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Price promotions as a threat to brands

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Abstract

Manufacturers frequently resist heavy discounting of their products by retailers. Since low prices should increase demand and manufacturers could simply refuse to fund deep price promotions, such resistance is puzzling at first sight. We develop a model in which price promotions cause shoppers to evaluate the relative importance of quality and price against a market-wide reference point. With deep discounting, consumers perceive quality differences as less pronounced, eroding brand value and the bargaining position of brand manufacturers. This reduces their profits and may even lead to a delisting of their products. By linking price promotions to increased one-stop shopping and more intense retail competition, our theory also offers an explanation for the rise of store brands.

1 | INTRODUCTION

“We take loss leading of our brands very seriously.” This exemplary statement was delivered by a spokesperson of Foster’s, who justified the company’s blitz action to withdraw key stock from two Australian supermarket chains after learning of their promotion to sell Foster’s beer brands below cost.¹ Staying with the country of the initial quote, also leading brand manufacturers of bread and milk reported trading losses and the need to cut cost, naming discounted prices at competing retailers as the primary reasons.² Turning to another country, in a well-known case in 2014, Lidl, one of the largest German discounters, stopped selling Coca-Cola, with both sides citing different views about the product’s store price as reason. This was preceded by heavy discounting of Coca-Cola at the discounter.³ In light of Germany’s notoriously competitive food retailing environment, manufacturers frequently express concerns about the impact of price wars on their brand value and profits.⁴

The above examples echo brand manufacturers’ general fears of losing profits and brand equity when retailers heavily discount their products. However, given that price discounts should drive demand for manufacturers’ products and that, at first glance, there is no reason why manufacturers would need to fund such deep price promotions, manufacturers’ resistance may come as a surprise.

To shed light on this phenomenon, we set up an analytically tractable model of multiproduct retail competition incorporating manufacturer–retailer negotiations, retailers’ product-stocking decisions, consumer one-stop shopping, and retail-price promotions. Precisely, our model combines the following four key elements. First, to capture retail competition with frequent price promotions, we employ a “model of sales,” as in Varian (1980) or Narasimhan (1988). Second, due to limitations either in consumer attention or advertising space, such promotions take place only in one product category, following Lal and Matutes (1994).⁵ We can thus compare implications for this promoted category and other categories. Third, as we are interested in the distribution of profits between retailers and manufacturers, we model the manufacturer–retailer channel via vertical contracting. Fourth, next to a benchmark model where

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consumers exhibit standard (rational) preferences, we build on recent advancements in behavioral economics and employ a model of consumer reference-dependent (relative) preferences.

Our main results are as follows. First, when consumers exhibit standard preferences, we show that brand manufacturers' fears are indeed unfounded in our model. As retailers' lower prices expand demand, manufacturers would even tend to benefit when their products are used for promotions, rather than being adversely affected by the retailers' margin loss. Thus, from the viewpoint of classical economics, our model does not support the claims of brand manufacturers that heavy retailer discounting erodes the value of their brands.

In contrast, our model can explain manufacturers' resistance to deep discounts when consumers, faced with frequent price promotions, do not have "fixed" preferences, but form their relative preferences for price and quality with respect to a market-wide reference point. Specifically, our consumer choice criterion of "relative thinking" builds on the concept of "salient thinking" introduced in Bordalo et al. (2013), as subsequently adapted to imperfect retailing competition in Inderst and Obradovits (2020).⁶

A key property of the applied consumer choice rule is that as the price level in the promoted category decreases, the same quality difference becomes less important in the eyes of shoppers who compare offers across retailers. Retailers' deep discounting thus undermines brand manufacturers' quality advantage over low-quality rivals' products and thereby their bargaining power vis-à-vis retailers. This may lead to lower profits and possibly even to a delisting of their products, such as in favor of store brands.

Importantly, the depth of discounts offered in the promoted category—and thereby, the overall equilibrium outcome—is tightly linked to the extent of consumer one-stop shopping, that is, the size of consumers' baskets at individual shopping trips. Expressing our results in relation to consumers' degree of one-stop shopping, we find the following.

First, when consumers have standard preferences, brand manufacturers in promoted categories are not disadvantaged relative to brand manufacturers in other categories, and all brand manufacturers' profits are independent of the degree of one-stop shopping. This continues to hold even when consumers exhibit relative thinking, provided that the degree of one-stop shopping is fairly small.

Second, when consumers are relative thinkers *and* the size of their shopping basket exceeds a certain threshold, the resulting deep discounting of promoted manufacturers' products leads to a weakening of their bargaining position with retailers. This is because stocking a low-quality substitute (e.g., a store brand/private label) becomes relatively more attractive for retailers in the face of consumers' diminished perception of quality differences. From that point onwards, brand manufacturer profits are lower in the promoted category than in nonpromoted ones, and they keep decreasing as the extent of one-stop shopping grows. Yet, also in the promoted category, all retailers still stock the branded high-quality product.

Lastly, eventually a point is reached where the average price level in the promoted category becomes so low that affected brand manufacturers lose all their bargaining power vis-à-vis retailers. They then make zero profit in equilibrium, and retailers remove their products with positive probability, replacing them with low-quality alternatives.

Our mechanism may thus shed new light on some general trends that have shaped retailing over the last decades, especially in the food sector. Since in our model retailers replace branded high-quality products with lower-quality variants in the promoted category when the extent of consumer one-stop shopping is sufficiently large, our model provides a possible explanation for the widely observed long-term growth of private labels.⁷ This is consistent with an increasing consumer preference for one-stop shopping, as claimed by some authors and policy reports (see, e.g., Baye et al., 2018; Johansen & Nilssen, 2016, and the references therein). Also, again following the main thrust of our model and argument, an increase in retail competition reduces the bargaining power of brand manufacturers, as they can then no longer bank on their superior quality or investment in brand value. In our concluding remarks, we argue how this should have far-reaching implications for brand manufacturers' product positioning and investment strategies.

To our knowledge, this paper is the first to analyze the impact of heavy discounting by retailers on the profits of manufacturers whose brands are promoted, in contrast to profits of manufacturers in nonpromoted categories. We acknowledge that the literature has identified alternative explanations for why manufacturers would want to prevent heavy discounting of their products (and possibly even impose a minimum resale price). For example, manufacturers may want to ensure sufficient margins to retailers so as to incentivize services, or, in the language of Telser (1960), to ensure "fair trade" among retailers.⁸ Such theories seem most applicable to service-intensive products or to new-product introductions. Our model instead focuses on the conflict of interest between manufacturers and retailers.

Moreover, our showcased mechanism, by which deep discounting negatively affects manufacturer profits, is such that manufacturers could not fully escape these negative implications by adopting retail-price-maintenance (RPM) strategies—provided that they are not anyhow prohibited by antitrust laws.⁹ This follows from the fact that the

mechanism depends on the average price in the considered category, as this affects the relative importance of quality and price.

In particular, in our model, a retailer's price-cutting of a particular product does not by itself undermine a consumer's perception of the product's quality or brand value.¹⁰ To fully defend the value of their brand and thereby their bargaining position vis-à-vis retailers, brand manufacturers in a given category would have to act in concert to prevent that their products are heavily discounted. But such horizontal agreements would clearly fall foul of antitrust laws. Hence, when manufacturers are rightly concerned that retailers' intense price promotions reduce their bargaining position and destroy brand value, they would need to rely on the support of regulation, such as through the establishment of minimum sale prices.¹¹ But even when such regulations are not (yet) in place, manufacturers may be able to constrain retailers by raising the awareness of policymakers or the general public.

Another insight of our model is that brand manufacturers, particularly those of promotion-intense products, should be aware of increasing retail competition. This could be triggered by the entry of hard discounters or, potentially, also by the rise of alternative shopping formats, such as online retailing—even more so if this forces retailers to compete more aggressively on few, particularly visible products.

The underlying concept of context-dependent preferences has gained wide acceptance in behavioral economics and marketing, with literature dating back to at least Monroe (1973).¹² Several authors in marketing have also related this to Kahneman and Tversky's (1979) seminal Prospect Theory (e.g., Diamond & Sanyal, 1990). Much of this literature has however focused on how a single firm's offers can shape consumer perceptions. For example, Huber et al. (1982) show that the choice among two alternatives can crucially be affected if a third, dominated alternative is added (the so-called "attraction effect"). Similarly, Simonson (1989) demonstrates that adding an alternative that is particularly good on one dimension, but bad on another (e.g., a product with very high quality, but also a very high price), may tilt consumers' choice among the initially available alternatives ("compromise effect").

Departing from this, our paper contributes to the burgeoning literature in behavioral industrial organization investigating the impact of context-dependent or reference-point-dependent consumer preferences in strategic market environments. Like us, many recent works build on the seminal formalization of "salient thinking" developed in Bordalo et al. (2013).¹³ Moreover, several of these articles have also shown that such preferences can lead to distorted consumer choices, prices, and ultimately firms' product choices. For instance, Bordalo et al. (2016) find that depending on the specific technological relationship between product quality and the corresponding marginal costs of production, consumers' biased attention may induce "commoditized" price-salient equilibria (where product quality is distorted downwards relative to the rational benchmark) or "decommoditized" quality-salient equilibria (where the opposite is the case).

Other articles in this vein include Herweg et al. (2017), Johnson (2017), Helfrich and Herweg (2020), Apffelstaedt and Mechtenberg (2021), Dertwinkel-Kalt and Köster (2022), and our companion work in Inderst and Obradovits (2020). Notably, the present contribution builds on our earlier framework in Inderst and Obradovits (2020), where we also study retail competition with salient-thinking consumers. Next to the application of this consumer choice criterion to a workhorse model of imperfect competition (Varian, 1980), the main focus of that article was the analysis of the effects of a prohibition of loss leading. Compared with Inderst and Obradovits (2020), we now introduce a vertical structure (and the respective manufacturer-retailer contracting) as well as additional, nonpromoted categories in retailers' offers. This allows us to analyze and compare manufacturers' offers in promoted and nonpromoted categories, and how these are affected when promoted products are deeply discounted due to consumer one-stop shopping. Moreover, we can determine the distribution of profits among retailers and manufacturers.

Vertically related markets are also examined in Helfrich and Herweg (2020) and Dertwinkel-Kalt and Köster (2022). However, both of these articles focus on the effects of vertical restraints in online retailing. For example, Dertwinkel-Kalt and Köster (2022) demonstrate that, in a setting where price differences across sales channels (offline and online) lead consumers to undervalue product quality, a monopolistic upstream manufacturer may find it optimal to bias product quality away from the (rational) first best to counteract the associated profit loss. Under some circumstances, vertical restraints can then correct market outcomes. Similar considerations are also at the heart of Helfrich and Herweg (2020); in contrast to the present contribution, neither article takes into account multiple (promoted and nonpromoted) brands or a profit comparison between those.

The remainder of this paper is organized as follows. Section 2 sets out the model. Section 3 solves the baseline case where consumers follow a standard choice criterion, thereby setting up the respective puzzles. Section 4 presents the main analysis under relative consumer preferences. Section 5 concludes by deriving from our results potentially testable hypotheses as well as managerial implications. All proofs are relegated to Appendix A. In Appendix B, we

outline several alternative consumer choice rules that are equivalent to the choice concept of salient thinking employed in the main analysis. Appendix C considers a variation of our baseline model with elastic demand.

2 | MODEL SETUP

2.1 | Retail competition

We consider a market where $N = 2$ possibly multiproduct retailers compete for final consumers.¹⁴ The retailers may stock a *single* product in each of $I \geq 1$ different product categories,¹⁵ with the respective products supplied by manufacturers that compete for shelf space at the retailers (see below). Consumers are one-stop shoppers and thus make all their purchases at a single retailer.¹⁶ We abstract from retailers' own (handling) costs, which however can be included without affecting results. It is convenient to denote the respective sets of retailers and product categories also by N and I . The price of the product offered by retailer $n \in N$ in product category $i \in I$ is denoted by p_n^i , and we suppose that the product's respective quality can be described by a real-valued variable q_n^i . When this does not cause confusion, we will sometimes omit the superscript i denoting the specific product category.¹⁷

2.2 | Manufacturers

For simplicity, we assume that in each product category $i \in I$, only two different product variants exist: a low-quality product with quality $q_L > 0$ and constant marginal costs of production $c_L \in (0, q_L)$ and a high-quality product with quality $q_H > q_L$ and constant marginal costs of production $c_H \in (c_L, q_H)$.¹⁸ We denote $\Delta_q = q_H - q_L$ and $\Delta_c = c_H - c_L$.

For each product category, we further suppose that the low-quality variant can be supplied by at least two undifferentiated manufacturers, or that it represents a private label (that can be produced by the retailers themselves). Because of this, we assume that in each product category, retailers can procure the respective low-quality variant at cost c_L . In contrast, motivated by our introductory examples, we suppose that in each product category, there is a single high-quality brand manufacturer that negotiates with retailers (see below for our specification of the brand manufacturer–retailer negotiations). We focus on the interesting case where the brand manufacturers' products provide a strictly higher surplus, $\Delta_q > \Delta_c$. Otherwise, the retailers would always stock the low-quality variant in each product category, irrespective of consumers' (rational or relative) preferences.

2.3 | Brand manufacturer–retailer negotiations

It is well known from the large literature on vertical contracting and channel management that the equilibrium characterization depends crucially on whether retailer competition can be affected through the strategic choice of wholesale contracts.¹⁹ In this paper, we abstract from such issues of optimal channel management by choosing a specification that results in marginal wholesale prices equal to marginal costs. Precisely, we assume that even when a manufacturer supplies both retailers, he negotiates separately (through independently acting agents) with them.²⁰ Another way to obtain such a result is to have a “dedicated” manufacturer for each retailer, so that the setup becomes that of competing vertical chains.²¹

As the intricacies of bilateral negotiations are also not the subject of our model, we stipulate that in each bilateral meeting, the manufacturer's agent makes a take-it-or-leave-it offer in the form of a two-part tariff contract. This contract specifies a fixed fee T_n^i together with a constant (per-unit) wholesale price w_n^i .

2.4 | Consumers

We follow Varian (1980) by assuming that a fraction $(1 - \lambda)/2$ of consumers can only shop at their (local) retailer n (for $n \in \{1, 2\}$), such that a total fraction $1 - \lambda$ of consumers does not compare offers. In contrast, the remaining

fraction λ of consumers, called “shoppers,” is free to choose any retailer, so that λ also captures the intensity of competition.

We next stipulate that only the offer in category $i = 1$ is observed before a consumer enters the respective shop.²² Shoppers thus observe offers (q_n^1, p_n^1) across both retailers, while nonshoppers only observe the respective offer of their (local) retailer. No consumer observes offers in categories $i > 1$ before entering a shop, though consumers hold (rational) expectations $(\hat{q}_n^i, \hat{p}_n^i)$ for all $i > 1$. Once in a shop, a consumer then observes all of this retailer's offers and decides which products to buy. We normalize consumers' (common) outside option to provide zero utility/surplus and assume that they demand at most one unit in each product category. We describe consumers' choice rules next.

2.5 | Consumer choice with rational preferences

In our baseline analysis, we suppose that consumers have standard (rational) preferences. This means that the actual *and* perceived utility a consumer derives from purchasing any product i , now dropping retailer subscripts, is given by $u^i = q^i - p^i$. This is compared with the outside option of not-buying, which yields zero utility. Hence, given their expectations of the product offers in categories $i > 1$, shoppers will frequent the retailer n for which

$$(q_n^1 - p_n^1) + \sum_{i>1} (\hat{q}_n^i - \hat{p}_n^i) \quad (1)$$

is largest.²³ Nonshoppers have no choice and thus simply visit their (local) retailer. Once in a store, each consumer purchases all products i that provide a nonnegative net utility.

2.6 | Consumer choice with context-dependent preferences

Here, we follow closely the concept of “salient thinking,” as applied also in Inderst and Obradovits (2020), which in turn builds on the seminal framework provided by Bordalo et al. (2013). As we discuss in Appendix B, the resulting consumer choice criterion can however also be given alternative foundations, which is why we will subsequently refer to it more broadly as “relative thinking.”

As a first guiding principle, relative thinking can only occur when consumers are faced with at least two different but *comparable* options, such that a relative evaluation is even possible. We thus stipulate that relative thinking may only apply when making comparisons within the *same* product category. Since nonshoppers cannot choose between retailers, and shoppers may only observe different offers in product category $i = 1$, it follows directly that relative thinking may only matter for shoppers through retailers' offers in category $i = 1$.

Note next that if both retailers stock the same product quality in $i = 1$, then either their offers are exactly the same (such that relative thinking does not matter), or one retailer's offer is strictly dominated. For the latter case, as in Inderst and Obradovits (2020), we assume that relative thinking will then not apply either, since dominated options are not relevant for a comparison (a dominated option will never be chosen, so it should be discarded by consumers).

Suppose hence that the two retailers offer different qualities in category $i = 1$. Following Bordalo et al. (2013), we may then define a “reference product” that has the average quality $Q = \frac{q_L + q_H}{2}$ and the average price $P = \frac{p_L + p_H}{2}$ of the two offers (where $p_L < p_H$, as otherwise, the low-quality product would be strictly dominated). Take now, first, the low-quality product. For this product, its low price, rather than its low quality, is salient when

$$\frac{p_L}{P} < \frac{q_L}{Q},$$

that is, when its price is *relatively* lower (in percentage terms), compared with the average price P in the consideration set, than its quality, compared again to the average quality Q . When instead the converse holds strictly, its lower quality is salient. Similarly, for the high-quality product, its high quality is salient when

$$\frac{q_H}{Q} > \frac{p_H}{P},$$

while its high price is salient when the converse holds strictly. As is easy to check, for both products, the same attribute must be salient.²⁴ Namely, substituting for Q and P , price is salient for both products when

$$\frac{p_L}{p_H} < \frac{q_L}{q_H}, \quad (2)$$

while quality is salient for both products when the converse of (2) holds strictly.²⁵

We next stipulate that consumers compare products *only* on the salient attribute, so that they prefer the (lower-priced) low-quality product in category $i = 1$ if (2) holds, while they prefer the high-quality product in $i = 1$ if the converse of (2) holds strictly. While this may seem somewhat stark, as the nonsalient attribute is basically fully neglected, this heavily simplifies the analysis.²⁶ Based just on retailers' offers in category $i = 1$, shoppers would thus form their preferences over retailers accordingly. While in general one would have to specify how this preference carries over when also including shoppers' expectations $(\hat{q}_n^i, \hat{p}_n^i)$ of the offers provided in categories $i > 1$, for our purposes it is sufficient to assume that, in the expectation of *equal* offers in categories $i > 1$ across retailers, consumers choose the retailer based on their preference in category $i = 1$.

Finally, in line with the earlier discussion, the described decision criterion applies only to choices that can indeed be compared along the two attributes, price and quality. We thus follow Inderst and Obradovits (2020) and suppose that consumers evaluate offers correctly with respect to their outside option (of value zero). Hence, once in a shop, where within a category consumers can no longer compare different offers, a purchase is made if and only if the respective utility from that category exceeds the consumer's reservation utility of zero.²⁷

2.7 | Sequence of moves

The game proceeds as follows. In $t = 1$, at each retailer $n = 1, 2$ and for each product category i , the corresponding brand manufacturer with high quality q_H and costs c_H and at least two nonbrand manufacturers with quality q_L and costs c_L compete by simultaneously offering contracts to the respective retailer. In $t = 2$, retailers simultaneously choose for each category $i \in I$ which product to stock, that is, which contract to accept, and at which prices p_n^i to offer these to consumers. Finally, in $t = 3$, consumers choose which retailer to frequent and which bundle to purchase. Precisely, of the fraction $1 - \lambda$ of nonshopping consumers, half frequents retailer 1 and half frequents retailer 2. The fraction λ of shopping consumers decides which retailer to visit, depending on, first, observed qualities and prices (q_n^1, p_n^1) in category $i = 1$ and, second, on retailers' anticipated choices $(\hat{q}_n^i, \hat{p}_n^i)$ in categories $i > 1$. Once in a shop, a consumer purchases the product in category $i \in I$ if and only if $q_n^i - p_n^i \geq 0$.

3 | BENCHMARK ANALYSIS

In our benchmark analysis, we suppose that consumers have standard preferences, so that shoppers choose the retailer for which (1) is highest. Most of the subsequent analysis for the baseline model follows well-established results (see Narasimhan, 1988; Varian, 1980), which is why we can be short, though all remaining gaps are filled in the proof of Proposition 1.

3.1 | Product choices

Consider first products in categories $i > 1$. Recall that even shoppers do not observe the offers of these products before entering a shop, but only that of the promoted product in category $i = 1$. It is thus optimal for all retailers to set (monopolistic) prices $p_n^i = q_n^i$ for products in all nonpromoted categories $i > 1$. As consumers rationally anticipate that $\hat{p}_n^i = q_n^i$ for $i > 1$, they anticipate to realize zero surplus on these products. Since $\Delta_q > \Delta_c$, it is next obvious that the high-quality product must be stocked in all categories $i > 1$ by both retailers. Otherwise, the respective brand manufacturer and retailer could jointly achieve a higher surplus in this category (with the retailer serving at least its

locked-in consumers), such that a profitable deviation would exist. We now extend this insight to category $i = 1$. To see this, suppose to the contrary that in some candidate equilibrium, at least one retailer $n \in \{1, 2\}$ would instead choose $q_n^1 = q_L$ and some price p_n^1 . In this case, the retailer and the high-quality manufacturer could however jointly realize strictly higher profits by offering instead q_H at a price $p_n^1 + \Delta_q$, so that this leaves consumers indifferent (and thus does not affect expected demand), while the margin would increase by $\Delta_q - \Delta_c > 0$.

3.2 | Vertical contracting

So as to avoid double marginalization, in equilibrium products are provided to the retailer at a marginal wholesale price that is equal to marginal cost. Depending on the chosen quality q_n^i , the retailer's marginal cost of offering product i is thus either $w_n^i = c_L$ or $w_n^i = c_H$. Given manufacturer competition for the provision of the low-quality product, the respective offers will not contain a positive fixed part: low-quality products are thus offered by manufacturers at cost. In contrast, the offer of the respective high-quality manufacturer at retailer n may contain a fixed part $T_n^i > 0$. When this offer is accepted, T_n^i is thus the profit of the high-quality manufacturer. By optimality, the specification of T_n^i will leave the respective retailer just indifferent between acceptance and rejection.

To determine T_n^i , as offered by the brand manufacturer in category i , we can leave all other fixed fees constant. Recall now that consumers do not anticipate to get a positive surplus from any product in categories $i > 1$, so that shoppers only need to compare offers in category $i = 1$. Intuitively, when all retailers stock the same quality in all categories, including $i = 1$, with standard preferences the pricing equilibrium shares the key features of Varian (1980). In particular, a retailer realizes the same profits as when choosing the highest feasible price also for the product in $i = 1$, $p_n^1 = q_H$, thereby attracting only its share of nonshoppers $(1 - \lambda)/2$. Thus, all profits that could be realized with shoppers are fully competed away in equilibrium; compare below for the precise characterization of the (mixed-strategy) pricing equilibrium. Hence, equilibrium profits for each retailer equal gross profits $(q_H - c_H)I(1 - \lambda)/2$ minus the sum of fixed fees $\sum_i T_n^i$. When the retailer instead stocks a low-quality product in some category i , the deviating gross profit equals the sum of $(q_H - c_H)(I - 1)(1 - \lambda)/2$ and now $(q_L - c_L)(1 - \lambda)/2$. The difference is extracted by the respective manufacturer i , so that $T_n^i = (\Delta_q - \Delta_c)(1 - \lambda)/2$. Note that this holds irrespective of the product's category, thus both for the promoted category $i = 1$ and for all other categories $i > 1$. This will be markedly different with relative thinking.

3.3 | Promotions

We finally turn to the characterization of equilibrium pricing in the promoted category. The considered demand system does not afford an equilibrium where all retailers choose pure strategies.²⁸ Dropping for convenience the superscript $i = 1$, we denote retailers' pricing strategies for the promoted product in $i = 1$ by the cumulative distribution function (CDF in what follows) $F_n(p_n)$ with support $[\underline{p}_n, \bar{p}_n]$. In line with the literature, we refer to choices $p_n < \bar{p}_n$ as promotions. The lower boundary \underline{p}_n thus denotes the deepest promotion of retailer n . With symmetry, $\underline{p}_n = \underline{p}$ is obtained from retailers' indifference between setting \underline{p} and attracting all shoppers or setting $p = q_H$ and attracting only loyal customers:

$$[(\underline{p} - c_H) + (I - 1)(q_H - c_H)]\left(\frac{1 - \lambda}{2} + \lambda\right) = (q_H - c_H)I\left(\frac{1 - \lambda}{2}\right),$$

which solves for

$$\underline{p} = c_H + (q_H - c_H)\left[1 - I\left(\frac{2\lambda}{1 + \lambda}\right)\right]. \quad (3)$$

Promotional depth $q_H - \underline{p}$ is strictly increasing in the scope of products I that consumers purchase during their one-stop shopping trip. For a retailer to be indifferent over all $p \in [\underline{p}, q_H]$, the (symmetric) pricing strategy $F_n(p_n) = F(p)$ of its rival must satisfy

$$[(p - c_H) + (I - 1)(q_H - c_H)] \left[\frac{1 - \lambda}{2} + \lambda(1 - F(p)) \right] = \pi.$$

Substituting $\pi = (q_H - c_H)I \left(\frac{1 - \lambda}{2} \right)$, it follows that

$$F(p) = 1 - \frac{1 - \lambda}{2\lambda} \left(\frac{q_H - p}{p - c_H + (I - 1)(q_H - c_H)} \right). \quad (4)$$

As I increases, this shifts the distribution of (promoted) prices downwards in the sense of first-order stochastic dominance, thus making lower prices more likely. Note that retailers' equilibrium pricing also shifts downwards (in the sense of first-order stochastic dominance) when there are more shoppers in the market (higher λ), as does the deepest promotion \underline{p} derived in (3). We summarize our equilibrium results in the following proposition.

Proposition 1. *In the benchmark case with rational consumers, we have the following unique characterization of equilibrium product choice, profits, and prices:*

- (i) Quality: Both for the promoted category $i = 1$ and for all other categories $i > 1$, the brand manufacturers' (high-quality) product is chosen.
- (ii) Prices: Nonpromoted (high-quality) products in categories $i > 1$ are always offered at prices equal to consumers' willingness to pay, $p_n^i = q_H$. Instead, the price for the promoted product in $i = 1$ depends on the extent of one-stop shopping (I) as follows: The lowest price at which it is offered in equilibrium, \underline{p} as given by (3), is strictly decreasing in I , so that the depth of promotion increases. The full pricing strategy $F(p)$ is given by (4).
- (iii) Profits: At each retailer n and for all product categories i , that is, again independent of whether $i = 1$ or $i > 1$, the respective (high-quality) brand manufacturer realizes the same profit $\Pi_i^M = \Pi^M = (\Delta_q - \Delta_c)(1 - \lambda)/2$. Each retailer earns $\pi_n = (q_L - c_L)I(1 - \lambda)/2$.

Proof. See Appendix A. □

3.4 | Discussion of the benchmark case

We note first that when setting $I = 1$, one recovers the single-product analysis of retail competition in the seminal work of Varian (1980). While retail prices in categories $i > 1$ are unaffected, when I increases, prices in the promoted category $i = 1$ decrease and, at a certain point, can even drop below the respective marginal wholesale price, c_H . In fact, for the lowest promoted price, \underline{p} , this is immediately evident from the derivation in (3). However, this does not affect either the profits of the manufacturer in category $i = 1$ or the provision of quality. For the benchmark case with rational consumers, results are thus *not* consistent with the fears of brand manufacturers that profits decline when their product is deeply discounted by retailers. We summarize this observation as follows.

Corollary 1. *When consumers maximize expected utility (1), brand manufacturers realize the same profits irrespective of both the extent of one-stop shopping (I) or whether their product is used for promotions ($i = 1$) or not ($i > 1$).*

At this point, it is instructive to briefly mention the results of an extension of our baseline model where demand is elastic as consumers have heterogeneous reservation values (see Appendix C for the full analysis). Then, as the extent of one-stop shopping increases and as thus promotion discounts in category $i = 1$ increase, the brand manufacturer in this category becomes strictly better off, and it is also strictly better off than other brand manufacturers. With standard preferences and now elastic demand, we thus arrive indeed even at the *opposite* prediction to the aforementioned fears of manufacturers.

4 | ANALYSIS WITH RELATIVE THINKING

Above, we have established that in the benchmark case with rational consumers, retailers stock the brand manufacturers' products in all product categories, and that the degree of one-stop shopping does not affect their profits, also in the promoted category. In what follows, we will show that this may be markedly different when consumers are relative thinkers. We proceed in two steps. First, in Section 4.1, we determine under which circumstances relative thinking will still not affect product provision in the promoted category—that is, a “brand equilibrium” prevails. Doing so, we will however show that brand manufacturer profits in the promoted category will be lower than in the benchmark case when the degree of one-stop shopping is sufficiently large or when competition (as governed by the share of price-comparing consumers) is sufficiently strong. Second, in Section 4.2, we examine what happens when an equilibrium where retailers deterministically stock the high-quality brand product in the promoted category cannot be supported anymore. As we show, in the resulting “nonbrand equilibrium,” in the promoted category the brand manufacturer's product is delisted with positive probability, and its profit is driven down to zero.

4.1 | Brand equilibrium with relative thinking

Consider first a candidate equilibrium where both retailers stock the high-quality product in the promoted category, despite consumers' relative thinking. Clearly, with $q_n = q_H$ for all $n \in N$, consumers' relative thinking does not matter for retailers' pricing strategies *on equilibrium*, such that, in the promoted category, equilibrium pricing is still given by the CDF specified in (4) as derived for the rational case. Likewise, retailers' gross profits (gross of any fixed fees paid to manufacturers) remain the same.

Nevertheless, as we show, relative thinking may increase the profitability of a retailer's strategy to deviate and stock the low-quality product in $i = 1$. If this is the case, this leads to a shift of manufacturer profits in $i = 1$ to retailers; moreover, if deviating to low quality in $i = 1$ becomes too profitable, the candidate brand equilibrium breaks down. We note at this point that even though firms compete in mixed strategies, on a given equilibrium path, a consumer who shops between different retailers only observes two offers, which she then compares.

We start by analyzing under which condition the brand equilibrium can still be supported. For this, the subsequent lemma first determines the optimal deviation price and associated profit when a retailer deviates from his supposed equilibrium strategy and instead stocks the low-quality variant in $i = 1$, triggering shoppers' relative thinking.

Lemma 1. *Suppose that consumers are relative thinkers and consider a candidate equilibrium where both retailers stock high quality in all categories. When the extent of one-stop shopping is small, $I \leq \hat{I}$, where*

$$\hat{I} \equiv \frac{q_H}{\Delta_q} \left(\frac{\Delta_q - \Delta_c}{q_H - c_H} \right), \quad (5)$$

the optimal price for product $i = 1$ of a deviating retailer n stocking low quality in $i = 1$ is $p_n^1 = q_L$, for a maximal gross deviation profit (disregarding the fixed fees charged by brand manufacturers $i = 2, \dots, I$) of

$$\pi_n(q_L; q_L) = [q_L - c_L + (I - 1)(q_H - c_H)] \frac{1 - \lambda}{2}.$$

If instead the extent of one-stop shopping is large, $I > \hat{I}$, the optimal price for product $i = 1$ of a deviating retailer n stocking low quality in $i = 1$ is $p_n^1 = \frac{q_L}{q_H} \underline{p}$, for a maximal gross deviation profit (disregarding the fixed fees charged by brand manufacturers $i = 2, \dots, I$) of

$$\pi_n \left(\frac{q_L}{q_H} \underline{p}; q_L \right) = \left[\frac{q_L}{q_H} \underline{p} - c_L + (I - 1)(q_H - c_H) \right] \frac{1 + \lambda}{2},$$

where \underline{p} is given in (3).

Proof. See Appendix A. □

Naturally, to determine a retailer's optimal deviation price when stocking low quality in $i = 1$, the proof takes into account that, when deviating in this way, the presence of products with different qualities in the promoted category induces shoppers' relative thinking. That is, with its low-quality offer (p_L, q_L) in $i = 1$, the deviating retailer only manages to attract the shoppers if, for some given realization p_H of the rival retailer's (random) price of its high-quality product in $i = 1$, it holds that $p_H > (q_H/q_L)p_L$ (compare with condition [2]). Anticipating that the rival draws prices in category $i = 1$ according to the CDF $F(p)$ defined in (4), for a given deviation price p_L , the probability of attracting the shoppers is thus $1 - F((q_H/q_L)p_L)$.

Applying this logic, the lemma establishes that when the high-quality rival's average price in the promoted category is relatively high as the extent of one-stop shopping I is not very large, the deviating retailer still finds it optimal to completely forgo competition for shoppers, as in the benchmark model. It thus chooses the maximal price $p_n^1 = q_L$ in category $i = 1$ that still generates demand from its locked-in consumers. Since in this case the optimal deviation price and thereby the maximal deviation profit is the same as with rational consumers, retailers' outside option in the contracting stage with the promoted brand manufacturer does not improve relative to the benchmark. Because of this, the equilibrium outcome, including the profit distribution between retailers and brand manufacturers, remains unaffected.

On the other hand, if the rival's average price is low as the extent of one-stop shopping is sufficiently large, the deviating retailer's profit is largest if he sets such a low price as to attract the shoppers with probability one. Due to consumers' relative thinking, this can be achieved by setting $p_n^1 = \frac{q_L}{q_H}p$. The intuition is that when the price level, here the rival's random price p_H , is low, to achieve the same *relative* effect, p_L needs to undercut p_H by less in *absolute terms*. This is precisely how one-stop shopping affects the profitability of a price reduction: the more pronounced it is, the lower the price level and thus, in mixed strategies, also any possible price of the high-quality rival, as each attracted shopper becomes more profitable given the larger basket of goods they buy on each trip. Through this mechanism, one-stop shopping and the resulting discounting of prices attenuates quality differences, which, as we will derive formally below, reduces brand manufacturers' bargaining position and profits.

Before doing so, we are now equipped to establish the condition for the existence of the candidate brand equilibrium. Notice that to avoid being delisted, a brand manufacturer in $i = 1$ would be prepared to make zero profit, thereby offering the high-quality product at costs c_H and setting $T_n^1 = 0$ for the respective retailer. The (potentially deviating) retailer would thus have the option to either procure the low-quality or the high-quality variant at costs. This makes his deliberation of which product to provide to compete for shoppers particularly simple: The retailer only needs to compare the respective per-consumer profit margin $p_L - c_L$ at the optimal deviation price with low quality (where either no or all shoppers are attracted; see Lemma 1) with that of offering the high-quality product at the corresponding upper or lower boundary of the pricing support²⁹ and thus with a margin of $q_H - c_H$, respectively, $\underline{p} - c_H$.

Specifically, when $I \leq \hat{I}$ such that the optimal deviation price is $p_n^1 = q_L$ and competition for shoppers is foregone, the retailer compares $q_L - c_L$ to $q_H - c_H$, where the former is strictly lower by assumption. Hence, when $I \leq \hat{I}$, a low-quality deviation is not profitable. When instead $I > \hat{I}$, the retailer compares $\frac{q_L}{q_H}p - c_L$ to $\underline{p} - c_H$, where the former is strictly larger if and only if

$$\underline{p} < \frac{\Delta_c}{\Delta_q} q_H. \quad (6)$$

Note that $\Delta_c/\Delta_q < 1$. Hence, a deviation to low quality is optimal for a retailer if and only if the price level, as expressed by the lower boundary \underline{p} , is sufficiently low so that (6) holds. In Section 4.2, we will examine this situation.

If instead the converse of condition (6) holds, such a deviation to offering low quality is instead not optimal for a retailer even in category $i = 1$. Then, in equilibrium both retailers achieve a mutually beneficial agreement also with the brand manufacturer in $i = 1$. Rewriting the converse of condition (6) in terms of the degree of one-stop shopping I , we immediately obtain the following:

Proposition 2. *Suppose that consumers are relative thinkers. Then, a brand equilibrium where both retailers stock the brand manufacturer's high-quality product also in the promoted category $i = 1$ exists if and only if the degree of one-stop shopping is sufficiently small. Precisely, this is the case when*

$$I \leq \tilde{I} \equiv \frac{q_H}{\Delta_q} \left(\frac{\Delta_q - \Delta_c}{q_H - c_H} \right) \frac{1 + \lambda}{2\lambda}, \quad (7)$$

where $\tilde{I} > \hat{I}$.

When this condition holds, we can finally use the optimal deviation profits from Lemma 1 to determine the distribution of profits in the brand equilibrium. This is our key result.

Proposition 3. *Suppose that consumers are relative thinkers and that condition (7) holds such that the brand equilibrium exists. Then, when the extent of one-stop shopping is low with $I \leq \hat{I}$, the distribution of profits is the same as in the rational benchmark model, where for all categories i and retailers n it holds that*

$$\Pi_i^M = \frac{1 - \lambda}{2} (\Delta_q - \Delta_c)$$

and

$$\pi_n = \frac{1 - \lambda}{2} I (q_L - c_L).$$

If instead the extent of one-stop shopping is relatively large with $I \in (\hat{I}, \tilde{I}]$, the supplier of the branded product in the promoted category $i = 1$ makes a strictly lower profit than in the rational benchmark model and also than the suppliers of all other brand products, with

$$\Pi_1^M = \frac{1 - \lambda}{2} (\Delta_q - \Delta_c) - \lambda (I - \hat{I}) \frac{\Delta_q (q_H - c_H)}{q_H} \geq 0$$

and

$$\Pi_{i>1}^M = \frac{1 - \lambda}{2} (\Delta_q - \Delta_c).$$

Compared with the benchmark model, each retailer's profit strictly increases to

$$\pi_n = \frac{1 - \lambda}{2} I (q_L - c_L) + \lambda (I - \hat{I}) \frac{\Delta_q (q_H - c_H)}{q_H}.$$

Moreover, the promoted suppliers' profits are strictly decreasing in the extent of one-stop shopping I , with $\Pi_1^M(\hat{I}) = \Pi_{i>1}^M(\hat{I})$ and $\Pi_1^M(\tilde{I}) = 0$.

Proof. See Appendix A. □

Note first that $\hat{I} < \tilde{I}$, so that there is indeed an interval of values I where the product of the brand manufacturer in $i = 1$ is still listed with probability 1, but where its profits are strictly lower than those of brand manufacturers in other categories (and also strictly lower than in the benchmark model with rational consumers). Starting from $I = \hat{I}$, manufacturer profits in $i = 1$ strictly decrease as the extent of one-stop shopping increases further. For $I = \tilde{I}$, they fall down to zero, which is precisely the point from where on (i.e., for higher I) the brand manufacturer in $i = 1$ will be delisted with positive probability. We describe the respective equilibrium in Section 4.2. We now further elaborate on manufacturer profits.

Recall that, independently of the extent of one-stop shopping, suppliers in categories $i > 1$ make profits of $\Pi_{i>1}^M = (\Delta_q - \Delta_c)(1 - \lambda)/2$, reflecting the part of their value-added that is not competed away downstream. For $I > \hat{I}$, the profit differential between suppliers in categories $i > 1$ and the supplier in the promoted category is given by

$$\Delta \Pi^M = \lambda(I - \hat{I}) \frac{\Delta_q(q_H - c_H)}{q_H}. \quad (8)$$

It is immediate that this profit differential strictly increases in the extent of one-stop shopping I , as asserted in Proposition 3. Moreover, since \hat{I} is independent of the share of shoppers λ , the profit differential linearly increases in λ as well. In other words, the brand manufacturer in the promoted category $i = 1$ suffers *more* from an increase in the shopping propensity of consumers. But to be precise, the latter is only true as long as, for fixed $I > \hat{I}$, λ does not become so large that $I > \tilde{I}$.³⁰ Otherwise, the brand equilibrium breaks down, the manufacturer in $i = 1$ makes zero profit, and only the profits of the brand manufacturers in $i > 1$ keep decreasing in λ until they reach zero for $\lambda = 1$.

Figure 1 illustrates the dependency of manufacturer profits on I . There, for greater transparency, the parameters have been chosen such that at $I = 2$, profits exactly coincide (i.e., $\hat{I} = 2$). The relative profit loss $\Pi_{i>1}^M - \Pi_1^M$ of a promoted brand manufacturer then increases strictly (and in a linear fashion, as follows from Equation 8), until it is maximal at $I = \tilde{I}$. From there on, the promoted manufacturer's profits remain at zero and its brand will be delisted with strictly positive probability, as we show below.

In Figure 2, we compare profits in terms of λ . This parameter has two intertwined roles in our model. The implications of relative thinking obviously become more pronounced if λ increases, simply as only shoppers compare the offers in category $i = 1$ across retailers. This is the first reason for why λ affects also the comparison of manufacturer profits in different categories. Further, as λ increases, the price level decreases for the promoted product. With relative thinking, a lower price level makes it cheaper to attract shoppers with a low-quality offer, which increases the outside option of a retailer, as we have discussed above. For these two reasons, the profit loss of a brand manufacturer in $i = 1$ relative to brand manufacturers in $i > 1$ also increases in λ , as depicted in Figure 2. With increasing competition at the retail level, all profits clearly decrease, but the decrease is more pronounced for the promoted category. Again, we have $\Pi_1^M = 0$ from a certain level of $\lambda < 1$ onwards, where still $\Pi_{i>1}^M > 0$, as then the branded product will be delisted with positive probability in category $i = 1$. In sum, regardless of the reason for why retail competition intensifies in our model, provided that $I > \hat{I}$, the brand manufacturer in the promoted category is affected strictly more than brand manufacturers in other categories.

When consumers exhibit relative thinking, deep discounting thus indeed hurts brand manufacturers, even when their products are still listed. They should thus be particularly (i.e., more than other manufacturers) aware of the implications of intensifying retail competition. This is even more so as the preceding discussion also suggests that, when promotion competition becomes sufficiently extensive, brand manufacturers may find their products delisted. We finally turn to this case.

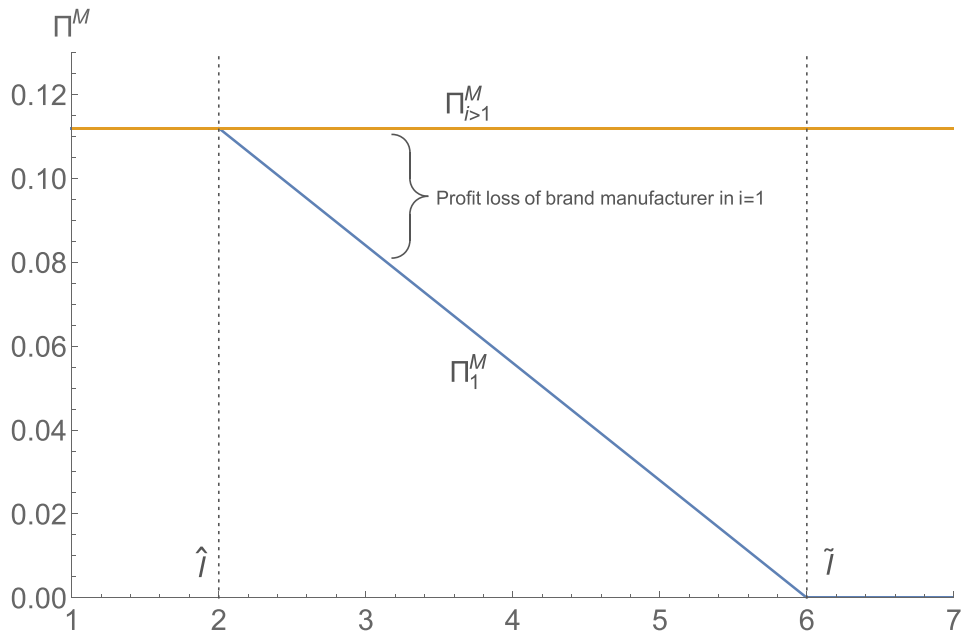


FIGURE 1 Manufacturer profits as a function of I . The parameters used are $q_H = 1$, $c_H = 0.6$, $q_L = 0.65$, $c_L = 0.53$, and $\lambda = 0.2$. [Color figure can be viewed at wileyonlinelibrary.com]

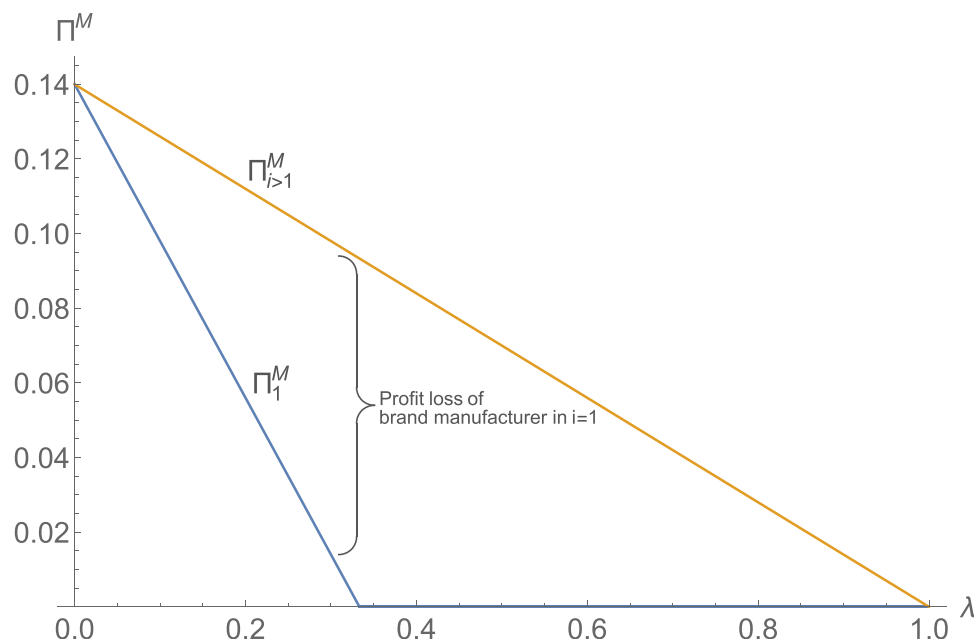


FIGURE 2 Manufacturer profits as a function of λ . The parameters used are $q_H = 1$, $c_H = 0.6$, $q_L = 0.65$, $c_L = 0.53$, and $I = 4$. [Color figure can be viewed at wileyonlinelibrary.com]

4.2 | Nonbrand equilibrium: The threat of being delisted

When (7) no longer holds as I is too large, an equilibrium where both retailers always stock the brand manufacturer's product also in the promoted category does not exist. This is what we have already shown.

Note next that there can also not be an equilibrium where both retailers for sure choose the low-quality (i.e., possibly store-brand) product in category $i = 1$. As profits from shoppers are always fully competed away, the resulting profits would be strictly lower than when stocking a brand manufacturer's product in $i = 1$ (at cost) and targeting only nonshoppers.³¹ Hence, in a symmetric equilibrium, product choice in the promoted category must be in mixed strategies. We provide a characterization of the respective probabilities in the proof of the subsequent proposition. There, we also characterize the corresponding mixed pricing strategies. In particular, we show that the respective pricing supports (which depend on whether high or low quality is stocked in $i = 1$) are such that when two different qualities are offered, triggering indeed shoppers' relative thinking *on* equilibrium, shoppers always prefer the retailer featuring the low-quality product.³²

Proposition 4. *Suppose that consumers are relative thinkers and that condition (7) does not hold. While brand manufacturers' profits in all other categories $i > 1$ are not affected, the brand manufacturer in the promoted category then makes zero profit. With positive probability its product is no longer listed, and this probability is higher when the extent of one-stop shopping I and thus discounts are larger.*

Proof. See Appendix A. □

In our model, retailer discounting of a manufacturer's own brand does not hurt the manufacturer directly. In fact, such a direct impact on brand image might be more relevant in the case of luxury goods, to which our model of sales and promotions may be less applicable. Instead, in our model it is the overall lower price level that affects, via consumers' relative thinking, the relative perception of quality and price. As a consequence, unless one brand manufacturer virtually controls the branded supply in a given category, here $i = 1$, and can commit to impose a sufficiently high shelf price at all competing retailers, a single manufacturer cannot successfully lean against heavy discount competition and its negative implications for all suppliers of branded products in the given category.

This insight can also be framed as follows. Consider, just for now, the image of competing vertical chains—or, likewise, that of forward-integrated manufacturers, who still face downstream competition. Then, in any such vertical

chain, downstream pricing and aggregate profits would remain the same as in our analysis. And the same applies to the provision of high- versus low-quality products. While such a picture is helpful to stress why an individual branded-goods manufacturer could not escape the described pitfall of low prices, for our key result on the distribution of profits in the vertical chain it was necessary to consider retailers and manufacturers separately. In our concluding remarks, we now elaborate on additional implications.

5 | CONCLUSION AND IMPLICATIONS

Our main empirical motivation comes from the observation that brand manufacturers, notably of consumer packaged goods, seem to resent retailers' practice to heavily discount prices of their products. As this should increase demand and as it is not obvious why manufacturers should co-fund such promotions, this is at first sight puzzling. Also, as we noted in the Introduction, often other reasons for why manufacturers would impose minimum resale prices may be less applicable, notably those relating to incentivizing services or quality certification by all or selected retailers. Our model thus offers a formal derivation of one possibly widely applicable channel that explains this relationship. From this, we derive various implications, on which we now further expand.

We first recall the two main features of our model. First, with one-stop shopping, consumers base their choice of retailers only on the comparison of a selected number of products. These are consequently the products on which price competition is fiercest. Second, the relative weight that consumers give to different attributes of a product, notably price and quality, may depend on market circumstances, such as the relative difference to other offers in the market. Our analysis captures these two features by combining a model of one-stop shopping, set into a model of sales (Varian, 1980), with insights from the marketing and behavioral economics literature on consumers' relative perception of quality and prices ("relative thinking"). Our main focus is on the implications for the vertical layer, notably brand manufacturers' profits.

The role of consumer preferences is crucial, as an increase in the extent of one-stop shopping will only negatively affect manufacturer profits with relative thinking and not with standard preferences. And this is the case only in the promoted category. Thus, when consumers exhibit such relative thinking, but not otherwise, we can indeed support brand manufacturers' concerns when retailers discount the respective product category to compete for one-stop shoppers.


Brand manufacturers may have little influence on whether their product belongs to a promoted category or not, which may depend, for instance, on whether it represents a staple product that many households demand. Still, management can learn the following from our analysis. Unless a manufacturer virtually controls the supply of branded products in a given category, unilateral strategies of RPM, imposed either directly or indirectly through the threat of withdrawing supply, cannot shore up manufacturers' profits. This is because it is the overall low price level in the promoted category that affects consumers' preferences over prices and quality. Instead, manufacturers could benefit when, for instance, minimum sale prices were imposed, such as possibly through an industry-wide ban of loss leading, as is the case in some countries (at least for food retailing). If this is not the case and when the category into which their main products fall is known for sales promotions, they should watch out more carefully than other brand manufacturers for trends in retailing that could lead to intensified retail competition. Looking backwards, this may indeed apply to the rise of one-stop shopping. Looking into the future, online shopping even for staple grocery products may further increase retail competition. In addition, online promotions of only few items could increase the prominence of heavy discount competition. When management anticipates such changes, the return from an investment in brand value might fall. Then, it may be more profitable to direct investments into cutting costs. We plan to explore such longer-term strategic considerations of our model in future work.

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ENDNOTES

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- ² The Sydney Morning Herald, November 22, 2011, “Heinz hits out at home brands,” <https://www.smh.com.au/business/heinz-hits-out-at-home-brands-20111121-1nr1l.html>, accessed August 26, 2021. In the same article, as the title suggests, Heinz’ CFO blamed “relentless promotional pressure” at the two national discounters, Coles and Woolworths, as the main reason for bad financial performance.
- ³ Welt, January 29, 2014, “Coca-Cola kämpft sich zurück in das Lidl-Regal” [“Coca-Cola fights its way back to the Lidl shelf”], <https://www.welt.de/wirtschaft/article124337516/Coca-Cola-kaempft-sich-zurueck-in-das-Lidl-Regal.html>, accessed August 26, 2021.
- ⁴ For example, Welt, January 29, 2017, “Unilever kritisiert ‘Brandrodung’ im Supermarkt” [“Unilever criticizes ‘fire clearing’ in the supermarket”], <https://www.welt.de/wirtschaft/article161630067/Unilever-kritisiert-Brandrodung-im-Supermarkt.html>, accessed August 26, 2021.
- ⁵ In our already rich model, we however do not endogenize which of the considered product categories is used by retailers for promotions.
- ⁶ As in the present context the same choice criterion as under “salient thinking” can also be obtained with other concepts used in the literature, we refer to it more broadly as “relative thinking.” See Appendix B for a discussion of these alternative concepts.
- ⁷ There is by now a large literature documenting and analyzing the spread of store brands. For an early survey, see, for example, Bergès-Sennou et al. (2004). Various rationales have been proposed for why retailers introduce store brands, for example, so as to exert downwards pricing pressure on national brands (Mills, 1995; cf. Chintagunta et al., 2002, for an empirical analysis). In our model, instead, retailers are only reactive to external forces (e.g., the increase in one-stop shopping). As, in line with the literature, shoppers in our model exhibit the same preferences, at present our model cannot be immediately extended to the case where in a given category store brands and national brands are simultaneously offered by a given retailer.
- ⁸ Compare the seminal work by Telser (1960), Mathewson and Winter (1984), and Marvel and McCafferty (1984). Overall, the literature on minimum resale prices or resale price maintenance is too large to review here. Other identified rationales for such practices include a facilitation of tacit collusion, a softening of downstream competition to ensure overall higher channel profits, or exclusion of upstream rivals.
- ⁹ RPM is severely restricted in the European Union, where some countries even treat it similarly to anticompetitive practices prohibited per se. Since the 2007 Leegin-decision of the US Supreme court, which clearly ruled against a per se prohibition of RPM, in the United States matters are less clear-cut—also as some states, like, California under the Cartwright-Act, still seem to practice such a prohibition.
- ¹⁰ Indeed, such a mechanism would seem more reasonable with luxury products, where a high price may itself be a vital trait of the product (e.g., as it communicates to others the owner’s income and wealth or as it ensures that there is only a small, selective group of such owners). See, however, Dertwinkel-Kalt and Köster (2022) for a model where price variation across different retail channels leads consumers to focus on price, rather than quality.
- ¹¹ An obvious example is the prohibition of loss leading (i.e., below-cost selling). In the United States, federal law does not restrict loss leading, but several states, such as California, have enacted respective laws. Other countries have stricter rules or specifically forbid below-cost selling in food retailing. An interesting example is that of Germany where, following the aggressive loss leading of Walmart after its market entry, the law was changed to explicitly ban this practice in food retailing. Other European countries that have restrictions on below-cost pricing include Belgium, France, and Ireland.
- ¹² Possibly the most widely known evidence of such preferences relates to an experiment conducted by Tversky and Kahneman (1981). They document that 68% of subjects were willing to drive 20 min to save \$5 on the purchase of a calculator when the price was \$15, but less than half of this fraction (29%) were willing to do so to save again \$5 when the price was instead \$125.
- ¹³ Other noteworthy choice concepts describing different forms of reference-point-dependent preferences have been introduced, among others, in Kőszegi and Szeidl (2013) and Bushong et al. (2021).
- ¹⁴ We focus on a retailing duopoly merely for expositional simplicity. All our results readily extend to competition among $N > 2$ ex ante symmetric retailers. Details are available from the authors upon request.
- ¹⁵ Note that as all customers have the same preferences, as we will specify below, there would be no benefit from stocking multiple products in any given product category. An extension with heterogeneous consumer preferences must be left to future research.
- ¹⁶ We do not model consumers’ choice for one-stop shopping. An increase in I may have exogenous reasons, in particular when considered over a longer time horizon, such as caused by a change in mobility.
- ¹⁷ Usually, this will be the case for the “promoted” category $i = 1$ (see below).
- ¹⁸ The model could easily be extended to allow for different quality levels $q_{L,i}$ and $q_{H,i}$ (and corresponding constant marginal costs) in each category, albeit this would make some subsequent expressions less transparent, and does not yield any additional insights.
- ¹⁹ An obvious case is that of a monopolistic (brand) manufacturer who can commit to observable offers to all retailers and thereby dampen retail competition by a high marginal wholesale price (together with a low inframarginal price or even a negative fixed transfer). For a recent discussion of various models with such observable contracts, see Inderst and Shaffer (2019).

- ²⁰ Models where a supplier or retailer negotiates through independent agents are widely used in the literature. Admittedly, such an approach, where a player cannot orchestrate a simultaneous deviation across all his agents, may not be realistic in some contexts. On the other hand, some recent contributions have provided a foundation for this, such as through an appropriate extension of the respective game form (see, e.g., Inderst & Montez, 2019).
- ²¹ We will briefly return to this interpretation at the end of Section 4.2.
- ²² As discussed in the Introduction, only products in category $i = 1$ are prominent. For our purposes, it is inconsequential whether consumers' inability to observe retailers' offers in other categories is due to limited attention or memory or whether it follows from limits to advertising space.
- ²³ In case of indifference, we assume that shoppers choose randomly which retailer to visit.
- ²⁴ This property would also extend to more than two offers (as long as strictly dominated offers are deleted from the consideration set; cf. Inderst & Obradovits, 2020).
- ²⁵ If (2) holds with equality, both attributes are equally salient for both products, giving rise to rational preferences.
- ²⁶ We have also solved the model for the case where such discounting occurs only to some degree, where all subsequently derived insights survive, provided that this discounting is sufficiently strong. Details are available from the authors upon request. Inderst and Obradovits (2020) derive results for arbitrary discounting of the nonsalient attribute, though without the additional manufacturer–retailer layer that is at the core of the current analysis.
- ²⁷ This assumption corresponds to the overarching notion that consumers do not have a fixed valuation for an offer, but that this depends on the choice context. In our particular application, the first choice context is that of selecting which store to frequent, which is based on observed promotions from all retailers. The second choice context relates to the decision in the store.
- ²⁸ If $p_n^1 = p \leq q_H$ was the (symmetric) deterministic equilibrium price, each retailer would either find it profitable to marginally lower its price and thereby attract all shoppers, or to increase its price to extract (more) rent from its locked-in consumers.
- ²⁹ Recall that by construction, when stocking high quality in $i = 1$, a retailer is indifferent between choosing any price in the support $[\underline{p}, q_H]$, given the rival retailer's mixed pricing strategy.
- ³⁰ Note that \tilde{I} strictly decreases in λ , with $\lim_{\lambda \rightarrow 1} \tilde{I} = \hat{I}$. Hence, for any $I > \hat{I}$, there exists some $\bar{\lambda} \in (0, 1)$ where $I > \tilde{I}$ for all $\lambda > \bar{\lambda}$.
- ³¹ In fact, the increase in profits resulting from such a deviation from the candidate equilibrium would be $(\Delta_q - \Delta_c)(1 - \lambda)/2$.
- ³² From a technical perspective, the proof shows that retailers are indifferent as to which product to stock in $i = 1$ and what corresponding price (in the respective support) to set. Moreover, it shows that there are no profitable price deviations outside the characterized supports. This takes into account that if (and only if) two different qualities are offered, shoppers' relative thinking is triggered.
- ³³ More precisely, when we impose equality on the first condition, we can write this as

$$\begin{aligned}
 & [(q_L - s' - c_L + [(q_H - c_H) - (q_L - c_L)]) + (I - 1)(q_H - c_H)]X_n(s') \\
 & = [(q_L - s'' - c_L + [(q_H - c_H) - (q_L - c_L)]) + (I - 1)(q_H - c_H)]X_n(s''), \text{ i. e. ,} \\
 & [(q_L - s' - c_L) + (I - 1)(q_H - c_H)]X_n(s') \\
 & = [(q_L - s'' - c_L) + (I - 1)(q_H - c_H)]X_n(s'') + (\Delta_q - \Delta_c)[X_n(s'') - X_n(s')].
 \end{aligned}$$

From this, our second inequality follows as $\Delta_q > \Delta_c$ and as clearly $X_n(s'') > X_n(s')$.

- ³⁴ Indeed, some contributions in the literature, such as Azar (2014), start right from such a (re)formulation.
- ³⁵ However, while then the optimal choice is indeed (generically) a corner solution, with $x_n > 0$ only for the product where the respective “quality-per-dollar” q_n/p_n is highest, x_n would now depend on p_n .

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APPENDIX A: PROOFS

Proof of Proposition 1. To streamline the exposition of the proof, we first recognize that, by the arguments in the main text, each retailer will stock high quality at categories $i > 1$ and that the corresponding prices equal the respective consumer valuation q_H . We next consider category $i = 1$.

We argue to a contradiction and suppose that for at least one retailer n , $q_n = q_L$ (suppressing for now the index $i = 1$) in equilibrium. We may then write the expected demand of this retailer as a function of consumers' (perceived) net surplus s_n , which is $s_n = q_L - p_n$, given the anticipated monopolistic pricing at all products $i > 1$. Given the anticipated strategies at all other retailers $n' \neq n$, in an equilibrium retailer n faces some expected demand $X_n(s_n)$ (which, at this point, we need not derive explicitly). Take now some equilibrium price p_n (i.e., a price for $i = 1$ in the respective support of retailer n) with expected demand $X_n(q_L - p_n)$. Consider a deviation to $q_n = q_H$ and the choice of a price $\hat{p}_n = p_n + \Delta_q$, which thus realizes the same expected demand. In case the high-quality manufacturer offered his product at the wholesale price $w_n = c_H$, the retailer's increase in profit (gross of T_n) would then be at least

$$\Delta\pi_n = \frac{1 - \lambda}{N}(\Delta_q - \Delta_c) > 0.$$

By setting (e.g.) $T_n = \Delta\pi_n/2$, the respective high-quality manufacturer can thus ensure that its (deviating) offer is accepted for sure and that it generates strictly positive profits, which results in a contradiction to the claim that retailer n offers low quality for product $i = 1$ in equilibrium.

We next turn to wholesale contracts. We wish to support an equilibrium where marginal wholesale prices equal marginal costs. Take first $i = 1$ and note that, for a given wholesale price w_n^1 set by the respective brand manufacturer, the retailer's optimal price p_n^1 solves

$$\left[(p_n^1 - w_n^1) + (I - 1)(q_H - c_H) \right] X_n(q_H - p_n^1). \quad (\text{A1})$$

When $w_n^1 = c_H$, the retailer thus maximizes

$$\left[(p_n^1 - c_H) + (I - 1)(q_H - c_H) \right] X_n(q_H - p_n^1),$$

which are indeed the joint profits of retailer n and the respective high-quality manufacturer for any w_n^1 . This property extends also to the providers of products $i > 1$. Then, the respective objective function of the retailer becomes

$$\left[(p_n^1 - c_H) + (I - 2)(q_H - c_H) + (q_H - w_n^i) \right] X_n(q_H - p_n^1), \quad (\text{A2})$$

which equals that in (A1).

Next, given marginal wholesale prices equal to marginal brand manufacturer costs, the determination of fixed fees follows from the argument in the main text as follows. For this we show that when a retailer rejects the offer of the high-quality manufacturer of any category i , the deviation profit, gross of the fixed fees T_n^j for all other manufacturers j , is obtained by attracting only the respective locked-in fraction of consumers. We show this first when $i = 1$. Consider generally any two levels of net utility that a retailer may offer to consumers, $s' < s''$. We show that when offering s' is weakly preferred for a retailer that (on-equilibrium) chooses $q_n^1 = q_H$, offering the lower net utility is strictly preferred when the retailer deviates to $q_n = q_L$. Formally: Making use of the expression $X_n(s)$ for expected demand, as well as prices $p_H' = q_H - s'$ and $p_H'' = q_H - s''$ with high quality and prices $p_L' = q_L - s'$ and $p_L'' = q_L - s''$ with low quality, we claim that

$$[(q_H - s' - c_H) + (I - 1)(q_H - c_H)]X_n(s') \geq [(q_H - s'' - c_H) + (I - 1)(q_H - c_H)]X_n(s'')$$

implies

$$[(q_L - s' - c_L) + (I - 1)(q_H - c_H)]X_n(s') > [(q_L - s'' - c_L) + (I - 1)(q_H - c_H)]X_n(s''),$$

which indeed holds from $\Delta_q > \Delta_c$.³³ As we already know that offering zero net utility ($p_n = q_H$) yields the equilibrium profits, offering zero net utility (now $p_n = q_L$) must then indeed be uniquely optimal when deviating to $q_n = q_L$. From the respective expressions for π , we then obtain from a retailer's indifference, which must hold by optimality for the manufacturer, that

$$T_n^1 = (\Delta_q - \Delta_c) \frac{1 - \lambda}{2}.$$

We can now apply this argument also to all categories $i > 1$, after noting the equivalence of the respective expressions as used already when we compared (A1) with (A2). \square

Proof of Lemma 1. Consider a candidate equilibrium where retailers stock high quality in all categories. From this, we determine a retailer's deviation profits. Suppose thus that retailer n , instead of choosing $q_n = q_H$ in

category $i = 1$, deviates to $q_n = q_L$. Then, given the rival retailer's anticipated choice of $q_{n'} = q_H$ in the same category and the corresponding product price drawn from $F(\cdot)$ as given in (4), when setting an arbitrary price p_L , the deviating retailer n makes an expected deviation gross profit of

$$\begin{aligned}\pi_n(p_L; q_L) &= [p_L - c_L + (I - 1)(q_H - c_H)] \left[\frac{1 - \lambda}{2} + \lambda \left(1 - F\left(p_L \frac{q_H}{q_L}\right) \right) \right] \\ &= \frac{[p_L - c_L + (I - 1)(q_H - c_H)] \frac{1 - \lambda}{2} I (q_H - c_H)}{\frac{q_H}{q_L} p_L - c_H + (I - 1)(q_H - c_H)},\end{aligned}$$

where the last equality follows from inserting $F(\cdot)$ and simplifying. It now holds that $\frac{\partial \pi_n(p_L; q_L)}{\partial p_L}$ has the same sign as

$$\eta(I) \equiv \frac{q_H}{q_L} c_L - c_H - (I - 1)(q_H - c_H) \frac{\Delta q}{q_L},$$

which is, in particular, independent of p_L . Hence, the deviation gross profit $\pi_n(p_L; q_L)$ is monotonic in p_L . If $\eta(I) \geq 0$, which is equivalent to

$$I \leq \frac{q_H}{\Delta_q} \left(\frac{\Delta_q - \Delta_c}{q_H - c_H} \right) = \hat{I},$$

the optimal deviation price is the highest feasible price $p_L = q_L$, yielding thus a maximal deviation gross profit of

$$\pi_n(q_L; q_L) = [q_L - c_L + (I - 1)(q_H - c_H)] \frac{1 - \lambda}{2}.$$

If instead $\eta(I) < 0$ (i.e., $I > \hat{I}$), the optimal deviation price is $\frac{q_L}{q_H} \underline{p}$, which guarantees that all shoppers are attracted. The corresponding deviation gross profit is then

$$\pi_n\left(\frac{q_L}{q_H} \underline{p}; q_L\right) = \left[\frac{q_L}{q_H} \underline{p} - c_L + (I - 1)(q_H - c_H) \right] \frac{1 + \lambda}{2}.$$

□

Proof of Proposition 3. In Lemma 1, we have derived the optimal deviation pricing strategy and from this the corresponding profits when a retailer deviates to stocking q_L in category $i = 1$. Recall now that the brand manufacturer in $i = 1$ can extract as a fixed fee (and thereby, profit) the difference of the retailer's gross profit when stocking q_H at the marginal wholesale price c_H ,

$$\pi_n(q_H) = (q_H - c_H) I \frac{1 - \lambda}{2} = [\underline{p} - c_H + (I - 1)(q_H - c_H)] \frac{1 + \lambda}{2},$$

and the retailer's maximal deviation profit. Hence, when $I \leq \hat{I}$, the brand manufacturer in $i = 1$ makes a profit of

$$\begin{aligned}\Pi_1^M &= (q_H - c_H) I \frac{1 - \lambda}{2} - [q_L - c_L + (I - 1)(q_H - c_H)] \frac{1 - \lambda}{2} \\ &= (\Delta_q - \Delta_c) \frac{1 - \lambda}{2},\end{aligned}$$

that is, the same as other brand manufacturers. But when $I > \hat{I}$, the brand manufacturer in $i = 1$ makes a profit of

$$\begin{aligned}
 \Pi_1^M &= [\underline{p} - c_H + (I - 1)(q_H - c_H)] \frac{1 + \lambda}{2} - \left[\frac{q_L}{q_H} \underline{p} - c_L + (I - 1)(q_H - c_H) \right] \frac{1 + \lambda}{2} \\
 &= \left[\underline{p} \left(\frac{q_H - q_L}{q_H} \right) - (c_H - c_L) \right] \frac{1 + \lambda}{2} \\
 &= \frac{1 + \lambda}{2} (\Delta_q - \Delta_c) - \lambda I \frac{\Delta_q}{q_H} (q_H - c_H) \\
 &= \frac{1 - \lambda}{2} (\Delta_q - \Delta_c) - \lambda I \frac{\Delta_q}{q_H} (q_H - c_H) + \lambda (\Delta_q - \Delta_c) \\
 &= \frac{1 - \lambda}{2} (\Delta_q - \Delta_c) - \lambda \left[\frac{\Delta_q}{q_H} (q_H - c_H) \right] \left[I - \frac{(\Delta_q - \Delta_c) q_H}{\Delta_q (q_H - c_H)} \right] \\
 &= \frac{1 - \lambda}{2} (\Delta_q - \Delta_c) - \lambda \left[\frac{\Delta_q}{q_H} (q_H - c_H) \right] (I - \hat{I}),
 \end{aligned}$$

as stated in the proposition. Clearly, this is strictly lower than other brand manufacturers' profits of $\frac{1 - \lambda}{2} (\Delta_q - \Delta_c)$. Moreover, Π_1^M is clearly strictly decreasing in I , with $\Pi_1^M(\hat{I}) = \frac{1 - \lambda}{2} (\Delta_q - \Delta_c)$ and $\Pi_1^M(\tilde{I}) = 0$, as claimed. \square

Proof of Proposition 4. In the subsequent lemma, we provide a full characterization of the equilibrium (product and pricing) strategies in category $i = 1$, which implies the statements in the proposition. \square

Lemma 2. *If the converse of (7) holds such that $I > \tilde{I}$, no equilibrium exists in which both retailers stock the branded product or the low-quality product in category $i = 1$ with probability one. There exists a unique symmetric equilibrium involving mixed product strategies such that either retailer stocks the branded product in $i = 1$ with probability*

$$\alpha^* = \frac{1 - \lambda}{2\lambda} \left[\frac{(\Delta_q - \Delta_c) q_H}{(I - 1)(q_H - c_H) \Delta_q + q_L c_H - q_H c_L} \right] \in (0, 1),$$

where $\alpha^*(\tilde{I}) = 1$ and $\alpha^*(I)$ strictly decreases in I .

The equilibrium pricing strategies are as follows. Conditional on stocking q_H in $i = 1$, a retailer draws his price in $i = 1$ from the CDF

$$F_H(p_H) = 1 - \frac{1}{\alpha^*} \left[\frac{1 - \lambda}{2\lambda} \left(\frac{q_H - p_H}{p_H - c_H + (I - 1)(q_H - c_H)} \right) \right]$$

with support

$$[\underline{p}_H, \bar{p}_H] = \left[\frac{\Delta_c}{\Delta_q} q_H, q_H \right].$$

Conditional on stocking q_L in $i = 1$, a retailer draws his price in $i = 1$ from the CDF

$$F_L(p_L) = \frac{1 - \frac{1 - \lambda}{2\lambda} \left(\frac{q_H - \Delta_c - p_L}{p_L - c_L + (I - 1)(q_H - c_H)} \right)}{1 - \alpha^*}$$



with support

$$[\underline{p}_L, \bar{p}_L] = \left[\underline{p} - \Delta_c, \frac{\Delta_c}{\Delta_q} q_L \right],$$

where \underline{p} is given in (3). In this equilibrium, the brand manufacturer in $i = 1$ charges no fixed fee and consequently makes zero profit.

Proof. Recall from the main text that for $I > \tilde{I}$, no equilibrium exists in which both retailers stock the branded product in $i = 1$ for sure or where both retailers stock the low-quality quality product in $i = 1$ for sure. In what follows, we confine ourselves to proving existence of the outlined symmetric mixed-strategy equilibrium in product choice (and pricing). The proof for why this is also the unique symmetric equilibrium is slightly more subtle and is available from the authors upon request.

For existence, note first that when retailers stock different products in $i = 1$ in the candidate equilibrium, then firms' price distributions are such that $q_H/p_H < q_L/p_L$ with probability one (as $q_H/\underline{p}_H = q_L/\bar{p}_L$, $p_H \geq \underline{p}_H$ and $p_L \leq \bar{p}_L$). Hence, a retailer stocking q_H in $i = 1$ (at marginal wholesale price c_H) and setting some price $p_H \in [\underline{p}_H, \bar{p}_H]$ only attracts the shoppers if its rival stocks the high-quality product as well and chooses a price higher than p_H (which has joint probability $\alpha^*(1 - F_H(p_H))$). Therefore, such a retailer's expected gross profit is given by

$$\begin{aligned} \pi_n(p_H; q_H) &= [p_H - c_H + (I - 1)(q_H - c_H)] \left[\frac{1 - \lambda}{2} + \lambda \alpha^*(1 - F_H(p_H)) \right] \\ &= (q_H - c_H) I \left(\frac{1 - \lambda}{2} \right), \end{aligned}$$

where the second equality follows from inserting $F_H(\cdot)$ and simplifying. If instead a retailer stocks q_L in $i = 1$ and sets some price $p_L \in [\underline{p}_L, \bar{p}_L]$, the retailer attracts the shoppers whenever the rival stocks q_H in $i = 1$ (probability α^*) or when the rival stocks q_L in $i = 1$ and chooses a price higher than p_L (joint probability $(1 - \alpha^*)(1 - F_L(p_L))$). Therefore, such a retailer's expected gross profit is given by

$$\begin{aligned} \pi_n(p_L; q_L) &= [p_L - c_L + (I - 1)(q_H - c_H)] \left\{ \frac{1 - \lambda}{2} + \lambda [\alpha^* + (1 - \alpha^*)(1 - F_L(p_L))] \right\} \\ &= [p_L - c_L + (I - 1)(q_H - c_H)] \left\{ \frac{1 - \lambda}{2} + \lambda [1 - (1 - \alpha^*)F_L(p_L)] \right\} \\ &= (q_H - c_H) I \left(\frac{1 - \lambda}{2} \right) = \pi_n(p_H; q_H), \end{aligned}$$

where the third equality follows from inserting $F_L(\cdot)$ and simplifying.

As a first implication, note that the retailers are indeed indifferent between stocking q_H in $i = 1$ and setting any price $p_H \in [\underline{p}_H, \bar{p}_H]$, or stocking q_L in $i = 1$ and setting any price $p_L \in [\underline{p}_L, \bar{p}_L]$. A further implication from this indifference is that the brand manufacturer in $i = 1$ can indeed not charge a positive fixed fee. Further, retailers cannot profitably deviate by stocking q_H in $i = 1$ and pricing above $\bar{p}_H = q_H$ (as this would imply zero demand) or stocking q_L in $i = 1$ and pricing below \underline{p}_L (as already by setting $p_L = \underline{p}_L$, the shoppers are attracted with certainty). It remains to show that the retailers do not wish to deviate by stocking q_H in $i = 1$ and pricing strictly below \underline{p}_H (giving them a chance to attract the shoppers even when the rival stocks q_L in $i = 1$) or by stocking q_L in $i = 1$ and pricing strictly above \bar{p}_L (risking to lose the shoppers also when the rival chooses q_H in $i = 1$, but realizing a higher margin on each sale of $i = 1$). We prove this next.

To see the former, note that for $p_H < \underline{p}_H$, a retailer's expected gross profit is given by

$$\pi_n(p_H; q_H) = [p_H - c_H + (I - 1)(q_H - c_H)] \left[\frac{1 + \lambda}{2} - \lambda(1 - \alpha^*)F_L \left(p_H \frac{q_L}{q_H} \right) \right],$$

as the mass λ of shoppers is attracted unless the rival stocks low quality in $i = 1$ and prices below $p_H \frac{q_L}{q_H}$ (joint probability $(1 - \alpha^*)F_L(p_H \frac{q_L}{q_H})$). Plugging in $F_L(\cdot)$ and simplifying yields

$$\pi_n(p_H; q_H) = [p_H - c_H + (I - 1)(q_H - c_H)] \left(\frac{1 - \lambda}{2} \right) \left(\frac{I(q_H - c_H)}{p_H \frac{q_L}{q_H} - c_L + (I - 1)(q_H - c_H)} \right)$$

for $p_H < \underline{p}_H$. The derivative of $\pi_n(p_H; q_H)$ with respect to p_H has the same sign as

$$q_L c_H - q_H c_L + (I - 1)(q_H - c_H) \Delta_q.$$

This is strictly positive for $I > \hat{I}$, which is true since by assumption $I > \tilde{I}$ and it holds that $\tilde{I} > \hat{I}$. We have thus shown that it is indeed not profitable to deviate to prices p_H below \underline{p}_H . If instead a retailer stocks q_L in $i = 1$ and chooses a price $p_L \in (\bar{p}_L, q_L]$, its expected gross profit is

$$\pi_n(p_L; q_L) = [p_L - c_L + (I - 1)(q_H - c_H)] \left[\frac{1 - \lambda}{2} + \lambda \alpha^* \left(1 - F_H \left(p_L \frac{q_H}{q_L} \right) \right) \right],$$

as the mass λ of shoppers is only attracted when the rival retailer stocks q_H and chooses a price that exceeds $p_L \frac{q_H}{q_L}$ (joint probability $\alpha^*(1 - F_H(p_L \frac{q_H}{q_L}))$). Inserting $F_H(\cdot)$ and simplifying yields

$$\pi_n(p_L; q_L) = [p_L - c_L + (I - 1)(q_H - c_H)] \left(\frac{1 - \lambda}{2} \right) \left(\frac{I(q_H - c_H)}{p_L \frac{q_H}{q_L} - c_H + (I - 1)(q_H - c_H)} \right)$$

for all $p_L \in (\bar{p}_L, q_L]$. The derivative of $\pi_n(p_L; q_L)$ with respect to p_L now has the same sign as

$$-[q_L c_H - q_H c_L + (I - 1)(q_H - c_H) \Delta_q],$$

which is strictly negative as $I > \tilde{I} > \hat{I}$. Hence, also deviation prices p_L above \bar{p}_L are not profitable. Taken together, we have thus shown that the outlined symmetric strategies indeed constitute an equilibrium, while no equilibrium exists where in $i = 1$ either the high- or the low-quality product is chosen with probability one. We finally note that all CDFs and probabilities used in the construction of the equilibrium are well-behaved as follows: $\alpha^*(\tilde{I}) = 1$ (as is easy to check), so that $\alpha^*(I) \in (0, 1)$, which is also strictly decreasing in I for $I > \tilde{I}$, $F_H(\underline{p}_H) = F_L(\underline{p}_L) = 0$, $F_H(\bar{p}_H) = F_L(\bar{p}_L) = 1$, and $F_H(p_H)$ and $F_L(p_L)$ are strictly increasing in their arguments for $p_H \in [\underline{p}_H, \bar{p}_H]$ and $p_L \in [\underline{p}_L, \bar{p}_L]$, respectively. \square

APPENDIX B: ALTERNATIVE FOUNDATIONS FOR CONSUMERS' CHOICE RULE

As discussed in the Introduction, the notion of context-dependent preferences has been formalized in various ways in the literature, and we do not claim that our formalization based on “salient thinking” (building on Bordalo et al., 2013 and the adaptation to imperfect competition in Inderst & Obradovits, 2020) is generally preferable. In fact, in our specific context, the same outcome would be obtained from alternative specifications, as we will briefly outline in this appendix.

For this, suppose first that when comparing two offers, it is simply the *relative* difference in qualities and prices that matters (“pairwise relative thinking”). To make this precise, note that for two undominated offers with different qualities, the high-quality offer has a $100 \cdot \frac{q_H - q_L}{q_L}$ percent higher quality than the low-quality offer, but also a $100 \cdot \frac{p_H - p_L}{p_L}$ percent higher price. Suppose now that a consumer prefers the cheaper low-quality offer when the difference in quality is *relatively* lower than the difference in prices in this (percentage) sense, that is, when

$$\frac{q_H - q_L}{q_L} < \frac{p_H - p_L}{p_L}. \quad (\text{B1})$$

Reorganizing inequality (B1), we can alternatively say that the consumer prefers the low-quality offer when

$$\frac{q_L}{p_L} > \frac{q_H}{p_H} \quad (\text{B2})$$

and the high-quality offer when the converse holds strictly. In other words, consumers may also compare offers in terms of the respective “quality-per-dollar,” and choose the offer that provides the highest value in this sense, for example, low quality when condition (B2) holds.³⁴ It is immediate that conditions (B1) and (B2) are equivalent to our earlier condition (2).

Finally, we note that this choice logic also pertains when consumers derive a constant marginal utility from quality and maximize consumption with respect to a binding fixed budget constraint, as motivated from a theory of mental accounting (Thaler, 1985). To see this, suppose that consumers choose quantities $x_n \geq 0$ so as to maximize $\sum_{n \in N} x_n (q_n - p_n)$ subject to the (binding) category-specific resource constraint $\sum_{n \in N} x_n p_n \leq E$ (where E is the budget allocated to the considered category in the mental account). When the constraint binds, we are again back to our choice criterion of salient/relative thinking.³⁵

APPENDIX C: BENCHMARK MODEL WITH ELASTIC DEMAND

In this appendix, we consider a straightforward extension of our benchmark model in which all consumers had the same reservation value for shopping (of zero). Instead, we now suppose that consumers differ in their reservation values. Our aim is to show that in such a model variant, the brand manufacturer’s profit in the promoted category $i = 1$ is strictly *increasing* in the degree of one-stop shopping I , and that its profit is strictly larger than the profits of the brand manufacturers in all other categories $i > 1$.

Suppose henceforth that the consumers have heterogeneous reservation values $\theta \geq 0$, where θ is distributed according to some atomless CDF $G(\theta)$, with $G(0) = 0$ and strictly positive density $g(\theta) \equiv G'(\theta)$ in the interior of its support. To guarantee that the subsequent analysis is well-behaved, we further assume that $g(\theta)/G(\theta)$ is weakly decreasing, which is, for example, satisfied if the density of consumer reservation values is (weakly) decreasing in their size.

Following the logic from our baseline model, we start by observing that, first, for all products the more efficient high quality will be stocked and, second, that in equilibrium marginal wholesale prices equal marginal costs.

Observe next that a retailer’s expected (gross) profit with any nonshopping local consumer is

$$\pi(p) = [p - c_H + (I - 1)(q_H - c_H)]G(q_H - p). \quad (\text{C1})$$

Since, by assumption, g/G is weakly decreasing, it is easy to see that $p^m = \arg \max_p \pi(p)$ is uniquely determined and results in (per-consumer) expected profits of $\pi^m = \pi(p^m)$. Thus, when a retailer only attracts nonshoppers, its maximum profit is $\frac{1-\lambda}{2}\pi^m$ (gross of any fixed fee paid to the manufacturer).

We now turn to the derivation of manufacturer profits. Take $i = 1$ with respective profits Π_1^M . From the respective indifference condition for each retailer, we now have that

$$\Pi_1^M = \frac{1-\lambda}{2}(\pi_H^m - \pi_L^m),$$

where π_H^m denotes the maximum profit when the retailer stocks q_H at cost c_H and π_L^m denotes the respective maximum profit when the retailer instead stocks q_L at cost c_L . Using uniqueness of the respective prices p_H^m and p_L^m and applying the envelope theorem, it follows that

$$\frac{d\Pi_1^M}{dI} = (q_H - c_H) \frac{1-\lambda}{2} \left[G(q_H - p_H^m) - G(q_L - p_L^m) \right].$$

To show that the profits of the brand manufacturer in $i = 1$ increase with the extent of one-stop shopping, it thus remains to prove that $q_H - p_H^m > q_L - p_L^m$, that is,

$$p_H^m - p_L^m < \Delta_q. \quad (C2)$$

To see this, it is now convenient to denote more generally $p^m(q, c)$ as the “monopoly price” when, at $i = 1$, quality q is stocked at cost c . With this, we rewrite

$$\begin{aligned} p_L^m &= \arg \max_p [(p - c_L + (I - 1)(q_H - c_H))G(q_L - p)] \\ &= \arg \max_p [(p - \Delta_q - c_L + (I - 1)(q_H - c_H))G(q_L - (p - \Delta_q))] - \Delta_q \\ &= \arg \max_p [(p - (\Delta_q + c_L) + (I - 1)(q_H - c_H))G(q_H - p)] - \Delta_q \\ &= p^m(q_H, \Delta_q + c_L) - \Delta_q, \end{aligned}$$

where the second equality follows because $\arg \max_x f(x) = (\arg \max_x f(x + h)) + h$.

Hence, plugging in $p_L^m = p^m(q_H, \Delta_q + c_L) - \Delta_q$, the requirement (C2) transforms to

$$p_H^m = p^m(q_H, c_H) < p^m(q_H, \Delta_q + c_L).$$

This is true as $\partial p^m(q, c)/\partial c > 0$ and as $\Delta_q + c_L > c_H$ from $\Delta_q > \Delta_c$.

With respect to manufacturer profits, it remains to prove that, with elastic demand, $\Pi_1^M > \Pi_i^M$ for $i > 1$. To see this, we have to derive Π_i^M , using again retailer indifference. For this, we now make use of expression (C1) as follows. On equilibrium, the retailer's gross profits are $\frac{1-\lambda}{2}\pi^m$. Off equilibrium, after rejecting the offer of one manufacturer in some category $i > 1$, the retailer's maximum profits are again obtained by targeting only nonshoppers and choosing the respective optimal “monopoly” price p , thereby now realizing (per-consumer) profits

$$\max_p [p - c_H + (I - 2)(q_H - c_H) + (q_L - c_L)]G(q_H - p).$$

We denote these per-consumer profits by $\pi_{H,L}^m$, indicating that high quality is offered in category 1 (as well as in $I - 2$ additional categories), while in one (nonpromoted) category low quality is offered. Consequently, we have, for $i > 1$,

$$\Pi_i^M = \frac{1-\lambda}{2} (\pi_H^m - \pi_{H,L}^m),$$

so that $\Pi_1^M > \Pi_i^M$ holds if and only if $\pi_L^m < \pi_{H,L}^m$. This is the case if

$$\max_p [p - c_L + (I - 1)(q_H - c_H)]G(q_L - p) < \max_p [p - c_H + (I - 2)(q_H - c_H) + (q_L - c_L)]G(q_H - p).$$

Recall that the maximizer of the first expression is denoted by p_L^m . Clearly, the second expression is bounded from below when we substitute some arbitrary price p' , such as $p' = p_L^m + \Delta_q$. The second expression is thus bounded from below by

$$[p_L^m - c_L + (I - 1)(q_H - c_H)]G(q_L - p_L^m),$$

such that the above inequality is indeed satisfied.

For completeness, we finally extend our characterization of the pricing equilibrium. Both retailers randomize prices in the promoted category $i = 1$ according to some continuous CDF $F(p)$ over the support $p \in [\underline{p}, p_H^m]$. A retailer choosing $p = \underline{p}$ can be certain to sell to all shoppers whose reservation value is sufficiently low, while with $p = p_H^m$, the retailer sells only to its local nonshoppers (with sufficiently low reservation value). To make the retailer indifferent between these two choices, \underline{p} must satisfy

$$\left(\frac{1-\lambda}{2} + \lambda\right)[\underline{p} - c_H + (I-1)(q_H - c_H)]G(q_H - \underline{p}) = \frac{1-\lambda}{2}\pi_H^m,$$

while the distribution $F(p)$ is finally obtained from the requirement to make each retailer indifferent also with respect to all $p \in (\underline{p}, p_H^m)$:

$$F(p) = 1 - \frac{1-\lambda}{2\lambda} \left[\frac{\pi_H^m}{[p - c_H + (I-1)(q_H - c_H)]G(q_H - p)} - 1 \right].$$