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# Manufacturer-provided Services vs. Retailer-provided Services: Effect on Product Quality, Channel Profits and Consumer Welfare

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# Manufacturer-provided Services vs. Retailer-provided Services: Effect on Product Quality, Channel Profits and Consumer Welfare

## Abstract

Demand-enhancing services like automated help desks, toll-free technical support hotlines or delivery and installation services are routinely offered to consumers by manufacturers or retailers or both. This paper examines how the identity of the channel member (manufacturer or retailer) providing the demand-enhancing services can have a different impact on the manufacturer's product quality decisions and resultant channel and consumer welfare. We show that when a manufacturer wishing to sell its entire product line through a retailer provides demand-enhancing services to consumers, then it chooses higher product quality levels and channel member profits and consumer welfare are higher. However, when the retailer selling the manufacturer's product line is the one who provides the demand-enhancing services, then the manufacturer may choose a *lower* product quality level and retailer profit and consumer welfare may be *lower*. Our results therefore indicate that a manufacturer should not simply look at cost savings arising from shifting service responsibilities from itself to the retailer. Similarly, a retailer should not expect to always benefit from situations where it has secured the ability to choose its own desired levels of services to be provided to consumers.

**Keywords:** *Distribution Channels, Demand-enhancing services, Product Quality, Theoretical modeling, Game Theory.*

# 1 Introduction

It is well-documented in both academic literature and industry trade publications that firms provide a significant amount of demand-enhancing services to consumers for their products. Such services include automated help desks, toll-free technical support hotlines, maintenance or repair services, image advertising, detailed instructions on installation and recommended use, delivery and return services. In channel settings where the manufacturer sells to consumers through a retailer, such services are offered by either the manufacturer, the retailer or both. For example, computer manufacturers like Dell or Gateway offer consumers technical support even though the products may be purchased at retail stores like Best Buy. Similarly, wireless phone manufacturers like Research in Motion (which manufactures the Blackberry line of phones) or Motorola provide substantial over-the phone and online technical support for consumers who mostly purchase their phones through the various wireless carriers like Verizon Wireless or AT&T. At the same time, retailers like Macy's or Sears often provide the bulk of the demand-enhancing services like financing, customer service, in-store events and demonstrations and delivery services.

This paper examines how the *identity* of the provider of demand-enhancing services in the channel affects product quality, channel profits and consumer welfare. Several demand-enhancing services may be provided by either the manufacturer or the retailer, for example, advertising campaigns (Verizon Wireless advertising the Samsung Galaxy 4 smartphone versus Samsung advertising the Galaxy 4 smartphone by itself) or technical support (Best Buy's Geek Squad providing technical support versus the manufacturer providing the technical support for its product). In practice, a channel member may be better suited to provide a particular service than the other. Which channel member does provide the bulk of such services may be a function of logistics (for example, a large domestic retailer like Target or Walmart providing services for products manufactured by a small company located outside the US) or relative expertise (for example, a manufacturer of a high-tech product may be better equipped to provide technical support than a retailer selling the product). In this paper, we take the choice of who provides services in the channel – the retailer or the manufacturer

– as exogeneously given (for example, due to above-mentioned reasons such as whether the manufacturer is located in this country or outside, or decided through prior negotiations) and study the strategic implications of manufacturer-provided services where the manufacturer alone provides services versus retailer-provided services where the retailer alone provides services, on consumers and channel members. While there may be many instances where both channel members provide services simultaneously, we focus on these polar opposite cases to highlight differential economic effects that may occur when each channel member takes on a relatively more significant role in service provision in the channel. These implications are useful not only when the channel members have to take as given this service-provider choice (for reasons given above), but also when one could endogenize this choice of who provides this service; in the latter case, our insights enable one to compare the profitability of the retailer/manufacturer when it provides the service to the case where the other party provides this service.

We consider a framework where a manufacturer designs a product line and wishes to sell the entire product line to consumers through a retailer. In this setting, we examine how the provision of services, especially, the identity of the service provider, interacts with the incentives the manufacturer must provide to the retailer to induce it to carry the entire product line to have interesting implications on channel outcomes like product quality levels and channel member profits. As in Villas-Boas (1998), our intention is to highlight the following challenge faced by the manufacturer with a product line: since the retailer cares about its own interests while making decisions about retail prices and products purchased from the manufacturer, there is a potential source of conflict in the channel where the retailer may prefer to carry a subset of the manufacturer’s product line while the manufacturer would prefer to sell its entire product line to the consumers through the retailer. There are many real world scenarios where such a conflict of interest between manufacturers and retailers is likely to arise, for instance, in markets where a manufacturer with a stable of products must deal with a single or a dominant retailer to make all its products available to end consumers. In the model section, we describe certain characteristics of a market in terms of

the degree of heterogeneity among different consumer segments and proportion of different consumer types under which the manufacturer prefers offering the product line (in spite of the challenges in dealing with the retailer) to selling fewer items through the retailer.

In this framework, we show some interesting results. For example, when the manufacturer provides demand-enhancing services in the channel, product quality levels, channel member profits and consumer welfare are higher compared to levels under no service provision. However, when the retailer selling the manufacturer's product line provides the demand-enhancing services, then product quality level, retailer profit and consumer welfare may be *lower* than under no service provision. Similarly, we find that while all channel members benefit from manufacturer services, retail services may not always be preferred by all channel members. We also find that while the manufacturer always prefers to provide services itself rather than to delegate the responsibilities to the retailer, the retailer may prefer manufacturer services over its own service provision. Additionally, we present conditions under which retail services may be preferred by both channel members, yet makes the consumers worse off. This suggests that overprovision of services, from consumer perspective, is possible under some circumstances. Thus, one of our contributions is to show that these kind of asymmetric service arrangements have substantive strategic implications beyond just additional costs borne by the service provider. For example, the manufacturer should not simply look at cost savings arising from shifting service responsibilities from itself to the retailer. Similarly, while a retailer may expect that possessing the ability to choose its own desired service levels should be profitable, we highlight circumstances where such a strategy may actually lead to lower profits for the retailer compared to yielding that decision power to the manufacturer and even to a situation where no services are provided at all.

The intuition behind our results is as follows. As we described above, the manufacturer wishing to sell its entire product line through the retailer must provide the retailer with the proper economic incentive to do so, rather than carry only a subset of the product line. The magnitude of that incentive will be a function of the level of profit the retailer can make from choosing to carry fewer items than that desired by the manufacturer. When the retailer

provides demand-enhancing services, it chooses the level of services optimally depending on the number of products it carries and as a result, succeeds in optimizing its profit in *every* situation – i.e., when it carries the entire product line or when it carries a subset of the product line. This potential for the retailer to raise its profit in scenarios where it carries only the partial product line is absent in the case of no service provision. As a result, when the retailer provides the demand-enhancing services in the channel, the manufacturer must leave a higher surplus with the retailer to induce it to carry the product line. Since the retailer’s profit under the scenarios where it carries the partial product line will be higher with higher product quality, the manufacturer then takes into account this potential for higher retailer opportunism when making its own decisions regarding its product qualities and wholesale prices. This results in a dampening force on the product quality decision by the manufacturer. At the same time, the higher consumer valuations caused by the demand-enhancing services at all quality levels yields a positive force on the product quality decision by the manufacturer. The net effect on the quality level therefore depends on which force dominates the other, and we show circumstances where the net effect is a lower product quality. Furthermore, this drop in product quality leads to lower consumer welfare and lower retailer profit in this scenario.

In terms of managerial implications, this paper sheds some light on the nature of discrepancy in channel outcomes that a manufacturer or a retailer may expect to occur when the bulk of service provision is carried out by the retailer rather than the manufacturer itself. This is particularly salient in situations where the retailer commits to take on several service responsibilities like installation and delivery services and in-store presentations that the manufacturer, given its remoteness from end consumers, can not fulfil in an adequate manner. This paper shows how once the retailer takes into consideration that this may have a feedback effect on the manufacturer’s product line decisions (product quality and prices), it should realize that its overall profit can be adversely affected. In such a case, the retailer would do well to engage in additional negotiation or compensation from the manufacturer. As mentioned above, we also highlight strategic implications for the manufacturer in its del-

egation of services, viz. it should not simply look at cost savings arising from shifting service responsibilities from itself to the retailer.

■ **Relationship to Literature.** Our paper is related to three main streams of prior literature: (i) the effect of demand-enhancing services by retailers on channel coordination and other channel-related decisions made by the manufacturer, (ii) the effect of demand-enhancing instruments like advertising by manufacturers on channel outcomes, and (iii) effect of channel structure on product qualities chosen by a manufacturer.

A number of papers have studied the issue of channel coordination when retailers provide demand-enhancing services to consumers. For example, Taylor (2002) examines how target rebates and returns policies under demand uncertainty are effective in achieving channel coordination. Raju and Zhang (2005) examine the relative effectiveness of quantity discounts and menu of two-part tariffs to obtain channel coordination in the presence of a dominant retailer providing demand-enhancing services. Blair and Lewis (1994) and Desiraju and Moorthy (1997) consider a market where the retailer has better information on demand conditions than the manufacturer, and examine the effectiveness of various vertical restraints such as resale price maintenance to achieve channel coordination. Similarly, Perry and Porter (1990), Winter (1993) and Iyer (1998) consider the effect of retailer competition in price and service on channel coordination. Coughlan and Soberman (2005) study manufacturers' decisions regarding whether to sell through single distribution channels with primary retailers or through dual distribution channels with primary retailers and their own outlet stores in a framework where consumers are both price-sensitive and service-sensitive and where only primary retailers provide service. In contrast, our paper highlights the differences in the impact of retailer-provided services versus manufacturer-provided services on a manufacturer's product quality decisions and the resultant channel and consumer welfare.

A number of papers have highlighted a manufacturer's role in providing demand-enhancing services in the channel in the form of advertisements that raise the consumer's valuation of the product. Lal and Narasimhan (1996) examine how a manufacturer's value-enhancing advertising may induce competing retailers to use the advertised brand as a loss leader and



how that has implications for the level of price competition between the retailers for that brand and non-advertised brands. Shaffer and Zettelmayer (2004) and Wu et al (2009) consider how targeted value-enhancing advertising by competing manufacturers selling through a common retailer may have differential impact on the manufacturers' and the retailer's profit levels. While the cited papers primarily address issues like how advertising interacts with competition in the channel, either at the upstream or downstream level and the resultant impact on the profit levels of the channel members, the current paper is interested in examining how manufacturer-provision of value-enhancing services or retailer-provision of value-enhancing services can have different effects on product quality decisions, consumer welfare and channel member profits. Lin and Narasimhan (2008) examine how a monopolist firm selling directly to consumers chooses to persuasively advertise its entire product line and the effect of these advertisements on product quality and product line breadth. Our paper focuses on the implications of different channel members performing demand-enhancing services (which may include advertising) for products that are sold to consumers through distribution channels.

Finally, this paper is also related to the literature on product-line design when consumers have different tastes for product quality (e.g., Mussa and Rosen (1978); Gabszewicz et al (1986), Moorthy (1984)). Desai (2001) extends this analysis to an oligopolistic competitive setting and where consumers differ in both tastes for product quality and loyalty to the competing firms. Villas-Boas (1998) examines product line design when a manufacturer sells through a retailer. In our model, we study the manufacturer's decisions regarding the quality levels of its product line in a context where different channel members provide demand-enhancing services.

The rest of the paper is organized as follows. Section 2 presents our model of a distribution channel where the manufacturer sells through a retailer. We derive and compare the impact of manufacturer-provided services in Section 3 and the impact of retailer-provided services in Section 4. We conclude and discuss some possible extensions in Section 5.

## 2 Model

Consider a manufacturer selling a product line composed of two products of differentiated quality levels through a retailer to consumers who are heterogeneous in their tastes for the products. There are two segments of the population - a low-valuation segment of proportion  $\gamma$  and a high-valuation segment of proportion  $(1 - \gamma)$ , where  $\gamma \in (0, 1)$ . We normalize the total mass of consumers to equal 1. Each consumer purchases one unit of any one of the products offered by the manufacturer.

A consumer with a marginal valuation  $\theta$  for quality derives utility  $V(\theta, q) = \theta q$  from purchasing the quality level  $q$ , where  $\theta \in \{\bar{\theta}, \underline{\theta}\}$  and  $\bar{\theta} > \underline{\theta}$ . Here,  $\bar{\theta}$  is the marginal valuation of a high-valuation consumer and  $\underline{\theta}$  is the marginal valuation of a low-valuation consumer. Thus, a high-valuation consumer's utility from a product of quality  $q$  is  $V(\bar{\theta}, q) = \bar{\theta}q$  while the low-valuation consumer's utility from the same product is  $V(\underline{\theta}, q) = \underline{\theta}q$ . Note that  $V(\theta, q)$  satisfies the standard relations:  $V_q > 0$ ,  $V_{qq} \leq 0$ ,  $V_\theta > 0$  and  $V_{q\theta} \geq 0$ .

Receiving demand-enhancing service raises a consumer's valuation for the product. If a consumer with a marginal valuation  $\theta$  receives a service level of  $s$ , then her valuation of a product of quality  $q$  increases from  $\theta q$  to  $(\theta + s)q$ . Thus,  $\frac{\partial V}{\partial s}$  equals  $q$  which is positive and increasing in  $q$ , implying that the impact of one unit of service on the consumer's valuation of the product is positive and is higher when the quality of the product is higher. In other words, the more sophisticated a product is, higher is the value of a unit of customer service that is provided alongside this product. Examples of such services are technical support or in-store demonstrations for sophisticated electronic devices and appliances. Apart from analytical tractability, this formulation also has some empirical support in the literature. For example, Moorthy and Zhao (2000) find for durable goods, there is a significant correlation between the objective quality of the good and the perceived quality consumers assume for the same good after viewing advertisements. Literature on the impact of demand-enhancing persuasive advertising on consumer valuation for quality has also adopted this formulation (for example, Tremblay and Martins-Filho (2001), Lin and Narasimhan (2008)). At the same time, other formulations of the impact of demand-enhancing services like  $\theta(q + s)$  or

$\theta q + s$  are also reasonable and represent alternative interactions of service with consumer's preferences.<sup>1</sup>

The manufacturer's cost of producing a product of quality  $q$  is given by  $C(q) = q^2$ , with  $C_q > 0$  and  $C_{qq} > 0$ . The manufacturer's product line consists of a higher-end product with a quality level of  $\bar{q}$  and a lower-end product with a quality level of  $\underline{q}$ . We allow the service-providing firm to choose, if it so desires, different levels of services for the two products (including zero service) – denoted by  $\bar{s}$  for the high-end product and  $\underline{s}$  for the low-end product. The cost of providing the service for each product is denoted by  $G(s) = s^2$ .

In this paper, we focus on the scenarios where the manufacturer prefers to sell the entire product line to the consumers rather than only one product through the retailer. Here, under all circumstances – no services provided, services provided by the manufacturer or services provided by the retailer, the manufacturer's profit from designing the optimal product line and inducing the retailer to carry the entire product line is higher than the maximal profit it can earn from optimally designing only one product and inducing the retailer to (a) carry it rather than an outside option and (b) to choose the appropriate retail price targeting the desired customer segment. The following condition is sufficient to guarantee this:

$$1 - \gamma^2 < (\underline{\theta}/\bar{\theta}) \leq 1 - \gamma + \frac{\gamma\sqrt{(2+\gamma)(1-\gamma)}}{\sqrt{3+\gamma}}.^2$$

In words, this condition requires the degree of heterogeneity to be sufficiently high (i.e., the preference parameter for the low-valuation consumer  $\underline{\theta}$  to be sufficiently low relative to that for the high-valuation consumer  $\bar{\theta}$ ). In general, a higher degree of heterogeneity among consumer segments generates higher channel profit when offering a product line and pric-

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<sup>1</sup>For example,  $\theta(q + s)$  represents the case where the impact of the service is a function of the consumers' preferences, i.e., one unit of service has a higher impact for a higher-valuation consumer compared to a lower-valuation consumer. Or,  $\theta q + s$  represents the case where the impact of the service is constant. We thank the anonymous referees and AE for suggesting these possible alternative formulation for the effect of demand-enhancing service on consumer valuation.

<sup>2</sup>We derive this sufficient condition in Appendix B. Note that this sufficient condition implicitly requires  $\gamma \geq 0.303$ . The lower bound of the condition above guarantees that positive qualities will be offered in the product line and the upper bound guarantees that the product line yields higher profit to the manufacturer than a single product sold through the channel. We assume the above condition to hold in the remainder of the paper. The case of a single product sold by the manufacturer is considered in Section 5.

ing it to induce self-selection among the consumers. This is because the low-end product intended for the low-valuation consumer can have a quality level distorted downward to a greater extent which in turn allows a higher capture of the high-valuation consumers' surplus (since their surplus is nothing but the utility they would enjoy from consuming the low-end product rather than the high-end product intended for them). Thus, the downside of offering the product line (relative to selling a single product) in having to leave the high-valuation consumers with some surplus because of the availability of the low-end product is now milder. Now, the higher degree of heterogeneity reduces the incentive the manufacturer must provide the retailer to carry its entire product line. As was discussed above, this incentive is a function of the retailer's gain from deviating from carrying the product line and choosing only the low-end product. When the degree of heterogeneity is larger, extracting surplus from the two consumer segments through selling the product line is more profitable for the retailer relative to offering only the low-end product to all consumers at a single price and hence lower is the incentive the manufacturer must provide the retailer to carry the product line. This raises the manufacturer's share of channel profit from offering the product line.

The manufacturer makes a take-it-or-leave-it offer of a linear wholesale price to the retailer for each of its products, denoted by  $\bar{w}$  for a unit of the high-end product and  $\underline{w}$  for a unit of the low-end product. The retailer faced with these wholesale prices decides whether to carry both products or one product, and in case of the latter, which product from the manufacturer's product line. We assume that the retailer incurs no costs other than the wholesale prices it pays the manufacturer for the product line. The retailer decides the retail prices of the product(s) it carries and we denote those retail prices paid by final consumers for one unit of the low-end product by  $\underline{p}$  and one unit of the high-end product by  $\bar{p}$ .

In general, service provision in the channel can be carried out either by the manufacturer or the retailer or both. In this paper, we focus on each channel member providing the services individually so as to highlight differential economic effects on important variables like product quality, consumer surplus or channel member profits that may occur when each channel member takes on a relatively more significant role in service provision in the channel.

To this end, we consider the two polar opposite scenarios: manufacturer-provided services where the manufacturer alone provides services, and retailer-provided services where the retailer alone provides the services. The polar scenarios will help bring to the forefront how the role of service provision by the retailer can encourage its opportunistic behavior which in turn can alter incentives for the manufacturer in its own product line decisions in comparison to the case where the manufacturer performs the services in-house.

■ **No service provided in the channel.** We first look at the benchmark case where no demand-enhancing services are provided in the channel. Following Villas-Boas (1998), the timing of the game is as follows:

- (i) the manufacturer first decides the quality levels of the products in its product line;
- (ii) the manufacturer decides the wholesale price it will charge the retailer for each product and makes a take-it-or-leave-it offer to the retailer;
- (iii) the retailer decides which of the products to carry;
- (iv) the retailer selects the retail price for each of the products it carries and each consumer decides whether to buy one of the products or not, given the retail prices selected by the retailer.

We solve this game by backwards induction, i.e. we solve backwards starting from the retailer's pricing and product choice decisions before moving back to the manufacturer's wholesale pricing and quality choice decisions.

■ **Retailer's problem.** We start from the final stage of the game, i.e. the retailer's optimal choice of the retail prices of the products it carries. Since the retailer may be in different situations at this stage depending on which product or products it has chosen to carry, its optimal retail price or prices will accordingly be different depending on which path (both products carried, only low-end product carried or only high-end product carried) it has decided to pursue.

For instance, if the retailer has decided to carry both products, its optimal retail prices must be such that the different types of consumers self-select and choose the products intended for them. It is most profitable for the retailer to induce the high-valuation consumers with preference parameter  $\bar{\theta}$  to pick the high-end product and the low-valuation consumers with preference parameter  $\underline{\theta}$  to pick the low-end product. To induce such self-selection by the consumers, the retailer's choice of prices  $\underline{p}$  and  $\bar{p}$  must be such that the following constraints are satisfied:  $\underline{\theta}\underline{q} - \underline{p} \geq 0$  and  $\bar{\theta}\bar{q} - \bar{p} \geq \bar{\theta}\underline{q} - \underline{p}$ . These are the individual rationality constraint for the low-valuation consumer purchasing the low-end product (such that the low-valuation consumer enjoys a non-negative surplus from consuming the low-end product) and the incentive compatibility constraint for the high-valuation consumer purchasing the high-end product (such that the high-valuation consumers are provided enough inducements to purchase the high-end product rather than the low-end product) respectively. The retailer's profit maximization problem can then be expressed as

$$\max_{\underline{p}, \bar{p}} \gamma(\underline{p} - \underline{w}) + (1 - \gamma)(\bar{p} - \bar{w}) \quad (1)$$

subject to  $\underline{p} \leq \underline{\theta}\underline{q}$  and  $\bar{p} \leq \bar{\theta}\bar{q} - \bar{\theta}\underline{q} + \underline{p}$ , where  $\underline{w}$  and  $\bar{w}$  in (1) are the wholesale prices charged by the manufacturer for each unit of the low-end product and the high-end product respectively. Since the retailer's profit as shown in (1) is increasing in  $\underline{p}$  and  $\bar{p}$ , it follows that at the optimum, the retailer will choose these prices such that the constraints bind as equalities. This yields the optimal prices for the retailer:  $\underline{p} = \underline{\theta}\underline{q}$  and  $\bar{p} = \bar{\theta}\bar{q} - \bar{\theta}\underline{q} + \underline{\theta}\underline{q}$  for the low-end product and the high-end product respectively. These prices extract the entire surplus from the low-valuation consumers purchasing the low-end product and leave enough surplus with the high-valuation consumers purchasing the high-end product to make them indifferent between the two options. The retailer earns a profit of  $\pi_{RLH} = \gamma[\underline{\theta}\underline{q} - \underline{w}] + (1 - \gamma)[\bar{\theta}\bar{q} - \bar{\theta}\underline{q} + \underline{\theta}\underline{q} - \bar{w}]$ .

If the retailer has decided to carry only one product, its choice of retail price will depend on which consumer segment(s) it is targeting for the product. For instance, if the retailer

has decided to carry only the low-end product and wishes to sell it to all consumers, it needs to ensure that the retail price  $\underline{p}$  is such that the low-valuation consumer enjoys a non-negative surplus from consuming the low-end product, i.e.,  $\underline{\theta}q - \underline{p} \geq 0$ .<sup>3</sup> The retailer's profit maximization problem in this case is  $\max_{\underline{p}} (\underline{p} - \underline{w})$  subject to  $\underline{p} \leq \underline{\theta}q$ . Since the retailer's profit is increasing in  $\underline{p}$ , it pays for it to select  $\underline{p}$  such that the constraint binds as an equality. In other words, it optimally selects the retail price  $\underline{p} = \underline{\theta}q$  and its profit from carrying only the low-end product and selling it to all consumers is  $\pi_{RL} = \underline{\theta}q - \underline{w}$ . Similarly, if the retailer wishes to sell the low-end product to only the high-valuation consumers, it needs to ensure that the retail price  $\underline{p}$  is such that the high-valuation consumer enjoys a non-negative surplus from consuming the low-end product, i.e.,  $\bar{\theta}q - \underline{p} \geq 0$ . The retailer's profit maximization problem now is  $\max_{\underline{p}} (1 - \gamma) (\underline{p} - \underline{w})$  subject to  $\underline{p} \leq \bar{\theta}q$ . As above, it is optimal for the retailer to select  $\underline{p} = \bar{\theta}q$  and its profit from selling the low-end product to only the high-valuation consumers is  $\pi_{RL} = (1 - \gamma)(\bar{\theta}q - \underline{w})$ .<sup>4</sup>

Following the same reasoning as above, if the retailer has decided to carry only the high-end product and it wishes to sell it to only the high-valuation consumers, it will optimally select the retail price  $\bar{p} = \bar{\theta}q$  and its profit is  $\pi_{RH} = (1 - \gamma)[\bar{\theta}q - \bar{w}]$ , and if it wishes to sell the high-end product to all consumers, it will optimally select the retail price  $\bar{p} = \underline{\theta}q$  and its profit is  $\pi_{RH} = \underline{\theta}q - \bar{w}$ .

Moving back a step further to the penultimate stage, we analyze the retailer's decision regarding which products to carry given the wholesale prices  $\underline{w}$  and  $\bar{w}$  charged by the manufacturer for the products. In this decision, it takes into account the optimal retail prices it will choose at the last stage in each scenario and compares the resultant profits across the various options. From the profit expressions above, it follows that the retailer will pick both products if  $\pi_{RLH} = \max \{ \pi_{RLH}, \pi_{RL}, \pi_{RH} \}$ , i.e. if its profit from carrying both products exceeds its profits from carrying either only the low-end product or only the high-end

<sup>3</sup>This also guarantees that each high-valuation consumer enjoys a non-negative surplus from consuming the low-end product since  $\bar{\theta}q - \underline{p} \geq 0$  is also satisfied.

<sup>4</sup>At this retail price  $\underline{p} = \bar{\theta}q$  for the low-end product, each low-valuation consumer's surplus from consuming this product is  $\underline{\theta}q - \bar{\theta}q < 0$ . Therefore, the low-valuation consumers do not purchase the product.

product. Similarly, it will pick only the low-end product or only the high-end product if  $\pi_{RL} = \max\{\pi_{RLH}, \pi_{RL}, \pi_{RH}\}$  or  $\pi_{RH} = \max\{\pi_{RLH}, \pi_{RL}, \pi_{RH}\}$  hold respectively.

■ **Manufacturer's problem.** Next, we move back another step further and consider the manufacturer's optimal wholesale pricing and quality choice decision working under the constraints that it must ensure that the retailer picks both products. In this decision, it takes into account the retailer's optimal pricing at the downstream level and its profitability in each case – when it carries both products, only the low-end product or only the high-end product.

The manufacturer solves the following problem:

$$\max_{\underline{w}, \bar{w}, \underline{q}, \bar{q}} \gamma[\underline{w} - \underline{q}^2] + (1 - \gamma)[\bar{w} - \bar{q}^2] \quad (2)$$

where  $\bar{q} \geq 0, \underline{q} \geq 0$ , subject to the constraint  $\pi_{RLH} = \max\{\pi_{RLH}, \pi_{RL}, \pi_{RH}\}$  to induce the retailer to carry the entire product line. We show in Appendix A that this constraint translates to the following conditions on the wholesale prices  $\underline{w}$  and  $\bar{w}$ :

$$\frac{(\underline{\theta} - (1 - \gamma)\bar{\theta})(\bar{q} - \underline{q})}{\gamma} < \bar{w} - \underline{w} \leq \bar{\theta}\bar{q} - \bar{\theta}\underline{q}, \quad (3)$$

and,

$$\underline{w} \leq \underline{\theta}\underline{q} - \frac{(1 - \gamma)(\bar{\theta} - \underline{\theta})\underline{q}}{\gamma}. \quad (4)$$

Since the manufacturer's profit function in (2) is increasing in  $\underline{w}$  and  $\bar{w}$ , it follows that it is profit-maximizing for the manufacturer to select  $\underline{w}$  and  $\bar{w}$  such that the constraints (3) and (4) bind upwards as equalities. Thus, the manufacturer's optimal wholesale prices are

$$\underline{w}^{ns} = \underline{\theta}\underline{q} - \frac{(1 - \gamma)(\bar{\theta} - \underline{\theta})\underline{q}}{\gamma}; \quad \bar{w}^{ns} = \bar{\theta}\bar{q} - \bar{\theta}\underline{q} + \underline{w}^{ns} \quad (5)$$

Substituting the optimal wholesale prices in (5) in the manufacturer's profit maximization



problem in (2) and solving for the optimal quality levels, we obtain:

$$\underline{q}^{ns} = \frac{\underline{\theta} - (1 - \gamma^2)\bar{\theta}}{2\gamma^2}; \quad \bar{q}^{ns} = \frac{\bar{\theta}}{2}. \quad (6)$$

The segment of low-valuation consumers retains zero surplus:  $CS_L^{ns} = \gamma(\underline{\theta}\underline{q}^{ns} - \underline{p}) = 0$ , while the segment of high-valuation consumers retains a positive surplus given by  $CS_H^{ns} = (1 - \gamma)(\bar{\theta} - \underline{\theta})\underline{q}^{ns} = \frac{(1-\gamma)(\bar{\theta}-\underline{\theta})(\underline{\theta}-(1-\gamma^2)\bar{\theta})}{2\gamma^2}$ . The manufacturer's profit is

$$\pi_M^{ns} = \frac{(1 - \gamma^2(2 - \gamma))\bar{\theta}^2 - 2(1 - \gamma^2)\bar{\theta}\underline{\theta} + \underline{\theta}^2}{4\gamma^3} \quad (7)$$

and the retailer's profit is

$$\pi_R^{ns} = \frac{(1 - \gamma)(\bar{\theta} - \underline{\theta})(\underline{\theta} - (1 - \gamma^2)\bar{\theta})}{2\gamma^3} \quad (8)$$

### 3 Product Line Sold Through a Channel With Manufacturer - provided Services

We next consider the case where the manufacturer offers the demand-enhancing services. In this scenario, the sequence of events is as follows:

- (i) the manufacturer first decides the quality levels of the products in its product line;
- (ii) the manufacturer decides on the amount of service it wants to provide for each of its products;
- (iii) the manufacturer decides the wholesale price it will charge the retailer for each product and makes the offer to the retailer;
- (iv) the retailer decides which of the products to carry;
- (v) the retailer chooses the retail price(s) for the product(s) it carries and consumers make their purchase decisions.

This timeline takes into account that product line decisions are taken at the initial stage by the manufacturer before other marketing mix decisions like promotion or distribution strategies are made. As above, we start by analyzing the final step in the sequence of events, i.e. the retailer's problem of choosing the optimal retail prices.

■ **Retailer's problem.** Compared to the benchmark case above, here we must account for the effect of the manufacturer's services on the consumer's valuations for each product, and in turn, the retail prices for each product. The manufacturer's service  $\underline{s}$  for the low-end product augments the gross utility of a consumer of type  $\theta$  from the low-end product from  $\theta\underline{q}$  to  $(\theta + \underline{s})\underline{q}$  and similarly, the manufacturer's service  $\bar{s}$  for the high-end product augments the gross utility of a consumer of type  $\theta$  from the high-end product from  $\theta\bar{q}$  to  $(\theta + \bar{s})\bar{q}$ . Each consumer of type  $\theta$  thus enjoys a net utility of  $(\theta + \underline{s})\underline{q} - \underline{p}$  from purchasing a unit of the low-end product and a utility of  $(\theta + \bar{s})\bar{q} - \bar{p}$  from purchasing a unit of the high-end product, where  $\theta \in \{\underline{\theta}, \bar{\theta}\}$ .

Here too, the retailer's pricing decision at the retail level depends on which product(s) it has decided to carry. For instance, if the retailer has decided to carry both products, as before, it is most profitable for the retailer to induce the high-valuation consumers with preference parameter  $\bar{\theta}$  to pick the high-end product and the low-valuation consumers with preference parameter  $\underline{\theta}$  to pick the low-end product. To induce such self-selection by the consumers, the retailer's choice of prices  $\underline{p}$  and  $\bar{p}$  must be such that the following constraints are satisfied:  $(\underline{\theta} + \underline{s})\underline{q} - \underline{p} \geq 0$  and  $(\bar{\theta} + \bar{s})\bar{q} - \bar{p} \geq (\bar{\theta} + \underline{s})\underline{q} - \underline{p}$ . These constraints guarantee non-negative surplus to the low-valuation consumer purchasing the low-end product and sufficient incentive to the high-valuation consumer to buy the high-end product rather than the low-end product respectively. The retailer's profit maximization problem is therefore  $\max_{\underline{p}, \bar{p}} \gamma[\underline{p} - \underline{w}] + (1 - \gamma)[\bar{p} - \bar{w}]$  subject to the constraints  $\underline{p} \leq (\underline{\theta} + \underline{s})\underline{q}$  and  $\bar{p} \leq (\bar{\theta} + \bar{s})\bar{q} - (\bar{\theta} + \underline{s})\underline{q} + \underline{p}$ . Since the retailer's profit is increasing in  $\underline{p}$  and  $\bar{p}$ , it is optimal for it to select the prices such that constraints bind as equalities. Hence the optimal prices for the retailer are:  $\underline{p} = (\underline{\theta} + \underline{s})\underline{q}$  and  $\bar{p} = (\bar{\theta} + \bar{s})\bar{q} - (\bar{\theta} + \underline{s})\underline{q} + (\underline{\theta} + \underline{s})\underline{q}$ . The retailer's profit in this case is  $\pi_{RLH} = \gamma[(\underline{\theta} + \underline{s})\underline{q} - \underline{w}] + (1 - \gamma)[(\bar{\theta} + \bar{s})\bar{q} - (\bar{\theta} - \underline{\theta})\underline{q} - \bar{w}]$ .

Alternatively, if the retailer has decided to carry only the low-end product and wishes to sell to all consumers, then it will need to ensure that  $\underline{p} \leq (\underline{\theta} + \underline{s})\underline{q}$  to guarantee non-negative surplus to each low-valuation consumer buying the low-end product. As above, since its profit  $\underline{p} - \underline{w}$  in this case is increasing in  $\underline{p}$ , it will optimally select the retail price  $\underline{p} = (\underline{\theta} + \underline{s})\underline{q}$  and its profit is  $\pi_{RL} = (\underline{\theta} + \underline{s})\underline{q} - \underline{w}$ . Similarly, if it wishes to sell the low-end product to only the high-valuation consumers, it needs to ensure  $\underline{p} \leq (\bar{\theta} + \underline{s})\underline{q}$  to guarantee non-negative surplus to each high-valuation consumer buying the low-end product. In this case, it will be optimal to select the retail price  $\underline{p} = (\bar{\theta} + \underline{s})\underline{q}$  and the retailer will earn the profit  $\pi_{RL} = (1 - \gamma) [(\bar{\theta} + \underline{s})\underline{q} - \underline{w}]$ .

Finally, following the same reasoning as above, if the retailer has decided to carry only the high-end product and wishes to sell to all consumers, then it selects the optimal retail price  $\bar{p} = (\underline{\theta} + \bar{s})\bar{q}$  and earns profit  $\pi_{RH} = (\underline{\theta} + \bar{s})\bar{q} - \bar{w}$ , or if it wishes to sell the high-end product to only the high-valuation consumers, it selects the optimal retail price  $\bar{p} = (\bar{\theta} + \bar{s})\bar{q}$  and earns profit  $\pi_{RH} = (1 - \gamma)[(\bar{\theta} + \bar{s})\bar{q} - \bar{w}]$ .

Moving back a step further, we analyze the retailer's decision regarding which products to carry given the wholesale prices  $\underline{w}$  and  $\bar{w}$  charged by the manufacturer for the products. From the profit expressions above, it follows that the retailer will pick both products if  $\pi_{RLH} = \max\{\pi_{RLH}, \pi_{RL}, \pi_{RH}\}$ . Similarly, it will pick only the low-end product or only the high-end product if  $\pi_{RL} = \max\{\pi_{RLH}, \pi_{RL}, \pi_{RH}\}$  or  $\pi_{RH} = \max\{\pi_{RLH}, \pi_{RL}, \pi_{RH}\}$  hold respectively.

■ **Manufacturer's problem.** Next, we look at the manufacturer's decision to choose wholesale prices appropriately to induce the retailer to carry both products.

The manufacturer's optimal choice of wholesale prices, given its service and quality levels, must maximize its profit

$$\gamma[\underline{w} - \underline{q}^2] + (1 - \gamma)[\bar{w} - \bar{q}^2] - \bar{s}^2 - \underline{s}^2 \quad (9)$$

subject to the constraint  $\pi_{RLH} = \max\{\pi_{RLH}, \pi_{RL}, \pi_{RH}\}$ . We show in Appendix A that the optimal wholesale prices  $\bar{w}^{ms}$  and  $\underline{w}^{ms}$  for the high-end product and low-end product respectively that induce the retailer to carry the product line satisfy :

$$\bar{w}^{ms} - \underline{w}^{ms} = (\bar{\theta} + \bar{s})\bar{q} - (\bar{\theta} + \underline{s})\underline{q}, \quad (10)$$

and,

$$\underline{w}^{ms} = \frac{\gamma(\bar{\theta} + \underline{s})\underline{q} - (1 - \gamma)(\bar{\theta} - \underline{\theta})\underline{q}}{\gamma}. \quad (11)$$

Substituting these values of wholesale prices, we have the following profit maximization problem for the manufacturer :

$$\max_{\underline{s}, \bar{s}, \underline{q}, \bar{q}} \gamma[\underline{w}^{ms} - \underline{q}^2] + (1 - \gamma)[\bar{w}^{ms} - \bar{q}^2] - \bar{s}^2 - \underline{s}^2$$

Solving, we derive the optimum service levels for the products as functions of the quality levels:

$$\underline{s} = \frac{\gamma\underline{q}}{2}; \quad \bar{s} = \frac{(1 - \gamma)\bar{q}}{2}, \quad (12)$$

and the optimal quality levels:

$$\underline{q}^{ms} = \frac{2(\underline{\theta} - (1 - \gamma^2)\bar{\theta})}{\gamma^2(4 - \gamma)}; \quad \bar{q}^{ms} = \frac{2\bar{\theta}}{(3 + \gamma)}. \quad (13)$$

Using these, the manufacturer's profit when it provides the services is given by

$$\pi_M^{ms} = \frac{(1 - \gamma)(3 + 2\gamma(2 - \gamma - \gamma^3))\bar{\theta}^2 - 2(1 - \gamma^2)(3 + \gamma)\bar{\theta}\underline{\theta} + (3 + \gamma)\underline{\theta}^2}{(4 - \gamma)\gamma^3(3 + \gamma)}, \quad (14)$$

while the retailer's profit under service provision by the manufacturer is

$$\pi_R^{ms} = \frac{2(1 - \gamma)(\bar{\theta} - \underline{\theta})(\underline{\theta} - (1 - \gamma^2)\bar{\theta})}{\gamma^3(4 - \gamma)}. \quad (15)$$

The impact of the manufacturer's services in the distribution channel on the quality levels of the product line is obtained by comparing the quality levels of the high-end and low-end products under service provision in (13) above to those under no service provision in the channel in (6). This yields the following proposition.

**Proposition 1.** *When the manufacturer provides demand-enhancing services in the channel, quality levels for both low-end and high-end products are higher.*

**Proof:** Consider the difference between the quality levels of the low-end product:  $\underline{q}^{ms} - \underline{q}^{ns} = \frac{\theta - (1-\gamma^2)\bar{\theta}}{2\gamma(4-\gamma)} > 0$ . Similarly, the difference between the quality levels for the high-end product is  $\bar{q}^{ms} - \bar{q}^{ns} = \frac{\bar{\theta}(1-\gamma)}{2(3+\gamma)} > 0$ . ■

Proposition 1 demonstrates that the shift in consumer valuations that the manufacturer expects to be brought on by the positive levels of the services provides a significant incentive for it to improve the quality levels of both products in the first place. The higher willingness-to-pay of high-valuation consumers for any quality level of the products allows the retailer to extract a higher revenue from the sale of the high-end product to this consumer segment. This in turn allows the manufacturer to earn higher profit by raising its wholesale price appropriately. As a result, the quality level of the high-end product is higher when demand-enhancing services are provided by the manufacturer. Now, in general, the manufacturer has an incentive to distort downwards the quality of the low-end product relative to the high-end product to provide an additional layer of protection against any cannibalization by the low-end product of retail sales of the high-end one such that the retailer is not tempted to switch to carrying only one of the products. When services are provided by the manufacturer, the higher reservation values of the high-valuation consumers for the high-end product in tandem with higher quality level of the high-end product implies a weaker cannibalization problem and hence this downward distortion of the low-end product need not be too strong. At the same time, the low-valuation consumers' willingness-to-pay for the low-end product is now higher as a result of the demand-enhancing services, indicating the potential for higher revenues earned from sales of a higher quality low-end product to this segment. In all, when

services are provided by the manufacturer, the quality level of the low-end product is higher.

**Proposition 2.** *When the manufacturer provides demand-enhancing services in the channel, total consumer surplus is higher.*

**Proof:** In both scenarios where service is provided by the manufacturer and no service is provided, the consumer surplus of the segment of low-valuation consumers is given by  $CS_L^{ms} = CS_L^{ns} = 0$ . The consumer surplus of the segment of high-valuation consumers under no service is given by  $CS_H^{ns} \equiv (1 - \gamma)(\bar{\theta}\bar{q}^{ns} - \bar{p}^{ns}) = (1 - \gamma)(\bar{\theta}\bar{q}^{ns} - \bar{\theta}\bar{q}^{ns} + (\bar{\theta} - \underline{\theta})\underline{q}^{ns}) = (1 - \gamma)(\bar{\theta} - \underline{\theta})\underline{q}^{ns}$ , and, under manufacturer-provided services, is  $CS_H^{ms} \equiv (1 - \gamma)((\bar{\theta} + \bar{s}^{ms})\bar{q}^{ms} - \bar{p}^{ms}) = (1 - \gamma)((\bar{\theta} + \bar{s}^{ms})\bar{q}^{ms} - (\bar{\theta} + \bar{s}^{ms})\bar{q}^{ms} + (\bar{\theta} - \underline{\theta})\underline{q}^{ms}) = (1 - \gamma)(\bar{\theta} - \underline{\theta})\underline{q}^{ms}$ . Since  $\underline{q}^{ms} > \underline{q}^{ns}$ , it follows that  $CS_H^{ms} > CS_H^{ns}$ . ■

At the downstream market level, retail prices are selected by the retailer such that the entire surplus of the low-valuation consumers is extracted under both service-provided and no service-provided scenarios leaving these low-valuation consumers no better off when service is provided. High-valuation consumers retain a surplus given by the net utility they would gain if they purchase the low-end product. This net utility increases due to the rise in quality of the low-end product as well as the rise in valuation for one unit of the low-end product that each high-valuation consumer has after taking into account the services associated with the low-end product.

Next, we present results on the impact of manufacturer-provided services on channel member profits and the total channel profit as a whole.

**Proposition 3.** *When the manufacturer provides demand-enhancing services in the channel, the profits of both the manufacturer and retailer, and hence the total channel profit are higher.*

**Proof:** See the Appendix. ■

The demand-enhancing services provided by the manufacturer gives the retailer a larger scope for extracting more surplus from the consumers through appropriately altering the

retail prices. Now recall that the manufacturer has to leave some money on the table for the retailer to induce it to carry both products rather than just one. Under the manufacturer's service provision, the retailer's off-equilibrium profit from carrying just the low-end product is higher due to the higher consumer valuations for the product from the services. This requires the manufacturer to leave a higher profit margin for the retailer to induce it to carry both products. In spite of that, the manufacturer too earns a higher profit under its service provision. This is because the total profit coming into the channel from consumers in equilibrium is higher given the larger surplus consumers enjoy due to their enhanced valuations and higher quality levels. This larger pie of profits thus yields a larger share for the manufacturer as well as the retailer.

## 4 Product Line Sold Through a Channel With Retailer-provided Services

Next, we consider the scenario wherein the retailer is in charge of providing the demand-enhancing services. The sequence of events is as follows:

- (i) the manufacturer first decides the quality level of the products in its product line;
- (ii) the manufacturer decides on the wholesale price it will charge the retailer for each product and makes the offer to the retailer;
- (iii) the retailer decides which of the products to carry;
- (iv) the retailer decides the service levels for each product that it carries;
- (v) the retailer chooses the retail price and consumers make their purchase decisions.

We solve the game backwards starting from the retailer's decisions:

■ **Retailer's problem.** Similar to service provision by the manufacturer, there are three possible situations to consider at the retailer's optimal retail pricing and service choice stages

(i.e. stages (iv) and (v) in the timeline above) corresponding to the number and nature of product(s) chosen.

In the first alternative, consider the retailer's pricing problem when it has decided to carry both products. As under manufacturer-provided services, here too, the optimal retail prices are  $\underline{p} = (\underline{\theta} + \underline{s})\underline{q}$  and  $\bar{p} = (\bar{\theta} + \bar{s})\bar{q} - (\bar{\theta} + \underline{s})\underline{q} + (\underline{\theta} + \underline{s})\underline{q}$ . Now, taking into account these pricing decisions, the retailer's optimal service levels for the two products are chosen by solving the following problem:

$$\max_{\underline{s}, \bar{s}} \gamma[(\underline{\theta} + \underline{s})\underline{q} - \underline{w}] + (1 - \gamma)[(\bar{\theta} + \bar{s})\bar{q} - (\bar{\theta} + \underline{s})\underline{q} + (\underline{\theta} + \underline{s})\underline{q} - \bar{w}] - \underline{s}^2 - \bar{s}^2. \quad (16)$$

The retailer's optimal service levels for the high-end product and low-end product are obtained as

$$\underline{s} = \frac{\gamma \underline{q}}{2} \quad \text{and} \quad \bar{s} = \frac{(1 - \gamma)\bar{q}}{2} \quad (17)$$

respectively and the retailer's profit from carrying both products is  $\pi_{RLH} = \gamma \left[ \left( \underline{\theta} + \frac{\gamma \underline{q}}{4} \right) \underline{q} - \underline{w} \right] + (1 - \gamma) \left[ \left( \bar{\theta} + \frac{(1 - \gamma)\bar{q}}{4} \right) \bar{q} - (\bar{\theta} - \underline{\theta})\underline{q} - \bar{w} \right]$ .

In the second alternative, we consider the retailer's pricing problem when it has decided to carry only the low-end product. In this case, recall that it may (i) intend to sell it to all consumers in which case the optimal retail price is  $\underline{p} = (\underline{\theta} + \underline{s})\underline{q}$ ; or (ii) intend to sell it to only the high-valuation consumers in which case the optimal retail price is  $\underline{p} = (\bar{\theta} + \underline{s})\underline{q}$ . In case of (i) where it intends to sell it to all consumers, the retailer chooses the optimal service level by solving  $\max_{\underline{s}} [(\underline{\theta} + \underline{s})\underline{q} - \underline{w}] - \underline{s}^2$ . The optimal service level for the low-end product is  $\underline{s} = \frac{\underline{q}}{2}$  and the retailer's profit from carrying only the low-end product here is  $\pi_{RL} = \left[ \left( \underline{\theta} + \frac{\underline{q}}{4} \right) \underline{q} - \underline{w} \right]$ . In case of (ii) where it intends to sell it to only the high-valuation consumers, the retailer chooses the optimal service level by solving  $\max_{\underline{s}} (1 - \gamma)[(\bar{\theta} + \underline{s})\underline{q} - \underline{w}] - \underline{s}^2$ . The optimal service level for the low-end product is  $\underline{s} = \frac{(1 - \gamma)\underline{q}}{2}$  and the retailer's profit from carrying only the low-end product here is  $\pi_{RL} = (1 - \gamma) \left[ \left( \bar{\theta} + \frac{(1 - \gamma)\underline{q}}{4} \right) \underline{q} - \underline{w} \right]$ .

Finally, consider the retailer's pricing problem when it has decided to carry only the high-end product. In this case, recall that it may (i) intend to sell it only to the high-valuation



consumers in which case the optimal retail price is  $\bar{p} = (\bar{\theta} + \bar{s})\bar{q}$ ; or (ii) intend to sell it to all consumers in which case the optimal retail price is  $\bar{p} = (\underline{\theta} + \bar{s})\bar{q}$ . In case of (i) where the retailer intends to sell the high-end product to only the high-valuation consumers,, its optimal service provision problem is  $\max_{\bar{s}}(1 - \gamma)[(\bar{\theta} + \bar{s})\bar{q} - \bar{w}] - \bar{s}^2$  solving which, we obtain the retailer's optimal service level for the high-end product as  $\bar{s} = \frac{(1-\gamma)\bar{q}}{2}$  and the retailer's profit from carrying only the high-end product is  $\pi_{RH} = (1 - \gamma) \left[ \left( \bar{\theta} + \frac{(1-\gamma)\bar{q}}{4} \right) \bar{q} - \bar{w} \right]$ . In case of (ii) where the retailer intends to sell the high-end product to all consumers, the retailer's optimal service provision problem is  $\max_{\bar{s}} [(\underline{\theta} + \bar{s})\bar{q} - \bar{w}] - \bar{s}^2$  solving which, we obtain the retailer's optimal service level for the high-end product as  $\bar{s} = \frac{\bar{q}}{2}$  and the retailer's profit as  $\pi_{RH} = \left[ (\underline{\theta} + \frac{\bar{q}}{4}) \bar{q} - \bar{w} \right]$ .

Moving to the retailer's decision regarding which product(s) to carry, it follows that the retailer finds it more profitable to carry both products rather than only the low-end product or only the high-end product when  $\pi_{RHL} = \max \{ \pi_{RLH}, \pi_{RL}, \pi_{RH} \}$ .

■ **Manufacturer's problem.** Moving backwards, we next analyze the manufacturer's decisions. The manufacturer's wholesale pricing problem, given its product qualities, can be expressed as

$$\max_{\underline{w}, \bar{w}} \gamma[\underline{w} - \underline{q}^2] + (1 - \gamma)[\bar{w} - \bar{q}^2] \quad (18)$$

subject to the constraint that the retailer needs to be provided enough incentive to carry both products. In Appendix A, we show that the optimal wholesale prices  $\bar{w}^{rs}$  and  $\underline{w}^{rs}$  for the high-end product and low-end product respectively that induce the retailer to carry the product line satisfy :

$$\bar{w}^{rs} - \underline{w}^{rs} = \left( \bar{\theta} + \frac{(1 - \gamma)\bar{q}}{4} \right) \bar{q} - \left( \bar{\theta} + \frac{(1 + \gamma)\underline{q}}{4} \right) \underline{q}, \quad (19)$$

and

$$\underline{w}^{rs} = \frac{[\gamma(\underline{\theta} + \frac{\gamma\underline{q}}{4}) - (1 - \gamma)(\bar{\theta} - \underline{\theta})]\underline{q}}{\gamma}. \quad (20)$$

Using these wholesale prices, the manufacturer's problem of choosing the optimal quality levels can be rewritten as

$$\max_{\underline{q}, \bar{q}} \gamma \left[ \left( \underline{\theta} + \frac{\gamma \underline{q}}{4} \right) \underline{q} - \frac{(1-\gamma)(\bar{\theta} - \underline{\theta})\underline{q}}{\gamma} - \underline{q}^2 \right] + (1-\gamma) \left[ \left( \bar{\theta} + \frac{(1-\gamma)\bar{q}}{4} \right) \bar{q} - \frac{\bar{q}^2}{4} - \frac{(\bar{\theta} - \underline{\theta})\bar{q}}{\gamma} - \bar{q}^2 \right].$$

The optimal quality levels for the products are:

$$\underline{q}^{rs} = \frac{2(\underline{\theta} - (1-\gamma^2)\bar{\theta})}{\gamma(3\gamma + 1 - \gamma^2)}; \quad \bar{q}^{rs} = \frac{2\bar{\theta}}{(3 + \gamma)} \quad (21)$$

and using these, the manufacturer's profit under retailer-provided services is

$$\pi_M^{rs} = \frac{(3 + \gamma(1 - 5\gamma - \gamma^3 + 2\gamma^4))\bar{\theta}^2 - 2(1 - \gamma^2)(3 + \gamma)\bar{\theta}\underline{\theta} + (3 + \gamma)\underline{\theta}^2}{\gamma^2(3 + 10\gamma - \gamma^3)}, \quad (22)$$

while the retailer's profit when it provides the services is

$$\pi_R^{rs} = \frac{(1 - \gamma)(\underline{\theta} - (1 - \gamma^2)\bar{\theta})(\bar{\theta}(1 + 6\gamma - \gamma^2) - \underline{\theta}(1 + 6\gamma - 2\gamma^2))}{\gamma^2(3\gamma + 1 - \gamma^2)^2} \quad (23)$$

The following proposition presents results on the impact of retailer-provided services on the product quality decisions taken by the manufacturer.

**Proposition 4.** *When the retailer provides demand-enhancing services in the channel, the quality level for the high-end product is higher but the quality level for the low-end product may or may not be higher relative to the quality levels when no services are provided. Specifically, the quality of the low-end product is lower under retailer-provided services when the proportion of low-valuation consumers is low enough; otherwise, it is higher.*

**Proof:** The difference between the quality levels of the high-end product is  $\bar{q}^{rs} - \bar{q}^{ns} = \frac{\bar{\theta}(1-\gamma)}{2(3+\gamma)} > 0$ . For the low-end product, the difference between the quality levels is  $\underline{q}^{rs} - \underline{q}^{ns} = \frac{(\underline{\theta} - (1-\gamma^2)\bar{\theta})(\gamma - 1 + \gamma^2)}{2\gamma^2(3\gamma + 1 - \gamma^2)} \geq 0$ , according as  $\gamma \geq 0.62$ . Thus, it follows that if  $\gamma < 0.62$ , we get  $\underline{q}^{rs} < \underline{q}^{ns}$ . ■

As under service provision by the manufacturer, the higher willingness-to-pay of the high-valuation consumers at all quality levels that the manufacturer expects to be brought on by retailer-provided services induces it to optimally raise the quality of the high-end product intended for this segment. To extract as much as possible from the high-valuation consumers, the manufacturer has an incentive to keep the quality of the high-end product at the highest possible level (which is  $\bar{q}^{ms}$ , the optimal quality level that it chooses when it is providing the service).

Service provision by the retailer however has different implications for quality of the low-end product compared to manufacturer-provided services. As in the case of manufacturer-provided services, here too, the manufacturer must leave some money on the table for the retailer to induce it to carry both products. The amount of this inducement depends on the relative magnitudes of the retailer's *off-equilibrium* profit levels. As we discussed above, in general, the manufacturer has an incentive to distort downwards the quality of the low-end product to provide an additional layer of protection against any cannibalization by the low-end product of retail sales of the high-end one such that the retailer is not tempted to switch to carrying only one of the products. The presence of demand-enhancing services result in a shift upwards of consumer valuations for the products weakening this downward distortionary force. However, when the retailer is in charge of providing the services, an additional distortionary force comes into play. Specifically, the retailer can now optimally choose the demand-enhancing service for a product under all scenarios – when it is carrying that product as a part of the product line or when it is carrying it alone. Thus, the retailer is able to optimally choose a different service for the low-end product when it is carrying it alone compared to that when it is carrying the entire product line.<sup>5</sup> As a result, the retailer's off-

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<sup>5</sup>This is because when both products are carried by the retailer, its choice of service levels and retail prices are tempered by the individual rationality constraint that it needs to satisfy for the low-valuation consumer (i.e., allow the low-valuation consumer at least non-negative utility from consumption of the low-end product) and the incentive compatibility constraint for the high-valuation consumer (i.e., ensure that the high-valuation consumer gets at least as much utility from consuming the high-end product than the utility she gets from consuming the low-end product). When only the low-end product is carried by the retailer, the retailer needs to just ensure that the individual rationality constraint for the low-end consumer is satisfied.

equilibrium profit earned from carrying only the low-end product is now higher. This suggests that for given quality level of the products, the retailer will have to be provided a higher incentive to carry both products when it is providing the demand-enhancing services. Since the retailer's off-equilibrium profit from carrying the partial product line is higher with higher product quality, the anticipation of this higher level of retailer opportunism has a dampening effect on the manufacturer's product quality decision. By sufficiently lowering the quality of the low-end product, the manufacturer makes it less profitable for the retailer to take the off-equilibrium routes of carrying just one product instead of the entire product line (since profit from carrying only the low-end product is clearly lower while profit from carrying only the high-end product is lower compared to the profit from carrying both products where the retail price of the high-end product can now be made higher given the quality distortion). This in turn allows the manufacturer to leave less money on the table for the retailer and hence it earns a higher profit.

In fact, Proposition 4 demonstrates that the distortion in the quality level of the low-end product under service provision by the retailer can be strong enough to result in a lower quality level than under no service provision. While the drop in quality of the low-end product benefits the manufacturer through reducing the retailer's opportunistic behavior, the lower quality level of the low-end product at the same time results in a lower level of profit from selling to the low-valuation consumers who, after receiving the demand-enhancing services, have a higher willingness-to-pay for the product. Thus, this negative effect of foregone profit from the low-valuation consumers must be balanced against the positive gains from lower retailer opportunism. When the proportion of low-valuation consumers is low enough, this segment does not contribute significantly to the manufacturer's profit. It pays for the manufacturer in that case to significantly distort the low-end product to gain as much profit as possible without paying a huge price in terms of the loss in returns from the low-valuation consumers. This distortion in the quality of the low-end product can be so large that the low-end product quality is inferior compared to the case when there is no service provision.

The proposition below provides results on the impact of retailer-provided services on the level of consumer welfare.

**Proposition 5.** *When the retailer provides demand-enhancing services in the channel, total consumer surplus may or may not be higher, depending on the proportion of the low-valuation consumers ( $\gamma$ ).*

**Proof:** In both scenarios where service is provided by the retailer and no service is provided, the consumer surplus of the segment of low-valuation consumers is given by  $CS_L^{rs} = CS_L^{ns} = 0$ . The consumer surplus of the segment of high-valuation consumers under no service is given by  $CS_H^{ns} \equiv (1 - \gamma)(\bar{\theta}\bar{q}^{ns} - \bar{p}^{ns}) = (1 - \gamma)(\bar{\theta}\bar{q}^{ns} - \bar{\theta}\bar{q}^{ns} + (\bar{\theta} - \underline{\theta})\underline{q}^{ns}) = (1 - \gamma)(\bar{\theta} - \underline{\theta})\underline{q}^{ns}$ , and, under retailer-provided services is  $CS_H^{rs} \equiv (1 - \gamma)((\bar{\theta} + \bar{s}^{rs})\bar{q}^{rs} - \bar{p}^{rs}) = (1 - \gamma)((\bar{\theta} + \bar{s}^{rs})\bar{q}^{rs} - (\bar{\theta} + \bar{s}^{rs})\bar{q}^{rs} + (\bar{\theta} - \underline{\theta})\underline{q}^{rs}) = (1 - \gamma)(\bar{\theta} - \underline{\theta})\underline{q}^{rs}$ . From the proof of Proposition 4, we know that  $\underline{q}^{rs} \underset{\geq}{\leq} \underline{q}^{ns}$  according as  $\gamma \underset{\geq}{\leq} 0.62$ . This implies that  $CS_H^{rs} \underset{\geq}{\leq} CS_H^{ns}$  according as  $\gamma \underset{\geq}{\leq} 0.62$ . ■

We observe that even though it is the low-end product whose quality may be made inferior under retailer-provided services, the low-valuation consumers purchasing that product are not affected by the difference in quality. As in the case of manufacturer-provided services, the retail price for the low-end product has been selected to extract maximum surplus from these consumers. Thus, their surplus from purchasing the low-end product in either case is zero. On the other hand, the high-valuation consumers who do not purchase the low-end product in equilibrium are actually affected by the difference in quality of that product. This is because the surplus retained by the high-valuation consumer is the utility she would gain had she purchased the low-end product. This utility gain is positively related to the quality of that product. As a result, the surplus the high-valuation consumers retain under retailer-provided services depends on the incentive of the manufacturer to distort downwards the quality of the low-end product. When the proportion of low-valuation consumers is low enough, service provision by the retailer may cause the manufacturer to lower the quality of the low-end product to such an extent that the high-valuation consumers are worse off with service

provision. When the proportion of low-valuation consumers is higher, the manufacturer may face sufficient incentive to raise the quality level of the low-end product in which case the high-valuation consumers are better off under retailer-provided services.

The impact of the provision of demand-enhancing services by the retailer on the profit levels of the channel and each channel member is shown in the following propositions.

**Proposition 6.** *When the retailer provides demand-enhancing services in the channel,*

1. *Manufacturer profit is higher;*
2. *Retailer profit may or may not be higher. Specifically, retailer profit is higher when (i) the proportion of low-valuation consumers ( $\gamma$ ) is sufficiently high ( $\gamma > 0.62$ ); or (ii) for other values of  $\gamma$ , the degree of heterogeneity between the two types of consumers is sufficiently low ( $\underline{\theta}/\bar{\theta}$  is sufficiently high); otherwise, retailer profit is lower.*
3. *Total channel profit is higher.*

**Proof:** See the Appendix. ■

When the retailer provides demand-enhancing services, we have shown that the manufacturer ends up having to leave a higher profit with the retailer for a given product line. Yet, the manufacturer has two instruments – the wholesale price and the product quality level – at its disposal to maximize its own profit. It appropriately raises or lowers the quality of the low-end product to ensure that the minimum profit necessary is left for the retailer to induce it to carry both products. This, coupled with a higher quality level of the high-end product and appropriate wholesale prices, yields higher gains from the retailer’s sales of the high-end product to high-valuation consumers. Thus, the manufacturer is able to earn a higher profit.

However, the retailer may be left worse off by providing the services to the consumers. We know that it is in the manufacturer’s best interests to minimize the surplus the retailer is allowed to retain. When the low-valuation consumers are sufficiently well-represented or if the degree of heterogeneity between the two types of consumers is sufficiently low, the

manufacturer does not find it optimal to distort the quality of the low-end product too much. This allows the retailer to demand more from the manufacturer since it can earn a higher profit in the off-equilibrium one-product-only scenarios. In those instances, the retailer earns a higher profit when it provides the services. On the other hand, when the low-valuation consumers are relatively less significant in number and in their valuation in the manufacturer's profit equation, there is more incentive for the manufacturer to heavily distort the low-end product quality, thereby squeezing more profit from the retailer. Here, the retailer ends up earning a lower profit level compared to when there is no service provided at all.

Why does the retailer still choose to provide positive levels of services in the latter scenario? To understand this, note that the retailer, when it is put in charge of service provision, can not beforehand commit to a particular level of service, including zero services, prior to the manufacturer's selection of its product quality levels. Since the manufacturer benefits from service provision by the retailer, it will indeed pick product qualities corresponding to which it is actually optimal for the retailer to choose positive service levels. Of course, if the retailer could somehow commit to zero service level prior to the manufacturer's product quality decision, then our results imply that the retailer may want to do so under some circumstances. This would be tantamount to the "No Services" scenario. In that case, our results imply that the manufacturer will prefer to take on providing the service itself. Alternatively, in scenarios where a manufacturer may not find it feasible to provide such services in local markets (for example, if it were a small foreign supplier), it may want to induce the retailer to provide the services by offering it compensation in the form of side payments. As we see in Proposition 6, total channel profit increases under service provision by the retailer. This allows the manufacturer to share some of this higher profit with the retailer, while still benefiting from the retailer's services itself.

To see why total channel profit is higher, note that when both products improve in quality, this coupled with the shift upwards of the consumers' willingnesses-to-pay results in a larger pie from which the channel can extract profit. Thus, total channel profit increases

in this case. Also, when the low-end product declines in quality while the high-end product improves in quality, the retailer is able to extract more surplus from the high-valuation consumers. This is because the high-valuation consumers' option of switching to the low-end product becomes less attractive and so the retailer must now leave less on the table for these consumers. The higher revenues from the high-valuation consumers dominate the lower revenues earned from the low-valuation consumers. As a result, the channel again benefits from service provision.

A comparison of Propositions 5 and Proposition 6 yields the following result: While Proposition 5 above states that when  $\gamma < 0.62$ , consumers are worse off under retailer-provided services, from Proposition 6, we find that when  $\gamma < 0.62$ , both the manufacturer and the retailer may find it optimal to have services provided by the retailer if the degree of heterogeneity between the two types of consumers is sufficiently low, i.e., when  $\underline{\theta}/\bar{\theta}$  is sufficiently high. We summarize this below:

**Corollary 1.** *When the retailer provides demand-enhancing services in the channel, for low values of the proportion of low-valuation consumers ( $\gamma < 0.62$ ), there may be overprovision of demand-enhancing services, i.e. while both channel members may prefer that positive demand-enhancing services are provided by the retailer, consumers are better off with no service provision.*

## Manufacturer-provided Services vs. Retailer-provided Services

Here, we compare the impact of services provided by the manufacturer and those provided by the retailer.

**Proposition 7.** *The manufacturer chooses (weakly) higher quality levels for both products when it provides demand-enhancing services than when the retailer provides demand-enhancing services.*

**Proof:** It is evident from the expressions for  $\bar{q}^{rs}$  and  $\bar{q}^{ms}$  in (13) and (21) respectively that



the quality level of the high-end product is the same in both scenarios. Comparing the quality levels of the low-end product, we find that the difference  $\underline{q}^{rs} - \underline{q}^{ms} = \frac{2(\underline{\theta} - (1-\gamma^2)\bar{\theta})(\gamma-1)}{\gamma^2(4-\gamma)(3\gamma+1-\gamma^2)} < 0$ , since  $\gamma < 1$ . ■

Proposition 7 demonstrates that a distortion appears in the quality level of the low-end product under service provision by the retailer as compared to service provision by the manufacturer. As noted earlier, the difference in the quality levels in the two scenarios arises due to the differences in ability of the retailer to adopt the optimal service levels in the off-equilibrium situations when it makes its decisions regarding which products to carry. The ability to choose the service levels optimally under all scenarios gives the retailer an edge in forcing the manufacturer to leave a higher amount of profit when it is being induced to carry the entire product line. Thus, while the manufacturer has sufficient incentive to improve the quality level of the low-end product when it provides the services itself, its squeezed profits under retailer-provided services may lead it to actually lower the quality level of the low-end product.

Quality levels of the high-end product are the same under service provision by either the manufacturer or the retailer. This is because both the manufacturer and the retailer realize that it is most optimal to choose the quality levels of the product line, service levels and associated prices such that maximum surplus can be extracted from the more attractive high-valuation consumers. Thus, given the product quality level, the retailer's chosen service levels for the high-end product always matches that of the manufacturer. The manufacturer finds it optimal in either case to raise the quality level of the high-end product to the same level. In other words, there is no distortion at the top.

**Proposition 8.** *Consumer surplus is higher under demand-enhancing service provision by manufacturer than under demand-enhancing service provision by retailer.*

**Proof:** From Propositions 2 and 5, it is evident that for the low-valuation consumers,  $CS_L^{ms} = CS_L^{rs} = 0$ . For high-valuation consumers, the difference in surplus is  $CS_H^{ms} - CS_H^{rs} = (1-\gamma)(\bar{\theta} - \underline{\theta})(\underline{q}^{ms} - \underline{q}^{rs})$ . From Proposition 7, we know that  $\underline{q}^{ms} - \underline{q}^{rs} > 0$  implying that

$$CS_H^{ms} - CS_H^{rs} > 0. \blacksquare$$

We have seen that in case of either manufacturer- or retailer-provided services, the retail price set by the retailer for the low-end product always extracts the entire surplus from the low-valuation consumers. Thus, these consumers end up with the same level of surplus (equal to zero) under either service provision scenario. For the high-valuation consumers, their surplus equals the utility gain they get from consuming the low-end product which is a function of the quality level of the low-end product. The higher quality level of the low-end product under manufacturer-provided services implies that the high-valuation consumers are better off in this case compared to retailer-provided services.

**Proposition 9.** *The manufacturer prefers own provision of demand-enhancing services to the retailer's provision of demand-enhancing services but the retailer may not prefer own provision of services to the manufacturer's provision of services. Total channel profit is higher under demand-enhancing services provided by the manufacturer than under demand-enhancing services provided by the retailer.*

**Proof:** See the Appendix.  $\blacksquare$

It is intuitive that the manufacturer prefers to take on providing the demand-enhancing services itself rather than delegate it to the retailer. When it provides the services, the manufacturer not only chooses the optimal service levels for the product line but also restricts the retailer's opportunistic behavior discussed above thereby increasing its profit. For the retailer, it might seem more profitable to have greater control over service provision so that it may choose the service levels that are optimal for it, and not be forced to accept the manufacturer's chosen levels. This might be a naive retailer's course of action, and if this naive retailer has some bargaining power over the manufacturer, it may demand and succeed in appropriating the rights to provide the services. Indeed, it can be shown that fixing the product quality levels, the profit earned by a retailer is higher when it provides the services

compared to the case when the manufacturer provides the services.<sup>6</sup> The sophisticated retailer on the other hand will recognize that although its profit from a given product line is higher when it provides the services, the manufacturer will internalize the higher potential for retailer opportunism in its product quality decisions such that the profit retained by the retailer is minimized. Thus, whether a retailer may prefer to allow the manufacturer to take on service provision in the first stage depends on which of the two effects dominate.

Proposition 9 suggests that when the proportion of low-valuation consumers is low enough, both channel members prefer service provision by the manufacturer. In this case, it follows that channel profit is higher under manufacturer-provided services. On the other hand, when the proportion of low-valuation consumers is higher, the two regimes - manufacturer-provided services and retailer-provided services have opposing effects on the profit levels of the manufacturer and the retailer. However, it still follows that service provision by the manufacturer results in a higher profit at the channel level. This is because the quality levels of the product line are higher in this case. As a result, the size of the pie gets larger in this scenario although the sharing of the pie may be skewed towards the manufacturer and not the retailer. The reverse holds true under retailer-provided services.

## 5 Discussion and Future Research

In this paper, we have analyzed how the identity of the channel member providing demand-enhancing services can have varying impact on key variables like the manufacturer's product quality choices for its product line and resultant consumer welfare and channel profits. In channel settings where the manufacturer provides the demand-enhancing services, the increase in the willingness-to-pay of consumers caused by the demand-enhancing services results in incentives for the manufacturer to raise product quality levels which in turn raise consumer welfare and channel profit level. However, these results may unravel in channel settings with retailer-provided services. When the retailer provides the demand-enhancing

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<sup>6</sup>Fixing the product line at  $(\underline{q}, \bar{q})$ , the retailer's profit under manufacturer-provided services is  $\pi^{ms} = \frac{(1-\gamma)(\bar{\theta}-\underline{\theta})\underline{q}}{\gamma}$  and its profit under retailer-provided services is  $\pi^{rs} = \frac{(1-\gamma)(\bar{\theta}-\underline{\theta})\underline{q}}{\gamma} + \frac{(1-\gamma)\underline{q}^2}{4} > \pi^{ms}$ .

services, it can optimally make its service choice decision subsequent to its choosing which products to carry and hence it chooses service levels different from those chosen by the manufacturer in off-equilibrium scenarios (i.e. in scenarios where it carries a subset of the product line). The manufacturer must then leave the retailer with a higher profit level to induce it to carry the entire product line. Anticipation of the greater retailer opportunism may distort the manufacturer's product quality choices, which in turn adversely impact consumer welfare and profit levels for channel members.

**Single product sold to consumers:** In the main text of the paper, we examined the case where the manufacturer wishes to sell its entire product line through the retailer and must provide adequate incentives to the retailer to induce it to carry all the products. As in Villas-Boas (1998), the intention was to highlight a major challenge faced by a manufacturer with a product line who aims to sell all the products through a downstream retailer. In Appendix D, we consider the case where the manufacturer sells only one product through a retailer and compare the effects of manufacturer-provided services and retailer-provided services in this context. Unlike the product line case where the manufacturer faced constraints relating to inducing the retailer to carry an entire product line, in this case, the main constraint for the manufacturer lies in providing enough incentive to the retailer to not only carry the product (instead of an outside option) but also to choose an appropriate retail price for the product such that the desired consumer segment is targeted (only the high-valuation consumers or both high-valuation and low-valuation consumers). Although this makes the manufacturer's single product decision problem different from the product line case, we show that the key insight from our main model continue to hold. Specifically, the identity of the demand-enhancing service provider is important and has implications for product quality, channel member profits and consumer welfare.

**Cost of providing the service:** In the main model, we considered the case where the costs for service levels  $\bar{s}$  and  $\underline{s}$  are increasing in the quality of service but independent of the number of units sold (fixed costs of service). There are numerous instances where service

costs appear in this manner, for example, salaries paid to customer service personnel and technical support representatives, expenses related to store display and demonstrations and promotion budgets. This modeling of service costs is fairly common in the literature as well (for example, Iyer (1998), Coughlan and Soberman (2005), Raju and Zhang (2005)). In Appendix C, we characterize the situation where service cost is increasing in the quality of service and also in the number of units sold (variable cost of service). Examples of such situations include manufacturer warranty or delivery costs. Using this formulation for service costs, we compare the effect of manufacturer-provided services and retailer-provided services. We find that in this case, both manufacturer-provided services and retailer-provided services yield higher product quality levels, channel member profits and consumer welfare compared to a scenario where no services are provided. Furthermore, the identity of the demand-enhancing service provider does not matter and outcomes are identical under either manufacturer-provided services or retailer-provided services.

**Impact of Retail Competition:** In order to focus on the effect of identity of channel member providing demand-enhancing service on various channel and consumer outcomes, we formally modeled a framework with a single upstream manufacturer and a single downstream retailer. Incorporating retail competition in our framework would allow one to address the effect of competition in services among retailers on the manufacturer's decision regarding product line allocation across the retailers.

Although formal analysis is beyond the scope of this paper, we discuss next the effects of the presence of competition at the retail level. First consider the case where the manufacturer wants each retailer to carry the entire product line. In that case, we conjecture that each retailer still can influence the off-equilibrium profit to a greater extent when it provides services itself compared to when the manufacturer provides the services. Hence, as in our analysis in the main text, we expect that the retailer can extract greater profit from the manufacturer and anticipating that, the manufacturer would want to lower product quality to reduce the leverage the retailer has in the off-equilibrium situations where it carries only the low-quality product. Overall, we expect the forces generated by the manufacturer's desire

to induce the retailer to carry the entire product line combined with the retailer' increased opportunism in the case where it provides services (compared to when the manufacturer provides services) to still exist. These forces will disappear only if the retail competition is perfect in the sense that an individual retailer's profit is driven purely by retail competition rather than its strategic choice of service levels. In the reasonable case of imperfect retail competition, we expect these key economic forces highlighted in our model to continue to exist.

Next, consider the case where the manufacturer sells one of each product type through one retailer (for example, higher quality product through Retailer 1 and lower quality product through Retailer 2). In that case, the retailer's only threat is to not carry the manufacturer's product and then earn profit from an outside option. However it cannot affect the magnitude of the outside option by its choice of the service level it provides. Hence when it does provide service, it does not enjoy any extra leverage compared to when the manufacturer provides service. Overall, this invariance of the outside option to which channel member provides the service takes away the key forces of the retailer opportunism combined with manufacturer's product line decision.

**Impact of Manufacturer Competition:** As mentioned above, we have considered a framework with a a single upstream manufacturer and a single downstream retailer in the main paper. We discuss next the implications of incorporating manufacturer competition in our framework.

We expect that the presence of multiple manufacturers competing to induce the retailer to carry their product lines will exacerbate the retailer opportunism problem that we highlighted in our model and will provide qualitatively similar insights regarding the comparison of manufacturer-provided services versus retailer-provided services. This is because for each manufacturer, the retailer now has an expanded set of off-equilibrium options to choose from if it were to deviate from carrying the manufacturer's entire product line, viz., not only a subset of the manufacturer's product line but also some of the competing manufacturer's products or the entire product line of the competing manufacturer. This implies that the

manufacturer may have to leave a larger surplus with the retailer to induce it to carry its product line compared to the case where there is no manufacturer competition. To minimize this retailer opportunism problem, the manufacturer may face incentives to distort downwards the quality level of its low-end product. When the retailer decides its service levels, it can optimize its profit in all these off-equilibrium scenarios relative to the case where the manufacturers decide the service levels. This implies that the retailer needs to be provided even greater incentives to carry the product line when it provides service compared to when the manufacturer provides the services. Hence, we can expect this distortionary force on product quality level to be stronger under retailer-provided services relative to manufacturer-provided services.

**Nature of Vertical Relationship in Channel:** This paper considers the market situations where the manufacturer is the dominant player and makes take-it-or-leave-it offers to the retailer. Although there exist two other possible power structures — retailer making take-it or-leave-it offers to the manufacturer, or both manufacturer and retailer having equal power and neither party making take-it-or-leave-it offers – we focused on the most commonly examined power structure in the channels literature.<sup>7</sup> Finally, although we have pointed out each channel member’s incentive to subsidize service provision by the other member, formally modeling cooperating vertical arrangements where one channel member commits to paying a certain portion of the other member’s service expenditures may be useful.

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