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In this paper, we study how a retailer can benefit from acquiring consumer taste information in the presence of competition between the retailers store brand (SB) and a manufacturers national brand (NB). In our model, there is ex-ante uncertainty about consumer preferences for distinct product features, and the retailer has an advantage in resolving this uncertainty because of his close proximity to consumers. Our focus is on the impact of the retailers information acquisition and disclosure strategy on the positioning of the brands. Our analysis reveals that acquiring taste information allows the retailer to make better SB positioning decisions. Information disclosure, however, enables the manufacturer to make better NB positioning decisions - which in return may benefit or hurt the retailer. For instance, if a particular product feature is quite popular, then it is beneficial for the retailer to incorporate that feature into the SB, and inform the manufacturer so that the NB also includes this feature. Information sharing, in these circumstances, benefits both the retailer and the manufacturer, even though it increases the intensity of competition between the brands. But, there are situations in which the retailer refrains from information sharing so that a potentially poor positioning decision by the NB makes the SB the only provider of the popular feature. The retailer always benefits from acquiring information. However, it is beneficial to the manufacturer only if the retailer does not introduce an SB due to the associated high fixed cost.

Key words: supply chain management; uncertain consumer taste; product introduction; product positioning; store brands; national brands; information acquisition; information sharing; vertical differentiation; horizontal differentiation

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1. Introduction and Motivation

Accelerating technological change, coupled with intense competition, pressures companies towards shorter new-product introduction cycles. In their attempt to get products to market faster, firms are finding it difficult to incorporate all consumer insights into the product development process (Badgett et al. 2002). Consequently, which product features will turn out to be popular remains uncertain during product launch, despite the substantial market research available at the firms' fingertips (Van der Panne et al. 2003). This can be troublesome, especially given that consumers nowadays expect and demand a product tailor-made for their lifestyles (O'Regan 2009).

In this context, a retailer's direct interaction with consumers can provide rich insights. A retailer has the opportunity to learn the *specific* desires of consumers faster than a manufacturer (Kanellos 2005). Through customer-centric management styles, retail giants such as Best Buy, Kroger, Target, Tesco, Walgreen, and Walmart generate significant insights into consumers' taste (Crosby 2009, Hiemeyer 2010, Lal et al. 2006). One way retailers capitalize on the insights generated is by incorporating them into the store brands (SBs) they sell. Many retailers today have their own SBs, with some of them, like Kirkland (Costco) and President's Choice (Loblaws), becoming almost as popular as national brands (NBs).[1] Recently, Amazon introduced a range of SB products that seem perfectly tailored to customer demand, capitalizing on their vast amount of data concerning consumer purchasing habits.[2]

In this paper, our primary objective is to identify how a retailer can benefit from acquiring consumer taste information in the context of competition between NBs and SBs. Acquiring information about uncertain tastes bring forth unique questions in the presence of SBs - in particular, from a product positioning perspective. The first option for the retailer in utilizing this temporarily distinct information is to launch a similar SB product. A popular example is the laptop stand introduced by AmazonBasics that is a nearly identical version of the Rain Laptop Stand which received extremely positive reviews.[3] The second option for the retailer is to launch an SB that provides a "better" fit than the NB. One such case is the Insignia spill-resistant portable DVD player of Best Buy with ruggedized exterior and simplified interface. Introduced in 2007 after noticing that many portable DVD players were purchased for young children, it became a top seller and received a Red Dot Award (Bustillo and Lawton 2009). In this example, NBs like Samsung

[1] In 2009, 43% of shoppers switched from an NB to a corresponding SB, and 97% of those said they favour SBs to their previous choices (PLMA 2009).

[2] Spencer Soper, "Got a Hot Seller on Amazon? Prepare for E-Tailer to Make One Too", April 20, 2016, url: https://www.bloomberg.com/news/articles/2016-04-20/got-a-hot-seller-on-amazon-prepare-for-e-tailer-to-make-one-too

[3] Nick Bravo, "Amazon Private Labels Threaten Manufacturers", July 05, 2016, url: http://trustedinsight.trendsource.com/trusted-insight-trends/amazon-private-labels-threaten-manufacturers

and Sony perhaps overestimated the demand from tech-savvy consumers and underestimated the demand from adults with children - and, therefore, targeted the small segment with the product features included. The third option for the retailer is to share the taste information with a brand manufacturer in the spirit of "collaborative innovation" so as to develop better retailer-exclusive NB products. For instance, with its Blue Label brand, Best Buy shares information with Intel, Sony, and Toshiba as a part of their "You Spoke, We Listened" customization program, which continually incorporates consumer feedback into the product development process. These two examples clearly illustrate that consumers' taste information play, a role in the positioning of SBs in terms of product features.

In order to shed light on how the acquisition of consumer taste information by the retailer affects the positioning of the NB and the SB, we analyze a one-manufacturer and one-retailer supply chain. We model "taste" through the size of the consumer segment interested in a particular product feature such as screen resolution, shock resistance, etc. As such, we model the uncertainty in consumer taste as the uncertainty in the size of the consumer segment that prefers a particular product feature. Accordingly, being informed about consumer taste in our model setting means knowing the exact size of each segment. Our analysis consists of three steps.

1. We first characterize the equilibrium pricing strategy given the product features and taste information. In addition to the horizontal product differentiation that arises from heterogeneous consumer taste, our model captures the vertical differentiation between the brands and the heterogeneity in consumer valuation.

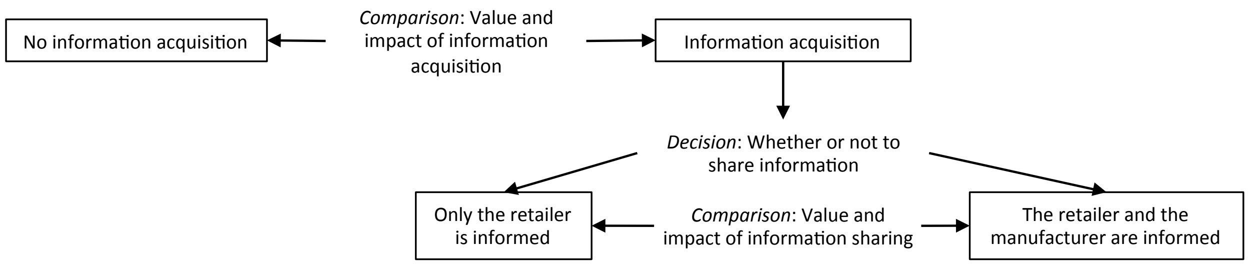
2. We characterize the exact NB and SB positioning strategies by analyzing the signaling game in which only the retailer is informed about consumer taste. Determining the separating perfect Bayesian equilibrium, we characterize the conditions under which the retailer shares (or withholds) information and how this affects the positioning of the NB and the SB.

3. We analyze the equilibrium positioning and pricing strategies when neither of the chain partners is informed about consumer taste.

Through the comparison of optimal profits when the retailer is informed about consumer taste and when not, we derive the strategic value of information acquisition, which can then be traded off against the cost associated with acquiring it. Figure 1 provides an illustration of the models that we analyze and compare in this paper.

In terms of the pricing decisions, our analysis shows that, as expected, if the NB and the SB integrate identical features into their design, then the degree of horizontal differentiation between them is reduced, which intensifies the price competition between the NB and the SB, and this decreases the degree of double marginalization for the NB. Consequently, the retailer attains higher

Figure 1 **Scenarios modeled, analyzed, and compared in this paper.**



profits from the NB while the manufacturer is hurt. The reverse is also true in that the manufacturer benefits if the SB has different features than the NB.

In terms of the product positioning decisions, we show that the retailer may *imitate* the manufacturer by duplicating the features of the NB - to achieve higher profits from the NB, as mentioned above - or *differentiate* by integrating different features in the SB. The specific strategy that benefits the retailer the most depends on the size of the consumer segment targeted by the NB: it is to the benefit of the retailer to imitate if the NB is targeting a very large consumer segment, and differentiate otherwise. In a similar vein, the manufacturer can also position its NB to target a large segment, or strategically stay away from that segment - to reduce the degree of price competition between the NB and the SB - by proactively recognizing that the retailer will then imitate.

In terms of information acquisition, we pinpoint two fundamental effects. The *direct effect* is that being informed about consumer taste allows the retailer to integrate the popular features into its product design as opposed to guessing what features will be popular. The *indirect effect* is that if the retailer shares taste information, then the manufacturer can also integrate the popular features into its product design. *As a result, through strategic information sharing, the retailer can influence the positioning of the NB even when the manufacturer moves first.* We show that these two effects interact with each other and that the nature of their interaction varies with operating factors such as the cost of SB introduction, the degree of vertical differentiation between the brands, and the relative sizes of the consumer segment interested in each product feature. On one hand, if the market is skewed, i.e., a majority of consumers prefers a particular feature, then both the direct and the indirect effects are positive for the retailer. In fact, the indirect effect augments the direct effect. The retailer shares information with the manufacturer so that the manufacturer targets the large segment. The retailer imitates and also targets the same segment. This a very beneficial scenario for the retailer as it is able to target a large consumer segment and also control the wholesale price of the manufacturer by the presence of the SB. As a result, the retailer shares taste information with the manufacturer, and both parties benefit from information acquisition. On the other hand, if the market is symmetric, i.e., all the product features are more or less equally popular, then the indirect effect is negative for the retailer and diminishes the value of the direct effect - which motivates the retailer to withhold information.

In terms of the value of information acquisition, we show that the retailer benefits from ex-ante information acquisition. We also show that the retailer's information acquisition about consumer taste hurts the manufacturer unless the SB introduction is very costly for the retailer. This is in contrast with the existing literature, which shows that the ex-ante value of information acquisition may be positive for the manufacturer when its impact on pricing decisions is considered. Another contrast of our findings is that the retailer may benefit from information disclosure by influencing the positioning of the NB.

We also generate managerial insights regarding the value of consumer taste information for the retailer with respect to the cost of SB introduction. It is plausible that retail managers consider an information acquisition decision concurrently when introducing an SB; therefore, we investigate how that cost shapes the value of consumer taste information. According to our analysis, retail managers should be cautious about these decisions since the cost of SB introduction has a non-monotonic affect on the value of information acquisition for the retailer.

2. Related Literature

The contribution of this paper to the extant literature is that we identify how a retailer's acquisition of consumer taste information shapes product positioning in the context of NB and SB competition. Our work is related to three streams of research: (*i*) information sharing in the context of supply chain and distribution channels, (*ii*) national brand (NB) and store brand (SB) competition, and (*iii*) uncertain consumer taste.

There is a substantial literature focusing on information sharing related issues in supply chain interactions. Early work in this stream investigates how information sharing affects ordering and inventory decisions (Aviv and Federgruen 1998, Cachon and Fisher 2000, Chen 1998, Gavirneni et al. 1999, Lee et al. 2000) and reduces the risk of information distortion (Lee et al. 2004). Chen (2003) provides an excellent review of the role of information in achieving supply chain coordination. [4] Similar to this stream of work, we also investigate a retailer's information sharing incentives.*However, we add to this stream by identifying the impact of information sharing on the positioning of brands rather than inventory decisions.* Our work is more related to the research exploring strategic information sharing (Chu and Lee 2006, Guo 2009, Guo et al. 2014). Chu and Lee (2006) study a dyadic supply chain, in which the retailer does not pre-commit to information

[4] More recent work in this domain investigates the incentives for chain partners to share demand and inventory information (Gal-Or et al. 2008, Niraj and Narasimhan 2004, Zhao et al. 2002), contract types that facilitate information sharing (Cachon and Lariviere 2001, Ha and Tong 2008, He et al. 2008, Kong et al. 2013, Thonemann 2002, Özer and Wei 2006, Yue and Liu 2006), and the role of trust in information sharing (Özer et al. 2011, 2014).

sharing but decides ex-post whether to share private demand information with a manufacturer. The manufacturer decides on the stocking level given the wholesale price. Guo (2009) looks at the same problem but with wholesale price as a decision variable for the manufacturer. Guo et al. (2014) extends Guo (2009) by considering competing channels. In these studies, the retailer acquires information about the size of the population interested in a single product (like NB). As a result, the retailer decides ex-post whether or not to share information, focusing only on the manufacturer's product. The difference in our model is that the retailer can use information for a better positioning of its own product, the SB. Furthermore, if the retailer shares information, then the manufacturer uses this information in NB positioning - which changes the degree of price competition between the brands. *In other words, our model not only extends the impact of information acquisition to competing brands, but also captures its role - through product positioning - in the degree of competition between brands.*

The growing popularity of SBs in industry has generated significant interest from the academic community. We refer the reader to Sethuraman (2009) for an extensive review of SB research. The most relevant stream of research explores the ramifications of SB introduction on the performance of supply chain partners.[5] One direct implication of SB introduction is that it makes the retailer a competitor of the manufacturer (Amrouche and Zaccour 2007). Consequently, SB introduction benefits the retailer not only by reaching a larger set of consumers through a larger assortment (Soberman and Parker 2004) but also by engendering better NB supply terms from the manufacturer, e.g., lower wholesale prices (Meza and Sudhir 2010, Mills 1995). In this context, SB positioning is critical due to its role in the degree of price competition between the brands (Du et al. 2005, Morton and Zettelmeyer 2004, Sayman et al. 2002). *Our model captures these elements and adds to the literature by allowing the retailer - through information sharing - to play a role in the positioning of the manufacturer's product.* In that sense, investigating information sharing enables us to endogenize the retailer's role in the positioning of NB and SB products.

Previous work such as Casado-Izaga (2000), Krol (2011), and Meagher and Zauner (2005) examines uncertainty in consumer taste; however, it considers neither vertical manufacturer-retailer interaction nor NB-SB competition. In this stream, most related to our work are Du et al. (2005) and Morton and Zettelmeyer (2004), both of which investigate SB positioning compared to existing NB products. In these papers, SB can be positioned to satisfy the tastes of different consumer segments; however, the positioning of the NBs are exogenously set, and firms are fully informed about

[5] Another stream of research less related to our work considers the supply chain efficiency and coordination problems in the face of SB introduction (Chen et al. 2009, Fang et al. 2011, Groznik and Heese 2010a, Kurata et al. 2007, Sachon and Martınez-de Albéniz 2009, Xia and Gilbert 2007) as well as the impact of SB introduction in the context of competing retailers (Groznik and Heese 2010b, Liao and Yano 2013).

consumer taste while making decisions. In our model setting, we do not address the competition across NBs, but we enrich the NB-SB competition literature by endogenizing the manufacturer's NB positioning decision. Moreover, we investigate the impact of uncertainty in consumers' taste and the issues related to information acquisition and sharing arising from that uncertainty.

In short, the main contribution of our paper is that we shed light on the acquisition of consumer taste information and its role in the positioning of competing brands. We achieve this by explicitly modeling the uncertainty in consumers' taste (rather than uncertain aggregate demand), allowing the retailer to acquire and share this information (rather than assuming that NB manufacturers are fully informed), and investigating the positioning of both the NB and the SB (rather than the SB only) in light of this information.

3. Model Framework

Our framework consists of a single manufacturer (she) and a single retailer (he). The manufacturer owns an NB, for which she is in control of activities such as design and production. She sells the NB through the retailer. The retailer has the option to introduce and sell an SB in addition to the NB. The SB is produced in a vertically integrated fashion (internally or by subcontracting), meaning that all the decisions regarding the SB, such as design, production, and pricing, are made by the retailer. We focus on a single-period framework since both products are assumed to have relatively short life cycles, e.g., fashion products (see Fisher 1997). Thus, consumers are impatient, and their waiting behaviour is not relevant (Balachander and Srinivasan 1998). Our demand model captures vertical differentiation, horizontal differentiation, uncertainty and heterogeneity in consumer taste, and heterogeneity in consumer valuations. In this section, we develop a model of consumer choice, present the market structure, and describe the detailed order of events.

3.1. Utility framework

Each consumer in the market purchases one unit of the product, either an SB or an NB, that maximizes her/his utility. If neither of the products provides a non-negative utility, then the consumer leaves the market. Our consumer choice model originates from the utility function for horizontally and vertically differentiated products by Desai (2001). Consumer utility, net of the retail price, from each product is as follows:

$$net\ utility = valuation * brand\ equity - misfit - price. \tag{1}$$

The *valuation* represents a consumer's willingness to pay for his/her ideal product. We allow for heterogeneity in valuation through a continuum of consumers indexed by their type υ, which is uniformly distributed over a unit line. Consumer type is private information, and only its distribution is known to the firms.

The *brand equity* captures the vertical differentiation in quality since, everything else being equal, consumers prefer the higher-quality product. It is common in the literature to assume that NBs enjoy a higher equity than SBs. Traditionally, this assumption was based on the idea that consumers perceive NBs to be superior in quality and reliability. Later on, consistent evidence has been presented to show that SBs can offer the same or even better quality (Quelch and Harding 2004). Yet, NBs are still able to capture a reputation premium regardless of the comparative quality. Sethuraman (2003) shows that consumers are willing to pay a 37% premium for NBs over SBs; nearly 80% of the premium is attributed to the brand equity. Moreover, 85% of the total brand equity is due to non-quality equity, which is defined as the premium that consumers would pay for NBs even when they perceive no quality difference. Although there may be exceptions, consistent with the above observations, we assume NB equity to be higher than SB equity. We normalize the NB equity to 1 and set SB equity as e, where $e < 1$. Accordingly, $1 - e$ is the measure of vertical differentiation between the two brands.

The *misfit* (or mismatch) measures the gap between the features present in a product and the features desired by a particular consumer type. Consumers are heterogeneous in terms of the desired product features; this is the source of consumer taste uncertainty, the main focus of our paper. In other words, for a given product, the degree of misfit varies randomly across consumer types.

Note that the retailer faces two kinds of uncertainty from the consumers side: the uncertainty about the valuation of a customer type and the uncertainty about the fit between a product and the features desired by the consumer type. In the following section, we discuss taste uncertainty in more detail.

3.2. Market structure

We use a spatial model with two consumer segments, $\mathcal{A}$ and $\mathcal{B}$, each with its own ideal product design, represented by the end points of a unit line, points A and B, respectively. There are three possible points for product placement in this product-feature space: the center (point C) and the two ends of the unit line (points A and B). The distance between the location of the consumer segment and the location of the product determines the degree of misfit. Let parameter t represent the misfit per unit of distance between the consumer segment and the product. Accordingly, if a product is located at the center, the misfit of this product for each consumer type would be $\frac{t}{2}$. We label this product as *generic* because it is somewhat appealing to all consumers in the market. If a product is located at one of the end points, say point A for the sake of illustration, then there would be no misfit for consumer segment $\mathcal{A}$, and the misfit for consumer segment $\mathcal{B}$ would be t. We label a product located at the end point as *specialized*, meaning that it is more appealing to a specific segment of consumers. Consequently, *misfit* $\in \left\{0, \frac{t}{2}, t\right\}$ depending on the distance between the location of the consumer segment and the product. A higher t implies a greater degree of horizontal differentiation between the tastes of consumer segments. Within each segment, consumers are homogeneous with respect to taste and heterogeneous with respect to valuation.

During our analysis, we assume that the degree of horizontal differentiation between the two consumer segments is sufficiently high that a product specializing in consumer segment $\mathcal{A}$ (i.e., located at point A) cannot attract consumers from segment $\mathcal{B}$ even if it is priced at the marginal cost. Similarly, a product specializing in consumer segment $\mathcal{B}$ (located at point B) cannot attract consumers from segment $\mathcal{A}$. The mathematical translation of our assumption is $t \geq 1$. This assumption, also made by Du et al. (2005), allows tractability in the demand derivation and pricing stage of our analysis by reducing the number of possible ways of partitioning the consumer segments based on their preferred products. In the absence of this assumption, a specialized product could also appeal (in addition to a generic product) to both segments by cutting its price. Therefore, a misjudgment of product positioning by firms could be mitigated through precise pricing strategies. Such a setting would increase the importance of pricing decisions at the expense of the product positioning decisions. We focus on product positioning, and, by doing so, we highlight the impact of information acquisition and information sharing on the positioning of NBs and SBs.

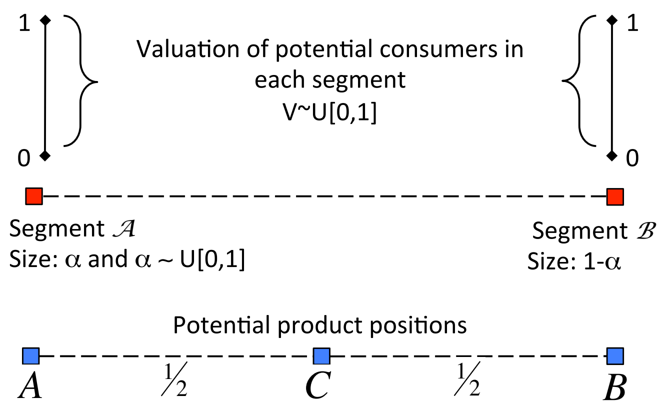
It is worthwhile to note that we are not trivializing the analysis by completely separating the two consumer segments. Brands can attract both segments simultaneously by offering a generic product. In addition, there is still price competition between a generic product and a specialized product. In that sense, we are not discounting the relation between product positioning and pricing decisions. Indeed, we are accentuating the importance of positioning decisions by increasing the trade-off between a specialized versus a generic product, which is in alignment with the idea of generic versus specialized products (Ghosh and Balachander 2007). Nonetheless, in section 6.2, we allow a specialized product to attract consumers from both segments. We also enlarge the discrete product-feature space and allow the brands to locate their products to *more* points in the unit line instead of the three discrete positions A, B, and C. Through the findings of our numerical analysis, we report, in section 6.2, on the robustness of our results with respect to the modeling assumptions.

We model the uncertainty in consumer taste using the size of each segment. The total number of consumers in the market is constant, and without loss of generality, we normalize it to 1. The sizes of segments $\mathcal{A}$ and $\mathcal{B}$ are denoted by α and $1-\alpha$, respectively. We assume that α is random and uniformly distributed between 0 and 1. This distribution function is common knowledge. However, the exact size of each segment is not known to either of the chain partners. Our market structure with two consumer segments is similar to Du et al. (2005) and Morton and Zettelmeyer (2004).

In both these papers, the size of the consumer segments is known to the firms in advance. In particular, Du et al. (2005) assumes that the two segments have equal masses, and Morton and Zettelmeyer (2004) allows the two segments to have unequal masses. We extend this framework such that the two segments have random *and* unequal masses.

Figure 2 provides an illustration of the consumer valuation and the horizontal differentiation.

Figure 2 **Consumer heterogeneity in valuation and taste.**



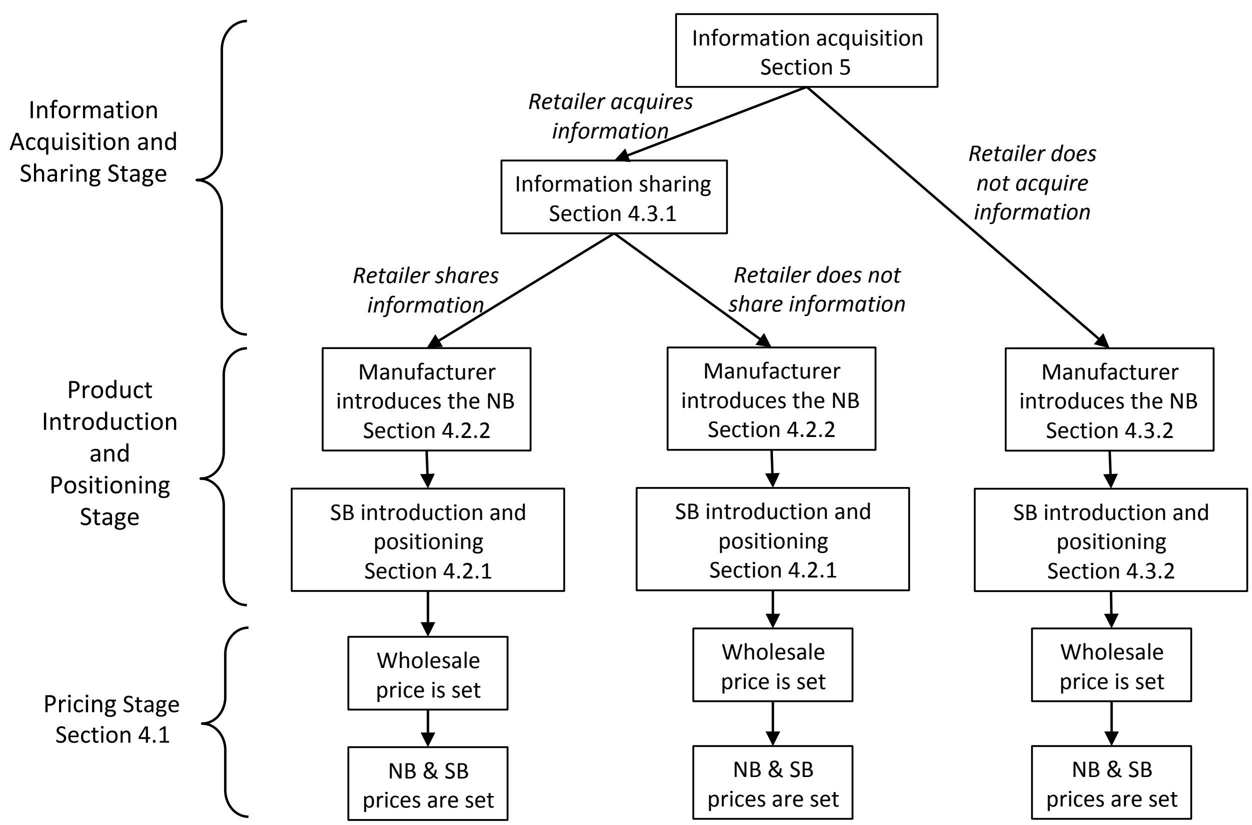
An important characteristic of our demand model is that firms have *perfect* information about the potential product positions and how these positions are valued by representative customers. This is in alignment with the reality that firms can use a variety of strategies, such as conducting market research and increasing customer orientation, to inform themselves about the product attributes and features considered important by consumers (Cooper 1990, Gatignon and Xuereb 1997). However, firms in our model have limited information with respect to the final taste choices of individual consumers, captured by the uncertainty about the size of each segment. As a result, firms face uncertainty while making their product positioning decisions. In that sense, we are not asserting that the retailer has better ex-ante information compared to the manufacturer about consumers' valuations of different attributes and features. Rather, we assume that the retailer has the ability to capture the final taste choices of individual consumers - i.e., the size of each segment - much quicker than the manufacturer. Furthermore, we incorporate this assumption into our static model setting by allowing the retailer to resolve the taste uncertainty, through information acquisition, before the manufacturer, as in the works of Chu and Lee (2006), Guo (2009), and Guo and Iyer (2010).

As an example, refer to the Insignia portable DVD player that was discussed in section 1. The vertical differentiation in that context refers to the perceived quality differential of the Insignia brand relative to the NB in the category (e.g., Samsung, Sony, LG). Moreover, the ex-ante uncertainty regarding product features is between technical features, such as screen resolution/battery life, and toughness, such as shock resistance. In this setting, the NB positioned its product by investing in its technical features. However, realizing that the majority of customers was interested in this product for children and that customers required shock and spill resistance, Best Buy capitalized on its private consumer taste information by introducing an Insignia DVD player with a ruggedized exterior. In other words, the SB Insignia focused on toughness as a product feature, while the NB focused on technical features such as screen resolution, weight, etc.

3.3. Sequence of events

We categorize the relevant decisions made by the retailer and the manufacturer into three stages: (i) information acquisition and sharing, (ii) product positioning, and (iii) pricing. Figure 3 provides an illustration of the detailed order of events, along with the sections in which the relevant analysis is reported.

Figure 3 Detailed sequence of events and the corresponding sections.



In the *information acquisition and sharing stage*, the retailer learns about consumer taste, i.e., a realization of α is revealed only to the retailer. After acquiring the information, he decides whether or not to share this information with the manufacturer. If he shares information, then it is available to the manufacturer immediately. Given that our focus is to investigate the retailer's incentive to share consumer taste information, in line with the related literature (e.g., Guo 2009, Ha and Tong 2008, Özer 2003), we assume that if there is information sharing, then the provided information will be truthful and credible. As in Guo (2009), truthful information sharing in our model is motivated by the long-term channel interaction and can be sustained while developing and maintaining a trustworthy channel relationship. Note that although information acquisition is costless, we report on the value and the impact of the acquired information thorough the comparison of two scenarios: information acquisition and no information acquisition.

The product positioning stage, the second stage, starts with the launch of the NB by the manufacturer. The retailer follows by announcing its SB. Three scenarios are possible at this stage for the manufacturer. In the first scenario, the retailer shares information about consumer taste. Thus, the manufacturer places the NB knowing the exact size of each segment. In the second scenario, the retailer acquires, but does not share, the information. Here, the manufacturer places the NB based on the distribution of demand, knowing that the retailer knows the exact size of each segment. In the third scenario, the retailer does not acquire information. So, the manufacturer places the NB based on the distribution of demand, knowing that the retailer will do the same. In terms of product positioning, the retailer has two available strategies, given the manufacturer's NB. The retailer may choose to co-locate its SB with the NB in the product-feature space and introduce an SB identical to the NB. We label this strategy as *imitate*. Alternatively, the retailer may choose to introduce an SB with unique features by locating it at a different location than the NB. We label this strategy as *differentiate*. We discuss and analyze these two strategies in detail in section 4.2.

The pricing stage, the third stage, is also a sequential game. After the introduction of products, the retailer and the manufacturer can quickly gather information about the specific features that are desired by consumers and the distribution of customers in terms of their tastes. We approximate this fact by allowing the firms to instantaneously capture consumer taste and rapidly adjust prices.[6] This means that, in the pricing stage, both parties are informed about the consumer taste, even if the retailer had not shared or had not acquired the information. Knowing the size of each segment, the manufacturer first announces the wholesale price, w, for the NB. The retailer follows by announcing the price for the NB, p_N, and for the SB, p_S.

Similar to previous studies, we assume that the marginal production costs for NB and SB are equal and negligible (Du et al. 2005, Sayman et al. 2002, Morton and Zettelmeyer 2004, Raju et al. 1995, Vandenbosch and Weinberg 1995). This assumption allows us to focus on the information sharing and product positioning conundrums.

[6] Making price decisions after the uncertainty regarding consumer preferences is resolved is in line with most of the literature involving uncertain taste (e.g., Biyalogorsky and Koenigsberg 2010, Bonein and Turolla 2009, Javier Casado-Izaga 2000). Furthermore, this setup allows us to focus on the impact of information on the product positioning decisions in the context of consumer taste uncertainty.

4. Analysis

We seek subgame perfect equilibrium. Working backwards, our analysis is performed in three sections: the pricing stage, the positioning stage, and the information acquisition and sharing stage.

4.1. Pricing stage

Recall that the pricing decisions in our model are made after the uncertainty about the consumer taste is resolved. In other words, the retailer and the manufacturer have full information about the size of each segment during the pricing stage in addition to the positioning of the two brands. There are three potential locations for each brand. Therefore, we need to consider nine product positioning combinations. In the analysis of the product positioning stage, we consider all the nine combinations in order to find the equilibrium product positioning decisions. However, for the sake of illustration and to generate some insights into the pricing stage, we report on the derivation of demand and profits for four representative scenarios in this section. The remaining cases can be analyzed similarly by swapping the location of the NB and the SB. The details of all the nine cases are available in the appendices. Furthermore, the equilibrium solution of the pricing stage for *all* product positioning strategies is set out in Table 1.

In the first three cases that we report on, the manufacturer introduces a specialized product for segment $\mathcal{A}$, and the retailer has either a specialized product for $\mathcal{A}$, or a generic product (at C), or a specialized product for segment $\mathcal{B}$. In the fourth scenario, the manufacturer and the retailer both introduce a generic product. Let $d_N(p_N,p_S)$ and $d_S(p_N,p_S)$ denote the resulting demands for the NB and SB, respectively.

NB and SB located at point A: In this case, the NB targets segment $\mathcal{A}$, and the retailer imitates with its SB. Thus, the utility achieved by consumers in segment $\mathcal{A}$ is $u_{N\mathcal{A}}(\upsilon)=\upsilon-p_N$ and $u_{S\mathcal{A}}(\upsilon)=\upsilon e-p_S$, and consumers in segment $\mathcal{B}$ achieve no utility from these products. We derive the demand by locating two particular consumers: the marginal consumer, who is indifferent between purchasing NB and SB, i.e., $\{\upsilon|u_{N\mathcal{A}}(\upsilon)=u_{S\mathcal{A}}(\upsilon)\}$, and the marginal consumer who is indifferent between SB and no purchase, i.e., $\{\upsilon|u_{S\mathcal{A}}(\upsilon)=0\}$. Accordingly, the demands for NB and SB are $d_N(p_N,p_S)=\alpha\big(1-\max\big\{\frac{p_N-p_S}{1-e},p_N\big\}\big)$ and $d_S(p_N,p_S)=\alpha\big(\frac{p_N-p_S}{1-e}-\frac{p_S}{e}\big)^+$ $((x)^+=\max\{0,x\})$.

NB located at A and SB located at C: In this case, NB is targeting $\mathcal{A}$, so $u_{N\mathcal{A}}(\upsilon)=\upsilon-p_N$ and $u_{N\mathcal{B}}(\upsilon)=0$. The SB is *partially differentiating* and trying to appeal to both segments, so $u_{S\mathcal{A}}(\upsilon)=u_{S\mathcal{B}}(\upsilon)=\upsilon e-\frac{t}{2}-p_S$. We locate three particular consumers: the marginal consumer in $\mathcal{A}$, who is indifferent between the two products; the marginal consumer in $\mathcal{A}$, who is indifferent between SB and no purchase; and the marginal consumer in $\mathcal{B}$, who is indifferent between SB and no purchase. Accordingly, $d_N(p_N,p_S)=\alpha\big(1-\max\big\{\frac{p_N-p_S-\frac{t}{2}}{1-e},p_N\big\}\big)$ and $d_S(p_N,p_S)=\alpha\big(\frac{p_N-p_S-\frac{t}{2}}{1-e}-\frac{p_S+\frac{t}{2}}{e}\big)^+ +(1-\alpha)\big(1-\frac{p_S+\frac{t}{2}}{e}\big)^+$.

NB located at A and SB located at B: The NB is targeting $\mathcal{A}$, and the SB is following the *maximal differentiation* strategy by targeting $\mathcal{B}$; so $u_{N\mathcal{A}}(\upsilon) = \upsilon - p_N$, $u_{N\mathcal{B}}(\upsilon) = 0$, $u_{S\mathcal{A}} = 0$ and $u_{S\mathcal{B}}(\upsilon) = \upsilon e - p_S$. Demand is driven by locating the marginal consumer in $\mathcal{A}$, who is indifferent between NB and no purchase and the marginal consumer in $\mathcal{B}$, who is indifferent between SB and no purchase. Accordingly, $d_N(p_N, p_S) = \alpha\big(1 - p_N\big)^+$ and $d_S(p_N, p_S) = (1-\alpha)\big(1 - \frac{p_S}{e}\big)^+$.

NB and SB located at the C: The utility of each segment is identical: $u_{N\mathcal{A}}(\upsilon) = u_{N\mathcal{B}}(\upsilon) = \upsilon - \frac{t}{2} - p_N$, and $u_{S\mathcal{A}}(\upsilon) = u_{S\mathcal{B}}(\upsilon) = \upsilon e - \frac{t}{2} - p_S$. Demand is driven by identifying the marginal consumer indifferent between NB and SB, and the marginal consumer indifferent between SB and no purchase. Accordingly, $d_N(p_N, p_S) = 1 - \max\left\{\frac{p_N - p_S}{1-e}, p_N\right\}$, $d_S(p_N, p_S) = \left(\frac{p_N - p_S}{1-e} - \frac{p_S + \frac{t}{2}}{e}\right)^+$.

The manufacturer, as the leader of the sequential game, sets the wholesale price, and the retailer follows her by setting the prices of the two products. The profits for the retailer and the manufacturer, respectively, are then given by,

$$\begin{aligned} \pi_R\big(p_N, p_S|w\big) &= (p_N - w)d_N\big(p_N, p_S\big) + p_S d_S\big(p_N, p_S\big) \\ \pi_M\big(w\big) &= w d_N\big(p_N, p_S\big) \end{aligned} \tag{2}$$

For the sake of expositional clarity and brevity, we bypass the derivation of the equilibrium solution of the pricing stage and summarize the results for all product positioning strategies in Table 1. All the technical details, including the derivation of the equilibrium prices and profits, are provided in the appendices.

Table 1 Equilibrium of the pricing game in stage three.

Position NB	Position SB	w	p_N	p_S	d_N	d_S	Retail Profit $\pi_R(pos_{NB}, pos_{SB})$	Manufacturer Profit $\pi_M(pos_{NB}, pos_{SB})$
A	A	$\frac{1-e}{2}$	$\frac{3-e}{4}$	$\frac{e}{2}$	$\frac{\alpha}{4}$	$\frac{\alpha}{4}$	$\pi_R(A,A) = \frac{\alpha(1+3e)}{16}$	$\pi_M(A,A) = \frac{\alpha(1-e)}{8}$
	C	$\frac{1}{2}$	$\frac{3}{4}$	$\frac{2e-t}{4}$	$\frac{\alpha}{4}$	$\frac{(1-\alpha)(2e-t)}{4e}$	$\pi_R(A,C) = \frac{\alpha}{16} + \frac{(1-\alpha)(2e-t)^2}{16e}$	$\pi_M(A,C) = \frac{\alpha}{8}$
	B	$\frac{1}{2}$	$\frac{3}{4}$	$\frac{e}{2}$	$\frac{\alpha}{4}$	$\frac{1-\alpha}{2}$	$\pi_R(A,B) = \frac{\alpha}{16} + \frac{(1-\alpha)e}{4}$	$\pi_M(A,B) = \frac{\alpha}{8}$
C	A	$\frac{2-t}{4}$	$\frac{3(2-t)}{8}$	$\frac{e}{2}$	$\frac{(1-\alpha)(2-t)}{8}$	$\frac{\alpha}{2}$	$\pi_R(C,A) = \frac{(1-\alpha)(2-t)^2}{64} + \frac{\alpha e}{4}$	$\pi_M(C,A) = \frac{(1-\alpha)(2-t)^2}{32}$
	C $(e \le \frac{2t}{2+t})$	$\frac{2-t}{4}$	$\frac{3(2-t)}{8}$	–	$\frac{2-t}{8}$	–	$\pi_R(C,C) = \frac{(2-t)^2}{64}$	$\pi_M(C,C) = \frac{(2-t)^2}{32}$
	C $(\frac{2t}{2+t} < e)$	$\frac{t(1-e)}{2e}$	$\frac{2e(1-t)+t}{4e}$	–	$\frac{2e-t}{4e}$	–	$\pi_R(C,C) = \frac{(2e-t)^2}{16e^2}$	$\pi_M(C,C) = \frac{t(1-e)(2e-t)}{8e}$
	B	$\frac{2-t}{4}$	$\frac{3(2-t)}{8}$	$\frac{e}{2}$	$\frac{\alpha(2-t)}{8}$	$\frac{1-\alpha}{2}$	$\pi_R(C,B) = \frac{\alpha(2-t)^2}{64} + \frac{(1-\alpha)e}{4}$	$\pi_M(C,B) = \frac{\alpha(2-t)^2}{32}$
B	A	$\frac{1}{2}$	$\frac{3}{4}$	$\frac{e}{2}$	$\frac{1-\alpha}{4}$	$\frac{\alpha}{2}$	$\pi_R(B,A) = \frac{1-\alpha}{16} + \frac{\alpha e}{4}$	$\pi_M(B,A) = \frac{1-\alpha}{8}$
	C	$\frac{1}{2}$	$\frac{3}{4}$	$\frac{2e-t}{4}$	$\frac{1-\alpha}{4}$	$\frac{\alpha(2e-t)}{4e}$	$\pi_R(B,C) = \frac{1-\alpha}{16} + \frac{\alpha(2e-t)^2}{16e}$	$\pi_M(B,C) = \frac{1-\alpha}{8}$
	B	$\frac{1-e}{2}$	$\frac{3-e}{4}$	$\frac{e}{2}$	$\frac{1-\alpha}{4}$	$\frac{1-\alpha}{4}$	$\pi_R(B,B) = \frac{(1-\alpha)(1+3e)}{16}$	$\pi_M(B,B) = \frac{(1-\alpha)(1-e)}{8}$

An important observation, one that will be useful in the remaining stages of the analysis, is the following. If the SB is located close to the NB (i.e., imitation strategy), then, degree of horizontal differentiation between the two brands is low, and this intensifies the price competition between them. The result is lower retail prices for the NB and the SB. Moreover, it reduces the degree of double marginalization, i.e., reduces the wholesale price and, therefore, hurts the manufacturer. However, the retailer is able to capture a higher margin and achieves higher profits from the NB sales, as expected. Conversely, if the SB is located far from the NB (i.e., differentiation strategy), then this leads to an increase in the wholesale price, and the retail price of the NB and, therefore, benefits the manufacturer, while hurting the retailer. In either case, the net result on the profitability of the SB depends on the size of each consumer segment.

4.2. Product positioning stage

In this section, we identify the equilibrium product positioning decisions with respect to the sequential game when both the retailer and the manufacturer are informed about consumer tastes. This preliminary analysis constitutes the backbone of our analysis in the following sections and also allows us to identify the economic incentives shaping the retailer's and manufacturer's product positioning.

4.2.1. Retailer's SB strategy Given the NB location, the retailer chooses the best of three options, i.e., target one of the segments (A or B) with a specialized product or target both with a generic product, while considering its implications on the wholesale price for the NB, retail prices for both brands, and the profits.

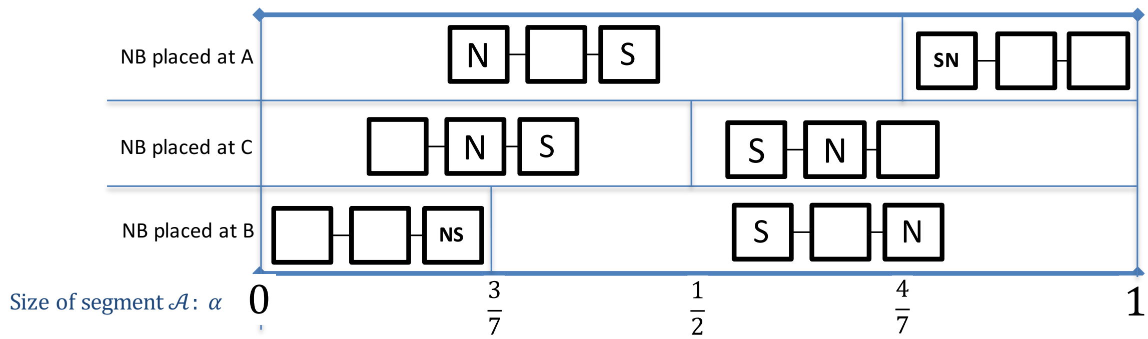
PROPOSITION 1. *The following are true for the retailer (given the position of the NB) if he has acquired taste information:*

- *If the NB is a specialized product, then the retailer imitates the NB when the size of the segment targeted by the NB is sufficiently large* (ii) *and differentiates otherwise.*
  - *If NB is located at A, then the retailer locates SB at B for $\alpha < \frac{4}{7}$ and at A for $\frac{4}{7} \leq \alpha$.*
  - *If NB is located at B, then the retailer locates SB at A for $1-\alpha < \frac{4}{7}$ and at B for $\frac{4}{7} \leq 1-\alpha$.*
- *If the NB is a generic product, then the retailer introduces an SB with the more preferred feature.*
  - *If NB is located at C, then the retailer locates SB at B for $\alpha < \frac{1}{2}$ and at A for $\frac{1}{2} \leq \alpha$.*

Figure 4 provides an illustration of the SB positioning by the retailer.

Let us first consider the case of a specialized NB. Suppose that the manufacturer targets segment $\mathcal{A}$ using a specialized product at A. If the size of segment $\mathcal{A}$ is sufficiently large, i.e., if $\alpha \geq \frac{4}{7}$, then the retailer *imitates* NB by introducing an SB with identical features. On the other hand, if the consumer segment targeted by the manufacturer is relatively small, i.e., if $\alpha < \frac{4}{7}$, then the retailer *differentiates* SB by targeting the other segment. There are two main effects taken into account

Figure 4 **SB positioning given the consumer taste information and NB position.**



by the retailer while positioning the SB: *margin effect* and *demand effect*. The margin effect refers to the fact that if the retailer imitates NB with SB, then he can effectively reduce the degree of double marginalization in the channel. The reason is that the manufacturer will have to reduce the wholesale price for the NB in the presence of an SB that is targeting the same consumer segment. *Thus, the margin effect always motivates the retailer to imitate the NB*. The demand effect refers to the SB demand. If the retailer differentiates the SB, locating at B, then he will face no competition for consumer segment $\mathcal{B}$. However, if the retailer imitates the NB, then the SB demand may suffer due to the perceived inferior quality of the SB. The net effect may be a decrease or an increase in the SB demand. In particular, if the size of the segment $\mathcal{A}$ is sufficiently large (i.e., $\alpha \geq \frac{2}{3}$), then the SB demand will be higher at A. This would motivate the retailer to imitate the NB. However, if the size of segment $\mathcal{A}$ is relatively low (i.e., $\alpha < \frac{2}{3}$), then the SB demand will be higher at B, and this would motivate the retailer to differentiate. When the two effects are combined, we observe that the demand effect dominates if the size of the consumer segment targeted by the NB is less than $\frac{4}{7}$, and the margin effect dominates otherwise.

In the case of a generic NB located at C, the retailer targets the larger consumer segment with its SB. The motivation for the retailer to introduce a specialized product is to capitalize on the market size and also decrease the degree of price competition between the NB and the SB. If, instead, the retailer also introduced a generic product, then there would be no horizontal differentiation between the two products, and this would intensify the degree of price competition. Introducing a specialized product eliminates the price competition between the two brands since the NB is sold to the smaller consumer segment only.

4.2.2. Equilibrium product positioning when both parties are informed: When the retailer shares information, there is a unique equilibrium in terms of positioning and pricing decisions. However, the closed form structure of equilibrium decisions depends on the SB equity (e) and the size of the consumer segments. In order to illustrate the equilibrium structure in an intuitive way, we define the *degree of market preference* as the size difference between the large and the small consumer segments, and denote as $\Delta \equiv |\alpha - (1-\alpha)|$. Note that $\Delta \in [0,1]$ does not represent a preference for a particular feature, but rather the degree of asymmetry between the sizes of the two segments. That is, a low Δ means a *weak-preference market* in that customers do not have a significant preference between the two product features, i.e., the two are more or less equally popular. For instance, $\Delta = 0$ means a no-preference market, i.e., neither of the features is more popular than the other. A high Δ means a *strong-preference market* in that the majority of consumers prefer one particular product feature; $\Delta = 1$ means *absolute preference* in that all consumers prefer the same product feature. Looking at the size difference between the two segments instead of the absolute sizes of the two segments does not impose any restrictions on our analysis because the equilibrium solutions are symmetric about the line $\alpha = \frac{1}{2}$, i.e., when both segments are equal in size.

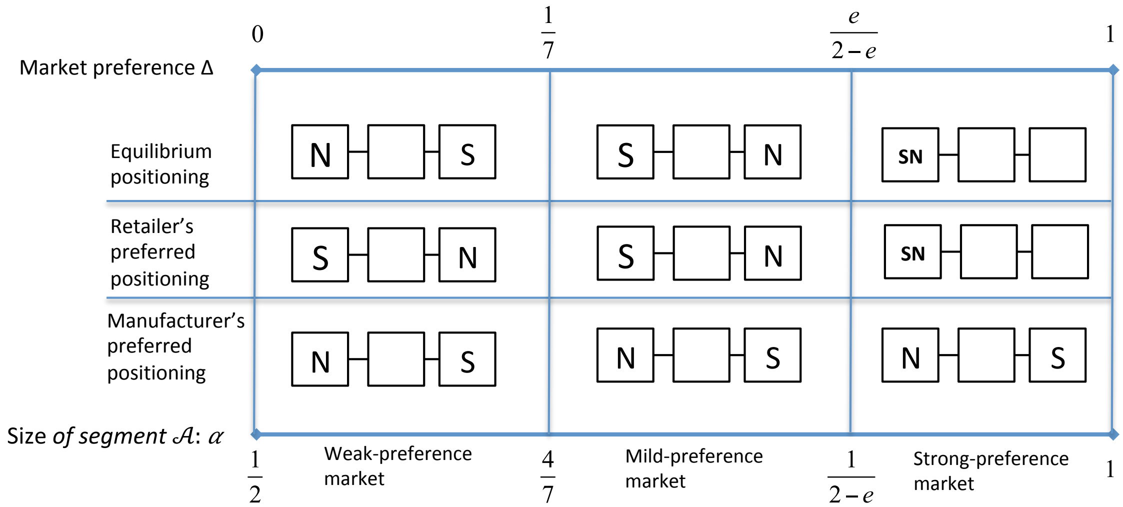
PROPOSITION 2. *Suppose that the retailer shares consumers' taste information with the manufacturer. The following are true regarding the product positioning stage:*

1. *In a strong-preference market, the unique equilibrium exhibits minimal-differentiation, in which both the NB and the SB include the more popular feature in their designs.*
2. *In a mild-preference market, the unique equilibrium exhibits maximal-differentiation, with a dominant SB, i.e., the SB and NB integrate the more and less popular features, respectively.*
3. *In a weak-preference market, the unique equilibrium exhibits maximal-differentiation, with a dominant NB, i.e., the NB and SB integrate the more and less popular features, respectively.*

The degree of market preference allows a simple presentation of the resulting equilibrium. In Figure 5, we provide a detailed description of the equilibrium for the illustrative case of $\frac{1}{2} \le \alpha$, i.e., $\mathcal{A}$ is the larger segment. If segment $\mathcal{A}$ is sufficiently larger than segment $\mathcal{B}$ ($\frac{1}{2-e} \le \alpha$ which gives $\frac{e}{2-e} \le \Delta$), then both NB and SB will be located at point A. If segment $\mathcal{A}$ is slightly larger ($\frac{4}{7} \le \alpha < \frac{1}{2-e}$ which gives $\frac{1}{7} \le \Delta < \frac{e}{2-e}$), then SB will target segment $\mathcal{A}$, and the manufacturer will differentiate by targeting segment $\mathcal{B}$. If segment $\mathcal{A}$ is slightly larger ($\frac{1}{2} \le \alpha \le \frac{4}{7}$, which gives $0 \le \Delta < \frac{1}{7}$), then SB will target segment $\mathcal{B}$, and the manufacturer will again differentiate by targeting segment $\mathcal{A}$. The positioning decisions are the mirror images of these for $0 \le \alpha \le \frac{1}{2}$.

Figure 5 also provides the positioning of the products for the cases where the decisions for both products were made by the retailer or by the manufacturer. We see that the ideal scenario for the manufacturer is that the NB targets the larger segment, and the SB targets the smaller segment. In other words, the manufacturer would differentiate the two products and target the larger segment with the NB. This would allow the manufacturer to avoid competition from the SB, while reaching a larger consumer segment. The ideal scenario for the retailer is similar in the sense that the SB targets the larger segment. However, the retailer's preference with respect to the NB depends on the

Figure 5 **NB and SB positioning with consumer taste information when segment $\mathcal{A}$ is larger, i.e., $\frac{1}{2} \leq \alpha$.**



degree of market preference and the SB equity. In particular, the retailer would also differentiate the two products and target the larger segment with the SB unless there was a strong-preference market. This strategy would allow the retailer to avoid competition. However, when there is a sufficiently strong-preference market, the retailer prefers to target the larger segment with both products. The reason is that the competition between the NB and the SB does not hurt the retailer as much as it hurts the manufacturer; as a result, the retailer wants to take advantage of the high segment size in A with both products.

Nonetheless, in our sequential game setting, the manufacturer places the NB as the leader, and then the retailer places the SB as the follower. The interactive mechanism in this game-theoretic setting leads to the following results.

When there is a strong-preference market, the retailer will target the larger segment regardless of the position of the NB. Knowing this, the manufacturer makes a choice between the following two options. If the manufacturer also targets the larger segment, then there will be minimal-differentiation, and if the manufacturer targets the smaller segment, then there will be maximal-differentiation. The *demand effect* motivates the manufacturer to place the NB with the larger segment, and the *margin* effect motivates maximal-differentiation in order to increase profits by setting a higher wholesale price. The strong market preference means that the demand effect dominates, and we observe minimal-differentiation, whereby both parties introduce a specialized product with the popular feature.

If there is a mild-preference market, the retailer will still target the larger segment, regardless of the position of the NB. Knowing this, the manufacturer again has to make a decision. However, the mild market preference means that the margin effect dominates, and we observe maximal-differentiation with a dominant SB, i.e., the SB appeals to the larger segment, while the NB targets the smaller segment. In other words, the manufacturer proactively differentiates her product with the features that appeal to the smaller consumer segment. Note that our model setting differs from the extant literature (Du et al. 2005, Morton and Zettelmeyer 2004) in that we allow both the retailer and the manufacturer to position their products in a game-theoretic setting as opposed to having exogenously positioned NBs. As a result, we identify conditions under which the manufacturer is willing to deliberately target the smaller consumer segment and leave the larger consumer segment to the SB, in order to maximize profitability rather than maximizing her market share. The main motivation for the manufacturer is to reduce the degree of competition between the NB and the SB so that she can achieve a higher margin. Note that the manufacturer's ideal positioning would be the reverse in that the NB targets the larger segment, and the SB targets the smaller segment. However, the manufacturer cannot control the SB and would rather avoid targeting the same segment with the SB.

If there is a weak-preference market, then the demand effect again dominates for the retailer, and the retailer again prefers *maximal-differentiation*, but the product positioning is exactly the opposite of the mild-preference market. Specifically, the margin effect for the retailer is weak, and therefore, the retailer avoids co-locating with the NB. Knowing this, the manufacturer takes advantage of being the leader in the product positioning game and targets the larger segment (and thus the retailer wins the smaller segment).

4.3. Information acquisition and sharing stage

We first determine the equilibrium in the signaling game between the retailer and the manufacturer when the retailer acquires consumer taste information. Next, we identify the equilibrium in the absence of information acquisition.

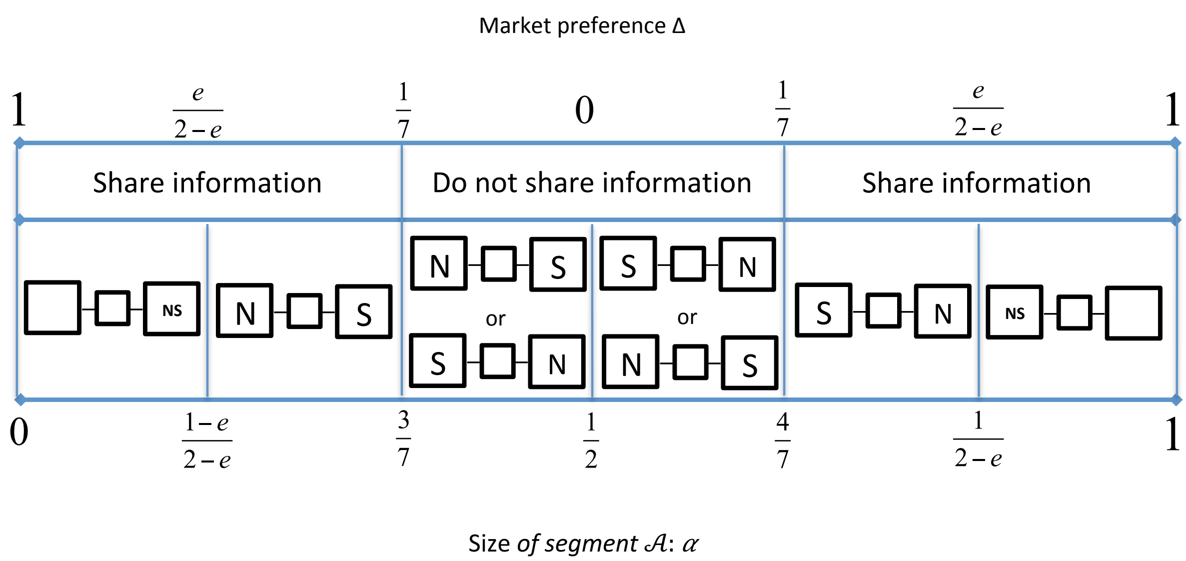
4.3.1. Equilibrium when retailer acquires information: We seek for the perfect Bayesian equilibrium to the signaling game between the retailer and the manufacturer. Note that the only signal received by the manufacturer from the retailer is that the retailer shares the realization of α with the manufacturer or not. If the retailer shares information, we assume that it is truthful information. However, if the retailer does not share information, then the manufacturer will update her beliefs regarding the distribution of α according to Bayes' rule and make the NB positioning decision accordingly.

In our modeling framework, the size of each consumer segment is random and follows a symmetric distribution. Therefore, for any realization $\alpha = a$, there exists another unique realization, namely, $\alpha = 1 - a$ leads to mirror-image positioning decisions, identical pricing decisions, and identical profits for the retailer and the manufacturer. This means that if the retailer is willing to share the size of the consumer segments with the manufacturer for a particular realization $\alpha = a$, then he is willing to share information for $\alpha = 1 - a$ as well. The reverse is also true: if the retailer is not willing to share information with the manufacturer for a particular realization, then he is not willing to share information for the mirror image of that realization neither. Consequently, if the retailer does not share information with the manufacturer, the manufacturer is not able to differentiate between the two realizations and cannot deduce the exact size of each consumer market. However, the manufacturer is still able to deduce the degree of the market preference, $\Delta = |2a - 1|$. Therefore, given the signal from the retailer, the manufacturer updates her belief about the degree of market preference and positions the NB accordingly.

PROPOSITION 3. *There exists a separating perfect Bayesian equilibrium in the information signaling game between the retailer and the manufacturer: in a weak-preference market, i.e., when* $\Delta \in [0, \frac{1}{7}]$, *the retailer does not share information with the manufacturer. Otherwise, the retailer voluntarily shares taste information with the manufacturer.*

The resulting equilibrium structure in summarized in Figure 6.

Figure 6 Equilibrium solution when the retailer acquires information.



If there is a weak preference for a particular feature ($\Delta \le \frac{1}{7}$), then there is no benefit of information sharing for the retailer. If the retailer shared information, then the manufacturer would take the lead and target the larger segment with the NB, resulting in maximal-differentiation with a dominant NB. However, the retailer does not share information, and, thus, there is still a possibility that the NB introduced by the manufacturer ends up being located in the smaller segment, meaning that the SB will capture the larger consumer segment. Taking this chance turns out to be more profitable for the retailer.

If there is a mild-preference market ($\frac{1}{7} \leq \Delta \leq \frac{e}{2-e}$), then the retailer should share information. By sharing information, the retailer shows to the manufacturer that one particular feature is popular amongst consumers, and that he will integrate this feature into the SB. The manufacturer, after learning the consumers' taste and understanding that the retailer will integrate the popular feature into his SB design, differentiates her NB in order to reduce the price competition between the two brands.

If there is a strong-preference market, then the retailer should again share information with the manufacturer. Similar to the previous scenario, by sharing information, the retailer communicates to the manufacturer which feature is popular, how popular it is, and that he will integrate this feature into his SB design. Seeing the very large number of customers interested in a particular feature, the manufacturer also integrates this feature into her NB design. The retailer settles on a minimal-differentiation scenario by sharing information instead of a possible maximal-differentiation with the dominant SB scenario, which could be realized if the information was withheld. In other words, *the retailer shares information even in scenarios in which he intensifies the degree of price competition*. By doing so, the retailer is hurt in terms of the profitability of the SB due to the intensified competition between the NB and the SB. However, the increase in the profitability of the NB, because of the significant competition effect and lower wholesale price, more than compensates the loss in the profitability of the SB.

4.3.2. Equilibrium when retailer does not acquire information: If the retailer does not acquire taste information, then the manufacturer and the retailer place their products without knowing the exact size of the consumer segments (i.e., they both know only the distribution of α).

PROPOSITION 4. *If the retailer does not acquire consumer taste information, then the equilibrium exhibits maximal-differentiation, in which the manufacturer introduces a specialized NB with either one of the features, and the retailer introduces a specialized SB with the opposite feature.*

Note that in the absence of any information, if the manufacturer introduces a generic NB, then the retailer will introduce a specialized product. In addition, the manufacturer is ex-ante indifferent between the two specialized alternatives for the retailer. If the manufacturer introduces a specialized product, then the retailer will introduce a specialized SB at the opposite end. Realizing that the retailer always responds with a differentiated specialized product, the manufacturer sees no value in introducing a generic product. Thus, in the absence of taste information, the manufacturer introduces a specialized NB with either one of the features, and the retailer introduces a specialized SB with the other feature.

5. Impact and Value of Information Acquisition

In this section, we report on the ex-ante value of information acquisition. We do not consider information acquisition as a decision variable; however, using the comparison of the retailer's equilibrium profit with and without information, we extract the value of information acquisition as well as its impact on decisions. We first discuss how positioning decisions are shaped by the retailer's information acquisition. To that end, we identify two fundamental effects: the direct effect and the indirect effect.

The *direct effect* of information acquisition is that the retailer can position the SB better by being informed about consumer taste. The direct effect ensures that the retailer introduces an SB with the popular feature and targets the larger consumer segment, as opposed to taking chances by introducing an SB without taste information. In general, as expected, the direct effect benefits the retailer and is likely to hurt the manufacturer.

The *indirect effect* of information acquisition is that if the retailer shares information, then the manufacturer makes better NB positioning decisions. The indirect effect may benefit or hurt the retailer since the product positioning decision of an informed manufacturer may decrease or increase retail profits. For instance, for mild and strong market preference cases, the indirect effect is positive since the NB positioning decision of the manufacturer is aligned with the interests of the retailer. When there is a weak market preference, on the other hand, the indirect effect is negative for the retailer since an informed manufacturer takes the lead and integrates the popular feature into the NB design, when the retailer actually wants that position for his SB only.

These effects are similar to the *efficiency* effect and the *strategic* effect in Guo (2009). Guo (2009) looks at the impact of demand uncertainty on the pricing decisions of the manufacturer and the retailer for an NB product (there is no SB). As such, the efficiency and the strategic effects are materialized in pricing decisions. In our setting, however, the direct and indirect effects manifest themselves through product positioning. Moreover, we identify new interactions between these effects that have not yet been observed in the extant literature. Specifically, we do not observe the direct effect when there is weak market preference. For mild and strong market preference cases, the indirect effect not only benefits the retailer but also increases the value of the direct effect; as a result, the retailer voluntarily shares information with the manufacturer.

Proposition 5. *Acquisition of consumer taste information by the retailer hurts the manufacturer and benefits the retailer.*

This proposition suggests that information acquisition by the retailer does not necessarily benefit the manufacturer, even if the retailer is sharing consumer taste information voluntarily. This is because the direct effect of the retailer's information acquisition is detrimental to the manufacturer. In particular, without information acquisition, firms position their products so that there is maximal-differentiation in the market, which reduces the degree of price competition between the two brands. The two brands share the same risk in terms of integrating the popular feature into their products.

However, when the retailer acquires and shares consumer taste information, there are situations in which we observe minimal-differentiation. This happens when a particular product feature is extremely popular in the market. The retailer voluntarily shares information with the manufacturer, and both brands integrate the popular feature into their product design. The margin effect in this case hurts the manufacturer and benefits the retailer. There are also cases in which the manufacturer integrates the less popular feature (as a result of information sharing) in order to proactively eliminate the margin effect. Consequently, the manufacturer may benefit from information sharing in some ex-post scenario (by staying away from the SB); however, the ex-ante value of information acquisition is negative for the manufacturer. The proposition also shows that, in contrast to the extant literature on strategic information sharing by the retailer, the retailer benefits from acquiring and disclosing information regarding taste. For instance, Guo (2009) shows that the retailer can be hurt by disclosing information to the manufacturer since it may lead to a higher wholesale price. Unlike our model, the wholesale price decision in that model is made before the uncertainty in demand is resolved. In other words, we show in this paper that when demand uncertainty is disconnected from the pricing decisions and concentrated in the positioning decisions, the retailer benefits from information acquisition as it leads to better NB and SB positioning decisions from the retailer's perspective.

Going back to the Blue Label brand we discussed in the introduction section, our model illustrates that one reason for Best Buy to share information with the manufacturer is the significant concentration of consumers in a specific segment, namely, the "school shoppers." The disclosure of consumer taste information allows the manufacturer to target the same segment, and this increases the intensity of price competition between the NB and the SB products. As such, the benefits for the retailer are two fold: target a large market with two products, NB and SB, and pressure the retailer for a lower wholesale price through its SB. Note that there may be many other examples of information sharing by the retailer that can not necessarily be observed except by insiders. It is, rather, possible to observe the admirable performance of SBs in providing the desired features to consumers. Fisher et al. (2017) describe Home Depot‘s process for SB products: "The retailer first identifies market-brand items that are performing poorly and examines customer complaint data to see how the products could be improved. It then develops private-label products - for example, Hampton Bay ceiling fans, Husky tools, and Glacier Bay toilets - and continually refines them to improve quality and lower costs." Indeed, loyalty programs, by providing detailed consumer insights, is playing an increasingly important role in retailers' decisions and reshaping the way manufacturer, and retailers interact with each other (Ailawadi et al. 2010). Our model provides an insight into this interaction by identifying the incentives for information sharing.

6. Further Analysis

In this section, we discuss two relevant extensions of our model framework: (1) what happens if the retailer faces a cost of SB introduction and (2) how the results are affected if the retailer and the manufacturer are able to place their brands at any point in the product-feature space - as opposed to the three discrete points.

6.1. The cost of store brand introduction

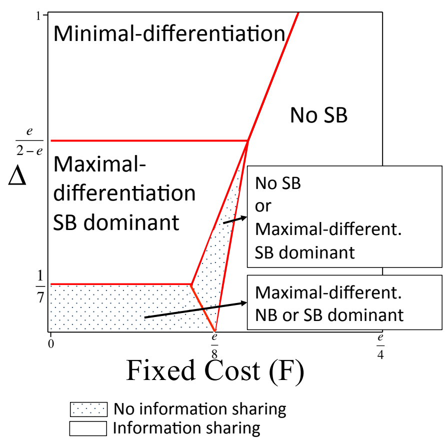
The cost of introducing and maintaining an SB can be significant for small retailers as large retailers are better positioned to build scale economies than smaller chains (Dhar and Hoch 1997). In order to factor in this variation, we extend our model framework so that the retailer incurs a fixed cost F as soon as he decides to introduce an SB. It is established in the literature that fixed costs play a major part in determining the number of distinct products offered to customers (Groznik and Heese 2010a,b, Chen et al. 2009, Horowitz 2000, Soberman and Parker 2004). This fixed cost is associated with the research and development, design, patenting, product introduction, marketing, promotion, advertising, supplier selection, warehousing, and distribution costs that are incurred prior to, and always independent of, the volume of output and sales. One direct consequence of this fixed cost is that the retailer may not find it profitable to introduce an SB in some states of the world, for instance, depending on the degree of market preference. In the following, we report on the impact of the fixed cost on the equilibrium and the value of information acquisition by the retailer.

Proposition 6. *The retailer's equilibrium information sharing strategy in the presence of a fixed SB introduction cost is as follows:*

- *If the degree of market preference is such that* $\max\{0, \frac{16F-2e}{2e-1}\} \leq \Delta \leq \max\{\frac{1}{7}, \frac{32F}{3e} - 1\}$, *then the retailer does not share information with the manufacturer.*
- *Otherwise, the retailer voluntarily shares taste information with the manufacturer.*

The resulting equilibrium structure in summarized in Figure 7. In particular, there are two cases where the retailer chooses not to share information with the manufacturer. The first case is when there is relatively weak-market preference (i.e., $\Delta \leq \min\{\frac{1}{7}, 1 - \frac{8F}{e}\}$). In this setting, if the retailer shares information, then the manufacturer will take the lead and target the larger segment with the NB, resulting in maximal-differentiation with a dominant NB. However, if the retailer does not share information, then there is still a possibility that the NB introduced by the manufacturer will end up being located in the smaller segment, meaning that the SB will capture the larger consumer segment. Taking this chance turns out to be more profitable for the retailer. In the second case (i.e., $\max\{1-\frac{8F}{e}, \frac{16F-2e}{2e-1}\} \leq \Delta \leq \frac{32F}{3e}-1$), if the retailer shares information, then the NB targets the larger consumer segment, and the retailer cannot afford to introduce an SB. Therefore, by leaving the manufacturer uninformed, the retailer hopes that the manufacturer will locate the NB in the smaller segment, so that the retailer can afford to introduce an SB that appeals to the larger consumer segment. In the remaining cases, the retailer voluntarily shares taste information with the manufacturer.

Figure 7 **Equilibrium when retailer acquires information in the presence of fixed SB introduction cost.**



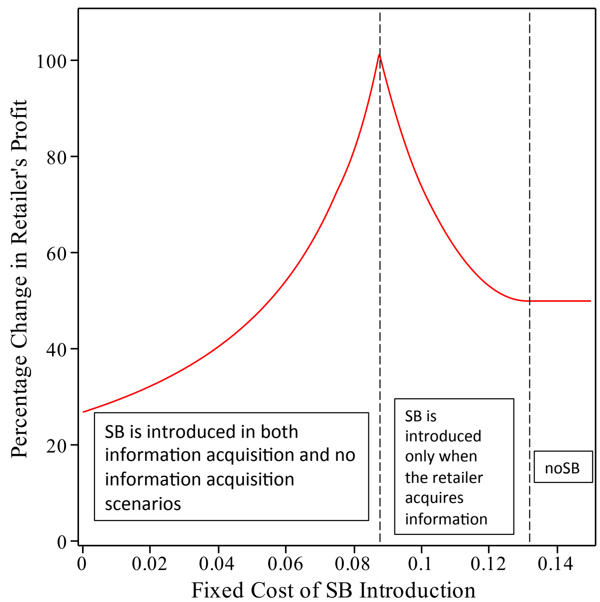
Condition	Information shared?	Equilibrium
$\Delta \leq \min\{\frac{1}{7}, 1-\frac{8F}{e}\}$	No	Max-diff. NB dominant
		Max-diff. SB dominant
$\max\{1-\frac{8F}{e}, \frac{16F-2e}{2e-1}\} \leq \Delta \leq \frac{32F}{3e}-1$	No	No SB
		Max-diff SB. dominant
$\max\{\frac{1}{7}, \frac{32F}{3e}-1\} \leq \Delta \leq \frac{e}{2-e}$	Yes	Max-diff. SB dominant
$\max\{\frac{e}{2-e}, \frac{32F}{3e}-1\} \leq \Delta$	Yes	Min-diff.
$\Delta \leq \min\{\frac{16F-2e}{2e-1}, \frac{32F}{3e}-1\}$	Yes	No SB

Proposition 7. *Information acquisition is still beneficial for the retailer in the presence of a fixed SB introduction cost. From the manufacturer's perspective, the retailer's information acquisition can be profitable if the fixed SB introduction cost is sufficiently high.*

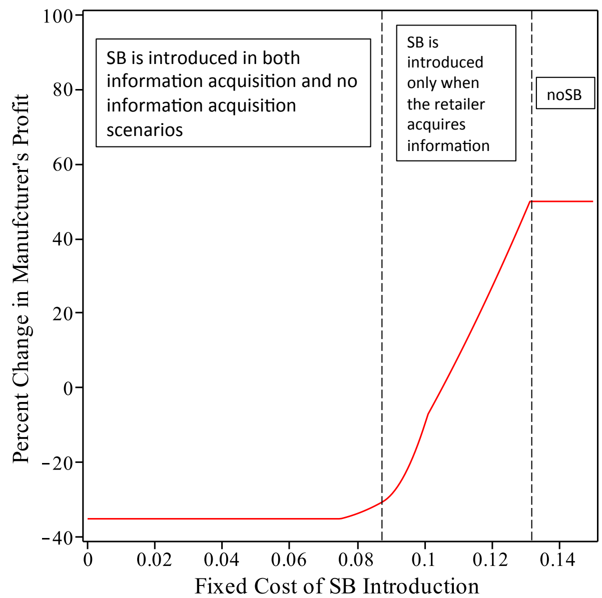
Figure 8 illustrates the value of information with respect to the fixed cost of SB introduction. There are three regions of interest in these figures. In the first region, for low values of the fixed cost, the retailer introduces the SB with or without information acquisition. In the third region, for large values of the fixed cost, the retailer does not introduce the SB with or without information acquisition. For the range in the middle, the retailer does not introduce an SB in the absence of information - since the expected benefits of the SB introduction do not justify the fixed cost. In this region, taste information may allow the retailer to introduce an SB.

In the middle region, the value of information for the manufacturer is monotone increasing with respect to the fixed cost. Looking at the extreme cases is sufficient to see the intuition behind this result; if the retailer does not introduce an SB due to the high fixed cost, in some or all states

Figure 8 The value of information acquisition. SB equity is assumed to be $e = 0.7$ in this illustration.



(a) Retailer



(b) Manufacturer

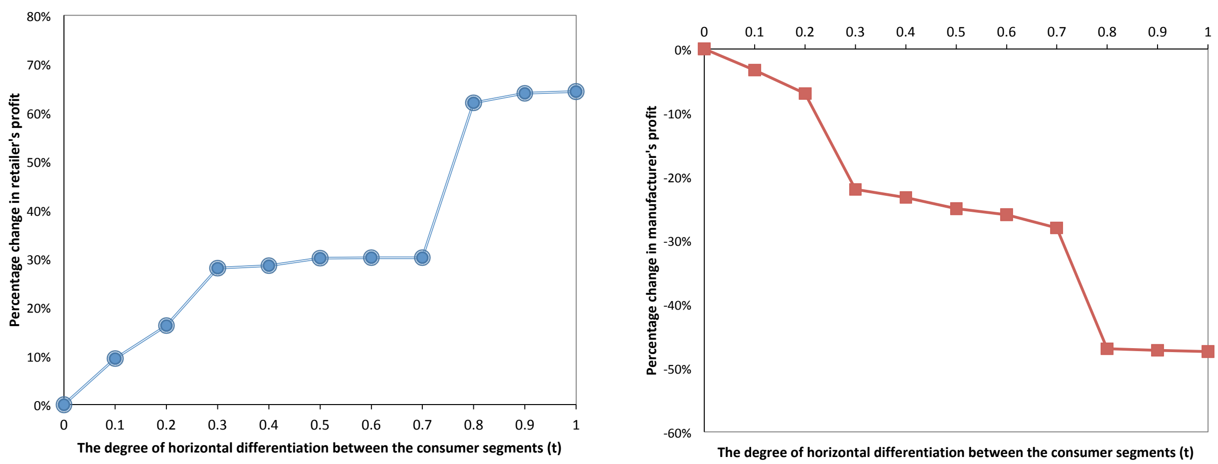
of uncertain consumers' taste, then the manufacturer need not provide a competitive wholesale price in the channel. In addition, the information shared by the retailer allows the manufacturer to introduce the NB with the "right innovation" features. Thus, not only the retailer but also the manufacturer benefits from the retailer's information acquisition. In this range, a higher fixed cost reduces the benefits of information acquisition for the retailer. However, if the fixed cost is sufficiently low that the retailer always introduces an SB, then information acquisition hurts the manufacturer and benefits the retailer, for the reasons we previously discussed in section 5. From a managerial perspective, this highlights the fact that the value of information acquisition is not necessarily higher when there is no fixed cost or for a stronger SB. In fact, gathering information regarding consumer taste is likely to be more valuable when the retailer faces difficulty in justifying the SB introduction - either due to high costs or due to lower equity.

6.2. The degree of horizontal differentiation and the product positioning space

In our analysis, we assumed that the degree of horizontal differentiation between the two consumer segments was sufficiently high that a product specializing in one consumer segment could not attract consumers from the other segment, even if it was priced at the marginal cost. Furthermore, we restricted the product-feature space to three discrete points. In this section, we check the robustness of our results with respect to these assumptions using a numerical setup. Specifically, we allow the brands to be positioned in the following points: $\{0.1, 0., 0.3, ..., 1\}$. We replicate our analysis by varying the degree of vertical differentiation through the equity of the SB, $e \in \{0.1, 0.2, 0.3, ..., 1\}$, and also the degree of horizontal differentiation through the parameter $t \in \{0.1, 0.2, 0.3, ..., 1\}$.

We find that neither the degree of horizontal differentiation between the two consumer segments nor the restriction of possible product positioning decisions (to the edges and to the center) pose any restrictions on our main findings: (1) the retailer benefits from acquiring consumer taste information, and (2) the manufacturer is hurt when retailer acquires information unless the fixed cost of SB introduction is high. Figure 9 illustrates the value of information for the retailer and the manufacturer with respect to the degree of horizontal differentiation.

Figure 9 **The value of information acquisition. SB equity is assumed to be $e = 0.7$ in this illustration.**



(a) Retailer (b) Manufacturer

Note that if the degree of horizontal differentiation is low, then the two consumer segments are closer to each other, and a product can appeal to both segments regardless of its location as long as its price is sufficiently low. At the extreme, if there is no horizontal differentiation (i.e., no taste difference), then brands can do no wrong in positioning their products. Both place at the same point as the consumer, and there is no value in acquiring the taste information. However, if the degree of horizontal differentiation is high, then the two segments are further from each other, and the price of a product needs to be cut significantly to appeal to both segments. Therefore, product positioning decisions are much more important when the degree of horizontal differentiation is high. As such, acquiring consumer taste information is much more valuable when the degree of horizontal differentiation is high. In that sense, our numerical investigation confirms that our analytical model assumption for a high degree of differentiation brings attention to the value of taste information, and important role of product positioning.

7. Concluding Discussion

Retailers' proximity to consumers gives them a great opportunity to learn about consumer preference - and identify product features that are valued highly. In this paper, we investigate the impact of retailers acquiring of consumer taste in the context of NB and SB competition. Embedded in this, we identify the optimal information sharing strategy for the retailer and the resulting product positioning strategies for the NB and SB in a dyadic supply chain framework.

Our analysis shows that the expected value of costless information acquisition regarding consumer taste is always positive for the retailer. Information acquisition reduces the uncertainty about taste and allows the retailer to make better product introduction and positioning decisions. However, the impact of the retailer's information acquisition on the manufacturer is not straightforward. In fact, we show that the manufacturer benefits from the retailer's information acquisition only when the cost of SB introduction is high for the retailer.

Our findings show that disclosure of the acquired taste information by the retailer changes the NB positioning of the manufacturer. Moreover, depending on the relative popularity of different features and the cost of SB introduction, information sharing can be beneficial or detrimental for the retailer.

- If different product features are about equally popular among customers, then retail managers should not share taste information with the manufacturer. Moreover, unfortunately, there is no value in the acquired information for the retailer.
- If a product feature is slightly more popular among customers compared to the other, retail managers should still avoid information sharing. However, the retailer can capitalize on the information acquired by making better SB introduction decisions.
- If a product feature is very popular among customers, retail managers should capitalize on this opportunity by introducing an SB with the popular feature. *Furthermore, they should be eager to share the acquired information.* Information sharing, through the better-positioned NB, increases the value of the acquired information for the retailer, even though it intensifies the price competition between the NB and the SB.
- If it is very costly, then it is likely that the retailer will not introduce an SB. However, the retailer should still share information with the manufacturer; it leads to a better NB in terms of fit, which benefits both parties. In fact, there is no value in the acquired information for the retailer unless shared with the manufacturer.

In our analysis, we make some simplifying assumptions. For instance, in order to keep the analysis tractable, we do not consider the role of NB competition. Obviously, modeling NB competition (as well as retail competition) would provide new insights. However, it would also complicate the product positioning decisions. Indeed, to the best of our knowledge, papers in the extant literature incorporate NB competition at the expense of product positioning decisions - which is an important aspect of our research.

In closing, this study is a first attempt to examine the implications of information acquisition regarding consumer taste in the context of NB and SB positioning. We show to what extent, and why, retailers are likely to benefit from such information. We also identify the conditions that motivate the retailer to share taste information with the manufacturer as well as the conditions that motivate withholding such information from the manufacturer.

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