

Marketing Expenditures over the Product Life Cycle: Asymmetries between Dominant and Weak Brands

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Do managers vary their brands' advertising and sales force expenditures as the brands move from the growth to the mature stages of the product life cycle (PLC)? Are these changes different for dominant (high market share) and weak (low market share) brands? How do dominant (weak) brands respond to weak (dominant) brands' marketing spending over the life cycle? The answers to these questions have important implications for marketing resource allocation formulation and the outcome of competition in product-markets. We address these important questions in this paper. Building on previous research in strategic management, innovation, industrial organization, and marketing, we develop several hypotheses. We test them through an econometric model estimated on cross-sectional and time-series data, comprising 40 brands from their introduction through their life cycle in eight pharmaceutical markets. The results show that advertising and sales force expenditures vary differently across the life cycle for dominant and weak brands. As they move from the growth to the mature stages, dominant brands spend more on the high-elasticity marketing weapon in the market (sales force for pharmaceuticals) and shift expenditures toward this instrument. In contrast, weak brands shift their allocation toward the low-elasticity instrument (advertising for pharmaceuticals). Furthermore, while dominant brands do not react to changes in weak brand spending over the life cycle, weak brands increase their advertising spending in response to any increase in marketing expenditures of dominant brands over the PLC. We also validate these results through interviews of executives who have a combined experience of managing 41 brands of ethical drugs. The findings suggest that it may be advantageous to spend aggressively on the high-elasticity marketing variable early to build market share and escalate it over the life cycle to maintain market dominance.

Key words: product life cycle; marketing strategy; resource allocation; industrial organization; competition

1. Introduction

In many industries, the success of brands increasingly depends on their expenditures on marketing variables such as advertising and sales force over the product life cycle (PLC). Expenditures on advertising and sales force over the PLC are important because they reflect utilization of a firm's marketing resources and may have long-term effects on the success of products (Dekimpe and Hanssens 1995a; 1999). Therefore, it is important to study patterns in marketing expenditures over the PLC to better understand the success of new products.

Advertising and sales force expenditures may vary across the different stages of the PLC from introduction or early growth to late growth or maturity. Despite some limitations, the PLC concept has been extensively used by marketing researchers (e.g., Bayus 1998; Lambkin and Day 1989) and industrial organization economists (e.g., Porter 1980; Sherer and Ross 1990). Variations in marketing spending over the PLC contribute to the market performance of products and have strategic managerial implications for changes in marketing mix resources over the PLC. A greater allocation of expenditures toward advertising over the PLC indicates a move toward "pull" marketing strategy, whereas an increased allocation toward sales force signifies a shift toward "push" marketing strategy (Kotler and Keller 2008). Because market evolutionary pattern may suggest different marketing strategies, it is important to study marketing spending patterns over the PLC (Dekimpe and Hanssens 1995b, 1999).

The stages in the PLC (hereafter, PLC) may have both main (direct) and interaction or moderating (indirect) effects on advertising and sales force expenditures. The main effect of the PLC is present when firms inherently change their advertising or sales force expenditures across the different stages in the life cycle due to significant changes in market growth. Prior research has primarily examined the main effect of the PLC on *advertising* expenditures and the results are inconclusive. Lilien and Weinstein (1981) and Parsons (1975) suggest that advertising expenditures should decline over the life cycle. In contrast, Winer (1979) suggests that advertising spending should increase over the life cycle. Farris and Buzzell (1979), however, find no evidence for the main effect of the PLC on advertising expenditures. These studies did not consider any interaction or moderating effects of the PLC.

The PLC may have moderating effects on the advertising and sales force expenditures of brands. Advertising and sales force expenditures may be driven by a variety of *firm*-specific factors such as relative product quality and firm size, and *industry*- or *competition*-specific factors such as market concentration,

entry of new products in the market, and competitor spending (Gatignon, Anderson, and Helsen 1989). Over the PLC, the relationships between some of these factors and marketing spending may change, suggesting important moderating roles for the PLC. The presence and extent of these moderating effects may offer valuable guidance to product managers. For example, if brands generally increase their sales force spending as their quality improves by a greater amount in the early stage than in the late stage, then this behavior provides a benchmark for sales force spending over the PLC. The positive effect of product quality on advertising is stronger in the later than the earlier stages of the PLC, that is, as a brand's product quality increases, a firm advertises more in the mature stage than it does during the growth stage (Tellis and Fornell 1988). Previous research has not, however, explored the interaction of the PLC and industry-specific factors on a brand's advertising or sales force expenditures. An examination of these interaction effects of the PLC may offer important insights into the variation of advertising and sales force expenditures over time. How are the effects of firm- and industry-specific factors on advertising and sales force expenditures in the growth stage different from those in the mature stage of the PLC?

Surprisingly, very little is known about the variation of *sales force* spending over the life cycle (Vandenbosch and Weinberg 1993). Like advertising, sales force expenditures may also be influenced by firm- and industry-specific factors and these effects may be different during the different stages of the PLC. These potential effects of the PLC on sales force spending, however, have not been explored by prior research.

Over time, firms tend to spend more on the most elastic marketing mix variable for that product category (e.g., Gatignon et al. 1989). Typically, category expenditures on the most elastic marketing instrument increase over the product life cycle. This pattern is understandable as a rational firm will likely spend more on the marketing instrument that offers more bang for the buck. However, such an observation could mask an important underlying asymmetry in spending behavior among brands within the category. Advertising and sales force expenditures over the life cycle could be different for *dominant* (high market share) and *weak* (low market share) brands because the relative effectiveness of different marketing variables may depend on the market power of brands (Borenstein 1991; Cubbin and Domberger 1988). An examination of these differences is essential to better understand which spending strategies are associated with successful brands. In particular, analyses of interactions among market dominance, the PLC and firm-

and industry-specific factors on marketing expenditures could reveal longitudinal patterns of marketing spending associated with dominant and weak brands, offering useful insights.

Although pricing decisions of dominant and weak firms have been studied in the industrial organization literature (Borenstein 1989; 1991) and the effectiveness of marketing spending decisions have been analyzed in the marketing literature (e.g., Dekimpe and Hanssens 1995a; 1999; Sethuraman and Tellis 1991), not much is known about differences in marketing spending of dominant and weak brands *over the PLC*. Furthermore, dominant (weak) brands' reactions to changes in weak (dominant) brands' marketing spending over the life cycle are likely to be important to the outcome of competition between these types of brands. While much is known about factors that shape competitor responses (e.g., Gatignon, Weitz, and Bansal 1990), little is known about the actions and the responses of dominant and weak brands over the life cycle. A better understanding of dominant (weak) brands' advertising and sales force decisions will help weak (dominant) brands better plan their own marketing spending decisions over the PLC.

In this paper, we address these gaps in prior research. Put another way, the purpose of this paper is to investigate the interaction effects of the PLC with market dominance and their interactions with some firm- and industry-specific factors on advertising and sales force expenditures of products. Building on previous research in strategic management, innovation, industrial organization, and marketing, we first develop a conceptual framework relating the stages in the PLC, market dominance and a comprehensive set of firm-specific and industry-specific factors to advertising and sales force expenditures. We develop hypotheses on the interaction effects of the PLC on these expenditures, in particular, how the effects of the PLC may be different for dominant and weak brands. To test the hypotheses, we develop models of sales, advertising spending, and sales force spending and estimate them simultaneously in structural form, using cross-sectional and time-series data comprising 40 products from their introduction through their life cycle in eight pharmaceutical markets. We validate these results with reactions from 17 brand managers who have a combined experience of managing 41 brands of ethical drugs.

Our results show that advertising and sales force expenditures vary differently across the life cycle for dominant and weak brands. As they move from the growth to the mature stages, dominant brands spend more on the high-elasticity marketing weapon in the market (sales force for pharmaceuticals) and shift expenditures toward this instrument. In contrast, weak brands shift their allocation toward the low-elasticity instrument (advertising for pharmaceuticals). Furthermore, while dominant brands do not react to changes

in weak brand spending over the life cycle, weak brands increase their advertising spending in response to any increase in marketing expenditures of dominant brands over the PLC. The findings suggest that it may be advantageous to spend aggressively on the high-elasticity marketing variable early to build market share and escalate it over the life cycle to maintain market dominance.

Our analysis extends prior research in three important ways. First, unlike prior research that has mostly studied the main effects of the PLC on advertising, our study explores both the main and interaction effects of the PLC in the same framework. Second, prior studies have examined variations in only advertising expenditures, but not in sales force spending. Investigating both advertising and sales force variables in the same study is important from the viewpoint of understanding resource allocation. We simultaneously analyze a structural model of advertising and sales force expenditures. Third, we focus on the role of market dominance of brands in explaining asymmetric competitive marketing spending behavior, providing useful benchmarking guidelines for managers.

2. Conceptual Development and Hypotheses

We begin by identifying some firm-specific and industry- or competition-specific determinants of advertising and sales force, the associated relationships, and the roles of the PLC and market dominance. We then develop hypotheses on the interaction or moderating effects of the PLC on these expenditures. In our discussion of these determinants, we mention the empirical context of our study, the U.S. pharmaceutical industry, wherever necessary. Following prior research (Farris and Buzzell 1979; Lilien and Weinstein 1981; Vakratsas and Kolsarici 2008), we primarily focus on two key phases of the life cycle, the introduction and early growth (hereafter, growth) and late growth and mature (hereafter, mature) stages.¹ We use the term “the effect of the PLC” to denote the effect of the mature stage relative to the growth stage in the life cycle.

2.1. Main Effects of the PLC and Market Dominance

It is unclear if the PLC has a main effect on marketing spending. Advertising expenditures may be inherently higher or lower during the growth stage than during the mature stage of the PLC. On the one hand, because advertising elasticities decline over the life cycle (Parsons 1975) and with multiple entrants

¹ The major reasons for prior research to combine the PLC stages in this manner are: (1) the transitions between introduction and early growth and between late growth and mature stages are difficult to pinpoint and (2) firm expenditures appear to be more discontinuous between early growth and late growth stages than between any other two stages in our data. Furthermore, the decline stage is seldom observed in our empirical context, the drug industry, unless a disease is eradicated or about to be eradicated, so we do not study the decline stage in our study.

(Parker and Gatignon 1996), advertising expenditures may decrease over the PLC. Indeed, Lilien and Weinstein (1981) found that advertising expenditures were lower in the later stages of the PLC. On the other hand, because brands sell more in the mature stage when the market is bigger, they are likely to spend more in the mature stage than in the growth stage. Winer (1979) found that sales response to advertising increases over time, suggesting that advertising spending should increase over the life cycle. Interestingly, Farris and Buzzell (1979) did not find the main effect of the PLC on advertising and promotion spending to be significant. The arguments for the main effect of the PLC on sales force expenditures are similar. Given the mixed evidence, we do not predict a main effect of the PLC. We leave it as an empirical issue to be examined in this study.

The main effect of market dominance on marketing spending is somewhat obvious. Dominant brands, by virtue of their higher sales, will have higher marketing expenditures than weak brands.

2.2. Interaction/Moderating Effects of the PLC

The PLC may have interaction effects with several determinants of advertising and sales force expenditures, including market dominance. These effects have not been explored by prior research and could explain the inconclusive results of past research which shows both positive and negative relationships between market maturity and marketing spending. These inconclusive results suggest that there may be contingency variables (moderators), that is, interaction effects of the PLC with firm- and industry-specific factors and market dominance that would better explain the pattern of marketing spending over the PLC.

We examine a total of six firm- and industry-specific factors. Although there are potentially six two-way interactions of the PLC with the firm- and industry-specific factors, a PLC x Market dominance interaction, and six three-way interactions of the PLC x Market dominance x Firm/Industry-specific factors, totaling 13 interaction factors involving the PLC, we develop hypotheses on five of the factors that have stronger theoretical underpinnings than the others and which are central to our analysis. In each of the hypotheses, the sub-hypothesis relating to advertising is subscripted by *a* and that relating to sales force is subscripted by *b*.

Market Dominance

The PLC and market dominance, interacting together, contribute to differences in marketing expenditures. We anticipate important differences between dominant and weak brands in advertising and sales force spending over the PLC, consistent with the literature on dominant and weak brands (e.g.,

Borenstein 1989; 1991). Our reasoning for these differences is based on the hierarchy of marketing communication effects (Kotler and Keller 2008).

According to the theory of hierarchy of communication effects, a decision-maker goes through different stages of readiness: awareness, interest, conviction, action and repeat action. Advertising is more powerful than sales force to create brand awareness, whereas sales force is more useful to convince customers (Kotler and Keller 2008). Awareness creation is important in the early stages of the launch of a brand while persuasion is critical once the brand goes past the launch stage. Early in the PLC, all brands face the problem of creating brand awareness, so they find advertising to be the most effective marketing instrument to overcome this problem. As the market continues to grow, one or a few brand(s) come out on top and become dominant. By that time, these dominant brands have already overcome the awareness hurdle and have developed or deepened key brand associations. Dominant brands focus on conviction, action and repeat action after the growth stage, so they find it advantageous to allocate more marketing investment to sales force.

In the pharmaceutical industry, in particular, sales force is more effective than advertising over the long-term (Rangaswamy and Krishnamurthi 1991).² Managers allocate their scarce resources to the marketing variable with the greatest long-term impact on sales and profitability (Dekimpe and Hanssens 1999). Relative to advertising, sales force efforts involve higher fixed costs of training. Typically, dominant brands emerge early in the life cycle. Over time, they spend more on sales force than do weak brands to capitalize on the earlier investments in sales force. In allocating marketing resources across its product portfolio, a firm typically allocates more expenditures to the more effective marketing variable to its best-performing brands or those that are dominant in their markets over the life cycle (Fogg 1974). In the ethical drug industry, a sales representative details or canvasses multiple drugs on a visit to the physician. Most firms have a fixed size of sales force and each sales person has a fixed detailing time. Over time, a salesperson will likely detail the brands that are dominant in their markets first, devoting her remaining time to the weak brands in the company's portfolio. Thus, a dominant brand's sales force expenditures increase by a greater extent over the PLC than does a weak brand's sales force spending.

² We verified this finding in subsequent analyses of our data. We note that in some other markets, however, other marketing spending variables such as advertising or consumer sales promotion may be more effective.

In contrast, even in the later stages of the PLC, weak brand firms may still need to spend on advertising to surmount the awareness and brand association hurdles. Therefore, they spend more on advertising in the later stages than they do in the earlier stages of the PLC, relative to dominant brands.

The following hypotheses summarize these arguments.

- H_{1a}: The PLC and market dominance interact to affect spending on the market's *low*-elasticity instrument (advertising) in such a way that the positive relationship between market dominance and advertising spending will be stronger in the early growth than it is in the late growth stage.
- H_{1b}: The PLC and market dominance interact to affect spending on the market's *high*-elasticity instrument (sales force) in such a way that the positive relationship between market dominance and sales force spending will be weaker in the early growth than it is in the late growth stage.

Much of the changes in advertising and sales force expenditures of dominant and weak brands are also due to changes in firm and industry factors over the life cycle. These changes in firm and industry factors form the underlying rationale for dominant brands' emphasis on sales force and weak brands' focus on advertising over the life cycle in the hypotheses that we develop below.

Firm-specific Factors

Relative product quality. A brand may spend more on a marketing variable if it is perceived to be of higher quality relative to other brands (Gatignon et al. 1990). This effect of relative product quality on a brand's advertising and sales force expenditures, however, may be influenced by the stage in the PLC. In the growth stage when the category is evolving, it may be effective for a firm with a high quality brand to spend moderately in its marketing variables because the high product quality may be able to generate repeat purchases (Kuehn 1962). In the mature stage, however, as the market becomes more established, a brand may have to spend more heavily on advertising or on sales force with increasing relative product quality. Indeed, Tellis and Fornell (1988) found that the relationship between product quality and advertising is strongest in the mature stage when consumers are less responsive to advertising. This relationship, however, is contingent on market dominance.

Dominant brands with higher relative product quality are likely to spend more on the market's high-elasticity instrument (sales force in the market we study) during the mature stage relative to the growth stage. Although the category may be more established in the mature stage, the large customer base of the dominant brands together with high relative product quality may enable their sales force to be more effective than those for the other brands (Borenstein 1991). In contrast, as its product quality increases, a weak brand

may spend more on advertising during the mature stage relative to the growth stage to overcome the gap in awareness with the dominant brand. These arguments lead to the following three-way interaction hypotheses.

- H_{2a}: The relationship between product quality and expenditures on the market's *low*-elasticity instrument (advertising) will be more strongly positive when the brand is weak and in the mature stage, relative to when the brand is dominant and in the early stage of the PLC.
- H_{2b}: The relationship between product quality and expenditures on the market's *high*-elasticity instrument (sales force) will be more strongly positive when the brand is dominant and in the mature stage, relative to when the brand is weak and in the early stage of the PLC.

Industry- or Competition-specific Factors

Market concentration. Marketing spending may be strongly shaped by market concentration, an important measure of competition (Ramaswamy, Gatignon, and Reibstein 1994). Market concentration indicates the extent of rivalry, with a greater concentration ratio suggesting lower rivalry (Farris and Buzzell 1979).

A brand may vary its spending differently according to changes in market concentration between the growth and the mature stages. Market concentration typically decreases over time as more brands enter the market over the life cycle, in particular, in the pharmaceutical industry.³ In the growth stage, as market concentration decreases, a brand may decrease its spending because it can benefit from category growth stimulated by the spending of all the brands (Scherer and Ross 1990) and because the impact of marketing on category sales declines with rising number of competitors (Bowman and Gatignon 1996), suggesting a positive relationship between concentration and marketing spending. In this stage, high fixed costs like advertising spending are associated with concentrated industry structure (Shaked and Sutton 1987). In the mature stage, however, as market concentration continues to fall, the brand may have to raise its spending to protect its market position, implying a negative relationship.

This relationship could depend on market dominance, creating a three-way interaction effect of the PLC, market dominance and market concentration on marketing spending. Dominant brands could have an advantage over weak brands in that they may have greater marketing elasticities than do weak brands. Indeed, pioneers and early followers, which often are dominant brands, may have this advantage (Shankar et

³ In some markets, market concentration could increase over the life cycle as larger brands may consolidate by acquiring weaker brands. In the pharmaceutical industry, however, typically, more brands enter over the life cycle and more so when the patents of some brands expire. Therefore, market concentration typically decreases over the life cycle in ethical drug markets.

al. 1999). This advantage suggests that dominant brands may not have to spend as much as weak brands do in the mature stage as the market becomes less concentrated. Therefore, the stronger negative relationship in the mature stage is attenuated for dominant brands. These arguments lead to the following three-way interaction hypotheses.

- H_{3a}: The PLC, market dominance and market concentration interact to affect advertising in such a way that the strongly negative relationship between market concentration and advertising spending in the late growth stage is attenuated for dominant brands relative to weak brands.
- H_{3b}: The PLC, market dominance and market concentration interact to affect sales force in such a way that the strongly negative relationship between market concentration and sales force spending in the late growth stage is attenuated for dominant brands relative to weak brands.

Multimarket contact. A brand's spending may also depend on whether the firm already competes (has multimarket contact) with one or more of its current rivals in other markets (DeSarbo and Grewal 2007; DeSarbo, Grewal, and Wind 2006). Two contrasting perspectives exist in the strategic management literature (see Baum and Korn 1996 and Chen 1996 for detailed reviews). One view is that multimarket contact increases competitive rivalry (Porter 1980). The other view is that multimarket exposure leads to greater mutual forbearance, dampening rivalrous spending activities (Bernheim and Whinston 1990).

A brand's marketing spending may vary with multimarket contact differently in the growth and mature stages of the PLC. As more brands enter a market, the likelihood of multimarket contact for an incumbent firm increases over the life cycle. In the growth stage, increase in multimarket contact may result in aggressive marketing behavior due to the rivalrous tendency on the part of competitors to establish themselves in the market (Porter 1980). In the mature stage, however, firms may realize that the incremental returns from competing more vigorously may not be worth the prospect of retaliatory attacks in shared markets (Bernheim and Whinston 1990). In the mature stage, the greater the market commonality (shared markets), the less likely a firm will attack another in any marketing variable (Chen 1996). Multimarket contact is generally associated with lower advertising and sales force spending (Shankar 1999).

This relationship could also be determined by brand dominance, creating a three-way interaction effect of the PLC, market dominance and multimarket contact on marketing spending. Because dominant brands typically have higher response to their marketing spending than do weak brands, their need for forbearance may be somewhat less than that for weak brands, especially over time. This reasoning suggests that the increasing negative relationship between multimarket contact and marketing expenditures over the life cycle may be attenuated by market dominance, leading to H₄.

- H_{4a}: The PLC, market dominance and multimarket contact interact to affect advertising in such a way that the strongly negative relationship between multimarket contact and advertising spending in the late growth stage is attenuated for dominant brands relative to weak brands.
- H_{4b}: The PLC, market dominance and multimarket contact interact to affect sales force in such a way that the strongly negative relationship between multimarket contact and sales force spending in the late growth stage is attenuated for dominant brands relative to weak brands.

Competitor spending. Consider the effect of competitor marketing efforts on a brand's advertising or sales force spending over the life cycle. A firm may base its marketing spending differently according to the marketing efforts of groups of dominant and weak competitors (Porter 1980; Shankar 1999). The relationship between a brand's marketing spending and the expenditures of its *dominant* rivals may be either negative or positive. On the one hand, a brand may advertise less and have a smaller sales force since it may not want to escalate a spending war with dominant rivals (Scherer and Ross 1990). Indeed, there is an incentive to avoid retaliation, given its negative associations with performance (Chen and Miller 1994). On the other hand, a brand may actually increase its spending in some marketing instrument to counter or discourage the prospect of aggressive spending by dominant competitors (Lynn 1987).

In response to dominant competitors' marketing efforts, dominant brands will likely react differently than will weak brands over the life cycle due to power asymmetry (Kumar, Scheer, and Steenkamp 1998). As its dominant competitors increase their spending, a dominant brand may reduce its marketing expenditures to a greater extent in the mature stage than in the growth stage to avoid escalating an advertising or sales force war with dominant competitors. In a growing market, these brands' marketing expenditures might increase with dominant competitor spending (Hanssens 1980). In a mature market, however, brands may not find it cost effective to raise their spending as dominant competitors increase their spending. Indeed, Dekimpe and Hanssens (1999) found that Prozac, a dominant brand in the antidepressants category increased its sales force efforts initially but decreased them as its dominant competitor, Zoloft, increased its spending.

Weak brands, on the other hand, may behave differently due to competitive asymmetry with dominant brands, that is, due to the fact that these groups of brands may not pose an equal degree of threat to each other (Chen 1996). They may have to step up their marketing efforts much more in the mature stage than in the growth stage to prevent being driven out of the market. To defend their market shares, these brands may have to increase their marketing efforts in the mature stage (McGrath, Chen, and MacMillan 1998). They, however, are likely to increase their spending on the less powerful marketing instrument

(advertising) for dominant brands to raise their awareness levels to wider target audience. Thus, we expect the three-way interaction effect PLC x Market dominance x Dominant competitor spending on advertising and sales force to be negative.

In contrast to dominant rivals, *weak* rivals may not be viewed as a threat, so their spending may not affect a brand's (dominant or weak) advertising or sales force spending, regardless of the stage in the PLC. Competitor independence increases the chances of nonresponse (Chen and MacMillan 1992). Therefore, we do not expect significant differences between the marketing actions of dominant and weak brands in response to increased expenditures by weak competitors over the life cycle. These arguments can be summarized by the following three-way interaction effect hypotheses.

- H_{5a}: As their dominant rivals increase marketing spending, dominant brands will reduce their advertising spending by a greater amount in the mature stage than the growth stage, relative to weak brands.
- H_{5b}: As their dominant rivals increase marketing spending, dominant brands will reduce their sales force spending by a greater amount in the mature stage than the growth stage, relative to weak brands.

2.3. Control Variables and Other Interaction Effects of Market Dominance

Market entry of a new product. Incumbent brands may retaliate (increase spending) or accommodate (decrease spending) or not change their spending upon the entry of a new brand. Some studies show that firms accommodate (e.g., Hauser and Shugan 1983) while a few others show that they retaliate (e.g., Gruca, Kumar, and Sudarshan 1992) under different conditions.

Sales level or firm size. Because most brands typically base their marketing budgets on their sales revenues, sales level or firm size is an important predictor of a firm's advertising and sales force spending (Lilien 1979 and Lilien and Weinstein 1981). Furthermore, controlling for sales level as a potential determinant is similar in principle to analyzing the drivers of advertising or sales force spending or marketing spending to sales ratios.

Relative leadership in the marketing mix variable. Some firms are regarded as industry leaders in advertising or sales force, that is, they have a reputation for trend-setting advertising or sales force campaigns (for example, Merck and Pfizer in sales force), which are then typically imitated by their competitors, the followers. In the case of pricing, for example, Roy, Hanssens, and Raju (1994) found that Ford Thunderbird was a price leader in the midsize sedan segment of the automobile market. A leader in a

marketing mix variable is likely to spend aggressively in that variable relative to its rivals, regardless of the stage in the life cycle or market dominance (Bensoussan, Bultez, and Naert 1978; Shankar 1997).⁴

Spending in the other marketing variable. Because firms tend to use their marketing mix variables synergistically, higher spending in one variable may be associated with higher spending in another variable (Gatignon, Anderson, and Helsen 1989). On the other hand, it might be argued that if firms have fixed marketing budgets, expenditures in advertising and sales force may be inversely correlated (Gatignon and Hanssens 1987). This relationship is not likely to be driven by the stage in the PLC or market dominance.

Market dominance may have two-way interaction effects with some of these firm- or industry-specific control variables. Because such potential interactions are not strongly driven by theory, we leave them as empirical issues to be discussed in our results section. Overall, as the market moves from the growth to the mature stage, we expect dominant brands to shift their allocation toward sales force and push promotion, and weak brands to change toward advertising and pull promotion, with variations in firm- and industry-specific factors.

3. Model Formulation

To test the hypotheses, following prior studies (e.g., Farley and Lehmann 1986; Shankar, Carpenter, and Krishnamurthi 1999), we develop a structural model of sales, advertising spending and sales force spending. We first formulate a parsimonious mixed log-linear sales response model. In this model, we focus on the effects of own and competitor marketing mix expenditures.

$$\ln S_{it} = \delta_{1t} + \sum_{k=2}^K \delta_k I_{ik} - \varphi_{1t} / T_{it} + \varphi_{2t} CCS_{i(t-1)} + \theta_{1t} \ln(PQ_{i(t-1)} + 1) + \theta_{2t} \ln AD_{it} + \theta_{3t} \ln SF_{it} + \theta_{4t} \ln DCOMPEX_{i(t-1)} + \theta_{5t} \ln FCOMPEX_{i(t-1)} + \omega_{it} \quad (1)$$

where S_{it} is the sales of brand i at time t , I_{ik} is a dummy variable denoting if brand i is in category k , K is the total number of categories, T_{it} is the time in market of brand i until time t , CCS_{it} is the cumulative competitor sales for brand i until time t , PQ_{it} is relative product quality of brand i at time t , AD_{it} is the advertising expenditure of brand i at time t , SF_{it} is the sales force expenditure of brand i at time t , $DCOMPEX_{it}$ and

⁴ Note that dominant brands may not necessarily be leaders in a marketing mix variable. For example, in the computer printer market, Canon, a weak brand, is regarded as the price leader.

FCOMPEX_{it} are the expenditures of dominant and weak competitors of brand i, respectively, at time t, and ω_{it} is an error term assumed to be normal, independent with mean 0.⁵

In Equation (1) and in the subsequent equations for the endogenous variables, AD and SF, because we have data across multiple categories, we allow for differential intercepts (fixed effects) for these categories. The term with T captures the diffusion of brand, that with CCS accounts for the effect of competitor diffusion over time, and those with PQ, AD, SF, DCOMPEX, and FCOMPEX capture the effects of marketing mix (own and competitor). Because PQ can be less than one, one is added to it to ensure that logarithm of the term with PQ is positive. As CCS, PQ, DCOMPEX and FCOMPEX are endogenous, we use lagged variables as instruments in this and the other equations in the system. We subsequently test for the exogeneity of these variables using the Hausman (1978) test.

We expect the stage in PLC to affect the coefficients of the different determinants of sales. We also anticipate dominant and weak brands to have different market responses. Therefore, the parameters are made a function of the stage in the PLC and market dominance as follows, consistent with the process function approach.⁶ In general, dominant brands are likely to have more favorable market response parameters.⁷

$$\lambda_t = \lambda_G + \lambda_P PLC_{ijt} + \lambda_M MD_{ij(t-1)} + \lambda_{PM} PLC_{ijt} * MD_{ij(t-1)} \quad (2)$$

where λ_t is the parameter vector ($\lambda \in \{\delta_1, \phi_1, \phi_2, \theta_1-\theta_5\}$) at time t, PLC_{ijt} is a dummy variable indicating late growth or mature stage and beyond for brand i in the PLC at time t (early growth or introduction stage, otherwise), MD_{ijt} is the market dominance share of brand i in category j at time t, and $\lambda_G, \lambda_M, \lambda_P,$ and λ_{PM} are the associated parameter vectors. Incorporating these market dominance-varying parameters into Equation (1) produces a new equation, Equation (1)'. To save space, this expanded model is not fully written out.

⁵We choose advertising and sales force because these are the important variables in the markets we study in the empirical analysis. The model can be extended for other marketing spending variables such as sales promotion without loss of generality.

⁶ An alternative way to capture the effects of market dominance is to separate the brands as dominant and weak brands based on a cut-off market share and estimate the models separately for the two samples. The proposed approach using a continuous measure of market dominance, however, allows us to directly estimate the main and interaction effects of market dominance.

⁷ An alternative model that allows for different marketing mix effectiveness of dominant and weak brands is a market share attraction model. In such a model, however, marketing mix elasticity increases linearly with market share. In contrast, in the proposed model, elasticities vary by both market dominance and the PLC, so we use the proposed model.

Next, we develop the advertising and sales force spending models based on the conceptual framework presented earlier. The advertising spending model is given by:

$$\ln AD_{it} = \alpha_{01t} + \sum_{k=2}^K \alpha_{0k} I_{ik} + \alpha_{1t} \ln(PQ_{i(t-1)} + 1) + \alpha_{2t} \ln(CONR_{i(t-1)} + 1) + \alpha_{3t} MMC_{i(t-1)} + \alpha_{4t} NE_{i(t-1)} \quad (3)$$

$$+ \alpha_{5t} \ln DCOMPEX_{i(t-1)} + \alpha_{6t} \ln FCOMPEX_{i(t-1)} + \alpha_7 \ln S_{it} + \alpha_8 ALDR_i + \alpha_9 \ln SF_{it} + \varepsilon_{it}$$

where $CONR_{it}$ is the market concentration in the market with brand i at time t , MMC_{it} represents the multimarket contact of brand i with other brands in the market at time t , NE_{it} is a dummy variable denoting if there was a new entry in the last six months preceding t in brand i 's market, and $ALDR_i$ is a dummy variable denoting if brand i is a leader in advertising. ε_{it} is an error term assumed to be normal, independent with mean 0, and α_0 - α_9 are the parameters. α_{0k} parameters are category-specific, α_1 - α_6 relate to the hypotheses, and α_7 - α_9 pertain to the control variables. Because $CONR$ is not greater than one, the term with $CONR$ has one added to $CONR$ to ensure that logarithm of the term is positive.

Similar to the advertising spending model, the sales force model is given by:

$$\ln SF_{it} = \beta_{01t} + \sum_{k=2}^K \beta_{0k} I_{ik} + \beta_{1t} \ln(PQ_{i(t-1)} + 1) + \beta_{2t} \ln(CONR_{i(t-1)} + 1) + \beta_{3t} MMC_{i(t-1)} + \beta_{4t} NE_{i(t-1)} \quad (4)$$

$$+ \beta_{5t} \ln DCOMPEX_{i(t-1)} + \beta_{6t} \ln FCOMPEX_{i(t-1)} + \beta_7 \ln S_{it} + \beta_8 SLDR_i + \beta_9 \ln AD_{it} + \eta_{it}$$

where $SLDR$ is a dummy variable denoting if brand i is a leader in sales force and η_{it} is an error term assumed to be normal, independent with mean 0, β_0 - β_9 are the parameters, and the rest of the terms are as defined earlier. The parameters are similar to those in the advertising model.

3.1. The Impact of the PLC and Market Dominance on Marketing Spending

To explore the impact of the PLC and market dominance on the expenditures and test hypotheses H_1 - H_6 , we allow the parameters in Equations (3) and (4) to vary by the stage in the product life cycle and market dominance as follows.

$$\phi_t = \phi_G + \phi_P PLC_{ijt} + \phi_M MD_{ij(t-1)} + \phi_{PM} PLC_{ijt} * MD_{ij(t-1)} \quad (5)$$

where ϕ_t is the parameter vector $\phi \in \{\alpha_{01}, \alpha_1$ - $\alpha_6, \beta_{01}, \beta_1$ - $\beta_6\}$ at time t , ϕ_G , ϕ_M , ϕ_P and ϕ_{PM} are the associated parameter vectors, and the rest of the terms are as defined earlier. Incorporating these PLC- and market dominance-varying parameters into Equations (3) and (4) produces a new set of equations, Equations (3)' and (4)'. To save space, these expanded models are not fully written out.

4. Data and Model Estimation

4.1. Data

We test the hypotheses using data from the U.S. prescription drug industry that has been the focus of research on marketing strategy (e.g., Gatignon, Anderson and Helsén 1989; Mantrala, Sinha, and Zoltners 1992). The North American pharmaceutical industry, valued at about \$275 billion, is one of the world's most innovative, yet marketing-driven industries (PhRMA 2007). Firms in the pharmaceutical industry spend considerably on marketing variables such as advertising and sales force to bolster the success of products. Physician-directed advertising and sales force has grown steadily over the decades to about \$23 billion in 2006, contributing substantially to the success of new products (PhRMA 2007).

Using data from a single industry is advantageous in the sense we do not need to include a wide array of cross-industry factors to control for heterogeneity of estimates when multi-industry studies are undertaken (Bass, Cattin, and Wittink 1978). The data include 40 brands from eight U.S. prescription drug product markets, primarily during the late 1970s, 1980s and 1990s.⁸ The data comprise monthly sales, journal advertising, and sales force expenditures in each category starting from the introduction of the pioneering brand until late growth or market maturity, adjusted for inflation using the Consumer Price Index (CPI).⁹ Direct-to-consumer (DTC) advertising, which can be found in some categories today, was not relevant for these product categories during the period of the data. The data span anywhere from 6 to 13 years in these categories. Nine out of 19 firms in the data had multimarket contact with at least one other firm.

We measure sales using the total number of prescriptions.¹⁰ We measure product quality based on repeated surveys of 86 physicians every three years for each product category. The physicians were asked to evaluate each drug on four dimensions, namely, efficacy, dosage, side effects and range of indications, consistent with Gatignon et al. (1990) and Hahn et al. (1990). On each dimension, we measure physician perceptions of product quality of each brand on a five-point scale ranging from "Very Good" on one end to "Very Poor" on the other. We computed an overall product quality measure by averaging across the

⁸ Although part of our data share a few similarities to the data used by Shankar (1999) and Shankar et al. (1999), our data are more comprehensive, covering a wider range of product categories and a longer span of time.

⁹ We cannot disclose the names and product details of the brands and categories for proprietary reasons.

¹⁰ Because dollar sales figures were not available, we could not carry out an analysis of marketing spending to sales ratios that might help to normalize sales spending across brands before pooling the brands in our analysis. Note, however, that by using sales as an independent variable in the spending equations, we effectively do this normalization.

dimensions. Based on this composite measure, we constructed a relative product quality measure that is the ratio of the quality of that brand with respect to the average quality of all available brands at the given time, consistent with Gatignon et al. (1990). To identify firms in the data that are regarded as leaders in advertising or sales force, we interviewed a panel of 17 experts who were involved in the management of most of the products in the database. Among the 17 experts, 14 were (are) marketing managers, 11 were (are) brand managers and seven were (are) vice presidents of at least one of the brands in the database. Their perceptions were remarkably similar. To operationalize “dominant” and “weak” *competitor* brands in each product category, we define dominant brand as one with a market share of 25 percent and above, similar to Cubbin and Domberger (1988). We classified the remaining brands as weak brands. In each market, the dominant brands had a combined market share of at least 60 percent.¹¹ There were 15 dominant and 25 weak brands in our data.

Price and distribution were not important marketing variables in explaining sales across brands and over time. The markets for ethical drugs during the period of data were generally considered price-inelastic, consistent with other studies (e.g., Gatignon et al. 1989; Gatignon et al. 1990).¹² The product categories did not exhibit any significant seasonality in terms of their usage, so we did not include an additional term for seasonality in the model.

A sample product category (aggregated across brands) curve for sales, advertising and sales force appears in Figure 1. The difference between sales force and advertising expenditures expands over the product life cycle, that is, category sales force expenditures relative to advertising spending increase substantially more during the mature stage than during the growth stage. Is this pattern of category spending over the PLC the same for dominant and weak brands? Our research seeks to answer this question.

[Figure 1 about here]

Summary statistics of advertising, sales force and other key variables in the data, including the correlation matrix appear in Table 1. The operationalization of all the variables is shown in Table 2. The data comprise a total of 2,995 observations. The average monthly sales force spending of a brand is more than twice that of advertising, highlighting the importance of sales force in this industry, consistent with

¹¹ Using this definition, the gap in market shares between any of the dominant brands and any of the weak brands in the same market was at least 20 percent in our data, so our definition of the dominant brands is fairly robust.

¹²This conclusion is also consistent with consensus views of the executives we interviewed in the pharmaceutical industry.

prior research on this industry (Rangaswamy and Krishnamurthi 1991). The key research question is: what are the roles of the PLC and market dominance in determining these expenditures?

[Tables 1 and 2 about here]

4.2. Estimation

Before estimating the models, we determined the transition points between the growth and mature stages in the life cycle for each product category so that we can operationalize the PLC variable. We did this by estimating a logistic regression model of category sales and by identifying the inflection point, consistent with Shankar et al. (1999).

We estimate equations (1)', (3)' and (4)', that is, the sales response, the advertising spending, and the sales force spending models as a simultaneous system of equations. Doing so, we capture the endogeneity of sales force and advertising expenditures in the sales response equation and the fact that a firm jointly decides advertising and sales force expenditures every period. Prior research, however, has not considered this simultaneity. In estimating the models, we tested for multicollinearity, autocorrelation, and heteroscedasticity. We also tested for cross-error correlation among brands belonging to the same firm and category. Although we have a few dummy variables in our model, multicollinearity was not a problem in our data (the variance inflation factors ranged from 1.3 to 2.8). The autocorrelations were not significant. The likelihood ratio test of heteroscedasticity (Greene 2008) rejected equal error variances for all the models. Therefore, we estimate them by accounting for heteroscedasticity. Furthermore, we estimated the advertising and sales force equations by both two-Stage Generalized Least Squares (2SGLS) and checked for the cross-equation error correlations. They were significant ($p < 0.01$). We therefore estimate the model by Generalized Method of Moments (GMM), which is appropriate when the cross-equation errors are significant and errors are heteroscedastic (Greene 2008).

5. Results

We now present the results of the estimation of simultaneous Equations (3)' and (4)' for advertising and sales force spending. These results appear in Tables 3 and 4. The effects of sales force spending and advertising spending on each other are significant ($p < 0.05$), reinforcing our use of the structural model of simultaneous advertising and sales force spending equations.

[Tables 3 and 4 about here]

5.1. Advertising Spending

From Table 3, the main effect of the PLC is not significant ($p > 0.10$), that is, both dominant and weak brands' advertising expenditures are not inherently different during the growth and mature stages. The main effect of market dominance is also insignificant. The PLC, however, has important interaction effects. The interaction of the PLC with market dominance is negative and significant ($p < 0.05$). Dominant brands have less advertising spending in the mature stage than in the growth stage, relative to weak brands, consistent with H_{1a} .

The three-way interaction of the PLC with market dominance and product quality is not significant ($p > 0.10$). The relationship between product quality and advertising spending over the life cycle is not significantly different across dominant and weak brands. Thus, H_{2a} is not supported. The three-way interaction of the PLC, market dominance and market concentration is positive and significant ($p < 0.01$), as predicted by H_{3a} . The strongly negative relationship between market concentration and advertising spending in the mature stage relative to the growth stage is diminished for dominant brands when compared to weak brands. Furthermore, the three-way interaction of the PLC, market dominance and multimarket contact is positive and significant ($p < 0.01$), as expected from H_{4a} . The negative relationship between multimarket contact and advertising over time is less severe for dominant brands than for weak brands. The three-way interaction of the PLC, market dominance and dominant competitor spending on advertising is negative and significant ($p < 0.05$), supporting H_{5a} . As they move from the growth to the mature stages, dominant (weak) brands spend less (more) on advertising with increasing marketing expenditures by their dominant competitors.

5.2. Sales force Spending

The results for sales force spending are shown in Table 4. As in the case of advertising spending, the direct effect of the PLC is not significant ($p > 0.10$). The interaction of the PLC and market dominance is positive and significant ($p < 0.05$), supporting H_{1b} . Compared to weak brands, dominant brands spend more on sales force during the mature stage than during the growth stage.

The three-way interaction of the PLC, market dominance and product quality on sales force expenditures is positive and significant ($p < 0.001$). Relative to weak brands, dominant brands with higher quality spend more on sales force over the life cycle than those with lower quality, consistent with H_{2b} . The three-way interaction of the PLC, market dominance and market concentration is positive and significant (p

< 0.05), as predicted by H_{3b}. That is, the negative relationship between market concentration and sales force spending between growth and mature stages is weaker for dominant brands than for weak brands. The three-way interaction of the PLC, market dominance and multimarket contact is not significant ($p > 0.10$), as predicted by H_{4b}. Evidently, dominant and weak brands are not different when it comes to the strength of the negative relationship between multimarket contact and sales force expenditures across the stages in the life cycle. As their dominant competitors spend more, dominant brands spend less on sales force in the mature stage than in the growth stage relative to weak brands ($p < 0.05$), consistent with H_{5b}.

Summary

Combined, the results from Tables 3 and 4 support most of our hypotheses. The PLC has no main effect, but has important interaction effects on advertising and sales force expenditures, in particular, with market dominance. Many interactions of the PLC and market dominance with firm- and industry-specific factors are significantly different between dominant and weak brands. As brands move from the growth to mature stages of the PLC and as the firm and industry factors vary over the PLC, dominant brands appear to shift spending toward the high-elasticity marketing instrument (sales force) and hence push promotion, while weak brands shift expenditures toward the low-elasticity marketing weapon (advertising) and thus pull promotion.

Two key interaction results are graphically shown in Figures 2a to 4b. For the graphical illustrations, the dominant and weak brands are defined at market shares of one standard deviation above and below the mean level, respectively. The dominant and weak competitor expenditures are defined in a similar manner. The X-axis shows the two key stages of the PLC, the growth and the mature stages. In the Y-axis, to clearly visualize the effects, only the incremental logarithms of advertising and sales force expenditures are shown. Figures 2a and 2b capture the two-way PLC x Market dominance interaction effect on advertising and sales force expenditures, respectively. In the case of advertising, the incremental effect is negative for dominant brands, but marginally positive for weak brands. In contrast, for sales force, the incremental effect is more positive (steeper slope) than it is for weak brands. These figures, thus, illustrate the negative (positive) PLC x Market dominance effect on advertising (sales force). Figures 3a and 3b show the PLC x Dominant competitor spending x Market dominance interaction effect on advertising spending. For dominant brands, the incremental effect over the life cycle is negative and more negative when dominant competitor spending is high. For weak brands, however, it is positive and more positive when dominant

competitor spending is high. These figures reinforce the finding of negative three-way interaction of PLC x Market dominance x Dominant competitor spending on advertising expenditures. Figures 4a and 4b show the PLC x Dominant competitor spending x Market dominance interaction effect on sales force spending. Note that the increase between the growth and mature stages is primarily due to other factors, so to examine the role of dominant competitor spending, we focus on the slopes in the two conditions. Like in the case of advertising, the slope for high level of dominant competitor spending relative to low level is more positive and steeper for weak brands than it is for dominant brands. Thus, over time, as their dominant rivals increase their spending, dominant brands reduce their sales force spending more than do weak brands. The other interaction effects can also be shown in a similar manner, but are not presented to save space.

[Figures 2a, 2b, 3a, 3b, 4a, and 4b about here]

5.3. The Importance of the PLC Interaction Factors in Advertising and Sales force Expenditures

An analysis of the relative sizes of the interaction effects of the PLC reveals interesting insights. Tables 3 and 4 show the standardized coefficients for the advertising and sales force spending models, respectively. In the advertising spending model, PLC x Market dominance, PLC x Market dominance x Dominant competitor spending, PLC x Dominant competitor spending, are the most important PLC- interaction factors among the significant variables. The first two factors also emerge among the most influential set of factors in the sales force spending model as well. Other most influential factors in the sales force spending model include: PLC x Market dominance x Product quality, PLC x Market dominance x Market concentration, and PLC x Multimarket contact. Taken together, the PLC's interaction effects with market dominance, relative product quality, dominant competitor spending, market concentration, and multimarket contact are the most influential effects of the PLC on advertising and sales force expenditures.

5.4. Effects of Control Variables and Variables in the Sales Response Model

The results on the control variables are consistent with our expectations. The results from the sales response model are not shown to save space. They show that product quality and sales force elasticities significantly increase with market dominance. The average product quality ratings were also substantially higher for dominant brands than for weak brands. The dominant brands are either early entrants or those with innovative products. These reasons for brand dominance, however, are not the focus of the paper, so we do not present the results of the sales response model. Our interest is in explaining changes in marketing spending by brand dominance over the life cycle.

The results from the sales response model show that sales force is the most powerful variable in the markets---sales force elasticity is about twice as large as advertising elasticity for both dominant and weak brands. Furthermore, the sales force elasticities increase slightly over the life cycle. Sales force elasticity of dominant brands during the introduction and growth stage is significantly higher than that of non-dominant brands (0.43 vs. 0.34, $p < 0.05$). During mature stage, the difference in elasticity between the two types of brands becomes even greater (0.49 vs. 0.36, $p < 0.01$). Dominant brands widen their market share lead over weak brands in going from the growth to the mature stage. Dominant brands appear to preempt weak brands with heavy spending in the high-elasticity marketing variable in the growth stage and spend more on this variable over the life cycle to perpetuate or further their dominance.

5.5. Robustness Checks

We performed a number of analyses to check for the robustness of our results. First, we tested alternative model functional forms such as linear and semi-log, but the effects of the significant variables in these functional forms had the same signs as those in our proposed double log model. Second, although we hypothesize that the PLC and brand dominance have interaction effects with a limited set of variables, we also estimated a model in which we allowed all the variables to be moderated by the PLC and brand dominance so as to get the most unrestricted model. The significant variables and the directions of the effects in the models remained the same. Third, we do not use a quadratic form in time as a proxy for life cycle changes because it does not recognize that categories have different lengths of life cycle. Even so, we estimated a model with a quadratic form in time. The results showed that the significant variables and the direction of the effects were not different from those in our proposed models.

Fourth, strictly speaking, the inflection point provides the transition from the early to the late growth stage. Because many categories do not exhibit prolonged sales flatness in our data, we use this point as a proxy for transition to the mature stage, consistent with Shankar et al. (1999). We also explored other functional forms for category sales such as log-reciprocal and ADBUDG. The inflection points were not very different. We also tested for change from the introduction to the growth stage, that is, the take-off point, through the logistic curve rule and the maximum growth rule (Golder and Tellis 1997). In each alternate model, the inflection points in each category remained within four months of the inflection points that we obtained in the logistic model. The results did not suggest that the spending behaviors across the introduction and early growth stages are substantially different.

Fifth, because spending varies directly or with elasticity or sales (Gatignon, Anderson, and Helsen 1989), we also estimated Equations (3)' and (4)' with estimates of elasticities instead of sales. The significant variables and their direction of effects were the same as those in our proposed models. Sixth, one could argue that the stages in the PLC may be endogenous in our context in that they may be influenced by the marketing mix expenditures of the brands. We argue that it is exogenous in our system because (1) it is very unlikely that a single brand's marketing decisions determine the transitions in the PLC and (2) a test for endogeneity of the PLC using the Hausman (1978) test suggested that this is not a problem in our data. The null hypothesis of exogeneity of PLC was not rejected ($p < 0.05$).

Seventh, to better understand the inter-dependence of advertising and sales force expenditures, we compared our results to those from the estimations of restricted versions of Equations (3)' and (4)' without these variables. The models showed significantly lower fits and the differences between restricted and unrestricted models were statistically significant ($p < 0.001$), suggesting the importance of impact of advertising spending on sales force spending and vice-versa. To save space, we do not present the results.

Eighth, we estimated the models with other measures of market concentration such as the number of competitors, four-firm ratio, market share variance, and some combinations of these measures. In particular, we tried a model with two measures, concentration ratio and market share variance as suggested by Gielens and Dekimpe (2001). These two measures, however, were highly correlated (0.76). The significant variables and the directions of the effects of the significant variables were the same across all the models, including the model with both concentration ratio and market share, so we use the traditional and parsimonious measure of Herfindahl index.

Ninth, to ensure that the presence of mature-stage entrants do not skew the results, we also performed the same analysis without these brands. The results of the tests of the hypotheses did not change. Tenth, we tested for pooling of the categories for all the models. The results reinforced the use of fixed intercept effects for categories, but materially insignificant differential effects of the slopes in these models ($p > 0.05$). Eleventh, to explore if market concentration has a non-monotonic relationship with advertising or sales force expenditures, we also estimated a model with a square term for market concentration. The square term turned out to be insignificant in all the models ($p > .05$), so we dropped the quadratic term in our final model.

Finally, we estimated the models using an alternative operationalization of multimarket contact, namely, number of markets of contact. Again, the significant variables and the directions of the effects of these variables were no different from those from a model with dummy variable operationalization of multimarket contact. Therefore, we retain the simpler dummy variable measure of multimarket contact. Overall, our results are stable and robust to alternative measures, models, and explanations.

6. Managers' Comments

To examine the validity of our results, we interviewed a total of 17 brand managers from six pharmaceutical organizations and analyzed their responses. Such an approach is consistent with previous approaches undertaken to validate empirical results (e.g., Carpenter and Nakamoto 1990). These managers had a combined experience of managing 41 brands. Eleven managers had the experience of managing both dominant and weak brands. We provide a summary of these managers' responses in Table 5 and discuss their implications.

[Table 5 about here]

In general, managers believed that their decisions on advertising and sales force over the life cycle were mainly driven by the variables we proposed in our framework, that is, relative product quality, market concentration, multimarket contact, other brands' spending, and so on. All the asterisked percentages in Table 5 are significantly different from 50% ($p < 0.01$). The managers generally agreed with the implications of our results—they do not inherently change their expenditures over the life cycle (that is, no main effect of the PLC), but the changes are due to differential effects of the other drivers over the life cycle; dominant brands tend to raise their spending on sales force over the life cycle and weak brands tend to concentrate on advertising efforts in going from the early to the late stages in the PLC. Managers of both dominant and weak brands stated that they did not typically respond to the actions of weak brands. A majority of weak brand managers stated that they react strongly in advertising to a dominant brand's increased expenditures. Two weak brand managers, however, also stated that they had lowered their sales force expenditures in response to aggressive sales force spending by dominant competitors over the life cycle. They did that because they believed that they did not need to increase their expenditures as the dominant brands' aggressive spending actually helped their brands which were perceived as close substitutes to the dominant brands.

Our results did not show a significant difference between dominant and weak brands in their responses to new market entry over the life cycle. Based on brand managers' responses, however, there appears to be a significant difference. Upon probing the managers further, we learned that dominant brands' stronger sales force response in the mature stage relative to weak brands typically occurs before a new market entry (when product managers have prior knowledge of the entry and when they can change their spending commitments quickly). The timing of this anticipated reaction varied across dominant brand managers—some significantly increased sales force spending as early as about nine months before market entry, whereas others raised their expenditures as late as just about a month before entry. In our empirical analysis, we had considered the response only after the month of entry. This reasoning likely explains the insignificant three-way interaction among the PLC, market dominance and new entry.

In addition, we also learned that in a few exceptional cases, managers of weak brands, over time, considered responding strongly in sales force. These exceptional cases are typically characterized by the following conditions. The firm supporting the weak brand has a world-class sales force, has a partnership with another firm for a larger detailing alliance, or expects the brand to get Federal Drug Authority (FDA) approval for a new range of indications that might provide an edge in product quality. Some weak (dominant) brand managers viewed the results on dominant (weak) brands as new insights to them. In summary, the interviews with executives validated our empirical results, explained contrary empirical results, and shed new lights on the spending behavior of managers in exceptional circumstances.

7. Discussion

Our analysis of 40 brands in eight different markets reveals important moderating roles for the PLC in advertising and sales force expenditures. Table 6 presents a comparison of the hypothesized parameter signs and the results, together with a brief interpretation and rationale for the results. Most effects are consistent with our hypotheses.

[Table 6 about here]

Although Figure 2 shows a pattern, in which category sales force spending relative to advertising expenditures increases over the life cycle of a product category, the empirical analysis reveals deeper insights. This difference at the product category level is driven mainly by dominant brands, which spend significantly more on sales force in the mature stage than in the growth stage of the PLC. Because dominant

brands significantly outspend weak brands, the product category curves reflect mostly the spending patterns of dominant brands.

Relative to weak brands, dominant brands appear to decrease spending when their dominant rivals step up their spending over the life cycle. The main purpose may be to prevent the escalation of a spending war that may dilute the profitability of all the brands. The idea behind such a move is that if there is no retaliation, their dominant rivals would stop excessive spending. This guideline is somewhat opposite to conventional thinking that a dominant brand should counteract any action by its rivals with equal or a greater force. Because competitors may not be able to sustain high spending levels in the mature stage without sacrificing profitability, a dominant brand does not jump on the spending bandwagon.

7.1. Results Relative to Previous Research Findings

Some of our results are consistent with prior research. First, the results on the role of multimarket contact and competitor spending are consistent with Chen (1996) and Chen and Miller (1994). Second, the result on the moderating effect of the PLC on the relationship between relative product quality and advertising expenditures is consistent with Tellis and Fornell (1988). Third, the reduction in marketing spending by dominant brands in response to increase in marketing expenditures by their dominant rivals is consistent with Dekimpe and Hanssens (1999). Finally, the result on escalation of spending by dominant brands is consistent with Bronnenberg et al. (2000).

More importantly, our findings significantly extend prior research. Prior research found mixed effects of the PLC on advertising expenditures. Lilien and Weinstein (1981) showed that the advertising expenditures decreased over the life cycle, while Winer (1979) found that they increased over the PLC. Farris and Buzzell (1979) found no main effects of the PLC on advertising. Lilien (1979) and Lilien and Weinstein (1981) studied industrial markets, while Farris and Buzzell (1979) and Winer (1979) examined consumer packaged goods. Our results from the pharmaceutical industry show that the PLC has important two-way and three-way *interaction or moderating* effects on both advertising and sales force expenditures through product quality, market concentration, multimarket contact, and dominant competitor spending. When we include these moderating effects, we do not find a main effect of the PLC on advertising or sales force expenditures.

Unlike previous research, our results offer new insights into the roles of product life cycle and market dominance on advertising and sales force expenditures. Dominant brands significantly shift their

allocation toward sales force between growth and mature stages of the PLC. Weak brands, on the other hand, shift their allocation toward advertising from the growth to mature stages. The impact of marketing spending of dominant and weak brands on each other is asymmetric. Dominant brands have a significant effect on weak brand spending, but weak brands have no effect on dominant brand spending. Furthermore, the effect of dominant brands on weak brand spending is different in the early and the late stages of the PLC.

8. Managerial Implications, Limitations, and Extensions

The results have important implications for managers. First, they suggest that it may be advantageous for a brand to spend aggressively on the high-elasticity marketing variable early in the life cycle to build market share and escalate it over the life cycle to maintain market dominance. Thus, a market share acquisition launch strategy through aggressive spending on the strongest marketing weapon may pay off in the long run.

Second, managers can better understand the PLC-based drivers of marketing mix expenditures, which can help them benchmark their expenditures on advertising and sales force over the life cycle. For example, managers of both dominant and weak brands can plan their spending decisions knowing that the interaction of the PLC with each of market dominance, relative product quality, dominant competitor spending, market concentration, and multimarket contact are the key moderating effects of the PLC.

Third, the results provide a clear profile of the shifting marketing mix expenditures of dominant (weak) brands over the PLC, which should help weak (dominant) brands better plan their marketing resources over the life cycle. Although the results are descriptive, they offer useful benchmarking insights. These implications were reinforced in our interviews with practicing managers.

The spending behavior of weak brands has important implications for those dominant brands that may want to marginalize weak brands. Dominant brands that wish to reduce weak brands' marketing efforts in the most effective marketing instrument efforts over time, should step up their spending in this instrument in the mature stage because weak brands respond primarily in the low-elasticity marketing variable. If they raise their marketing expenditures, weak brands may scale down their expenditures on the marketing weapon that works best for dominant brands, signaling that they are mild threats to dominant brands.

Weak brands can expect dominant brands to focus their efforts on the most effective marketing mix variable over the life cycle, increasing their expenditures on this instrument with rising relative product quality, decreasing concentration, but tempering the spending with greater multimarket contact and

dominant competitor spending, over the life cycle. They should generally expect to see decline in spending by dominant brands when other dominant rivals increase their spending. Marketing spending by weak brands, however, has an insignificant impact on the marketing mix expenditures of dominant brands. Therefore, weak brands may not be in a position to influence the marketing spending behavior of dominant rivals through their marketing actions. Those weak brands that wish to discourage spending by dominant brands in the mature stage, however, should enter additional common markets if possible. Sharing multiple markets would decrease the likelihood of aggressive marketing spending by dominant brands. Otherwise, they have to prepare for increased spending in the high-elasticity weapons by their dominant rivals in the mature stage.

Our research has limitations that offer interesting opportunities for future research. First, our results are from a specific industry, namely, the pharmaceutical industry. To examine the generalizability of the results, our study can be replicated in other industries with additional relevant data although such data is difficult to obtain. Second, analyses of expenditures on product and pricing could be added where relevant. Third, analyses of how dominant brands achieve and maintain their dominance would be a useful supplement to this research. Finally, we have not analyzed the allocation of a firm's marketing resources over its entire product portfolio as it is outside the scope of our paper. Such an analysis is important for further understanding of firm-level marketing decisions (Mantrala, Sinha, and Zoltners 1992) and would be a useful complement to our analysis.

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Table 1
Summary of Advertising, Sales Force, and Other Key Variables in the Data⁺

<i>Variable</i>	<i>Mean</i>	<i>Std Dev</i>	<i>AD</i>	<i>SF</i>	<i>S</i>	<i>PQ</i>	<i>CONR</i>	<i>MMC</i>	<i>NE</i>	<i>DCOMPEX</i>	<i>FCOMPEX</i>
Advertising spending (AD) (\$ '000) ⁺⁺	418.15	397.48	1.00								
Sales force spending (SF) (\$ '000) ⁺⁺	1,011.56	767.60	0.24	1.00							
Sales level (S) ('000 prescriptions)	691.41	548.10	0.16	0.23	1.00						
Relative product quality (PQ)	0.25	0.07	0.11	0.12	0.29	1.00					
Market concentration (CONR) (0—1)	0.48	0.25	-0.17	-0.18	-0.00	0.00	1.00				
Multimarket contact (MMC) (0—1)	0.43	0.50	0.03	0.42	-0.03	-0.26	-0.22	1.00			
New market entry (NE) (0—1)	0.12	0.32	0.04	0.17	0.08	0.04	-0.02	0.23	1.00		
Dominant competitor spending (DCOMPEX)(\$ '000) ⁺⁺	2,625.71	1,972.68	0.19	0.43	-0.16	-0.22	-0.55	0.36	0.16	1.00	
Weak competitor spending (FCOMPEX) (\$ '000) ⁺⁺	1,512.20	1,483.86	0.03	0.18	0.01	0.12	-0.39	0.24	0.38	0.10	1.00

All means are average monthly figures.

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++ The expenditures are adjusted for inflation using the Consumer Price Index (CPI).

Number of observations = 2,995.

Table 2
Operationalization of Variables Used in Empirical Analysis

<i>Variable</i>	<i>Operationalization</i>
Advertising spending (AD)	Advertising expenditure for the brand in \$
Sales force spending (SF)	Sales force expenditure for the brand in \$
Sales (S)	Total number of prescriptions for the brand
Relative product quality (PQ)	A composite measure of a brand's product quality on four key dimensions of quality relative to average quality of the category
Market concentration (CONR)	Herfindahl index or the sum of squares of market shares of all the brands in the market
Multimarket contact (MMC)	Dummy variable indicating if the brand competes with any of its competitors in other market(s)
New product entry (NE)	Dummy variable indicating if there was any new entrant in the last six months
Dominant competitor spending (DCOMPEX)	Total marketing expenditures of the group of dominant competitors for the brand in \$
Weak competitor spending (NCOMPEX)	Total marketing expenditures of the group of weak competitors for the brand in \$
Relative leadership in marketing mix variable (LDR)	Dummy variable indicating if the firm is perceived to be a leader in the marketing variable relative to its competitors
Product Life Cycle (PLC)***	Dummy variable indicating if the time period is in the growth or the mature stage of the life cycle
Market dominance (MD)	Market share

*** We determine the transition from the growth to the mature stages of a market by estimating a logistic regression model of category sales and by identifying the inflection point.

Table 3
Advertising Spending Model Results (GMM Estimation)

<i>Variable(Hypothesis)</i>	<i>Parameter (Standard Error)</i>	<i>Std. Coefft.</i>
Main effect of Market dominance	-6.33 (3.91)	1.24
MAIN EFFECT OF PLC	5.73 (5.50)	2.59
PLC x MARKET DOMINANCE (H_{1a})	-15.36 (6.72)*	2.63
TWO-WAY INTERACTION/MODERATING EFFECTS OF PLC		
PLC x Product quality	1.03 (5.70)	0.39
PLC x Market concentration	-11.60 (3.34)***	1.69
PLC x Multimarket contact	-2.62 (0.50)***	1.53
PLC x New product entry	-0.09 (0.72)	0.07
PLC x Dominant competitor spending	0.41 (0.17)**	2.08
PLC x Weak competitor spending	-0.20 (0.17)	0.26
THREE-WAY INTERACTION/MODERATING EFFECTS OF PLC & MARKET DOMINANCE		
PLC x Market dominance x Product quality (H _{2a})	-7.14 (12.18)	0.72
PLC x Market dominance x Market concentration (H _{3a})	19.17 (7.04)**	1.48
PLC x Market dominance x Multimarket contact (H _{4a})	2.41 (1.10)**	0.60
PLC x Market dominance x Dominant competitor spending (H _{5a})	-1.10 (0.46)*	2.24
PLC x Market dominance x Weak competitor spending	0.38 (0.24)	0.10
TWO-WAY INTERACTION/MODERATING EFFECTS OF MARKET DOMINANCE		
Market dominance x Product quality	-7.62 (11.21)	0.78
Market dominance x Market concentration	13.91 (7.90)	1.96
Market dominance x Multimarket contact	-3.50 (2.86)	0.87
Market dominance x New product entry	-1.10 (1.12)	0.06
Market dominance x Dominant competitor spending	0.45 (1.21)	0.96
Market dominance x Weak competitor spending	0.04 (0.17)	0.24
CONTROL VARIABLES		
Firm-specific Main Effects		
Relative product quality	1.85 (5.69)	0.08
Industry- or Competition-specific Main Effects		
Market concentration	-6.11 (2.91)*	1.26
Multimarket contact	2.14 (0.48)***	1.50
New product entry	0.62 (0.67)	0.06
Dominant competitor spending	-0.20 (0.15)	0.91
Weak competitor spending	0.03 (0.06)	0.15
Fit Statistics		
System-weighted R ²	0.76	
System-weighted MSE	1.59	

* Significant at 0.05 level. ** Significant at 0.01 level. *** Significant at 0.001 level.

Sample size = 2,995.

Notes: The effect of PLC refers to the effect of “Mature stage relative to Growth stage.” The results of the intercept, category dummies and control variables are not reported in the interest of space.

Table 4
Sales Force Spending Model Results (GMM Estimation)

<i>Variable(Hypothesis)</i>	<i>Parameter (Standard Error)</i>	<i>Std. Coefft.</i>
Main effect of Market dominance	3.84 (1.54)**	3.95
MAIN EFFECT OF PLC	3.57 (3.21)	4.65
PLC x MARKET DOMINANCE (H_{1b})	7.56 (2.79)**	3.45
TWO-WAY INTERACTION/MODERATING EFFECTS OF PLC		
PLC x Product quality	2.07 (1.98)	9.71
PLC x Market concentration	-3.67 (1.11)**	2.48
PLC x Multimarket contact	-0.41 (0.20)**	3.14
PLC x New product entry	0.17 (0.28)	0.66
PLC x Dominant competitor spending	-0.24 (0.11)	1.68
PLC x Weak competitor spending	0.10 (0.08)	1.48
THREE-WAY INTERACTION/MODERATING EFFECTS OF PLC & MARKET DOMINANCE		
PLC x Market dominance x Product quality (H _{2b})	17.09 (5.03)***	6.82
PLC x Market dominance x Market concentration (H _{3b})	5.19 (2.49)*	3.32
PLC x Market dominance x Multimarket contact (H _{4b})	0.08 (0.42)	1.90
PLC x Market dominance x Dominant competitor spending (H _{5b})	-0.28 (0.11)*	3.82
PLC x Market dominance x Weak competitor spending	-0.29 (0.29)	1.11
TWO-WAY INTERACTION/MODERATING EFFECTS OF MARKET DOMINANCE		
Market dominance x Product quality	1.04 (4.22)	6.84
Market dominance x Market concentration	-6.08 (4.56)	2.74
Market dominance x Multimarket contact	0.48 (0.33)	1.73
Market dominance x New product entry	0.82 (0.42)*	0.21
Market dominance x Dominant competitor spending	-0.28 (0.21)	0.63
Market dominance x Weak competitor spending	0.07 (0.07)	0.64
CONTROL VARIABLES		
Firm-specific Main Effects		
Relative product quality	1.29 (1.88)	3.67
Industry- or Competition-specific Main Effects		
Market concentration	3.53 (0.80)***	9.27
Multimarket contact	-0.44 (0.20)**	5.12
New product entry	-0.45 (0.26)	0.07
Dominant competitor spending	0.03 (0.01)*	1.20
Weak competitor spending	0.00 (0.02)	0.91
Fit Statistics		
System-weighted R ²	0.76	
System-weighted MSE	1.59	

* Significant at 0.05 level. ** Significant at 0.01 level. *** Significant at 0.001 level.
Sample size = 2,995.

Notes: The effect of PLC refers to the effect of “Mature stage relative to Growth stage.”
The results of the intercept, category dummies and control variables are not reported in the interest of space.

Table 5
Summary of Managers' Comments

<i>Questions</i>	<i>No. of dominant brand managers (%)</i>		<i>No. of weak brand managers (%)</i>	
	<i>Yes</i>	<i>No</i>	<i>Yes</i>	<i>No</i>
Did/Do you significantly change your advertising or sales force spending over the life cycle because of changes in market growth?	3 (19%)*	13 (81%)*	3 (12%)	22 (88%)*
Did/Do you significantly change your advertising or sales force spending if your product quality relative to your competitors' changes over the PLC?	14 (88%)*	2 (12%)	24 (96%)*	1 (4%)
Did/Do you significantly change increase your advertising or sales force spending as the number of competitors (concentration) increase (decreases) over the PLC?	14 (88%)*	2 (12%)	17 (68%)**	8 (32%)
Did/Do you significantly reduce your advertising or sales force spending as you share more markets with your competitors over the PLC?	14 (88%)*	2 (12%)	18 (72%)**	7 (28%)
Did/Do you significantly change your <i>advertising</i> spending when your dominant competitors change their marketing spending over the PLC?	13 (81%)*	3 (19%)	20 (80%)*	5 (20%)
Did/Do you significantly change your <i>sales force</i> spending when your dominant competitors change their marketing spending over the PLC?	12 (75%)**	4 (25%)	11 (44%)	14 (56%)

* Significantly greater than 50% at 0.001 level. ** Significantly greater than 50% at 0.01 level.

Note: The total number of responses (brands) for each question is 41.

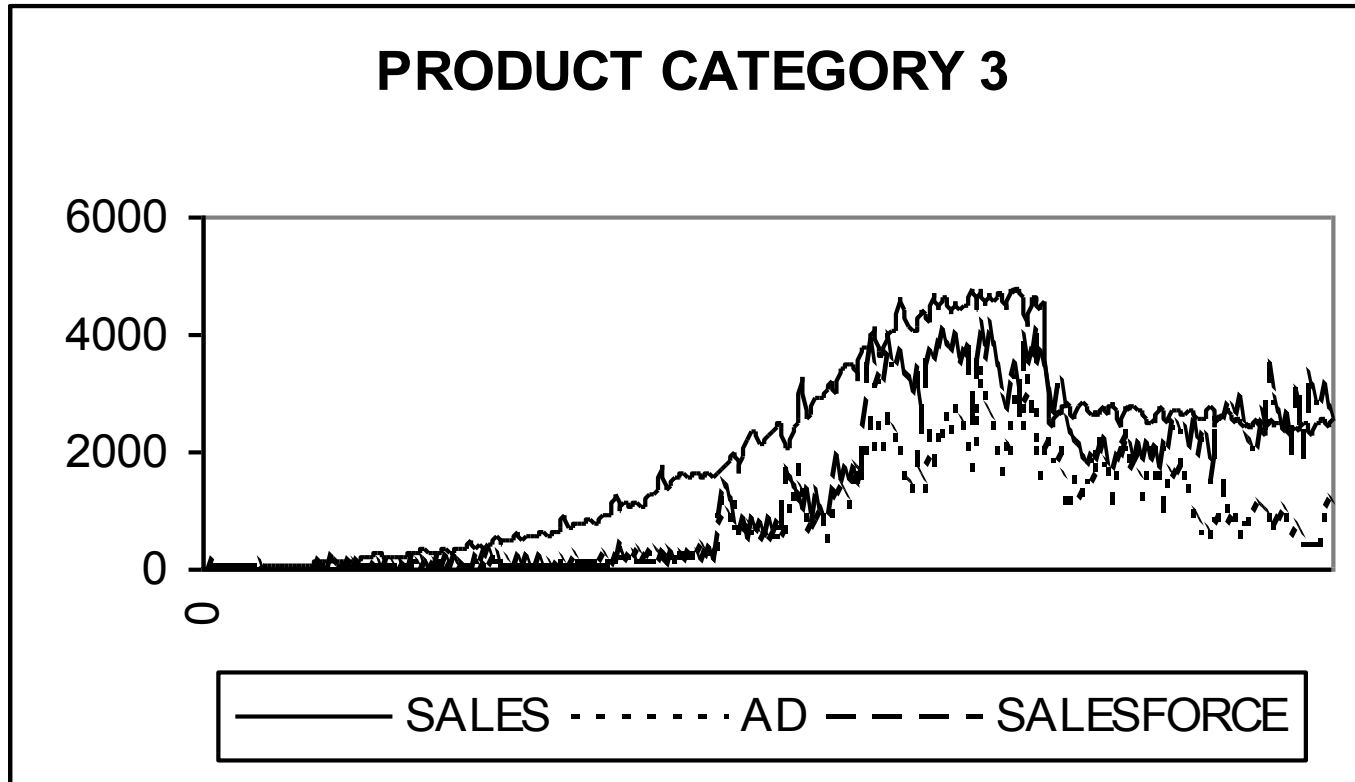
Table 6
Summary of Hypotheses and Results

<i>Hypothesis: Variable</i>	<i>Advertising</i>		<i>Sales Force</i>		<i>Interpretation or/and Brief Rationale</i>
	<i>Expected</i>	<i>Actual</i>	<i>Expected</i>	<i>Actual</i>	
H₁ : PLC x Market dominance	-	-	+	+	Relative to weak brands, dominant brands spend more (less) on the high (low)-elasticity instrument over the life cycle.
H₂ : PLC x Market dominance x Product quality	-	NS	+	+	The incremental gains to advertising with higher quality over the PLC are not significantly different across dominant and weak brands. In the mature stage, customers are already aware of most brands, but need to be persuaded to buy one brand over the other. In this stage, dominant brands can better persuade customers with greater sales force efforts for higher quality products than weak brands can.
H₃ : PLC x Market dominance x Market concentration	+	+	+	+	Dominant brands may not have spend as much on advertising or sales force as weak brands in the mature stage as the market becomes less concentrated, attenuating the ad-concentration-PLC link.
H₄ : PLC x Market dominance x Multimarket contact	+	+	+	NS	Because advertising mainly builds awareness, dominant brands may not have to advertise as much as weak brands in the mature stage as they more share multiple markets with other brands, attenuating the ad-multimarket contact-PLC link.
H₅ : PLC x Market dominance x Dominant competitor spending	-	-	-	-	As dominant competitors spend more, a dominant brand decreases its marketing spending in the mature stage to avoid escalation of marketing expenditures, relative to weak brands.

NS- Not Significant at 0.05 level.

Note: The effect of PLC refers to the effect of “Mature stage relative to Growth stage.”

Figure 1
Sample Product Life Cycle Curve



Notes: Sales are in prescriptions, while advertising and sales force expenditures are in thousands of dollars. The sales variable has been rescaled so that it can be presented in the same figure together with the marketing variables.

Figure 2a
PLC x Market Dominance Interaction Effect on Advertising Spending

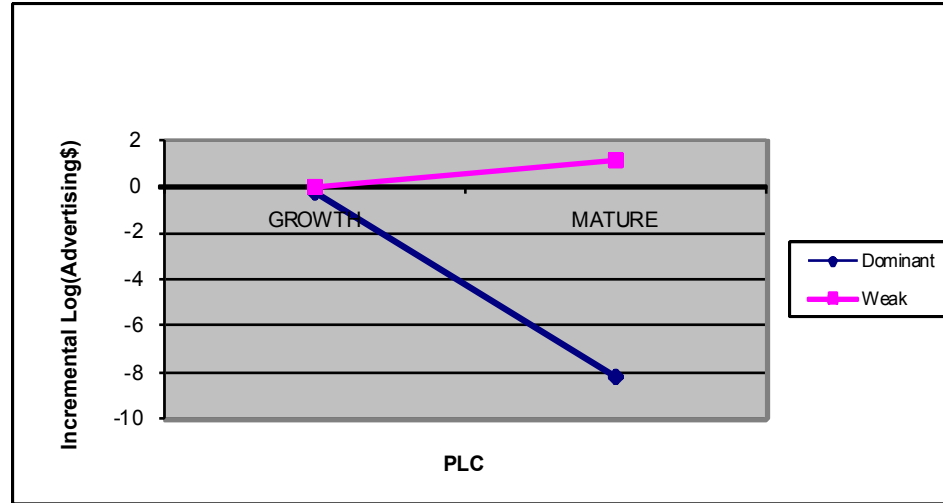


Figure 2b
PLC x Market Dominance Interaction Effect on Sales Force Spending

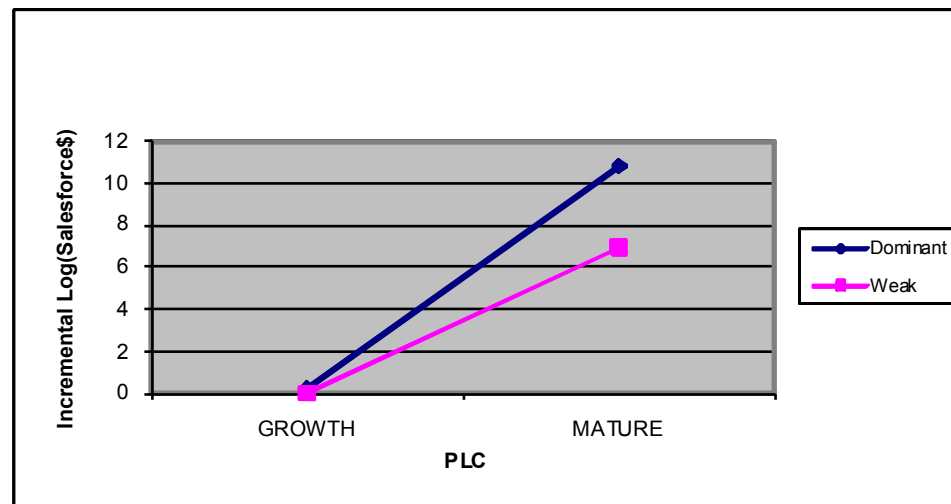


Figure 3a
PLC x Dominant Competitor Spending Effect on Advertising for Dominant Brands

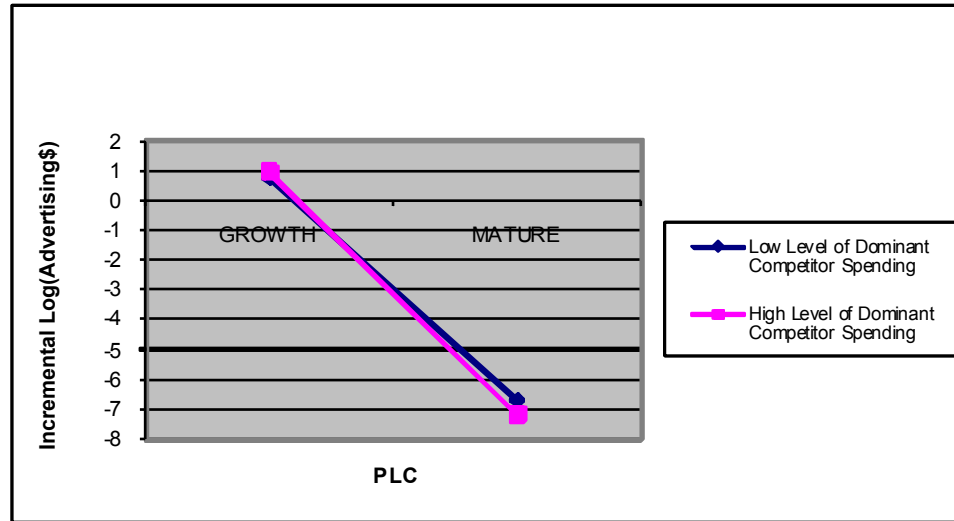


Figure 3b
PLC x Dominant Competitor Spending Effect on Advertising for Weak Brands

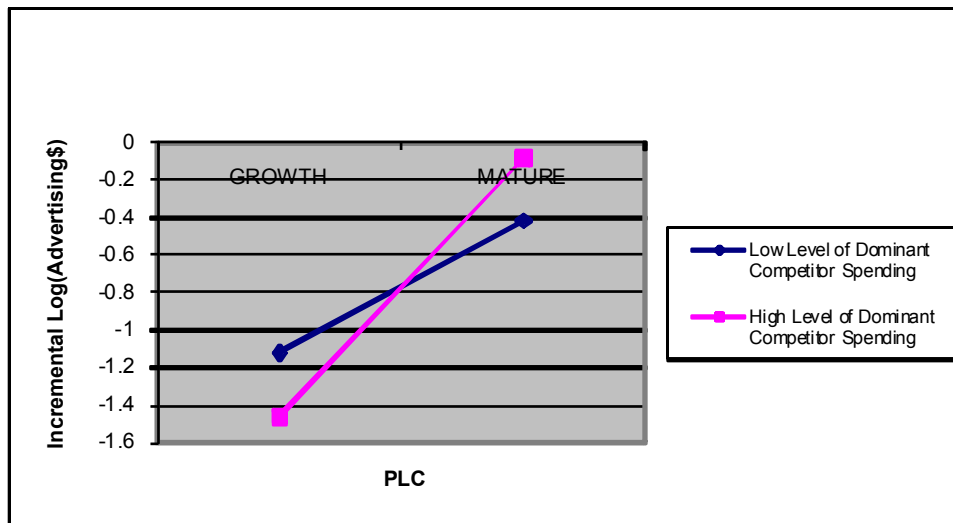


Figure 4a
PLC x Dominant Competitor Spending Effect on Sales Force for Dominant Brands

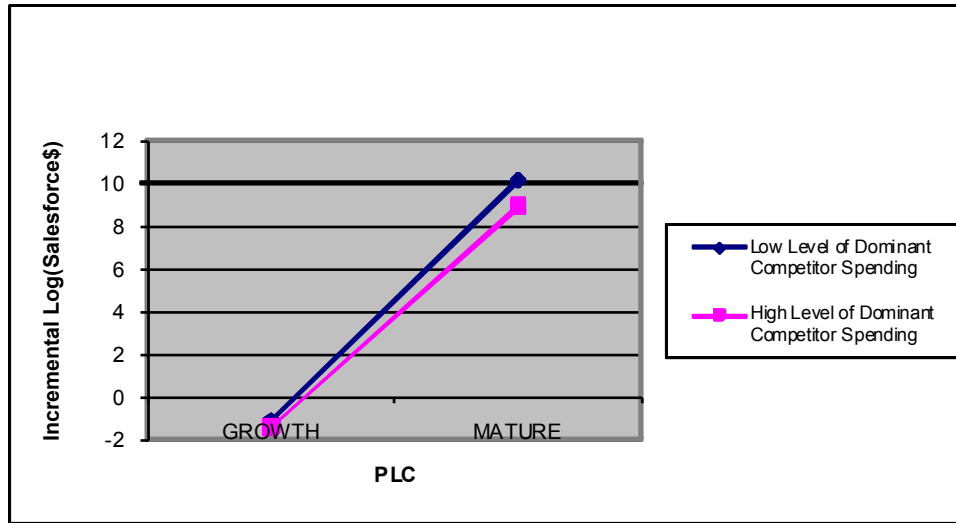


Figure 4b
PLC x Dominant Competitor Spending Effect on Sales Force for Weak Brands

