"Call for Prices": Strategic Implications of Raising Consumers' Costs

Preyas S. Desai
Fuqua School of Business, Duke University, Durham, North Carolina 27708, desai@duke.edu

Anand Krishnamoorthy
College of Business Administration, University of Central Florida, Orlando, Florida 32816,
akrishnamoorthy@bus.ucf.edu

Preethika Sainam
Kelley School of Business, Indiana University, Bloomington, Indiana 47405,
preesesh@indiana.edu

Many consumer durable retailers often do not advertise their prices and instead ask consumers to call them for prices. It is easy to see that this practice increases the consumers' cost of learning the prices of products they are considering, yet firms commonly use such practices. Not advertising prices may reduce the firm's advertising costs, but the strategic effects of doing so are not clear. Our objective is to examine the strategic effects of this practice. In particular, how does making price discovery more difficult for consumers affect competing retailers' price, service decisions, and profits?

We develop a model in which a manufacturer sells its product through a high-service retailer and a low-service retailer. Consumers can purchase the retail service at the high-end retailer and purchase the product at the competing low-end retailer. Therefore, the high-end retailer faces a free-riding problem. A retailer first chooses its optimal service levels. Then, it chooses its optimal price levels. Finally, a retailer decides whether to advertise its prices. The model results in four structures: (1) both retailers advertise prices, (2) only the low-service retailer advertises price, (3) only the high-service retailer advertises price, and (4) neither retailer advertises price.

We find that when a retailer does not advertise its price and makes price discovery more difficult for consumers, the competition between the retailers is less intense. However, the retailer is forced to charge a lower price. In addition, if the competing retailer does advertise its prices, then the competing retailer enjoys higher profit margins. We identify conditions under which each of the above four structures is an equilibrium and show that a low-service retailer not advertising its price is a more likely outcome than a high-service retailer doing so. We then solve the manufacturer's problem and find that there are several instances when a retailer's advertising decisions are different from what the manufacturer would want. We describe the nature of this channel coordination problem and identify some solutions.

Key words: price advertising; channel coordination; retailing; free-riding
History: Received: June 26, 2007; accepted: February 27, 2009; processed by Anne Coughlan. Published online in *Articles in Advance* August 14, 2009.

1. Introduction

Many retailers help consumers in their purchase process by providing information about the products being sold. For example, retailers routinely advertise prices in weekly fliers and other forms of advertisements. However, not all advertisements contain price information. Several mail-order and online retailers do not reveal the prices of products even when advertising those products. The advertisements may request consumers to "call the toll-free number" or "visit the store" to find out the price. In an online shopping environment, consumers may be asked to place the product in the shopping cart before its price is revealed.

Given that price advertising reduces consumers' costs of finding price information, why do we not see retailers advertising prices all the time? Not advertising the price can possibly reduce a firm's advertising costs, but it is not clear if retailers' decisions are always driven by the cost of advertising. In particular, the cost of inserting the price information may not be much more than the cost of inserting the text that asks consumers to call for prices. Why, then, do retailers put out "call-for-pricing" advertisements? Are there strategic reasons for retailers to engage in this practice? How does making price discovery more difficult for consumers affect competing retailers' price, service decisions, and profits? How do retailers' advertising

policies affect the manufacturer's profits? Our objective is to answer these questions.

To illustrate the prevalence of retailers not advertising prices, we checked advertisements in several hobbyist magazines by electronic retailers selling digital cameras, camcorders, audio recorders, etc.[1] We discovered 10 retailers advertising about 200 products in these magazines. Seven of these retailers had advertisements that specifically mentioned one or more products for which prices were not given and consumers were asked to call the retailer for prices.[2] There are also differences across retailers in advertising strategies. For example, one retailer, http://www.Newegg.com, provided prices for all the digital cameras mentioned in its advertisement, whereas another online retailer, http://www.BeachCamera.com, did not give price information for any of the digital cameras that were mentioned in its advertisement. Still others, like http://www.Samys.com, revealed prices for only some of the digital cameras that were advertised.

Reviewing these advertisements reveals that retailers that advertise prices are likely to be high-end retailers, i.e., stores that offer extended service hours, free product use classes, extensive product selection, etc. Newegg.com, for example, has won many awards, including the "Shopper's Choice Award" for its customer service. BeachCamera.com, on the other hand, focuses more on price than on service.

The differences across retailers in price advertising policies raise additional questions. First, it is not clear why different types of retailers would have different incentives to advertise prices. In fact, if low-service retailers have lower prices, they have more to gain from advertising lower prices and, hence, should have stronger incentives to advertise their prices. It is therefore puzzling that we see low-service retailers not advertising prices. Second, the effects of the retailers' advertising policies on the manufacturer are also not a priori clear. Are manufacturers better off when retailers advertise prices than when they do not? Can retailers' price advertising policies be different from what the manufacturer would like them to be? If so, this difference could represent another source of channel conflict and a new type of channel coordination problem.

As a step toward unraveling the price advertising puzzle, we develop a model in which a high-service retailer competes with a low-service retailer. Consumers can purchase the retail service at the high-end retailer and purchase the product at the low-end retailer. Therefore, the high-end retailer faces a free-riding problem. A retailer first chooses its optimal service level. Then, it chooses its optimal price level. Finally, a retailer decides whether or not to advertise its prices. The model results in four structures: (1) both retailers advertise prices, (2) only the low-service retailer advertises price, (3) only the high-service retailer advertises price, and (4) neither retailer advertises price.

We identify conditions under which each of the four structures is an equilibrium and find that when a retailer makes price discovery more difficult for consumers, the competition between the retailers is less intense. Therefore, the lack of price advertising by a retailer mitigates price competition. However, the imposition of this price discovery cost forces the retailer to charge a lower price. In addition, if the competing retailer advertises its price, it is that retailer that reaps most of the benefits of the reduced competitive intensity. We also show that a low-service retailer not advertising its price is a more likely outcome than a high-service retailer doing so. We then solve the manufacturer's problem and find that there are several instances in which a retailer does not advertise when the manufacturer would want it to. We describe the nature of this channel coordination problem and identify solutions for it.

We briefly review the related literature in the next section.

1.1. Relationship with Prior Literature
Most of the economics and marketing literature on price advertising assumes that retailers *do* price advertise and use that assumption to study various issues like the effect of price advertising on prices (Stigler 1961, Benham 1972, Kaul and Wittink 1995, Milyo and Waldfogel 1999) and whether price advertising spending is socially optimal (Butters 1977, Grossman and Shapiro 1984, Stegeman 1991). Starting with Stigler's (1961) seminal paper, researchers have argued that price advertising can reduce observed prices. However, this stream of literature has not looked at price advertising decisions by asymmetric retailers or explained interfirm differences in price advertising policies.

It can be argued that the interfirm differences that we describe can be explained from Salop and Stiglitz (1977): firms that provide "bargains" to consumers would have the incentives to advertise and firms that "rip off" consumers would not. Note, however, that many of the firms that do not advertise prices

---

[1] *Videography* (February 2007), *Shutterbug* (March 2007), *Popular Photography* (March 2007), *Hi-Fi News* (March 2007), *The Absolute Sound* (April 2007), *PC World* (April 2007), and *PC Magazine* (March 20, 2007).

[2] We found some instances where the unadvertised prices were higher than the advertised prices for the same products, and other instances where the unadvertised prices were lower than the advertised prices for the same products. Therefore, not all of these examples can be explained by minimum advertised price ("MAP") contracts. We discuss MAP arrangements in more detail in §4.

do engage in product and store advertising without revealing prices. In addition, Salop and Stiglitz (1977) cannot explain the phenomenon of lower-priced retailers often not advertising prices. In Salop and Stiglitz, the informed and uninformed consumers get different outcomes in equilibrium, with the latter group being worse off because of the higher price it pays. In a similar way, in our model, consumers who are uninformed about a particular store's price incur an additional cost to discover that store's price and thus get a lower utility. In addition, when the high-service retailer advertises its price and the low-service retailer does not, consumers of the high-service retailer enjoy the additional benefits of higher service.

Furthermore, the practice of not advertising prices cannot be explained by the signaling incentives of firms as suggested by Nelson (1970, 1974) and Kihlstrom and Riordan (1984). Kihlstrom and Riordan analyze a competitive market in which firms are price takers. We do not believe this to be a good description for the consumer electronics markets that we are studying. In addition, the explanation of Kihlstrom and Riordan is based on repeat purchases. The notion of repeat purchases is not as applicable to the durable goods market that we study. Furthermore, Nelson (1970, 1974) and Kihlstrom and Riordan (1984) focus on uninformative advertising. Our paper deals with informative advertising—once the price is advertised, consumers know the price of the product. Finally, for the arguments in Nelson (1970, 1974) and Kihlstrom and Riordan (1984) to hold, consumers have to know the retailers' cost structure—an assumption that we think is unrealistic.

The effect of the consumers' price discovery process on retailers is somewhat similar to that of branded variants (Shugan 1989, Bergen et al. 1996) in that the consumers' price comparison process becomes more difficult and costly. However, there is an important difference between the two situations. In the case of branded variants, consumers know the prices of the products but do not know the exact difference between the branded variants. In our case, consumers do know that the products are identical but do not know the price of one or more products. Furthermore, retailers often encourage manufacturers to create branded variants to make price comparison more difficult. As a result, implementation of branded variants requires retailers to have the power to influence the manufacturer to incur the cost of introducing multiple versions of similar products. In our model, retailers simply need to decide whether to impose consumer price discovery costs through price advertising decisions. As a result, we can have asymmetric advertising outcomes where one retailer advertises its price and the other retailer does not. Such asymmetric outcomes are not possible with branded variants.

A retailer's ability to advertise prices is also affected by its participation in MAP programs.[3] Kali (1998) models a manufacturer that offers MAP contracts to two symmetric retailers and finds that the manufacturer can use a cooperative advertising subsidy along with a price floor to give the retailers more incentives to advertise. As alluded to earlier, our interest in this paper is in analyzing the strategic implications of not advertising prices. Although not advertising prices as a strategic decision is prevalent in the MAP context, we do not restrict our attention to MAP alone. Our results hold in other cases where the retailer may choose not to advertise prices independent of the manufacturer's policy.

Simester (1995) studies the impact of price advertising on retail price image. Stores sell two products but advertise the price of only one of the products. As a result, consumers do not know the price of the second product until they visit the store. Simester finds that when consumers do not know the marginal cost structure of the store, the store can use its advertised price to signal its cost structure and, in effect, signal the price of the other product in the store. In this paper, we study a slightly different problem in that our objective is to understand why some types of retailers advertise prices while others do not. In our model, the retailers' choice is not about which products to price advertise; it is about deciding whether to price advertise at all.

Our paper is also related to the vast channel coordination literature in marketing. This literature has focused on the potential for conflict between manufacturers and retailers in the choice of retail prices (e.g., Jeuland and Shugan 1983, McGuire and Staelin 1983) and retail service and manufacturer inputs (e.g., Lal 1990, Desai 1997).[4] These papers have looked at contractual and structural remedies to address coordination problems about various decisions made by retailers and manufacturers. We study how the retailers' decisions about advertising prices can add to the conflict between a manufacturer and its retailers, and show how the manufacturer can remedy the situation in some cases.

The rest of the paper is organized as follows. Section 2 describes the model. Section 3 presents the analysis. Section 4 concludes with a discussion of the implications of our findings and directions for future research.

---

[3] MAP policies typically involve the manufacturer's provision of an advertising subsidy to the retailer if the retailer agrees not to advertise the product at a price below the manufacturer-specified price.

[4] This is only a representative list from a vast literature.

2. Model

Our overarching objective is to examine the effects of competition and service externalities between high-service retailers and low-service retailers on the retailers' decisions to advertise prices and the profitability of manufacturers. Therefore, we develop a model that includes three channel members: a manufacturer, a high-service retailer, and a low-service retailer. The model also allows consumers to take the benefit of service at the high-end store and purchase the product at the low-end store. We now describe the model in more detail.

Firms. We consider a manufacturer selling a complex consumer durable product through two retailers, H and L. Retailer H provides a higher level of service to consumers during the selling process than Retailer L. Because the product is complex, an important part of the retail service is the provision of detailed product information, including the explanation of different attributes and features and the appropriateness of the product in a given situation. The manufacturer charges the same per-unit wholesale price w to both retailers. Retailer i ($i =$ H, L) chooses its price p_i and service level s_i. We assume that the cost of service is $\lambda_i s_i^2/2$ with $\lambda_H = 1$ and $\lambda_L = \lambda > 1$ so that holding all else constant, Retailer H will provide a higher level of service than Retailer L. This formulation allows us to incorporate asymmetric service provision by the two retailers while endogenizing the retailers' service decisions. In addition to price and service decisions, each retailer chooses whether or not to advertise its price at a cost of F.

Consumers. Consumers are uniformly distributed on a Hotelling line of unit length (Hotelling 1929) in the [0, 1] interval. Retailer H is located at a distance a from the left extreme ($x = a$) and Retailer L is located at a distance a from the right extreme ($x = 1 - a$). We assume that the transportation cost is t per unit distance and represents the psychological costs as a result of a store's layout and information delivery format being different from those at a given consumer's ideal store. Each consumer also has an outside option of not purchasing any product from either retailer. We assume that consumers get zero utility from exercising this outside option.

Consumers' valuation for their ideal product is V and their valuation for receiving service s_i is θs_i. As is often the case in consumer durable markets, consumers can receive service from one retailer and purchase the product from another retailer. In our model, consumers could consume the service provided by Retailer H and then purchase the product from Retailer L. In doing so, however, consumers may be unable to take the full benefit of the service provided by Retailer H. We assume that free-riding

Figure 1   Consumers and Locations of the Two Retailers
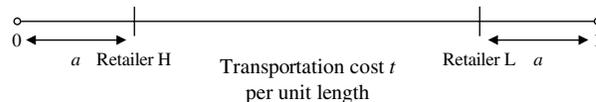
consumers who go to Retailer H first and then to Retailer L to purchase the product enjoy a benefit of $\delta \theta s_H$ ($\delta < 1$).[5] These consumers have to familiarize themselves with both stores, and therefore, they incur the transportation cost at both stores.

When a retailer does not advertise its price, consumers may decide to visit the retailer's store based on expectation about its price (Lal and Matutes 1989, 1994; Lal and Rao 1997). To purchase a product whose price is not advertised, however, consumers have to incur a price discovery cost to complete the transaction. This cost is incurred when consumers need to first figure out how to obtain the price of the specific product and then go through the required steps to obtain that information. Web stores often require that consumers either call the store or fill out an online form requesting price information. To experience this cost firsthand, we called some retailers to ask about unadvertised prices and sent e-mails to a few others. When we called, we frequently experienced extended hold times. For our e-mail price requests, our response times varied from a few minutes to a few hours to no response at all. Furthermore, if we wanted to discover the price of a product over a weekend or after business hours, we had to wait until the next business day for a response. These experiences suggest that the cost of price discovery is nontrivial. We capture these price discovery costs in our model using the parameter c. Thus, a consumer at location x who goes to Retailer H and buys the product there will enjoy a utility $U(x) = V - p_H + \theta s_H - |a - x|t$ if p_H is advertised and a utility $U(x) = V - p_H + \theta s_H - |a - x|t - c$ if p_H is not advertised.

We want to ensure that the total market demand is not constant but expands or shrinks based on the two retailers' price and service decisions. Therefore, we assume that the consumers' valuation for the product is not so high that every consumer would buy the product. Instead, we consider a situation in which the

---

[5] This implies that we do not consider situations where service levels are additive and consumers get the benefit of $\delta s_H + s_L$; instead, we consider situations where consumers get the benefit of the higher of two service levels: δs_H and s_L. When $\delta s_H < s_L$, free-riding consumers get the benefit of s_L and, hence, will not find it worthwhile to go to Retailer H before going to Retailer L. The analysis of the model without free-riding is available from the authors on request.

Figure 2   Consumer Indifference Points

consumers at the two extremes of the Hotelling line do not purchase from either retailer (see Figure 1).[6]

Timeline. The sequence of events is as follows:

Stage 1. The manufacturer, as the Stackelberg leader, chooses the wholesale price w.

Stage 2. Taking the manufacturer's wholesale price as given, the retailers choose service levels s_H and s_L.

Stage 3. After choosing service levels, the retailers choose prices p_H and p_L.[7]

Stage 4. Retailers decide whether or not to inform consumers about prices.

Stage 5. Consumers make their store visit and purchase decisions.

We adopt the notion of subgame perfect Nash equilibrium (SPNE) and begin our analysis by developing demand functions from an analysis of consumers' decisions in Stage 5.

Demand Functions. The demand functions for the two retailers depend not only on the retailers' price and service levels but also on decisions to advertise prices. The various consumer indifference points are depicted in Figure 2.

A consumer at location x_1 is indifferent between buying from Retailer H and the outside option (i.e., not buying from either retailer). The indifference point of the consumer at x_1 can be obtained by solving

$$V - p_H + \theta s_H - (a - x_1)t - i_H c = 0, \quad (1)$$

where i_H denotes the price advertising policy of Retailer H such that $i_H = 1$ if Retailer H does not advertise its price and $i_H = 0$ otherwise. When the retailer does not advertise its price, the consumer experiences the price discovery cost (c). Solving the above equation, we obtain the indifference point (x_1) to be

$$x_1 = \frac{at - (V - p_H + \theta s_H - i_H c)}{t}. \quad (2)$$

A consumer at x_2 is indifferent between buying from Retailer H and consuming the service provided by Retailer H and then purchasing the product from Retailer L. Such a consumer incurs the cost of

[6] If the parameters are such that consumers in the middle of the Hotelling line are inactive, each retailer would enjoy a local monopoly and would have no competition.

[7] We model the service provision decision as occurring before the pricing decision because creating and running service functions takes more advance planning than does changing prices. We thank the area editor for this suggestion.

traveling to Retailer H first and then to Retailer L. Therefore, the indifference point x_2 is such that

$$V - p_H + \theta s_H - (x_2 - a)t - i_H c - \big(V - p_L + \theta \delta s_H$$
$$- (x_2 - a)t - (1 - a - x_2)t - i_L c\big) = 0, \quad (3)$$

where i_L denotes the price advertising policy of Retailer L such that $i_L = 1$ if Retailer L does not advertise its price and $i_L = 0$ otherwise.

Solving Equation (3), we obtain the indifference point (x_2) to be

$$x_2 = \frac{i_L c - i_H c + (1 - a)t - p_H + p_L + \theta(1 - \delta)s_H}{t}. \quad (4)$$

At x_3, the consumer is indifferent between purchasing from Retailer L after having visited Retailer H and traveling to Retailer L directly. The indifference point x_3 is the solution of

$$V - p_L + \theta \delta s_H - t(1 - a - x_3) - t(x_3 - a) - i_L c$$
$$- \big(V - p_L + \theta s_L - t(1 - a - x_3) - i_L c\big) = 0. \quad (5)$$

Solving the above equation, we obtain the indifference point (x_3) to be

$$x_3 = \frac{at + \delta \theta s_H - \theta s_L}{t}. \quad (6)$$

Finally, at x_4, the consumer is indifferent between buying from Retailer L and the outside option. The indifference point x_4 is the solution of

$$V - p_L + \theta s_L - (x_4 - (1 - a))t - i_L c = 0. \quad (7)$$

Solving the above equation, we obtain the indifference point (x_4) to be

$$x_4 = \frac{(1 - a)t - i_L c + V - p_L + \theta s_L}{t}. \quad (8)$$

Given the various consumer indifference points, Retailer H's demand is given by

$$d_H = x_2 - x_1$$
$$= \frac{i_L c - 2i_H c + (1 - 2a)t + V - 2p_H + p_L + \theta(2 - \delta)s_H}{t}. \quad (9)$$

The demand for Retailer L comes from consumers (1) who free-ride from Retailer H and purchase from Retailer L and (2) those who buy directly from Retailer L. Retailer L's demand is given by

$$d_L = (x_3 - x_2) + (x_4 - x_3) = x_4 - x_2$$
$$= \frac{i_H c - 2i_L c + V + p_H - 2p_L - \theta(1 - \delta)s_H + \theta s_L}{t}, \quad (10)$$

where i_H and i_L denote the price advertising policies of Retailers H and L, respectively, such that for $j \in \{H, L\}$, $i_j = 1$ if Retailer j does not advertise its price and $i_j = 0$ otherwise.

3. Analysis

In this section, we describe the decisions made by the two retailers and the manufacturer. We start with the retailers' price advertising decisions in Stage 4.

3.1. Stage 4: Price Advertising Decisions

In the remainder of the paper, we use the following notations to denote the four possible cases of price advertising. In case YY, both retailers do price advertising. In case NY, Retailer L advertises its price but Retailer H does not. In case YN, Retailer H advertises its price but Retailer L does not. In case NN, neither retailer does price advertising. In Stage 4, the two retailers decide whether or not to advertise prices given prices p_H and p_L (chosen in Stage 3) and the service levels s_H and s_L (chosen in Stage 2). Given the demands in Equations (9) and (10), the profits of the two retailers in the four cases are given by

$$\Pi_H^{YY} = (p_H - w)d_H^{YY} - s_H^2/2 - F,$$
$$\Pi_L^{YY} = (p_L - w)d_L^{YY} - \lambda s_L^2/2 - F,$$
$$\Pi_H^{NY} = (p_H - w)d_H^{NY} - s_H^2/2,$$
$$\Pi_L^{NY} = (p_L - w)d_L^{NY} - \lambda s_L^2/2 - F,$$
$$\Pi_H^{YN} = (p_H - w)d_H^{YN} - s_H^2/2 - F,$$
$$\Pi_L^{YN} = (p_L - w)d_L^{YN} - \lambda s_L^2/2,$$
$$\Pi_H^{NN} = (p_H - w)d_H^{NN} - s_H^2/2, \quad \text{and}$$
$$\Pi_L^{NN} = (p_L - w)d_L^{NN} - \lambda s_L^2/2$$

where the superscript denotes the case under consideration.

In this stage, a retailer enjoys a higher demand when it advertises but pays the cost of advertising. This trade-off between the higher demand and the higher cost determines each retailer's optimal strategy in this case. For example, case YN is an equilibrium if neither retailer has an incentive to unilaterally deviate. If Retailer H deviates to no-advertising strategy, the change in its profit is given by $\Pi_H^{NN} - \Pi_H^{YN} = F - 2c(p_H - w)/t$. Similarly, if Retailer L deviates to the advertising strategy, the change in its profit is given by $\Pi_L^{YY} - \Pi_L^{YN} = 2c(p_L - w)/t - F$. Therefore, case YN is an equilibrium if $2c(p_L - w)/t < F < 2c(p_H - w)/t$. Similarly, case NY is an equilibrium if $2c(p_H - w)/t < F < 2c(p_L - w)/t$, case YY is an equilibrium if $F < \min\{2c(p_L - w)/t, 2c(p_H - w)/t\}$, and case NN is an equilibrium if $F > \max\{2c(p_H - w)/t, 2c(p_L - w)/t\}$.

We now consider the two retailers' optimal pricing decisions. We treat case YY as the benchmark case and compare the prices in all the other cases with those in the benchmark case. This helps develop insights for the equilibrium price advertising choices made by the retailers.

3.2. Stage 3: Optimal Pricing Decisions

In Stage 3, each retailer anticipates the Stage 4 outcomes and chooses its retail price for a given set of wholesale price and service levels chosen in Stages 1 and 2, respectively. We start by considering the retailers' pricing decisions when the retailers anticipate the Stage 4 outcome to be a symmetric one: case YY and case NN.

In case YY, both retailers' prices are known to consumers without any additional price discovery costs. Solving the two retailers' first-order conditions, we get

$$p_H^{YY*} = \frac{4(1-2a)t + 5(V+2w) + \theta(7-3\delta)s_H + \theta s_L}{15},$$
$$p_L^{YY*} = \frac{(1-2a)t + 5(V+2w) + \theta(3\delta-2)s_H + 4\theta s_L}{15}. \tag{11}$$

In case NN, the retailers' optimal prices are

$$p_H^{NN*} = \frac{4(1-2a)t + 5(V+2w) + \theta(7-3\delta)s_H + \theta s_L - 5c}{15},$$
$$p_L^{NN*} = \frac{(1-2a)t + 5(V+2w) + \theta(3\delta-2)s_H + 4\theta s_L - 5c}{15}. \tag{12}$$

Proposition 1 describes the differences in the equilibrium prices in the two symmetric cases.

PROPOSITION 1. *For a given wholesale price, both retailers have lower prices and per-unit margins when neither retailer advertises price compared to the case in which both retailers advertise prices.*[8]

Both retailers charge a lower price in case NN than in case YY.[9] The lack of price advertising by a retailer in case NN imposes an additional price discovery cost of c on the consumers buying from that retailer. Because both retailers do not advertise prices in case NN, consumers of both retailers end up incurring this cost. As a result, in case NN, both retailers have to reduce prices to make up for this additional cost to the consumers, leading to lower per-unit margins in case NN relative to case YY.

Next, we look at the retailers' pricing decisions in the two asymmetric cases: cases NY and YN.
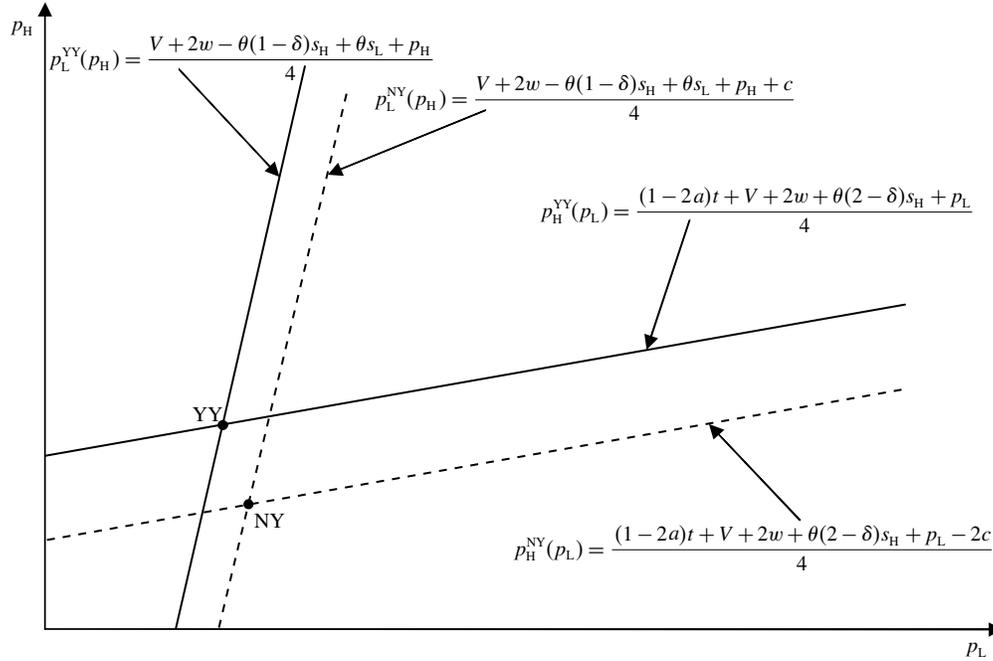
In case NY, where only Retailer L advertises its price, solving the two retailers' first-order conditions, we get

$$p_H^{NY*} = \frac{4(1-2a)t + 5(V+2w) + \theta(7-3\delta)s_H + \theta s_L - 7c}{15},$$
$$p_L^{NY*} = \frac{(1-2a)t + 5(V+2w) + \theta(3\delta-2)s_H + 4\theta s_L + 2c}{15}. \tag{13}$$

---

[8] We have relegated all the proofs to the appendix.

[9] For ease of exposition, we say "case YY" instead of "when the retailers anticipate the Stage 4 equilibrium to be case YY." The game has been solved using backward induction, starting with the last stage.

Figure 3   Price Reaction Functions for Cases YY and NY in Stage 3

In case YN, where only Retailer H advertises its price, the retailers' optimal prices are

$$p_H^{YN*} = \frac{4(1-2a)t + 5(V+2w) + \theta(7-3\delta)s_H + \theta s_L + 2c}{15},$$

$$p_L^{YN*} = \frac{(1-2a)t + 5(V+2w) + \theta(3\delta-2)s_H + 4\theta s_L - 7c}{15}.$$

$$(14)$$

Here, again, our goal is to compare the prices in cases NY and YN with those in the benchmark case. Figure 3 shows the reaction functions for cases NY and YY. When Retailer H does not advertise its price (case NY), Retailer L charges a higher price for a given p_H charged by Retailer H. In other words, Retailer L's reaction function is shifted to the right when Retailer H does not advertise its price.

The lack of advertising by Retailer H imposes an additional price discovery cost of c on its consumers, thereby increasing the consumers' effective cost of buying from Retailer H. Retailer L reacts to the higher effective price of its competitor by charging a higher price for its product. On the other hand, for a given price p_L, Retailer H charges a lower price when it does not advertise because it needs to offset the consumers' cost of price discovery. Similar shifts in price reactions are observed in case YN: when Retailer L does not advertise its price (case YN), Retailer H charges a higher price for a given p_L charged by Retailer L. Retailer L ends up charging a lower p_L for a given p_H charged by Retailer H. Figure 4 shows that when Retailer L does not advertise its price, its price reaction function is shifted to the left, whereas Retailer H's price reaction function is shifted up. Thus, the lack

of advertising by one of the retailers in the asymmetric cases has a strategic effect in addition to the inefficiency that was observed in the symmetric case (case NN).

Proposition 2 summarizes the above effects.

PROPOSITION 2. *When only one retailer advertises its price, the advertising retailer enjoys a higher per-unit margin and the nonadvertising retailer has a lower per-unit margin compared to the case in which both retailers advertise prices.*

We now analyze the two retailers' service decisions.

### 3.3.   Stage 2: Optimal Service Decisions
In this stage, the two retailers anticipate the outcomes in Stages 3 and 4 and choose optimal service levels for a given wholesale price.

Propositions 1 and 2 describe the strategic effects when service levels are held constant across the different cases. We now discuss how the optimal service decisions vary across various cases.

PROPOSITION 3. $s_H^{YN*} > s_H^{YY*}$ *and* $s_H^{NN*} > s_H^{NY*}$ *when* $t > 8\theta^2/(15\lambda)$. $s_H^{YN*} \le s_H^{YY*}$ *and* $s_H^{NN*} \le s_H^{NY*}$ *when* $64\theta^2/(225\lambda) < t \le 8\theta^2/(15\lambda)$.

Proposition 3 shows how Retailer H's service provision changes across the various cases as a result of the pricing decisions described in Propositions 1 and 2 and other strategic effects. In case YN, Retailer H anticipates that it will enjoy a higher per-unit profit margin than in case YY. This offers Retailer H an incentive to provide a higher service level and increase its demand.

Figure 4 Price Reaction Functions for Cases YY and YN in Stage 3
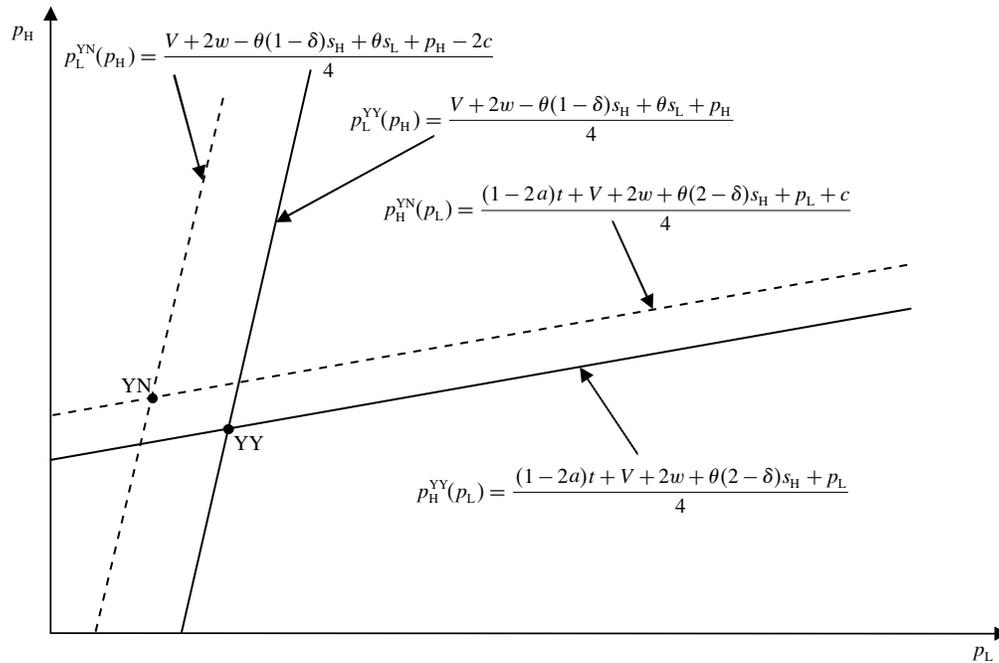
Retailer L, on the other hand, has an incentive to provide a lower service level in case YN than in case YY because it has a lower per-unit profit margin in the former. With a reduction in Retailer L's service, Retailer H faces less intense service competition and therefore has an incentive to reduce its service level. However, as the transportation cost t increases, it becomes difficult for consumers to free-ride, thereby increasing the incentives for Retailer H to provide a higher level of service in case YN. As t decreases, it becomes easier for consumers to free-ride; this results in a lower service provision by Retailer H. Retailer H's equilibrium service is determined by the net effect of these forces. The difference in Retailer H's service across cases NN and NY are similarly determined. Note that in our model, $t > 64\theta^2/(225\lambda)$ for the demands to be positive. Therefore, Retailer H's service level is higher under case YN (and case NN) than under case YY (and case NY) for a larger part of the feasible parameter space.

These service decisions as well as the pricing decisions discussed earlier determine which type of equilibrium would emerge in the game between the two retailers. We discuss this next.

3.4. Retail Equilibrium

The price advertising decisions in §3.1 were characterized by taking the retailers' prices and services as given. However, any outcome is not an equilibrium if either firm can benefit from deviating from it in any stage. Depending on the values of model parameters, each of the four cases can be an equilibrium.

However, it is interesting to examine if the two retailers have asymmetric incentives to advertise.

PROPOSITION 4. *If only one retailer advertises its prices in equilibrium, that retailer is more likely to be the high-service retailer than the low-service retailer.*

Proposition 4 states that the differences between the two retailers result in different price advertising strategies. We are more likely to see an equilibrium in which only the high-service retailer advertises its price than an equilibrium in which only the low-service retailer advertises its price. In any asymmetric equilibrium, the nonadvertising retailer faces a competitive disadvantage, leading to a lower demand and a lower profit margin compared to the case where it advertises. On the other hand, the advertising retailer in an asymmetric equilibrium has a higher profit margin, service, and demand compared to the case when both retailers advertise prices. Therefore, the asymmetric equilibrium can break if the nonadvertising retailer can be better off by deviating to the strategy of advertising its price. That is, the YN equilibrium is broken when Retailer L has incentives to move to the YY equilibrium and the NY equilibrium is broken when Retailer H has incentives to deviate to the YY equilibrium.

We find that there are two reasons why Retailer H has more incentives to deviate from the NY equilibrium than Retailer L has to deviate from the YN equilibrium. The first reason is that holding all else constant, Retailer H enjoys a higher profit margin than Retailer L. Therefore, for a given level of advertising

cost, Retailer H gains more from the increase in its demand that comes from the consumers' not incurring the price discovery cost. The second reason is related to the free-riding benefits enjoyed by Retailer L. For a large set of parameter values, Retailer H provides a higher level of service in case YN than in case YY. This higher level of service provides a higher free-riding benefit to Retailer L. Therefore, some of competitive disadvantage that Retailer L suffers in case YN is mitigated by the higher free-riding benefit that it enjoys. On the other hand, Retailer H's competitive disadvantage is not mitigated by such free-riding benefits in case NY. Therefore, Retailer H has more incentives to deviate from case NY than Retailer L has to deviate from case YN.

An asymmetric equilibrium can also break if the advertising retailer deviates to the strategy of not advertising. The two effects described above apply here as well. Deviating to the no-advertising strategy reduces demand, which hurts Retailer H more than Retailer L. In addition, for a large set of parameter values, Retailer H provides a higher service in case NN than in case NY, which provides Retailer L some additional benefits from deviating to case NN.

Proposition 4 explains why we may see differences across retailers in price advertising policies. We are more likely to see a situation in which high-service retailers advertise prices and low-service retailers do not. This is consistent with our observation in §1 that retailers that do not advertise prices tend to be lower-service retailers.

The optimal profits of the two retailers are presented in Table T1 in the electronic companion.[10]

3.5. Stage 1: Manufacturer's Profits
We now analyze the first stage of the game and determine the optimal wholesale price w that the manufacturer should charge. Our focus here is to examine how the retailers' choices affect the manufacturer's profits. Although the effects of retailers' pricing decisions on the manufacturer through the double marginalization problem are well understood, the effects of retailers' price advertising policies on the manufacturer are as yet unexplored. Our interest is in studying whether the retailers' advertising policies cause a new type of channel coordination problem between the manufacturer and the retailers that has not been previously identified. If the manufacturer's profits are adversely affected by the retailers' choices, the manufacturer can possibly attempt to influence the retailers' incentives and change the Stage 4 equilibrium outcome. Therefore, we are also interested in exploring the solution

---

[10] An electronic companion to this paper is available as part of the online version that can be found at http://mktsci.pubs.informs.org/.

to any channel coordination problem that may arise because of the retailers' advertising policies.

The manufacturer's profit is given by

$$\Pi_M = (w - \kappa)(d_H + d_L), \qquad (15)$$

where κ is the marginal cost of production. Because d_H and d_L are determined by the retailers' service, price, and price advertising decisions, the manufacturer's profit function is different in each of the four cases. We derive the manufacturer's optimal wholesale prices and profits for the four cases and report them in Table T2 in the electronic companion.

We denote the manufacturer's profit in cases YY, NY, YN, and NN by Π_M^{YY}, Π_M^{NY}, Π_M^{YN}, and Π_M^{NN}, respectively.

Our earlier results about the equilibria in Stages 2, 3, and 4 are valid for any value of the wholesale price chosen by the manufacturer in Stage 1. Proposition 5 describes how the manufacturer is affected by the retailers' choices.

PROPOSITION 5. *For a given wholesale price w, the manufacturer's profits are ordered as follows*:
(A) *when* $\theta^2 < 75t\lambda/(4((3-\delta)(7-3\delta)\lambda - 4))$, $\Pi_M^{YY} > \Pi_M^{YN} > \Pi_M^{NY} > \Pi_M^{NN}$;
(B) *when* $\theta^2 \geq 75t\lambda/(4((3-\delta)(7-3\delta)\lambda - 4))$, $\Pi_M^{YN} > \Pi_M^{YY} > \Pi_M^{NN} > \Pi_M^{NY}$.

Proposition 5 shows that for a given wholesale price, the manufacturer prefers cases YY and YN to cases NY and NN. However, the manufacturer's profit in case YN is higher than that in case YY when θ is sufficiently high. In other words, retail service plays an important role in stimulating product demand.

After the wholesale price is chosen, the manufacturer's profit is higher when the sales are higher. The demand across the four cases differs primarily because of two reasons: (1) the level of deadweight price discovery cost and (2) the level of service provided by the two retailers. The total retail demand is higher in case YY than in either case NY or case NN because no consumer has to incur the price discovery cost in case YY and because consumers also enjoy a higher service level in case YY. In case YN, the total demand is higher than that in case NN because fewer consumers incur the price discovery cost. Case YN has a higher demand than case NY because of the higher service levels enjoyed by consumers of both retailers. Thus, the manufacturer enjoys the highest demand in either case YN or case YY.

Interestingly, the total demand in case YN can be higher or lower than that in case YY. On one hand, in case YY both retailers do price advertising, which results in a lower price discovery cost for consumers than in case YN. On the other hand, the high-service retailer provides a higher level of service in case YN

than in case YY. As a result, when retail service plays a more important role in the demand function, i.e., θ is sufficiently high, the latter effect dominates the former effect, and case YN results in a higher demand than case YY. This difference in demand translates to a higher (lower) profit for the manufacturer in case YN when service plays a more (less) important role in the demand function.

Next, we examine when the condition in Proposition 5 is likely to be satisfied. Note that $\theta^2 < 75t\lambda/(4((3-\delta)(7-3\delta)\lambda-4))$ essentially requires that θ be sufficiently low. When θ is low, consumers care more about price than service and the cost of price discovery adversely affects the demand to a greater extent. Therefore, the manufacturer can gain from the demand expansion if the retailers eliminate the consumers' price discovery cost by providing price information. This explains why the manufacturer prefers case YY when θ is low. The above condition is more likely to be satisfied when $75t\lambda/(4((3-\delta)(7-3\delta)\lambda-4))$ is high; i.e., t is high or λ is low. First, consider the transportation cost t. As stated in Proposition 3, high values of t offer Retailer H an incentive to provide higher levels of service. Retailer L benefits by free-riding on Retailer H's higher service provision. Second, note that when λ is low, Retailer L's service is more effective, which leads to an increase in demand.

The channels literature has traditionally focused on double marginalization and moral hazard issues as important channel coordination problems. Proposition 5 shows a new kind of channel coordination problem in which the retailers' price advertising policies may be different from what the manufacturer would prefer. Sometimes the channel coordination problem is caused by one or both retailers not advertising prices when the manufacturer would like them to advertise prices. For example, the manufacturer's profit may be highest in case YY but the retail advertising equilibrium may be one of the other cases. Interestingly, sometimes the channel coordination problem may also be caused by the "wrong" retailer advertising its prices. For example, the manufacturer may prefer case YN but the retail advertising equilibrium may be case YY or case NY.

If wholesale price is the only control instrument the manufacturer can use, then the manufacturer cannot resolve this coordination problem. However, if the manufacturer can affect the retailer's cost of advertising, then it can influence the equilibrium outcomes. We discuss these possibilities next.

3.6. Advertising Support
In this section, we discuss how a very common manufacturer-controlled mechanism can help a manufacturer address the above coordination problem.

Manufacturers often provide advertising funds to retailers that help reduce the retailers' cost of advertising (featuring) the manufacturer's products (Blattberg and Neslin 1990, Coughlan et al. 2006). We next discuss how this type of support can help the manufacturer change the retailers' strategies in some situations when the channel coordination problem is caused by one or both retailers not advertising prices when the manufacturer would like them to.

PROPOSITION 6. *When* $\theta^2 < 75t\lambda/(4((3-\delta)(7-3\delta)\cdot\lambda-4))$, *the manufacturer can fully resolve the channel coordination problems because of the retailers' price advertising policies by offering advertising or featuring support.*

From Proposition 5, we know that when the condition in Proposition 6 is satisfied, the manufacturer enjoys the highest demand and profit in case YY. Proposition 6 shows that the increase in the manufacturer's profit when the retailers move to case YY is high enough that the manufacturer can subsidize the retailers' advertising costs and still be better off. If either of the two retailers is not advertising, then the manufacturer can offer advertising support to them with the requirement that the advertising support money be spent on price advertising. The retailers would then find it optimal to advertise prices. For example, consider a situation in which the manufacturer anticipates that only the high-service retailer would advertise its price, but it would prefer to see both retailers advertise. If the manufacturer provides advertising or featuring support that exceeds $F - F_L^{YYYN}$, where

$$
\begin{aligned}
F_L^{YYYN} \\
= \Big(& 2c\lambda(225t\lambda-64\theta^2)\big(105t-4(3-\delta)(7-3\delta)\theta^2\big) \\
& \cdot \big(15t(2(1-2a)t+10(V-w)-7c)-4(7-3\delta) \\
& \cdot \big(2((1-2a)(1-\delta)t+(V-w)(3-2\delta))-c(3-\delta))\theta^2\big)\Big) \\
& \cdot \Big((3{,}375t^2\lambda-60t\theta^2(16+(7-3\delta)^2\lambda) \\
& \quad\quad +64(2-\delta)(7-3\delta)\theta^4)^2\Big)^{-1},
\end{aligned}
$$

the low-service retailer would find it optimal to advertise its prices while the high-service retailer would continue to advertise its price, which would result in both retailers advertising prices. This way, the manufacturer can shift the Stage 4 equilibrium from case YN to case YY. Essentially, the advertising support offsets the retailers' gains from not advertising their prices for competitive reasons.[11]

---

[11] We show in the appendix that the manufacturer would have an incentive to move the retailers to the different cases as discussed here.

Proposition 6 is applicable when the effect of retail service on demand; i.e., θ is not very high. When retail service is more important, the manufacturer prefers that only the high-service retailer advertise its prices. Clearly, the retail advertising equilibrium may be different. Proposition 7 shows that advertising support from the manufacturer may have a more limited role in remedying the channel coordination problems in such cases.

PROPOSITION 7. *When* $\theta^2 \geq 75t\lambda/(4((3-\delta)(7-3\delta) \cdot \lambda - 4))$, *the manufacturer cannot fully resolve the channel coordination problems because of the retailers' price advertising policies by offering advertising or featuring support.*

When $\theta^2 \geq 75t\lambda/(4((3-\delta)(7-3\delta)\lambda - 4))$, the manufacturer would like only Retailer H to advertise its prices. Because the manufacturer would be required to offer the same level of advertising support to both retailers, the manufacturer finds it harder to offer an advertising support that would induce Retailer H to advertise its prices but not Retailer L. If the retail advertising equilibrium is case NN, the manufacturer can attempt to resolve this coordination problem by offering advertising support in the range $(F - F_H^{\text{YNNN}}, F - F_L^{\text{NYNN}})$, where

$$
\begin{aligned}
F_H^{\text{YNNN}} = &\left(2c\left(225t - 4(7-3\delta)^2\theta^2 \right)\left(105t\lambda - 32\theta^2 \right) \right.\\
&\cdot \left(15t\lambda\left(2(4(1-2a)t + 5(V-w)) - 3c \right) \right.\\
&\left. \quad - 32((1-2a)t + V - w)\theta^2 \right)\Big)\\
&\cdot \left(\left(3{,}375t^2\lambda - 60t\theta^2(16 + (7-3\delta)^2\lambda) \right.\right.\\
&\left.\left. \quad + 64(2-\delta)(7-3\delta)\theta^4\right)^2 \right)^{-1}
\end{aligned}
$$

and

$$
\begin{aligned}
F_L^{\text{NYNN}} = &\left(2c\lambda\left(225t\lambda - 64\theta^2 \right)\left(105t - 4(3-\delta)(7-3\delta)\theta^2 \right)\right.\\
&\cdot \left(15t(2(1-2a)t + 10(V-w) - 3c) \right.\\
&\quad - 4(7-3\delta)\big(2((1-2a)(1-\delta)t\\
&\left. \quad + (V-w)(3-2\delta)) - 3c(1-\delta) \big)\theta^2 \right)\Big)\\
&\cdot \left(\left(3{,}375t^2\lambda - 60t\theta^2(16 + (7-3\delta)^2\lambda) \right.\right.\\
&\left.\left. \quad + 64(2-\delta)(7-3\delta)\theta^4\right)^2 \right)^{-1},
\end{aligned}
$$

to the retailers in such a way that only the high-service retailer would find it optimal to advertise its price, thereby moving the equilibrium to case YN. If the manufacturer offers advertising support that exceeds $F - F_L^{\text{NYNN}}$, then the low-service retailer will also find it optimal to advertise. This would move the equilibrium to case YY, which provides the manufacturer a higher profit than case NN but lower than case YN.

Sometimes the channel coordination problem is caused by the "wrong" retailer, i.e., the low-service retailer, advertising its prices. In such cases, the manufacturer cannot achieve full channel coordination by offering advertising support because any additional advertising support can only get the high-service retailer to advertise but cannot prevent the low-service retailer from advertising.[12] The best that the manufacturer can achieve through advertising support is to get both retailers to advertise, i.e., obtain case YY as the equilibrium even when case YN yields the manufacturer a higher profit.

In summary, the manufacturer can address the channel coordination problem through a combination of wholesale prices and advertising support more easily when Retailer H's service plays a less important role in stimulating the demand for the product.

4. Summary and Conclusions

Retailers selling consumer durables often do not advertise prices and instead get consumers to incur a price discovery cost. Conventional wisdom in marketing would recommend providing the price information to consumers, thus making their transactions easier to complete. Therefore, this practice seems puzzling. In addition, some anecdotal evidence suggests that low-service retailers, who tend to have low prices, are the ones who do not advertise prices. In this paper, we examine the strategic implications of retailers not advertising prices. We find that in a duopoly, the lack of price advertising by one or both retailers changes the intensity of price competition by changing the reaction functions of the retailers. When only one retailer does not advertise its prices, the competing retailer's reaction function is shifted to the right. However, the cost of price discovery imposed by the nonadvertising retailer results in that retailer charging a lower price, leading to a lower per-unit profit margin. In other words, the nonadvertising retailer incurs a cost in shifting the competitor's price reactions.

Because we model competition between a high-service retailer and a low-service retailer, we derive interesting insights about how the strategic effects of nonadvertising by the two retailers differ. In our model, the low-service retailer free-rides on the service provided by the high-service retailer. When the high-service retailer does not advertise its price, it has a lower per-unit profit margin and consequently chooses a lower service level. This reduction in service hurts both retailers. On the other hand, when the low-service retailer is the only one not advertising

---

[12] We conjecture that in such cases, perhaps the manufacturer can encourage the low-service retailer to charge a higher price through the MAP mechanism.

its price, the high-service retailer enjoys a higher per-unit profit margin and provides a higher service level that benefits both retailers. As a result, we find that the equilibrium in which only the high-service retailer advertises its price is more likely than the equilibrium in which only the low-service retailer advertises its price. This result can help explain the anecdotal evidence presented earlier that shows high-service retailers are more likely to advertise prices.

We also identify a new type of channel coordination problem that can take two forms: (1) in some instances, the manufacturer would prefer both types of retailers to advertise prices but only one type may do so, and (2) in other instances, the manufacturer would prefer that the low-service retailer not advertise its price but the low-service retailer *does* advertise its price. Our results also demonstrate that manufacturers, through the use of advertising or featuring support, can improve channel coordination of price advertising by retailers, suggesting a new role for advertising or featuring support.

Some consumer durable manufacturers use MAP contracts that provide an advertising subsidy to retailers that do not advertise prices below the price floor specified by the contract. Some of the instances of low-price retailers not advertising prices may stem from such MAP contracts. Our results show that the phenomenon of low-priced retailers not advertising prices could in some cases be because MAP and in other cases could stem solely from the retailers' incentives that can exist even in the absence of MAP contracts. In addition, we offer a new explanation for MAP that is different from Kali (1998). Because MAP contracts are based on advertising support provided by the manufacturer, it cannot achieve the desired results if the retailers do not value the manufacturers' advertising support or if the manufacturers cannot monitor the implementation perfectly.[13]

There are two other reasons why sellers may not advertise prices.[14] One is that when retailers do not advertise prices and instead have customers call to find price information, they may have a higher probability of conversion to a sale. Although this is indeed possible, in general, note that the retailers in our model are catalog and Internet stores. The consumers who shop at these stores prefer the convenience and efficiency of these stores over interaction with the retailers' salespeople. These consumers are also more likely to "self-study" and educate themselves about the product features. Therefore, we believe they have

a low probability of being "converted" by a salesperson's pitch. Furthermore, when we called several retailers to ask about unadvertised prices, the salespeople merely provided the price information and did not try to convince us to buy the product. This may be because all other product-related information was already available to the consumers in the retailers' advertisements, and the salespeople recognize the above argument about consumers' self-selection. Another possibility is that retailers may wish to retain the flexibility of changing the price once they have more information about demand. Note, however, that if this were the only reason for the absence of price advertising, one would not expect it to asymmetrically affect low-service retailers and high-service retailers. In our shopping experiences, we observed differences between low-service and high-service retailers in their propensity to advertise prices. Second, the call for price phenomenon that we are studying also applies to Internet stores where it is significantly easier to change prices. Finally, if a retailer decides not to advertise prices solely because it does not want to commit to prices, we would expect that as retailers learn about demand characteristics, the incentive to "hide" prices will be diminished. In particular, we should see fewer "call for price" advertisements for older product models. That is not what we observed in our shopping experiences. For example, the Canon EOS 40D digital SLR camera has been around for awhile (it was introduced in October 2007), but we still see retailers not advertising the price of this camera.

In deriving the above results, we have made a few assumptions that may appear as limiting. For example, our assumption of a monopolist manufacturer may seem restrictive in the analysis of the manufacturer's preferences. We acknowledge that modeling two manufacturers will add another layer of richness to the model. Doing so, however, will render the analysis intractable and prevent us from focusing on our primary research objective: to understand why different types of retailers may have different incentives to advertise prices. Based on the results of McGuire and Staelin (1983), we conjecture that if the level of competition between the two manufacturers is not too intense, the insights from our model will hold. Furthermore, in another attempt to make the analysis tractable, we limit the asymmetry in our model to the provision of service and its free-riding. Future research could model the asymmetry in other model parameters such as the consumer's preference for service and the price discovery cost.

Our model assumes that the retailers' price advertisements reach all the consumers in the market. Future research could investigate the role of price advertising when such advertisements have partial

---

[13] For example, we checked the prices of 18 retailers selling the Nikon D700 digital SLR camera, with a reported MAP of $2,999.95. Nine retailers charged a price below $2,999.95 with six of those retailers advertising prices and three not advertising prices.

[14] We thank the editor for suggesting these.

reach. One could also study the role of category advertising in explaining the phenomenon of call for price.[15] Finally, one could study the behavioral aspects of not advertising prices. Does not advertising prices lead consumers to have higher expectations about product quality or lower expectations about price? If consumers invest time and effort in obtaining price information, are they likely to perceive the product as a "better deal" than when they do not? These are just some of the interesting issues in price advertising that merit exploration.

5. Electronic Companion

An electronic companion to this paper is available as part of the online version that can be found at http://mktsci.pubs.informs.org/.

Acknowledgment

Appendix

PROOF OF PROPOSITION 1. We use the optimal prices in Equations (11) and (12) to compare the price charged by each retailer in case NN and that in case YY, the benchmark. For Retailer H, we find that $p_H^{NN*} - p_H^{YY*} = -c/3$. Similarly, the difference in the price of Retailer L in cases NN and YY is also $-c/3$. Therefore, both retailers have lower per-unit margins when neither retailer advertises its price (case NN) than when both of them do (case YY). □

PROOF OF PROPOSITION 2. Comparing the optimal prices of the two retailers in cases NY and YN (Equations (13) and (14), respectively) with those in case YY, we have $p_H^{YN*} - p_H^{YY*} = 2c/15$ and $p_H^{NY*} - p_H^{YY*} = -7c/15$. Similarly, for Retailer L, we have $p_L^{YN*} - p_L^{YY*} = -7c/15$ and $p_L^{NY*} - p_L^{YY*} = 2c/15$. Therefore, Retailer H (L) charges a higher (lower) price in case YN relative to case YY, and Retailer L (H) charges a higher (lower) price in case NY relative to case YY. □

PROOF OF PROPOSITION 3. Using the optimal service levels for the two retailers in the various cases from Table A.1, one can see that

$$s_H^{YN*} - s_H^{YY*}$$
$$= \frac{8c\theta(7-3\delta)(15t\lambda - 8\theta^2)}{3{,}375t^2\lambda - 60t\theta^2(16 + (7-3\delta)^2\lambda) + 64(2-\delta)(7-3\delta)\theta^4}.$$

Similarly,

$$s_H^{NN*} - s_H^{NY*}$$
$$= \frac{8c\theta(7-3\delta)(15t\lambda - 8\theta^2)}{3{,}375t^2\lambda - 60t\theta^2(16 + (7-3\delta)^2\lambda) + 64(2-\delta)(7-3\delta)\theta^4}.$$

Since $7 - 3\delta > 0$, $s_H^{YN*} > s_H^{YY*}$ and $s_H^{NN*} > s_H^{NY*}$ if $15t\lambda - 8\theta^2 > 0$ or if $t > 8\theta^2/(15\lambda)$. □

PROOF OF PROPOSITION 4. Substituting the optimal prices in Equations (11)–(14) into the profit expressions, we obtain the profits of the two retailers in the four cases to be

$$\Pi_H^{YY} = \frac{2(4(1-2a)t + 5(V-w) + (7-3\delta)\theta s_H + \theta s_L)^2}{225t}$$
$$- \frac{s_H^2}{2} - F,$$

$$\Pi_L^{YY} = \frac{2((1-2a)t + 5(V-w) - (2-3\delta)\theta s_H + 4\theta s_L)^2}{225t}$$
$$- \frac{1}{2}\lambda s_L^2 - F, \tag{16}$$

$$\Pi_H^{NY} = \frac{2(4(1-2a)t + 5(V-w) + (7-3\delta)\theta s_H + \theta s_L - 7c)^2}{225t}$$
$$- \frac{s_H^2}{2},$$

$$\Pi_L^{NY} = \frac{2((1-2a)t + 5(V-w) - (2-3\delta)\theta s_H + 4\theta s_L + 2c)^2}{225t}$$
$$- \frac{1}{2}\lambda s_L^2 - F, \tag{17}$$

$$\Pi_H^{YN} = \frac{2(4(1-2a)t + 5(V-w) + (7-3\delta)\theta s_H + \theta s_L + 2c)^2}{225t}$$
$$- \frac{s_H^2}{2} - F,$$

$$\Pi_L^{YN} = \frac{2((1-2a)t + 5(V-w) - (2-3\delta)\theta s_H + 4\theta s_L - 7c)^2}{225t}$$
$$- \frac{1}{2}\lambda s_L^2, \tag{18}$$

$$\Pi_H^{NN} = \frac{2(4(1-2a)t + 5(V-w) + (7-3\delta)\theta s_H + \theta s_L - 5c)^2}{225t}$$
$$- \frac{s_H^2}{2},$$

$$\Pi_L^{NN} = \frac{2((1-2a)t + 5(V-w) - (2-3\delta)\theta s_H + 4\theta s_L - 5c)^2}{225t}$$
$$- \frac{1}{2}\lambda s_L^2, \tag{19}$$

where the superscript denotes the case under consideration.

First, consider case NY. Case NY is an equilibrium if neither retailer has an incentive to deviate from it. For Retailer L not to deviate from case NY to case NN, we need $\Pi_L^{NY} - \Pi_L^{NN} \geq 0$. Similarly, for Retailer H not to deviate from case NY to case YY, we need $\Pi_H^{NY} - \Pi_H^{YY} \geq 0$. Because we are looking for deviations from case NY, evaluating the profit expressions for Retailers H and L at the optimal service levels in case NY from Table A.1 (denoted s_H^{NY*} and s_L^{NY*})[16] yields

$$\Pi_L^{NY} - \Pi_L^{NN}$$

Table A.1   Optimal Service Levels in Stage 2

Case

Retailer H

YY

$$s_H^{YY*} = \frac{4\theta(7-3\delta)(15t\lambda(4(1-2a)t+5(V-w))-16((1-2a)t+V-w)\theta^2)}{3{,}375t^2\lambda-60t\theta^2(16+(7-3\delta)^2\lambda)+64(2-\delta)(7-3\delta)\theta^4}$$

NY

$$s_H^{NY*} = \frac{4\theta(7-3\delta)(15t\lambda(4(1-2a)t+5(V-w)-7c)-16((1-2a)t+V-w-2c)\theta^2)}{3{,}375t^2\lambda-60t\theta^2(16+(7-3\delta)^2\lambda)+64(2-\delta)(7-3\delta)\theta^4}$$

YN

$$s_H^{YN*} = \frac{4\theta(7-3\delta)(15t\lambda(4(1-2a)t+5(V-w)+2c)-16((1-2a)t+V-w+c)\theta^2)}{3{,}375t^2\lambda-60t\theta^2(16+(7-3\delta)^2\lambda)+64(2-\delta)(7-3\delta)\theta^4}$$

NN

$$s_H^{NN*} = \frac{4\theta(7-3\delta)(15t\lambda(4(1-2a)t+5(V-w)-5c)-16((1-2a)t+V-w-c)\theta^2)}{3{,}375t^2\lambda-60t\theta^2(16+(7-3\delta)^2\lambda)+64(2-\delta)(7-3\delta)\theta^4}$$

Retailer L

YY

$$s_L^{YY*} = \frac{240t((1-2a)t+5(V-w))\theta-64(7-3\delta)((1-\delta)(1-2a)t+(V-w)(3-2\delta))\theta^3}{3{,}375t^2\lambda-60t\theta^2(16+(7-3\delta)^2\lambda)+64(2-\delta)(7-3\delta)\theta^4}$$

NY

$$s_L^{NY*} = \frac{240t((1-2a)t+5(V-w)+2c)\theta-64(7-3\delta)((1-\delta)(1-2a)t+(V-w)(3-2\delta)+\delta c)\theta^3}{3{,}375t^2\lambda-60t\theta^2(16+(7-3\delta)^2\lambda)+64(2-\delta)(7-3\delta)\theta^4}$$

YN

$$s_L^{YN*} = \frac{240t((1-2a)t+5(V-w)-7c)\theta-64(7-3\delta)((1-\delta)(1-2a)t+(V-w)(3-2\delta)-(3-\delta)c)\theta^3}{3{,}375t^2\lambda-60t\theta^2(16+(7-3\delta)^2\lambda)+64(2-\delta)(7-3\delta)\theta^4}$$

NN

$$s_L^{NN*} = \frac{240t((1-2a)t+5(V-w)-5c)\theta-64(7-3\delta)((1-\delta)(1-2a)t+(V-w)(3-2\delta)-(3-2\delta)c)\theta^3}{3{,}375t^2\lambda-60t\theta^2(16+(7-3\delta)^2\lambda)+64(2-\delta)(7-3\delta)\theta^4}$$

$$= \frac{14c(2(1-2a)t+10(V-w)-2(2-3\delta)\theta s_H^{NY*}+8\theta s_L^{NY*}-3c)}{225t}-F\geq 0,$$

$$\Pi_H^{NY}-\Pi_H^{YY}$$

$$=F-\frac{14c(2(4(1-2a)t+5(V-w))+2(7-3\delta)\theta s_H^{NY*}+2\theta s_L^{NY*}-7c)}{225t}\geq 0. \tag{20}$$

From the above incentives not to deviate, it can be shown that case NY is an equilibrium if

$$F_L^{NY-NN}\geq F\geq F_H^{NY-YY}\geq 0, \tag{21}$$

where

$$F_L^{NY-NN}$$

$$= \frac{14c(2(1-2a)t+10(V-w)-2(2-3\delta)\theta s_H^{NY*}+8\theta s_L^{NY*}-3c)}{225t}$$

and

$$F_H^{NY-YY}$$

$$= \frac{14c(2(4(1-2a)t+5(V-w))+2(7-3\delta)\theta s_H^{NY*}+2\theta s_L^{NY*}-7c)}{225t}.$$

We now consider the incentives for the two retailers not to deviate from case YN. Evaluating the relevant profit expressions at the optimal service levels in case YN from Table A.1 (denoted s_H^{YN*} and s_L^{YN*}), we have

$$\Pi_L^{YN}-\Pi_L^{YY}$$

$$=F-\frac{14c(2(1-2a)t+10(V-w)-2(2-3\delta)\theta s_H^{YN*}+8\theta s_L^{YN*}-7c)}{225t}\geq 0,$$

$$\Pi_H^{YN}-\Pi_H^{NN}$$

$$= \frac{14c(2(4(1-2a)t+5(V-w))+2(7-3\delta)\theta s_H^{YN*}+2\theta s_L^{YN*}-3c)}{225t}-F\geq 0. \tag{22}$$

From the above incentives not to deviate, it can be shown that case YN is an equilibrium if

$$F_H^{YN-NN}\geq F\geq F_L^{YN-YY}\geq 0, \tag{23}$$

where

$$F_H^{YN-NN}$$

$$= \frac{14c(2(4(1-2a)t+5(V-w))+2(7-3\delta)\theta s_H^{YN*}+2\theta s_L^{YN*}-3c)}{225t}$$

and

$$F_L^{YN-YY}$$

$$= \frac{14c(2(1-2a)t+10(V-w)-2(2-3\delta)\theta s_H^{YN*}+8\theta s_L^{YN*}-7c)}{225t}.$$

Case YN is more likely than case NY if the range of F in case YN is greater than that in case NY. Evaluating the difference in the two ranges yields

$$F_H^{YN-NN}-F_L^{YN-YY}-(F_L^{NY-NN}-F_H^{NY-YY})$$

$$= \frac{28c(2(1-2a)t+\theta((3-2\delta)s_H^{NY*}-s_L^{NY*}+(3-2\delta)s_H^{YN*}-s_L^{YN*}))}{75t}, \tag{24}$$

which is always positive because $a < \frac{1}{2}$, $\delta \leq 1$, and $s_H^{i*} > s_L^{i*}$, $i \in \{NY, YN\}$, for free-riding to occur.

In other words, the range of values for which case YN can be an equilibrium is greater than that for case NY to be an equilibrium. Therefore, if only one retailer advertises its prices in equilibrium, that retailer is more likely to be Retailer H than Retailer L. □

PROOF OF PROPOSITION 5. For a given wholesale price, the manufacturer's profits under different cases are ordered according to the demand levels. Therefore, we compare the total demand from the two retailers in the four cases after substituting the optimal prices and service into the demand functions. The difference between the manufacturer's demands in cases YN and NY is given by

$$d_H^{YN} + d_L^{YN} - (d_H^{NY} + d_L^{NY})$$
$$= \frac{360c((7-3\delta)\lambda - 4)\theta^2}{3,375t^2\lambda - 60t\theta^2(16+(7-3\delta)^2\lambda) + 64(2-\delta)(7-3\delta)\theta^4}, \quad (25)$$

which is always positive because $\delta \leq 1$ and $\lambda \geq 1$. Therefore, the manufacturer's demand in case YN is always higher than that in case NY.

The difference between the manufacturer's demands in cases YN and NN is given by

$$d_H^{YN} + d_L^{YN} - (d_H^{NN} + d_L^{NN})$$
$$= \frac{30c(75t\lambda - 4(8-\delta(7-3\delta)\lambda)\theta^2)}{3,375t^2\lambda - 60t\theta^2(16+(7-3\delta)^2\lambda) + 64(2-\delta)(7-3\delta)\theta^4}. \quad (26)$$

We know that $225t - 4(7-3\delta)^2\theta^2 > 0$ for Retailer H's profit to be nonnegative. This ensures that $75t\lambda - 4(8 - \delta(7-3\delta)\lambda)\theta^2 > 0$, so the total demand in case YN is greater than that in case NN. Therefore, the manufacturer will prefer case YN to cases NY and NN for all values of the model parameters; i.e., $\Pi_M^{YN} > \Pi_M^{NY}$ and $\Pi_M^{YN} > \Pi_M^{NN}$.

The manufacturer will also prefer case YY to cases NY and NN, as shown below:

$$d_H^{YY} + d_L^{YY} - (d_H^{NY} + d_L^{NY})$$
$$= \frac{30c(75t\lambda - 4(8-\delta(7-3\delta)\lambda)\theta^2)}{3,375t^2\lambda - 60t\theta^2(16+(7-3\delta)^2\lambda) + 64(2-\delta)(7-3\delta)\theta^4} > 0, \quad (27)$$

$$d_H^{YY} + d_L^{YY} - (d_H^{NN} + d_L^{NN})$$
$$= \frac{60c(75t\lambda - 2(4+(21-\delta(23-6\delta))\lambda)\theta^2)}{3,375t^2\lambda - 60t\theta^2(16+(7-3\delta)^2\lambda) + 64(2-\delta)(7-3\delta)\theta^4}, \quad (28)$$

which is positive because $225t - 4(7-3\delta)^2\theta^2 > 0$.

The difference between the demands in cases YY and YN and that between cases NY and NN depends on the consumers' preference for retail service. In particular, when retail service is ineffective in stimulating demand, i.e., $\theta^2 < 75t\lambda/(4((3-\delta)(7-3\delta)\lambda-4))$, we find that the demand in case YY is higher than that in case YN and that the demand

in case NY is higher than that in case NN, as shown below:

$$d_H^{YY} + d_L^{YY} - (d_H^{YN} + d_L^{YN})$$
$$= \frac{30c(75t\lambda - 4((3-\delta)(7-3\delta)\lambda-4)\theta^2)}{3,375t^2\lambda - 60t\theta^2(16+(7-3\delta)^2\lambda) + 64(2-\delta)(7-3\delta)\theta^4} > 0, \quad (29)$$

$$d_H^{NY} + d_L^{NY} - (d_H^{NN} + d_L^{NN})$$
$$= \frac{30c(75t\lambda - 4((3-\delta)(7-3\delta)\lambda-4)\theta^2)}{3,375t^2\lambda - 60t\theta^2(16+(7-3\delta)^2\lambda) + 64(2-\delta)(7-3\delta)\theta^4} > 0, \quad (30)$$

if $\theta^2 < 75t\lambda/(4((3-\delta)(7-3\delta)\lambda-4))$. Therefore, when $\theta^2 < 75t\lambda/(4((3-\delta)(7-3\delta)\lambda-4))$, the ordering of the total demand and hence of the manufacturer's profit is $\Pi_M^{YY} > \Pi_M^{YN} > \Pi_M^{NY} > \Pi_M^{NN}$.

Conversely, when $\theta^2 \geq 75t\lambda/(4((3-\delta)(7-3\delta)\lambda-4))$, the demand in case YN is higher than that in case YY and the demand in case NN is higher than that in case NY. Therefore, when $\theta^2 \geq 75t\lambda/(4((3-\delta)(7-3\delta)\lambda-4))$, the ordering of the total demand and the manufacturer's profit is $\Pi_M^{YN} > \Pi_M^{YY} > \Pi_M^{NN} > \Pi_M^{NY}$. □

PROOF OF PROPOSITION 6. Consider the situation in which case YN is the equilibrium for the retailers; i.e., Retailer H advertises price but Retailer L does not. Proposition 5 reveals that the manufacturer would prefer to be in case YY if $\theta^2 < 75t\lambda/(4((3-\delta)(7-3\delta)\lambda-4))$. We know that case YN is an equilibrium if $\Pi_L^{YN} \geq \Pi_L^{YY}$ and $\Pi_H^{YN} > \Pi_H^{NN}$, where the retailers' profits are as given in Table T1 in the electronic companion.

Evaluating the difference in Retailer L's profit in cases YN and YY yields

$$\Pi_L^{YN} - \Pi_L^{YY} = F - F_L^{YYYN}, \quad (31)$$

where

$$F \geq F_L^{YYYN}$$
$$= \Big(2c\lambda(225t\lambda - 64\theta^2)(105t - 4(3-\delta)(7-3\delta)\theta^2)$$
$$\cdot (15t(2(1-2a)t + 10(V-w) - 7c) - 4(7-3\delta)$$
$$\cdot (2((1-2a)(1-\delta)t + (V-w)(3-2\delta)) - c(3-\delta))\theta^2) \Big)$$
$$\cdot \Big((3,375t^2\lambda - 60t\theta^2(16+(7-3\delta)^2\lambda)$$
$$+ 64(2-\delta)(7-3\delta)\theta^4)^2 \Big)^{-1} > 0.$$

Therefore, Retailer L can be made to deviate from case YN to case YY if the manufacturer offers advertising support of at least $F - F_L^{YYYN}$ so as to make $\Pi_L^{YY} > \Pi_L^{YN}$. Note that this provision of advertising support will not change Retailer H's strategy; i.e., Retailer H will continue to advertise its price.

Next, consider the situation in which case NY is the equilibrium for the retailers; i.e., Retailer L advertises price but Retailer H does not. We know that case NY is an equilibrium if $\Pi_L^{NY} > \Pi_L^{NN}$ and $\Pi_H^{NY} > \Pi_H^{YY}$, where the two retailers' profits are as given in Table T1 in the electronic companion.

Evaluating the difference in Retailer H's profit in cases NY and YY yields

$$\Pi_H^{NY} - \Pi_H^{YY} = F - F_H^{YYNY}, \qquad (32)$$

where

$$
\begin{aligned}
F &\geq F_H^{YYNY} \\
&= \Big(2c(225t - 4(7-3\delta)^2\theta^2)(105t\lambda - 32\theta^2) \\
&\quad \cdot (15t\lambda(2(4(1-2a)t + 5(V-w) - 7c)) \\
&\qquad\qquad - 32((1-2a)t + V - w - c)\theta^2)) \Big) \\
&\quad \cdot \Big((3{,}375t^2\lambda - 60t\theta^2(16 + (7-3\delta)^2\lambda) \\
&\qquad\qquad + 64(2-\delta)(7-3\delta)\theta^4)^2 \Big)^{-1} > 0.
\end{aligned}
$$

The manufacturer can move the advertising equilibrium from case NY to case YY by providing advertising or featuring support of at least $F - F_H^{YYNY}$, making $\Pi_H^{NY} > \Pi_H^{YY}$. Note that this provision of advertising support will not change Retailer L's strategy; i.e., Retailer L will continue to advertise its price.

Finally, consider the case in which the manufacturer anticipates that neither retailer would advertise its price, i.e., the retailers would end up in case NN as the equilibrium. We know that case NN is an equilibrium if $\Pi_L^{NN} > \Pi_L^{NY}$ and $\Pi_H^{NN} > \Pi_H^{YN}$, where the profits are as given in Table T1 in the electronic companion.

Evaluating the difference in Retailer H's profit in cases NN and YN yields

$$\Pi_H^{NN} - \Pi_H^{YN} = F - F_H^{YNNN}, \qquad (33)$$

where

$$
\begin{aligned}
F &\geq F_H^{YNNN} \\
&= \Big(2c(225t - 4(7-3\delta)^2\theta^2)(105t\lambda - 32\theta^2) \\
&\quad \cdot (15t\lambda(2(4(1-2a)t + 5(V-w)) - 3c) \\
&\qquad\qquad - 32((1-2a)t + V - w)\theta^2)) \Big) \\
&\quad \cdot \Big((3{,}375t^2\lambda - 60t\theta^2(16 + (7-3\delta)^2\lambda) \\
&\qquad\qquad + 64(2-\delta)(7-3\delta)\theta^4)^2 \Big)^{-1} > 0.
\end{aligned}
$$

Similarly, evaluating the difference in Retailer L's profit in cases NN and NY yields

$$\Pi_L^{NN} - \Pi_L^{NY} = F - F_L^{NYNN}, \qquad (34)$$

where

$$
\begin{aligned}
F &\geq F_L^{NYNN} \\
&= \Big(2c\lambda(225t\lambda - 64\theta^2)(105t - 4(3-\delta)(7-3\delta)\theta^2) \\
&\quad \cdot (15t(2(1-2a)t + 10(V-w) - 3c) - 4(7-3\delta) \\
&\quad \cdot (2((1-2a)(1-\delta)t + (V-w)(3-2\delta)) - 3c(1-\delta))\theta^2)) \Big) \\
&\quad \cdot \Big((3{,}375t^2\lambda - 60t\theta^2(16 + (7-3\delta)^2\lambda) \\
&\qquad\qquad + 64(2-\delta)(7-3\delta)\theta^4)^2 \Big)^{-1} > 0.
\end{aligned}
$$

If the manufacturer provides advertising support of at least $F - F_H^{YNNN}$, Retailer H will have an incentive to

advertise its price. Similarly, Retailer L will advertise its price if the manufacturer offers advertising support of at least $F - F_L^{NYNN}$. Since $F_H^{NYNN} > F_L^{NYNN}$, the provision of an advertising support of at least $F - F_L^{NYNN}$ will automatically result in Retailer H also advertising its price. Therefore, the manufacturer can move the advertising equilibrium from case NN to case YY by providing advertising or featuring support that exceeds $F - F_L^{NYNN}$. $\square$

PROOF OF PROPOSITION 7. We know from Proposition 5 that the manufacturer would prefer to be in case YN; i.e., Retailer H advertises price but Retailer L does not if $\theta^2 \geq 75t\lambda/(4((3-\delta)(7-3\delta)\lambda - 4))$. Consider the situation in which case NN is the equilibrium for the retailers; i.e., neither retailer advertises price. As shown earlier, the manufacturer can make Retailer H advertise by providing advertising or featuring support of at least $F - F_H^{YNNN}$. Similarly, the manufacturer can make Retailer L advertise by providing advertising or featuring support of at least $F - F_L^{NYNN}$. Since $F_H^{YNNN} > F_L^{NYNN}$, providing advertising support in the range $(F - F_H^{YNNN}, F - F_L^{NYNN})$ will cause Retailer H to advertise its price while Retailer L will continue with its no-advertising strategy, moving the equilibrium from case NN to case YN. Finally, note that providing advertising support that exceeds $F - F_L^{NYNN}$ will result in both retailers advertising their prices, moving the equilibrium from case NN to case YY.

If the price advertising equilibrium is expected to be case NY, the manufacturer can provide advertising support of at least $F - F_H^{YYNY}$ to the two retailers. With this level of advertising support, Retailer H will start advertising its price and Retailer L will continue to advertise its price, thus moving the equilibrium to case YY. In this case, this is the best that the manufacturer can do—get both retailers to advertise their prices.

Finally, consider case YY as the equilibrium for the retailers. The manufacturer cannot use advertising support to move the retailers from case YY to case YN because the provision of advertising support will not be able to prevent Retailer L from advertising its price. The manufacturer can provide advertising support to entice retailers to advertise; advertising support, by definition, cannot prevent a retailer from advertising its price. $\square$

Manufacturer's Incentives to Provide Advertising Support

Moving the Equilibrium from Case NY to Case YY

Substituting the retailers' optimal choices into the manufacturer's profit in cases YY and NY yields

$$
\begin{aligned}
\Pi_M^{NY} &= \Big(30(w-\kappa)((75t((1-2a)t + 2(V-w) - c) - 4(7-3\delta) \\
&\quad \cdot ((3-2\delta)(V-w) + (1-2a)(1-\delta)t + c\delta)\theta^2)\lambda \\
&\qquad\qquad - 16((1-2a)t + V - w - 2c)\theta^2)) \Big) \\
&\quad \cdot \Big(3{,}375t^2\lambda - 60t\theta^2(16 + (7-3\delta)^2\lambda) \\
&\qquad\qquad + 64(2-\delta)(7-3\delta)\theta^4 \Big)^{-1}, \qquad (35)
\end{aligned}
$$

and

$$\Pi_M^{YY} = \Big(30(w-\kappa)30(w-\kappa)((75t((1-2a)t + 2(V-w))$$

$$-4(7 - 3\delta)((3 - 2\delta)(V - w) + (1 - 2a)(1 - \delta)t)\theta^2)\lambda$$
$$- 16((1 - 2a)t + V - w)\theta^2))$$
$$\cdot \left(3{,}375t^2\lambda - 60t\theta^2(16 + (7 - 3\delta)^2\lambda)\right.$$
$$\left. + 64(2 - \delta)(7 - 3\delta)\theta^4\right)^{-1}. \tag{36}$$

The optimal wholesale prices in the two cases are given in Table T2 in the electronic companion. To determine whether the manufacturer has an incentive to move from case NY to case YY, we compare the manufacturer's profit in the two cases at $w^{\text{NY}*}$. For the purposes of illustration, we examine this numerically to see whether the manufacturer has an incentive to provide advertising support. Consider the following set of parameter values: $t = 0.75$, $\theta = 0.75$, $a = 0.44$, $c = 0.14$, $V = 0.8$, $\lambda = 2$, $\kappa = 0.1$, and $F = 0.04$. Evaluating the manufacturer's profit in case YY at $w^{\text{NY}*}$ yields 0.3108. Similarly, evaluating the manufacturer's profit in case NY at $w^{\text{NY}*}$ yields 0.2514. In other words, the manufacturer gains 0.0614 in profit by moving Retailer H from case NY to case YY. Therefore, the manufacturer has an incentive to provide advertising support as long as that support does not exceed the incremental gain to the manufacturer from doing so.

Next, we calculate the amount of advertising support that the manufacturer will have to provide for Retailer H to have an incentive to move from case NY to case YY. For the parameter values specified above, Retailer H's profit in case NY is 0.0259. Evaluating Retailer H's profit in case YY at $w^{\text{NY}*}$ yields 0.04. Therefore, the manufacturer has to provide advertising support of at least 0.0141 $(0.04 - 0.0259)$ for Retailer H to move from case NY to case YY. Because the manufacturer's incremental profit from doing so (0.0614) exceeds the amount of advertising support (0.0141), the manufacturer will have an incentive to provide the required level of advertising support.

Similar conditions can be derived for the incremental gain for the manufacturer to move the price advertising equilibrium from case YN to case YY, case NN to case YY, and case NN to case YN as indicated by Propositions 6 and 7. □

References

Benham, L. 1972. The effect of advertising on the price of eyeglasses. *J. Law Econom.* **15**(2) 337–352.

Bergen, M., S. Dutta, S. M. Shugan. 1996. Branded variants: A retail perspective. *J. Marketing Res.* **33**(February) 9–19.

Blattberg, R. C., S. A. Neslin. 1990. *Sales Promotion: Concepts, Methods, and Strategies*, 2nd ed. Prentice Hall, Englewood Cliffs, NJ.

Butters, G. R. 1977. Equilibrium distributions of sales and advertising prices. *Rev. Econom. Stud.* **44**(3) 465–491.

Coughlan, A. T., E. Anderson, L. W. Stern, A. El-Ansary. 2006. *Marketing Channels*, 7th ed. Prentice Hall, Upper Saddle River, NJ.

Desai, P. S. 1997. Advertising fee in business-format franchising. *Management Sci.* **43**(10) 1401–1419.

Grossman, G. M., C. Shapiro. 1984. Informative advertising with differentiated products. *Rev. Econom. Stud.* **51**(1) 63–81.

Hotelling, H. 1929. Stability in competition. *Econom. J.* **39**(153) 41–57.

Jeuland, A. P., S. M. Shugan. 1983. Managing channel profits. *Marketing Sci.* **2**(3) 239–272.

Kali, R. 1998. Minimum advertised price. *J. Econom. Management Strategy* **7**(4) 647–668.

Kaul, A., D. R. Wittink. 1995. Empirical generalizations about the impact of advertising on price sensitivity. *Marketing Sci.* **14**(3, Supplement) 151–160.

Kihlstrom, R. E., M. H. Riordan. 1984. Advertising as a signal. *J. Political Econom.* **92**(3) 427–450.

Lal, R. 1990. Improving channel coordination through franchising. *Marketing Sci.* **9**(4) 299–318.

Lal, R., C. Matutes. 1989. Price competition in multi-market duopolies. *RAND J. Econom.* **20**(4) 516–537.

Lal, R., C. Matutes. 1994. Retail pricing and advertising strategies. *J. Bus.* **67**(3) 345–370.

Lal, R., R. C. Rao. 1997. Supermarket competition: The case of every day low pricing. *Marketing Sci.* **16**(1) 60–80.

McGuire, T. W., R. Staelin. 1983. An industry equilibrium analysis of downstream vertical integration. *Marketing Sci.* **2**(2) 161–191.

Milyo, J., J. Waldfogel. 1999. The effect of price advertising on prices: Evidence in the wake of 44 Liquormart. *Amer. Econom. Rev.* **89**(5) 1081–1096.

Nelson, P. 1970. Information and consumer behavior. *J. Political Econom.* **78**(2) 311–329.

Nelson, P. 1974. Advertising as information. *J. Political Econom.* **82**(4) 729–754.

Salop, S., J. Stiglitz. 1977. Bargains and ripoffs: A model of monopolistically competitive price dispersion. *Rev. Econom. Stud.* **44**(3) 493–510.

Shugan, S. M. 1989. Branded variants. *Research in Marketing, AMA Educators' Proc. Series 55*. AMA, Chicago, 33–38.

Simester, D. 1995. Signalling price image using advertised prices. *Marketing Sci.* **14**(2) 166–188.

Stegeman, M. 1991. Advertising in competitive markets. *Amer. Econom. Rev.* **81**(1) 210–223.

Stigler, G. J. 1961. The economics of information. *J. Political Econom.* **69**(3) 213–225.