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National brand's local advertising and wholesale-price incentive under prior versus no prior information

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ABSTRACT

We study the context of one private label (PL) competing against one national brand (NB) through a unique retailer. We propose a novel utility-demand function that includes the consumer's brand valuation, the retail prices, and the brands' qualities. We investigate the effect of the NB local advertising strategy on supply chain players' profits when either one of the players supports the advertising. Also, we explore the role of prior information about the manufacturer's incentive function on supply chain players' behaviors. We show that although the support for advertising from either the manufacturer or the retailer is Pareto improving, the manufacturer prefers to incite the retailer to invest in local NB advertising through profit sharing instead of using its money to counter the threat of the PL. Furthermore, we also show that the wholesale price incentive motivating the retailer to invest further in advertising is not preferred as expected, and all supply chain players are better off without prior information about the manufacturer's behavior in the context of branding competition and advertising-level dependent incentive.

1. Introduction

The relationship between manufacturers and retailers has been evolving between wars, negotiations, control of power, and collaboration (Dawar and Stornelli, 2013). There is more than ever a need for mutual understanding and balance of power to reach win-win results. Dawar and Stornelli (2013) suggest that manufacturers should learn from retailers' business models and adapt the model to their needs in order to improve the interrelationships with retailers. They describe four business models namely the information model (e.g., Tesco), the private label model (e.g., Loblaws), the margin model (e.g., Wal-Mart), and the working capital model (e.g., Costco) knowing that some retailers could use a mixture of approaches. In our paper, we focus on the first three business models and the crucial research question becomes: how supply chain players could use the advertising collaboration and the wholesale price incentive in the context of national and private labels in order to rebuild and enhance their relationship? Besides, we investigate the role of information sharing as a tool to impact the behaviors of both supply chain players.

Private labels (PL) play a key role for retailers by offering more variety to consumers, and a negotiation basis to deal with national brands' (NB) manufacturers. The PL has reached a tremendous growth in many countries. For instance, the PL shares of value sales have reached 51.8% in UK with the strongest penetration and around 38% in France and Germany in 2015 (IRI, 2016). In US, the unit share of the PL is 23.1% in supermarkets and 17.3% in drug chains (PLMA, 2015). According to Surveylab conducted for PLMA, 50% of consumers shopping for groceries buy every time or frequently a PL (PLMA, 2016). Consumers' perception about the PL has progressed over time. While in the past consumers were looking for good deals based mostly on price, nowadays more consumers are looking for the overall value based on quality rather than just on price (IRI, 2013). Hence, retailers are proposing a variety of PL concepts focusing on the quality dimension. Generics and distinct-second tiers have very low quality (e.g., Saving Plus Line and Smart Price from A&P; Great Value from Wal-Mart and Basic Red from Safeway). Me-too brands are copycats to NB and have close quality to the NB (e.g., Chipz of Tesco imitating Pringles; Choco Rice of Aldi imitating Coco Pops of Kellogs and ChipMates of Kroger imitating Chips Ahoy!). Premiums have a high quality and a distinct positioning from the NB (e.g., Up & Up brands of Target; Sainsbury's Taste the Difference and President's Choice from Loblaws). Super-premiums have higher quality than NB (e.g., O Organics brands of Safeway and Game Day of 7-Eleven). Value innovators propose functional quality and value for money (e.g., IKEA and H&M). The PL quality becomes so important to the point that some retailers are exporting their own brands. For instance, the Italian retailer Conad is exporting its premium PL Sapori & Dintorni to US (IRI, 2013).

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While retailers use the PL as a strategy to put more pressure on manufacturers, the latter invests heavily in advertising and that investment helps increase store traffic. Ultimately, consumers often purchase PL instead of NB (IRI, 2013), and this incites manufacturers to rethink strategically when they advertise their brands and look for innovative ways to promote them. Hence, cooperation becomes a must for the manufacturer in order to reach a win-win situation. According to NRP and Trade Management Associates (2011), investment in cooperative advertising reached $520 billion worldwide, and worth $50 billion in US alone each year according to SproutLoud. Examples in the auto industry are Volvo and Ford, in the home improvement industry are Jenn-Air and GE, and in the HVAC industry are Trane and Lennox (www.makethunder.com). There are two categories of cooperative advertising (www.buzzle.com) either horizontal between players at the same channel level (e.g., two retailers who want to endorse the same product), or vertical between supply chain players at different levels of the channel (e.g., a retailer and a manufacturer or a manufacturer and a wholesaler). We focus in this paper on the vertical category of coop-advertising. This type of arrangement could come in different forms such as product flyers, direct mail campaigns, trade shows, sports events, and giveaway items (www.inc.com). More specifically, there are 4 types of plans under this category: 1/ the full cover of the advertising costs by the manufacturer, 2/ the shared costs where both partners split the costs based on a pre-determined percentage, 3/ the unlimited plan where the manufacturer pays a fixed percentage of the costs, and 4/ the fixed plan where the manufacturer offers a fixed budget for the costs per year (www.cpcstrategy .com). One solution that will be analyzed in this paper is a form of collaborative advertising where the manufacturer versus the retailer supports fully the NB local advertising in order to boost the retail sales instead of sharing the advertising costs. The rationale of such investment is to increase the category demand instead of favoring one specific demand. While cooperative advertising based on cost sharing between the manufacturer and the retailer has been widely studied by the literature (e.g., Berger, 1972; Berger and Magliozzi, 1992; Dant and Berger, 1996; Huang and Li, 2001; Li et al., 2002; Yue et al., 2006; Yan and Bhatnagar, 2008; Karray and Zaccour, 2006, 2007; Xie and Neyret, 2009; Xie and Wei, 2009; He et al., 2009; Yan, 2010; SeyedEsfahani et al., 2011; He et al., 2011, 2012; Aust and Buscher, 2012; Zhang et al., 2013; Aust and Buscher, 2014; Jogensen and Zaccour, 2014), none of the existent papers investigated the role of a full support for local advertising from each part of the supply chain, and specifically, in the context of NB and PL competition. For example, when the retailer has to pay upfront all the advertising investment, it will block important funds to do other marketing efforts (Deshpande, 2015).

We propose a game-theoretic model consisting of a retailer and a manufacturer in a distribution channel where the manufacturer is the leader and the retailer is the follower. We investigate different contexts: 1/ the manufacturer offers full support for local advertising, 2/ the retailer supports totally the local advertising, 3/ the manufacturer proposes a wholesale-price incentive to boost the advertising level of the retailer under the condition that the latter has no prior information about the manufacturer's behavior in terms of incentive reaction function, and 4/ the manufacturer proposes a wholesale-price incentive to boost the advertising level of the retailer under information sharing and that will lead to prior information about the manufacturer's behavior in terms of incentive reaction function. The research questions, that we will try to answer, are then:

- When the retailer adds the PL to the shelf and sells both brands (the PL and the NB), what is the role of each brand quality in impacting strategies and profits of both supply chain players?
- Is it better for the retailer to support fully the NB local advertising or let the manufacturer bear those costs when both brands are offered on the shelves?
- Why is it important for the manufacturer to motivate the retailer to invest in local NB advertising instead of using its own money to promote its brand?
- What incentive mechanism can the manufacturer use to motivate the retailer to support fully the NB advertising, boost its advertising investment level, and ultimately, create better results for both supply chain players?
- Considering the importance of information process and sharing, what is the effect of having prior information about the manufacturer's incentive reaction (compared to no prior information) on both supply chain players' decisions and performances?

The main results show that the full support of the manufacturer or the retailer for NB advertising is a Pareto improving. This means that each supply chain player's profit increases following the implementation of that strategy compared to the benchmark scenario where there is no NB advertising, and hence the total supply chain profit increases. Comparing both support contexts, the retailer could have lower profits by advertising the NB, but the manufacturer always benefits from the retailer's full support in advertising compared to the scenario where the manufacturer is the one investing in NB advertising. In other words, the manufacturer will never lose profits if the retailer invests in NB advertising. Thus, the manufacturer prefers to motivate the retailer to invest in NB advertising instead of using its own money to counter the PL threat. In other words, the manufacturer will opt for a partnership strategy. To examine further this strategy, we study the scenario where the manufacturer tries to push the retailer to invest further in this advertising using the wholesale price incentive without sharing information, then the scenario where the manufacturer uses the wholesale price incentive and shares some information.

We find that the retailer prefers to have prior information about the manufacturer's behavior in terms of incentive reaction function because that allows extracting some incentive from the manufacturer which was not the case without prior information. However, the manufacturer will avoid that option because it lowers its profits following a lower advertising investment. The whole supply chain performance is also not improving if information sharing takes place and an incentive is provided compared to the case where only the retailer is advertising the NB. As a result, these two scenarios (using a wholesale price incentive) do not add value to the supply chain players, and thus we conclude that the overall preferred strategy is to let the retailer advertise the NB without offering an incentive as a reduction on the wholesale price and without providing any information sharing that could reflect the manufacturer's behavior in terms of incentive allocation (as a function of the advertising level invested by the retailer). To convince the retailer to do so, the manufacturer does need to share the surplus of profit using "profit sharing mechanism".

Many prior researches studied shared cooperative advertising in the context of a single brand, and some studies (e.g., Karray and Zaccour, 2006) investigated its effect in the context of competitive brands (NB vs. PL) and showed that the retailer will accept such a cooperative program only if the NB competes strongly with the PL. Thus, we need to examine the scenario of a fully supported NB advertising either from the manufacturer side or the retailer side to see if this strategy also can help supply chain players achieve a Pareto result and if this strategy is optimal to implement. Our results show that, although the fully supported NB advertising can help the supply chain players achieve a win-win result, the optimal strategy is to motivate the retailer to fully support the NB advertising through profit sharing mechanism. Our research derives a novel finding that no prior research ever shed light on. In other words, prior studies showed that the manufacturer and the retailer should employ the shared cooperative advertising strategy conditionally in order to improve their respective performance, however, our study shows another good option which is to motivate the

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retailer to fully support the NB advertising through profit sharing mechanism under no conditions.

The paper is organized as follows. In Section 1, we introduce the paper and explain the importance of collaborative strategies in the context of PL and NB competition. In Section 2, we review the literature about PL, cooperative advertising and information sharing. In Section 3, we explain the development of the model, describe each scenario, and provide comparative analyses. In Section 4, we conclude with managerial implications, and propose extensions for future research. All relevant proofs are given in the Appendices for clarity of exposition.

2. Literature review

2.1. Private label literature

PL brands have existed for more than 100 years. For instance, Sainsbury started to sell his first PL in 1882. The literature about PL is extensive, and Sethuraman (2009) proposed an analysis of 22 papers using mathematical modeling and published between 1966 and 2006. He assessed their modeling robustness, their empirical support and their credibility in terms of managerial implications. He explained that papers during the 60s focused on survey studies to determine the characteristics of PL consumers. During the 80s, the focus shifted to empirical studies using scanner data to determine the effect of marketing efforts on sales. Recently, the literature related to PL is emphasizing modeling and mathematical analysis to determine optimal strategies for supply chain players.

Different topics have been covered about PL and NB competition such as the determinants of PL success (Dhar and Hoch, 1997), the consumers' purchase behavior (Erdem et al., 2004), the price competition between the PL and the NB (Sethuraman et al., 1999), the extension to non-price strategies (Abe, 1995), the effectiveness of promotion on category expansion versus brand switching (Putsis and Dhar, 2001), the impact of PL introduction on pricing and performance of supply chain players (Mills, 1995; Raju et al., 1995; Narasimhan and Wilcox, 1998; Mills, 1999; Chintagunta et al., 2002; Morton and Zettelmeyer, 2004; Ailawadi and Keller, 2004), and the effect of a dual channel when the manufacturer opens an online store to counter the PL threat (Amrouche and Yan, 2012).

Quality has been the focus of many papers related to the PL. For instance, Raju et al. (1995) modeled the PL quality in the intercept of the usual demand function. The latter includes an intercept, the prices of all brands and the cross-price competition measuring the sensitivity to the direct and competing prices. Corstjens and Lal (2000) modeled the quality of the PL through the proportion of quality-conscious consumers trying the PL and considering it at an acceptable level. Choi and Coughlan (2006) used a demand structure derived from consumer utility and modeled the quality differential through a parameter. Their demand function depends on the prices, the product quality, the decline rate of marginal utility of consumption for one product with respect to the consumption of one of the other products, and the satiation rate with consumption of the product. Amrouche and Yan (2012) modeled the quality differential through a parameter in the usual demand function. The demand is function of an intercept, the prices and the cross-price competition. To our knowledge, none of the aforementioned papers dealing with the PL topic addressed simultaneously the manufacturer's support and the retailer's support in local advertising and assessed their impacts on the performance of supply chain players, while we do. Furthermore, none of the aforementioned papers investigated the effect of information process and sharing on the performance of supply chain players, while we do. Finally, the demand function's format and its components (quality differential between the PL and the NB, both brands' prices and the marginal valuation) have not been used in any of the previous papers.

2.2. Cooperative advertising literature

Cooperative advertising is widely studied in the literature. However, many prior studies focused solely on the effect of cooperative advertising on a single brand, rather than competitive brands. For example, Dant and Berger (1996) studied cooperative advertising decision in a franchise setup and showed that cooperative advertising can help the franchisor and its franchisee increase their respective profits and enhance the goodwill of the franchise-system. They showed also that local and national advertising are complementary initiatives in such a system to reach better total payoffs. Huang et al. (2002) studied three types of cooperative advertising between the manufacturer and the retailer namely brand name investments, local advertising and manufacturer's participation rate. Their results showed that cooperative advertising can help improve the performance of the supply chain, particularly if the supply chain players behave in a partnership structure maximizing the whole channel profit instead of a leader-follower relationship. Yan (2010) conducted a theoretical study for cooperative advertising in a manufacturer–e-retailer supply chain and showed that the manufacturer and the e-retailer can improve their individual profits through a cooperative advertising strategy compared to the leader-follower structure. He showed also that the value of the channel coordination increases when the product-web fit increases. Aust and Buscher (2012) revealed that vertical cooperative advertising in a cooperation relationship can help the manufacturer – retailer supply chain achieves the highest total profits and lead to lowest retail price for consumers. Some study investigated the effect of cooperative advertising on competitive brands. For example, Karray and Zaccour (2006) investigated the profitability of implementing a cooperative advertising program that allows the manufacturer to counter the harm of a PL's introduction. They showed that the retailer will accept such a program only if the NB competes strongly with the PL. Furthermore, Jogensen and Zaccour (2014) and Aust and Buscher (2014) provided a good summary of studies about cooperative advertising by discussing the works of Berger (1972), Berger and Magliozzi (1992), Dant and Berger (1996), Huang and Li (2001), Li et al. (2002), Yue et al. (2006), Karray and Zaccour (2006, 2007), Xie and Neyret (2009), Xie and Wei (2009), He et al. (2009), Yan (2010), SeyedEsfahani et al. (2011), He et al. (2011, 2012), Aust and Buscher (2012), and Zhang et al. (2013). However, all aforementioned papers focused on a traditional type of cooperative advertising when the retailer makes a decision regarding how much to spend on a local advertising campaign while the manufacturer pays a percentage of the costs. Our research focuses on the manufacturer offering full support to the retailer in order to implement local advertising for the NB while the retailer pays a zero percentage of the advertising cost. Besides, we also compare that type of collaborative advertising to the retailer's full support for local advertising. Furthermore, the previous papers did not consider the strategic value of brand quality difference between the NB and the PL, while we do. Finally, the aforementioned papers did not address the important impact of information sharing on the firm performance while advertising is being considered, while we do.

2.3. Information sharing literature

A number of topics on information sharing have been analyzed in the literature of supply chain management. For example, Gavirneni et al. (1999) discussed shared information about inventory policies between a manufacturer and a retailer to estimate the savings for the manufacturer as a result of information collaboration. Cachon and Fisher (2000) investigated the value of information sharing between one manufacturer and multiple identical retailers. They found that information sharing led to savings due to a reduction in lead time and batch size. Lee et al. (2000) studied the value of information sharing in a two-level supply chain and found that information sharing can provide significant inventory reduction and cost savings. Guo and Iyer

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(2010) investigated the information acquisition and sharing in a vertical manufacturer-retailer channel structure and found that the manufacturer has a motivation to acquire more information about customer preferences and demand under a voluntary sharing mechanism.

Few studies examined information sharing between the retailer and the manufacturer in the environment of dual channel distributions. Yue and Liu (2006) showed that both the manufacturer and the retailer can benefit from information sharing only when the manufacturer's forecast is higher than the retailer's forecast. If the manufacturer's forecast is lower than the retailer's forecast, the manufacturer would benefit from information sharing while the retailer would not. Yan and Ghose (2010) examined the effect of forecast information accuracy on the performance of traditional and online retailers in a dual-channel distribution. They found that the profits of both retailers always increase with forecast accuracy. The latter has a greater effect on the performance of the traditional retailer especially when there is an increasing volatility in the market, an increasing level of consumer valuation for the product, and an increasing intensity in market competition. Yan and Pei (2011) studied the case of a multi-channel manufacturer and a single retailer and found that information sharing has a positive impact on the manufacturer, but no impact on the retailer. The higher is the product compatibility to the web, the higher is the impact on the manufacturer's profitability. Yan et al. (2016) revealed that information sharing with cooperative advertising can effectively improve the performance of both supply chain players under demand uncertainty. However, the manufacturer is inclined to understate its forecast to gain more profit; and the retailer is inclined to overstate its forecast to receive more support for advertising from the manufacturer.

The literature modeled information sharing using different perspectives. Some papers used a periodic inventory problem (e.g., Gavirneni et al., 1999; Cachon and Fisher, 2000; Lee et al., 2000). Others modeled prior belief about consumer preferences reflecting the product fit and how that information could be shared between supply chain players according to different formats (e.g., Guo and Iyer, 2010). Others used a stochastic model to represent the forecast about product demand uncertainty (e.g., Yan and Ghose, 2010; Yan et al., 2016). Our paper, however, is completely different from the previous papers because we model information process and sharing in terms of optimization stages indicating the order of decision making between supply chain players. This order of decisions induces more knowledge about the behavior of the previous supply chain player in the sequence of event, and helps the next player to improve his following decision making. Thus, our paper is novel in terms of offering a new perspective to solve the game-theory model and to derive optimal strategies and profits for each player of the game. Indeed, such stages-game approach induces that the manufacturer does not have full power anymore as a leader of the game and is willing to compromise in return for higher performance and better tailored decisions.

3. The model framework

We consider a game-theoretic model based on utility function to represent the competition between the PL and the NB. The manufacturer is the leader while the retailer is the follower. The quality is an important parameter affecting the utility that the consumer will perceive about either brand. Four models are compared: 1/ the manufacturer offers full support for local advertising, 2/ the retailer supports totally the local advertising, 3/ the manufacturer proposes a wholesale-price incentive to boost the advertising level support of the retailer under the condition that the latter has no prior information about the manufacturer's behavior in terms of incentive reaction function, and 4/ the manufacturer proposes a wholesale-price incentive to boost the advertising level support of the retailer under negotiation basis (stages-game approach) leading to prior information about the manufacturer's behavior in terms of incentive reaction function. We explain below each model in detail and provide comparative analyses for all scenarios.

3.1. Scenario 0: selling both brands via traditional retailer without local advertising

The manufacturer is producing the NB and selling its brand through a traditional retailer. The latter is also offering its own brand, the PL. The consumer will decide to purchase the brand that maximizes his utility based on the price and the quality. Due to brand competition, the quality differential is important and impacts the consumer evaluation of the product and his purchase decision. Zhao (2000) and Desai et al. (2001) illustrated the few literature examples that included the role of product quality in affecting consumer valuation. Zhao (2000) considered the scenario of a single product and two firms competing in the market where one firm is offering the high-quality version and one firm offering the low-quality version. Desai et al. (2001) considered a manufacturer selling two products targeted to two segments (high-valuation and low-valuation segments). Each product is composed of two components of a given quality level (high or low). Desai et al. (2001) investigated the design decision in terms of components' choice across products knowing that the overall product quality (based on both components) will affect the consumer valuation of the product.

We assume the quality of the PL is q_P and the PL has a lower quality than the NB ($q_N > q_P$). This instance refers to all types of PL except the super-premiums. Hence, knowing v is the perceived brand value, the valuation of the PL is vq_P and thus the consumer utility is: $U_P = vq_P - p_P$. The valuation for the NB is vq_N and thus the consumer utility is: $U_N = vq_N - p_N$. The marginal valuation $v^P = \frac{p_P}{q_P}$ means that the consumer is indifferent to buy the PL. The marginal valuation $v^N = \frac{p_N}{q_N}$ means that the consumer is indifferent to buy the NB. Since consumers can buy either brand, they would prefer to buy the brand where they can derive more utility. Thus, consumers will compare the consumer utility derived from the NB with the consumer utility derived from the PL (i.e., $vq_N - p_N$ versus $vq_P - p_P$) when they make purchase decision. If $vq_N - p_N > vq_P - p_P$, then the NB would be preferred over the PL. If $vq_N - p_N < vq_P - p_P$, then the consumer would like to buy the PL. The consumer would be indifferent between the NB and the PL if the marginal valuation is $v^{NP} = \frac{p_N - p_P}{q_N - q_P}$.

Furthermore, it can be shown that when $v^P < v^N$, then $v^P < v^N < v^{NP}$. Hence, all consumers with marginal consumption value in the interval $[v^P, v^{NP}]$ prefer to buy the PL. All those in the interval $[v^{NP}, 1]$ prefer to buy the NB. Finally, all consumers whose marginal valuation in the interval $[0, v^P]$ will not purchase any brand. Let D_{NB} and D_{PL} denote the demands of the NB and PL respectively, then we have:

$$D_{NB} = 1 - \frac{p_N - p_P}{q_N - q_P}; D_{PL} = \frac{p_N - p_P}{q_N - q_P} - \frac{p_P}{q_P}$$

where $q_i (i = N, P)$ is the quality of respectively the NB and the PL ($q_i \geq 0$) and $p_i (i = N, P)$ is the price of respectively the NB and the PL ($p_i \geq 0$).

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When $v^P > v^N$, then $v^P > v^N > v^{NP}$. As a result, none of the consumers would buy the PL but all consumers whose marginal consumption values are in the interval $[v^N, 1]$ would buy the NB. Let D_{NB} and D_{PL} denote the demands of the NB and the PL respectively, then we have:

$D_{NB} = 1 - \frac{p_N}{q_N}; D_{PL} = 0.$

The option where $v^P > v^N$ induces that only the NB is sold through the retailer and no consumer would buy the PL from the retailer (see Appendix A — valuation comparison for proof). In other words, there is no brand competition (NB vs. PL) which is not the focus of our research as we study brand competition and co-existence of both brands. Thus, here in Scenario 0 (benchmark scenario), we consider only the option where $v^N > v^P$.

Without losing any generality and to simplify the computations, we assume the cost of producing the NB and the PL equal to 0 as they are not decision variables in our model similar to Raju et al. (1995). The optimal pricing and advertising strategies will not be affected by these costs. As a result, the profit functions to be maximized for the supply chain players are given as:

$$\underset{p_N, p_P}{Max}\, \pi_R = (p_N - w)D_{NB} + p_P D_{PL}$$

$$\underset{w}{Max}\, \pi_M = wD_{NB}$$

Proposition 1. *The unique Stackelberg strategies are given by*:

$$w = \frac{q_N - q_P}{2}; p_N = \frac{3q_N - q_P}{4}; p_P = \frac{q_P}{2}$$

Proof: See Appendix A — Scenario 0 for proof.

These results show that the quality of each brand affects both strategies related to the NB but the PL retail price is independent from the NB quality effect. The higher is the PL quality the lower is the wholesale price, and consequently, the lower is the NB retail price. In other words, offering a PL of higher quality adds pressure on the manufacturer to give better deals for the retailer. The results also show that the retailer has flexibility to set its PL price and a higher PL quality allows the retailer to ask for a higher price for his brand.

We propose the following Table 1 summarizing all parameters, strategies, and functions:

3.2. Scenario 1: local advertising fully supported by the manufacturer

When the retailer adds the PL to compete with the NB, the PL could take away some consumers from the NB. Hence, we propose that the manufacturer provides full support of the NB advertising to the retailer to promote his brand and counter the PL threat. Though this invested advertising strategy decreases the PL demand, it increases the NB demand, and ultimately, increases the category demand. So, the important research questions are the following: is it beneficial for the manufacturer to invest in such advertising and pay all the costs for this investment? Is it also beneficial for the retailer to avoid retaliation and more intense competition?

When the manufacturer decides to invest in local advertising for its NB through the retailer, the purpose is to increase sales in the short term (Huang et al., 2002). Through local media such as newspapers and through access to better market information such as brands being offered, and store location (Young and Greyser, 1983), the retailer can use local advertising to stimulate demand efficiently. In other words, the local advertising is not intended to create more favorable product attitudes or influence consumer's valuation of the brand, but acts as an informative tool to help consumers obtain the needed information when they move through the final stages of the purchase process (Huang et al., 2002). The manufacturer's support for local advertising helps the retailer offer creative promotional efforts that the retailer normally wouldn't undertake without his support. In the business market, Apple, Dell and HP actively apply this strategy to their businesses and always provide money support to retailers carrying their products to help them implement a local advertising campaign (Pei et al., 2014).

Table 1
Description of parameters, strategies, and functions.

Parameters	Interpretation
V	Perceived brand value
q_N	NB quality
q_P	PL quality
R	Advertising effectiveness on PL demand
M	Advertising effectiveness on NB demand
Strategies	
w	NB wholesale price
p_N	NB retail price
p_P	PL retail price
A	NB advertising supported by the manufacturer
a	NB advertising supported by the retailer
S	Wholesale price reduction
Functions	
D_{NB}	NB demand
D_{PL}	PL demand
π_M	Manufacturer profit
π_R	Retailer profit
π_C	Total supply chain profit

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When the manufacturer spends an amount A for the NB local advertising, the invested advertising increases the NB sales. In the meantime, the invested advertising has a negative impact on PL sales (e.g., Karray and Zaccour, 2006). In addition, we assume a linear relationship between advertising and sales following previous literature (e.g., Zaccour, 2008). The demand functions are then:

$$D_{NB} = 1 - \frac{p_N - p_P}{q_N - q_P} + mA; D_{PL} = \frac{p_N - p_P}{q_N - q_P} - \frac{p_P}{q_P} - rmA$$

where, the parameter m $(0 < m < 1)$ is the advertising effectiveness on the NB sales. The parameter r $(0 < r < 1$ and $r < m)$ is the advertising effectiveness on the PL sales. The decision A is the advertising investment that the manufacturer provides for his NB. This advertising has a positive impact on the category demand compared to scenario 0 and increases the category demand by $(1 - r)mA > 0$. Hence, this advertising is not intended to steal market share from the PL, but rather, to expand the market for both brands.

As in Roberts and Samuelson (1988), Sorger (1989), and Espinosa and Mariel (2001), we also assume a convex advertising cost in our model $(\frac{A^2}{2})$. Thus, the profit functions to be maximized for the supply chain players are given as:

$$\underset{p_N, p_P}{Max}\, \pi_R = (p_N - w)D_{NB} + p_P D_{PL}$$

$$\underset{w, A}{Max}\, \pi_M = wD_{NB} - \frac{A^2}{2}$$

Proposition 2. *Assuming $m = 1$, the unique Stackelberg strategies are given by:*

$$w = \frac{2(q_N - q_P)}{q_P - q_N + 4}; p_N = \frac{q_N(rq_P - 6) - q_P(rq_P - 2)}{2(q_N - q_P - 4)}$$
$$p_P = \frac{q_P[r(q_N - q_P) - 4]}{2(q_N - q_P - 4)}; A = \frac{q_N - q_P}{q_P - q_N + 4}$$

Proof: See Appendix A — supply chain players' profits for proof.

These results show that the quality of each brand affects all strategies including the PL retail price. However, the NB's advertising effectiveness on the PL sales (parameter r) affects only the retail price decisions. It is interesting to find that both reaction functions of the retail prices are affected positively by the advertising investment level and, obviously, the NB retail price increases with the increase of the wholesale price. The PL price, however, varies independently from the wholesale price. The reaction functions are as follows:

$$p_N(w, A) = \frac{w + q_N + A(q_N - rq_P)}{2}$$
$$p_P(w, A) = \frac{q_P + Aq_P(1 - r)}{2}$$

We perform sensitivity analysis to understand further the influence of these parameters on the strategies' fluctuation (see Appendix A-Scenario 1 for proof and Table 2 for the signs).

The results show that a higher NB quality has a positive influence on all strategies. In other words, both supply chain players will be willing to ask for a premium retail price. But, the PL quality has a negative influence on all strategies except on the PL retail price. Hence, an increase of the PL quality will push the manufacturer to decrease its wholesale price and the advertising investment and constitutes a good threat for the NB. Finally, the NB advertising effectiveness on the PL sales has a negative impact on both retail prices. This means that the more the NB advertising hurts the PL sales, the lower are the retail prices asked by the retailer. The retailer will then try to boost the sales by offering lower prices for its PL. It is interesting to see that the NB retail price will be also decreased.

3.3. Comparing Scenario 1 and Scenario 0

We present below a comparison of profits to investigate if it is beneficial for the manufacturer to provide money support to the retailer and engage in local advertising for its brand. We thus compare the equilibrium profits in Scenario 1 with the equilibrium profits in Scenario 0 which leads to the following proposition.

Proposition 3. *The profits of both the manufacturer and the retailer in Scenario 1 are higher than their profits in Scenario 0. In other words, using local advertising supported fully by the manufacturer is Pareto improving for all supply chain players.*

Table 2
Sensitivity analysis for Scenario 1 strategies.

Strategies	$\frac{d}{dq_N}$	$\frac{d}{dq_P}$	$\frac{d}{dr}$
w	+	−	*NA*
p_N	+	−	−
p_P	+	+	−
A	+	−	*NA*

NA: means not applicable.

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Proof: See Appendix A—Scenario 2 for proof.

When the manufacturer provides monetary support from its own pocket to the retailer in order to invest in NB advertising, and the invested money promotes the NB sales but hurts the PL sales, the profits of both supply chain players are increasing (i.e., Pareto improving). In other words, the manufacturer offers support to the retailer by paying full local advertising investment for its NB, and that helps all players benefit from it. The outcome is even more beneficial than Scenario 0. By offering such support, the manufacturer is generating further profit surplus compared to Scenario 0, and is ultimately boosting the profits of both supply chain players.

3.4. Scenario 2: local advertising fully supported by the retailer

While the manufacturer achieves a Pareto result for both supply chain players by its support to the NB, what will be the consequence if the local advertising for the NB is fully supported by the retailer? We expect that advertising the manufacturer's product using the retailer's budget isn't a wise decision because doing so is beneficial mainly to the manufacturer and may not be profitable to the retailer. Our model, however, indicates that this reasoning may not always hold. The rationale behind this strategy is the increasing importance of category management over brand management for the retailer. Some studies highlighted the evolving strategic focus of the retailer to category management using different marketing and operational efforts such as promotion, shelf space decision, product assortment, cost efficiencies, pricing, store atmospheric, supplier collaboration, and customer service (e.g., Basuroy et al., 2001; Amine and Cadenat, 2003; Dupre and Gruen, 2004; Desrochers and Nelson, 2006; Huddleston et al., 2009). We propose then that the retailer fully supports the NB advertising because its main focus is on managing the whole category rather than micro managing its own brand. By doing so, the retailer is helping drive traffic to the store and might generate higher revenues for both brands.

We examine how the local advertising fully supported by the retailer influences the performances of both the manufacturer and the retailer. Thus, we assume, in this setting, that the retailer decides now to invest in local advertising in order to boost the market demand of the NB. The important research questions here become: Is it beneficial, profit-wise, for the retailer to invest in such advertising by paying all the costs for this investment? If so, to what extent does it add extra profits to each supply chain player? The demand functions are then:

$D_{NB} = 1 - \frac{p_N - p_P}{q_N - q_P} + ma; D_{PL} = \frac{p_N - p_P}{q_N - q_P} - \frac{p_P}{q_P} - rma$

For comparability reasons, we assume that the parameter m and r are the same as scenario 1. The decision a is the advertising investment that the retailer provides for the NB. Thus, the profit functions to be maximized for the supply chain players are given as:

$$\underset{a,p_N,p_P}{Max}\ \pi_R = (p_N - w)D_{NB} + p_P D_{PL} - \frac{a^2}{2}$$

$$\underset{w}{Max}\ \pi_M = wD_{NB}.$$

Proposition 4. *Assuming $m = 1$, the unique Stackelberg strategies are given by*:

$$w = \frac{(q_N - q_P)[rq_P(r-1) - 2]}{2[q_P - 2 + rq_P(r-2)]}$$

$$p_N = \frac{(r-1)rq_P[8q_P + 2q_N^2 - rq_P^2(3r-5) + q_N q_P(r-2)(3r+1)] - 4q_N[(q_N - 3) + rq_P(3r-4) - 4q_P]}{4[q_P - 2 + rq_P(r-2)][q_N - 2 + rq_P(r-2)]}$$

$$p_P = \frac{q_P\left[-2(q_N + q_P) - 2r[q_N + q_P(2r-5)] + rq_P(r-1)^2(q_N - q_P) + 8\right]}{4[q_P - 2 + rq_P(r-2)][q_N - 2 + rq_P(r-2)]}$$

$$a = \frac{2q_N - 2q_P(2r-1) + q_P(r-1)[rq_P(2r-3) - q_N(r-2)]}{2[q_P - 2 + rq_P(r-2)][q_N - 2 + rq_P(r-2)]}$$

Proof: See Appendix A — Scenario 2 for proof.

These results show a completely different picture from Scenario 1. When the retailer invests in NB advertising, the quality of each brand as well as the NB advertising effectiveness on PL sales affect all strategies. However, in Scenario 1 (when the manufacturer supports the NB advertising), the advertising effectiveness affects only the retail prices. Another interesting observation is that the expressions in Scenario 2 are much more complicated than Scenario 1.

Table 3
Sensitivity analysis for Scenario 2 strategies.

Strategies	$\frac{d}{dq_N}$	$\frac{d}{dq_P}$	$\frac{d}{dr}$
w	+	−	−
p_N	+	−	$-^*$
p_P	+	$+^*$	$-^*$
a	+	$-^*$	$-^*$

The symbol "*" means the sign is obtained using simulations.

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Table 4
Comparison of profits in Scenarios 2, 1 and 0.[a]

Profits	Scenario 1–Scenario 0	Scenario 2–Scenario 0	Scenario 2–Scenario 1
π_M	>0	>0	>0
π_R	>0	>0	>0 or <0
$\pi_{Channel}$	>0	>0	>0

[a] In Scenarios 2: the R advertises the NB – in Scenario 1: the M advertises the NB – In Scenario 0: no advertising.

Looking at the reaction functions, we notice that the PL retail price and the NB advertising supported by the retailer are decreasing on the wholesale price. However, the NB retail price is increasing on the wholesale price. The reaction functions are as follows:

$$p_N(w) = \frac{w[2(q_N-1) + rq_P(r-3)] - 2q_N + r^2 q_P(q_N - q_P)}{2[q_N - 2 + rq_P(r-2)]}$$
$$p_P(w) = \frac{wq_P(1-r) + q_P[r(q_N - q_P) - 2]}{2[q_N - 2 + rq_P(r-2)]}$$
$$a(w) = \frac{w + rq_P - q_N}{[q_N - 2 + rq_P(r-2)]}$$

We perform sensitivity analysis to understand further the influence of these parameters on the strategies' fluctuation (see Appendix A-Scenario 2 for proof and Table 3 for the signs). The results show that a higher NB quality has a positive influence on all strategies. In other words, both supply chain players will be willing to ask for a premium retail price and the retailer will be more willing to advertise further the NB. Besides, the higher is the PL quality, the higher is the PL retail price and the lower is the wholesale price. This confirms the power played by the PL quality as a negotiation basis. The higher is the PL quality also motivates the retailer to invest less in NB advertising, since more investment lead to higher costs for the retailer and hurts further the PL demand. Finally, our results reveal that a higher advertising effectiveness has a negative effect on all strategies. In other words, when the advertising has a higher influence on demands, the retailer reduces its investment and charges lower PL price to attract customers. The manufacturer tries then to decrease its wholesale price in order to avoid retailer's retaliation.

3.5. Comparing Scenario 2 with Scenario 0 versus 1

We present below a comparison of profits (see Table 4) to investigate if it is beneficial for the retailer to fully support the NB local advertising compared to Scenario 0 and then compare it to Scenario 1. We cannot get straightforward the sign from the differences' expressions, so we resort to simulations to perform this task. We obtain the following proposition when we compare scenarios 2 and 0.

Proposition 5. *The profits of both supply chain players are higher when the retailer supports the advertising compared to no advertising. In other words, using local advertising supported fully by the retailer is also Pareto improving as it is the case when the manufacturer advertises his brand.*

The comparison of Scenarios 2 and 1 allows for the following interesting observations. The retailer has a preference for the manufacturer support of NB advertising (see Fig. 1) in two instances 1/ whatever is the advertising effectiveness on its PL demand combined with a moderate quality differential ($q_N - q_P$), between 0.2 and 0.5, and any level of each brand quality, and 2/ intense harm from advertising on its PL demand combined with extremely intense quality competition (0.1) or almost low quality competition (0.6). However, the manufacturer is better off when the retailer supports its NB through advertising investment. Besides, Scenario 2 will always lead to better profit for the whole supply chain which means that the retailer's full support for advertising generates higher profit surplus compared to the manufacturer's full support for advertising. The last result adds more argument to the manufacturer in order to motivate the retailer to invest further in advertising its brand. Comparing Scenario 2 with Scenario 1, we find that the profit of the retailer could be lower or higher but the profit of the manufacturer is always higher when the retailer advertises the NB. Consequently, the manufacturer always prefers the full advertising support of the retailer for its NB. However, the retailer may refuse to advertise the NB when it hurts its profit unless an incentive mechanism is provided.

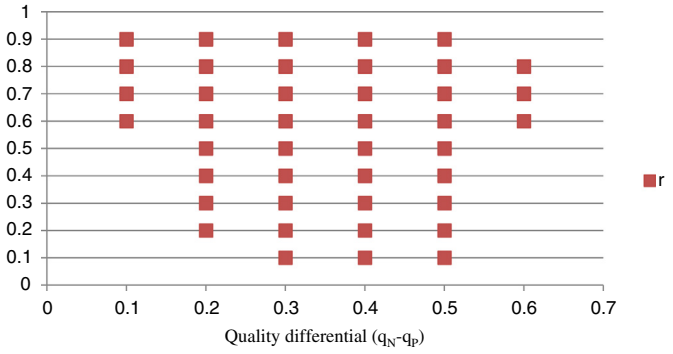

Fig. 1. Negative retailer profit comparing Scenarios 2 and 1.

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As a gesture of reciprocity, the manufacturer could propose an incentive to lower the wholesale price for the retailer and, in return, encourage the latter indirectly to advertise further its brand and thus create win-win result. We propose that the manufacturer utilizes a wholesale-price incentive for the retailer and the incentive depends directly from the NB demand. Hence, the higher the NB demand, the lower is the wholesale price paid by the retailer. This means that the manufacturer is indirectly pushing the retailer to advertise further the NB in order to improve the demand, and ultimately, to get higher amount of price reduction on the wholesale price. Specifically, we study two formats of implementing such strategy namely 1/ no prior information about the manufacturer's incentive reaction function, versus 2/ prior information about the manufacturer behavior. Previous studies such as Dawar and Stornelli (2013) discussed the need for sharing information between supply chain players in order to alleviate the possible conflicts and also to enhance performances. We would like to investigate if such format of information sharing is suitable in the context of NB and PL competition and when the incentive is given in order to boost the level of advertising investment.

3.6. Scenario 3: wholesale-price incentive when the retailer has no prior information

The local advertising supported by the retailer is decreasing on the wholesale price (see Scenario 2). Thus, the higher is the wholesale price, the lower is the local advertising the retailer will invest in. Knowing that fact, the manufacturer is interested to offer an incentive to push the retailer to invest further money for its brand. Moreover, by using such strategy, the manufacturer is interested in generating further profit surplus for the whole supply chain that could be shared between both supply chain players. Hence, we propose $w' = w - s$ where s is a positive decision variable for the manufacturer constituting the reduction amount (i.e., incentive) applied to its wholesale price w. We keep the same wholesale price w (here considered parameter) as obtained in Scenario 2. Hence, the manufacturer will need to decide on an optimal incentive s trying to lower the wholesale price to the maximum level in order to incite the retailer to invest further in advertising its NB. The retailer has to decide again on both retail prices and the local ad for the NB. The demand functions are the same as Scenario 2 and the profit functions are then:

$$\underset{a,p_N,p_P}{Max}\ \pi_R = (p_N - w')D_{NB} + p_P D_{PL} - \frac{a^2}{2}$$

$$\underset{s}{Max}\ \pi_M = w' D_{NB}$$

We also assume that the supply chain players still follow the regular leader-follower game. This means that the retailer has no information about the reaction of the manufacturer in terms of setting the incentive. Knowing that $w = \frac{(q_N - q_P)[rq_P(r-1)-2]}{2[q_P - 2 + rq_P(r-2)]}$, the results are as follows:

Proposition 6. *Assuming* $m = 1$, *the unique Stackelberg strategies are given by*:

$$p_N = \frac{-4q_N[q_N - 3 + rq_P(3r-4)] - 4q_P + (r-1)rq_P[rq_P^2(5-3r) + 8q_P + q_N q_P(r-2)(3r+1) + 2q_N^2]}{4[q_N - 2 + rq_P(r-2)][q_P - 2 + rq_P(r-2)]}$$

$$p_P = \frac{q_P\left[8 - 2(q_N + q_P) - 2r(q_N - 5q_P) - rq_P(4r + q_P) + rq_N q_P(r-1)^2 - rq_P^2(r-2)\right]}{4[q_N - 2 + rq_P(r-2)][q_P - 2 + rq_P(r-2)]}$$

$$a = \frac{2q_N - 2q_P(2r-1) + q_P(r-1)[rq_P(2r-3) - q_N(r-2)]}{2[q_P - 2 + rq_P(r-2)][q_N - 2 + rq_P(r-2)]}$$

$$s = w + \frac{[rq_P(1-r) + 2](q_N - q_P)}{2[q_P - 2 + rq_P(r-2)]} = 0$$

We compare Scenario 3 and Scenario 2 to investigate what is the added value of giving an incentive to the retailer and if it has an impact on the retailer's decisions. We obtain the results in Table 5 below.

It seems that using an incentive without prior information in the format of a reduced amount from the wholesale price is not adding any value for the retailer. In other words, the incentive combined with no prior information does not provide enough motivation for the retailer to advertise further the NB. Indeed, following the maximization rule, Scenario 2 offers the lowest possible wholesale price that the manufacturer could ask for, and that explains why this format of incentive is equal to 0.

Next, we investigate the role of sharing information along with providing an advertising -dependent incentive to assess the additional benefit for the supply chain. We propose an incentive that is function of the advertising level and the result of a maximization problem for the manufacturer in order to reveal its behavior to the retailer. Hence, the incentive in next Scenario 4 is not exogenously given but is determined by maximizing the manufacturer profit. We also check if sharing information in this context could alleviate the non-added value of providing an incentive that is defined as a mere decrease of the wholesale price.

3.7. Scenario 4: wholesale-price incentive when the retailer has prior information

In this scenario, we would like to explore the role played by the additional information that the retailer could have from the manufacturer and how this extra information could change the results of the game. Ziobro and Ng (2015) explained that while retailers are putting pressure on

Table 5
Comparison of Scenarios 3 and 2 results.

Strategies and profits	Comparison Scenarios 3–2
a	$=0$
π_M	$=0$
π_R	$=0$

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manufacturers to decrease their wholesale prices, manufacturers don't have any control over how their brands are promoted and displayed, specifically, in the presence of the PL competition. In other words, even if manufacturers are willing to offer wholesale price reduction (such as an incentive), they need a guarantee that retailers will boost their marketing efforts toward the NB as well. Hence, it becomes crucial to share information in order to adjust their decisions. Dawar and Stornelli (2013) described this information sharing and the role of information advantage as critical in shaping the manufacturer-retailer relationship.

To model this idea of information sharing, we assume that the wholesale price w is kept the same as Scenario 2 and considered here as a parameter. The manufacturer determines again the incentive s as a decision variable. The profit functions are then the same as in Scenario 3 and the demand functions are the same as in Scenario 2. However, we assume that there is a negotiation that will occur between the retailer and the manufacturer, and this will affect how the game is played compared to Scenario 3. The steps of the game are as follows:

3.8. Period 1: the retailer decides on the retail prices only

Here the retailer is showing only its reaction functions for p_N andp_P, then asks the manufacturer to divulge its reaction in terms of incentive mechanism (i.e., incentive function). That function will play the role of a signal to the retailer, and allow the latter to know how to act accordingly in terms of advertising investment. We obtain:

$$p_N(a,s) = \frac{(w-s) + q_N + a(q_N - rq_P)}{2}$$
$$p_P(a,s) = q_P \frac{1 + a(1-r)}{2}$$

3.9. Period 2: the manufacturer divulges its reaction in terms of incentive mechanism

Here the manufacturer reveals the offering in terms of an incentive s as a function of the advertising investment. We obtain:

$$s(a) = w - \frac{(a+1)(q_N - q_P)}{2}$$

The result shows that the amount of s is decreasing with the advertising level. So, the manufacturer is offering less price reduction on the wholesale price if the advertising increases. Hence, by giving extra information to the retailer, the manufacturer reduces its incentive level to the retailer. Besides, it shows a completely different behavior compared to Scenario 3 where the incentive was increasing with the adverting level. Indeed, when the retailer was not having any information advantage, it seems that the manufacturer was helping by reducing the incentive when the retailer advertises more NB. However, by having prior information on the manufacturer's move, the latter is still willing to offer an incentive but the incentive is reduced the more the retailer advertises the NB.

3.10. Period 3: the retailer decides on the advertising level investment

Once the retailer has the information about the manufacturer's reaction in terms of incentive function, the retailer decides on the advertising level to invest in. We obtain the advertising's optimal strategy:

$$a = \frac{q_P(4r-3) - q_N}{q_N - 8 + q_P(2r-1)(2r-3)}$$

Comparing the advertising level at Scenario 4 and 3, the retailer obviously decreases its advertising investment to avoid having a lower incentive. Consequently, the advertising level at Scenario 4 (prior information) is lower than that at Scenario 3 (no prior information).

$$a_{Scenario\_4} - a_{Scenario\_3} = \frac{(q_N - q_P)[rq_P(r-1)-2][3q_P - q_N - 4 + 2rq_P(r-2)]}{2[q_N - 8 + q_P(2r-1)(2r-3)][q_P - 2 + rq_P(r-2)][q_N - 2 + rq_P(r-2)]} < 0$$

A more interesting result is when we compare the incentive at Scenario 4 and the one at Scenario 3. We find that the incentive is higher when the retailer has prior information compared to the situation where there is no prior information about the manufacturer's incentive reaction. Hence, by knowing the manufacturer's reaction, the retailer decides to decrease the investment in advertising and pushes the incentive to a higher level compared to no prior information.

$$s_{Scenario\_4} - s_{Scenario\_3} = \frac{(q_N - q_P)[rq_P(r-1)-2][q_N + 7q_P - 16 + 8rq_P(r-2)]}{2[q_N - 8 + q_P(2r-1)(2r-3)][q_P - 2 + rq_P(r-2)]} > 0$$

We compare next (see Table 6) the results of Scenarios 4 and 3 in terms of strategies, demands and profits in order to understand better the dynamic and behavior of the supply chain players following the prior information about the manufacturer's reaction. The results show that, though the NB margin decreases due to the increase of incentive in Scenario 4 and decrease of advertising level, the NB demand increases. However, the loss in NB margin outweighs the gain from the demand and the manufacturer ends up with a lower profit compared to Scenario 3. It is interesting to find that the NB demand increases even so the advertising level decreases. Hence, the higher incentive following prior information seems to impact mainly the retail prices and that helps in boosting the demand for the NB. The retailer is better off having prior information. Indeed, the retailer is gaining more revenue from the NB and less revenue from the PL. However, the loss in the manufacturer's profit is higher than the gain from the retailer's profit and the whole supply chain obtains a reduced profit.

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Table 6
Comparison of Scenarios 4 and 3 results.

Strategies	Difference Scenarios 4–3	Demands and profits	Difference Scenarios 4–3
w'	<0	D_{NB}	>0
p_N	<0*	D_{PL}	<0[a]
p_P	<0	π_M	<0[a]
s	>0	π_R	>0[a]
a	<0	$\pi_{Channel}$	<0

[a] Simulation is performed for the sign of this expression.

Following this dynamic, it is clear that the final choice will be to not divulge the information to the retailer. While Dawar and Stornelli (2013) insisted on the role of information sharing between manufacturers and retailers as one of the effective strategies in order to reshape their relationship, it is clear from our result that the manufacturer will disregard such option in the specific context where an incentive is dependent on the retailer's advertising investment.

In the extant literature, prior studies (e.g., Gal-Or et al., 2008; Yan and Pei, 2011; Yan et al., 2016; etc.) showed that information sharing always leads to a Pareto result for both supply chain players. However, our Scenario 4 shows a different result. Information sharing is not always a valuable strategy to be employed by the supply chain players, particularly if we consider: 1/ branding competition, and 2/ a wholesale-price incentive that requires sharing of information from the leader (here the manufacturer).

4. Summary results

We obtain the following summary results based on all previous findings. The Table 7 provides the order of profits in all scenarios for the manufacturer, the retailer, and the supply chain (see Appendix A — Summary results for proof).

Hence, we can conclude the following observations:

1. If either the retailer or the manufacturer is advertising the NB, it is always Pareto improving for both players. In other words, it is always a good strategy to advertise the NB as long as the local advertising increases the category demand.
2. Considering the total supply chain, it is better to have the retailer advertise the NB rather than the manufacturer doing so as long as both players agree on how to share the total profits. Otherwise, the retailer will not be interested to invest in advertising the manufacturer's brand.
3. When the manufacturer adds an incentive to the retailer in order to motivate the latter to advertise further the NB, this motivation does not seem to be enough as there is no gain for all players.
4. When the manufacturer gives an incentive and also share information with the retailer (double incentives), the retailer is better off compared to no information sharing. But this is not the case for the manufacturer and it seems that the latter is giving too much incentives. The total supply chain is not improving as well.
5. If the advertising does not hurt too much the PL demand (r very low and does not exceeds 0.2), the players prefer to have the retailer invest in advertising the NB, get the reduced incentive and enjoy information sharing all together instead of having the manufacturer advertise its brand.
6. The best option over all is to let the retailer advertise the NB without incentive and information sharing. In that case, both players will agree on a profit-sharing mechanism (e.g., Amrouche and Yan, 2015; Amrouche and Yan, 2016) in order to share the surplus of profit.

In the previous literature, coordination mechanisms have been shown to always improve the total profit for the supply chain (e.g., Huang et al., 2002; Raju and Zhang, 2005; Cai, 2010; Yan, 2010; SeyedEsfahani et al., 2011). Hence, our findings provide special contexts where some coordination mechanisms are not the preferred option. The optimal strategy for both supply chain players is to use the scenario where the retailer invests in NB advertising then use a profit sharing mechanism to split fairly the profit surplus of the total supply chain. In other words, we propose reciprocity of actions to help both the manufacturer and the retailer increase their respective profits. The scenario where the manufacturer tries to push the retailer to invest further in this advertising by using wholesale price incentive without sharing information and the scenario where the manufacturer uses a wholesale price incentive and also share information, however, don't add value to the supply chain players. We conclude that the best option is to push the retailer to invest fully in NB advertising and share the surplus of profit using profit sharing mechanism.

5. Conclusion

This paper is intended to analyze the interplay of the relationship between the retailer and the manufacturer in the context of PL and NB competition. For that purpose, we compare the optimal strategies and profitability when the retailer (versus the manufacturer) offers full support for the NB advertising. We also propose a form of incentive that

Table 7
Order of profits for all scenarios.

	Order of profits		
Manufacturer profit	$\pi^{S-4}{}_M = \pi^{S-3}{}_M > \pi^{S-2}{}_M > \pi^{S-1}{}_M$	AND	$\pi^{S-2}{}_M > \pi^{S-5}{}_M$
Retailer profit	$\pi^{S-5}{}_R > \pi^{S-4}{}_R \geq \pi^{S-2}{}_R > \pi^{S-1}{}_R$ OR $\pi^{S-5}{}_R > \pi^{S-2}{}_R > \pi^{S-4}{}_R = \pi^{S-3}{}_R > \pi^{S-1}{}_R$		
Supply chain profit	$\pi^{S-4}{}_C = \pi^{S-3}{}_C > \pi^{S-2}{}_C > \pi^{S-1}{}_C$	AND	$\pi^{S-3}{}_C = \pi^{S-4}{}_C > \pi^{S-2}{}_C > \pi^{S-5}{}_C$ OR $\pi^{S-3}{}_C = \pi^{S-4}{}_C > \pi^{S-5}{}_C > \pi^{S-2}{}_C$ (if r is very low)[a]

[a] Based on simulations results.

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pushes the retailer to invest further in local advertising and we assess the role of prior information about the manufacturer's behavior in terms of the incentive function. We summarize below the managerial implications:

- When the manufacturer is offering full support for advertising its brand, both supply chain players are gaining and that allows them to have extra profits compared to the situation where there is no advertising. Hence, even if the advertising of the NB hurts the PL demand, the retailer should not retaliate in such a situation because of the overall benefits that such advertising will generate.
- The full support of the retailer is preferred over the manufacturer support for advertising as it generates higher surplus of profit for the whole supply chain. However, if there is a disagreement on how to share the surplus, the retailer will certainly opt for the manufacturer's support when 1/ the quality differential between both brands is moderate and for any level of advertising effectiveness affecting its PL demand; or 2/ when there is intense harm from advertising on its PL demand and the quality competition is extremely intense or very low.
- When the retailer is offering full support for advertising the NB, the manufacturer is always gaining extra profits compared to its full support for advertising. Hence, an incentive mechanism from the manufacturer to the retailer is encouraged here in order to show reciprocity and boost the advertising investment of the retailer.
- It is better to avoid information sharing between supply chain players in the context of advertising-level dependent incentive because that could lead to conflict when the manufacturer obtains lower profits compared to the scenario where the manufacturer's reaction is hidden.
- If the advertising does not hurt too much the PL demand, both players prefer to have the retailer invest in advertising the NB, get the reduced incentive and enjoy information sharing all together instead of having the manufacturer advertise its brand.
- The best option over all scenarios is to let the retailer advertise the NB without incentive and information sharing. In that case, both players will agree on a profit-sharing mechanism and share the surplus of profit. Hence, not all coordination mechanisms provide higher benefits as expected.

Our research could be extended in different directions. First, this research assumes a linear demand function for brand competition. Next, research studies can examine if the results derived from this demand function can be generalized to non-linear demand functions. Second, this research uses analytical models through a game-theory approach. Future research can continue to investigate whether the qualitative implications derived from our analytical models can be generalized to empirical models that incorporate more variables and that influence the purchasing decision process. Third, other forms of collaborative strategies could be assessed such as shelf-space incentives to examine the effect of these solutions on consumers' valuation, and ultimately, on the performances of all supply chain players. Finally, analyzing the instance where the PL is produced by the NB's manufacturer versus a separate PL's manufacturer could lead to different results when those agreements are implemented.

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Appendix A. Appendices: proof of propositions

A.1. Proof of valuation comparison

When $v^P<v^N$, then we have $p_N/q_N>p_P/q_P$ (because $v^P=\frac{p_P}{q_P}$ and $v^N=\frac{p_N}{q_N}$). We obtain $p_Nq_P>p_Pq_N$ and add p_Nq_N to both sides, we have $p_Nq_N-p_Nq_P<p_Nq_N-p_Pq_N$. We divide both sides by q_N-q_P to obtain: $\frac{p_N}{q_N}<\frac{p_N-p_P}{q_N-q_P}$. Because $v^{NP}=\frac{p_N-p_P}{q_N-q_P}$ and $v^N=\frac{p_N}{q_N}$, we obtain $v^{NP}>v^N$. Similarly, we can prove $v^N>v^{NP}$ when $v^P>v^N$.

Therefore, we have $v^{NP}>v^N>v^P$ when $v^P<v^N$; and $v^P>v^N>v^{NP}$ when $v^P>v^N$.

A.1.1. Proof of Proposition 1–Scenario 0

The demand functions in Scenario 0 are:

$D_{NB}=1-\frac{p_N-p_P}{q_N-q_P}$; $D_{PL}=\frac{p_N-p_P}{q_N-q_P}-\frac{p_P}{q_P}$

The profit functions to be maximized for the supply chain players are given as:

$$\underset{p_N,p_P}{Max}\,\pi_R=(p_N-w)D_{NB}+p_PD_{PL}$$

$$\underset{w}{Max}\,\pi_M=wD_{NB}$$

First, the retailer's profit function is solved to determine its reaction function. If $q_N\neq q_S$ then we obtain:

$p_N(w)=\frac{w+q_N}{2}$ and $p_P(w)=\frac{q_P}{2}$

Including the reaction functions in the manufacturer's profit function and maximizing with respect to w, we obtain:

$w=\frac{q_N-q_P}{2}$; consequently $p_N=\frac{3q_N-q_P}{4}$ and $p_P=\frac{q_P}{2}$

A.1.2. Proof of Proposition 2–Scenario 1

The demand functions in Scenario 1 are:

$$D_{NB}=1-\frac{p_N-p_P}{q_N-q_P}+mA;D_{PL}=\frac{p_N-p_P}{q_N-q_P}-\frac{p_P}{q_P}-rmA$$

The profit functions to be maximized for the supply chain players are given as:

$$\underset{p_N,p_P}{Max}\,\pi_R=(p_N-w)D_{NB}+p_PD_{PL}$$

$$\underset{w,A_N}{Max}\,\pi_M=wD_{NB}-\frac{A^2}{2}$$

First, the retailer's profit function is solved to determine its reaction function. If $q_N\neq q_P$ then:

$p_N(w,A)=\frac{w+q_N+mA(q_N-rq_P)}{2}$ and $p_P(w,A)=\frac{q_P+mAq_P(1-r)}{2}$

Including the reaction functions in the manufacturer's profit function and maximizing with respect to w and A, we obtain the following strategies if $m^2q_P-m^2q_N+4\neq0$:

$w=\frac{2(q_N-q_P)}{m^2q_P-m^2q_N+4}$ and $A=\frac{m(q_N-q_P)}{m^2q_P-m^2q_N+4}$

Consequently:

$p_N=\frac{q_N(m^2rq_P-6)-q_P(m^2rq_P-2)}{2(m^2q_N-m^2q_P-4)}$; $p_P=\frac{q_P[m^2r(q_N-q_P)-4]}{2(m^2q_N-m^2q_P-4)}$

Assuming $m=1$, the strategies of Proposition 2 and the reaction functions are proven.

A.1.3. Proof of Proposition 3 — supply chain players' profits.

The expressions of the supply chain players' profits in Scenarios 0, 1 and 2 are as follows:

Item	Scenario 0	Scenario 1	Scenario 2
π_M	$\frac{q_N-q_P}{8}$	$\frac{q_P-q_N}{2(q_N-q_P-4)}$	$\frac{(q_N-q_P)[rq_P(r-1)-2]^2}{8[q_P-2+rq_P(r-2)][q_N-2+rq_P(r-2)]}$
π_R	$\frac{q_N+3q_P}{16}$	$\frac{\left(\begin{array}{l}4(q_N+3q_P)+rq_P^2(rq_P+8)\\+rq_Nq_P[r(q_N-2q_P)-8]\end{array}\right)}{4(q_N-q_P-4)^2}$	$\frac{\left(\begin{array}{l}4q_N(1-2q_P)+12q_P(1+rq_P)\\-r^2q_P^2[q_P(r-1)^2+4]\\+rq_Nq_P(r-1)[rq_P(r-1)-4]\end{array}\right)}{16[q_P-2+rq_P(r-2)][q_N-2+rq_P(r-2)]}$

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A.1.4. Proof of Proposition 4–Scenario 2

The demand functions in Scenario 2 are:

$$D_{NB} = 1 - \frac{p_N - p_P}{q_N - q_P} + ma; D_{PL} = \frac{p_N - p_P}{q_N - q_P} - \frac{p_P}{q_P} - rma$$

The profit functions to be maximized for the supply chain players are given as:

$$\underset{a,p_N,p_P}{Max}\ \pi_R = (p_N - w)D_{NB} + p_P D_{PL} - \frac{a^2}{2}$$

$$\underset{w}{Max}\ \pi_M = wD_{NB}$$

First, the retailer's profit function is solved to determine its reaction function. When$q_N - 2 + rq_P(r-2) \neq 0$, we obtain the following reaction functions:

$$p_N(w) = \frac{w[2(q_N - 1) + rq_P(r-3)] - 2q_N + r^2 q_P(q_N - q_P)}{2[q_N - 2 + rq_P(r-2)]}$$
$$p_P(w) = \frac{wq_P(1-r) + q_P[r(q_N - q_P) - 2]}{2[q_N - 2 + rq_P(r-2)]}$$
$$a(w) = \frac{w + rq_P - q_N}{[q_N - 2 + rq_P(r-2)]}$$

Including the reaction functions in the manufacturer's profit function and maximizing with respect to w, we obtain the strategies as listed in Proposition 4 if $q_P - 2 + rq_P(r-2) \neq 0$ and $q_N - 2 + rq_P(r-2) \neq 0$.

A.2. Proof — summary results

The table below offers a summary of profit results for all pairwise scenarios. We provide a comparison of profits of all scenarios for the manufacturer, the retailer and the whole supply chain in order to generate Table 7.

Profits	Scenarios 1–0 M. advertising vs no advertising	Scenarios 2–0 R. advertising vs no advertising	Scenarios 2–1 R. advertising vs M. advertising	Scenarios 3–2 R. advertising + incentive vs R. advertising	Scenarios 4–3 R advertising + incentive + information sharing vs R. advertising + incentive	Scenarios 4–1 R advertising + incentive + information sharing vs M. advertising
π_M	>0	>0	>0	=0	<0	<0
π_R	>0	>0	>0 or <0	=0	>0	>0
$\pi_{Supply-Chain}$	>0	>0	>0	=0	<0	<0 or >0

R. for retailer and M. for manufacturer.

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