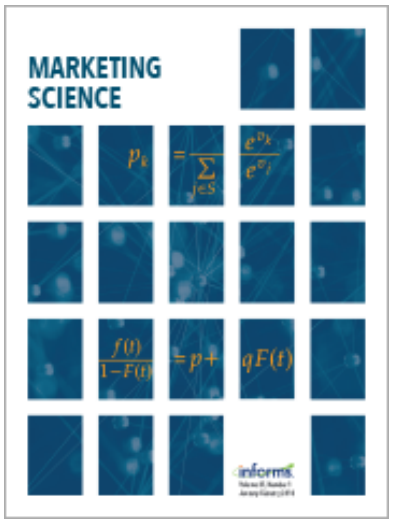

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Is Persuasive Advertising Always Combative in a Distribution Channel?

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The existing marketing literature suggests that persuasive advertising elicits counteractions from competing manufacturers and consequently leads to wasteful cancellation of the advertising effects. Thus, persuasive advertising is widely perceived to be combative in nature. A series of previously published papers demonstrates that appropriate targeting may partially mitigate the combative nature of persuasive advertising in that either the rival manufacturer or the retailer may benefit. In this paper, we complement their results by demonstrating the possibility that every channel member may benefit from persuasive advertising, i.e., a Pareto improvement along the distribution channel, thereby leading to the conclusion that persuasive advertising need not result in channel conflict.

Key words: persuasive advertising; product substitutability; channel conflict; game theory
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1. Introduction

By adopting persuasive advertising, a manufacturer is able to influence consumers' preferences so that its own product is more favorable from the consumers' viewpoint and at the same time makes the rival product a poorer substitute (thus attracting more consumers from the rival); see, e.g., Kelton and Kelton (1982). In light of this view, persuasive advertising is widely believed to be combative in nature (benefiting the advertising manufacturer but harming the rival manufacturer). However, a sequence of papers by Shaffer and Zettelmeyer (2002, 2004a, b) shows that this need not be the case if the manufacturers target their advertising appropriately to consumer segments within a market. Shaffer and Zettelmeyer (2002) find that a manufacturer's advertising may benefit the rival but unambiguously hurt the common retailer. In a similar vein, Shaffer and Zettelmeyer (2004b) show that the common retailer may be better off, but the rival manufacturer inevitably obtains a lower profit; see also Shaffer and Zettelmeyer (2004a). Collectively, they demonstrate that targeted advertising can *partially* mitigate the combative nature of the persuasive advertising.[1]

However, given the importance of avoiding channel conflict, and given the need to mitigate tit-for-tat advertising by the competitor, it is of interest to know whether persuasive advertising could ever be done so as to benefit all the channel members. To this end, we adopt the elegant framework proposed by Shaffer and Zettelmeyer (2004a) with two manufacturers, one independent common retailer, and a continuum of consumers with heterogeneous preferences. A consumer's gross utility of purchasing a product depends on the "transportation cost" that indicates the difference/distance between her ideal point and the product's position, and the manufacturers can decide whether to adopt persuasive advertising or not to affect consumers' preferences. The main difference from Shaffer and Zettelmeyer (2004a)

[1] The impact of targeting in informative advertising is studied in Iyer et al. (2005). They find that targeted advertising may mitigate the manufacturers' competition.

is that in our model, persuasive advertising enhances the consumers' valuation and at the same time reduces the product substitution through increasing the transportation cost (regarding the advertised product).

We find that the channel conflict can be eliminated when the manufacturer wisely targets those consumers without strong brand preferences. In doing so, targeted advertising may lead to a Pareto improvement along the entire distribution channel. The rival manufacturer may benefit from persuasive advertising because the targeting strategy allows the advertising manufacturer to focus on the consumers with moderate product preferences. This in turn allows the channel to extract more consumer surplus, and at the same time it reduces the originally intense competition between two products. Thus, both manufacturers can be better off.

Moreover, even though persuasive advertising decreases the product substitutability between competing manufacturers (which is widely believed to be to the retailer's detriment), we show that the retailer may be better off when the manufacturer's bargaining power is relatively limited. Thus, in contrast to the existing literature, we show that *these two consequences need not be mutually exclusive*; in other words, both the rival manufacturer and the retailer may benefit from persuasive advertising at the same time. Overall, our results speak to the strategic role and the versatile nature of persuasive advertising in line with Shaffer and Zettelmeyer (2002, 2004a, b).[2]

The targeting strategy discussed in this paper may be implemented either through tailored advertising contents or through a specific targeted media vehicle. For example, tobacco companies typically promote their cigarettes directly to women by "using feminine images" in their advertising,[3] and these tobacco companies typically sell their cigarettes to consumers through chain store retailers such as Rite Aid and Walgreens. Traditionally, R. J. Reynolds Tobacco Company targeted primarily male smokers and women who intend to show their preferences for being masculine, whereas Virginia Slims Capri and Misty identify themselves as the purely female brands. In this context, our proposed targeting strategy would suggest that one of these companies will make persuasive advertisement to those switchers that want a dual sex brand. Interestingly, in January 2007, R. J. Reynolds intended to target those younger adult female smokers who desire cigarettes that are "not too masculine, but not strictly female"; its advertisement appeared in numerous womens' magazines such as Glamour, Cosmopolitan, and Vogue to reach these "new consumers."[4]

As another example, in 2006, the Coca-Cola-owned juice brand Minute Maid launched an overarching campaign that shows their products "sprouting from trees and flowers" to target women between 25 to 54 years old. Furthermore, a primary goal of this campaign is to "lock up brand switchers—many of whom interchangeably substitute Minute Maid for other brands or other beverage choices."[5] Using a specific medium to precisely target consumer segments within a market is also widely observed. For instance, the hair-color products provider Clairol frequently purchases TV ads on high-profile sporting events and network and cable news programming to reach its target market—35- to 54-year old males who are 10%–50% gray.[6] Our results may provide useful guidelines for these companies to design their appropriate targeting strategies.

We organize the remainder of this paper as follows. In §2, we introduce our model characteristics. In §3, we describe the advertising impacts on the channel members' profits. Section 4 offers some discussions and concluding remarks. All the proofs are relegated to the appendix.

2. The Model

We consider a distribution channel with two manufacturers, one retailer, and a continuum of consumers with heterogeneous preferences. Each consumer is

[2] A recent paper by Chen et al. (2009) also investigates the impact of persuasive advertising in an *integrated channel* context without considering the possibility of using targeting. They find that persuasive advertising may mitigate (enhance) the manufacturers' competition if the consumers are highly sensitive (insensitive) to the advertising. In contrast, we focus exclusively on the common retailer channel and elaborate the benefit of targeting.

[3] Two classical examples are the "You've Come A Long Way Baby" and "Find Your Voice" ad campaigns by The Virginia Slims in the 1970s and 1980s. In these campaigns, strikingly beautiful women are featured demonstrating how smoking may signal their independence. Currently, tobacco companies continue running advertisements with strong images of "independence, stylishness, weight control, sophistication, and power" in numerous popular women's magazines (http://www.moalpha.org).

[4] This anecdote is described in more detail in "Tobacco industry targeting of women and girls" from http://www.tobaccofreekids.org. In reality, the company may need other marketing tools to make this strategic move successful, because simply showing the masculine cigarettes in magazines may not convince the switchers. Thus, R. J. Reynolds also modified their brand to "create" the new Camel No. 9 cigarettes to attract these younger female smokers.

[5] This is quoted from the campaign designer Doner, Southfield, Michigan; see http://www.brandweek.com/bw/esearch/article_display.jsp?vnu_content_id=1002875580. On a related note, among many others, Minute Maid's main competitor is the Pepsi-owned juice brand Tropicana, whose target market includes kids and older people. These juice manufacturers typically sell through (common) supermarkets such as Safeway, Costco, Walgreens, etc.

[6] See http://www.brandweek.com/bw/esearch/article_display.jsp?vnu_content_id=545926.

willing to purchase at most one unit of a product, and her preference is modeled as an ideal point, denoted by z, that lies on a Hotelling linear segment. Without loss of generality, the line segment is normalized to the unit interval, $[0, 1]$. The two manufacturers, labeled as manufacturer X and manufacturer Y, are symmetric and located at the endpoints of this line segment: 0 for manufacturer X and 1 for manufacturer Y. With some abuse of notation, we denote product $X(Y)$ as the product produced by manufacturer $X(Y)$. The production cost of each manufacturer is normalized to zero.

Upon purchasing the product, a consumer obtains a (gross) valuation V, irrespective of the product identity (X or Y). In addition, because the ideal point z may differ from the manufacturers' locations, the consumer incurs a "transportation cost." This transportation cost captures the negative utility arising from the discrepancy between her ideal point and the product position. In the standard Hotelling model, this transportation cost is assumed to be the same for both products X and Y. To model the advertising effect on the consumers' preferences, we consider a more general framework with (potentially) asymmetric transportation costs, and we let t_x and t_y denote the transportation costs per unit of length for products X and Y, respectively. By our construction, if a consumer located at z purchases product X, her net utility is $V - t_x z - p_x$, where p_x is the price charged by manufacturer X. Likewise, her net utility is $V - t_y(1-z) - p_y$ while purchasing from manufacturer Y (with p_y being the price of product Y).

The valuation can be enhanced by the manufacturer-initiated persuasive advertising (cf. Shaffer and Zettelmeyer 2004b). The transportation parameters t_x and t_y have identical initial values (denoted by t) and are affected by the manufacturer-initiated persuasive advertising. Specifically, if manufacturer X engages in persuasive advertising, the valuation of consumers exposed to that advertisement increases from V to $V + \Delta V$, and their transportation parameter increases from t to $t + \Delta t$ for product X ($t_x = t + \Delta t$), where $\Delta V > 2\Delta t$.[7] On the other hand, neither the valuation nor the transportation parameter for product Y is affected ($t_y = t$).[8] To simplify our analysis, we assume that the effect of persuasive advertising is limited and the consumers' valuation V is sufficiently large.[9]

In our model, the manufacturers sell the products through the common retailer, who determines the prices p_x and p_y, and we adopt the elegant framework in Shaffer (2002) to model the bargaining between the manufacturers and the retailer. Specifically, let Π_{xy} denote the integrated channel profit when the common retailer carries both products, and let $\Pi_x(\Pi_y)$ denote the integrated channel profit when the retailer carries only product $X(Y)$. Furthermore, the profit-sharing proportions (denoted by λ_x and λ_y) of manufacturers X and Y represent the bargaining power each manufacturer possesses vis-à-vis the common retailer. Given the profit-sharing proportions, the profits of manufacturers X and Y and the common retailer (denoted by π_x, π_y, and π_r, respectively) can be described as follows:

$$\pi_x = \lambda_x(\Pi_{xy} - \Pi_y),$$
$$\pi_y = \lambda_y(\Pi_{xy} - \Pi_x), \quad \text{and}$$
$$\pi_r = \Pi_{xy} - \pi_x - \pi_y.$$

In the next section, we investigate the impact of manufacturer-initiated persuasive advertising on the channel members.

3. The Impact of Persuasive Advertising

To highlight the role of persuasive advertising, as in Shaffer and Zettelmeyer (2004a), we focus on the situation in which only one manufacturer (X) advertises. Note that given the advertising strategies, the retailer can determine whether to carry the products or not by choosing appropriate prices p_x and p_y. Thus, we let Π_{xy}^{ad}, Π_x^{ad}, and Π_y^{ad} denote the channel profits if the common retailer carries both products, only product X, and only product Y, respectively, where the superscript ad depicts "advertising." Furthermore, we denote $\Delta\Pi_{xy}$, $\Delta\Pi_x$, and $\Delta\Pi_y$, respectively, as the

[7] This assumption ensures that the persuasive advertising increases the consumers' net utilities upon purchasing product X, and all the consumers are served if the retailer decides to carry only product X.

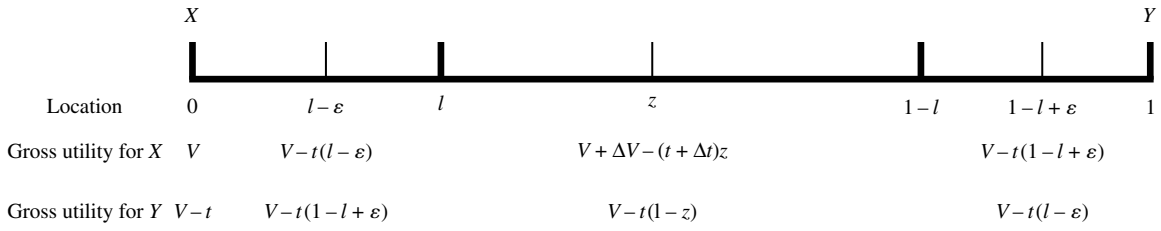
[8] Note that this is different from the setting of Shaffer and Zettelmeyer (2004a), where they assume that persuasive advertising increases the transportation parameters for both the manufacturer's own product and the opponent product simultaneously.

[9] Specifically, we require that $0 < \Delta t < (\sqrt{2} - 1)t$, $2\Delta t < \Delta V < (2t(t + \Delta t))/(3t + \Delta t)$, and

$$V \geq \max\Bigg\{2t, \frac{1}{2(2t+\Delta t)(2t+\Delta t-\Delta V)}[2t^2(3t-2\Delta V) + t\Delta t(8t-4\Delta V+3\Delta t)+2t(\Delta V)^2], \frac{1}{2t(2t+\Delta t)[(3t+\Delta t)\Delta V-2t(t+\Delta t)]}[4t^3(t-\Delta V)(3t+4\Delta t) + 2t^2(\Delta t)^2(3t-2\Delta V)+t^2(\Delta V)^2(t-6\Delta t) - (\Delta t)^2(\Delta V)^2(5t+\Delta t)]\Bigg\}.$$

These assumptions are made merely for ease of illustration; all our qualitative results are not sensitive to these assumptions.

Figure 1 Gross Utilities When Consumers from $[l, 1-l]$ Are Exposed to Ads



Note. ε is a very small number.

profit changes before and after the advertising by manufacturer X:

$$\begin{aligned} \Delta\Pi_{xy} &= \Pi_{xy}^{\text{ad}} - \Pi_{xy}, \\ \Delta\Pi_{x} &= \Pi_{x}^{\text{ad}} - \Pi_{x}, \quad \text{and} \\ \Delta\Pi_{y} &= \Pi_{y}^{\text{ad}} - \Pi_{y}. \end{aligned} \tag{1}$$

The corresponding profit changes for the manufacturers and the retailer are, respectively,

$$\begin{aligned} \Delta\pi_x &= \lambda_x(\Delta\Pi_{xy} - \Delta\Pi_y), \\ \Delta\pi_y &= \lambda_y(\Delta\Pi_{xy} - \Delta\Pi_x), \\ \Delta\pi_r &= \Delta\Pi_{xy} - \Delta\pi_x - \Delta\pi_y \\ &= (1-\lambda_x-\lambda_y)\Delta\Pi_{xy} + \lambda_x\Delta\Pi_y + \lambda_y\Delta\Pi_x. \end{aligned} \tag{2}$$

Having defined the profit changes, we are now ready to examine the impacts of manufacturer X's advertising on channel members' profits. As the manufacturer is able to adopt targeted advertising, we assume that the consumers located in $[l, 1-l]$, where $l \in [0, 1/2)$, are exposed to the advertisement. The parameter l specifies the portions of consumers who are exposed to the advertisement: the larger the value of l is, the smaller the portion of consumers the advertising reaches. From the above expression, we have implicitly assumed that the manufacturer intends to target the consumers in the middle (i.e., those without strong brand preferences). Note also that when $l = 0$, persuasive advertising increases the manufacturer's own profit and the retailer's profit but decreases the profit of the other manufacturer. In Figure 1, we illustrate the consumers' gross utilities for obtaining products X and Y when manufacturer X adopts such targeted advertising. As seen in Figure 1, only those consumers that lie in $[l, 1-l]$ obtain higher utilities upon purchasing from manufacturer X. The next proposition summarizes the profit changes in response to such strategic interaction.

Proposition 1. *Suppose consumers in* $[l, 1-l]$ *are exposed to manufacturer X's persuasive advertising.*

1. *Without targeting* (*i.e.*, $l = 0$), *persuasive advertising increases the manufacturer's own profit and the retailer's profit but decreases the profit of the other manufacturer.*

2. *With targeting* (*i.e.*, $l \in (0, 1/2)$), *manufacturer X always benefits from its persuasive advertising. Also, there exists a threshold* $l^* \in (0, 1/2)$ *such that* (a) *manufacturer Y gains from manufacturer X's persuasive advertising if and only if* $l > l^*$; *and* (b) *in this region, the retailer gains if manufacturer X's bargaining power* (λ_x) *is sufficiently low.*[10]

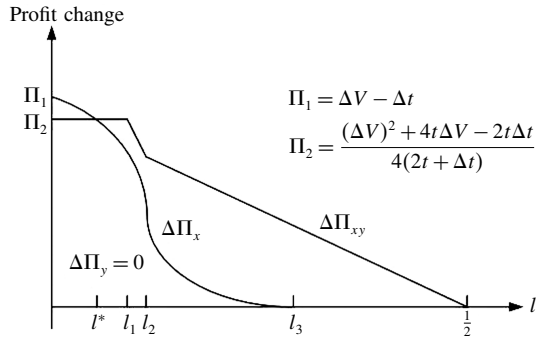
The above proposition states that if the manufacturer abandons the targeting strategy, the rival manufacturer loses; however, by targeting consumers located around the middle of the preference line $[0, 1]$, it may be possible that persuasive advertising makes all the channel members better off. Thus, the targeting strategy may allow the advertising manufacturer to eliminate the channel conflict.

Let us first focus on the case in which all consumers are exposed to the persuasive advertising. In such a scenario, since the persuasive advertising made by manufacturer X enhances the consumers' preferences toward product X, the retailer's strategic decision is whether to carry both products, only product X, or only product Y. To understand this result, observe in (2) that manufacturer X's profit change comes from the change in its marginal contribution because of its persuasive advertising. Persuasive advertising increases a consumer's utility upon purchasing product X and induces the retailer to carry product X and obtain more revenue. On the contrary, because persuasive advertising makes the retailer more willing to carry product X, manufacturer Y's marginal contribution goes down. This gives rise to a higher profit for the advertising manufacturer (X) but hurts the rival manufacturer (Y). We further find that the retailer always benefits from persuasive advertising because the enhanced valuation outweighs the substitution effect.

Now let us illustrate how the targeting alters the impacts of a manufacturer's persuasive advertising on the profits of other channel participants. As demonstrated in the proposition, targeting the consumers with moderate brand preferences may avoid channel conflict. To understand why a rival

[10] The exact values of these thresholds are characterized in the appendix.

Figure 2 Channel Profit Changes When Consumers from $[l, 1-l]$ Are Exposed to Ads



Note. The scales are not in regular proportion.

manufacturer may benefit from persuasive advertising, we first recall that the marginal change of manufacturer Y's profit is determined by $\Delta\pi_y = \lambda_y(\Delta\Pi_{xy} - \Delta\Pi_x)$ (see (2)). As shown in Figure 2, targeting the consumers in the middle increases Π_{xy} ($\Delta\Pi_{xy} > 0$) and does not affect Π_x ($\Delta\Pi_x = 0$). This is because manufacturer X's advertising increases the utilities of only the consumers in the middle over the advertised product X.

While carrying both products, the retailer can extract more surplus by raising prices of both products and selling more product X and less product Y. However, when the retailer carries only product X, targeting the consumers in the middle does not make the retailer change its decision on product X's price and market size. This is because the advertising does not earn so much utility-increasing effect and it is not profitable to increase product X's price to serve consumers located only in $[0, 1-l]$. Thus, $\Delta\pi_y = \lambda_y(\Delta\Pi_{xy} - \Delta\Pi_x)$ is positive, and manufacturer Y may benefit from the persuasive advertising as well. This implies that a manufacturer can benefit from its rival's persuasive advertising.

We also observe that the retailer benefits from persuasive advertising if manufacturer X's bargaining power (indicated by λ_x) is small enough. This is because persuasive advertising may lead to a higher channel profit, and the retailer benefits from it when she is able to seize a moderate portion. It is worth mentioning that such a win-win-win situation does not require any market expansion for the channel. In our model, the main driving force is that when manufacturer X advertises to the consumers in the middle, it induces the retailer to increase the price for product X and sell it to some consumers who would purchase product Y in the absence of the advertisement. This in turn allows the retailer to increase the price for product Y as well since now the consumers purchasing product Y are relatively more loyal to it and their willingness to pay is higher.

Our results demonstrate that even when manufacturer X intends to make its product more favorable through persuasive advertising, it may not provoke the rival's counteraction and the common retailer's resistance. We also find that *delegation to a retailer does not result in any paradoxical consequence*, in strict contrast with the prediction of Shaffer and Zettelmeyer (2004a). The driving force for this difference is that persuasive advertising described in our model has a net positive utility increase in the consumers' preferences over the advertised product and no impact on the consumers' preferences over the rival product.

4. Discussions and Concluding Remarks

In this paper, we allow the persuasive advertising to shift the consumers' preferences toward the advertised product and decrease the cross-price elasticities simultaneously. We show that persuasive advertising can lead to a win-win-win situation among competing manufacturers and the retailer at the same time. This result is particularly strong if the manufacturer is endowed with low bargaining power. Moreover, it can be verified that the results are qualitatively similar even if we ignore the impacts on the consumers' transportation cost upon purchasing the advertised product. To some extent, our results further enhance the insights of Shaffer and Zettelmeyer (2002, 2004a, b). They successfully establish that targeted advertising may partially mitigate the combative nature of persuasive advertising; we complement their results by demonstrating the possibility that every channel member may benefit from persuasive advertising.

Several extensions are in order. In this paper, we do not attempt to characterize the optimal targeting strategy. It is conceivable that this optimal targeting strategy should depend on the advertising cost function, the specific form of consumer preferences, and the relative bargaining power in the manufacturer-retailer relationship. Moreover, it is intriguing to investigate the scenario in which both manufacturers can adopt persuasive advertising. Studies along this line can provide a more complete picture of the strategic interaction between channel members. Finally, in our paper the bargaining power is unaffected by the adoption of persuasive advertising (as in Shaffer 2002, Shaffer and Zettelmeyer 2004a). Nevertheless, if the advertising game is extended to multiple periods, it is possible that a manufacturer's persuasive advertising increases not only its marginal contribution in the current period but also its bargaining power in subsequent periods. This may further enhance a manufacturer's incentive to adopt persuasive advertising.

It is worth mentioning that our suggested targeting strategy is radically different from that in Iyer

et al. (2005), where they suggest that manufacturers target consumers with strong brand preferences. These contrasting results mainly arise from the differences in the content of advertising and on the channel structure found in Iyer et al. (2005) and our paper. While adopting the informative advertising in the integrated channel, targeting consumers with strong brand preferences allows the manufacturers to extract more revenue; on the contrary, targeting consumers with moderate preferences is more beneficial in a common retailer channel with persuasive advertising. Because the targeted media vehicles keep growing rapidly and the quality of consumer information is improving, the optimal targeting strategy under different channel structures appears to be a promising direction for future research.

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Appendix. Proof of Proposition 1

We divide our analysis into two cases, depending on whether the manufacturer adopts the targeting strategy or not.

Case 1 (Without targeting). If the retailer intends to serve the entire market, its optimization problem is formulated as follows:

$$\begin{aligned}\max_{z\in[0,1]}\ & \Pi_{xy}^{\mathrm{ad}} = p_x z + (1-z)p_y\\ \text{s.t.}\ & U_x = V + \Delta V - (t+\Delta t)z - p_x \geq 0 \quad \text{and}\\ & U_y = V - t(1-z) - p_y \geq 0.\end{aligned}$$

The constraints thus give rise to

$$p_x^* = V + \Delta V - (t+\Delta t)z \quad \text{and} \quad p_y^* = V - t(1-z)$$

at optimality. Plugging these prices into the objective function, we obtain that $z^* = (2t+\Delta V)/(2(2t+\Delta t))$ and $\Pi_{xy}^{\mathrm{ad}} = V - t/2 + ((\Delta V)^2 + 4t\Delta V - 2t\Delta t)/(4(2t+\Delta t))$. Likewise, if the retailer intends to carry only product $X(Y)$, the retailer will set $p_x^* = V + \Delta V - (t+\Delta t)$ ($p_y^* = V - t$) accordingly and serve the entire market. The corresponding profit is $\Pi_x^{\mathrm{ad}} = V + \Delta V - t - \Delta t$ ($\Pi_y^{\mathrm{ad}} = V - t$). To obtain the manufacturers' marginal contributions, we shall also obtain the channel profits in the absence of advertising. It follows from straightforward algebra that $\Pi_{xy} = V - t/2$ and $\Pi_x = \Pi_y = V - t$. Collectively, we have $\Delta\Pi_{xy} = ((\Delta V)^2 + 4t\Delta V - 2t\Delta t)/(4(2t+\Delta t))$, $\Delta\Pi_x = \Delta V - \Delta t$, and $\Delta\Pi_y = 0$. Substituting these values into (2), we obtain that

$$\Delta\pi_x = \lambda_x\left[\frac{(\Delta V)^2 + 4t\Delta V - 2t\Delta t}{4(2t+\Delta t)}\right] > 0,$$

$$\Delta\pi_y = \lambda_y\left[\frac{4t^2 + 2t\Delta t - (\Delta V - 2(t+\Delta t))^2}{4(2t+\Delta t)}\right] < 0 \quad \text{when} \quad 2\Delta t < \Delta V < \frac{2t(t+\Delta t)}{3t+\Delta t},$$

and

$$\Delta\pi_r = (1-\lambda_x)\left[\frac{(\Delta V)^2 + 4t\Delta V - 2t\Delta t}{4(2t+\Delta t)}\right] - \lambda_y\left[\frac{4t^2 + 2t\Delta t - (\Delta V - 2(t+\Delta t))^2}{4(2t+\Delta t)}\right] > 0,$$

which leads to the first part of the proposition.

Case 2 (With targeting). Now we switch to the case in which the targeting strategy is adopted, i.e., $l \in (0, 1/2)$. We first obtain the channel profits Π_x^{ad}, Π_y^{ad}, and Π_{xy}^{ad}, respectively, and then calculate the profit changes accordingly.

Step 1 (Characterize the channel profits). Let us first focus on Π_x^{ad}. The retailer has two options to choose from (1) serving the entire market or (2) serving only a portion of consumers. If the retailer intends to serve the entire market, she sets $p_x^* = V - t$ and obtains profit $\Pi_x^{\mathrm{ad}} = V - t$. On the contrary, to serve only some part of the market, there are two cases.

Case (i) $l < (t + \Delta t - \Delta V)/(2t + \Delta t) \equiv l_2$. In this case, the retailer optimally sets $p_x^* = V + \Delta V - (t+\Delta t)(1-l)$ and obtains the profit $\Pi_x^{\mathrm{ad}} = [V + \Delta V - (t+\Delta t)(1-l)](1-l)$.

Case (ii) $l \geq l_2$. It can be verified that the retailer's optimal strategy is to set $p_x = V - tl$, serve consumers in $[0, 1-l]$, and obtain $\Pi_x^{\mathrm{ad}} = (V - tl)(1-l)$. Comparing the retailer's profits under these two options, we obtain that

$$\Pi_x^{\mathrm{ad}} = \begin{cases}[V + \Delta V - (t+\Delta t)(1-l)](1-l), & 0 < l < l_2,\\ (V - tl)(1-l), & l_2 \leq l < l_3,\\ V - t, & l_3 \leq l < \frac{1}{2},\end{cases}$$

where $l_3 = (V + t - \sqrt{(V+3t)(V-t)})/(2t)$.

Next, we investigate the case in which the retailer carries both products. In this case, she will choose the consumer located at either $z^* = (2t+\Delta V)/(2(2t+\Delta t))$ or $1-l$ as the marginal consumer (who is indifferent between purchasing either product). It is conceivable that the retailer's choice depends on the extension of ads coverage (i.e., the value of l). Thus, we divide the analysis into three cases.

Case (i) $0 < l < l_1 \equiv (2t(t+\Delta t) - \Delta V(3t+\Delta t))/(2t(2t+\Delta t))$. In this case, $V - tl > V + \Delta V - (t+\Delta t)z^*$; thus, the retailer chooses the consumer located at z^* as the marginal consumer, serves the entire market, and obtains $\Pi_{xy}^{\mathrm{ad}} = V - t/2 + ((\Delta V)^2 + 4t\Delta V - 2t\Delta t)/(4(2t+\Delta t))$.

Case (ii) $l_1 \leq l < l_2$. In this case, $V + \Delta V - (t+\Delta t)\cdot(1-l) < V - tl \leq V + \Delta V - (t+\Delta t)z^*$. It can be verified that this condition implies that the retailer should simply give up the consumers in (l_1, l), in which scenario the optimal prices are set at $p_x = V + \Delta V - (t+\Delta t)z^*$, $p_y = V - t(1-z^*)$, and the retailer's optimal profit is

$$\Pi_{xy}^{\mathrm{ad}} = V - \frac{t}{2} + \frac{(\Delta V)^2 + 4t\Delta V - 2t\Delta t}{4(2t+\Delta t)} - \left[V + \Delta V - (t+\Delta t)\frac{2t+\Delta V}{2(2t+\Delta t)}\right](l - l_1).$$

Case (iii) $l_2 \leq l < 1/2$. The retailer now finds it optimal to serve the entire market. Given this, the optimal prices

are $p_x = p_y = V - tl$, and the retailer's maximum profit is $\Pi_{xy}^{ad} = V - tl$. Collectively, Π_{xy}^{ad} can be expressed as follows:

$$\Pi_{xy}^{ad} = \begin{cases} V - \dfrac{t}{2} + \dfrac{(\Delta V)^2 + 4t\Delta V - 2t\Delta t}{4(2t+\Delta t)}, & 0 < l < l_1, \\ V - \dfrac{t}{2} + \dfrac{(\Delta V)^2 + 4t\Delta V - 2t\Delta t}{4(2t+\Delta t)} \\ \quad - \left[V + \Delta V - (t+\Delta t)\dfrac{2t+\Delta V}{2(2t+\Delta t)} \right](l - l_1), & l_1 \le l < l_2, \\ V - tl, & l_2 \le l < \frac{1}{2}. \end{cases}$$

When the retailer carries only product Y, the channel profit is independent of whether manufacturer X advertises since his advertising has no impact on the consumers' valuations of product Y. Thus, $\Pi_y^{ad} = V - t$ for all $l \in (0, 1/2)$.

Step 2. (Calculating the profit changes). Without advertising, $\Pi_{xy} = V - t/2$ and $\Pi_x = \Pi_y = V - t$. According to (1), we then obtain the following (channel) profit changes:

$$\Delta\Pi_x = \begin{cases} [V + \Delta V - (t+\Delta t)(1-l)](1-l) - V + t, & 0 < l < l_2, \\ tl^2 - (V+t)l + t, & l_2 \le l < l_3, \\ 0, & l_3 \le l < \frac{1}{2}, \end{cases}$$

$$\Delta\Pi_y = 0,$$

$$\Delta\Pi_{xy} = \begin{cases} \dfrac{(\Delta V)^2 + 4t\Delta V - 2t\Delta t}{4(2t+\Delta t)}, & 0 < l < l_1, \\ \dfrac{(\Delta V)^2 + 4t\Delta V - 2t\Delta t}{4(2t+\Delta t)} \\ \quad - \left[V - \dfrac{t}{2} + \dfrac{t(3\Delta V - \Delta t) + (\Delta t)(\Delta V)}{2(2t+\Delta t)} \right](l - l_1), & l_1 \le l < l_3, \\ -tl + \frac{t}{2}, & l_3 \le l < \frac{1}{2}. \end{cases} \tag{3}$$

Finally, we derive the individual profits based on these profit changes by applying (2). Here, we do not attempt to characterize the explicit expressions of these individual profits; rather, our goal is to illustrate whether each channel member can benefit from the adoption of a manufacturer-initiated persuasive advertising. Thus, we focus on the signs of $\Delta\Pi_{xy} - \Delta\Pi_y$, $\Delta\Pi_{xy} - \Delta\Pi_x$ and these profit changes.

The signs of profit changes $\Delta\Pi_x$, $\Delta\Pi_y$, and $\Delta\Pi_{xy}$ follow immediately from (3), and the signs of $\Delta\Pi_{xy} - \Delta\Pi_y$ and $\Delta\Pi_{xy} - \Delta\Pi_x$ are summarized as follows (under the assumption that V is sufficiently large; see §2): (1) When $l = 0$, $\Pi_x - \Delta\Pi_{xy} = (4t^2 + 2t\Delta t - [\Delta V - 2(t+\Delta t)]^2)/(4(2t+\Delta t)) > 0$; (2) when $l = l_1$,

$$\begin{aligned} \Delta\Pi_x - \Delta\Pi_{xy} &= \frac{1}{4t^2(2t+\Delta t)^2}[2tV(2t+\Delta t)[(3t+\Delta t)\Delta V - 2t(t+\Delta t)] \\ &\quad + 4t^3(t-\Delta V)(3t+4\Delta t) + 2t^2(\Delta t)^2(3t-2\Delta V)] \\ &\quad + \frac{t^2(\Delta V)^2(t-6\Delta t) - (\Delta t)^2(\Delta V)^2(5t+\Delta t)}{4t^2(2t+\Delta t)^2}, \end{aligned}$$

which can be shown to be negative; and (3) when $l = l_2$,

$$\begin{aligned} \Delta\Pi_x - \Delta\Pi_{xy} &= (2t^2(3t - 2\Delta V) + t\Delta t(8t - 4\Delta V + 3\Delta t) \\ &\quad + 2t(\Delta V)^2 + 2V(2t+\Delta t)(\Delta V - 2t - \Delta t)) \\ &\quad \cdot (2(2t+\Delta t)^2)^{-1} < 0. \end{aligned}$$

These discussions then lead to the following conclusion: (1) $\Delta\pi_x = \lambda_x(\Delta\Pi_{xy} - \Delta\Pi_y) > 0$ for all $l \in (0, 1/2)$; (2) $\Delta\pi_y = \lambda_y(\Delta\Pi_{xy} - \Delta\Pi_x) < 0$, for $l \in (0, l^*)$, and is positive otherwise; and (3) $\Delta\pi_r = (1 - \lambda_x - \lambda_y)\Delta\Pi_{xy} + \lambda_y\Delta\Pi_x > 0$ for all $l \in (0, 1/2)$ if $\lambda_x < ((1-\lambda_y)\Delta\Pi_{xy} + \lambda_y\Delta\Pi_x)/(\Delta\Pi_{xy})$. A graphic illustration of these results is presented in Figure 2. □

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