Multi-Tier Store Brands and Channel Profits

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Abstract

Multi-tier store brands are growing in significance in retail outlets. In this paper, we theoretically examine the rationale for the existence of multi-tier store brands, their optimal quality levels, and their implications for consumer welfare and channel profits. We show that despite manufacturer's efforts to deter the entry of store brands by providing side payments and/or introducing additional national brands, the retailer will offer multi-tier store brands in equilibrium. Furthermore, the quality levels of store brands and national brands are interlaced, with the top-quality position being taken by a store brand unless national brands outnumber store brands. Even though the proliferation of store brands reduces product differentiation, it does not decrease consumer welfare or channel profits. However, store brands hurt the manufacturer's profits and make two-part tariff ineffective in improving channel coordination. Nonetheless, the retailer can enhance channel coordination by procuring the store brand from the national brand manufacturer. We extend our model in several directions to capture additional features of retail markets and assess the robustness of our findings.

Keywords: Multi-Tier Store Brands, Store Brand Quality, Pricing Power, Channel Coordination, Vertical Differentiation.

1   Introduction

Many retailers offer multi-tier store brands, and we see premium and mid-quality store brands in addition to economy store brands (Geyskens, Gielens, and Gijsbrechts 2010). For example, Target provides two tiers of store brands in the grocery category: Market Pantry and Archer Farms. Tesco pursues a similar strategy in the UK with three tiers of store brands: Tesco Value, Tesco Standard, and Tesco Finest (Kumar and Steenkamp 2007). IRI, a leading retail market research firm, also advises retailers to offer multi-tier store brands to expand sales (Howlett 2010). Given that the quality of store brands is an important strategic lever at the disposal of the retailer, offering multiple store brands at different quality tiers can make the retailer a formidable competitor to the national brand manufacturer. Empirical evidence suggests that store brands have helped retailers to increase their share of channel profits (Kadiyali, Chintagunta, and Vilcassim 2000, Brady, Brown, and Hulit 2003). In this paper, we take a step toward theoretically analyzing the implications of a retailer offering multi-tier store brands. In particular, we examine how multi-tier store brands can affect national brand manufacturers, retailers and consumers.

It is interesting to see the growth of multi-tier store brands despite the efforts of national brand manufacturers to deter the entry of store brands. For example, some manufacturers have used various forms of payments to motivate retailers to support the national brands (Kim and Staelin 1999, Ailawadi 2001). Other manufacturers have introduced new products to curb multi-tier store brands (Gielens 2012). This raises the question of why such strategies are less effective in handling the store brand problem. With the advent of multiple store brands in the same product category, retailers now can strategically choose the quality levels of store brands to target different consumer segments. Thus it will be useful to understand how the relative quality levels of store brands and national brands are determined. In addition, as store brands become more common in a retail outlet, the degree of product differentiation might also change. However, it is not evident how this change affects channel profits and consumer welfare. Interestingly, instead of competing against store brands, a few national brand manufacturers such as Bausch and Lomb, Bird's Eye, Del Monte, Nestle and H. J. Heinz, have chosen to join hands with retailers and supply them with store brands.

Some are skeptical about this strategy, as store brands will cannibalize the national brand sales (Kumar and Steenkamp 2007). It is also an open question why a retailer would ever procure its store brand from a national brand manufacturer when the retailer can buy it at marginal cost from a fringe manufacturer.

Given that multi-tier store brands are of different quality levels, we analyze the multi-tier store brand phenomenon using a vertical differentiation model that allows for *quality differentiation*. In the quality-setting stage of our model, the manufacturer and the retailer sequentially choose the quality levels of the national brands and the store brands, respectively. In the following price-setting stage, the manufacturer sets the wholesale price of the national brands and then the retailer chooses the retail prices for all the products in its store. Using this simple setting, we highlight some surprising results about multi-tier store brands. Our modest goal is to offer proofs for the existence of such counterintuitive results and explain how they are driven by retailer's pricing power and retailer's ability to garner all the profits from the store brand and a part of the profits from the national brands. First note that because of the threat posed to its profits, the national brand manufacturer could seek to prevent the entry of the store brand by making a side payment to the retailer and/or introducing additional national brands. We find that the retailer can introduce the store brand despite these efforts of the manufacturer. To understand why side payments may not deter store brand entry, notice that the store brand not only draws sales from the national brand but also expands the market. Thus, in addition to transferring some profits from the national brand manufacturer to the retailer, the store brand creates additional profits to the channel. Therefore, the national brand manufacturer cannot afford to make an attractive enough side payment that will prevent the entry of a store brand. Furthermore, by introducing additional products, the national brand manufacturer can reduce the retailer's incentive to offer a store brand, but cannot totally crowd out the store brand unless the retailer's fixed cost of introducing a product is very large.

Our analysis suggests that the top-quality position can be taken by one of the store brands. However, the lowest-quality position is given to one of the national brands. Moreover, the quality levels of store brands and national brands will be interlaced. An interlaced quality pattern helps to better manage inter-firm and intra-firm competition. We also find

that proliferation of store brands could lead to reduced product differentiation in retail outlets. One may wonder whether this would decrease channel profits and consumer welfare. On the contrary, we find that an increase in the proportion of store brands raises total channel profits and consumer welfare. In particular, the retailer is able to increase total channel profits by charging on average a lower price for all products and thereby expanding the market. While it is true that some consumers may be hurt because of reduced product differentiation, others may benefit from it. On the aggregate, consumer welfare improves because quality does not decrease as much as price.

Store brands not only hurt the manufacturer's profits but also make two-part tariff ineffective in improving channel coordination. But the retailer can improve channel coordination by strategically procuring the store brand from the national brand manufacturer. Our analysis shows that by doing so, the retailer can help better differentiate the quality levels of the store brand and the national brand, reduce cannibalization, and improve total channel profits. This suggests that quality could be a useful lever for coordinating channel profits when the retailer offers a store brand.

We also extend the model to investigate additional issues. First, consumers may perceive the quality of the store brand to be lower than its objective quality. If the perception is significantly distorted, the retailer may give up taking the top-quality position with its store brand even in circumstances where it would have otherwise taken the top-quality position. Second, we examine the sensitivity of our results to the decision sequence in the quality-setting game as well as to the number of products. In most cases, the relative quality of the store brands remains invariant to such changes in model structure. Third, note that sometimes the manufacturer may motivate the retailer to conform to the manufacturer's suggested retail price by offering a lump-sum allowance to the retailer. However, such a tactic does not help to improve total channel profits. Fourth, when the manufacturer enjoys cost advantage over the retailer in producing the store brand, procuring the store brand from the national brand manufacturer might improve channel coordination. Yet for some intermediate levels of cost advantage, the retailer may choose not to procure the store brand from the manufacturer. Finally, we examine how the presence of store brands could moderate the effect of competition on channel profits and quality ordering.

The rest of the paper is organized as follows. Section 2 reviews prior literature on store brands and relates it to our work. Section 3 introduces a bilateral monopoly model, presents the results of the model, and examines several model extensions. Section 4 investigates the implications of competition among manufacturers and competition among retailers. Finally, Section 5 concludes by summarizing the key findings and outlining directions for further research.

2 Related Literature

Raju, Sethuraman, and Dhar (1995) propose a parsimonious framework for studying the store brand phenomenon. Using an aggregate demand formulation, they show that it is profitable for the retailer to introduce a store brand when the cross-price sensitivity among national brands is low and the cross-price sensitivity between the national brands and the store brand is high. Furthermore, in such situations, the store brand garners a larger share of the market compared to the national brand. Sayman, Hoch, and Raju (2002) extend this aggregate model to examine how a store brand should be positioned in a market comprised of two national brands. They show that under some conditions, it is profitable for the retailer to position its store brand close to the leading national brand. By doing so, the retailer can improve its margin on the national brands and increase category profits. In their model, the cross-price sensitivity parameter reflects the position of the store brand in relation to a national brand, and the retailer decides the size of the cross-price sensitivity parameter. They pursue this formulation because it is a challenge to capture in a store brand model the competition among the national brands as well as the competition between the store brand and the national brands while recognizing that the national brands and the store brand operate at different levels of the distribution channel. In this paper, we propose a *vertical differentiation* model that allows for competition among the national brands as well as competition among store brands and that is faithful to the channel structure. The formulation permits us to investigate the use of store brand quality levels as a strategic lever and its implications for national brand manufacturers, retailers and consumers. Using a vertical differentiation formulation, Nasser, Turcic, and Narasimhan (2013) study how a

manufacturer can handle the store brand by supplying the store brand or adjusting the quality of the national brand. They show that the optimal strategy of the manufacturer depends on the manufacturer's relative cost efficiency. The optimal quality of the national brands, however, is derived keeping the quality of the store brand at an exogenously specified level. In contrast, we *fully endogenize* the quality decisions of both the manufacturer and the retailer, and recognize that the quality of the store brand is set after the quality choice of the national brand manufacturer. Furthermore, our focus is different. We are primarily interested in the quality levels of multiple store brands and how they relate to the quality levels of national brands. In addition, we identify a new avenue for channel coordination: by procuring its products from the national brand manufacturer, a retailer can improve channel profits.

Our research is also related to prior work on horizontally differentiated store brands. Soberman and Parker (2006) suggest that if a manufacturer were to produce both a national brand and a store brand that are horizontally differentiated, it could price discriminate between advertising-sensitive and price-sensitive consumers. We find that if the retailer procures the store brand from a national brand manufacturer, it can help facilitate channel coordination. Thus we provide a way to turn store brands into a source of mutual benefits, rather than a source of channel conflict (see also Mittendorf, Shin, and Yoon 2013). Moreover, we show that quality is an important lever in coordinating the channel. Using a bargaining model, Scott-Morton and Zettelmeyer (2004) show that the mere threat of a retailer offering a close substitute to the leading national brand (namely, a store brand) is sufficient to reduce the disagreement payoff of the leading national brand manufacturer, and help the retailer negotiate a lower wholesale price for the national brand. Narasimhan and Wilcox (1998) suggest that a store brand enhances the retailer's ability to obtain concessions from the manufacturer, whereas Corstjens and Lal (2000) show that a store brand can help differentiate a retailer, develop a loyal customer base, and improve profits. In our vertical differentiation model, competition from the store brand helps to lower the wholesale price of the national brand, expand the market and improve the retailer's profits.

Our work adds to prior literature on product line design in the context of a distribution channel. Liu and Cui (2010) analyze the optimal product line length of a manufacturer when

consumers are horizontally heterogeneous, while Villas-Boas (1998) examines the manufacturer's optimal product qualities that will induce the retailer to either serve all or target a certain segment of consumers. Our model allows both manufacturer and retailers to choose optimal quality levels and their respective product line length. This permits us to investigate a manufacturer's incentive to offer more national brands to curb the entry of the store brand, explore the retailer's motivation to provide multiple store brands, and assess the relative quality levels of store brands and national brands.

Our work builds on prior empirical studies on store brands. Ailawadi and Harlem (2004) show that a retailer earns a higher margin on store brands compared to national brands. Moreover, the retailer's margin on national brands increases with the store brand's share of the category, implying that the store brand enables a retailer to obtain better terms from manufacturers (see also Chintagunta, Bonfrer, and Song 2002, Pauwels and Srinivasan 2004, and Meza and Sudhir 2010). Our analysis shows how a retailer can leverage a store brand to translate its pricing power to profits. We also clarify how our findings are sensitive to market structure. Bloom, Gundlach, and Cannon (2000) provide evidence on side payments that manufacturers offer retailers to encourage them to promote the national brands (See also Kim and Staelin 1999). In particular, they argue that slotting allowances help compensate retailers for the risk of introducing a new product. We examine whether a manufacturer can use side payments to dissuade a retailer from introducing the store brand. In our context, side payments compensate the retailers for the profits forgone because of not introducing their store brands.

More recently, two empirical studies have brought to the fore the issue of multi-tier store brands. Geyskens, Gielens, and Gijsbrechts (2010) provide empirical evidence on multi-tier store brands, and examine how context effects may affect competition in a retail outlet. In particular, they show that economy and premium store brands may cannibalize the sales of mid-tier store brands, highlighting the need to optimize the portfolio decision. Gielens (2012) presents empirical support for the idea that premium store brands may increase category sales. Furthermore, new products by national brands may help reduce the decline in the market share of national brands. In keeping with this work, our model of store brands allows for economy, mid-tier and premium store brands. We also consider the possibility

that the manufacturer could introduce additional national brands to protect its market from store brands. Our analysis offers a rationale for the phenomenon of multi-tier store brands, and investigates how the endogenous quality choices of a retailer affects channel members and consumers. Next we introduce our theoretical framework and examine its implications.

3 Bilateral Monopoly

Consider a distribution channel consisting of one manufacturer and one retailer. The manufacturer, denoted by M, produces N national brands and sells them through the retailer, denoted by R. In addition to selling the national brands, the retailer offers S store brands. Thus, we have N national brands and S store brands in the market.

Consumers are heterogeneous in their valuation of quality. They are indexed by a preference parameter θ, which indicates their sensitivity to quality. Assume that θ is uniformly distributed over the interval $[a, b]$, where a is the lowest valuation of quality and b is the highest valuation of quality among the consumers in the market $(0 < a < b)$. Further, consumers' willingness to pay for product i depends not only on its quality q_i but also on the preference parameter θ, and the (indirect) utility derived by a consumer on purchasing product i is given by $U_i(\theta) = \theta q_i - p_i$ where p_i is the price of the product. Each consumer purchases the product which offers the highest utility. If a consumer does not derive a positive net utility from any product, she buys nothing. To allow for this possibility, we let the preference distribution have a wide support. In particular, we assume $b > 4.1032a$ so that the market has room to expand under any of the product configurations considered in this paper. The demand for any given product i in the market is as follows:

$$
z_i = \begin{cases}
\left(\frac{1}{b-a}\right)\left(b - \frac{p_i - p_{i+1}}{q_i - q_{i+1}}\right) & \text{if } \frac{p_i}{q_i} > \max_{i' \neq i}\{\frac{p'_i}{q'_i}\} \\
\left(\frac{1}{b-a}\right)\left(\frac{p_{i-1} - p_i}{q_{i-1} - q_i} - \frac{p_i}{q_i}\right) & \text{if } \frac{p_i}{q_i} < \min_{i' \neq i}\{\frac{p'_i}{q'_i}\} \\
\left(\frac{1}{b-a}\right)\left(\frac{p_{i-1} - p_i}{q_{i-1} - q_i} - \frac{p_i - p_{i+1}}{q_i - q_{i+1}}\right) & \text{otherwise,}
\end{cases}
\tag{1}
$$

where $i - 1$ and $i + 1$ denote the products placed before and after product i, respectively, when sorted on price per unit of quality (namely, $\frac{p_i}{q_i}$).

To offer the products, firms incur a marginal cost and a fixed cost. The marginal cost of producing a product of quality q_i is $c(q_i) = q_i^2$. When the manufacturer sells its national

brand j $(j = 1, \ldots, N)$ at the wholesale price of w_{Nj}, its profits before considering the fixed cost (namely, gross profits) are given by:

$$\pi_M = \sum_{j=1}^{N} z_{Nj}(w_{Nj} - q_{Nj}^2) \tag{2}$$

The retailer sells the national brand j $(j = 1, \ldots, N)$ at the retail price p_{Nj}, and its store brand k $(k = 1, \ldots, S)$ at price p_{Sk}. The retailer's corresponding gross profits are given by:

$$\pi_R = \sum_{j=1}^{N} z_{Nj}(p_{Nj} - w_{Nj}) + \sum_{k=1}^{S} z_{Sk}(p_{Sk} - q_{Sk}^2). \tag{3}$$

Denote the manufacturer's fixed cost for introducing a product by F_M and the corresponding fixed cost of the retailer by F_R. After accounting for the fixed costs of offering N national brands and S store brands, the manufacturer's and the retailer's net profits are as follows:

$$\Pi_M = \pi_M - N \cdot F_M \tag{4}$$

$$\Pi_R = \pi_R - S \cdot F_R. \tag{5}$$

Note that the fixed cost determines the number of products a firm offers. The fixed cost, however, does not directly influence the choice of product qualities and prices, given the product configuration. To focus our attention on a market with a small set of national brands ($N \leq 4$) and store brands ($S \leq 2$), we assume that $F_M \geq \frac{0.0002b^3}{b-a}$ and $F_R \geq \frac{0.0007b^3}{b-a}$.[1] Moreover, we allow for the possibility that $F_R > F_M$, implying that the manufacturer may be more cost-efficient than the retailer in introducing a new product.[2] To avoid confusion, we denote the gross profits by π and the (net) profits by Π.

In our game, the manufacturer and the retailer choose the quality levels of their products before deciding on the prices. In the quality-setting stage, the quality levels are chosen in a sequential manner. The manufacturer first chooses the quality levels of its national brands;

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[1]Given this assumption about fixed costs, in equilibrium we could observe up to four national brands when there is no store brand, up to three when there is only one store brand, and up to two when there are two store brands. On the other hand, under this fixed cost condition, the retailer can produce two store brands or less when there are one or two national brands, but one or zero when there are three national brands. We prove these claims in the Appendix (see Lemma A14 and Lemma A15). Thus, the fixed cost assumption restricts the product configurations that could be observed in equilibrium.

[2]However, our analysis is not limited to cases where $F_R > F_M$ holds. We illustrate this point in the Appendix (See Claim 1).

after observing the quality choices of the manufacturer, the retailer determines the qualities of its store brands. Next in the price-setting stage, the manufacturer sets the wholesale prices for the national brands. After observing the wholesale prices, the retailer sets the retail prices for all the products sold in its store. Using this model of bilateral monopoly, we analyze the phenomenon of multi-tier store brands, assess the relative quality levels of multiple store brands and examine channel coordination issues. As noted earlier, the purpose of our analysis is to establish the existence of counterintuitive results and explain the rationale of such outcomes. Hence, for a given (F_M, F_R) pair in the range of permissible fixed costs, we derive the equilibrium product configuration in Corollary A1 (See Appendix for details). For each product configuration, Lemmas A1 and A2 present the closed-form equilibrium solution for qualities and prices. Based on these equilibrium solutions, we offer a few insights on multi-tier store brands.

3.1   Multi-tier Store Brands

Retailers often carry a portfolio of store brands serving different quality tiers (Kumar and Steenkamp 2007). While store brands are beneficial to retailers, it hurts the profits of the national brand manufacturers (Ailawadi and Harlem 2004, Pauwels and Srinivasan 2004). Thus, a national brand manufacturer may consider deterring the entry of a store brand by providing a side payment to the retailer. The manufacturer may also reduce the potential market for store brands by introducing additional products. The question is whether these strategies will deter the entry of store brands. On analyzing the bilateral monopoly model, we have the following result.

Proposition 1. *Even if the manufacturer offers a side payment to the retailer and/or introduces an additional national brand, the retailer can still choose to introduce a store brand unless the retailer's fixed cost of entry is too large. Moreover, in equilibrium, the retailer can provide a portfolio of multi-tier store brands.*

We prove the propositions and the associated claims in the Appendix. To see the intuition for Proposition 1, first consider the simple setting with only one national brand. In the absence of a store brand, the manufacturer chooses the quality and the wholesale price of

the national brand whereas the retailer determines the retail price of the national brand. In this context, because of its first-mover advantage, the manufacturer earns more gross profits than the retailer. Specifically, we have $\pi_M = \frac{0.0185b^3}{b-a} > \pi_R = \frac{0.0093b^3}{b-a}$. The retailer, however, can limit the manufacturer's first-mover advantage by introducing a store brand. When the retailer offers a store brand, the manufacturer still moves first; however, the quality and the wholesale price choices for the national brand are restricted by the retailer's pricing power. To appreciate this, note that the retailer profits from all the products sold in its store whereas the manufacturer profits from only the national brand. Furthermore, the retailer sets the prices for all the products in its outlet. Consequently, the retailer is able to leverage the store brand to earn more (gross) profits: $\pi_R = \frac{0.0376b^3}{b-a} > \pi_M = \frac{0.0013b^3}{b-a}$. To further grasp the pricing power of the retailer, notice that if the manufacturer were to increase the wholesale price of a national brand, the retailer could set the retail prices such that more consumers buy the store brand. Thus, the store brand constrains the manufacturer's ability to profit from the national brand and thereby increases the retailer's profits. In essence, the reversal in the order of the relative profits of the two channel members is a result of the retailer leveraging the store brand to translate its pricing power to profits.

Given the shift in profits induced by the store brand, one may wonder whether the national brand manufacturer can make a side payment to the retailer that will dissuade the retailer from introducing the store brand. According to Proposition 1, the answer is no unless the retailer's fixed cost is very large. For the side payment to be attractive to the retailer, the payment needs to keep the retailer's net profits at least at the same level after the withdrawal of the store brand. We find that it is not profitable for the manufacturer to offer such an attractive side payment to the retailer unless retailer's fixed cost for introducing a product is very large. This is because the store brand increases the retailer's profits much more than it decreases the manufacturer's profits. Note that the store brand not only transfers some profits from the manufacturer to the retailer, but also expands the market and thereby generates additional profits for the retailer. Specifically, in the absence of the store brand the total gross profits of the channel is $\frac{0.0278b^3}{b-a}$, and it increases to $\frac{0.0389b^3}{b-a}$ when a store brand is introduced. Because the store brand expands the market, it is hard for the manufacturer to fully compensate the retailer for withdrawing the store brand from the

market. Therefore, unless the retailer's fixed cost for introducing a new product is so high that it cancels out the market expansion effect of the store brand, it is not possible for the manufacturer to make an attractive side payment to the retailer and prevent the entry of the store brand. For example, the manufacturer with one national brand cannot profitably make a side payment to the retailer and deter the entry of a store brand if the retailer's fixed cost for introducing a product is less than $\frac{0.0111b^3}{b-a}$ (which is the difference between the profits lost by the manufacturer and the profits gained by the retailer upon the entry of the store brand). However, as the retailer's fixed cost increases, the manufacturer's ability to deter store brand entry is strengthened.

As side payments are not effective in deterring store brand entry, one may ask the question whether the manufacturer can prevent the entry of the store brand by introducing additional national brands. In other words, can the manufacturer crowd the market with national brands such that there is no room for the entry of a store brand? To explore this issue, consider the case where the manufacturer offers multiple national brands. Here we find that the store brand expands the market even in the presence of multiple national brands and that introducing the store brand is still profitable to the retailer. This is because the retailer can manage to sell its store brand by appropriately pricing all the products in its store, and thereby increase its profits. For example, if the manufacturer offers four national brands, introducing a store brand increases the total demand from $\frac{0.2222b}{b-a}$ to $\frac{0.3954b}{b-a}$ and raises the retailer's gross profit from $\frac{0.0103b^3}{b-a}$ to $\frac{0.0381b^3}{b-a}$ (see column 5 in Table 1). Thus the manufacturer will not be able to crowd out the store brand by introducing additional national brands. It is interesting to note that adding an additional national brand to manufacturer's portfolio weakens the retailer's incentive to introduce a store brand but does not completely eliminate it (see Table 1(b) for the retailer's additional profits due to store brand entry).

–Insert Table 1 here–

The preceding analysis shows that a manufacturer may not be able to deter the entry of a store brand by either adding national brands to its portfolio or by making a side payment. However, it remains to be explored whether making a side payment on top of introducing an additional national brand would help the manufacturer to discourage the entry of a store brand. As noted above, the entry of an additional national brand limits the retailer's ability

to expand the market with a store brand. Consequently, now the manufacturer does not have to pay the retailer as much as it did when it had just one national brand, but it still needs to compensate the retailer enough for not introducing the store brand. On analyzing this issue further, we find that the additional profits that the retailer earns by introducing a store brand is more than the reduction in profit experienced by the manufacturer because of the store brand (unless the retailer's fixed cost of introducing the store brand is high). For example, the incremental profits that a retailer gains on introducing a store brand in addition to the two national brands in its store is $\frac{0.0280b^3}{b-a} - F_R$, and it is more than $\frac{0.0182b^3}{b-a}$, which is the profit lost by the manufacturer because of the store brand, if F_R is less than $\frac{0.0098b^3}{b-a}$. Thus, although the side payment necessary to deter store brand entry gets smaller with more national brands, it is not profitable for the manufacturer to provide a side payment that will prevent the entry of a store brand when the retailer's fixed cost is not too large.[3]

Finally, multi-tier store brands raise an interesting question about the retailer's pricing power in the channel: can the retailer drive out the national brands from the market by charging very high retail prices for them? We find that it is never profitable for the retailer to do so. To see this, recall that in the price-setting stage of the game, the retailer sets the optimal retail prices over all products based on the product configuration and the product qualities determined in the previous stages. In this case, it is always better for the retailer to offer more products in its store (including national brands) rather than fewer products, because with more products the retailer can better serve the heterogeneous consumers and extract more surplus from them. Therefore, the retailer will not be motivated to drive out the national brand.

Having shown that multi-tier store brands can coexist with the national brands, next we examine their quality levels. As noted earlier, due to our assumption about fixed costs, we confine attention to markets with a maximum of four national brands and two store brands.

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[3]The thresholds for retailer's fixed cost are given in the proof of Proposition 1 (See equations (A88)-(A95) in the Appendix).

3.2 Relative Quality Levels of Store Brands

Traditionally, consumers have viewed store brands to be of lower quality than national brands (Mills 1995, Pauwels and Srinivasan 2004). However, many stores offer premium store brands (Choi 2012). In addition, Proposition 1 implies that the retailer will introduce a portfolio of store brands at different quality levels and the empirical observation confirms this (Gielens 2012, Geyskens et al. 2010). For example, H-E-B offers three store brands in the ice-cream category, namely Hill Country Fare, H-E-B, and Central Market. Target sells two different qualities of flour tortillas under Market Pantry and Archer Farms private labels.[4] Then the key theoretical question is what the quality levels of these store brands should be. Upon studying the optimal quality levels of store brands in relation to national brands across the different product configurations that would be observed in equilibrium, we have the following finding:

Proposition 2. *The top-quality position is taken by one of the store brands unless the national brands outnumber the store brands. The lowest-quality position, however, is taken by one of the national brands. Furthermore, the retailer interlaces the quality levels of its store brands with those of the national brands.*

The first part of the proposition suggests that the store brand could take the top-quality position. To follow this result, note that the top-quality position is in general more profitable than a lower-quality position. This is because a product in a position other than the top faces competition on both sides: it confronts the higher-quality product at the upper end and the lower-quality product at the lower end. In the case of the lowest-quality product, it competes with the option of buying nothing at the lower end. Therefore, the retailer is better off taking the highest-quality position rather than any other position. The manufacturer also finds the highest-quality position attractive. Furthermore, because the manufacturer first sets the quality of the national brand, it can potentially take the top-quality position. Yet, recognizing the retailer's pricing power over all the products, the manufacturer anticipates and accommodates the more powerful retailer's strategic decisions. Therefore, one of the retailer's store brands comes to occupy the top-quality position. This result offers a potential

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[4]More details on these examples can be seen at www.heb.com and www.target.com.

explanation for why we observe premium store brands that are of a higher quality level than the national brands.

To understand when the store brand may concede the top-quality position to a national brand, consider a market where the national brands outnumber the store brands. When the retailer sells fewer store brands compared to the national brands, the store brands cannot cover as many market segments as the national brands do. Then, the retailer has two options: either retain the top-quality position and not cater to some segments, or give up the top position and instead serve as many segments as possible in the midst of the national brands. For a concrete example, consider a market with two national brands and one store brand. In this case, the retailer can choose to serve only the highest-quality segment with its store brand while yielding the rest of the market to the national brands. Or, it can position its store brand in the middle of the two national brands. While the latter option may seem to yield less profits because of intense competition from national brands, it is in fact the more profitable strategy for the retailer. This is because when the retailer uses its store brand as a buffer between national brands, it reduces the competition between the two national brands and thus the manufacturer sets the qualities more favorable to the retailer and claims a lower margin in setting the wholesale prices of national brands. The resulting improvement in the retailer's profits more than offsets the potential loss the retailer incurs on conceding the top-quality position to the manufacturer. Because of factors such as economies of scale and reputation, a leading manufacturer can develop and introduce a new product to the market at a lower fixed cost compared to a retailer. If this is the case, the national brands may outnumber the store brands in a retail store, and thus one of the national brands may take the top-quality position.

According to the second part of the proposition, the retailer will never position its store brand at the lowest-end of the market. To understand this finding, notice that in the bilateral monopoly there is always room for more profits if the market expands. To serve as many consumers as possible, the retailer could lower the price of the lowest-quality product. However, this strategy comes with a downside: a lower margin. If the lowest-quality product is a store brand, all the loss in margin is borne by the retailer. But if it is a national brand, the loss can be shared with the manufacturer. Hence the retailer prefers the national brand

to take the lowest-quality position. Interestingly, taking the lowest-quality position is also beneficial to the manufacturer because it helps to soften price competition. Specifically, when the national brand takes the lowest-quality position, the retailer is motivated to sell more of this product to expand the market, and hence competes less aggressively with this product. This analysis further clarifies the potential role of technological barrier in the vertical positioning of store brands and national brands. If the retailer faces technological constraint, its store brand will be the lowest-quality product in the market. In our model, since we do not impose any such constraint, we could tease out the effect of market power from that of technology barrier: in the absence of technology barrier, the retailer can induce the national brand to occupy the lowest-quality position in equilibrium.

Finally, to understand the rationale for the interlaced pattern of quality levels highlighted in the third part of the proposition, note that the retailer can consider two potential strategies for the vertical positioning of its multiple store brands. First, the retailer can position each store brand between a pair of national brands. Alternatively, the retailer can focus on the high-end or the low-end of the market and let the manufacturer cater to the other segment. The first strategy minimizes the cannibalization within the retailer's product line but intensifies competition between the national brands and the store brands. The second strategy, on the other hand, has the opposite effect: it increases intra-firm competition but minimizes inter-firm competition. According to Proposition 2, on considering the trade-offs involved in pursuing these two potential strategies, the retailer will adopt interlaced quality levels. The driving force behind this finding is the retailer's power to set the prices of all the products in its store, including the national brands. Even if store brands face competition from the national brands on all possible fronts because of the interlaced pattern of quality levels, the retailer can reduce the negative impact of intensified inter-firm competition by setting the prices of store brands relatively lower than those of the adjacent national brands. Furthermore, the lower price of store brands exerts a downward pressure on the wholesale price of competing national brands, thus helping the retailer to extract better terms from the national brand manufacturers. However, if the retailer pursues the second strategy of either focusing on the high-end or the low-end of the market, then reducing the price of its store brands will be less effective in weaning sales from the national brands because store

brands and national brands now serve very different segments (except for the two brands at the border). In addition, under this strategy, the retailer may try to set the qualities of the store brands such that the national brands are squeezed into a small corner of the market. Recognizing this possibility, the manufacturer would set its product qualities such that the retailer is discouraged from pursuing the focus strategy. Therefore, in equilibrium, the quality levels of the store brands and national brands are interlaced. This interlaced quality pattern is consistent with many retailers' attempts to offer a line of store brands that cater to consumers ranging from the high-end to low-end segment, rather than serving only the low-end market with multiple store brands.[5]

In retail stores, we observe quality patterns that are consistent with the predictions of our model. Publix sells three tiers of bagged salads under its own brand to compete with national brands: Publix Greenwise (high quality), Publix Premium (mid quality), and Publix (low quality). Compared to national brands, such as Dole and Fresh Express, Greenwise brand bagged salad offers the highest-quality (organic) vegetables, and it is a good example of a store brand being the highest quality product in a category. HEB also provides multi-tier store brands in categories such as water. In particular, it provides Natural Sparkling Mineral Water under its Central Market brand to compete against the top-tier national brands such as Evian, then Texas spring water under its HEB brand positioned against mid-tier national brands such as Nestle's Ozarka, and finally Hill Country Fare spring water to compete against low-tier national brands.[6] Next, we also observe the national brand taking the lowest-quality position in some categories. In the meats category, for example, HEB provides a high-quality fully-cooked beef brisket leaving the national brand to take a lower quality position. Note that our predictions are obtained based on the assumption that the retailer does not face any technology or perceptual barrier. When such barriers exist, however, we may observe a store brand of a lower quality than that of the national brands. For instance, HEB sells Hill Country Fare Essentials hair care products, which constitute the lowest-quality products in

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[5]Note that the main model allows for up to two store brands for simplicity, but as we show later in Section 3.6.3, the results can extend to the case of three store brands.

[6]More generally, as noted by an anonymous reviewer, in 21 different product categories of an IRI data set, the store brands are interlaced with national brands. Moreover, the store brand takes the highest-quality position in several store-category combinations.

that category. Next we examine how the entry of store brands affects total channel profits and product differentiation.

3.3 Product Differentiation and Channel Profits

As store brands proliferate in a retail outlet, they begin to account for a larger fraction of the products sold in the store. In the context of our model, we will see a proliferation of store brands in equilibrium when retailer's fixed cost for introducing a product decreases (see Lemma A15). Now we seek to understand how an increase in the proportion of store brands affects product differentiation and channel profits. Typically, when a firm adds a new product to its portfolio, it attempts to reduce cannibalization by better differentiating the qualities of its products. However, on analyzing the retailer's strategy, we obtain the following result.

Proposition 3. *As the proportion of store brands in a retail outlet increases, products may become less differentiated in both qualities and prices. Despite the decrease in product differentiation, consumers can be better off and total channel profits can increase.*

Like any firm, the retailer can use the quality lever to reduce cannibalization. However, the retailer can also leverage retail prices to better manage the competition among all the products in its store. When store brands compete with the national brands, we find that the retailer can squeeze the manufacturer by reducing quality differentiation and yet improve its profits. In particular, by charging lower prices for both national brands and store brands on average, the retailer can expand the market and soften the potential negative impact of cannibalization.[7] Therefore, with more store brands, the qualities of the products in a retail outlet can become less differentiated.

Now one may expect the reduced product differentiation to lower consumer welfare. On the contrary, according to the second part of the proposition, consumers may be better off when the proportion of store brands increases. This is because a product with lower price

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[7]To see that the average equilibrium price decreases, notice that when the total number of products is 3, the average price is $0.2381b^2$ when $S = 0$ but $0.2160b^2$ when $S = 1$ and $0.1597b^2$ when $S = 2$. Similarly, when the total number of products is 4, the average price is $0.2315b^2$ with $S = 0$, but $0.1898b^2$ with $S = 1$ and $0.1700b^2$ with $S = 2$.

can provide more surplus even if its quality is lower than ideal. More generally, depending on how the product choices of each consumer change with an increase in the proportion of store brands, some consumers may become better off whereas certain others may be worse off. For example, if the total number of products in the market is three ($N + S = 3$), consumers at the highest-end of the market who always choose the highest-quality product will gain when the number of store brands increases from 1 to 2. However, consumers with preference $\theta \in [0.7715b, 0.8088b]$ who always choose the second-highest quality product will lose because of the increase in the proportion of store brands.[8] On the aggregate, the total consumer welfare still increases, because although the average price decreases with more store brands, the qualities do not decrease as much. Furthermore, the lower price expands the market and increases consumer welfare by attracting new consumers to buy the lowest-quality product. Therefore, when the proportion of store brands increases in a retail outlet, consumers could be better off despite the reduced product differentiation.

The higher consumer welfare may raise the question whether consumers are gaining at the expense of the retailer and the manufacturer. While lower retail prices reduce the per-unit margin of store brands, the retailer sets the retail prices such that the increased volume more than offsets the lower margin. As retail prices of national brands are set by the retailer, the manufacturer cannot likewise easily increase its sales volume. Moreover, the lower retail price of store brands exerts a downward pressure on the wholesale price of national brands, making the margin on national brands thinner. Thus, because the reduced margin of national brands is not offset by increased sales, the manufacturer's profits are hurt. Nevertheless, the total channel profits increase because store brands help expand the market. As this discussion highlights, the introduction of a store brand reduces the manufacturer's profits, and it could hurt the retailer's relationship with the manufacturer. Next, we explore a potential avenue

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[8]When the total number of products in the market is three ($N + S = 3$), the highest-quality product's quality is $0.4426b$ and its price is $0.3256b^2$ when the retailer offers only one product (namely, $S = 1$), but when the retailer offers two products (namely, $S = 2$), the highest-quality product's quality is $0.4044b$ and its price is $0.2840b^2$. Since $0.4426b\theta - 0.3256b^2 \leq 0.4044b\theta - 0.2840b^2$ is equivalent to $\theta \leq 1.0890b$, those who always choose the highest-quality product (i.e., $\theta \in [0.9433b, b]$) are better off with $S = 2$. Similarly, the quality and the price of the second-highest quality products are given as (quality, price)= $(0.3308b, 0.2201b^2)$ for $S = 1$ and $(0.2131b, 0.1293b^2)$ for $S = 2$. Since $0.3308b\theta - 0.2201b^2 \geq 0.2131b\theta - 0.1293b^2$ is equivalent to $\theta \geq 0.7715b$, those who always choose the second-highest quality product (with preference $\theta \in [0.7715b, 0.8088b]$) are better off with $S = 1$.

by which the channel members can increase the manufacturer's profits and thus improve the channel coordination.

3.4 Store Brand and Channel Coordination

It is well-known that a two-part tariff can improve channel coordination by eliminating the double marginalization problem (Zusman and Etgar 1981, Jeuland and Shugan 1983, Tirole 1988). This result, however, is based on a market where the retailer does not offer a store brand. The open question is whether the manufacturer can use a two-part tariff to improve the total channel profits in the presence of the store brand. To examine this issue, consider a market with one national brand and one store brand. Recall that according to Corollary A1 in the Appendix, when $\frac{0.0005b^3}{b-a} < F_M \leq \frac{0.0013b^3}{b-a}$ and $\frac{0.0015b^3}{b-a} < F_R \leq \frac{0.0111b^3}{b-a}$, we will observe a market with one national brand and one store brand. In this market, the manufacturer offers the retailer a two-part tariff where it charges a per-unit wholesale price (w_N) along with a lump-sum fixed fee (W) for the national brand. Based on the two-part tariff, the retailer chooses the retail prices for both the national brand and the store brand. On assessing the effectiveness of two-part tariff in facilitating channel coordination, we have the following result.

Proposition 4. *In the absence of a store brand, the two-part tariff can improve total channel profits. However, in the presence of a store brand, the two-part tariff cannot improve total channel profits.*

In the absence of the store brand, when the manufacturer uses the two-part tariff scheme, it delegates the pricing decision to the retailer. Since the retailer retains all the margins, the retailer is motivated to choose a retail price that maximizes the total channel profits. The manufacturer then extracts all the profits by charging a high fixed fee. The two-part tariff thus increases both the manufacturer's profits and the total channel profits. In particular, the two-part tariff lowers the retail price and increases the sales of the national brand (compared to those obtained in the absence of a two-part tariff). Denote the two-part tariff model by $1N(T)$ and the wholesale-price contract model by $1N$. Then we have $p_N^{1N(T)} = 0.2222b^2 < p_N^{1N} = 0.2778b^2$ and $z_N^{1N(T)} = \frac{0.3333b}{b-a} > z_N^{1N} = \frac{0.1667b}{b-a}$. Furthermore, by avoiding double

marginalization, the manufacturer increases the total channel profits: $\pi_M^{1N(T)} + \pi_R^{1N(T)} = \frac{0.0371b^3}{b-a} > \pi_M^{1N} + \pi_R^{1N} = \frac{0.0278b^3}{b-a}$. (See Lemmas A1 and A3 for equilibrium solutions.)

According to the second part of the proposition, the two-part tariff is not effective in handling the double marginalization problem when the retailer offers a store brand. This is because when the retailer sells a store brand, the national brand competes with the store brand and the retailer softens this competition by lowering the margins on both products, thus hurting channel profits. Specifically, under the wholesale-price contract, the retailer considers the retail margin of the national brand and the gross margin of the store brand while setting prices. However, under the two-part tariff contract, the retailer takes into consideration the whole gross margin of the national brand (instead of just the retail margin) when setting prices. This leads the retailer to set a lower retail price for the national brand under the two-part tariff contract (compared to that under the wholesale-price contract) and it reduces total channel profits. Interestingly, the manufacturer seeks to coordinate the channel by providing the national brand even below its cost (i.e., $w_N < q_N^2$) to the retailer. But the retailer does not fully use this cost advantage to increase the sales of the national brand because the retailer's goal is to maximize its total profits from all the products in its store (not just the national brand). Thus under the two-part tariff scheme, while the manufacturer earns more profits by taking the top-quality position, the total channel profits does not increase beyond the level observed under the wholesale-price contract. It has long been a puzzle as to why manufactures do not often offer two-part tariffs to retailers despite their perceived theoretical advantage (see also Iyer and Villas-Boas 2003). Our analysis highlights the ineffectiveness of a two-part tariff in the presence of a store brand and helps us better appreciate the common practice of selling the national brand at a uniform wholesale price.

Clearly, it is the store brand that prevents the national brand from gaining larger sales and earning more profits under the two-part tariff plan. This may make one wonder whether there exists any way to facilitate channel coordination in the presence of the store brand. We next investigate this issue.

3.5   Channel Coordination through Strategic Procurement of Store Brand

A retailer could improve channel coordination by strategically sourcing the store brand from the national brand manufacturer. To examine this issue, consider a channel with one national brand and one store brand. In our analysis, as in the previous section, we focus on a market with one national brand and one store brand by assuming $\frac{0.0005b^3}{b-a} < F_M \leq \frac{0.0013b^3}{b-a}$ and $\frac{0.0015b^3}{b-a} < F_R \leq \frac{0.0111b^3}{b-a}$.[9] In this case, the manufacturer can offer the retailer three potential contracts. After ruling out the first two, we discuss the implications of the third option. First, the retailer can specify the quality for its store brand and ask the manufacturer to supply the store brand at its current procurement cost. In this case, unless the manufacturer has a cost advantage compared to the fringe manufacturer which currently supplies the store brand, it is not profitable for the manufacturer to offer the store brand at the current procurement cost.[10] On the other hand, if the manufacturer adds a markup to the marginal cost of producing the store brand, there is no incentive for the retailer to switch its supplier. Second, the retailer can ask the manufacturer to supply the store brand at the same absolute wholesale price that the retailer pays its current supplier, but give the manufacturer the right to set the quality of the store brand. In this case, the manufacturer will distort the quality of the store brand downward to improve its profits. This option will not appeal to the retailer, as now the retailer is being asked to pay a higher price for a unit of quality. Having ruled out these two obvious options, we turn our attention to the contract where the retailer buys the store brand at marginal cost but gives the manufacturer the privilege of optimizing the quality of the store brand. Under this third contract, the retailer may tolerate the manufacturer choosing the quality of the store brand, as long as the retailer is guaranteed to earn the same

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[9]The fixed cost may include both the production cost (such as the product development cost and the labor cost) and the product introduction cost (such as the advertising cost and the distribution cost). The former type of the fixed cost would change the net profit of both firms depending on who produces the store brand and thus affect the procurement decision of the store brand. However, the latter type does not affect the profitability of the procurement decision. We analyze both cases and for expositional reason we provide the case based on the latter type of fixed cost in the main paper while deferring the discussion on the former type of the fixed cost to the Appendix (see Claim 5).

[10] If the manufacturer can reduce its marginal cost due to economies of scale by a factor of α, such a contract can enhance the channel coordination when $\alpha \leq 0.9336$ or $\alpha \geq 0.9994$. We prove this claim in the Appendix (see Claim 6).

profits as when the store brand is supplied from the fringe manufacturer. In this setting, the manufacturer sets the qualities of both products in the first stage, such that the retailer earns the same profits as before. In the second stage, the manufacturer sets the wholesale price of the national brand, and then the retailer sets the prices of both products. On examining this third contract, we have the following result.

Proposition 5. *By procuring the store brand from the national brand manufacturer, the retailer can weakly improve its own profits and facilitate channel coordination.*

This proposition shows that it is possible to improve channel coordination by relegating all the quality decisions to one member of the channel: the manufacturer. In this contract, the manufacturer earns zero profits from store brand sales. Yet supplying the store brand is helpful to the manufacturer. This is because the manufacturer can reduce the competition between the national brand and the store brand by strategically choosing their quality levels. In particular, the manufacturer can now increase the quality difference between the products in the market compared to the case where qualities are independently set by the two firms without any coordination. The increased differentiation raises the profits from the national brand. Also, the increased quality difference reduces the scope for cannibalization and gives the retailer more latitude in setting prices. Taken together, this analysis shows that channel members can better coordinate their actions by allowing one member to set the qualities of both products. Thus it is profitable for the retailer to procure its store brand from the manufacturer. This finding may in part explain why some leading national brand manufacturers, such as Del Monte and Nestle, have chosen to supply store brands.

3.6   Discussion

The preceding analysis shows that the retailer can introduce multi-tier store brands despite manufacturer's effort to offer a side payment and to crowd out the store brands. With multi-tier store brands, the retailer may take the top-quality position and interlace the quality levels of the store brands with those of the national brands. As more store brands are introduced, products may become less differentiated and yet consumer welfare does not reduce. Moreover, in the presence of store brands, a two-part-tariff contract cannot solve

the channel coordination problem; but the retailer can enhance channel coordination by procuring the store brand from the national brand manufacturer. In this section, we extend the model in several ways to examine the robustness of these results and to further investigate related issues. Below we highlight the key findings and its intuition relegating the proof to the Appendix.

3.6.1 Store Brand with Lower Perceived Quality

Recall that in our main model, we assumed that consumers do not perceptually distort the objective quality of a product. According to Proposition 2, in the absence of any quality distortion, the retailer would take the top-quality position with its store brand in a market with one national brand and one store brand. Specifically, we obtain $q_S = 0.3449b > q_N = 0.1785b$ (see Lemma A2). Consumers, however, may perceive the quality of the store brand to be lower than its objective quality. To entertain this possibility, let the perceived quality of the store brand be δq_S, where $\delta \in (0, 1)$ is the discount factor and q_S is the objective quality of the store brand. The question is whether the retailer can occupy the top-quality position by virtue of its power in the channel despite its lower perceived quality. On analyzing this extension, we find that the retailer may still take the top-quality position when consumers discount its quality only slightly. For example, if $\delta = 0.99$, we have $q_N = 0.1829b < q_S = 0.3420b$ in equilibrium. However, if consumers sufficiently discount the quality of the store brand, the retailer may find it profitable to concede the top-quality position. For instance, when $\delta < \frac{2}{3}$, the optimal product qualities are $q_N = \frac{1}{3}b > q_S = \frac{\delta}{3}b$. We obtain this result because consumers' tendency to discount the store brand's quality makes it too costly for the retailer to take the top-quality position despite having pricing power. Thus consumers' negative perception of store brands comes to affect the retailer's quality position.

3.6.2 Decision Sequence

In our original model, despite the manufacturer being the Stackelberg leader in the quality-setting stage, the retailer could use its pricing power to gain the top-quality position and earn a larger fraction of channel profits. This may lead to the question of what might happen if the retailer is the leader in the quality-setting stage. Consistent with Proposition 2, the retailer

continues to occupy the top-quality position unless the national brands outnumber the store brands. But in contrast to Proposition 2, there exists a case where the manufacturer may not take the lowest-quality position. To see this, consider a market with one national brand and two store brands. In our original model, the manufacturer recognizes the retailer's pricing power and takes the lowest-quality position to soften the competition with the store brands. We observe this despite the manufacturer being the Stackelberg leader. But when the retailer becomes the Stackelberg leader, the retailer possesses all the power at the quality-setting stage and the price-setting stage, leaving the manufacturer the minimum profits regardless of its position. Consequently, the manufacturer is indifferent between taking the mid-quality position and the lowest-quality position (See Lemma A7). Therefore, the manufacturer may also take the mid-quality position in equilibrium.

3.6.3 Product Configuration

In our original model, the configuration of the products offered in the channel is endogenously determined by the fixed costs. In particular, our assumption about the fixed costs confined the equilibrium number of products to be less than or equal to four ($N + S \leq 4$). To further assess the robustness of our finding, we extend the model in a small way to consider the implications of having five products in the channel ($N + S = 5$). On analyzing this extension, we still find that the top-quality position is taken by one of the store brands when $S \geq N$, but by one of the national brands when $S < N$. In addition, one of the national brands takes the lowest-quality position and the quality levels of the store brands and national brands are interlaced. Moreover, as the number of store brands increases, the products in the market may become less differentiated in both qualities and prices; yet consumer welfare and channel profits always increase. These findings are in keeping with our original analysis.

3.6.4 Manufacturer with Pricing Power

Typically, the retailer sets the retail price of all products (including the national brand) in its store. However, sometimes the manufacturer may motivate the retailer to adopt the manufacturer's recommended retail price by offering an attractive allowance. This possibility

may lead to the question: how would the manufacturer's pricing power affect channel coordination? We examine this issue, by letting the manufacturer set the retail price and induce the retailer to implement the manufacturer's suggested retail price by providing a lump-sum allowance. In contrast to the traditional wholesale-price contract examined in the original model, we label this pricing scheme an allowance contract. Our analysis shows that in the absence of the store brand, the allowance contract eliminates the double marginalization and improves total channel profits. In the presence of the store brand, however, the allowance contract reduces the total channel profits despite resolving the double marginalization problem. To see why, note that in the absence of the store brand, the allowance contract lowers the retail price to expand the market enough to compensate for the loss in margin. In the presence of the store brand, however, due to the competition with the store brand, the lower price does not sufficiently increase the demand for the national brand to compensate for the loss in margin. Thus, the allowance contract yields lower total channel profits compared to the wholesale-price contract. An important implication of this finding is that an increase in manufacturer's pricing power may not necessarily enhance the channel coordination.[11]

3.6.5 Asymmetric Marginal Costs

In our original model, we assumed that the marginal costs of the retailer and the manufacturer are the same. According to Proposition 5, when the marginal costs are symmetric, the retailer can weakly improve its own profits and enhance channel coordination by procuring the store brand from the national brand manufacturer. However, it is easy to conceive of situations where the manufacturer can benefit from economies of scale. We allow for this possibility by letting manufacturer's marginal cost for a product be αq_i^2 with $\alpha \in (0, 1)$ when the manufacturer produces both the store brand and the national brand. If the manufacturer does not produce the store brand, $\alpha = 1$ as in our original model. Thus, we conservatively confer economies of scale to the manufacturer only when it also produces the store brand. On analyzing this extension, we find that the size of α could influence the prospect of channel

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[11]Note that in our analysis, we conservatively assume that the manufacturer suggests the wholesale price as the retail price to minimize the double marginalization. Even then the total channel profits do not increase under the allowance contract. Also note that, under the allowance contract, a store brand occupies the top-quality position.

coordination and the quality ordering of the store brand and the national brand. First, note that as α decreases below 1, manufacturer's production efficiency improves and this helps to improve channel profitability when the manufacturer produces all the products. Next, when α decreases below 0.9994, another force comes into play. Now its lower marginal cost motivates the manufacturer to take the top-quality position, and further improves its profitability at the expense of the retailer. Because of the negative effect on its profits, the retailer will not facilitate channel coordination by procuring the store brand from the manufacturer when $0.9336 < \alpha < 0.9994$. But if production efficiency improves further such that $\alpha < 0.9336$, even though the retailer loses its top-quality position it gains so much from the improved cost efficiency that it sources the store brand from the manufacturer and facilitates channel coordination. Our analysis further shows that when $\alpha < 0.2578$, the retailer's profits *strictly* increase on procuring the store brand from the national brand manufacturer. Therefore a positive development such as greater economies of scale generally improves the channel coordination. However, it could also impede channel coordination for some intermediate values of α ($0.9336 < \alpha < 0.9994$).[12]

So far, the analysis was based on a bilateral monopoly model with one manufacturer and one retailer. Next we advance to study how competition affects the strategic behavior of channel members.

4   Model of Competition

In this section, to understand the effect of competition, we first contrast our bilateral monopoly results with the case where we allow for two competing manufacturers. Then we compare the bilateral monopoly findings with the case where we allow for competition among retailers. Regardless of the market structure, the demand for product i in the market

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[12]In our analysis, we conservatively assume that the manufacturer retains the gains from production efficiency. Said differently, the manufacturer supplies the store brand at the retailer's cost (q_S^2) and keeps the difference in marginal costs ($(1 - \alpha)q_S^2$) as its per-unit margin from the store brand. If, alternatively, we assume that the gains from efficiency are totally transferred to the retailer (i.e., the wholesale price is reduced to αq_S^2), the channel will always be coordinated. This is because the efficiency gain always benefits the retailer and its profits never drop below the benchmark even when the store brand takes the low-quality position. We prove this claim in the Appendix.

is given as in (1). When manufacturers compete, each firm's profits are as follows:

$$\Pi_{M1} = z_{N1}(w_{N1} - q_{N1}^2) - F_{M1} \tag{6}$$

$$\Pi_{M2} = z_{N2}(w_{N2} - q_{N2}^2) - F_{M2} \tag{7}$$

$$\Pi_R = z_{N1}(p_{N1} - w_{N1}) + z_{N2}(p_{N2} - w_{N2}) + z_S(p_S - q_S^2) - F_R, \tag{8}$$

where $M1$ and $M2$ refer to the two competing manufacturers, Nj is the national brand produced by Manufacturer Mj, and F_{Mj} is the fixed cost of Manufacturer Mj ($j = 1, 2$). When retailers compete, each firm's profits are given by:

$$\Pi_M = z_{N1}(w_{N1} - q_{N1}^2) + z_{N2}(w_{N2} - q_{N2}^2) - F_M \tag{9}$$

$$\Pi_{R1} = z_{N1}(p_{N1} - w_{N1}) + z_{S1}(p_{S1} - q_{S1}^2) - F_{R1} \tag{10}$$

$$\Pi_{R2} = z_{N2}(p_{N2} - w_{N2}) + z_{S2}(p_{S2} - q_{S2}^2) - F_{R2}. \tag{11}$$

where $R1$ and $R2$ refer to the two competing retailers, Sj is the store brand produced by Retailer Rj, and F_{Sj} is the fixed cost of Retailer Rj ($j = 1, 2$). Here note that $N1$ and $N2$ refer to the identical national brand product. However, since prices are set by distinct retailers, we allow for the possibility that the prices could be different.[13] The sequence of decisions in the game is as given in the bilateral monopoly: qualities are set before the prices are chosen, and the manufacturer(s) act as Stackelberg leaders in quality setting stage of the game. Below, we discuss how competition affects channel profits and quality choices.

4.1 Competition and Channel profits

In retail markets, in the absence of store brands, the channel profits increase with competition (either among manufacturers or among retailers). We observe this because competition mitigates the double marginalization problem in the channel, raises demand close to the level of the integrated channel and improves total channel profits. This raises the question:

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[13]Since they are identical products, q_{N1} and q_{N2} are the same. However, for the analytical tractability, we assume $q_{N1} - q_{N2} = \epsilon$ in the demand specification and later in deriving the equilibrium solution, we treat ϵ as zero. Also note that the following sets of fixed costs ensure that each firm introduces only one product in equilibrium: ($F_{M1} = \frac{0.0007b^3}{b-a} - \epsilon$, $F_{M2} = \frac{0.0011b^3}{b-a} - \epsilon$, and $F_R = \frac{0.0380b^3}{b-a} - \epsilon$) under manufacturer competition, and ($F_M = \frac{0.0072b^3}{b-a} - \epsilon$, $F_{R1} = \frac{0.0057b^3}{b-a} - \epsilon$, and $F_{R2} = \frac{0.0029b^3}{b-a} - \epsilon$.) under retailer competition. Given this, in our discussion of the channel profits, we focus on the gross profits.

how would the presence of the store brand moderate the effect of competition on channel profits? We have the following result.

Proposition 6. *In the presence of a store brand, the total channel profit increases with manufacturer competition but decreases with retailer competition.*

To understand why competition in the presence of a store brand yields a different result from that observed in the absence of a store brand, recall that competition mitigates the double marginalization problem and increases the sales of the national brands. However, in the presence of a store brand, reducing double marginalization of a national brand does not sufficiently increase the sales of the national brand due to competition with the store brand. Nevertheless, when manufacturers compete, the market expansion can still be significant enough to improve total channel profits. This is because the retailer, who has the pricing power over all the products, can set the prices such that the profits from both types of products are coordinated and thus some of the benefits of mitigated double marginalization on the national brand are preserved. Next, when retailers compete, they compete away all the potential profits from national brand sales and thus lose the pricing power over the national brands to the manufacturer. This motivates the retailers to focus on the store brand and set its retail price low to earn more profits. The lower-priced store brands intensify competition between the store brands and the national brand, reduce the manufacturer's margin on the national brand and dampen manufacturer's potential benefit from reduced double marginalization. Furthermore, competing retailers do not earn much from selling the store brands. As a result, the total channel profitability does not improve when retailers compete.

4.2   Discussion

The focus of the above analysis was on channel profits. For completeness, in §4.2.1 we discuss how competition could alter the quality choices for store brands. Additionally, we examine the impact of the alternative decision sequence on the quality choices. Note that our analysis of the manufacturer competition implicitly assumed that the retailer does not face any shelf-space constraint and always carries both manufacturers' national brands. However, if the

retailer faces a shelf-space constraint, would it choose to replace one of the national brands with an additional store brand? How would shelf-space constraint affect the channel profits? We seek answer for these questions in §4.2.2.

4.2.1 Relative Quality of Store Brand

Recall that in a bilateral monopoly, the quality levels of the store brands are interlaced with those of national brands, with the top-quality position being taken by the firm offering more products. Consistent with this result, we find that in the presence of competition among manufacturers, the retailer sets the quality of its store brand between the quality levels of the two national brands. This softens the competition between the two national brands and, in turn, helps the retailer to charge higher retail prices for these products. However, in the presence of retailer competition, both retailers offer store brands that are of a lower quality than that of the national brand. This finding is different from the bilateral monopoly result. This is because when retailers compete, the balance of power shifts to the manufacturer. In differentiating its own national brand from the store brands, the manufacturer avoids the mid-quality position, but takes the more profitable high-quality position, forcing the retailers to produce lower-quality store brands. It is well-documented that many European retailers offer higher-quality store brands compared to the national brands. To a lesser extent, US retailers also offer higher-quality store brands (Kumar and Steenkamp 2007). Our analysis suggests that we observe high-quality store brands in many European retail outlets perhaps because of the lower level of retail competition in those markets.

We also extend the models of competition to examine how the decision sequence affects the quality choices of both firms. Under the manufacturer competition, when the retailer moves first, the retailer takes the top-quality position for its store brand, instead of the mid-quality position. This is because the manufacturers lose the first-mover advantage and thus cannot any longer preemptively occupy the top-quality position. For the same reason, under the retailer competition, when the retailers move first, the balance of power shifts back to the retailer and the manufacturer gives up the top-quality position. These claims are proved in the Appendix.

4.2.2 Shelf-Space Constraint and Channel Profits

In the preceding analysis the retailer does not have any shelf-space constraint in its store. In the short run, however, sometimes the retailer's shelf space may be limited, and the retailer needs to choose the optimal portfolio of products to carry in its store given this constraint. One would naturally expect the binding shelf-space constraint to hurt retailer's profits in particular and the total channel profits in general. Counter to some of our intuitions, we find that the shelf-space constraint could well improve the retailer's profits and the total channel profits when manufacturers compete. To understand this result, consider the case where the retailer carries two competing national brands and one store brand when there is no shelf-space constraint. Further assume that the retailer's shelf space has become limited and that it could carry only three products. Given this binding shelf-space constraint, will the retailer change the portfolio of products in its store? We note that in such a situation the retailer would choose to replace one of the national brands with an additional store brand. Interestingly, even though the retailer sells only one national brand, the two manufacturers still compete against each other for the shelf space. This motivates the manufacturers to set the quality of their national brands at the level that is most favorable to the retailer. This, in turn, reduces the competition between the national brand and the store brands, and thus increases the total channel profits. We note that the resulting increase in the channel profits is more than the loss suffered by the manufacturer not chosen by the retailer. Thus, a shelf-space constraint can give the retailer a chance to improve its profits and the total channel profits despite dropping one of the competing manufacturer's national brands from its store. We prove this claim in the Appendix.

5   Conclusion

Many retailers offer multi-tier store brands. The quality choice of these store brands is an important strategic lever of retailers, and it adds to the pricing power of retailers. The purpose of this paper is to theoretically explore this emerging phenomenon. The theoretical analysis offers insights into retailer's pricing power and its ability to profit from both the national brands and store brands, and provides a better understanding of a few questions of

managerial significance.

- *Can a retailer introduce store brands despite the national brand manufacturer's efforts to prevent their entry by offering a side payment to the retailer and/or introducing new national brands?* The answer is yes. First, the manufacturer cannot prevent the introduction of a store brand by making a side payment because the store brand not only transfers some profits from the national brand manufacturer to the retailer but also generates additional profits by expanding the market. As such, it is not feasible for the national brand manufacturer to make a large enough side payment that will prevent the retailer from introducing the store brand. Second, the national brand manufacturer may attempt to reduce the retailer's incentive to offer a store brand by filling the market with additional national brand products. However, the additional national brands cannot completely crowd out the store brand, because the retailer can set retail prices such that the market still expands with the store brand. Furthermore, even by using both these levers the manufacturer cannot prevent the entry of a store brand when the retailer's fixed cost of entry is small. Hence we often observe multiple store brands in retail outlets.

- *What should be the quality levels of muti-tier store brands?* Our analysis suggests that the retailer chooses to cover all segments by interlacing the quality levels of the store brands with those of the national brands. Although this strategy reduces cannibalization among store brand products, it increases the competition against national brands. While increased competition can potentially hurt this strategy's profitability, the retailer can reduce the negative effect by strategically setting the prices of all products, including the national brands. Interestingly, due to its pricing power, the retailer can take the top-quality position for one of its store brands in a bilateral monopoly. However, when the national brands outnumber the store brands, the retailer yields the top-quality position to a national brand in order to serve as many segments as possible in the midst of the national brands.

- *How does an increase in the proportion of store brands in a retail outlet affect product differentiation, consumer welfare, and channel profits?* Typically, when adding new

products to its portfolio, a firm tries to better differentiate its products. On the contrary, the retailer may reduce product differentiation when it adds more store brands. Yet the retailer effectively manages the cannibalization problem by exercising its power to set the prices of all products in its outlet. In particular, the retailer can charge a lower price on average to expand the market while squeezing the manufacturer to also reduce quality differentiation. Contrary to some of our intuitions, reduced differentiation does not decrease consumer welfare. We obtain this result because prices decrease more than qualities do, when the proportion of store brands increases. The increase in consumer welfare is not at the cost of total channel profits; in fact, the total channel profits also increase. This is because the retailer decreases the prices such that the increased volume more than offsets the reduced profit margin. The resulting increase in the retailer's profits raises total channel profits.

- *How do store brands affect channel coordination?* Store brands hurt the manufacturer's profits. Store brands also make a two-part tariff contract ineffective in enhancing the channel coordination. Still the retailer can improve channel coordination by strategically procuring the store brand from the national brand manufacturer. Channel profits improve because now all the quality decisions are delegated to one member of the channel, namely the manufacturer. This gives the manufacturer an opportunity to better differentiate the qualities such that the competition between the national brand and the store brand is minimized. The retailer, in turn, gains more latitude in setting prices. Thus both members of the channel can enhance their profits. Our analysis suggests channel coordination as a potential explanation for why a national brand manufacturer may supply store brands.

- *How do store brands moderate the impact of competition on channel profits?* In the absence of store brands, competition (either among manufacturers or among retailers) reduces the double marginalization problem faced by the national brand and improves channel profits. However, in the presence of store brands, channel profits increase with manufacturer competition but decrease with retailer competition. This is because when manufacturers compete, the retailer can preserve some of the benefits of mitigated

double marginalization by coordinating the prices of the national brands and the store brand. However, when retailers compete, they lose pricing power to the manufacturer. The competition between the national brand and store brands then intensifies to the point of totally losing the benefit of mitigated double marginalization. Hence, total channel profit decreases with retailer competition.

Limitations and Directions for further research. In developing our vertical differentiation model, we made several simplifying assumptions to keep the analysis tractable and gain insights into the multi-tier store brand phenomenon. To capture additional features of the market without losing tractability, we extended the model in several directions by relaxing one assumption at a time. Thus we examined the impact of factors such as asymmetric marginal costs, consumers' tendency to discount the quality of store brands, manufacturer with pricing power, alternative decision sequence and shelf-space constraint. Future research can examine the effect of feature advertising and in-store display on store brand performance and channel profits (e.g. Corstjens and Lal 2000). Next our assumption about the fixed costs helped us to examine the endogenous product configuration, quality choices and prices for a given pair of fixed costs (F_M, F_R) despite the complexity of the model. We also extended the model to consider up to five products, and obtained a similar pattern of results. Future research can seek to analyze the implications of extending the model beyond five products. We believe the literature on store brands could benefit from a vertical differentiation model of the channel that is amenable for deriving a general solution for product configuration and the associated qualities and prices without restrictive assumptions on fixed costs. This will be a challenging but fruitful avenue for future research. Currently, many leading retailers are open to engaging a national brand manufacturer as category captain to improve category profits. There is a need to study how a national brand manufacturer can leverage this role to better manage the store brand and coordinate channel profits (e.g., Subramanian, Raju, Dhar, and Wang 2010). Another avenue for further research is to experimentally validate the theoretical predictions of our analysis (e.g., Ho and Zhang 2008, Ho, Lim, and Cui 2010, Amaldoss and Shin 2011).

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Table 1: Equilibrium Results with and without Store brand

(a) Total Demand

Number of National Brands	$N = 1$	$N = 2$	$N = 3$	$N = 4$
Without Store Brand Entry	$\frac{0.1667b}{b-a}$	$\frac{0.2000b}{b-a}$	$\frac{0.2143b}{b-a}$	$\frac{0.2222b}{b-a}$
With Store Brand Entry	$\frac{0.3691b}{b-a}$	$\frac{0.3763b}{b-a}$	$\frac{0.3889b}{b-a}$	$\frac{0.3954b}{b-a}$
Change due to Store Brand Entry	$\frac{0.2024b}{b-a}$	$\frac{0.1763b}{b-a}$	$\frac{0.1746b}{b-a}$	$\frac{0.1732b}{b-a}$

(b) Retailer Profit (before subtracting the fixed cost)

Number of National Brands	$N = 1$	$N = 2$	$N = 3$	$N = 4$
Without Store Brand Entry	$\frac{0.0093b^3}{b-a}$	$\frac{0.0100b^3}{b-a}$	$\frac{0.0102b^3}{b-a}$	$\frac{0.0103b^3}{b-a}$
With Store Brand Entry	$\frac{0.0376b^3}{b-a}$	$\frac{0.0380b^3}{b-a}$	$\frac{0.0381b^3}{b-a}$	$\frac{0.0381b^3}{b-a}$
Change due to Store Brand Entry	$\frac{0.0283b^3}{b-a}$	$\frac{0.0280b^3}{b-a}$	$\frac{0.0279b^3}{b-a}$	$\frac{0.0278b^3}{b-a}$

(c) Manufacturer Profit (before subtracting the fixed cost)

Number of National Brands	$N = 1$	$N = 2$	$N = 3$	$N = 4$
Without Store Brand Entry	$\frac{0.0185b^3}{b-a}$	$\frac{0.0200b^3}{b-a}$	$\frac{0.0204b^3}{b-a}$	$\frac{0.0206b^3}{b-a}$
With Store Brand Entry	$\frac{0.0013b^3}{b-a}$	$\frac{0.0018b^3}{b-a}$	$\frac{0.0021b^3}{b-a}$	$\frac{0.0021b^3}{b-a}$
Change due to Store Brand Entry	$-\frac{0.0172b^3}{b-a}$	$-\frac{0.0182b^3}{b-a}$	$-\frac{0.0183b^3}{b-a}$	$-\frac{0.0185b^3}{b-a}$