacturer will take all surplus away from fringe retailers but not from the dominant retailer. From the two binding constraints, we can solve for  $F_c$  and  $F_d$ , all as a function of  $w_c$ . Substituting them into the target function (1), we can see that the target function is strictly concave in  $w_c$ . Thus, we can proceed to find the optimal  $w_c$  and then  $F_c$  and  $F_d$ . The solutions are given below:

$$F_c = \begin{cases} 0 & \text{if } 0 \leq f \leq f_d \\ \frac{(1-\gamma)(\alpha-\beta c-s)[\beta\gamma(4f+cs) - s(\alpha\gamma+(1-\gamma)s)]}{4\beta N\gamma s} & \text{if } f_d < f \leq f_c, \end{cases} \quad (6)$$

$$F_d = \begin{cases} \frac{3[\alpha\gamma-\beta c\gamma+(2-\gamma)s]^2}{16\beta\gamma} & \text{if } 0 \leq f \leq f_d \\ \bar{F}_d & \text{if } f_d < f \leq f_c, \end{cases} \quad (7)$$

$$w_c = \begin{cases} p^* & \text{if } 0 \leq f \leq f_d \\ w_s & \text{if } f_d < f \leq f_c, \end{cases} \quad (8)$$

$$\pi_m = \begin{cases} \frac{(4-\gamma)\gamma(\alpha-\beta c)^2 + s[2\gamma(2+\gamma)(\alpha-\beta c) - (4-8\gamma+\gamma^2)s]}{16\beta\gamma} & \text{if } 0 \leq f \leq f_d \\ \bar{\pi}_m & \text{if } f_d < f \leq f_c, \end{cases} \quad (9)$$

where

$$\bar{F}_d = \frac{1}{16\beta N\gamma s^2} \{-4\beta^2\gamma[4f^2N\gamma + 4cf(1-\gamma)s - c^2(N\gamma + \gamma - 1)s^2]\}$$

$$\begin{aligned}
& + s^2[4\alpha^2\gamma(N\gamma + \gamma - 1) - 4\alpha(1 - (3 + 4N)\gamma + 2(1 + N)\gamma^2)s \\
& + (4(1 - \gamma)^2 + N(15 - 16\gamma + 4\gamma^2))s^2] - 4\beta s[2\alpha\gamma(2f(\gamma - 1) + c(-1 + \gamma + N\gamma)s) \\
& + s(2f(2 + N - 2\gamma)\gamma + c(-1 + (3 + 4N)\gamma - 2(1 + N)\gamma^2)s)]\} \tag{10} \\
\bar{\pi}_m & = \frac{1}{16\beta N\gamma s^2} \{-4\beta^2\gamma[4f^2N\gamma + 4cf(1 - \gamma)s - c^2(N + \gamma - 1)s^2] \\
& + s^2[4\alpha^2\gamma(N + \gamma - 1) + 4\alpha(-1 + (3 + 2N)\gamma - 2\gamma^2)s \\
& + (4(1 - \gamma)^2 + N(4\gamma - 1))s^2] - 4\beta s[2\alpha\gamma(2f(\gamma - 1) + c(-1 + \gamma + N)s) \\
& + s(2f(2 + N - 2\gamma)\gamma + c(-1 + 3\gamma + 2N\gamma - 2\gamma^2)s)]\} \tag{11}
\end{aligned}$$

## 5. Winners and Losers of Channel Coordination

Due to the complexity of the payoff expressions, it is no longer possible to determine precisely under what conditions a quantity discount schedule may dominate a menu of two-part tariffs, even with the aid of *Mathematica*. However, we note that with this alternative specification, the process of the derivations has not changed qualitatively, generating similar expressions. Furthermore, with a sufficiently small  $s$ , we know that this alternative model converges to the model in our paper so that all conclusions in our paper should carry over. Although we cannot determine precisely how small  $s$  has to be relative to other parameters, we know that  $s$  does not have to be very small. For instance, if we let  $\gamma = 0.6$ ,  $N = 3$ ,  $\alpha = 15$ ,  $\beta = 0.5$ ,  $s = 0.5$ , and  $c = 1$  (all our assumptions are satisfied), we will have  $f_c = 7.45$ ,  $k_1^* \frac{s(2\alpha - 2\beta c + s)}{4\beta} = 2.566$ , and  $f_d = 3.71$ . It is then straightforward to show that for all  $0 < f \leq 6.5$ , the menu of two-part tariffs dominates the quantity discount schedule in coordinating the channel and for  $6.5 < f \leq 7.45$ , the quantity discount schedule dominates. Furthermore, channel coordination with the optimally-chosen coordination mechanism is always more profitable for the manufacturer than if the channel is not coordinated. Both conclusions are qualitatively the same as in our paper, as seen from Figure 2 in our paper where one simply fixes  $\gamma$  and let  $f$  vary.



## 6. Zero-Sum Service Provision

Alternatively, consider a dominant-retailer channel characterized by the following demand functions:

$$Q_d = \gamma(\alpha - \beta p + s), \quad (12)$$

$$Q_c = (1 - \gamma)(\alpha - \beta p - s), \quad (13)$$

$$Q_m = \alpha - \beta p. \quad (14)$$

In this case, the manufacturer has no incentive to encourage the provision of service for two reasons. First, the total demand for the manufacturer is not elastic with regard to the service provision. Second, the service provision will increase the sales made by the dominant retailer, an outcome that the manufacturer does not want to see happening (the manufacturer can take all profit away from the competitive fringe).

There are two reasons as to why this model is not be as interesting as it may first appear. First, the incentives introduced by this model are counter-factual. Second, if  $s$  is sufficiently small, this model will converge to the previous model. Here  $s$  must be sufficiently small relative to other parameters in our model.