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ORIGINAL ARTICLE

How do line extensions impact brand sales? The role of feature similarity and brand architecture

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Abstract
Brand architecture decisions have important performance implications but have seen little quantitative research. In particular, there is little empirical evidence on how the strength of the link established among clusters of products within the company's portfolio impact the sales effects of typical marketing actions such as line extensions. This paper quantifies the effect of different brand architecture choices and product feature similarity in moderating the impact of line extensions on brand sales. Based on categorization theory, the authors hypothesize that brand name similarity and feature similarity, both independently, and in interaction, increase brand cannibalization. The empirical analysis in three consumer packaged-goods categories shows that it is more critical to minimize the feature similarity than brand name similarity to limit cannibalization and generate higher incremental sales from line extensions. Controlling for feature similarity, line extensions introduced under sub-brands cause greater cannibalization.

Keywords Branding · Brand architecture · Line extensions · Categorization theory · Cannibalization

Introduction

Firms launch new products and services to maintain growth and sustain long-term financial performance. However, not all new product introductions help the brand overall: a TNS report found that, in the UK, 60% of new launches fail to provide growth or eat into companies' profits from existing products (Mathiesen 2013). The majority of these new product introductions can be viewed as line extensions, which are horizontally differentiated product lines that showcase minor but functional product variations—such as in flavor or package size—within product categories the firm is already active in. To avoid creating substitute products that cannibalize sales or erode profitability, the company has to design the new offerings to be different on various product attributes (e.g., Dawes 2012). Specifically, the manufacturers must decide how similar the new variants should be to the existing products in attributes such as brand name and product features, with an eye on top- and bottom-line performance. Whereas the need to differentiate along product features is obvious, an unresolved question involves the difference in brand name: whether to introduce the new product line as an extension of an existing brand in the portfolio (i.e., under a sub-brand, creating similarity in brand names) or under a new and unrelated brand (i.e., a stand-alone brand, creating dissimilarity in brand names). Our research distinguishes the brand name decision, related to brand architecture strategy, from the decision related to product features—hereafter called features. Both decisions are critical to the extension's success and the optimal performance of the brand portfolio, ideally through creating intra-brand and intra-product synergies rather than cannibalizing and wasting scarce resources.

As brands are important intangible assets, their management is critical for firm strategy at all levels. Indeed, a well-designed brand architecture enables each portfolio member's tight and purposeful positioning while at the same time generating positive feedback effects to the parent and corporate brands. We follow the seminal paper by Aaker

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and Joachimsthaler (2000) in defining brand architecture as the organizing structure of the brand portfolio, specifying brand roles, and managing the relationships between brands. In more recent work, Keller (2014, p.702) emphasizes that the "brand architecture strategy of a firm determines which brand elements a firm should apply across new and existing products and services." For multi-brand firms with proliferated product portfolios facing the challenge of maximizing brand equity across all the products and brands they offer, brand architecture performs two key roles (Keller 2012): (1) to improve consumer understanding of the role and meaning of each brand in the portfolio and communicate similarity and differences between individual products and (2) to maximize transfer of equity between the brand and individual products and services to improve trial and repeat purchase. Therefore, the right brand architecture has to get the right balance between seemingly conflicting goals of communicating similarity and differences across product lines.

The cluttered current media environment strengthens the relevance of this work on brand architecture. It is a challenge to achieve efficient and effective communication of value propositions from the level of the individual product to the level of the overarching brand(s). Valuable experimental work augments our understanding of effective brand architecture decisions but is concerned more with the consumer perspective, while extant research using secondary data deal more with "macro"-level firm outcomes, such as firm value. There is a need for sales-level analysis to guide managers regarding marketing strategies and tactics related to brand portfolio design and management. Unsurprisingly, several scholars have called for more empirical research due to the limited empirical insights that builds upon brand architecture decision's conceptual foundations (e.g., Sheth and Koschmann 2018; Oh et al. 2020).

This paper seeks to fill this gap in the literature by quantifying the effect of different brand architecture choices and product feature similarity in moderating the impact of line extensions on brand sales. To that end, we estimate models of brand sales response to product line extensions using data from three consumer packaged-goods categories and brands of manufactures with hybrid brand architectures (i.e., manufacturers with brand portfolios featuring both closely associated, similar brands—sub-brands—and unrelated, dissimilar brands—stand-alone brands). We find that both brand name and feature similarity may have detrimental effects on the performances of other brands in the portfolio (i.e., sales cannibalization). Moreover, brand name similarity and feature similarity generally, but not always, appear to have multiplicative cannibalization effects. Finally, we find that feature similarity is a greater driver of cannibalization effects than brand name similarity, implying that it is more critical to minimize feature similarity than brand name similarity to limit cannibalization and generate higher incremental sales from line extensions.

Research background

Three streams of research are particularly relevant to our question of understanding how to use branding-related decisions to achieve the best possible positioning of brand portfolio members and thereby attenuate cannibalization when introducing line extensions. These are the literatures of brand architecture, brand extensions, and line extensions.

A group of studies in the *brand architecture* literature provides empirical evidence at the macro-financial marketing level, such as the impact of brand architecture strategy on firm value (Rao et al. 2004; Hsu et al. 2016). Key drivers of firm-level financial performance effects of brand architecture strategy include the characteristics of brand portfolios, such as the number of brands owned, the number of segments pursued by each brand, and the degree to which brands compete with one another (Bahadir et al. 2008; Bharadwaj et al. 2011; Morgan and Rego 2009; Rego et al. 2009; Wiles et al 2012). Yet, no micro-level empirical studies explore the interaction of brand architecture decisions with marketing actions such as line extensions.

Related experimental work focuses on the attitudinal consequences of specific brand architecture decisions. For example, Sood and Keller (2012) examine the ability of sub-branding to extend brands farther than they would otherwise be able to do. Other experimental evidence supports the benefits of isolated brand architectures (Dacin and Smith 1994; John et al. 1998; Sheinin and Biehal 1999). No work, experimental or secondary data-based, compares the effects of different brand architectures in bringing about behavioral or market outcomes.

Next, we turn to the sister *brand extensions* literature.[1] The brand extensions literature examines two related phenomena: forward effects on the extension from the parent brand (e.g., Dawar and Anderson 1994; Goedertier et al. 2015; Miniard et al. 2020; Ulrich et al. 2020) and, to a lesser extent, feedback effects on the parent brand from the extension (e.g., Riley et al. 2013; Michel and Donthu 2014).

The forward extension-effects literature has established that it is the level of fit (i.e., similarity) between the parent and the extension that makes the extension successful in

[1] We can draw from this literature stream because different brand architectures, such as sub-branding, endorsed branding, and branded house (all classical brand architecture types other than house of brands), involve establishing some form of association among brands. The branded house type of brand architecture coincides perfectly with brand extensions. However, the other types of brand architectures are also related to the concept of brand extensions.

terms of generating positive evaluations (e.g., Aaker and Keller 1990; Bridges et al. 2000; Bottomley and Holden 2001; Klink and Smith 2001; Lane 2000; Völckner and Sattler 2007). However, this line of research almost exclusively studies impact at the level of consumer attitudes, raising the question of how results may differ in actual behavior. While similarity has been found to be an important driver of both brand attribute associations and brand affect transfer between a parent brand and its extension by the seminal paper of Aaker and Keller (1990) and later corroborated by many studies, some papers within the brand extension literature (e.g., Carter and Curry 2013) has discussed whether the forward extension-effects from the parent are positive when looking at market performance outcomes rather than focusing exclusively on consumer attitude evaluations. It has hence come into question whether similarity between the extension and the parent is always beneficial. Work from other fields also supports this more nuanced recent view. For example, substitution and income theory from economics (e.g., Ashenfelter and Heckman 1974) suggest that as perceived inter-product similarity increases, the potential substitution rates between the products also increase. Cannibalization research in marketing also follows this reasoning (e.g., Moorthy 1988; Desai 2001). Work on feedback effects of brand extensions is limited and at the level of consumer attitudes rather than market performance outcomes.

Lastly, we review the literature on *line extensions*. Line extensions—new product variant introductions belonging to a brand—are a special type of brand extensions, where the extension is within the same product category.[2] The literature stream looking specifically at the role of line extensions in cannibalization has found that line extensions give a firm price-setting power within a product category (Kadiyali et al. 1998); that price- and non-price promotions result in cross-package size cannibalization (González-Benito et al. 2010; Dawes 2012); and that some line extensions can lead to additional sales (i.e., stimulate category growth) rather than cannibalize (Reddy et al. 1994; Lomax et al. 1996). Though these studies advance our understanding of the sales performance implications of line extensions, they fail to address whether and how these effects may change under different brand architectures.

Would related brands benefit or suffer due to the similarity to the parent brand in the store? No work systematically addresses this unanswered question within either of the brand architecture, brand extensions, or line extensions literatures concerning possible cannibalization effects to the brand franchise at the level of sales performance. Hence, there is dearth of empirical evidence that can provide guidelines to firms concerning how to choose the optimal brand architecture for their ever-expanding proliferated product portfolios. Specifically, it is difficult to conclude from the literature whether the reciprocal transfer of brand affect and attribute associations between brand extensions and their parents lead to better outcomes for the parent. Could it be the case that a successful extension jeopardizes the sales of the parent? This paper seeks to answer the research question of whether and when line extensions benefit or damage parent brand sales.

Conceptual framework and hypotheses

Similarities between products and brands are perceived and conceptualized by consumers as categories. This paper considers both brand name similarity and feature similarity as potential bases for categorization that increases consumer perceptions of substitutability among a firm's offerings. While many variables may affect categorization decisions, work on categorization has shown the role of feature similarity in creating categories and in the transfer process of affect and attitudes across category members (e.g., Medin and Wattenmaker 1987). Brand name similarity has also been shown to play an important role (e.g., Schwarz and Bless 1992). Line extensions, as a special type of brand extensions, would also have a significant impact on consumers' categorization processes at both the brand and product feature levels. Thus, categorization theory and the empirical findings in the brand extension literature apply also to line extensions. Therefore, we apply categorization theory to develop our hypotheses.

Categorization theory posits that a brand is a category in memory with associations related to product attributes, brand image, and overall attitudes (Boush and Loken 1991; Czellar 2003; Loken and John 1993; Park et al. 1996; Van Osselaer and Alba 2003). Category information is vital to consumers in their judgments and decisions regarding new category members: it enables category inferences or inductions. It is those category inferences or inductions that marketers hope to capitalize on through their brand architecture strategies. Extant research on brand categories focuses on how category beliefs and affect have a driving role in the perception of new category members (brand extensions) and that in turn, these new category members have reciprocal effects upon category beliefs and attitudes (Loken et al. 2008).

At the time of judgment or decision-making, consumers focus on a subset of knowledge available about the brand category and product exemplars (Loken et al. 2002). This

[2] The defining boundary between a brand and a line extension can be blurry: Is Diet Coke a line extension or brand extension? The answer depends largely on the perspective of the manager that views the category at the superordinate product category or subordinate subcategory level.

selective focus is influenced by (1) the accessibility of information either retrieved from memory or in the environment and (2) the relevance of information in achieving specific goals. In any given context, information about either brand attributes or exemplar products of a brand, or both, may vary in accessibility, with some being much more accessible than others (Loken et al. 2002; Meyvis and Janiszewski 2004).

The highly accessible information for a new category member may include: its brand name—and, consequently, its connection to other brands in the portfolio—its individuating attributes. Depending on the consumer and the marketing environment, one or both of those highly accessible pieces of information may also be highly relevant on the consumer's goals. Hence, within the context of our study, both brand name and its features may be high in accessibility and relevance and become a basis for how the consumers construct consideration sets built upon the products they see as close substitutes.

Literature examining a new product's performance in isolation (i.e., focusing only on a new product's performance or the parent product's performance) finds positive impacts of each product upon the other when categorized together by consumers. For instance, research has shown a positive relationship between feature similarity and consumers' evaluations, purchase intentions, and sales of brand extensions (Chakravarti et al. 1990; Farquhar et al. 1989). However, as we pay attention to feedback effects, considering how new products' performance affects existing brands, we see a dark side of products having categorical similarities. Supporting this view, other lines of research have found that as similarity increases between a parent brand and its extensions, substitution effects come into play (Lomax and McWilliam 2001; Mason and Milne 1994; Srinivasan et al. 2005). As research has shown both feature similarity and brand name similarity to be linked to categorization, it follows that similarity in both brand name and features could result in cannibalization. Also, the problem of cannibalization could be expected to be exacerbated when brand name similarity and feature similarity work against the brand in interaction with one another. Thus, we predict that:

Hypothesis 1 As brand name similarity between the line extension and focal brand increases, brands suffer greater cannibalization effects.

Hypothesis 2 As feature similarity between the line extension and focal brand increases, brands suffer greater cannibalization effects.

Hypothesis 3 Increasing feature similarity between the line extension and the focal brand causes greater cannibalization when introduced as sub-brands than as stand-alone brands.

Aaker (2011, 2020) proposes that sustainable performance for brands arises from creating and claiming meaningful subcategories within product categories rather than fighting the perpetual brand preference battle. This argument implies that the real driver of success for brands lies in specifically targeted benefits, which should be protected through brand naming strategies. In other words, product benefit and branding decisions should be working together synergistically.

The question arises whether configuring feature or brand name similarity is more critical for the clear, crisp, and purposeful positioning of the portfolio as a whole and the portfolio members individually. Indeed, managers do not always have all options available, whether it be due to firm tangible and intangible resources or the micro- and macro-environment of the firm. Consumers may be hesitant to accept radical repositioning efforts due to brand heritage and history. The competition may make it unfeasible to pursue a certain portfolio design strategy. Hence, there are situations in which firms need to make a trade-off between minimizing brand name or feature similarity of their portfolios.

Accordingly, this study also examines the question of whether feature similarity or brand name similarity is a more important base for categorization and, hence, a driver for cannibalization. The question remains how consumers use different product attributes to categorize and, therefore, which product attributes, brand name or features, are more likely to cause consumers to group certain products as substitutes. As it is difficult to judge a priori the many consumer and internal complexities that may be involved in the categorization process of the formation of consumer consideration sets, we leave this question as an empirical issue and propose the following competing hypotheses.

Hypothesis 4A Brand name similarity is a more important driver of cannibalization than feature similarity.

Hypothesis 4B Feature similarity is a more important driver of cannibalization than brand name similarity.

Data and model

Data

The data for this study come from the 2008 IRI Academic Data Set (Bronnenberg et al. 2008), which contains weekly store-level sales, prices, and promotions of stock-keeping units (SKUs) for 30 product categories sold in the US representing 47 markets. The data cover six years (January 1, 2001–December 31, 2006). The data set also includes detailed information on SKU-level product descriptions (i.e.,

product attributes) and the SKUs' placements in the manufacturers' brand architectures.

To perform a stringent test of our predictions about the effects of brand versus feature similarity, we pick from this data set two functional product categories (Laundry Detergent and Toothpaste), both of which are experience goods, as in work by Broniarczyk and Alba (1994). We also test our predictions on one hedonic product category (Coffee). In each of the categories (e.g., Coffee), we select companies (e.g., P&G) that contain in their portfolio both sub-brands (e.g., Folgers, Folgers Lite, Folgers Coffee House, and so on) and stand-alone brands (e.g., Home Coffee, Millstone). Essentially, we analyze only companies that have hybrid brand architectures. Furthermore, to minimize the biases that may arise due to heterogeneity in preferences across markets and heterogeneity in marketing strategies across retail chains, we focus on single geographical market, Chicago, and use data from all stores (19 in total) belonging to a single supermarket chain operating in the Chicago market. The store-level data used for estimation cover the entire 2001–2006 period. Finally, as our expectations are at the brand level, we aggregated SKU-store-level weekly data to brand-store-level weekly data as described shortly.

Model specification

As the goal of this paper is to uncover how a manager's decision on the brand architecture of its line extensions with varying degrees of feature similarity impacts brand sales, we adapt a SCAN*PRO-type log–log sales response model (e.g., Leeflang et al. 2016; Van Heerde et al. 2000). Specifically, we have the following model as our starting point:

$$\begin{aligned}\ln(\mathrm{SALES}_{bst}) = {} & \phi_b + \gamma_s + \sum_{b'=1}^{B}\beta_{1b'b}\ln(\mathrm{PRICE}_{b'st}) \\ & + \sum_{b'=1}^{B}\beta_{2b'b}\ln(\mathrm{PI}_{b'st}) + \sum_{b'=1}^{B}\beta_{3b'b}\mathrm{FND}_{b'st} \\ & + \sum_{b'=1}^{B}\eta_{b'b}\ln(\mathrm{PLL}_{b'st}) + \omega_1\mathrm{SC}_{1bst} \\ & + \omega_2\mathrm{SC}_{2bst} + \varepsilon_{bst}, \end{aligned} \quad (1)$$

where SALES_{bst} is the sales volume of brand b (1,…,B) in store s (1,…,S) in week t (1,…,T). $\mathrm{PRICE}_{b'st}$ is the regular price of brand b' in store s in week t, and $\mathrm{PI}_{b'st}$ is the price index, which accounts for price promotions. As such, our model makes a distinction between regular and promotional price effects. $\mathrm{FND}_{b'st}$ is a variable for feature/display activity (i.e., non-price-oriented promotions). $\mathrm{PLL}_{b'st}$ is the product line length of brand b' in store s in week t. Finally, SC_{1bst} and SC_{2bst} are two variables included to control for seasonality (i.e., trigonometric seasonality correction). We discuss the operationalization of these variables shortly.

As for the parameters in Eq. (1), ϕ_b and γ_s are brand- and store-fixed effects filtering out cross-sectional differences in sales across brands and stores. $\beta_{1b'b}$ is the regular price elasticity, $\beta_{2b'b}$ is the promotional price elasticity, and $\beta_{3b'b}$ is the non-price-oriented promotion multiplier, $\eta_{b'b}$ is the elasticity of brand sales to product line length changes. For $b'=b$, these parameters are own elasticities for price, promotion, and product line length, whereas for all $b'\neq b$, they correspond to cross-elasticities. Finally, ω_1 and ω_2 are the coefficients capturing seasonal patterns in brand sales.

We utilize product line length cross-elasticities (i.e., $\eta_{b'b}$ for all $b'\neq b$) to quantify the beneficial (or deleterious) effect of product variant introductions and the attendant brand architecture decision. As suggested by our conceptual development, increasing product line length is likely to displace sales from the focal brand proportional to the similarity of the newly introduced alternative to the products of the focal brand based on brand name or features. Moreover, we expect cannibalization effects due to feature similarity to accentuate with brand similarity. Accordingly, we express $\eta_{b'b}$ as a function of similarity in the features of the product lines of different brands (i.e., feature similarity), brand similarity, and the interaction between the two similarities. Provided that the brands in the category other than the focal brand b (i.e., all $b'\neq b$) can be uniquely grouped under (i) sub-brands (i.e., brands of the focal brand's owner company that are associated with the focal brand through a common parent brand, similar in brand name), (ii) stand-alone brands (i.e., other brands of the focal brand's owner company that are not associated with the focal brand, dissimilar in brand name), and (iii) other brands (i.e., brands owned by other companies, unrelated brands), product line length cross-elasticity is expressed as

$$\begin{aligned}\eta_{b'b}\vee\eta_{b'bt} = {} & \eta_0 + \eta_1\mathrm{SUBBRANDED}_{b'b} + \eta_2\mathrm{STANDALONE}_{b'b} \\ & + \eta_3\mathrm{SIM}_{b'bt} + \eta_4\mathrm{SUBBRANDED}_{b'b}\times\mathrm{SIM}_{b'bt} \\ & + \eta_5\mathrm{STANDALONE}_{b'b}\times\mathrm{SIM}_{b'bt}, \end{aligned} \quad (2)$$

where $\mathrm{SUBBRANDED}_{b'b}$ is a dummy variable taking the value of 1 if brand b' and b are associated through a shared parent brand (i.e., high brand name similarity) and 0 otherwise. $\mathrm{STANDALONE}_{b'b}$ is a dummy variable taking the value of 1 if brand b' and b are not associated but owned by the same company (i.e., low brand name similarity) and 0 otherwise. $\mathrm{SIM}_{b'bt}$ is the feature similarity between the product lines of brands b' and b in week t and ranges between 0 (i.e., no overlap in features between two product lines) and 1 (i.e., identical product lines) theoretically. We discuss the operationalization of feature similarity variable shortly.

As the dummy coding of brand similarity uses other (i.e., unrelated) brands as the base category, η_0 captures the impact of a 1% change in an unrelated brand's product line length on focal brand sales when the new items are completely unique (i.e., $\mathrm{SIM}_{b'bt}=0$). We expect this effect to be negative. However, if the newly introduced alternatives

invite new consumers to the category and introduce new usage occasions, η_0 can decrease in magnitude and may even turn positive. η_3 captures how this impact changes as the similarity between these two brands' product lines increases, and we expect it to be negative due to substitution effects. If the brand extending its product line is linked to the focal brand through a common parent, η_1 and η_4 capture, respectively, the additional effect of this increase in product line length and the associated change in similarity on focal brand sales. Likewise, η_2 and η_5 capture the differential effect due to the introducing brand being unassociated in name to the focal brand yet owned by the same company.

Finally, we also express cross-price elasticities ($\beta_{1b'b}$), cross-promotional-price elasticities ($\beta_{2b'b}$), and cross-non-price-oriented promotion multipliers ($\beta_{3b'b}$) as functions of feature similarity, brand similarity, and the interaction between the two.

Operationalization of variables

Our dependent variable, brand sales, is calculated as the sum of volume equivalent unit sales of all stock-keeping units belonging to a brand in a given store-week. Volume equivalent regular price of each SKU sold in a given store-week is inferred from the actual price variable in combination with the promotion flag. Specifically, if the SKU was not offered on discount (i.e., the price promotion flag was zero) in a given store-week, we set the regular price equal to the actual price. Actual price is calculated by dividing total dollars earned by total volume equivalent units sold. Whenever a price promotion flag is encountered, the regular price is calculated by going backward and forward in time (−6 weeks and +6 weeks) and searching for non-promotional weeks for that SKU. The most frequently observed regular price in those non-promotional weeks is assumed to be the regular price for that week. If no non-promotional price is found for that SKU in that store and week within the set time window, we search other stores of the same retailer. The process runs such that when a regular price candidate is found, a check is conducted to make sure that it is higher than the actual price. However, regular price changes may render reliable inference impossible at times. In the case that the candidate regular price is lower than the actual price or could not be found by systematically searching the focal store and other stores, equipped with the knowledge that the data provider flags a promotion when the actual price is at least 5% lower than the regular price, we set a regular price such that the actual price is 5% lower than the regular price. Brand-level regular price is calculated as the SKU-share-weighted average of regular prices. We use static (i.e., average) SKU shares in the aggregation.

The price index for all SKUs is obtained by calculating the ratio of actual price to regular price in that store-week (e.g., Van Heerde et al. 2000).[3] Following Mela et al. (1997), we set the brand-level price index to the value corresponding to the highest discount depth among all SKUs belonging to a brand. As for non-price-oriented promotions, we combine feature and display activity under one variable and set it to 1 if the SKU was on feature and/or display and not offered on a discount. Coding feature and/or display in the absence of a price promotion as our non-price-oriented promotion variable ensures that promotional variables are uncorrelated in analyses. SKU-level feature and/or display indicators are aggregated to the brand level by taking the SKU-share weighted feature and/or display activity. Finally, the product line length variable is operationalized as the number of SKUs that a brand offers in a given store-week. Therefore, an increase in the product line length variable from week to week denotes new product introduction(s).

As for the similarity variable in Eq. (2), we start by calculating feature similarity at the SKU level. First, we reduce the number of distinct levels of each attribute by combining levels that can be clustered.[4] In the calculation of similarity, first, each SKU's attribute levels are compared against the attribute levels of other 'SKUs' attribute levels. In the case that two SKUs are the same on that attribute, a similarity level is calculated taking into consideration the frequency of occurrence of that attribute level (see Rooderkerk et al. 2013 for details). The approach looks first at whether two items share the same level of a nominal attribute (e.g., flavor of coffee). If they do share the same level of that nominal attribute, "their perceived similarity should be stronger when their shared attribute level occurs less frequently" (Goodall 1966, as cited in Rooderkerk et al. 2013, p. 703). This is accomplished by defining,

$$\mathrm{SIM}_{kk'lti} = I\left(A_{kl} = A_{k'l}\right)\left(1 - \frac{1}{N_{ti}}\sum_{\substack{k''=1 \\ X_{k''ti}=1}}^{K} I\left(A_{k''l} = A_{ki}\right)\right), \tag{3}$$

where $I(.)$ is an indicator function that is 1if its argument holds and is 0 otherwise, A_{kl} is the level attained by a SKU on attribute l such that $A_{kl} = m <> A_{klm} = 1$, and N_{ti} is the number of SKUs present in week t in store i. Finally, using

[3] The price index variable is bounded between 0 and 1. It is equal to one in non-promotional weeks and is less than one if the actual price is less than the regular price because there is a price promotion in that store and week. If the regular price changes, the price index changes with the regular price.

[4] All attributes used in similarity calculation are nominal.

Table 1 Data descriptives—laundry detergent category

Variable	Obs	Mean	Std. Dev	Min	Max
Sales Volume	89,198	279.38	682.18	0	21,674
Product Line Length	89,198	5.51	7.36	1	58
Regular Price	89,198	1.16	2.44	0.24	23.41
Price Index	89,198	0.97	0.07	0.28	1
Feature/Display	89,198	0.64	0.40	0	1
Similarity Sub-brands	89,198	0.03	0.05	0	0.23
Similarity Stand-alone Brands	89,198	0.07	0.06	0	0.23
Similarity Competitor Brands	89,198	0.10	0.04	0	0.23

Table 2 Data descriptives—coffee category

Variable	Obs	Mean	Std. Dev	Min	Max
Sales Volume	107,115	48.53	131.17	0	5662.10
Product Line Length	107,115	7.25	10.86	1	79
Regular Price	107,115	6.01	5.52	1.33	168.25
Price Index	107,115	0.95	0.09	0.25	1
Feature/Display	107,115	0.21	0.37	0	1
Similarity Sub-brands	107,115	0.01	0.04	0	0.78
Similarity Stand-alone Brands	107,115	0.03	0.15	0	0.83
Similarity Competitor Brands	107,115	0.02	0.09	0	0.99

Table 3 Data descriptives—toothpaste category

Variable	Obs	Mean	Std. Dev	Min	Max
Sales Volume	239,924	3.04	7.48	0	1152.90
Product Line Length	239,924	2.98	3.57	1	31
Regular Price	239,924	12.61	10.31	1.78	79.77
Price Index	239,924	0.97	0.07	0.22	1
Feature/Display	239,924	0.02	0.10	0	1
Similarity Sub-brands	239,924	0.11	0.13	0	0.99
Similarity Stand-alone Brands	239,924	0.14	0.14	0	0.98
Similarity Competitor Brands	239,924	0.18	0.10	0	0.32

the Nearest-Neighbor Approach, the mean of the similarities across each SKU for all attributes and across each brand for all SKUs is calculated. Tables 1, 2, and 3 display the summary statistics of all variables in the three selected product categories.

Results

Table 4 displays our estimation results. The predictors explained a sizable proportion of variance within each category: For the laundry detergent category $R^2 = 0.88$, $F(98, 81773) = 5847.58$, $p < 0.001$; for coffee $R^2 = 0.85$, $F(122, 98742) = 4687.91$, $p < 0.001$; and for toothpaste $R^2 = 0.80$, $F(186, 197669) = 4297.45$, $p < 0.001$.[5] Moreover, own elasticities for price, price promotion, and product line length and own feature and display multiplier are all significant and in the expected direction and magnitude.

Is brand name similarity a significant driver of cannibalization?

Examining the effect of line extensions under sub-brands and stand-alone brands requires us to test the linear combination (i.e., addition) of the effect of competitive line extensions and the respective changes of sub-brands and stand-alone brands in relation to the competitive line extensions (i.e., the reference category). Further, testing H1 requires testing the difference of the line extensions under stand-alone brands and sub-brands. Overall, two out of three categories show support for H1 that brand name similarity increases cannibalization.

In the *laundry detergent* category, the effect of line extensions under sub-brands is significantly negative ($\beta = -0.03$, $p < 0.05$); however, the effect of line extensions under stand-alone brands is significantly positive ($\beta = 0.02$, $p < 0.001$). Thus, line extensions introduced under sub-brands show evidence of cannibalization, whereas those introduced under stand-alone brands do not. To formally test H1 that brand name similarity increases cannibalization, we test the difference between the marginal effects of line extensions introduced under stand-alone brands versus sub-brands and find that when the line extension is introduced under a stand-alone brand, its impact on focal brand sales is significantly higher than when it is introduced under a sub-brand ($\beta = 0.05$, $p < 0.001$) demonstrating support for H1.

In the *coffee* category, we find positive and significant effects for line extensions under both sub-brands ($\beta = 0.23$, $p < 0.001$) and stand-alone brands ($\beta = 0.03$, $p < 0.001$), showing no evidence of cannibalization. The formal test for H1 that brand name similarity increases cannibalization (i.e., the difference between the marginal effects of line extensions introduced under stand-alone brands

[5] Though it is customary in SCAN*PRO models to control for variation across brands and stores using fixed effects, we conducted a Hausman test prior to estimating the results, which indicated that our fixed-effects model was the appropriate model (rather than a random-effects model).

Table 4 Coefficient estimates

Variable	DETERGENT	COFFEE	TOOTHPASTE
	Own effects		
$\ln(PI_{bbt})$	−4.15***	−3.69***	−1.85***
$\ln(PRICE_{bbt})$	−2.03***	−2.11***	−0.99***
$\ln(PLL_{bbt})$	0.90***	0.91***	0.59***
FND_{bbt}	0.29***	0.29***	0.37***
		Cross effects	
$\ln(PI_{b'bt})$	0.08***	0.05***	0.00ooo
$\ln(PI_{b'bt}) \times SUBBRANDED_{b'b}$	−0.30***	−0.26ooo	0.03***
$\ln(PI_{b'bt}) \times STANDALONE_{b'b}$	0.43***	−0.09***	−0.03***
$\ln(PI_{b'bt}) \times SIM_{b'bt}$	−0.78***	−0.02ooo	0.04***
$\ln(PI_{b'bt}) \times SUBBRANDED_{b'b} \times SIM_{b'bt}$	1.88*oo	0.43ooo	−0.41***
$\ln(PI_{b'bt}) \times STANDALONE_{b'b} \times SIM_{b'bt}$	−4.48***	−0.75***	0.12*oo
$\ln(PRICE_{b'bt})$	0.02***	0.01***	0.00***
$\ln(PRICE_{b'bt}) \times SUBBRANDED_{b'b}$	0.02ooo	−0.15***	−0.02***
$\ln(PRICE_{b'bt}) \times STANDALONE_{b'b}$	0.02ooo	−0.03***	−0.01***
$\ln(PRICE_{b'bt}) \times SIM_{b'bt}$	−0.01ooo	0.02***	−0.01***
$\ln(PRICE_{b'bt}) \times SUBBRANDED_{b'b} \times SIM_{b'bt}$	0.09ooo	0.23***	0.03***
$\ln(PRICE_{b'bt}) \times STANDALONE_{b'b} \times SIM_{b'bt}$	0.02ooo	0.08***	0.04***
$\ln(PLL_{b'bt})$	**−0.08*****	**0.00*****	**0.00ooo**
$\ln(PLL_{b'bt}) \times SUBBRANDED_{b'b}$	**0.06*****	**0.24*****	**−0.01*****
$\ln(PLL_{b'bt}) \times STANDALONE_{b'b}$	**0.11*****	**0.03*****	**0.02*****
$\ln(PLL_{b'bt}) \times SIM_{b'bt}$	**0.09*****	**0.00**	**0.05*****
$\ln(PLL_{b'bt}) \times SUBBRANDED_{b'b} \times SIM_{b'bt}$	**−0.84*****	**−2.61*****	**−0.15*****
$\ln(PLL_{b'bt}) \times STANDALONE_{b'b} \times SIM_{b'bt}$	**−0.36*****	**−0.10*****	**−0.17*****
$FND_{b'bt}$	−0.02***	−0.01***	−0.01ooo
$FND_{b'bt} \times SUBBRANDED_{b'b}$	0.07***	−0.07*	0.01ooo
$FND_{b'bt} \times STANDALONE_{b'b}$	−0.02*	−0.01***	−0.01ooo
$FND_{b'bt} \times SIM_{b'bt}$	0.21***	-0.03***	−0.02ooo
$FND_{b'bt} \times SUBBRANDED_{b'b} \times SIM_{b'bt}$	−1.19***	0.79***	0.05ooo
$FND_{b'bt} \times STANDALONE_{b'b} \times SIM_{b'bt}$	0.36***	0.10ooo	-0.06ooo
	Model fit		
R^2	0.88	0.85	0.80
$F(df_B, df_w)$	$F(98, 81773) = 5847.58$***	$F(122, 98742) = 4687.91$***	$F(186, 197669) = 4297.45$***

The bolded area shows that set of coefficients used to test the hypotheses

***$p < 0.001$, **$p < 0.01$, *$p < 0.05$

versus sub-brands) yields a negative and significant result ($\beta = -0.2$, $p < 0.001$), thus showing no support for H1.

In the *toothpaste* category, the effect of line extensions under sub-brands is significantly negative ($\beta = -0.01$, $p < 0.001$) showing evidence of sales cannibalization, while the effect of line extensions under stand-alone brands is significantly positive ($\beta = 0.02$, $p < 0.001$). Once again, to formally test whether brand name similarity increases cannibalization, we test the difference between the marginal effects of line extensions introduced under stand-alone brands versus sub-brands and find support for H1, as the difference is positive, significant, and in favor of stand-alone brands ($\beta = 0.03$, $p < 0.001$).

Is feature similarity a significant driver of cannibalization?

To test H2 that feature similarity increases cannibalization, we need to test whether this relationship holds both for line extensions introduced under sub-brands as well as stand-alone brands. Hence, we analyze the linear combination of increasing feature similarity for competitive brands and the change in the effect brought about by extensions under

Table 5 Marginal effects of line extensions under different brand and feature similarity

Marginal effect of…	DETERGENT	COFFEE	TOOTHPASTE
Line extensions under sub-brands (1)	0.04***	0.23****	−0.03****
Line extensions under stand-alone brands (2)	0.08****	0.03****	0.00
Similarity of line extensions under sub-brands (3)	−0.64****	−0.26****	−0.35****
Similarity of line extensions under stand-alone brands (4)	−0.33***	0.03*	−0.05*
[4 − 3] − [2 − 1]	0.26***	0.49***	0.28***

****$p<0.001$, ***$p<0.01$, **$p<0.05$, *$p<0.10$

sub-brands and stand-alone brands, respectively. We find support for H2 in all studied categories.

Specifically, we find that the effect of feature similarity on focal brand sales is negative and significant for line extensions introduced under sub-brands ($\beta=-0.76$, $p<0.001$ for *laundry detergent*; $\beta=-2.61$, $p<0.001$ for *coffee*; and $\beta=-0.10$, $p<0.001$ for *toothpaste*) and stand-alone brands ($\beta=-0.28$, $p<0.001$ for *laundry detergent*; $\beta=-0.10$, $p<0.001$ for *coffee*; and $\beta=-0.12$, $p<0.001$ for *toothpaste*). These render support for H2 that feature similarity increases cannibalization.

Does brand name similarity accentuate the cannibalizing effect of feature similarity?

To test H3 that brand name similarity increases the cannibalization effect of feature similarity, we test the difference between the coefficients capturing the effect of feature similarity on the effect of line extensions on brand sales under stand-alone brands versus sub-brands.

We find that the deleterious effect on focal brands sales of introducing similar product lines is stronger when these new products are introduced under sub-brands than when they are introduced under stand-alone brands in the *laundry detergent* ($\beta=0.48$, $p<0.001$) and *coffee* ($\beta=2.50$, $p<0.001$) categories, but identical in the *toothpaste* category ($\beta=-0.01$, $p>0.05$). Therefore, the results obtained in the *laundry detergent* and *coffee* categories support H3, but that of the *toothpaste* category do not.

Is feature similarity a more important driver of cannibalization than brand name similarity?

To test the competing hypothesis H4A (H4B) that brand name (feature) similarity is a more important driver of cannibalization than feature (brand name) similarity, we obtain two sets of marginal effects. First, we calculate the marginal effects of introducing line extensions under sub-brands (1) and under stand-alone brands (2). Second, we calculate the marginal effects of feature similarity for line extensions under sub-brands (3) and under stand-alone brands (4). To identify whether brand name or feature similarity is a more important driver of cannibalization, we test the "difference between differences in marginal effects" (i.e., [4 − 3] − [2 − 1]).[6] The results are presented in Table 5. For all three categories, we find support for H4B, which states that feature similarity is a stronger driver of cannibalization than brand name similarity. The specific linear combination produces positive and significant marginal effects, indicating that the cannibalizing effect of feature similarity is stronger than that of brand name similarity.

Conclusion

Summary

Achieving successful positioning of brands within a portfolio is an inherent goal of pursuing a particular brand architecture (e.g., Aaker and Joachimsthaler 2000). This requires careful consideration of the strength of association (i.e., the degree of similarity) between the features of product lines and the brands under which these product lines are offered to consumers. The brand extension literature has identified the positive aspects of similarity in introducing extensions. However, this literature is largely at the level of consumer evaluations; it neglects the effects of extensions on the parent brand's or other brands' performances, where similarity may have a negative impact on performance in the form of sales cannibalization; and it does not effectively distinguish between different sources of similarity: similarity in brand names versus product features.

The objective of this research was to answer the question whether brand name and feature similarity of line extensions could hurt sales of the brand extending its product line. Through exploring the relationship between a line extension's brand name and feature similarity to the focal brand, we have firstly shown that both brand name and feature similarity may have detrimental effects on the existing brands' performance. Second, we have demonstrated that brand name similarity and feature similarity generally, but not always, have multiplicative cannibalization effects. Finally,

[6] To that end, we use the mlincom command of the Stata plug-in SPost13.

Table 6 Summary of hypothesis tests

Hypothesis	DETERGENT	COFFEE	TOOTHPASTE
H1	Supported	Not Supported	Supported
H2	Supported	Supported	Supported
H3	Supported	Supported	Not Supported
H4A	Not Supported	Not Supported	Not Supported
H4B	Supported	Supported	Supported

we have shown that feature similarity is a greater driver of cannibalization effects than brand name similarity. The categories and the supported hypotheses are shown in Table 6.

Discussion

Our findings are consistent with some work on brand and/or line extensions and add to the extant knowledge base. For instance, our research empirically tests and finds support for Lomax et al.'s (1996) suggestion that radical line extensions (i.e., greater feature dissimilarity) do not cannibalize the core brand, whereas line extensions that have a close fit with the parent (i.e., greater feature similarity) are more likely to take sales from it. Speed (1998) suggests that introducing a line extension under an existing brand name rather than an unrelated second brand (i.e., creating brand name similarity rather than dissimilarity) could result in more cannibalization—an important assumption in his model. Our findings corroborate this assumption. Speed (1998) also calls for research on tools for managers to manage cannibalization, which is addressed in our work. Our results point toward the need to control both brand name and feature similarity levels to control cannibalization. Likewise, our paper's findings are in line with Reddy et al. (1994), who show some cannibalization effects of line extensions. Extending the work of Reddy et al. (1994), we explore the circumstances under which cannibalization may be exacerbated.

Considering the literature on brand extensions, our findings are consistent with work showing detrimental effects of having too much similarity between the parent and the extension (e.g., Carter and Curry 2013). Carter and Curry (2013) argue that functional fit, which is akin to our concept of feature similarity, acts in two opposing directions: transferring positive associations from the parent to the extension but also increasing the likelihood that the parent and the extension be seen as substitutes, exacerbating cannibalization. Although Carter and Curry (2013) focus on the parent cannibalizing the extension rather than the extension cannibalizing the parent, its implications for increased substitutability between the two products apply to our research and are supported by it. Further, Carter and Curry (2013) also examine the role of image fit in this process of parent-extension influences on performance at the point-of-sale. They argue that image fit acts only to support the extension due to positive association transfer. Our concept of brand name similarity can be likened to image fit, as products that carry the same brand name or sub-brand names would have the same image built up by brand communications. Carter and Curry (2013) find the low image fit/high functional fit to be the worst combination regarding the performance of the extension. Different from Carter and Curry (2013), we focus on the effect of the extension on the parent brand's sales and demonstrate that the high image fit (i.e., brand name similarity)/high functional fit (i.e., feature similarity) scenario is also detrimental for the portfolio's performance, this time resulting in cannibalization of the parent by the extension.

Carter and Curry's (2013) identification of functional fit (over image fit) as the greater culprit of consumers' placing the parent and the extension in the same consideration set and, hence, causing increased substitutability between them is also supported by our research, where we compare the cannibalizing effects of brand name similarity versus feature similarity. Buday (1989, p. 29) suggests that "Common branding implies a similarity: similarity invites replacement." We find, however, that feature similarity drives cannibalization more than brand name similarity—a result that is observed in all three categories. This finding supports the work of Aaker (2011, 2020) in his recent books *Brand Relevance* and *Owning Game-Changing Subcategories: Uncommon Growth in the Digital Age*. Aaker (2011, 2020) points to the importance of forming branded, benefit-driven subcategories that determine the "real" rules of competition in that product category. In this view, consumers are not so much loyal to brands than to benefit-inducing features that define the subcategories, switching between brands when there is feature similarity.

Our finding that feature similarity is more important to control to limit cannibalization than brand name similarity, is supportive of the work of Trinh et al. (2009) who find that different segments of consumers form loyalties to product variants rather than to brand names. Several empirical studies have also shown that different demographic or psychographic segments of consumers are not necessarily drawn to different brands (Dawes 2006; Fennell et al. 2003; Hammond et al. 1996; Kennedy et al. 2000; Kennedy and Ehrenberg 2001). Trinh et al. (2009) explains this phenomenon as arising mainly due to different brands offering similar product lines and that consumers engage in "repertoire buying" in which they switch regularly between brands (e.g., Dawes 2008).

At a theoretical level, consistent with the theory of categorization (Boush and Loken 1991; Czellar 2003; Loken and John 1993; Park et al. 1996; Van Osselaer and Alba 2003), brand name and feature similarity make certain products appear more similar and, therefore more substitutable.

However, goal-driven categorization (Barsalou 1985; Huffman and Houston 1993; Martin and Stewart 2001; Rathneshwar et al. 2001) stands out as the plausible mechanism to explain consumer reliance on product 'variants' feature similarity for substitution decisions. Indeed, Martin et al. (2005) find that goal-derived categories establish a framework for judgments of similarity. Similarity can cause substitution, and hence we suggest that our paper also provides indirect evidence for goal-driven categorization, consistent with Loken and Ward (1990) and Martin and Stewart (2001).

By demonstrating that context (marketing action and portfolio composition) influences substitution patterns among products within a particular brand architecture, we support conceptualizations of similarity within behavioral decision theory (e.g., Tversky 1977). Further, we conclude that because we observe increased cannibalization with sub-brands compared to stand-alone brands, sub-brands fail in creating a sub-type in their positioning within the brand category but just differentiation (see Sujan and Bettman (1989) for discussion on category schemas and brand positioning). Therefore, consumers perceive the sub-brands as substitutable.

Managerial implications

The objective of this research was to answer the question as to whether different configurations of product features within brand portfolios are more advantageous given a particular brand architecture when introducing new products. By exploring the relationship between the product feature composition of a brand portfolio and the effectiveness of different brand architectures, we have identified that managers should aim to cultivate different portfolio compositions considering their brand architecture. Specifically, our findings provide the following guidelines for marketing managers in pursuit of growth either by extending or rationalizing their portfolios.[7]

Managers seeking to grow the brand portfolio by extending product lines should compose the portfolio with as minimal overlap in product features as possible. Managers looking to minimize cannibalization within their existing brand portfolio should focus more on reducing feature similarity than on reducing brand name similarity. These considerations gain even more critical importance given a brand portfolio organization with sub-branded products rather than stand-alone ones. It follows that having a stand-alone branding strategy is not sufficient to reduce cannibalization within the product portfolio without new, highly differentiated features. A sub-branding strategy with differentiated features in harmony with the second (individual) part of the dual name structure, suggesting a positioning different from that of the parent brand, is more effective than having a stand-alone branding with redundant features.

Despite considerations that companies would rather cannibalize rather than leave potential revenue to competitors, it is crucial to remember that a poorly designed portfolio can result in a zero-sum game for the company. Considering the enormous costs involved in developing a line extension and the frequent low profitability of promotions (e.g., Wierenga and Soethoudt 2010), brands within the portfolio must be optimally positioned relative to each other to increase return on marketing investment (ROMI). Having ROMI targets for division managers and brand managers for particular investments could help install portfolio thinking between brand managers within a division.

In addition to devising an ideal portfolio composition, managers can also use our analyses to forecast the net impact on the brand portfolio of carrying out a particular marketing mix action given a specific brand architecture and portfolio composition. Our hypotheses tests revealed that the effects of increasing feature similarity are greater for line extensions under sub-brands. This finding makes us conclude that for categories where the similarity in product features is hard to overcome (the products are not easily differentiable), stand-alone branding is more advantageous and flexible for managers to use with any marketing mix action.

Limitations and directions for future research

In spite of the valuable insights gained from this study, it is essential to acknowledge its inherent limitations and identify potential avenues for future research to further advance our understanding of product line extensions' impact on brand sales. We believe there are several interesting directions where this line of research can go.

For instance, this study takes a snapshot view of the reallocation of the sales within a brand portfolio given a specific feature composition within the brand portfolio following a line extension. Future research could look at how these effects unfold over time and whether and which marketing mix actions exert favorable influences on cannibalization patterns. To give an example, it could be interesting to analyze the interaction between line extensions and price- and non-price-oriented promotions. Choi et al. (2014) find that line extensions that are price promoted produce more positive results than brand extensions that are price promoted. Future research could examine how these findings extend into our research domain of cannibalization patterns.

[7] Brand portfolio rationalization involves scrutiny of the positioning of the different brands within the portfolio vis-à-vis each other with the goal of accentuating the strengths and attenuating the weaknesses of the brand portfolio to maximize return on marketing investments. Changes to brand architecture are inevitable in brand portfolio rationalization endeavors. Therefore, our findings have important implications also for managers who want to rationalize their portfolios.

Moreover, our findings suggest that managers should pay close attention to the positioning their brands in terms of tangible (e.g., product features) and intangible (e.g., brand name) attributes, not only relative to the competition but also considering the other brands in their portfolio. This can be taken to mean that extensions exert an influence on all other brands in the portfolio while at the same time they are influenced by them. However, our work analyzes solely the cannibalization in brand sales resulting from extending product lines. Broadening the perspective and accommodating multi-directional cannibalization and spillover patterns to the modeling approach to look at the total (net) effect on portfolio sales would be an interesting extension of our work. The framework taking the perspective of "the net effect for the company" can be extended to investigate the impact of marketing actions other than line extensions. While there may not be a one-size-fits-all generic strategy, research can uncover many science-backed guidelines to guide companies making marketing mix decisions for a portfolio of product lines branded at varying levels of similarity.

With this study, we hope to have ignited an interest in other researchers to work further on this topic of outstanding academic and practical significance.

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Declarations

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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