Marketing Science

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The Benefits of Personalized Pricing in a Channel

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In this note, we explore channel interactions in an information-intensive environment where the retailer can implement personalized pricing and the manufacturer can leverage both personalized pricing and entry into a direct distribution channel. We study whether a retailer can benefit from personalized pricing and how upstream personalized pricing or entry into a direct distribution channel affects the allocation of channel profit. We find that the retailer is worse off because of its own or upstream personalized pricing, even when the retailer is a monopoly. However, it may still be optimal for the retailer to embrace personalized pricing in order to reap the strategic benefit of deterring the manufacturer from selling direct and targeting end consumers.

1. Introduction

As retailers build up their capability to gather and process detailed customer information, they acquire the unprecedented flexibility to charge different prices to different customers (Shaffer and Zhang 1995, 2002; Feinberg et al. 2002). Many retailing experts see "everyday personalized pricing" as a realistic practice in the near future (*Executive Technology* 2004).[1] In this note, we investigate whether a retailer can benefit from the practice of personalized pricing.

Scholars, as well as industry experts, agree that personalized pricing can indeed benefit the first firm that puts the concept into practice.[2] This is because the pioneering firm can target incremental consumers with a discount without giving the same discount to those consumers who would purchase from the firm without any discount (Shaffer and Zhang 2002). However, in this note we show that when the channel structure is accounted for, personalized pricing need

not be beneficial to a retailer, even if the retailer is a monopoly. This is because the manufacturer can take advantage of downstream personalized pricing by raising its wholesale price at the expense of the retailer.

The introduction of personalized pricing in a channel context also raises two broader issues related to channel management strategies. First, the union of direct selling and personalized pricing, enabled by the Internet, holds the promise for manufacturers to regain "leverage lost over the past decade to retailers growing in size and buying power" (May 2000),[3] while raising the prospect of "disintermediation" for retailers (Vanderbilt 1998). Indeed, as the Internet takes hold, "Travel agents, many retailers, real-estate agents and independent sales representatives, to name a few, are threatened as never before..." (Bailey 2002). Thus, new management imperatives are called for with regard to how a retailer may cope with the threat as well as how a manufacturer may take advantage of the opportunity. Second, manufacturers have long been recognized for targeting "pull" discounts to price-sensitive consumers (Gerstner et al. 1994, Gerstner and Hess 1995). However, with both upstream and downstream personalized pricing becoming feasible,

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[1] As an indication of things to come, a survey by *Gartner Inc.* shows that more than 50% of surveyed retailers rate Customer Relationship Management (CRM) as their highest business priority (*Business Wire* 2001). One key initiative of their CRM programs is to identify and target consumers with customized offers.

[2] For a sample of academic research on the benefit of monopolistic personalized pricing, see Thisse and Vives (1988), Shaffer and Zhang (1995, 2002). For a voice from industry, see, for instance, Hof (1998), McCollum (1998), and Mills (1999). In addition, *The Forrester Report* (Forrester Research 2000) and Jupiter Media Matrix (2001) both forcefully advocate personalized pricing.

[3] Messinger and Narasimhan (1995) and Ailawadi (2001) have examined this issue of channel power in depth in the packaged goods industry.

it is not clear whether the manufacturer or the retailer will or should take the initiative.

We address those two issues by developing a dyadic channel where the retailer can implement personalized pricing and the manufacturer can enter a direct channel as well as deploy personalized pricing. First, we show that the manufacturer benefits not only from either selling direct or targeting end consumers by itself, but also from downstream personalized pricing. Thus, an information-intensive channel environment may indeed favor manufacturers, as noted by some experts. Second, we show that, although the retailer is worse off when it adopts personalized pricing, it may still be optimal for the retailer to embrace it. This is because the manufacturer's gain from a direct entry is smaller when downstream personalized pricing is present than when it is not, but the retailer suffers more from the manufacturer's direct entry than from a rise in the wholesale price induced by the retailer's own personalized pricing. Thus, the retailer can choose the lesser of two evils by using personalized pricing to discourage the manufacturer from entering a direct channel. Similarly, the retailer is also motivated to preempt the manufacturer from targeting end consumers with personalized pricing incentives.

Our research is related to two streams of literature: personalized pricing and channel management. Theoretical analysis of personalized pricing has previously focused on the profitability of personalized pricing (Thisse and Vives 1988; Shaffer and Zhang 1995, 2002), optimal targeting strategy (Shaffer and Zhang 2000), the competitive implications of imperfect targetability (Chen et al. 2001), the effect of personalized pricing on social welfare (Shaffer and Zhang 1995, Chen and Zhang 2002), and the benefit of behavior-based targeting (Villas-Boas 2004, Chen and Zhang 2002). These studies are all carried out in a nonchannel context and do not investigate the complexity of strategic interactions among channel members in an information-intensive environment.

There has been a good deal of research on channel management issues. Many studies focus on channel coordination mechanisms (Jeuland and Shugan 1983, Moorthy 1987, Lal 1990, Ingene and Parry 1995, Gerstner and Hess 1995, Iyer 1998, Andersen 1999, Desai et al. 2001, Raju and Zhang 2005) and explore the competitive implications of mixed distribution channels (Purohit 1997, Bell et al. 2001, Chiang et al. 2003). However, none of these studies examines the implications of personalized pricing in a channel context. Other studies examine how different channel structures may affect price, competition, and profitability in a channel, all in a nontargeting context (McGuire and Staelin 1983, Coughlan 1985, Moorthy 1988, Choi 1991, Purohit 1997, Trivedi 1998). In addition, this latter stream of research focuses mostly on a manufacturer's channel strategy, and retailers are

assumed to be passive players. In this note, we take a first step in investigating how retailers could strategically invest in its targetability to alter channel structure.

We organize the rest of the note as follows. In §2, we set up the basic model where the manufacturer has the option of opening a direct channel and the retailer uses either uniform pricing or personalized pricing. In §3, we derive the optimal channel and pricing structures. In §4, we extend our model by allowing both the manufacturer and the retailer to pursue personalized pricing and also by introducing retail competition. Section 5 concludes the note with suggestions for future research.

2. Upstream Direct Entry and Downstream Personalized Pricing

Consider a channel where a manufacturer sells through an independent retailer located at the left end of a Hotelling line bounded between zero and one. We assume, à la Hotelling (1929), that consumers in the market make a unit purchase and are uniformly distributed along the line with a constant unit transportation cost of t. Each consumer's reservation price for his or her ideal product is V. We assume $V > 4t$ to insure complete market coverage before and after the retailer embraces personalized pricing.[4] For simplicity, we also assume that the manufacturer's marginal cost for producing the product in question is zero.

We analyze a four-stage game. In the first stage, the retailer decides whether to invest in the capability for personalized pricing, say, through purchasing a CRM program.[5] If the retailer chooses not to, it can charge only a constant price to all consumers in the market. If the retailer chooses to acquire targetability at the cost of F_r, we assume that it can, if it so chooses, tailor its pricing schedule to each consumer on the Hotelling line à la Thisse and Vives (1988) and Shaffer and Zhang (2002). In the second stage, the manufacturer decides whether to open a direct channel, say an online channel, at the cost of F_m—a fixed cost for setting up the direct channel. If the manufacturer opens such a channel, we assume that all consumers incur the same shopping cost s to purchase from the direct channel. This common cost mainly consists of the cost for accessing the Internet. We abstract away from any other cost to insure analytical clarity. To rule

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[4] It is straightforward to show that if $2t < V < 4t$, the market is uncovered before retail personalized pricing, but is covered after. In this case, all of our conclusions remain the same for some parameter values. The analysis for the case $V < 2t$ is also straightforward (the market is uncovered before and after retail personalized pricing). However, our current assumption paves the way for extending our model to the case of competitive retailers in §4.

[5] Such CRM programs are available from many software vendors such as Peoplesoft, Teradata, Siebel, etc.

out the trivial case where consumers never consider direct shopping and the manufacturer never opens a direct channel, we assume that the shopping cost is sufficiently small, or $s < 2t$. In the third stage, the manufacturer sets the wholesale price p_m. This simple contract assumption is consistent with the channel literature in marketing.[6] In the fourth stage, the retailer sets its retail price or prices, denoted respectively by p_r or $p_r(x)$, when the manufacturer has not opened a direct channel. When it has, we assume that the manufacturer is the price leader, setting its price p_d for its direct channel before the retailer. This assumption is necessary, as in Thisse and Vives (1988), to insure the existence of a pure-strategy equilibrium. It is also consistent with the fact that the manufacturer's direct channel has inside information about the wholesale price. Note that in both cases—at any given wholesale price—by setting its price to consumers, the retailer indirectly sets its mark-up rate over the wholesale price, which is also the "commission" rate for the retailer. Indeed, as shown in Tyagi (2005), when the retailer is the last to set its price, it makes no difference whether the retailer sets an absolute price or a percentage margin over the wholesale price. Given all these prices, consumers optimally decide where to shop.

This four-stage setup implicitly assumes that the retailer's ability to implement personalized pricing can influence a manufacturer's decisions on its direct entry and wholesale price, which in turn affect pricing decisions at the retail level. Although some other sequences of actions are also analytically feasible, we choose this setup to investigate channel interactions from the vantage point of a retailer, a perspective that is largely absent in the literature, but becomes increasingly important in the age of power retailers. As will soon become clear, this perspective seems to best explain the observed phenomenon of retail personalized pricing, and to offer the most interesting managerial insights. We solve the game backwards to insure subgame perfection.

2.1. Benchmark Game ($U\bar{E}$)
As the retailer has two options for its pricing scheme: uniform pricing (U) or personalized pricing (T), and the manufacturer can choose to enter (E) or not to enter ($\bar{E}$) a direct channel, there are altogether four subgames in the third stage. The subgame where the retailer does not invest in acquiring targetability, and the manufacturer sells only through the retailer, provides the benchmark case for channel interactions. In this subgame, it is easy to see that the manufacturer's profit is proportional to the wholesale price

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[6] A recent paper by Cui et al. (2004) discusses why a constant wholesale price contract is popular in channels by invoking fairness concerns.

it charges, as it will insure the full market coverage by the retailer given $V > 4t$. Therefore, it will set its wholesale price such that the retailer just covers the market. We have the manufacturer's and the retailer's profits, respectively, given by

$$\Pi_1 = V - 2t \quad \text{and} \quad \pi_1 = t, \tag{2.1}$$

where the subscript indicates the subgame.

In this benchmark game, the maximum channel profit, achievable under the existing channel structure through charging all consumers what they are willing to pay, is $V - t/2$, which is larger than the channel profit achieved, $V - t$ (the sum of the manufacturer's and the retailer's profits). Thus, the potential exists for the manufacturer to increase the channel profit and its own share of the channel profit, say, through opening a direct channel.

2.2. Manufacturer's Direct Entry and Retailer's Peril (UE)
The subgame where the manufacturer opens a direct channel and the retailer can charge only a uniform price illustrates the perils that the retailer faces when the manufacturer can directly access end consumers. As we show in Appendix A, in this subgame the manufacturer induces the outcome where the consumers who have a strong preference for the retailer because of proximity in their locations purchase from the retailer, and where the consumers who do not have a strong preference purchase from the manufacturer's direct channel. In this equilibrium, the payoffs for the retailer and the manufacturer are, respectively, given by

$$\Pi_2 = V - s + \frac{s^2}{8t} - F_m, \qquad \pi_2 = \frac{s^2}{16t}. \tag{2.2}$$

Relative to the benchmark case, the retailer is unambiguously worse off due to the manufacturer's direct channel. This is because the manufacturer can increase its wholesale price to appropriate more profits from the retailer and use its direct channel to cover the market left uncovered by the retailer. In effect, the manufacturer can now "squeeze" the retailer both on the margin and on the volume, such that its contribution margin and market share both decrease. Therefore, the manufacturer's direct channel entry is clearly a threat to the retailer.

Interestingly, the average price paid by consumers in the market need not decrease with the introduction of a direct channel. We can see this by noting that the average price paid by consumers in the benchmark case is $V - t$ and that in the current subgame is $V - s + 3s^2/16t$, the same expression as the total channel profit without the cost of direct channel entry. Therefore, the average price will decrease due to the

direct channel entry only when $s > \frac{4}{3}t$. When s is sufficiently small ($s < \frac{4}{3}t$), i.e., when consumers sufficiently value a direct channel shopping experience, the manufacturer has incentives to direct more consumers to its direct channel through raising its wholesale price, in an effort to take more profits through the direct channel instead of the retail channel. In fact, if $s < t$, all consumers in the market will pay a higher price. Such incentives provide a channel mechanism through which the use of the Internet may raise rather than decrease the prices in a market.[7]

2.3. Irony of Retail Personalized Pricing ($P\bar{E}$)

The subgame where the retailer has acquired targetability and where the manufacturer does not open a direct channel captures how targetability at the retail level affects channel relationships. As we show in Appendix B, the optimal wholesale price is given by $p_m = V - t$, and the payoffs for the retailer and the manufacturer in this subgame are given by

$$\pi_3 = \frac{t}{2} - F_r, \qquad \Pi_3 = V - t, \qquad (2.3)$$

where F_r is the fixed cost a retailer must incur to acquire targetability.

Comparing the payoffs for the benchmark case in Equation (2.1) with those in Equation (2.3), we can see that personalized pricing is, ironically, not a blessing for the retailer even if one ignores the cost of acquiring targetability. The retailer is worse off because the manufacturer can raise its wholesale price to appropriate the gains that the retailer gets from its personalized pricing.[8] Intuitively, with personalized pricing the retailer can impose higher markups on consumers located closer by and a lower markup on consumers located further away from the retailer. At any given wholesale price, the retailer benefits from such price discrimination. However, the pricing flexibility is also detrimental to the retailer, as it can no longer commit itself to a fixed markup and use market coverage as leverage for a lower wholesale price. The manufacturer can now take advantage of the retail pricing flexibility and raise its wholesale price without being concerned about inducing incomplete market coverage. Consequently, the manufacturer becomes strictly better off.

Nonetheless, ignoring the sunk cost of acquiring targetability, a retailer's payoff in this subgame of

personalized pricing is strictly higher than that in the previous subgame of the manufacturer's direct entry (see Equation (2.2)). To the retailer, personalized pricing is the lesser of the two evils.

2.4. Retail Personalized Pricing and Upstream Direct Channel (PE)

If personalized pricing and direct channel are both present, the retailer will, not surprisingly, become worse off still. As shown in Appendix C, the equilibrium payoffs in this subgame are given by

$$\pi_4 = \frac{s^2}{8t} - F_r, \qquad \Pi_4 = V - s + \frac{s^2}{4t} - F_m. \qquad (2.4)$$

Comparing the payoffs in Equation (2.4) with those in Equation (2.3), we can readily see that the manufacturer in this subgame may become even better off thanks to its direct entry, provided that the cost of entry F_m is sufficiently small.

However, this does not mean that retail personalized pricing is an inducement for the manufacturer to launch a direct channel. From Equations (2.1) and (2.2), we can see that when the retailer charges a constant price, the manufacturer's gain from direct entry is given by $\Delta\Pi^U = \Pi_2 - \Pi_1 = (4t - s)^2/8t - F_m$. Similarly, from Equations (2.3) and (2.4), the corresponding gain for the manufacturer when the retailer implements personalized pricing is $\Delta\Pi^T = \Pi_4 - \Pi_3 = (2t - s)^2/4t - F_m$. The manufacturer's gain is larger in the former case, i.e., $\Delta\Pi^U > \Delta\Pi^P$. This implies that for any given cost of direct entry, the manufacturer has more incentives to start a direct channel when the retailer uses uniform rather than personalized pricing. This also implies that personalized pricing by the retailer can serve as the disincentive for the manufacturer to start a direct channel.

## 3. Optimal Channel Structure and Personalized Pricing

Thus, our analysis shows that the manufacturer's direct channel initiative can indeed help the firm to regain leverage over the retailer. In fact, the retailer in our model is always worse off whenever the manufacturer introduces a direct channel. However, this does not mean that the manufacturer should always strive to obtain such leverage, not only because a direct entry is costly, but also because the pricing strategies at the retail level, whether the retailer adopts uniform pricing or personalized pricing, can significantly alter the manufacturer's gain from a direct channel. In this section, we derive the optimal strategies for both the manufacturer and the retailer.

To do so, we go back one stage to analyze the manufacturer's decision of whether to establish a direct channel. This decision is made based on

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[7] See Lal and Sarvary (1999) for a search cost explanation of the same phenomenon.

[8] If the wholesale price were to be held at the same level as in the benchmark case, i.e., $p_m = V - 2t$, a retailer's payoff in this subgame of personalized pricing would have been $3t/2$, higher than that in the benchmark case.

Figure 1   Equilibrium Channel and Pricing Structures
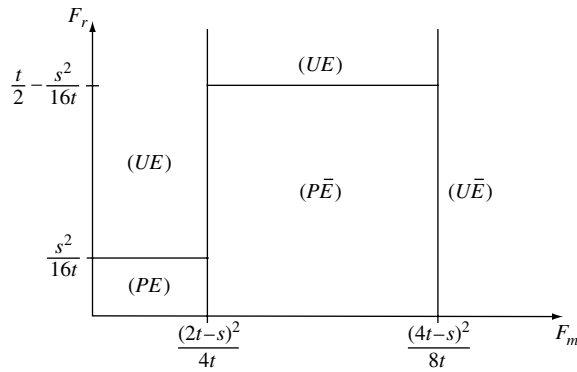
whether the manufacturer's gain from a direct entry is larger than the cost of such an entry, given a specific retail pricing strategy. The computation can be easily done using the manufacturer's payoffs in Equations (2.1)–(2.4). Then, the retailer chooses in the first stage whether to acquire targetability. For brevity, we omit the details of these derivations and report the equilibria of our four-stage game in Figure 1.

From Figure 1, we see that it is optimal for the manufacturer to open a direct channel when the cost of doing so is sufficiently small ($F_m < (2t-s)^2/4t$) and to stay put when it is sufficiently large ($F_m > (4t-s)^2/8t$), regardless of what the retailer chooses to do. Similarly, it is also optimal for the retailer to choose a constant price when the cost of acquiring targetability is sufficiently high ($F_r > t/2 - s^2/16t$), regardless of the manufacturer's strategic choice. Therefore, the cost is a driving force behind a channel member's strategy. However, regardless of the configuration in the costs, all the benefits from a direct entry or personalized pricing will accrue only to the manufacturer, as the following proposition makes clear.

PROPOSITION 1. *The upstream manufacturer becomes better off and the downstream retailer worse off whenever upstream market entry or downstream personalized pricing takes place.*

The proof for Proposition 1 is given in Appendix D. Although this proposition is obvious from a technical perspective, its implication is not. It uncovers the economic mechanisms through which channel power may shift in favor of manufacturers in an information-intensive environment, as anticipated by some industry experts. The manufacturer stands to gain from its direct channel because it can make sales directly at a better margin to those consumers who choose to shop direct, and also because it can raise its wholesale price to the retailer, taking advantage of the retail pricing flexibility. The retailer takes the brunt of both adverse impacts. However, this does not imply that the retailer should not embrace targetability. It should, for the following strategic reason.

PROPOSITION 2. *The retailer can deter the manufacturer from entering a direct channel by acquiring targetability.*

Proposition 2 can be deduced from the equilibrium ($P\bar{E}$) in the region defined by $(2t - s)^2/4t < F_m < (4t - s)^2/8t$ and $0 < F_r < t/2 - s^2/16t$ in Figure 1, the region where the equilibrium is not driven primarily by the costs. The retailer in this region is mainly motivated by entry deterrence to embrace targetability. This is because the manufacturer would surely enter a direct channel if the retailer had not acquired targetability and hence could only use uniform pricing and, given that the manufacturer were to stay out, the retailer would have been better off not acquiring targetability. Thus, the retailer acquires targetability and subsequently implements personalized pricing strategically to avoid the most damaging outcome—the manufacturer's direct entry.

Proposition 2 thus establishes a new role for targetability: It can be acquired and deployed as a strategic tool for entry deterrence. Note that entry deterrence by the retailer is credible because, had the manufacturer entered the direct channel, the retailer would still be better off implementing personalized pricing given that it had already incurred the cost of acquiring targetability.[9]

4. Extensions

In our basic model, we have implicitly assumed away the manufacturer's option of deploying personalized pricing. However, manufacturers can potentially target consumers directly with coupons or rebates even when they sell through retailers. This raises some interesting questions. If both manufacturers and retailers can acquire targetability, should they all engage in personalized pricing? Would a manufacturer want to start a direct channel while engaging in personalized pricing? In our basic model, we also assume that there is only one retailer. How will retail competition modify our conclusions? In this section, we extend our model to address those questions.

4.1. Upstream or Downstream Personalized Pricing?

We first modify our game to let the manufacturer choose whether to acquire targetability, *instead of* whether to open a direct channel, while maintaining all other assumptions. This extension will give us the opportunity to answer the question of who may initiate personalized pricing in a channel.

The analysis of this modified game is analogous to that for our basic game, and we omit the algebraic

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[9] We can see this clearly by comparing the retailer's payoff in Equation (2.2) with that in Equation (2.4), while treating F_r as a sunk cost.

details here.[10] What is notable from our analysis is the fact that either upstream or downstream personalized pricing may occur, but not both, even when costs permit. This is because when the manufacturer uses personalized pricing, it will offer personalized discounts in a way that will equalize the willingness-to-pay for all consumers at V when they purchase from the retailer and charge a wholesale price of V to claim all the profits from the channel. In that case, the retailer will never want to offer any positive discount to any consumer. However, the retailer can leverage its own personalized pricing to deter the manufacturer from engaging in personalized pricing. The rub is that even in that case, the manufacturer benefits from its ability to implement personalized pricing. This is because retail personalized pricing allows the manufacturer to increase its wholesale price, affirming our thesis that the manufacturer stands to gain in an information-intensive channel environment.

4.2. Strategic Focus: Upstream Personalized Pricing or Direct Entry?

If the manufacturer can both acquire targetability and enter the market directly, it then has four strategies at its disposal in the second stage. As the retailer decides in the first stage whether to acquire targetability, there are altogether eight possible equilibria in this expanded game.

Our analysis shows that only six out of the eight possible equilibria can be supported, depending on the configurations of F_r, F_m, and F_t,[11] but none involves both upstream and downstream personalized pricing. As expected, in this more general game, downstream personalized pricing can still play the strategic role of deterring the manufacturer from implementing personalized pricing, as well as from direct entry. The additional insight from this game is stated in the following proposition.

PROPOSITION 3. *Unless the cost of acquiring targetability and the cost of direct entry are both sufficiently small for the manufacturer ($F_t < 3s^2/8t$ and $F_m < (2t^2 - 4ts + s^2)/4t$), and the cost of shopping direct is also sufficiently small ($s < (2 - \sqrt{2})t$), the manufacturer does not engage in personalized pricing and direct entry simultaneously.*

Intuitively, personalized pricing is an effective way for the manufacturer to claim the channel profit, and there is no need for a direct entry after having adopted personalized pricing unless a direct channel can increase the channel profit. The channel profit can rise only if the shopping cost s is sufficiently low that

it is more profitable for the manufacturer to compensate consumers for their direct shopping cost than to offer them incentives to purchase at the retailer with personalized discounts.

Proposition 3 thus suggests that the manufacturer needs to decide judiciously on its strategic focus in an information-intensive channel environment. It may want to concentrate its resources on either personalized pricing or its direct channel presence, certainly at the nascent stage of e-commerce when at least one of the three types of costs is still high.

4.3. Retail Competition

In our basic model, the retailer is a monopolist. One may ask whether our main results will drastically change because of retail competition. We can address that question by locating another retailer at the right end of the Hotelling line in our basic model. Thus, in the first stage of this modified game, two retailers, instead of one, decide independently whether to use uniform pricing (U) or personalized pricing (P). As we show in Appendix TA3,[12] the analysis of this retail competition model is considerably more complex.

As one might expect, retail competition will not do away with our key conclusion that the retail implementation of personalized pricing can deter the manufacturer from entering a direct channel. However, as additional insights, we show that entry deterrence can take the form of either unilateral or competitive personalized pricing. When either unilateral deterrence or competitive deterrence happens, personalized pricing by competing retailers also benefits the rival. This result joins with Chen et al. (2001) in that a firm's targetability may actually help its rival in a channel environment.

5. Conclusion and Future Research

We have taken a first look at the strategic interactions between a manufacturer and a retailer in an information-intensive channel context. We have come to a number of rather intriguing conclusions. First, we show that both targetability and a ready access to consumers enabled by the Internet favors the manufacturer at the expense of the retailer. Indeed, we show that a retailer's profit decreases and the manufacturer's profit increases even when the manufacturer does not actually enter the market or target end-users with personalized discounts, but merely has the capability to do so.

Second, we show the irony of personalized pricing for the retailer: The retailer is worse off even when acquiring targetability and implementing personalized pricing is costless. This is because when the

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[10] The appendix that contains the details of the derivations is available from mktgsci@cba.ufl.edu.

[11] Technical details are omitted here but are available from mktgsci@cba.ufl.edu.

[12] Technical details are provided from mktgsci@cba.ufl.edu.

retailer possesses targetability and implements personalized pricing, it can no longer commit itself to a fixed markup and leverage incomplete market coverage for a low wholesale price; therefore, the manufacturer can increase its wholesale price to the detriment of the retailer.

Third, although targetability may actually hurt a retailer, the retailer may still want to embrace it! This is because the retailer can use personalized pricing to deter the manufacturer from direct entry or from personalized pricing. Therefore, personalized pricing is not only a tactical decision, but also a strategic decision in a channel context. This result advocates the strategy of using price discrimination, such as personalized pricing and perhaps haggling (Desai and Purohit 2004), as a way to deter an upstream firm from entering a direct channel. In this sense, this result is also consistent with the observation in the air travel industry, where, facing airliners' direct channels, travel agencies began to implement flexible pricing, rebating varying portions of commissions to business travelers (Clemons 2001).

Fourth, it is important for a firm to have a strategic focus in an information-intensive channel environment. It is not optimal for the manufacturer and the retailer to implement personalized pricing simultaneously, or for the manufacturer to pursue direct entry and personalized pricing simultaneously at the nascent stage of e-commerce.

All these conclusions suggest that our knowledge about channel management accumulated in the context of *anonymous consumers* needs to be updated. However, we need to emphasize that the models we have examined in this note, although quite complex technically already, are drastic simplifications of reality. In practice, retailers may, for instance, also initiate direct channels; manufacturers and retailers may have imperfect or asymmetric targetability; manufacturer competition may exist; firms may compete with service and targeted advertising (Gal-Or and Gal-Or 2005); manufacturers and retailers may bargain over channel profits; and the channel may start with nonlinear pricing, and a different game sequence may better capture some realistic aspects of channel interactions.

Nevertheless, we believe that the conclusions we have drawn through our simple models, i.e., the shifting channel power, the entry deterrence role of personalized pricing, and the need for a strategic focus, do seem to capture some basic economic incentives that manufacturers and retailers may want either to take advantage of or to guard against in an information-intensive channel environment. They also raise new issues and provide an initial structure for our discourse on the implications of such incentives for channel management. We hope that

our research will inspire further interests in exploring those implications in more complex channel settings.

Appendix

A. Manufacturer's Direct Entry and Retailer's Peril (UE)

In this subgame, the manufacturer opens a direct channel, and the retailer can only charge a uniform price. If the manufacturer sets the wholesale price $p_m \geq V$, the retailer cannot make any sale profitably, and the manufacturer sells only through its direct channel. Thus, the optimal direct channel price is $p_d = V - s$, and the manufacturer's profit is given by $\Pi = V - s - F_m$.

If $p_m < V$, the retailer can profitably sell to some consumers. The marginal consumers for the retailer and the direct channel are located at $x = (p_d + s - p_r)/t$. The retailer's payoff is given by $\pi = (p_r - p_m)x$, and its optimal price is $p_r = (p_d + p_m + s)/2$. The manufacturer's payoff is given by $\Pi = p_m x + p_d(1 - x)$, and its optimal direct channel price is $p_d = p_m - s/2 + t$. Because $p_d \leq V - s$, we must have $p_m \leq V - s/2 - t$. When $V - s/2 - t < p_m < V$, the optimal direct channel price is always at $p_d = V - s$. This is because for $p_d \leq V - s$, d_Π/d_{p_d} is positive. However, if $p_d > V - s$, no consumers will buy from the direct channel, and the retailer becomes the local monopolist. In that case, because $V - 2t < V - s/2 - t < p_m$, the market is not completely covered, and the manufacturer can always profitably lower its direct channel price to $p_d = V - s$ to cover the market.

Therefore, the manufacturer's profit is summarized as follows:

$$\Pi = \begin{cases} V - s - F_m & \text{if } p_m \geq V, \\[2mm] -\dfrac{p_m^2 + p_m(s - 2V) - (V - s)(V - 2t)}{2t} - F_m \\[1mm] \hspace{2cm} \text{if } V - \dfrac{s}{2} - t \leq p_m < V, \\[2mm] p_m + \dfrac{(2t - s)^2}{8t} - F_m & \text{if } p_m < V - \dfrac{s}{2} - t. \end{cases}$$

The equilibrium in this subgame is then given by:

$$p_m = V - \frac{s}{2}, \qquad p_r = V - \frac{s}{4}, \qquad p_d = V - s,$$
$$\pi_2 = \frac{s^2}{16t}, \qquad \Pi_2 = V - s + \frac{s^2}{8t} - F_m. \tag{A.1}$$

In this equilibrium, the marginal consumers for the retailer and the direct channel are located at $x = s/4t$. The consumers located close to the retailer ($x < s/4t$) buy from the retailer, and those located away from the retailer ($x > s/4t$) shop from the direct channel.

B. Irony of Retail Personalized Pricing ($P\bar{E}$)

In this subgame, the retailer has acquired targetability and the manufacturer does not open a direct channel. The wholesale price p_m can be either $p_m \in [V - t, V)$ or

$p_m \leq V - t$. In the former case, the market is uncovered. The marginal consumers for the retailer are determined by setting $V - t\tilde{x} - p_m = 0$, where $\tilde{x}$ is the distance to the retailer. For all consumers located at $x \leq \tilde{x}$, the retailer charges a location-specific price given by $p_r(x) = V - tx$. Therefore, the retailer's profit is given by

$$\pi = \int_0^{\tilde{x}} [p_r(x) - p_m]\, dx = \frac{(V - p_m)^2}{2t},$$

and the manufacturer's profit is given by $\Pi = p_m \tilde{x}$. When $p_m \leq V - t$, the market is always covered so that the manufacturer's payoff is given by p_m. The retailer's profit is given by

$$\pi = \int_0^1 (V - tx - p_m)\, dx.$$

We can now summarize the manufacturer's profit in this subgame as

$$\Pi = \begin{cases} 0 & \text{if } p_m \geq V, \\ \dfrac{p_m(V - p_m)}{t} & \text{if } V - t \leq p_m < V, \\ p_m & \text{if } p_m \leq V - t. \end{cases}$$

Because the left derivative of Π at the point of $p_m = V - t$ is positive and the right derivative is negative, the optimal wholesale price must be given by $p_m = V - t$. Then, the payoffs for the retailer and the manufacturer in this subgame are given by

$$\pi_3 = \frac{t}{2} - F_r, \qquad \Pi_3 = V - t. \tag{B.1}$$

C. Retail Personalized Pricing as Disincentive for Upstream Direct Channel (*PE*)

In this subgame, the retailer obtains targetability and the manufacturer opens a direct channel. Again, if $p_m > V$, the retailer cannot make a profitable sale, and the optimal direct channel price is given by $p_d = V - s$ and the manufacturer's profit is $\Pi = V - s - F_m$. If the manufacturer lowers the wholesale price, the retailer will be able to compete with the manufacturer's direct channel. However, if $p_d > V - s$, the retailer is a monopolist, as no consumer will buy from the direct channel. The optimal retail price is then given by $p_r(x) = \max\{V - tx, p_m\}$. If $p_d \leq V - s$, the retailer competes with the direct channel and the marginal consumers are determined by $V - t\tilde{x} - p_r(\tilde{x}) = V - (p_d + s)$. Because $p_r(\tilde{x}) \geq p_m$, the retailer charges the optimal price schedule $p_r(x) = \max\{p_d + s - tx, p_m\}$, and the market is separate at $\tilde{x} = (p_d + s - p_m)/t$. Given the retailer's price schedule, the manufacturer sets the direct channel price by maximizing $\Pi = p_m \tilde{x} + p_d(1 - \tilde{x})$, which leads to $p_d = p_m - s/2 + t/2$. Because $p_d \leq V - s$, we must have $p_m \leq V - (s + t)/2$ in this case.

If $p_m > V - (s+t)/2$, we need to consider two cases: (1) $s < t$ and (2) $t < s < 2t$. When $t < s < 2t$, because $p_m > V - (s+t)/2$, the optimal direct channel price will be $p_d = V - s$. This is because we have $d_\Pi/d_{p_d} = (2p_m - s + t - 2p_d)/t > 0$ for $p_d \leq V - s$. When $s < t$, we have $p_m > V - (s+t)/2 > V - t$. The market is again not completely covered without the direct channel. For the same reason, it is optimal to set the direct channel price at $p_d = V - s$.

Thus, the manufacturer's profit is summarized as follows:

$$\Pi = \begin{cases} \dfrac{-p_m^2 + p_m(2V - s) - (V - s)(V - t)}{t} \\ \qquad\qquad\qquad \text{if } p_m < V - \dfrac{s + t}{2}, \\ p_m + \dfrac{(t - s)^2}{4t} - F_m & \text{if } V - \dfrac{t + s}{2} < p_m \leq V, \\ V - s - F_m & \text{if } p_m > V. \end{cases}$$

Then, the manufacturer's profit is maximized at $p_m = V - s/2$. In the equilibrium, we have:

$$p_m = V - \frac{s}{2}, \qquad p_r = V - \frac{s}{4}, \qquad p_d = V - s,$$
$$\pi_4 = \frac{s^2}{8t} - F_r, \qquad \Pi_4 = V - s + \frac{s^2}{4t} - F_m. \tag{C.1}$$

D. Proof of Proposition 1

In this appendix, we show that when upstream market entry or downstream personalized pricing takes place, the upstream manufacturer becomes better off and the downstream retailer worse off, compared to the benchmark case. From Figure 1, the case where only upstream market entry takes place is in regions bounded by ($F_m < (2t - s)^2/4t$ and $F_r > s^2/16t$) and ($(2t - s)^2/4t < F_m < (4t - s)^2/8t$ and $F_r > t/2 - s^2/16t$). In those two regions, the retailer's and the manufacturer' profits are given by $\pi_2 = s^2/16t$ and $\Pi_2 = V - s + s^2/8t - F_m$. In the benchmark case, profits are, respectively, $\pi_1 = t$ and $\Pi_1 = V - 2t$. We have

$$\pi_2 - \pi_1 = \frac{s^2 - 16t^2}{16t} < 0,$$
$$\Pi_2 - \Pi_1 = \frac{(4t - s)^2}{8t} - F_m > 0. \tag{D.1}$$

Thus, the retailer's profit is lower and the manufacturer's profit is higher, compared to the benchmark case. Also from Figure 1, we see that the case where only downstream personalized pricing takes place is in the region bounded by ($(2t - s)^2/4t < F_m < (4t - s)^2/8t$ and $F_r < t/2 - s^2/16t$). In this region, the retailer's and the manufacturer's profits are, respectively, given by $\pi_3 = t/2 - F_r$ and $\Pi_3 = V - t$. We have

$$\pi_3 - \pi_1 = -\frac{t}{2} - F_r < 0, \qquad \Pi_3 - \Pi_2 = t > 0. \tag{D.2}$$

Once again, compared to the benchmark case, the retailer's profit is lower and the manufacturer's profit is higher.

Also from Figure 1, we see that the case where both upstream market entry and downstream personalized pricing take place is in the region bounded by ($F_m < (2t - s)^2/4t$ and $F_r < s^2/16t$). In this region, we have $\pi_4 = s^2/8t - F_r$ and $\Pi_4 = V - s + s^2/4t - F_m$. Therefore, we have

$$\pi_4 - \pi_1 = -\frac{8t^2 - s^2}{8t} - F_r < 0,$$
$$\Pi_4 - \Pi_1 = t + \frac{(2t - s)^2}{4t} - F_m > 0. \tag{D.3}$$

Once again, the retailer's profit is lower and the manufacturer's is higher, compared to the benchmark case. Q.E.D.

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