THE INFLUENCE OF PRODUCT LINE EXTENT ON BRAND EQUITY

Taylor Randall
Karl Ulrich
David Reibstein

The Wharton School
University of Pennsylvania
Philadelphia, PA 19104

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Abstract

Does offering a premium product enhance brand equity? Conversely, does offering an economy product diminish the equity of a brand? These research questions are relevant to three issues in product strategy. First, what are the costs and benefits of extending the product line of a brand “down market”? Second, what are the implications of introducing high-end models within a brand? Third, when should product lines be extended within an existing brand and when should new products be introduced in conjunction with a new brand? We address the research questions empirically through an analysis of the U.S. mountain bicycle industry. We use an estimate of price premium as a metric for brand equity. We then test several hypotheses related to the influence of product line extent on brand equity. The analysis reveals that brand equity is significantly positively correlated with the quality level of the lowest-quality model in the product line; and that for the middle-quality segment of the market, brand equity is also significantly positively correlated with the quality of the highest-quality model in the product line. We also use a simple experiment to bolster the findings from the statistical analysis. The paper discusses the managerial implications of these results and points to directions for future research.

Key words: brand equity, brand value, product line extent, product line quality, product line breadth, product variety, brand strategy, bicycle industry.

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1. Introduction

This paper addresses the question of how the extent of a product line influences brand equity. The specific research questions are: do “premium” or high-quality products enhance the brand equity of the entire line? Conversely, do “economy” or low-quality products diminish the brand equity of the entire line? Consider these questions in the context of one of the most significant recent brand events in the auto industry—the decision by Toyota to launch the Lexus brand (Automotive News 1988). Would Toyota have garnered enhanced brand equity if it had introduced the Lexus models as part of the Toyota product line (e.g., a “Toyota LS400”)? Conversely, would the equity associated with the Lexus brand have been diminished if the Lexus product line had included economy cars (e.g., a “Lexus Corolla”)?

The research questions are relevant to three managerial issues in product strategy. First, what are the costs and benefits of extending the product line of a brand “down market”? This assessment is important because product strategists often wish to exploit the equity of premium brands in the lower-priced parts of the market, where there is typically more product volume. The key issue is what implications does such a move have for the equity the brand enjoys with its existing customers and product line. While many such new product introductions may be profitable in their own right, and perhaps even on a net basis once the cannibalization effects have been accounted for, what is their impact on overall profitability once the effect on brand equity is factored in? Second, what are the implications of introducing high-end models within a brand? Similar to the potential effect at the lower end of the line, such a move may not be justified by the profitability of the new entries alone, but can it be justified when viewed in the context of its positive impact on overall brand equity? Third, when should product lines be extended within an existing brand and when should new products be introduced in conjunction with a new brand? That is, when are the costs of introducing a new brand outweighed by the benefits, either in terms of the equity a new high-end brand could develop, or in terms of the damage avoided to existing brand equity by using a new brand to introduce a set of economy models?

We address the research questions empirically through an analysis of the models and brands within the U.S. mountain bicycle industry. We use an estimate of price premium as a metric for brand equity. We then test several hypotheses related to the influence of product line extent on brand equity. We further support this analysis with a simple laboratory experiment.

In the balance of the introduction, we outline the theory and results of previous research, and formally pose our hypotheses. In section two, we provide an overview of the bicycle industry and of our data sources. The analytical research methods are detailed in Section 3, with the
results in Section 4. Section 5 presents the results of an experiment designed to supplement the statistical analysis. Section 6 is a discussion of the results. The final section comprises concluding remarks.

Theory

A brand is an identifier for a set of products offered for sale by the same organizational entity (Kotler 1997). Keller (1993) writes that “a brand is said to have positive (negative) customer-based brand equity if consumers react more (less) favorably to the product, price, promotion, or distribution of the brand than they do to the same marketing mix element when it is attributed to a fictitiously named or unnamed version of the product or service.” Brand equity may be manifest in at least three forms: price premium, increased market share, and reduced costs of introducing new products (Aaker 1991, Simon and Sullivan 1993).

There are at least two general theories of why consumers may react more positively or negatively to a branded version of a product than to its generic equivalent. First, brands may reduce search costs for the consumer with respect to difficult-to-observe product attributes. If the brand’s products offer consistency with respect to attributes that are costly to observe before purchase, then consumers can use the brand label as a surrogate for performance with respect to these attributes (Farquhar 1989, Kotler 1991). For example, assume that the Stanley brand of tools is associated with good functionality at a reasonable price. When purchasing a tool, the consumer may simply choose the Stanley product in lieu of spending the time and effort to carefully evaluate the utility and value of each alternative. Thus, the Stanley brand of tool offers more value to the consumer than an otherwise identical generic product. Stanley may reap the benefits of this brand equity in the form of a price premium, additional sales, and/or an enhanced ability to launch new products. Second, brands may offer consumers symbolic benefits because of the brand’s association with a particular image (Solomon 1983). This image may be of a lifestyle or set of values. For example, Nike has effectively associated its brand with exuberant athletic self expression (“Just Do It”). Consumers who identify with this value may respond more positively to the Nike brand than they would to another brand without this association. The brand image may also be of prestige, luxury, or exclusivity. For example, Armani, Rolex, and Mercedes are currently all prestige brands, so consumers who value this image may respond more positively to these brands. Note that while these two theories are complementary, they are quite distinct. In the case of reduced search costs, the brand is a surrogate for some other hoped-for tangible attribute of the product. In the case of the symbolic benefits of image, the consumer values the brand itself.
Given the potential benefits brands offer to consumers, how could the extent of the product line influence these benefits, and therefore brand equity? For conceptual clarity, assume that a product line consists of a single category of products differentiated only “vertically” (i.e., by quality\(^1\) level). The quality dimension corresponds approximately to consumer value, and therefore approximately to price. We view product line extent as having two poles: the degree to which the brand’s products include premium models, and the degree to which they include economy models. (We intend “premium”, “high-end”, and “high-quality” to be synonymous; as we do “economy”, “low-end”, and “low-quality”.)

The presence of high-end models in a product line may influence brand equity via both theories of brand benefits. First, the presence of high-end models may create a consumer belief that the brand possesses strong design and production capabilities. The consumer may further believe that such capabilities are likely to result in high product performance relative to difficult-to-observe product attributes, even for the non-premium models in the product line. This influence could be viewed as a belief in a “trickle-down” of quality from the high-end models to the low-end models. In economic terms, a high-end model can also be thought of as a signal of the quality of the product line in the same way some firms use advertising as quality signals (Hertzendorf 1993, Abbe-Decarroux 1994). For example, in the United States, Mercedes-Benz offers primarily high-end automobiles which consumers have come to associate with durability and safety (among other more directly observable attributes like driving performance and comfort). When Mercedes offers a middle-market automobile such as the C-Class sedan, consumers may believe that this product inherits the durability and safety attributes of its higher-quality siblings. Perhaps more obvious is the influence of high-end models on brand image. The presence of high-end models in a product line contributes to a brand image of prestige and exclusivity. For example, Mercedes is perceived as a prestigious brand primarily because of the high-end models in its product line. This prestige persists to some extent even for the middle-market models offered under the Mercedes brand.

The presence of low-end models in a product line may also influence brand equity via both theories of brand benefits, in a complementary way as the high-end models. The presence of low-end models may raise in the mind of the consumer the possibility that some of the lesser-quality materials, components, and processes used in the low-end products are also used in the high-end products; that perhaps the brand “cuts corners” in its high-end models. Again, these beliefs would apply primarily to difficult-to-observe attributes of the products. In experimental

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\(^1\) By \textit{quality} we mean primarily \textit{performance quality} (Garvin 1988), but some of the arguments apply to \textit{conformance quality} as well.
studies, Loken and Roedder-John (1993) find some support for the notion that consumers perceive a brand’s quality to be diminished if a low-quality product is added to the product line. Sullivan has shown that problems with one model in a line may influence the sales of another model. She showed that the perceived “sudden acceleration” problem of Audi 5000 reduced sales of Audi 4000 (Sullivan 1990). While in this case, a nominally high-end model had a negative influence on the brand, the underlying mechanism is similar to that proposed for the influence of low-quality models on brand equity.

Relative to brand image, just as high-end models may inflate the prestige of a brand, low-end models may diminish this prestige. Practicing managers and the business press often refer to the possibility that a low-end model within a product line may tarnish the image of the parent brand. For example, many believe that the introduction of the Cadillac Cimarron (a “low-end” Cadillac) diminished Cadillac’s overall brand equity (Yovovich 1988). Maintaining a brand image of prestige and exclusivity while simultaneously offering products in the low-end of the market under the same brand may be difficult or impossible.

This theory is basically harmonious with the theory of brand extensions and brand fit. Loken and Roedder-John (1993) posit that extensions containing attributes that are inconsistent (i.e., do not “fit”) with the existing brand image will dilute the belief in the attributes of the existing brands implying that brand equity is diminished. This theory, while it focused primarily on brand extensions to new product categories, is similar to the theory we offer for extensions within a product line. We would argue, however, that “dilution” may sometimes be a positive effect; that is, a brand may “dilute” its image of being a low-end brand by offering higher quality products.

**Hypotheses**

**H1:** Brand equity increases with the quality of the highest-quality model in the product line. This equity manifests itself primarily in lower-quality products.

This hypothesis arises from a consumer belief that brands offering high-quality products are more likely to impart unobservable quality attributes to the other models in the product line. Consumers may also perceive the prestige of brands offering high-end products to be higher than that of other brands. Both of these factors could give rise to increased brand equity. However, we would expect increased brand equity primarily for lower-quality products in the line. This is because in the high-end of the market, by definition all of the products in a consumer’s consideration set are offered by brands offering high-quality products, and therefore brands are not differentiated in this respect.
H2: Brand equity increases with the quality of the lowest-quality model in the product line (i.e., the higher the quality of the lowest-quality model, the higher the brand equity) This equity manifests itself primarily in higher-quality products.

Brands offering low-end products may experience diminished brand equity as customers associate the low-quality products with the other products in the line. Furthermore, brands that offer low-end products are not perceived as exclusive, and therefore do not offer the consumer the benefits of association with a prestigious image. We expect the increase in brand equity associated with an avoidance of the low end of the market to be manifest primarily in higher-quality products. This is because all of the models in a low-end consumer’s consideration set are, by definition, offered by brands that offer low-quality products, and therefore brands are not differentiated in this respect.

Approaches to Estimating Brand Equity

The literature suggests several methods for measuring brand equity (See Park and Srinivasan 1994 and Simon and Sullivan 1993 for reviews of methods). Methods such as conjoint analysis (Green and Wind 1975, Green and Srinivasan 1978) directly elicit a consumers’ utility for a brand by asking consumers to make tradeoffs between brand and other relevant product characteristics such as price or quality. Less formal direct approaches to measuring brand value use surveys to elicit consumer brand preferences (Aaker 1996). Under these methods, higher brand values manifest themselves in the form of higher consumer utility. While these methods are useful in making relative comparisons of brands, it is not easy to translate preference measures into financial measures for use in cost-benefit analyses. Simon and Sullivan (1993) estimate the market value associated with a firm’s portfolio of brands by extracting the equity of the brand portfolio owned by a firm from the market value of a firm’s intangible assets. This method captures several important elements of brand value including the price premium associated with a portfolio of brands, the expected future profits of the brand portfolio, and the ability of the brand portfolio to reduce the marketing costs associated with current and future products. However, the aggregate nature of the measurement procedure complicates the measurement of the value of a brand in a multi-brand environment.

We measure brand equity using the price premium elicited by each product sold under a unique brand name (Holbrook 1992, Bello and Holbrook 1995). We acknowledge several theoretical weaknesses in this methodology. First, our method only partially measures brand equity. Price premiums do not capture a brand’s ability to reduce the marketing costs of current and future products. Thus, the premium of brands that do not command a price premium, but have the
ability to reduce the marketing costs of current and future products, will be understated. Second, price premiums can be confounded by pricing strategies. For example, a firm may choose to take the benefits of brand equity in the form of greater market share. However, unlike the market value estimation method, the estimation of price premiums associated with each product allows us to measure brand premium on a product-by-product basis and does not require a capital market valuation of each brand. This flexibility is important since most of the brands in the bicycle industry belong to private companies.

2. The Bicycle Industry

The United States bicycle market consists of approximately 10 percent of the world market, with sales of approximately 12 million units per year. Total unit sales have been fairly constant over the past decade, but recent trends in mountain biking have increased that segment’s portion of total unit sales from 12 percent in 1985 to 66 percent in 1995. Approximately, 75 percent of all bicycles in the U.S. are sold through the mass merchandising channel in stores such as Toys R Us, Walmart, and Kmart. Bicycles sold through the mass merchandising channel are typically children’s bicycles and adult bicycles priced below $200. The remaining 25 percent of U.S. bicycle sales occur through independent bicycle dealers (IBDs). Ninety-five percent of all bicycles priced above $200 are sold through IBDs. As of 1995, there were approximately 6,000 IBDs in the U.S. with 1,500 of them accounting for 60 percent of all unit sales.

Our analysis focuses on the “over-$200” mountain bike segment. We focus here for several reasons. The number of manufacturers in the below-$200 category is limited to a few large-volume producers. The limited number of competitors in the low-end of the market limits the number of product line strategies that can be observed. In the over-$200 category, 75 different brands can be observed with an average of 10 models per brand. The competition in the over-$200 category allows for more natural variation in product line strategies, which provides a richer research environment. We focus on mountain bikes because this focus allows us to compare product line structure within a well-defined product category. Quality in this category can be readily described by the attributes of each model in the product line, without confounding the issue of quality with the diversity of categories of products that the firm offers.

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2 Despite the label, a few manufacturers in this segment offer bicycles through the IBDs at prices slightly below $200.
Data Sources

We obtained information on most 1995 adult bicycle models offered for sale in the United States. This information was supplied to us by *Bicycling Magazine*, whose technical editor gathered these data from the manufacturers for inclusion in the magazine’s annual buying guide. We believe that the database contains at least 95 percent of the models offered for sale in the United States in 1995. The descriptions of each model include the full list of components (spokes, rims, pedals, brakes, hubs, etc.), the weight, the suggested retail price, and the sizes and colors in which the bicycle is offered.

We supplemented this database with information from trade and consumer publications and with interviews with manufacturers and retailers in the industry. The details of this supplemental data gathering are given in the Methods section of this paper.

Overview of Product Lines

Figure 1 is a plot of the models in the product lines of 10 selected brands. Several observations can be made from these data. First, there is intense competition at all price points. Even looking at only 10 of 75 brands, there are many models in every price interval. Second, firms pursue widely divergent product line quality strategies. Conejo offers products only at the high-end. Raleigh offers products only at the low-end. Giant offers products at every price point. Third, the density of models with in a brand differs widely. Marin and Cannondale compete in roughly the same price interval, yet Marin offers 81 models and Cannondale offers 15.

3. Methods

The primary method for testing our hypotheses is a statistical analysis, using multiple regression, of the relationship between the extent of a product line and brand equity, as reflected by the price premium a brand commands in the market. We have several concerns about the validity of the statistical analysis, which we raise in this section and in the discussion of the results. To mitigate these concerns we also conducted a simple laboratory experiment. This section and the following describe the statistical analysis. Section 5 describes the experiment.

The statistical analysis consists of two steps. First, we estimate the price premium of each brand. Second, we test the relationship between brand price premium and the highest- and lowest-quality models in the product line.
Step 1: Estimating the Price Premium of Each Brand

We estimate the price premium of each brand by (a) estimating the price premium of each bicycle in the data set, and (b) aggregating these estimates of premium into a single measure of premium for the entire brand.

(a) Estimating the price premium for each bicycle

We employ a hedonic regression model to estimate the price premium of each bicycle. The hedonic approach (Waugh 1929, Griliches 1961, Ohta and Griliches 1986, Holbrook 1992, Bello and Holbrook 1995) assumes product prices are a function of the imputed prices customers assign to the quality characteristics in a product. In our case, we estimate the price of each individual bicycle model using quality and performance characteristics independent of brand. Brand premium per model is calculated using the regression residual which is the difference between the actual price of the bicycle and the predicted price from the hedonic model.

Variable Definition

Manufacturer’s suggested retail price (MSRP) serves as the dependent variable and as a proxy for the transaction price of each bicycle. Prior studies using hedonic models use the transaction price of a product to impute the price of product characteristics. However, for the mountain bike category, true transaction prices are not readily available. The use of MSRP rather than transaction price creates two problems for our study. First, if prices of particular brands are systematically discounted (inflated) at the time of purchase, a model using MSRP will overstate (understate) premiums for a systematically discounted (inflated) brand. Second, if prices of a particular range of bicycles (e.g., high end or low end) are systematically discounted (inflated) at the time of purchase, a model using MSRP will overstate (understate) the premium of brands with a higher concentration of models within the affected class.

Because of these concerns we carefully explored the extent to which MSRP reflects transaction prices in the over-$200 mountain bike category. We do not believe that systematic brand discounting or inflation is common in practice for four reasons. First, we observe that bicycle retailing is not intensely price competitive, unlike categories such as consumer electronics. IBDs rarely advertise via mass media and rarely advertise the price of specific models, which makes consumer price comparison difficult. Furthermore, consumers in this category typically purchase bicycles from local shops. Shops generally try to stock brands different from those of other shops in the area. For example, in Philadelphia, three bicycle shops operating within one mile of each other carry 14 different brands of mountain bikes. Only one brand is carried by two of the three stores. This type of retail strategy, supported by both the manufacturers and the retailers,
mitigates price competition between stores for the same brand. Second, manufacturers structure stringent contracts with IBDs (e.g., “uniform minimum advertised price” or “UMAP” policies) to discourage price deviation from MSRP. Third, each manufacturer lists its products, including MSRP, in the annual consumer buyers guide published by Bicycling magazine. The buyers’ guide is widely used, especially by consumers in the middle and upper segments of the market, and so a manufacturer’s position in the guide is competitively important. A product is listed by price and product characteristic side-by-side with competitive offerings of similar price. Under these circumstances, deviant pricing is transparent to consumers and IBDs. Inflated MSRPs make a brand’s bicycles appear to be poor values relative to the immediately neighboring competitive offerings. Deflated MSRPs will lead to price mark-ups with respect to MSRP at the retailer, a tactic likely to lead to consumer dissatisfaction. Fourth, we conducted a telephone survey of 40 IBDs to discuss discounting and other issues. Respondents indicated that when they discount, they do so on a product-by-product and customer-by-customer basis, not on a brand-by-brand basis. When negotiating with a particular consumer, IBDs do not tend to provide direct price discounts, but rather “throw in” service contracts or accessories, or swap components at no extra charge.

We model MSRP as a function of eight product characteristics: frame material, component group, front suspension, rear suspension, high performance accessories, colors per model, sizes per model, and whether or not the bicycle was made in the United States.

Figure 2 illustrates each characteristic on a typical mountain bike. Dummy variables represent the different quality levels for the frame material, component group, and front suspension characteristics. Dummy variables also represent the rear suspension, high performance component, and “made in U.S.A.” characteristics. We use the presence of clipless pedals as proxy for high performance components such as bar ends and titanium saddles. Discussions with industry personnel revealed a prevailing belief that consumers place additional value on bicycles produced in the United States. Bicycles are classified as made in the U.S.A. if bicycle assembly occurs in the United States.

Data Set Limitations

We place three limitations on the data. First, we exclude two brands, Terry and Swiss Army, because the brands contain product characteristics that are difficult to model. Terry is a producer of women’s bicycles while all other bicycles in the data set are unisex. Swiss Army produces one

3 These properties of bicycle retailing are in flux and we believe it is possible that the retail landscape will change dramatically over the next few years.
bicycle sold as a promotional item with a major automobile company. This bicycle is not available to the mass market. Second, we exclude bicycles offered in custom sizes and colors. Third, we exclude four brands, Maxcycles, Oryx, Timberlin, and Signature, because country of manufacture information was not available for these brands. After these limitations, the data set consists of 727 bicycles from 64 different brands.

Table 1 provides descriptive statistics for each product characteristic and its respective levels. For product characteristics where dummy variables represent quality levels, we report the number of models in the data set possessing a given quality level. For colors and sizes, we report typical summary statistics. Note that a few manufacturers supply the majority of the components and front suspensions. In the case of components, Shimano supplies 94 percent of all models. In the case of front suspension, Rock Shox and Manitou supply 74 percent of all models with front suspension. In fact, with the exception of Cannondale, the brand associated with components and forks is independent of the bicycle brand. The dominant independent suppliers allow us to predict price using the presence of a particular component as a proxy for the performance or quality of a characteristic. For example, in the case of front suspension, we use the presence of Rock Shox Judy or Manitou Comp as a proxy for suspension quality rather than directly measuring the performance specifications of front suspensions such as amount of travel or weight. This treatment is consistent with the way consumers evaluate product offerings. A consumer will typically identify a model as, for example, a Trek bicycle with Shimano XTR components and a Rock Shox Judy SL front suspension.

**Functional Form**

Consistent with hedonic pricing literature (Griliches 1961), we model bicycle price as a function of product characteristics by taking the natural logarithm of MSRP. In a log-linear model, coefficients of dummy variables may be interpreted as the constant difference in log price for containing a particular characteristic. Coefficients of continuous variables may be interpreted as an approximation for the percent increase in price for each additional unit of a given variable. We use a log-linear model for two reasons. First, examination of a family of Box-Cox transformations indicated a logarithmic transformation provides the best functional form. Second, we believe consumers view colors and sizes as having non-linear relationship with price which is captured by taking the log of price. For example, we believe that consumers are more likely to be willing to pay an additional X percent of purchase price for each additional color

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4 It is our observation that up to 8 brands enter or exit the market each year. After numerous attempts, we were unable to locate these firms and thus assumed they had ceased operations.

5 In the pricing model, we treat the Cannondale Headshock as if it were produced by an independent supplier. Any brand premium gained by Cannondale in association with the Headshock will be captured by that variable.
choice as opposed to an additional constant X dollars for each additional color choice independent of the price level of the bicycle. After logarithmic transformation of MSRP, the estimated model takes the following form

\[
\ln \text{MSRP}_i = \beta_0 + \beta_1(\text{FRAME MATERIAL}) + \beta_2(\text{FRONT SUSPENSION}) + \beta_3(\text{COMPONENT GROUP}) + \beta_4(\text{REAR SUSPENSION}) + \beta_5(\text{HIGH PERFORMANCE ACCESSORIES}) + \beta_6(\text{COLORS PER MODEL}) + \beta_7(\text{SIZES PER MODEL}) + \varepsilon_i,
\]

where \(\ln \text{MSRP}_i\) is the natural logarithm of MSRP of the ith bicycle, \(\beta_0\) is a constant, \(\beta_i\) are regression coefficients (or vectors of coefficients), FRAME MATERIAL, FRONT SUSPENSION, and COMPONENT GROUP represent vectors of dummy variables for frame materials, front suspension and component groups, and \(\varepsilon_i\) is an error term.

(b) Aggregate the estimates of price premium for each model into a single measure of brand price premium

Price premium of the ith model (PREMIUM\(_i\)) is calculated using the residual (\(\ln \text{MSRP}_i - \text{PREDICTED } \ln \text{MSRP}_i\)) from the hedonic model in the following fashion:

\[
\text{PREMIUM}_i = \exp[\ln \text{MSRP}_i - \text{PREDICTED } \ln \text{MSRP}_i] - 1
\]

This formulation allows us to interpret PREMIUM\(_i\) as the percent premium associated with the ith bicycle. PREMIUM\(_i\) is then aggregated by brand. The price premium of the jth brand, BRAND PREMIUM\(_j\), is defined as the median PREMIUM\(_i\) for all i offered by brand j.\(^6\)

\(^6\) We chose to use the median premium rather than the average, because some brands may introduce high-priced bicycles as "showcase" models which could inflate the average premium for the brand. The median is less susceptible to such outliers. The Pearson correlation between the mean and median percent residual is 0.97 (p<.001) and tests of our hypotheses using the mean in place of the median produced similar results. Alternatively, we could have used the weighted average of the premiums, with individual model volume serving as the weight. However, we did not have access to volume on a model-by-model basis.
Step 2: The Relationship Between Brand Price Premium and Product Line Extent

In two separate tests, we use regression analysis to examine our hypotheses that brand premium is a function of the highest and lowest quality bicycle in a product line. First, we test the relationship between brand price premium and product line extent over the entire data set. Second, we test this relationship in different segments of the market based on predicted price: less than $500, $500 to $1000, $1000 to $2000, and greater than $2000. Discussions with industry experts and bicycle retailers indicated that these are the natural price segments in the industry. Based on these discussions, we consider segments below $1000 to be “lower-quality” for the purposes of testing the hypotheses. Our model of brand price premium takes the following form:

\[
\text{BRAND PREMIUM}_j = \alpha_0 + \alpha_1 (\text{LOW}) + \alpha_2 (\text{HIGH}) + \alpha_3 (\text{ADVERTISING}) + \alpha_4 (\ln \text{MARKET SHARE}) + \alpha_5 (\#\text{MODELS}) + \varepsilon_j
\]

Where BRAND PREMIUM$_j$ is the median brand premium for the jth brand in the appropriate market segment, $\alpha_0$ is a constant, $\alpha_i$ are regression coefficients, and $\varepsilon_j$ is an error term. HIGH, LOW, ADVERTISING, Ln MARKET SHARE, and #MODELS are described below.

**HIGH and LOW.** The maximum (HIGH) and minimum (LOW) predicted priced bicycles serve as metrics for the highest and lowest quality levels in the brand’s product line. We exponentiate the predicted price in order to express predicted price in terms of dollars rather than natural logarithm of dollars. Predicted prices assign the same dollar value to each non-brand related product characteristic across all brands creating a brand-neutral “quality index.”

**ADVERTISING.** Advertising can enhance brand premium by reinforcing a brand’s association with a level of quality or with a particular image (Kirmani and Wright 1989, Nelson 1974). Klein, for example, currently advertises its brand with the slogan, “Gorgeous, ultra-light, and as you’d expect… Very Expensive” (Bicycling 1996). We expect higher premiums to be associated with higher levels of advertising. Advertisements in bicycling magazines represent the bulk of the advertising expenditures in the industry. In our model, we represent advertising level by the

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7 The following example illustrates why we use predicted prices as our proxy for quality levels rather than actual price. Consider a market with two brands, A and B, offering three products with identical characteristics, except for brand. However, brand A commands a ten percent premium over brand B. Since the differences between the price of the highest and lowest priced products are exactly equal to brand premium, the hypotheses that premium is related to the high and low price becomes tautological. This problem is alleviated if predicted prices are used.
number of advertising pages purchased by a brand in the major bicycling magazines during 1995.

**Ln MARKET SHARE.** Market share has several potential effects on brand premium. First, firms with high market share may benefit from economies of scale, allowing them to price lower than firms without equivalent market share. Second, firms may sacrifice price premium in the short run for higher market share. In either case, we would expect market share to be negatively correlated with our measure of brand premium. To account for economies of scale in production, we take the natural logarithm of market share (Ln MARKET SHARE) to estimate brand premium as a linear function of the natural logarithm of market share. The use of market share as an independent variable may introduce a simultaneity bias which we discuss in the section on methodological issues.

**#MODELS.** Reibstein et al. (1975) suggest that customers will pay more in order to have a choice of products, implying that brands offering more models within a given range of products will have higher premiums. Baumol (1957) also suggests variety is valued by consumers, but that the marginal benefit of variety decreases in the number of products offered. We use the number of models (#MODELS) offered by a brand in a given segment as a measure of product variety.

Table 2 shows the Pearson correlation coefficients between the variables used to predict brand premium. While many of the variables exhibit significant correlation, several relations merit specific attention. First, LOW and HIGH are significantly and positively correlated (r=0.41, p<0.01) indicating that brands entering the market with higher quality low-end products also tend to offer higher quality high-end products. Second, Ln MARKET SHARE and ADVERTISING exhibit a strong positive correlation (r=0.73 p<0.01). Due to the high correlation between Ln MARKET SHARE and ADVERTISING, we do not simultaneously include both variables in our tests. Third, LOW and Ln MARKET SHARE show a significant negative relation (r=-0.32 p<0.01) consistent with the fact that most of the volume is sold at the low-end of the market and brands offering low-end bicycles garner higher market share. Finally, #MODELS and Ln MARKET SHARE exhibit a significant positive correlation (r=0.27, p<0.05) indicating brands offering more bicycles have higher share.

**Methodological Issues**

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8 To control for the potential lagged effects of advertising, we also ran models using advertising pages from 1994. Furthermore, we used a measure of advertising reach by weighting the number of advertising pages by the subscriber reach of each bicycling magazine. No significantly different results were noted.
Three methodological issues merit discussion. First, there is a potential simultaneity bias in the brand model. Price is reflected in the dependent variable, BRAND PREMIUM, and volume is reflected in an independent variable MARKET SHARE. Yet, price and volume may be determined simultaneously. This is because on the demand side an increase in price implies a decrease in volume, yet on the supply side an increase in price implies an increase in volume. (See Greene 1990, chapter 19, for a discussion of precisely this type of simultaneity.) If an OLS estimator is used in the presence of this simultaneity, the estimates of the coefficients will be biased. However, we defend our use of a non-simultaneous model in two ways. First, although the OLS estimator is biased, so also are other estimators in small sample sizes. Monte Carlo studies have shown that the OLS estimator is less sensitive than alternative estimators to the presence of estimation problems particularly in small sample sizes (Kennedy 1987). Second, we can replace the potentially endogenous variable, MARKET SHARE, with an instrumental variable—a variable that is highly correlated with market share, but exogenous—which will alleviate the problem of simultaneity bias (Kennedy 1987). We use ADVERTISING as such an instrumental variable, because it is highly correlated with market share, but is largely exogenous to the simultaneous supply-demand system. We report results using both MARKET SHARE and ADVERTISING.

The second methodological issue is the choice of a two-stage analysis. An alternative approach would be to test, in a single stage, the influence of product line extent by including the variables HIGH and LOW as independent variables in the hedonic regression explaining the MSRP for each bicycle. A single-stage regression has several appealing properties: (1) if any brand characteristics co-vary with model characteristics, coefficient estimates in a single-stage model will be more precise than in a two-stage model and (2) the sample size at a model level will result in more powerful tests. However, the single-stage model also has disadvantages. Brands with unusually large product lines may exert undue influence on the OLS regression results, and measurement of the product line extent becomes problematic and less precise. As noted earlier, predicted price must be used for the values of HIGH and LOW; and so how would one determine the values of HIGH and LOW for use in a single-stage regression? One approach would be to use a preliminary hedonic regression model, without HIGH and LOW as independent variables, to obtain predicted prices which could then be used for HIGH and LOW in a second hedonic regression. The highest- and lowest-quality models in each line would be deleted from the data set for this second regression. We did the single-stage analysis as outlined here and found no significant qualitative difference from the results presented in the paper. Because we find the two-stage regression more intuitively appealing and because it avoids the problems noted above, we chose to use it in describing our analysis.
A third methodological issue is that the imputed value of each product characteristic as determined by the hedonic regression may vary depending on the price segment of the market. For example, a Rock Shox Judy front suspension may be valued differently by a buyer of a $3000 bicycle than by a buyer of a $1000 bicycle. To address this concern, we also estimated a separate hedonic function for each price segment of the market. The results were largely consistent with those reported, although significant differences are reported in the results section.

4. Results

Results of Price Premium Model

Table 3 presents the results of the hedonic pricing model. The adjusted $R^2$ for the model is 0.93. We interpret the intercept as the log price of the lowest quality bicycle which is a one color, one size, unsuspended, low-quality steel bicycle with Shimano Tourney components. The exponentiated intercept is $183, which is consistent with the prices of the entry-level products in the data set. Tests of individual coefficients indicate whether or not the coefficient is significantly different than its relevant attribute in the baseline bicycle. Chi-square tests indicate heteroskedastic residuals. To account for heteroskedasticity, we perform tests of individual coefficients using corrected standard errors (White 1980). Further regression diagnostics reveal no serious problems with multi-collinearity. All frame material coefficients are significantly different than low-quality steel. All front suspension coefficients are significantly different than unsuspended bicycles. All component group coefficients are significantly different than Shimano Tourney. The coefficients for high-performance accessories and assembled-in-the-U.S.A. are also significant. The coefficients of colors and sizes are also significant indicating that on average consumers pay an additional 5 percent for each additional color choice offered and an additional 1 percent for each additional size choice offered.

We aggregate the residuals of the hedonic model by brand. Figure 3 plots the percent premium by model for two brands, Trek and Raleigh, as examples.\textsuperscript{10} While substantial variation in

\textsuperscript{9}Bello and Holbrook (1995) report $R^2$ from regressions of selling prices on quality indices in several categories that range from 0.53 in popcorn to 0.93 in automobiles. Holbrook (1992) reports $R^2$ from regressions of selling price on product attributes in several categories of consumer electronics that range from 0.71 in Home CD players to 0.93 for Home VCRs. The conclusion of these studies is that quality attributes explain a high proportion of variance in price. In the case of the consumer electronics study, Holbrook observed that brand name explains very little variance in price. While we agree that brand explains little variance relative to that explained by tangible product characteristics, this is what we would expect for very tangible products. We would consider differences of a few percent in price premium to have a highly significant impact on profitability.

\textsuperscript{10}The negative premiums for many models results from the OLS procedure used in the hedonic price model. Regression residuals by definition must be negative and positive. Thus a negative premium simply implies that a model is priced below the average price of models with similar characteristics.
premium exists among models, Trek appears to garner more premium than Raleigh. We use the median percent residual per brand to represent brand price premium.

**Results of Brand Model**

Table 4 presents the results of three different regression models used to predict brand premium over the entire data set. The adjusted $R^2$ for the models range from 0.03 to 0.06. The F-statistic is only significant in the first model. Consistent with Hypothesis 2, the results of all models indicate a strong positive association between LOW and brand premium. We observe a 1 percent increase in brand premium for a $100 increase in the lowest quality level offered. The results indicate no association between HIGH and brand premium, providing no support for Hypothesis 1. To test the robustness of the results, we deleted influential observations using cutoffs suggested by Belsley, Kuh, and Welsch (1980). Tests without influential observations yielded similar results.

We report no relation between ADVERTISING and brand premium. Alternative models including advertising levels from 1994, cumulative advertising over 1994 and 1995, and advertising reach yield similarly inconclusive results. Furthermore, Ln MARKET SHARE and #MODELS offer no explanatory power to the model.

Table 5 reports results of brand premium models by price segment. We only present models including LOW, HIGH, #MODELS, and ADVERTISING. Unreported models including Ln MARKET SHARE produced similar results. Adjusted $R^2$ ranges from -0.002 in the less-than-$500 segment to 0.33 in the $500-to-1000 segment. The F-statistics on the models are significant in the $500-to-1000 segment and the greater-than-$2000 segment. If we delete one influential observation from the $1000-to-2000 segment (based on the Belsley et al. cutoffs), the F-statistic becomes significant at the 1 percent level ($F=3.66$) for this segment. The magnitude and significance of the coefficient estimates remain unchanged.

We report that HIGH is positive and significant in the $500-to-1000 segment, but not significant in the other segments. This result partially supports Hypothesis 1, which asserts the effect of high quality bikes manifests itself in the lower quality products end of the market. We conjecture that price competition among manufacturers at the very low end of the market is fierce, and therefore brands cannot garner substantial price premium at the very low end. Consistent with Hypothesis 2, which asserts the effect of low-quality bicycles will manifest itself in higher-quality products, we find that LOW is positively associated with brand premium in the market segments above $500, but not significant in the less-than-$500 price segment. In the greater-than-$2000 segment, ADVERTISING is positive and significant indicating that, on average, an
increase in brand premium of 0.30 percent is associated with each additional page of advertising.\textsuperscript{11}

To test the price segment results for robustness, we performed three separate tests. First, we performed sensitivity analyses on the end points of each group. Each segment end point was extended by $100 of predicted price and brand premiums were recalculated. For example, the brand premium in the $500-to-1000 segment was recalculated using individual premiums for bicycle models falling between $400 and $1100. The results of this analysis confirm the results of Table 5. Nothing is found significant in the below-$600 segment. LOW is positive and significant in the $400-to-1100, $900-to-2100, and above-$1900 segments. HIGH is positive and significant in the $400-to-1100 segment. Advertising is positive and significant in the above-$1900 segment. Second, we created three new segments, $350-to-750, $750-to-1500, and $1500-to-4000, which overlap the segments used in Table 5. We find that HIGH is significant in the $750-to-1500 segment, but not in the $350-to-750 segment. These results are only partially consistent with our hypothesis that HIGH would be influential in the lower quality market segments. It appears that HIGH only has an effect in the moderately priced segments of the market. Consistent with our hypotheses, LOW is positive and significant in the higher market segments ($750 to $1500 and $1500 to $4000). Advertising was positive and significant in the $1500-to-4000 segment. Finally, in all models, we deleted influential observations based on cutoffs suggested by Belsley, Kuh and Welsch (1980). Except as noted above, models without influential observations yielded similar results.

Here we note the differences in the results that are obtained when the hedonic regression is completed for each price segment individually instead of with the data from the entire sample. The $R^2$ for the hedonic models declines substantially from 0.93 to between 0.55 and 0.75, implying that the brand premium variable has substantially more variance than when the hedonic regression is performed on the entire data set. In the less-than-$500 segment, the coefficient on MODELS becomes negative and significant. The coefficient on HIGH becomes positive and significant in the $1000-to-2000 segment when influential observations are deleted as recommended by Belsley et al. In the greater-than-$2000 segment, none of the coefficients are significantly different from zero.

**Competing Hypotheses**

\textsuperscript{11}Replacing ADVERTISING with Ln MARKET SHARE in the greater than $2000 segment yields a significant positive relation between Ln MARKET SHARE and BRAND PREMIUM.
The statistical evidence is strongly supportive of Hypotheses 2, and mildly supportive of Hypothesis 1. However, there are several competing hypotheses. Here we consider four competing hypotheses and the factors which we believe minimize their plausibility.

1. Omitted product attributes

High-end brands may offer products with tangible attributes that are both valuable to consumers and not captured by our hedonic price model. The presence of such attributes would bias our estimate of brand premium in favor of accepting Hypotheses 1 and 2. We know that some such attributes exist. For example, the IBIS brand offers bicycles featuring brake cable supports die cast in the form of a human fore arm and clenched fist. Our pricing model does not include this attribute. Therefore, if this brake support feature is valued by consumers, its value will be included within our estimate of IBIS’s brand premium, when it should be attributed to a tangible physical attribute. We have attended the primary industry trade show (Interbike) for two years and have visited many bicycle retailers. We observe very few unmodeled attributes. The unmodeled attributes we do observe are: differences in graphic design and color schemes of paint, differences in details of cable routing and component supports, and differences in rear suspension schemes for full-suspension models. We consider the paint schemes and mounting details to be relatively minor features, which we do not believe could account for very much of the variation in prices left unexplained by the price model. The suspension designs are more highly varied, and may account for substantial variation in prices for fully suspended models. However, in 1995, relatively few models offered full suspension and there was no consensus as to which suspension design was best. Therefore, we do not view our lack of a more complex model of rear suspension types as a serious threat to the results.

We also note that some tangible features of products are closely related to the concept of brand. For example, the IBIS fist is much like a hood ornament for a car. While it is a tangible attribute, it is also a brand identifier. Many of the unmodeled attributes that we observed at the trade shows fall into this category.

Finally, we note that many different brands source bicycles from the same smaller set of manufacturers. For example, A-Pro and Giant are two large Taiwanese manufacturers who produce bicycles for Barracuda, Fuji, Gary Fisher, Giant, Haro, Marin, Raleigh, Scott, Specialized, Trek, and Univega. These bicycles are produced with approximately the same frame fabrication and finishing technology. In effect, these bicycles differ only in brand and in the features we have modeled. As a result, for many brands we are certain that there are no significant differences among bicycles not captured by the pricing model. While we do know of a few isolated instances of unmodeled attributes, such as the IBIS fist, our observations of the
bicycles themselves and our knowledge of the brand-manufacturer relations lead us to conclude that unmodeled attributes are not an overwhelming threat to the validity of our results.

2. Systematic differences among firms in elasticity of supply

High-end firms may have inelastic supply curves due to capacity constraints. When faced with increased demand for their products, these firms would charge price premia rather than increase production volume. These firms would appear to have more brand equity than firms with equal equity who increased production volume instead of raising prices. To explore this competing hypothesis, we performed our analysis on the subset of firms (n=45) that outsource frame production. Discussions with industry experts revealed that Asian bicycle suppliers experienced excess capacity during 1995 implying that firms which outsource frame production should have had similar, relatively elastic supply curves. The results were qualitatively identical to those reported in Tables 4 and 5.

3. Systematic manufacturing cost bias

High-end brands may have higher manufacturing costs than low-end brands, even for products of equal quality. This situation could arise because there is greater sales volume at the low end of the market, giving low-end brands greater scale economies. In such a competitive situation, it would be rational for the high-end brands to set their prices higher than the low-end brands. True cost data are not available for the brands in our data set. Consistent with the literature on economies of scale, we would expect costs to decline with volume, and would expect diminishing returns to scale. We have therefore attempted to control for any cost-driven pricing decisions by including in the brand model the variable Ln MARKET SHARE (and the instrumental variable ADVERTISING to cope with the simultaneity problem of using market share as an independent variable). To the extent that these variables do not adequately reflect the cost structures of the brands, our estimate of price premium may include cost-driven pricing decisions, and will bias our results in favor of accepting Hypotheses 1 and 2.

We believe that brand volume should capture cost differences among the brands. We note again that most brands source their products from a smaller set of manufacturers. As a result, we expect that differences in direct manufacturing costs will arise primarily from differences in bargaining power among brands, with the larger brands wielding greater power in negotiating prices than the smaller brands. However, the bicycle manufacturing industry is intensely competitive, and so we do not expect dramatic differences in direct manufacturing costs among the brands. We would expect more substantial differences in indirect costs, including the costs associated with selling, administration, inventory, distribution, and technical support.
Differences in these costs, however, should be largely captured by differences in sales volume. This argument is further bolstered by the analysis of the subset of manufacturers who outsource frame production (noted in point 2. above), and therefore are likely to have very similar cost structures.

4. Brand equity causes product line extent; product line extent does not cause brand equity

Assume that the statistical evidence is valid; brands with high-end models tend to have high brand equity. Can we conclude that the presence of the high-end models causes the brand equity? As noted above, we can not eliminate the possibility that some omitted variable, which happens to be correlated with the extent of the product line, is the real cause of the brand equity. This problem plagues any cross-sectional statistical analysis. However, even assuming there are no significant omitted variables, the causality could be inverted, with brand equity causing product line extent. That is, firms with high brand equity systematically choose to offer high-end products. This does not seem likely. Given that the unit volume distribution in the bicycle market is highly skewed to the low end of the market, a firm with high brand equity would certainly desire to offer products in this part of the market, if doing so would have no adverse impact on its brand equity.

5. Experimental Evidence

While the statistical analysis is supportive of the hypotheses, several weaknesses in measurement, data availability, and methodology threaten the internal validity of the study. These threats can never be eliminated entirely, and so we would like to triangulate on the results using some other evidence. To bolster our findings, we conducted an experiment measuring the preference of consumers for an identical bicycle offered by two brands with differing product line extent. While the survey offers little external validity, it does support the findings of our statistical analysis and offers insight into the consumer behavior that gives rise to differences in brand equity.  

Eighty-four subjects from a convenience sample (two classes at the Wharton School) were presented with “catalogs” of two fictitious mountain bike brands: a high-end brand and a low-end brand. The catalogs each displayed photographs of six different bicycles with their associated specifications and were reproduced in color on 11 in. by 17 in. sheets. The bicycles in each catalog were a mix chosen from the product lines of Giant, Trek, and ProFlex (chosen

12 The authors are grateful to Richard Staelin and an associate editor for suggesting the use of an experiment to bolster the study results.
because they used very similar photographs in their brochures), but the photographs were retouched to remove brand identifiers. Bicycles in the high-end brand ranged in price from $759 to $2,799. Bicycles in the low-end brand ranged in price from $199 to $959. To control for presentation, we randomized the brand names (“Timber” and “Frontier”) and the catalog graphic design (“A” and “B”). For half of the subjects, Frontier was the high-end brand with catalog design A, and for the other half, Timber was the high-end brand with catalog design B.

On a written response form, respondents were asked for their impressions of each brand and then asked the following question:\textsuperscript{13}

“Timber and Frontier each plan to introduce a new model of mountain bike (not shown) priced at about $800. Both models will have the same basic features: frame made from Cro-Moly double-butted steel tubing, Shimano Deore LX components (e.g., hubs, derailleurs, cranks, etc.), and Manitou 4 front suspension fork. If you had to choose between the bike offered by Timber and that offered by Frontier, which would you choose, assuming that the prices of the two new bikes were the same?”

They were then asked how much extra they would be willing to pay for their choice (<$5, $5-10, $11-20, $21-50, >$50) and why they made the choice they did. We also gauged the respondents’ interest in bicycles as a consumer category by asking if they owned a mountain bicycle and if they were planning on purchasing a mountain bicycle within the next five years.

Note that in order to manage the scope of the experiment, the survey design combines tests of Hypotheses 1 and 2. In other words, if a respondent prefers the high-end brand, we cannot determine if the choice is due to a higher quality low-end model or a higher quality high-end model.

Sixty-three percent of the respondents selected the high-end brand. At 63 percent, we reject the null hypotheses that respondents prefer the brands equally (Z=2.40, p=.016). Twenty-seven percent of the respondents indicated that they owned mountain bicycles. Of those that owned mountain bicycles, 70 percent preferred the high-end brand (Z=1.88, p=.060).

We coded a respondent as perceiving a quality difference between product lines if they observed that a brand was high end, high priced, high tech, high performance, high quality, low end, low tech, low quality, or low priced.\textsuperscript{1} Eight-four percent of the respondents mentioned these phrases.

\textsuperscript{13} A copy of the catalogs and survey is available from the authors.
when recording impressions of the brands. Among those that perceived a quality difference between brands, 67 percent chose the high-end brand ($Z=2.77$, $p=.006$).

Those that chose the high-end brand were willing to pay $21-50$ (median category) more for their choice, while those that chose the low-end brand were willing to pay $11-20$ (median category) more. This corresponds to about a 5 percent price premium for those choosing the high-end brand.

We noted two dominant reasons for preferring either the high-end or low-end brand: quality and value (i.e., quality per dollar). Of those choosing the high-end brand, 75 percent chose the brand because they perceived the quality of the brand to be superior. In fact, several respondents literally wrote that the quality of high-end products would probably “trickle down” to the lower end of the product line. Interestingly, of those choosing the low-end brand, 52 percent felt the low-end brand offered more value, even after we specified that the bikes had the “same basic features” and were “the same price.” Only 16 percent felt the low-end brand was of higher quality. It appears that for a substantial segment of the market, the presence of high-end models makes consumers somewhat suspicious that they are being “ripped off” when they buy the low-end models. This is analogous to the automobile shopper who is suspicious that the low-end Lexus ES300 is really just an over-priced Toyota Camry. Other reasons for choosing a particular brand included preference for the image portrayed by the brand (“it’s just me”) or preference for some attribute of the catalog design.

While we cannot independently distinguish between the effect of low-end and high-end models, the results of the experiment corroborate the general hypothesis that brand equity is affected by the extent of the product line and that the influence is consistent with Hypotheses 1 and 2. Furthermore, we find support for the underlying theory that the perceived quality of higher-end models will affect how other models in the product line are perceived. However, we were intrigued to learn that some classes of consumers seem to be somewhat suspicious of brands. We speculate that for some consumers (i.e., “value shoppers”) and perhaps some product categories, attempting to elevate brand equity with high-end models in the product line may be ineffectual, or even counterproductive.

6. Discussion

We hypothesized that brand equity increases with the quality of the lowest-quality model in the product line, and that this equity manifests itself primarily in higher-quality products. We also hypothesized that brand equity increases with the quality of the highest-quality model in the product line, and that this equity manifests itself primarily in lower-quality products.
The statistical evidence from the mountain bike industry strongly supports the role of the “low end” in influencing brand equity. Firms with low-quality products in their lines tend to have lower brand equity. We see this effect principally in the above-$500 products. The statistical evidence provides some support for the role of the “high end” in influencing brand equity. Firms with high-quality products in their lines tend to have higher brand equity for their middle-priced ($500 to $1000) products.

The experimental results also support these hypotheses, although our experimental design did not attempt to distinguish between the role of high-quality products and low-quality products.

These results also have substantial face validity. We presented the findings of the research to a group of approximately 30 bicycle industry executives at the Interbike trade show in the Fall of 1996, including marketing managers, general managers, and chief executives of a dozen of the leading bicycle brands. There was widespread agreement with our general findings, with several managers commenting that our results were consistent with their experiences. In one case, a manager from a brand with "top-ten" market share showed us how his booth at the Interbike trade show was used in a fashion consistent with our results. The booth showcased an extremely expensive model, mounted on a rotating platform, and illuminated with numerous spot lights. When asked how many of these models he sells, the manager responded, "we don't sell any of these—maybe a few hundred a year—we sell those over there," pointing to a set of low- and mid-quality models off in the corner of the booth. He asserted that the high-end model is justified by its ability to enhance the brand's overall equity. We received similar comments from managers of other brands.

Considering the statistical evidence, the experimental evidence, and the face validity, we believe that there is strong support for the hypotheses. However, there are four key moderating issues: (1) Is product line quality determined only by the lowest- and highest-quality products? (2) what constitutes a product offering? (3) dynamics and path dependence, and (4) trading off costs and benefits.

Is product line quality determined only by the lowest- and highest-quality products?

The theory of brand equity that we outline in the introduction argues that the impression of the quality extent of the product line has an impact on a consumer’s beliefs about a brand. We argued that the highest- and lowest-quality products are key determinants of the quality extent of the product line. However, other properties of the product line may be important in creating an
impression of a brand. For example, consider two brands, each with 10 models and each with the same lowest- and highest-quality level. The brand with the remaining 8 products concentrated near the upper quality level should have greater brand equity than the brand with the remaining 8 products concentrated near the lower quality level. Such differences in the distribution of the models might be captured by the mean or median quality level of the product line. We do not take the strong position that the only features of a product line that contribute to the brand equity effect are the highest- and lowest-quality model. Rather, we note that any few metrics of the structure of the product line will fail to capture some relevant characteristics. HIGH and LOW appear to be useful metrics and seem to be consistent with a theory of how consumers develop impressions of brands, but other characteristics of the structure of the product line may be important.

**What Constitutes a Product Offering?**

Our results support the hypothesis that the presence of high- or low-quality models in a product line influences brand equity, but what exactly is required to achieve this effect? Does merely listing a single high-end product in a catalog lead to an increase in brand equity, or does a larger set of activities associated with offering high- or low-quality models give rise to the change?

Because brand equity is ultimately expressed in the marketplace, we posit that the marketplace ó dealers and/or consumers ó must be aware of the structure of the product line for the effect to be active. This awareness probably requires more than a catalog entry alone, but probably does not require that sales of the models at the high and low extremes of the product line be large. Dealer awareness of the extent of product line is created by catalogs, brochures, advertising, displays of the brandís models at trade shows, and direct communication from the sales force. Consumer awareness of the extent of product line is created by the presence of products in the use environment (e.g., seeing bikes on the trail), advertising, media coverage, and retail displays. If the marketplace is not aware of the extent of the product line, then this extent is unlikely to influence brand equity. We expect that the brandís activities to communicate the extent of its line to the marketplace will modulate the effect of this extent on brand equity.

Brand equity may also be influenced by the marketís perception of where the brand focuses its marketing efforts. For a given product line, we might expect that a firm that chooses high-end distribution channels and that advertises in media targeting the high-end would garner more brand equity in the middle of the market than a firm focusing its marketing resources on mass channels and mass media. That is, part of the exclusiveness and prestige of the brand may be associated with its marketing emphasis at the high-end. However, a dilemma presents itself in
this situation. While the impression of a focus on the high end requires a commitment of marketing resources to the high end of the market, the value of this impression accrues in the middle of the market. So a firm may have to simultaneously create the impression of focusing on the high end, while communicating this impression strongly to the middle of the market.

**Dynamics and Path Dependence**

We do not believe that brand equity increases or decreases instantaneously in response to changes in the structure of the product line. We would expect that firms that have enjoyed consistently high brand equity and who concentrate their models at the higher end of the market could reap this equity over some time period after they begin offering lower-quality products. Conversely, we would expect that low-end brands would not garner enhanced brand equity for some time after they extend their product lines up market.

For example, our analysis indicates that Klein, a high-end brand, is an outlier in the brand-level models, commanding more premium than the HIGH and LOW for Klein would indicate. Further investigation reveals that Klein introduced two new models in 1995 at price points of $1200 and $1400, approximately $1000 less than the least expensive model in 1994. Our estimates of Klein's premium are consistent with the product line extent of the previous year. There are at least two possible interpretations of this observation. First, brand equity may decrease gradually with time, and Klein is spending the equity it had accrued previously. Second, Klein may have made pricing errors in 1995, adopting prices that were consistent with 1994 brand equity, but which were too high, given the structure of the product line in 1995.

We also suspect that brands moving their product lines down market may enjoy higher brand equity than brands moving their product lines up market, even if both brands ultimately arrive at product lines with the same extent. If this is true, then brand equity is path dependent, which implies that managers may wish to launch new brands higher than they ultimately expect to settle, rather than lower. Of course, competitive dynamics may also be important. As a brand extends its line, this may precipitate a competitive response (Day and Reibstein 1997). Both the extension of the line and the competitive offerings would have an impact on the originating brand’s equity.

**Trading Off Costs and Benefits**

Firms add products to existing lines under the premise that the new items’ profit contribution outweighs the cannibalized sales of other products in the product line and the fixed costs of
launching the new items. Cannibalization is generally considered to be highest the closer the new item is positioned to other products in the product line. The findings of this study indicate that the costs or benefits of adding a new item may also include an impact on brand equity. Unlike the cannibalization effect, where the greatest impact is on the nearest neighbors, the brand-equity effect can impact the entire product line. Furthermore, the equity impact can have both a positive and negative effect on the entire product line.

According to the strong interpretation of our results, a firm would choose to offer only high-quality products under a brand if its objective were to maximize brand equity. However, maximizing brand equity is rarely the sole objective. Brand equity is a means to achieving higher profitability, which may arise from higher margins, higher market share, or decreased costs of launching new products. In most markets, there is a downward sloping demand curve, so the industry sales volume is much higher in the lower-quality segments than in the higher-quality segments. This is why high-end brands extend their product lines down market (e.g., Klein in bicycles, Mercedes in automobiles). This type of market structure gives rise to a cost-benefit trade-off. For a brand considering extending its product line up market, the trade-off is between the investment and support costs associated with the new models and the increase in profits that may arise from enhanced brand equity across the rest of the product line (in addition to any profits that may actually be generated by selling the premium models). For a brand considering extending its product line down market, the trade-off is between the increased profit contribution from the presumably large new sales volume in the lower-quality segment and the lost profits due to diminished brand equity across the rest of the product line (in addition to any investment costs required to introduce the new models).

The trade-off between costs and benefits of a product line extension in this context can be expressed analytically as follows. Let $Q_o$, $p_o$, and $c_o$ be the sales quantity, average unit price, and average unit cost of the old product line. Let $Q_i|o$, $p_i|o$, and $c_i|o$ be the corresponding values for the old products after a line extension. Let $Q_n$, $p_n$, and $c_n$ be the corresponding values for the new product. Let $F_n$ be the fixed costs of performing the line extension. The old profits can be expressed as

$$Q_o(p_o - c_o).$$

The new profits can be expressed as

$$Q_n(p_n - c_n) + Q'||o(p'_o - c'_o) - F_n.$$
The condition for a profitable line extension can therefore be expressed as

\[ Q_n(p_n - c_n) + Q_o'(p_o' - c_o') - F_n > Q_o(p_o - c_o). \]

When extending a product line up market, we expect \( Q_o' \) to be greater than \( Q_o \) and \( p_o' \) to be greater than \( p_o \), increasing the profitability of existing models. However, the line extension will require investment, \( F_n \) and the profit contribution from the new models, \( Q_n(p_n - c_n) \), may even be negative if \( Q_n \) is very small, because unit costs are likely to be high for these models.

When extending a product line down market, we expect \( Q_o' \) to be less than \( Q_o \) and \( p_o' \) to be less than \( p_o \), and the line extension will require investment, \( F_n \). However, the profit contribution from the new models, \( Q_n(p_n - c_n) \), may be large enough to justify this action.

The cost-benefit analysis is further complicated by the option of using a new brand to introduce models at the high end or low end of the market. This practice is common in other industries, and has begun to be adopted in the bicycle industry. A firm wishing to enhance its total brand equity may choose to both extend the models of its existing brand(s) up market, while also introducing a new brand offering only high-end models. This is the strategy we observe with Trek (Frothingham 1995). Trek has acquired and invested substantially in several premium brands ó Gary Fisher, LeMond, Bontrager, and Klein ó but has carefully managed their identities; it is not generally known in the marketplace that Trek owns these brands. We also observe Diamondback pursuing this strategy. In a recent article in *Bicycle Retailer and Industry News*, a senior executive of Diamondback discussed a new brand strategy in which it will introduce a new high-end brand, \( DBR \). Noting that the Diamondback name will be absent from the DBR bikes, he commented, “it will be like Camry and Lexus” (Frothingham 1997).

An alternative to extending an existing brand down market is to preserve the structure of the existing product line, while using a new brand for the low-end models, perhaps with its own premium models to enhance its brand equity. This strategy was first adopted in the bicycle industry in 1996. Specialized introduced a new brand, Full Force, aimed at the low-quality segment of the market and intended to be sold through mass merchandisers. However, Specialized’s initial strategy of labeling the brand iFull Force by Specializedi backfired due to an extreme negative reaction from dealers concerned that this action would tarnish the equity of the Specialized product sold through the traditional bicycle retail channel. The company responded by downplaying the relationship between the two brands (Frothingham 1996).
The wisdom of the strategy of using a new brand to offer products at the low or high end hinges on the trade-off between the costs of launching an entirely new brand and the benefits that accrue from preserving the separate identities of the new brand and the existing brands. In the Future Work subsection of the paper we discuss decision support tools for evaluating such strategies.

7. Concluding Remarks

Generalizing the results

Our analysis is of a single product category in a single industry. An important question is the extent to which our results apply to other situations. An identifying characteristic of the mountain bike category is that the primary dimension of market segmentation is product quality. The mountain bike category is relatively young, having emerged within the last 10 - 15 years. To date, there has been little segmentation within the category other than by performance quality, and therefore by price. Because of our focus on the role of the “quality extent” of the product line, we would expect our results to generalize primarily to categories in which a clear ordering of products by quality is possible.

There are beginning to emerge unique application segments, such as downhill and cross country mirroring the types of mountain bike racing currently practiced. As the category matures, we would expect to see further segmentation based on age, sex, and lifestyle, much as has happened in automobiles and other mature product categories. In an increasingly segmented market, one can imagine that the extent of the product line on other dimensions beyond quality may influence brand equity. For example, for an automobile brand attempting to build its equity in the sporty segment of the market, offering a vehicle targeted at the sports car enthusiast may elevate the equity of the brand for the non-enthusiast (e.g., the Corvette for Chevrolet and the Viper for Dodge).

Our experimental results also suggest that our findings may not apply in markets or segments of markets were consumers are extremely value conscious. In such markets, consumers may be suspicious of brands, fearing that high-end brands may be overcharging for their low-end products.

Future Work
There are several opportunities for future work. First, the dynamics and path dependence issues raised in the discussion need to be tested empirically. The key research questions would be:
What are typical delays in gaining and losing brand equity in response to managerial action? Does a high-end brand moving down market achieve higher brand equity than a low-end brand moving up market (assuming the same eventual product line extent)?

Second, the basic trade-offs raised in the discussion need to be explored analytically. This analysis may give rise to some conceptual insights, but would also form the basis of a decision support tool. This tool would allow a brand strategist to compare the expected profits of different product line strategies, including the use of multiple brands by the same firm.

Third, practical application of such a decision support tool requires at least two types of information, in addition to the effect of product line extent on brand equity: (1) the sales volume that could be expected for a given product portfolio, and (2) the cost of introducing new models and brands. Further research to gather detailed sales volume and cost information is necessary to determine the value of such a decision support tool.

**Summary**

- This paper addresses the question of how product line extent relates to brand equity. Does offering a premium product enhance brand equity over the entire line? Conversely, does offering an economy product diminish the equity of a brand over the entire product line?

- We address the research questions empirically through an analysis of the U.S. mountain bicycle industry. We use an estimate of price premium as a metric for brand equity. We then test several hypotheses related to the influence of product line extent on brand equity.

- The analysis reveals that brand equity is significantly positively correlated with the quality of the lowest quality model in the product line; and that for the middle-quality segment of the market, brand equity is also significantly positively correlated with the quality of the highest-quality model in the product line.

- The results of the analysis are supported by the results of an experiment in which 63 percent of the subjects preferred a product offered by a high-end brand to the equivalent product offered by a low-end competitor.

- These results imply that managers wishing only to maximize the equity of their brands would offer only high-quality products and avoid offering low-quality products. However, this result must be moderated by the overall objective of maximizing profits.
is likely to involve a tradeoff between preserving high brand equity (and therefore high margins) and pursuing the volume typically located in the lower end of the market.

• One of the most significant implications of this research is that product line managers need to be mindful not just of the incremental cannibalization or stimulation of sales of products that are immediate neighbors of an extension to the product line, but also the effect of such an extension on the brand equity in other, possibly quite different, parts of the product line.
References


Bicycling (1996), Klein Advertisement, (March) p. 36.


Table I
Summary Statistics of Bicycle Characteristics
727 Models

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<tr>
<th>Frame Materials</th>
<th>N</th>
<th>Component Groups</th>
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<th>Rear Suspension</th>
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Mean  Std  Maximum  Minimum
Colors  1.64  1.17  10     1
Sizes    4.60  1.34  10     1

N = number of models having a given product characteristic
Table 2: Correlation Among Independent Variables  
(N=62, p values in brackets)

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*** = p < .01, ** = p < .05
LOW = Lowest predicted price of the models of a particular brand,
HIGH = Highest predicted price of the models of a particular brand,
ADVERTISING = Number of advertising pages in national bicycling magazines in 1995,
Ln MARKET SHARE = Natural logarithm of 1995 market share,
#MODELS = number of models per brand,
TABLE 3: Relation Between MSRP and Bicycle Characteristics  
N=727

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Adjusted $R^2 = .93$, F Value = 211.89***; *** = $p<0.01$, ** = $p<0.05$

Tests performed using White's adjusted T-statistics
### TABLE 4
Relation Between Lowest/Highest Quality Bicycle and Brand Premium
(T statistics in brackets, N=64)

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** = p < .05, * = p < .10, two tailed test

BRAND PREMIUM = Brand premium for a particular brand,
LOW = Lowest predicted price of the models of a particular brand,
HIGH = Highest predicted price of the models of a particular brand,
ADVERTISING = Number of advertising pages in national bicycling magazines in 1995,
Ln MARKET SHARE = Natural logarithm of market share 1995,
#MODELS = Number of models per brand between $200 and $6,000.
TABLE 5  
Relation Between Lowest/Highest Quality Bicycle and Brand Premium by Price Segment  
(T statistics in brackets)

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<td>F Value</td>
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<td>5.74***</td>
<td>1.88</td>
<td>2.96**</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>37</td>
<td>40</td>
<td>49</td>
<td>44</td>
<td></td>
</tr>
</tbody>
</table>

*** = p < .01, ** = p < .05, * = p < .10, two tailed test

BRAND PREMIUM = Brand premium for each brand calculated using models in market segment,
LOW = Lowest predicted price of the models of a particular brand,
HIGH = Highest predicted price of the models of a particular brand,
ADVERTISING = Number of advertising pages in national bicycling magazines in 1995,
#MODELS = Number of models per brand in the market segment.
Figure 1: Product lines of ten representative mountain bike brands. Each mark represents a model. The brands are organized vertically in order of the price of the lowest priced model in the product line.
frame

front suspension

component group
Figure 2: A mountain bicycle with front suspension.
Figure 3: Plots of price premium by model for Trek and Raleigh.