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Proactive and Reactive Product Line Strategies: Asymmetries Between Market Leaders and Followers

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To what extent do firms engage in product line actions simultaneously with actions in other marketing variables? What are the determinants of product line actions? To what extent are product line actions proactive? To what degree are they reactive? How can a firm's product line action elasticity (percent change in product line length with respect to percent change in competitor's past and anticipated actions) be decomposed into reaction and anticipation elasticities? Are product line actions and elasticities symmetric across market leaders and followers? To address these questions, we develop a conceptual framework comprising determinants of product line and other marketing actions in a single framework. We formulate hypotheses about the asymmetries between market leaders and followers regarding product line actions based on extended expectancy-valence and competitive demand elasticity theories. We develop a simultaneous equation model of demand and supply with product line and other marketing actions, which can be used to identify reaction and anticipation elasticities through the rational expectations approach. We estimate the model using data from the computer printer market comprising the market leader, Hewlett Packard (HP), and followers: Epson, Canon, and Lexmark. The results show that the market leader practices a product-proliferation strategy and rarely fights on price. In contrast, market followers adopt a price-fighting strategy. A firm is more likely to engage in product line actions when its competitors changed their product lines in the past, when the firm is large, and when its price is high. Product line reaction and anticipation elasticities are asymmetric between themselves and across the firms. For the market leader (followers), product line reaction elasticity is higher (lower) than product line anticipation elasticity. These differences are related to product line demand elasticities, which are higher for the market leader than they are for the followers.

Key words: product development; innovation; competitive strategy; econometric models; reaction and anticipation elasticities
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1. Introduction

> (Product) Innovation is still important in this business.
> Vyomesh Joshi, CEO, HP Printers

This quote sums up the importance of new products and product line toward competitive advantage of firms. Firms increasingly use product line length[1] (hereafter, product line) as a competitive weapon to grow their business. Development and introduction of new products and changes to product line provide firms with a competitive edge (Dyer and Song 1998, Krishnan et al. 2000, Souder et al. 1998). By strategically increasing (product proliferation) or decreasing (product pruning) the number of product models they offer, firms can effectively compete in the marketplace (Bayus and Putsis 1999, Putsis and Bayus 2001). An example of a firm practicing a product-proliferation strategy is Hewlett Packard (HP), which spent roughly $1 billion on printer research and development and introduced around 100 new product models during fall 2003 to maintain its market leadership (*BusinessWeek* 2003). An example of a company adopting a product pruning strategy is Procter & Gamble, which reduced a quarter of its product line to gain competitive leadership (Narisetti 1997).

A firm's action in product line is typically accompanied by actions in other marketing variables, such as price and distribution channel.[2] These actions can be primarily proactive (that is, driven by anticipation of future competitor actions) or reactive (reactions to past competitor actions) (Gatignon and

[1] For expositional ease, we use product line length and breadth interchangeably, consistent with prior research (e.g., Bayus and Putsis 1999, Putsis and Bayus 2001).

[2] For ease of exposition, we use the terms strategy, action, and decision interchangeably throughout this paper.

Reibstein 1997). In general, every action will likely have anticipatory and reactive components of which the anticipatory component is important to study (Venkataraman et al. 1997).

A firm's strategy or action in product line or other marketing variables can be complex, hybrid, and asymmetric. A simple action is a move in the same marketing variable in which a competitor action was initiated in the previous period, but a complex action is one in a different marketing variable. For example, if a firm reduces its price after its competitor cuts price, then it follows a simple action. If, however, a firm expands its product line after a decrease in price of its main rival, then it follows a complex action. In addition, actions can be hybrid in that they may involve more than one marketing variable. Furthermore, these actions may be asymmetric in that the domain or the variable(s) of action and the magnitude of action may be different for market leaders and followers. These complex and hybrid actions involving product line are becoming increasingly important in today's growing competitive environment.

Consider the following examples that illustrate complex or hybrid actions involving product line for market leaders versus followers. In the computer printer market, the market leader, HP, lost its market share from 60% to 48% to followers, Canon, Epson, and Lexmark over a six-month period in 1998 (*The Wall Street Journal* 1999). During this period, Canon and Epson reduced their prices relative to HP. HP, however, regained its market share within the next three months. It did not dramatically reduce its prices, but significantly increased its product line and expanded its distribution coverage. Intel, the market leader in computer chips, did not act aggressively in price when its leading competitor, Advanced Micro Devices cut prices in 1997. Instead, it introduced the MMX-technology-based high-end chip (*The Wall Street Journal* 1997). Microsoft, the market leader in suite software, did not lower its prices on its MS Office suite when IBM reduced the price of its Lotus Smartsuite and Sun Microsystem offered its StarOffice free of charge. It expanded its product line (*Business Marketing* 1999, *Computer Reseller News* 1996). The product line actions of market leaders like HP, Intel, and Microsoft were apparently based on past actions and possibly anticipated future actions of their competitors in product line and other marketing variables.

Important research questions in this regard are: To what extent do firms engage in product line actions that are complex and hybrid? What are the determinants of product line actions? To what extent are product line actions proactive? To what degree are they reactive? How can a firm's product line action elasticity (percent change in product line length with respect to percent change in competitor's past and anticipated actions) be decomposed into reaction and anticipation elasticities? Are product line actions and elasticities symmetric across market leaders and followers?

Managers need a better understanding of the answers to these related questions. First, identification of complex and hybrid product line actions is important from the perspective of resource allocation and marketing coordination. For example, if a large percentage of actions are complex and hybrid, a firm may want to allocate its product and marketing spending suitably across the appropriate variables and coordinate an expanded product line (say) with increased distribution channel coverage. Second, knowing when to use product line strategies can help managers avoid the trap of price competition. For example, if a firm's main competitor acts passively regarding product line but aggressively in another marketing variable, and if the firm's product line is longer relative to the competitor, the firm may want to use product line as a major weapon. Third, an understanding of the reaction and anticipation components of product line actions can help a firm decide which actions will evoke the least retaliation from competitors. On the one hand, if the firm's major rival acts mainly in response to the firm's actions, the firm can directly manipulate its product line and other marketing actions to obtain a desired outcome. On the other hand, if the rival's actions are based on anticipated actions from the firm, the firm may want to act differently regarding product line. Finally, a manager can better allocate his or her resources to product line if he or she can determine whether the reaction and anticipation elasticities of product line and other marketing variables are unique (asymmetric) or similar (symmetric) for market leaders and followers.

Two important studies on determinants of product line length by Bayus and Putsis (1999) and Putsis and Bayus (2001) show that price, market share, and market growth are positively related to product line length in the personal computer industry. In an empirical study of the consequences of product line competition, Draganska and Jain (2005) show that there are decreasing returns to product line length in the yogurt market. These studies, however, do not consider complex/hybrid actions to model simultaneously the actions of all major competitors in marketing variables other than product line or price (possibly due to a lack of data), do not focus on identifying the effects of reaction and anticipation components of competitor actions, and do not address asymmetries between market leaders and followers. We extend these studies by focusing on these issues in this paper.

With regard to competitive reactions in product line and other marketing variables, much previous

research has examined simple reactions (Gatignon et al. 1989; Leeflang and Wittink 2001; Shankar 1997, 1999). Although Ramaswamy et al. (1994) examined complex reactions in industrial markets, they focused more on retaliation and cooperation behaviors and less on reactions in product line. Furthermore, not much is known about whether a firm's action in product line is just a reaction to its competitors' actions or is based on the anticipation of competitors' future actions. A noteworthy contribution by Hanssens (1980) investigated reaction elasticities for advertising and frequency of flights in the airline market. Gatignon et al. (1989) considered anticipated reactions, but did not decompose action elasticities into reaction and anticipation elasticities. We extend these studies by exploring complex and hybrid actions, the reaction and anticipation components of actions with a focus on product line length, and the asymmetries between market leaders and followers.

Drawing on literatures in innovation, strategic management, marketing strategy, industrial organization, and organizational behavior, we develop a conceptual framework and formulate hypotheses about asymmetries between market leaders and followers regarding product line actions based on extended expectancy-valence and competitive demand elasticity theories. We formulate a simultaneous equation model of demand and supply, involving product line and other marketing variables. We include anticipated competitor actions through a rational expectation model. We estimate the model on data from the computer printer market. We validate the model using analyses of a holdout sample and alternative models. Our results show the extent of complex and hybrid product line actions in the market, identify the determinants of product line actions, reveal asymmetries in product line reaction and anticipation elasticities and in own- and cross-product-line demand elasticities between market leaders and followers, and guide managers on product line decisions.

2. Conceptual Framework

Firms' actions in product line and other marketing variables can be examined along five key dimensions; namely, domain, marketing weapon, competitive stance, magnitude, and speed (Gatignon and Reibstein 1997). While weapon (e.g., Gatignon et al. 1989, Shankar 1997), magnitude (e.g., Gatignon et al. 1997, Krishnan et al. 2000, Shankar 1999), and speed (e.g., Bowman and Gatignon 1995, Chen et al. 1992, Venkataraman et al. 1997) individually have been widely researched, there has been limited or no analysis of domain (simple, complex, and hybrid), weapon (particularly, product line), magnitude, and competitive stance (anticipatory, reactive) in the same framework. Notable exceptions regarding product line weapon and magnitude are Bayus and Putsis (1999), Draganska and Jain (2005), and Putsis and Bayus (2001). We study these dimensions in the same framework with a focus on product line, on reaction and anticipation components, and on asymmetries between market leader and followers.

2.1. Domain of Actions

With regard to domain, if a firm acts after its leading competitor acts in a marketing variable, it can act in product line or any other marketing variable, resulting in either a simple or a complex action.[3] If the other marketing variables of interest are price and distribution intensity or channel coverage, 16 competitive actions are possible, leading to two types of generic strategies, tit-for-tat and non-tit-for-tat strategies. If a firm acts in the same variable as its leading competitor's marketing variable of action (cells 1, 6, and 11), then the strategy is a simple "tit-for-tat" strategy (Smith et al. 1997). Non-tit-for-tat strategies can be broadly classified into four strategies as shown in Table 1.[4] First, if a firm acts by predominantly changing the number of product models after its leading competitor changes price or distribution intensity or practices some combinations of actions in more than one marketing variable (cells 2, 3, and 4), then the firm practices a "product-proliferation/product-pruning" strategy (Bayus and Putsis 1999, Putsis and Bayus 2001). Second, if the firm acts by primarily changing its price when its leading competitor increases product models or distribution intensity or practices some combinations of actions (cells 5, 7, and 8), then the firm's strategy can be termed a "price-fighting" strategy (Dekimpe and Hanssens 1999, Heil and Helsen 2001). Third, if the firm predominantly changes its channel coverage after its leading competitor changes its price or product line or practices some combinations of these actions (cells 9, 10, and 12), then the firm's strategy can be labeled a "channel encirclement" strategy. Finally, if a firm predominantly acts in more than one variable that is different from the competitor's variable of action (cells 13, 14, 15, and 16), then the resulting strategy can be termed a "hybrid complex" strategy.

Firms will likely engage in complex and hybrid actions for many theoretical reasons. According to

[3] For ease of exposition, we view the changes in product line and other marketing variables as increases. We recognize that the changes could be decreases (e.g., product pruning) as well. We examine the anticipation and reaction components of these actions in our subsequent analysis.

[4] Hybrid strategies could be further classified as product line price hybrid, product line distribution hybrid, price-distribution hybrid, and so on. However, analysis of such strategies is outside the scope of this paper and is left as a fruitful avenue for future research.

the resource dependence theory (Pfeffer and Salancik 1978), the criticality of a firm's resources drives a firm's marketing actions. A firm's critical resources are those that significantly affect the performance of the firm. For example, if new products are a critical resource for a firm, then the firm may practice a product-proliferation strategy (Putsis and Bayus 2001), although its competitors may have initiated an action in other marketing variables such as price or distribution. Complex and hybrid actions may also be rooted in the concept of avoidance of competition by the small firm with the large firm in the same marketing weapon (Shomberg et al. 1994). This notion is consistent with the idea that a firm acts in product line or other marketing variable that is its best relative competitive weapon (Carpenter 1987). Organizational inertia may also contribute to complex actions. As a firm gets more established, it tends not to change its action pattern because of inertia and resorts to simpler rules, such as actions in a marketing variable that had worked well for the firm before, regardless of the marketing variables in which competitors initiate actions (Gresov et al. 1993).

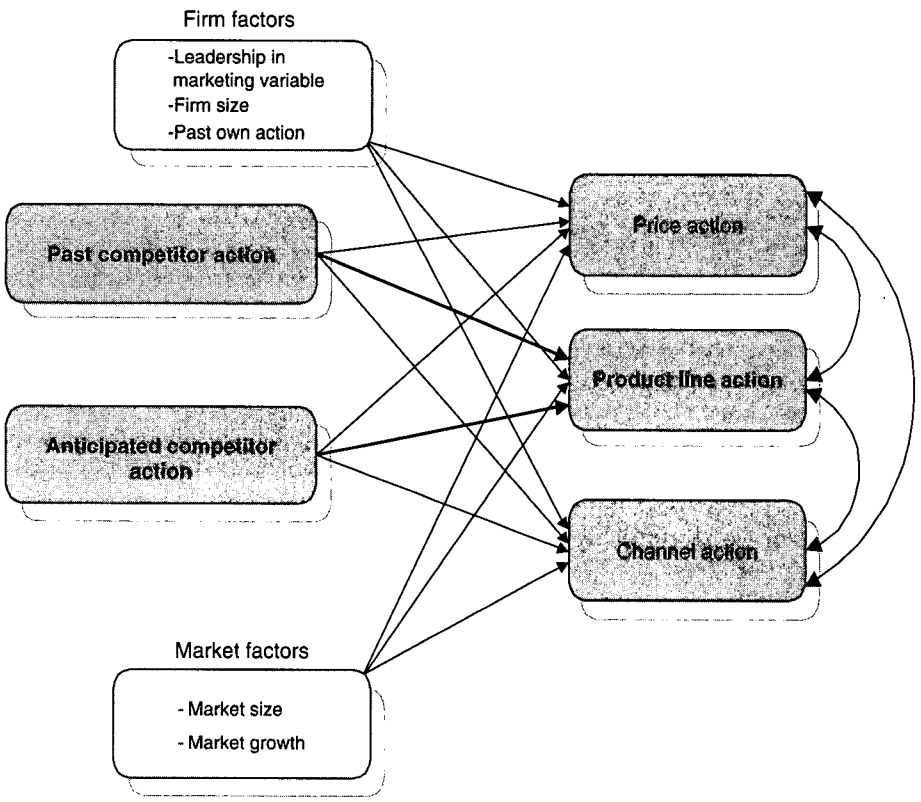
Table 1 Domains/Types of Actions in Product Line and Other Marketing Variables

Firm moving next/focal firm	Firm moving first: **Product line**	Price	Channel	Hybrid
Product line	**(1) Product tit for tat**	**(2) Product proliferation**	**(3) Product proliferation**	**(4) Product proliferation**
Price	**(5) Price fighting**	(6) Price tit for tat	(7) Price fighting	(8) Price fighting
Channel	**(9) Channel encirclement**	(10) Channel encirclement	(11) Channel tit for tat	(12) Channel encirclement
Hybrid	**(13) Hybrid complex**	(14) Hybrid complex	(15) Hybrid complex	(16) Hybrid complex

2.2. Determinants of Product Line and Other Marketing Actions

Although the moves in Table 1 appear to be reactions, what we observe are firms' actions and these actions may have both reaction and anticipation components. A firm's product line and other marketing actions are influenced by three broad sets of factors: competition, firm, and market factors as shown in our conceptual framework in Figure 1. Our major research questions pertain to the determinants of product line actions in the presence of actions in other marketing variables, the relative influence of past and anticipated competitor actions on the firm's actions, and the asymmetries between market leader and followers, so we treat

Figure 1 Conceptual Framework of Determinants of Product Line Actions



firm and market factors as control variables in our analysis.

2.2.1. Past and Anticipated Competition Actions. A firm's actions in product line and other marketing variables are driven by two major competitive components. First, the actions may be primarily reactive, that is, based on the past actions of its competitor(s) (Chen et al. 1992). Second, the actions are likely to be mainly proactive, based on the anticipated action(s) of its competitor(s) (Shankar 1999). Thus, a firm's action elasticity in product line or other marketing variables reflects both competitor reaction and anticipation elasticities in product line or other marketing variables. Prior research has focused mainly on reaction elasticities (e.g., Hanssens 1980, Leeflang and Wittink 2001). We examine both reaction and anticipation elasticities in the marketing variables with a focus on product line.

A firm may respond to its competitors' actions in the previous periods if it perceives them to significantly affect its own performance (Chen 1996, Chen and MacMillan 1992). It is likely to pay close attention to its competitors' actions in the recent past. Past actions serve as communication vehicles for firms to signal competitive intent to one another (Heil and Helsen 2001). The effect of past competitor actions on a firm's action in a marketing variable will be positive or negative, depending on whether the firm retaliates against or accommodates its competitors (Shankar 1997). The magnitude of response is likely to be high if the firm perceives the threat of competitor action to be high (Gatignon and Reibstein 1997). The reaction elasticities of such firms are expected to be significant.

In addition to past actions, a firm is also likely to consider the anticipated future actions of its competitors before it makes a move (Venkataraman et al. 1997). Anticipated responses are a key determinant of new product introduction strategies (Shankar 1999). Similar to the effect of the reaction component, the effect of the anticipation component on a firm's action in product line or other marketing variable can be positive or negative, depending on the firm's perception of the threat level of such an anticipated action.

We develop a theory of asymmetries between market leaders and followers with regard to product line and other marketing actions by extending the expectancy-valence theory. The expectancy-valence theory proposes that a firm is more likely to act aggressively in a marketing variable if a rival's past action is visible, less difficult to respond, and central to the performance of that firm (Chen and Miller 1994). We extend these conditions to anticipated competitor actions as well. Thus, with regard to anticipated future actions, a firm will likely act strongly in product line if it expects its competitors' future actions to be salient, if it can easily engage in actions to counter such future competitor actions, and if those anticipated actions can make a critical difference to the firm's performance.

Based on the extended expectancy-valence theory, we propose that the relative influence of past and anticipated competitor actions on a firm's action in product line may be different for market leaders and followers. Consider market leaders first. The market leader will likely engage in product line actions in response to past competitor actions, particularly those visible actions involving product line. A market leader typically derives its dominance from selling a wide range of product models. Given its strong product development resources and wide product range, the market leader may find it not difficult to introduce or withdraw product models in a given period. A market leader's response in product line to changes in competitor product line may be important to maintain its market share, so it is likely to engage in product line actions in response to the past actions of market followers.

While the market leader may place importance on past actions of market followers in product line, it may not seriously consider the future actions of market followers. It may be difficult for it to speculate what new products or technologies market followers may bring to the market, so future competitor actions may be less salient. Moreover, market leaders are typically large firms that may find it difficult to make significant changes to their established product line or other marketing actions in anticipation of possible future actions because of organizational inertia (Gresov et al. 1993). Furthermore, a market leader may not perceive the threat of market followers to be greater than that posed by new market entrants with new technologies, and hence may not expect the future actions of market followers to significantly alter its future performance.

Thus, a market leader is likely to place more emphasis on its competitors' past actions than anticipated future actions. We therefore expect its product line reaction elasticity to be higher than its anticipation elasticity.

Consider next, market followers. Market followers will likely place significantly greater emphasis on the anticipated actions than on the past actions of its competitors (especially product line actions) in making their product line decisions. Market followers may not be in a position to strongly react to changes in the market leader's product line. They may not have adequate resources to introduce new product models directly after their competitors expand their product lines. Furthermore, even if they could change their product line length quickly in response to the market leader's past product line actions, changes to the followers' product line may not be as effective

in the marketplace as those for the market leader, particularly if product line is a stronger weapon for the market leader. By placing less emphasis on past competitor actions, market followers may also avoid direct competition in product line with the leader (Shomberg et al. 1994).

If, however, they anticipate their competitors' future actions to have an important bearing on their own future, market followers could plan their product development activities and changes to their product line. Anticipation of future competitor actions is thus important for smaller firms' survival and growth (Venkataraman et al. 1997). Therefore the anticipation elasticities of market followers may be higher than their reaction elasticities. These arguments lead to our first two hypotheses.

HYPOTHESIS 1. *For market leaders, the effect of past competitor product line actions on own product line action is more than that of anticipated competitor product line actions.*

HYPOTHESIS 2. *For market followers, the effect of past competitor product line actions on own product line action is less than that of anticipated competitor product line actions.*

2.2.2. Product Line Demand Elasticities. Based on past and anticipated future competitor actions, firms may act in product line and other marketing variables with different magnitudes, leading to complex and hybrid actions. The magnitudes of product line or other marketing actions depend on the market capabilities of the firm (Smith et al. 1991). The market capabilities and marketing actions of the firm are explained by the theory of competitive demand elasticity. According to this theory, a firm acts passively with its competitively (that is, relative to competitors) low-elasticity (of demand) variable and acts aggressively with its competitively high-elasticity variable (Shankar 1997). For instance, in the context of reactions to new product entries, incumbent firms' responses are based on the competitive demand elasticities of its marketing variables. There are two components of competitive demand elasticity; namely, own elasticity of demand and cross-elasticity of demand. A firm is likely to act aggressively in a marketing variable with competitively high own elasticity of demand and competitively low cross-elasticity of demand.

The own and cross-demand elasticities of product line may be asymmetric between market leaders and followers. Typically, a market leader has a wide product line (Ratchford 1990), so it is likely to be competitively strongest with regard to product line. In contrast, market followers could be competitively strongest in prices, which can be changed more readily than product line to challenge the leader. A market leader may have a competitively high own product line demand elasticity. At the same time, its cross-product-line demand elasticity is likely to be competitively low. That is, market followers' product line action is not likely to make a sizeable impact on the leader's sales. Thus, a market leader's own product line demand elasticity is likely to be higher than its cross-product-line demand elasticity.

The relationship between own and cross-product-line demand elasticities for market followers may be opposite to that for market leaders. A market follower is likely to have shorter product line than the market leader (Lancaster 1990), and may not have as much leverage with its product line as the market leader. Therefore, a market follower's own product line demand elasticity is likely to be competitively low. However, its cross-product-line demand elasticity can be expected to be competitively high. That is, the effects of changes in competitors' product lines, including the market leader's, on the market followers' demand is likely to be high. Based on these arguments, we specify the third and fourth hypotheses as follows.

HYPOTHESIS 3. *For market leaders, own product line demand elasticity is greater than cross-product-line demand elasticity.*

HYPOTHESIS 4. *For market followers, own product line demand elasticity is smaller than cross-product-line demand elasticity.*

2.2.3. Firm Factors.

Own Actions in Other Marketing Variables. A firm's action in product line or any other marketing variable is likely to be related to its own actions in the remaining marketing variables. Bayus and Putsis (1999), Putsis and Bayus (2001), and Draganska and Jain (2005) show that product line length is positively associated with own price. If, however, firms abide by fixed marketing budgets, the actions in some of the variables may be inversely related.

Firm Size. The size of the firm, as reflected by its sales revenues, will likely impact its marketing actions (Gatignon et al. 1989). Relative to a small firm, a large firm, because of its superior resources, is likely to introduce more product models (Bayus and Putsis 1999) or engage more aggressive actions in other marketing variables (Gatignon et al. 1990).

Relative Leadership in the Marketing Variable. A firm's leadership relative to its competitors in a marketing variable may determine its action in that variable (Heil and Helsen 2001). Sony, Southwest Airlines, and IBM are widely perceived to be leaders in product variety, price, and distribution, respectively. A leader in product line or any other marketing variable is

likely to act aggressively in that variable (Roy et al. 1994). This leadership is different from market-share leadership.

Own Past Action. A firm's action in product line or any other marketing variable could be influenced by its action in that variable in the previous period because of inertia. The direction of this influence could be positive or negative, depending on whether the firm seeks to continue the momentum or balance the intensity of actions over multiple time periods.

2.2.4. Market Factors.

Market Size. Market size is likely to be positively related to product line and other marketing actions. A larger market may indicate the need for more product models and greater marketing efforts to achieve deeper market penetration (Gatignon et al. 1990, Ramaswamy et al. 1994).

Market Growth. A firm is likely to increase its product line and marketing activities in a fast-growing market than in a slow-growing market (Gatignon et al. 1990). Market growth and product line length are positively related (Bayus and Putsis 1999). Fast-growing markets offer high scope for market penetration, so product line and other marketing actions will likely be aggressive in growing markets.

The effects of these control variables, that is, firm and market factors, on product line actions may be different for market leaders and followers. However, in the absence of a compelling theory for differences, we explore any differences as empirical issues.

3. The Model

3.1. Main Model

Consistent with the conceptual framework, product line length or their marketing action of each firm is posited as a function of competition (past actions and anticipated actions of competitor(s) in each marketing variable), firm (other marketing variables, leadership in the marketing variable, firm size, and own past action), and market (market size and market growth) factors. It is given by

$$\begin{aligned}\mathrm{PMA}_{ijt} &= \overbrace{\alpha_{0ij} + \sum_{k=1}^{J} \alpha_{1ijk}\mathrm{PCA}_{ik(t-1)}}^{\text{Past competitor action}} \\ &+ \sum_{k=1}^{J} \overbrace{\alpha_{2ijk}\mathrm{ACA}_{ik(t+1)}}^{\text{Anticipated future competitor action}} + \overbrace{\sum_{k=1,\,k\neq j}^{J} \alpha_{3ijk}\mathrm{PMA}_{ikt}}^{\text{Own other marketing action}} \\ &+ \underbrace{\alpha_{4ij}\mathrm{LEAD}_{ijt} + \alpha_{5ij}\mathrm{FS}_{it} + \alpha_{6ij}\mathrm{PMA}_{ij(t-1)} + \alpha_{7ij}\mathrm{MS}_t + \alpha_{8ij}\mathrm{MG}_t}_{\text{Control variables}} + \varepsilon_{ijt}, \end{aligned} \tag{1}$$

where PMA_{ijt} is the action of firm i (L = Market leader, F = Market follower) in product line or other marketing variable j at time t, $\mathrm{PCA}_{ik(t-1)}$ is the total action of the major competitor(s) in product line or other marketing variable k in the period previous to t, J is the total number of marketing variables, $\mathrm{ACA}_{ik(t+1)}$ is the anticipated total action of the major competitor(s) in product line length or other marketing variable k in the period following t, LEAD_{ijt} is a dummy variable denoting if firm i is a leader in variable j at t relative to the other firms, FS_{it} is the size or sales of firm i at time t, MS_t is the size of the market at time t, MG_t is the market growth rate at time t, ε_{ijt} is an error term assumed to be normal, independent with mean 0, and $\alpha_{0ij} - \alpha_{7ij}$ are parameters. In our context, $\mathrm{PMA}_{ijt} \in \{\mathrm{PROD}_{it}, \mathrm{PRICE}_{it}, \mathrm{DIST}_{it}\}$, where PROD_{it}, PRICE_{it}, and DIST_{it} are the product line, price, and distribution actions, respectively, of firm i at time t.[5] The focus of this research is the PROD variable.

The model captures both past and anticipated competitor actions in product line and other marketing variables. In addition, it allows for differences in the effects of competitor actions across (1) past and future periods, (2) firms, and (3) product line or other marketing variables.[6] Anticipated competitor actions can also be captured in terms of lead effects in the model, that is, through the use of actual future actions of competitors (Gatignon et al. 1989). We, however, do not use their approach because it requires that firms should be able to accurately predict future competitor actions.

These marketing actions affect demand for the firm. A broad or long product line increases market demand (Lancaster 1990, Ratchford 1990) and market share (Kekre and Srinivasan 1990). Consistent with prior research (e.g., Shankar 1999), we model sales response or demand through the following equation:

$$\begin{aligned}\mathrm{FS}_{it} = e^{a_i - \beta_i/T_t}\mathrm{PROD}_{it}^{\eta_i}\mathrm{PRICE}_{it}^{-\theta_i}\mathrm{DIST}_{it}^{\lambda_i}\mathrm{CPROD}_{it}^{-\phi_i} \\ \cdot \mathrm{CPRICE}_{it}^{\varphi_i}\mathrm{CDIST}_{it}^{-\rho_i}e^{\omega_{it}}, \end{aligned} \tag{2}$$

where T is a variable representing time trend or diffusion effect, CPROD_{it}, CPRICE_{it}, and CDIST_{it} are the product line, price, and distribution actions, respectively, of competitors of firm i at time t, and the other

[5] Market concentration is another variable that is likely to influence marketing actions of a firm (e.g., Ramaswamy et al. 1994). We do not, however, include this variable because market concentration (as measured by four-firm concentration and the Herfindahl index) did not vary significantly in our context during the period of the data.

[6] We also explored alternative functional forms such as log-log and semi-log forms. Because the results were directionally the same, the model fits were inferior to the linear model, and the linear model is parsimonious, we retain the linear model.

variables are as defined earlier. ω_{it} is an error term assumed to be normal, independent, and identically distributed (i.i.d.) with mean 0 and variance σ_ω^2. a_i, β, η_i, θ_i, λ_i, ϕ_i, φ_i, and ρ_i are parameters. The terms with PROD, PRICE, and DIST reflect the effect of product line length, price, and distribution intensity, respectively.[7] The firm-specific parameters allow for asymmetric competition. Equations (1) and (2) form a system of simultaneous equations in supply (product line, other marketing variables) and demand (sales response).

3.2. Anticipated Competitor Action Model

To capture anticipated competitor actions, we must use a model in which we can replace them by observable variables because these actions are unobservable. Following Muth (1961), we begin by modeling anticipated competitor action using the theory of rational expectations. This approach has been used by researchers to model reference price formation and new product entry decisions (e.g., Shankar 1999, Winer 1986). Under this theory, economic agents (firms in our case) use all available information in forming expectations about future actions. These expectations should be unbiased estimates of the true values of the actions because they are informed predictions of future events (Muth 1961, p. 316). In our context, this reasoning implies the following equation:

$$\mathrm{CA}_{ij(t+1)} = \mathrm{ACA}_{ij(t+1)} + \zeta_{ijt}, \tag{3}$$

where $\mathrm{CA}_{ij(t+1)}$ is the actual competitor action in product line or other marketing variable j for firm i in the period following t and ζ_{ijt} is an error term assumed to be normal, i.i.d. with mean 0, and uncorrelated with the errors in Equations (1) and (2).[8]

Following Winer (1986), we formulate a parsimonious model of how anticipated competitor actions are formed based on past competitor actions as follows:[9]

$$\mathrm{ACA}_{ij(t+1)} = \gamma_{0j} + \gamma_{1j}\mathrm{CA}_{ijt} + \tau_{ijt}, \tag{4}$$

where CA_{ijt} is the actual action of the competitor(s) firm i in marketing variable j at time t (previous time period), and τ_{ijt} is an error term assumed to be normal, i.i.d. with mean 0 and uncorrelated with the other error terms. Substituting Equation (4) into Equation (3), we get Equation (5). This is essentially an approach based on extrapolative expectations.[10]

$$\mathrm{CA}_{ij(t+1)} = \gamma_{0j} + \gamma_{1j}\mathrm{CA}_{ijt} + \zeta_{ijt} + \tau_{ijt}. \tag{5}$$

We use the predicted values of the dependent variable in Equation (5) for anticipated competitor actions in Equation (1) to obtain the final product line or other marketing action model as follows:

$$\begin{aligned}\mathrm{PMA}_{ijt} = {} & \alpha_{0ij} + \sum_{k=1}^{J}\alpha_{1ijk}\mathrm{CA}_{ik(t-1)} + \sum_{k=1}^{J}\alpha_{2ijk}\widehat{\mathrm{CA}}_{ik(t+1)} \\ & + \sum_{k=1,\,k\neq j}^{J}\alpha_{3ijk}\mathrm{PMA}_{ikt} + \alpha_{4ij}\mathrm{LEAD}_{ijt} \\ & + \alpha_{5ij}\mathrm{FS}_{it} + \alpha_{6ij}\mathrm{PMA}_{ij(t-1)} + \alpha_{7ij}\mathrm{MS}_t \\ & + \alpha_{8ij}\mathrm{MG}_t + \nu_{ijt},\end{aligned} \tag{6}$$

where ν is a combined disturbance term that may be serially correlated and/or heteroscedastic. This approach of modeling anticipated actions is consistent with the logic that a rational firm would want to minimize the prediction errors in anticipating its competitors' actions.

4. Data and Model Estimation

4.1. Data

We address the research questions and test our hypotheses by estimating the model using data from the computer printer market obtained from the National Purchase Diary. The data set comprises monthly data on variables such as product line length, price, channel coverage, sales, market size, and market growth for the major firms, HP, Epson, Canon, and Lexmark, during the 1990s.

[7] We do not follow the New Empirical Industrial Organization (NEIO) approach (e.g., Kadiyali et al. 1999, Shankar 1997, Sudhir 2001) for the following reasons. First, our intent is in decomposing action elasticities into reaction and anticipation elasticities, whereas the NEIO approach's purpose is to identify the competitive game that best describes market conduct. Second, since we have multiple marketing variables (three), the potential number of leader-follower and simultaneous games for the NEIO approach is excessive (27). Third, closed-form expressions for equilibrium product line and other marketing actions cannot be obtained without making several simplifying assumptions, diminishing the usefulness of such an approach for our research task. Because current period actions subsume lagged actions (see Equation (1)), we do not include lagged marketing variables.

[8] The error terms in Equations (1) and (3) may be correlated because of any demand shock. We subsequently tested for this possibility in our empirical analysis and even estimated a final model with an instrumental variable approach. However, the correlations were low and the results were not significantly different, so we retain our original model.

[9] We do not include a term for trend in this model, because it was not significant in a subsequent estimation of this model with its inclusion and because of model parsimony.

[10] We recognize that some studies have used a simpler approach in which current realizations are used as expected values (e.g., Van Heerde et al. 2001). Our model extends this approach. We could also use a more general adaptive expectations approach, which involves a weighted combination of all past reactions (Nerlove 1958). This approach is more cumbersome and the properties of estimators are weak. Even so, we estimated this model, but the results did not provide any new insights, so we do not report them.

We measure product line length by the number of product models. We operationalize distribution intensity/channel coverage by weighted share of presence in channels, including office superstores, computer stores, direct mail, value-added resellers, and dealers. We determined leadership in marketing variable through the consensus views of marketing managers of the four major firms in the industry. Based on these views, we identified HP as a leader in product line for the earlier part of the data and a leader in distribution intensity for the later part of the data, Epson as the leader in distribution intensity for part of the data, Canon as a price leader for a major part of the data, and Lexmark as the product line leader for the later part of the data. The operationalization of the key variables appears in Table 2.

We do not include advertising and promotion in our analysis. Advertising and promotion during the period of data were brand and printer-model specific. Attributing market performance of printer brands to firm-level advertising would require making several simplifying assumptions. Furthermore, according to industry executives, firm-level advertising was not central to short- and medium-term competitor actions. Sales promotion is embedded in the net price variable, so we do not include it as a separate variable. Because sales force efforts are directly embedded in distribution intensity measure, we do not use a separate variable for sales force in our analysis.

A summary of the main variables in the data is shown in Table 3. With \$520 million in monthly sales, HP was the market leader by a wide margin. HP also had the longest product line with an average number of product models of 114, whereas Canon had the shortest product line with an average number of 33 product models. HP had the highest average distribution intensity (77%), whereas Canon had the lowest average distribution intensity (5%). Canon had the lowest average price (\$225), whereas Lexmark (\$1,080) had the highest average price over the period covered by the data.[11] Our research objective is to explore the extent of complex and hybrid actions, the drivers of actions in product line with emphasis on reaction and anticipation components, and potential asymmetries between market leaders and followers.

Table 2 Operationalization of Key Variables Used in Empirical Analysis

Variable	Operationalization
Product line length (PROD)	Number of product models for the firm
Price (PRICE)	Weighted average price of the firm
Distribution intensity (DIST)	Share of firm's coverage in the channels through which the products are sold
Action of competitor(s) (CA)	Action of the firm's main competitor(s) in the marketing variable of interest
Leadership in the marketing variable (LEAD)	Dummy variable indicating if the firm is a leader in the marketing variable of interest
Firm size (FS)	Average sales revenues of the firm
Market size (MS)	Total market sales
Market growth (MG)	Percentage change in total market sales

Note. The variables in bold are marketing variables.

Table 3 Summary of Product Line and Other Marketing Actions and Variables in the Data

Item	HP	Epson	Canon	Lexmark
Average product line length	114	37	33	50
Average price (\$)	887	504	226	1,080
Average distribution intensity (%)	77	11	5	6
Average firm sales/size (million) (\$)	520	72	30	85
Average market size (million) (\$)	708	708	708	708
Average market growth (%)	1.06	1.06	1.06	1.06

Note. All averages are monthly.

A summary of the hypotheses tested and the expected parameter relationships or signs appears in Table 4. Each pair of parameters tested is nested within the same model, so the comparisons can be done using the means, variances, and cross-covariances of the relevant parameter estimates.

4.2. Model Estimation

Equations (2) and (6) comprise a system of four (product line, price, distribution, and sales) simultaneous equations for each firm. We estimate all the systems by both three-stage least squares (3SLS) and generalized method of moments (GMM) methods, consistent with Bayus and Putsis (1999). Because the predicted value from Equation (5) contains a normal i.i.d. error, its effect on substitution into Equation (1) is to create a net error term that could be serially correlated and/or heteroscedastic. The GMM is an appropriate method for obtaining efficient parameter estimates of a simultaneous system in which the errors are serially correlated and/or heteroscedastic (Greene 2003). We also tested for heteroscedasticity using the Glesjer (1969) test. The test rejected the assumption of homoscedasticity ($p < 0.01$), so we use the GMM method. We did a pooling test (Chow 1960) to determine if the parameters are different for each firm. The pooling test rejected homogeneity of parameters (intercepts and slopes) between HP and each of the other firms ($p < 0.01$). Therefore we estimate the system separately for HP. Because the homogeneity of parameters across Canon, Epson, and Lexmark was not rejected ($p < 0.10$), we pool these firms and estimate the system. Thus the pooling test reveals asymmetries between the market leader and the followers. We also

[11] A firm's average price is based on the prices of its different product models weighted by their sales.

Table 4 Summary of Hypotheses

Hypothesis	Hypothesized relationship	Expected parameter signs
h_1	For market leaders, the effect of past competitor action on product line action is more than that of anticipated competitor action.	$\alpha_{1LPROD} > \alpha_{2LPROD}$
h_2	For market leaders, the effect of past competitor action on product line action is less than that of anticipated competitor action.	$\alpha_{1FPROD} < \alpha_{2FPROD}$
h_3	For market leaders, own product line demand elasticity is more than cross-product-line demand elasticity.	$\eta_L > \phi_L$
h_4	For market followers, own product line demand elasticity is less than cross-product-line demand elasticity.	$\eta_F < \phi_F$

tested for multicollinearity among the independent variables in each equation. The variance inflation factor for each independent variable ranged from 1.7 to 2.7, indicating no serious multicollinearity.

5. Results and Discussion

5.1. Domain of Actions

The aggregate classification of actions of the various firms is shown in Table 5. This classification is based on monthly percentage changes (of 5% and above) in product line and other marketing variables by each firm in the data. An overwhelming majority of the actions (91.7%) appears to be "non-tit-for-tat, non-simple" actions. The hybrid tit-for-tat complex strategy is the most frequent action among the firms (36.7%), followed by product-proliferation and price-fighting strategies (11.7% each), and channel encirclement strategy (8.3%), following a hybrid competitor action. Thus, product-proliferation and hybrid strategies that include product line action comprise 48.4% of the actions. A further analysis of the actions of the four major competitors reveals interesting differences among the four firms. Only 7% of HP's actions constitute price-fighting strategy, whereas 47% hybrid complex strategy, 20% product-proliferation strategy, and 19% channel encirclement strategy. In contrast, 40% of Canon's actions and 20% of Epson's actions constitute price-fighting strategy, whereas about 40% of Lexmark's actions reflect product-proliferation, channel encirclement, and to a lesser extent, price-fighting strategies. At least 30% of each firm's actions reflect a hybrid complex strategy.

Table 5 Competitive Actions of Firms in Product Line and Other Marketing Variables

Firm moving next/focal firm	Firm moving first: Product line	Price	Channel	Hybrid
Product line	**(1) Product tit for tat 0%**	**(2) Product proliferation 1.6%**	**(3) Product proliferation 1.6%**	**(4) Product proliferation 11.7%**
Price	**(5) Price fighting 3.3%**	(6) Price tit for tat 3.3%	(7) Price fighting 3.3%	(8) Price fighting 11.7%
Channel	**(9) Channel encirclement 3.3%**	(10) Channel encirclement 1.6%	(11) Channel tit for tat 1.6%	(12) Channel encirclement 8.3%
Hybrid	**(13) Hybrid complex 5%**	(14) Hybrid complex 1.6%	(15) Hybrid complex 1.6%	(16) Hybrid complex 36.7%

Note. About 3.3% of the actions involved insignificant or no change and are not shown in the table. The sample size is 102.

5.2. Determinants of Product Line Actions

The results from the estimation of Equations (2) and (6) provide insights into the determinants of actions, particularly the roles of prior and anticipated competitor actions in product line actions. The results for the market leader and follower firms appear in Table 6.

With regard to product line actions, the market leader, HP acts strongly regarding *past* competitor actions but weakly with respect to *anticipated* competitor actions, supporting Hypothesis 1. Past competitor product line action positively influences HP's product line action ($p < 0.001$). The impact of anticipated competitor product line actions on HP's product line action is insignificant ($p > 0.05$). The effect of past competitor action is significantly greater than that of the anticipated competitor ($p < 0.001$). HP also increases the number of product models when its competitors lower their prices ($p < 0.001$) and when they increase their channel coverage ($p < 0.05$). HP, however, tends to decrease the number of product models if it anticipates that its product line action would lead to competitors increasing their channel coverage ($p < 0.001$), suggesting a somewhat cooperative behavior. Thus, although HP is likely to increase its product range in response to an increase in competitor distribution intensity, it tempers this action by limiting its product expansion if it anticipates that competitors may increase their channel coverage in the future.

When engaging in product line actions, the follower firms, Cannon, Epson, and Lexmark, not only consider past competitor actions in product and channel, but also consider future competitor moves in product line. These firms increase their product line length in response to their competitors introducing more product models ($p < 0.001$). They also expand their product lines when they anticipate their competitors to expand their product lines ($p < 0.001$). The results

Table 6 Results for Product Line and Other Marketing Actions of HP, Cannon, Epson, and Lexmark

Variable	Product line equation	Price equation	Distribution equation
Past competitor product line action	**2.87 (0.17)*****	−2.44 (3.44)	0.00 (0.00)
	0.14 (0.04)***	−3.70 (1.40)***	−0.00 (0.00)**
Past competitor price action	**−0.15 (0.01)*****	−0.68 (0.10)***	2.7×10^{-4} (3×10^{-5})***
	0.00 (0.01)	−0.09 (0.18)	-5.0×10^{-5} (1.8×10^{-5})**
Past competitor distribution action	**98.74 (31.48)****	5,271.64 (602.80)***	−0.75 (0.07)***
	−24.95 (7.12)***	1,043.74 (283.00)***	−0.00 (0.03)
Anticipated competitor product line action	**0.15 (0.14)**	9.18 (3.08)**	−0.00 (0.00)***
	0.17 (0.04)***	−4.30 (1.74)**	0.00 (0.00)***
Anticipated competitor price action	**−0.01 (0.01)**	−0.27 (0.08)**	9.7×10^{-5} (1.5×10^{-5})***
	−0.01 (0.00)	0.33 (0.14)**	−0.00 (0.00)
Anticipated competitor distribution action	**−320.03 (65.15)*****	616.49 (674.90)	−0.86 (0.08)***
	0.60 (7.26)	−1,193.12 (277.50)***	−0.04 (0.03)
Own product line action	**NR**	2.20 (0.50)***	0.00 (0.00)
	NR	17.52 (1.52)***	20.0×10^{-6} (4.2×10^{-6})***
Own price action	**0.02 (0.00)*****	NR	9.5×10^{-5} (8.7×10^{-6})***
	0.04 (0.00)***	NR	−0.00 (0.00)***
Own distribution action	**26.27 (33.70)**	3,484.10 (203.50)***	NR
	−11.03 (8.04)	104.32 (314.00)	NR
Own past (lagged) action in same variable	**0.07 (0.02)*****	0.17 (0.04)***	−0.00 (0.03)
	0.39 (0.03)***	0.56 (0.04)***	0.67 (0.03)***
Relative leadership	**1.27 (0.66)**	16.21 (6.68)*	0.00 (0.00)
	21.53 (2.00)***	−196.89 (29.74)***	−0.00 (0.00)**
Firm size	**24.92 (5.54)*****	−543.23 (66.30)***	0.15 (0.02)***
	0.98 (0.09)***	−55.26 (6.41)***	−0.00 (0.00)
Market size	**0.04 (0.01)*****	0.79 (0.09)***	0.00 (0.00)***
	−0.00 (0.00)***	0.08 (0.04)**	0.00 (0.00)
Market growth	**2.93 (0.97)***	30.52 (14.30)*	−0.00 (0.00)*
	−3.23 (1.07)***	184.42 (44.35)***	0.01 (0.00)*
Nonlinear adjusted R^2	**0.99**	0.94	0.95
	0.97	0.96	0.95
Sample size	**101**	101	101
	303	303	303

Note. In each cell, the numbers in the first line denote the parameter estimate and standard error (within parentheses) for the market leader (HP), while the numbers in the second line denote the parameter estimate and standard error for the follower firms (Canon, Epson, and Lexmark).

*Indicates significance at 0.05 level, **indicates significance at 0.01 level, and ***indicates significance at 0.001 level. Standard errors are in parentheses. NR indicates "not relevant."

support Hypothesis 2 in that the effect of anticipated future competitor product line action is significantly greater than that of past competitor product line action ($p < 0.05$). The follower firms reduce their line length when their competitors increase channel intensity ($p < 0.001$).

To understand the magnitude of and rationale for actions in product line, we turn to the reaction and anticipation elasticities, and the own and cross-elasticities of demand for each marketing variable. From the results of the model estimation, we compute the reaction and anticipation elasticities for the market leader and followers. The average reaction and anticipation elasticities for HP and its followers (in parentheses) are shown in Tables 7 and 8, respectively (based on average values of the relevant variables). The marketing variables of the firm(s) moving second form the rows and the marketing variables of the firms moving first form the columns.

5.2.1. Reaction Elasticities. HP's product product reaction elasticity is highest at 0.92 and its

Table 7 Average Reaction Elasticities in Product Line and Other Marketing Variables for the Focal Firm

Focal firm HP (followers)	Competitor firm(s) followers (HP)		
	Product line	Price	Distribution
Product line	**0.92* (0.33*)**	**−0.63* (0.03)**	**0.07* (−0.28*)**
Price	**−0.10 (−0.58*)**	−0.37* (−0.12)	0.48* (0.09*)
Distribution	**0.04 (−0.02*)**	0.18* (−0.03*)	−0.08* (0.00)

Note. In each cell, the numbers in the first line denote the reaction elasticity for HP and for the other firms; that is, Epson, Canon, and Lexmark (in parentheses).

*Indicates significance at 0.05 or higher level.

Table 8 Average Anticipation Elasticities in Product Line and Other Marketing Variables for the Focal Firm

Focal firm HP (followers)	Competitor firm(s) followers (HP)		
	Product line	Price	Distribution
Product line	**0.05 (0.37*)**	**−0.04 (−0.20)**	**−0.20* (0.01)**
Price	**0.39* (−0.71*)**	−0.15* (0.43*)	0.05 (−0.87*)
Distribution	**−0.12* (0.86*)**	0.06* (0.18)	−0.086* (−0.24)

Note. In each cell, the numbers in the first line denote the anticipation elasticity for HP and for the other firms; that is, Epson, Canon, and Lexmark (in parentheses).
*Indicates significance at 0.05 or higher level.

Table 9 Own and Cross-Product-Line Length and Other Marketing Elasticities of Demand

Elasticity	Leader (HP)	Follower firms
Own product line	**0.20***	**0.13*****
Own price	−2.45***	−3.39***
Own distribution	4.72***	3.65***
Cross-product-line	**−0.16*****	**−2.68*****
Cross-price	−0.15	5.04**
Cross-distribution	−0.17*	−2.55***

Note. *Indicates significance at 0.05 level, **indicates significant at 0.01 level, and ***indicates significance at 0.001 level.

distribution-product reaction elasticity is lowest in magnitude at 0.04. That is, if follower firms increase their product lines by 10%, then HP expands its product line by about 9.2%, but does not significantly change its distribution intensity. In contrast, the price product line reaction elasticity of the follower firms is highest in magnitude at 0.58. That is, Epson, Canon, and Lexmark decrease their prices by about 5.8% when there is a 10% increase in the number of competitors' product models. HP's price reaction elasticities are low and range from 0.48 to −0.37, whereas the followers' price reaction elasticities range from 0.09 to −0.58. Similarly, HP's distribution reaction elasticities are also low, ranging from −0.08 to 0.18, while the followers' distribution reaction elasticities are small, ranging from −0.03 to 0.00. HP's product product reaction elasticity is nearly three times that of the followers. In sum, the reaction elasticities show that HP strongly reacts in product line, whereas the followers react aggressively in price and passively in distribution channel coverage. These elasticities are consistent with the resource dependence theory (Pfeffer and Salancik 1978) and the theory of avoidance of direct competition (Shomberg et al. 1994).

5.2.2. Anticipation Elasticities. From Table 8, HP's anticipation elasticities are typically low, ranging from −0.20 to 0.39. The low level of anticipation could be because of the low salience of market followers' future actions and the low centrality of the follower firm's future actions to HP's overall position, consistent with the expectancy-valence theory (Chen and Miller 1994). In contrast, the anticipation elasticities of the follower firms are high and range from −0.87 to 0.86. HP's price product anticipation elasticity is highest at 0.39, followed by its product distribution anticipation elasticity at −0.20. The price anticipation elasticities of the follower firms are quite high (−0.71, 0.43, and −0.87 for product line, price, and distribution, respectively). These elasticities reflect the tendency of the follower firms to fight on price if they expect a competitive action in any marketing variable. To summarize, HP's anticipation elasticities are low, whereas followers' anticipation elasticities, particularly their price anticipation elasticities, are high.

5.2.3. Demand Elasticities. The rationale for the actions of the leader and the follower firms is provided by the relative magnitudes of own and cross-demand elasticities of product line and other marketing variables for HP and the follower firms obtained from the parameter estimates of Equation (2). These elasticities appear in Table 9. The market leader's own product line demand elasticity is significantly higher than its cross-product-line demand elasticity ($p < 0.05$), consistent with Hypothesis 3. In contrast, the own product line demand elasticity of follower firms is much lower than their cross-product-line demand elasticity ($p < 0.001$), supporting Hypothesis 4. HP's own product line demand elasticity (0.20) is also higher than the own product line demand elasticity for the follower firms (0.13). Moreover, HP's absolute value of cross-product-line demand elasticity on its competitors (2.68) is much higher than the absolute value of cross-product-line demand elasticity of the follower firms on HP (0.16), which is positive, albeit small. Therefore it stands to reason that HP engages in strong actions in product line. On the other hand, HP's absolute own price elasticity of demand (2.45) is lower than that of the follower firms (3.39). Thus, HP does not prefer to react strongly in price, but the follower firms tend to respond aggressively in price. These results are consistent with the rationale that firms react in those marketing variables only if their competitor moves have nonzero effects on their own sales (Chen and MacMillan 1992). They also support the competitive demand elasticity theory (Shankar 1997).

5.2.4. Other Determinants and Other Marketing Actions. Regarding actions in price, HP considers past competitor actions in price and distribution and anticipated competitor actions in product line and price, in keeping with the market leader's desire to maintain its image and avoid price competition. HP reduces its channel coverage when it anticipates that its competitors might lower their prices, or raise their distribution intensity. Epson, Canon, and

Lexmark slash their prices when competitors introduce new product models, but increase their prices as competitors expand their distribution. These firms adopt a price-fighting strategy, regardless of the anticipated competitor actions. With regard to distribution actions, these followers scale back distribution efforts when their competitors expand product lines and increase prices. If, however, they anticipate their competitors would expand product lines in the future, they intensify their distribution efforts. The signs of the effects of control variables on product line, price, and distribution actions of HP are mixed, but the effects of HP's product line, price, and distribution actions on one another are consistent. The signs of the coefficients of most of the control variables for Canon, Epson, and Lexmark are in the expected directions.

5.3. Comparison of Product Line and Other Marketing Actions of Market Leader and Followers

The results reveal interesting asymmetries between the market leader and the followers. First, the leader's actions in product line and price are predominantly driven by *past* competitor actions, whereas the product line and price actions of market followers are strongly influenced by *anticipated* competitor actions. Second, the leader responds strongly by introducing more product models whenever the followers act aggressively in any marketing variable, while its competitors act strongly in price in response to a competitor move regarding product line. This result is consistent with Putsis and Bayus (2001) who found that high market share firms aggressively expand their product lines. Third, product line actions by market followers do not evoke a complex reaction from the leader, but product line moves by HP elicit complex reactions from the followers. Thus, there is a distinct asymmetry—the market leader's primary weapon is product line, whereas the follower firms' major tool is price.

There are also important differences between the reaction and the anticipation elasticities for the market leader and followers. For the market leader, product distribution, distribution-price, and distribution-distribution elasticities are significant for both the reaction and the anticipation elasticities. For the follower firms, product product, price-product, price-distribution, and distribution-product elasticities are significant, regardless of whether they are reaction or anticipation elasticities.

For the market leader, in general, the average reaction elasticities are higher than the average anticipation elasticities, particularly for product line actions. The signs of reaction and anticipation components of product distribution elasticity, however, are different. While HP is likely to expand its product line in response to an increase in channel coverage by its competitors, it might actually prune its product line if it anticipates that the followers might further expand their channel coverage. In contrast, the anticipation elasticities for the follower firms are, in general, higher than the corresponding reaction elasticities. This result is consistent with Venkataraman et al. (1997) in that anticipation is more likely with respect to the future actions of large competitors (HP in this case) than small competitors. Interestingly, for the follower firms, the signs of reaction and anticipation elasticities for both price distribution and distribution product are opposite to each other. Their likelihood of price increase in response to a competitor move to expand channel coverage is countered by their tendency to lower prices if they anticipate competitors to deepen their distribution. Similarly, the prospect of scaling back distribution by follower firms in response to competitive moves to expand product line is outweighed by the tendency to raise channel coverage if they expect competitors to introduce new product models.

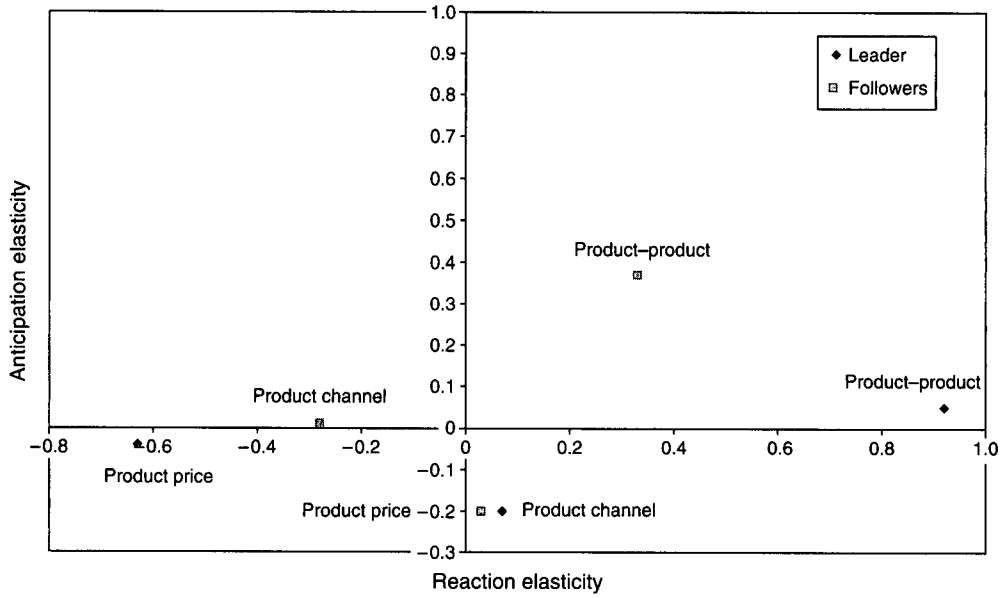
To visually capture the asymmetry in product line and other marketing actions between the leader and the followers, a plot of the anticipation versus reaction elasticities of the market leader and the follower firms is shown in Figure 2. In general, the leader's reaction elasticities are greater than those of the followers, but its anticipation elasticities are lower than those of the followers.

To better understand the clout and the vulnerability of the market leader and followers regarding product line, price, and distribution, a graph of clout (own demand elasticity) versus vulnerability (cross-demand elasticity) for the market leader and followers is presented in Figure 3. The market leader's own demand elasticities are generally higher than those of the followers. Its cross-demand elasticities are close to the zero level; that is, the effect of follower firms on its demand is minimal. Market followers have considerably lower own demand elasticities and higher cross-demand elasticities than those of the market leader; that is, the influence of market leader's marketing actions on the followers' demand is higher than the effect of followers' marketing actions on the leader's demand.

5.4. Model Validation

To test the sensitivity of the classification of competitor actions in Table 3, we varied the cutoff figure for marketing action changes from 1% to 10%. The results did not substantively change. Because validation check is an important aspect of an econometric model (Frances 2005), we validate our model in four ways. First, to test the predictive ability of the model, we estimated the model with two-thirds of

Figure 2 Product Line Anticipation vs. Reaction Elasticities

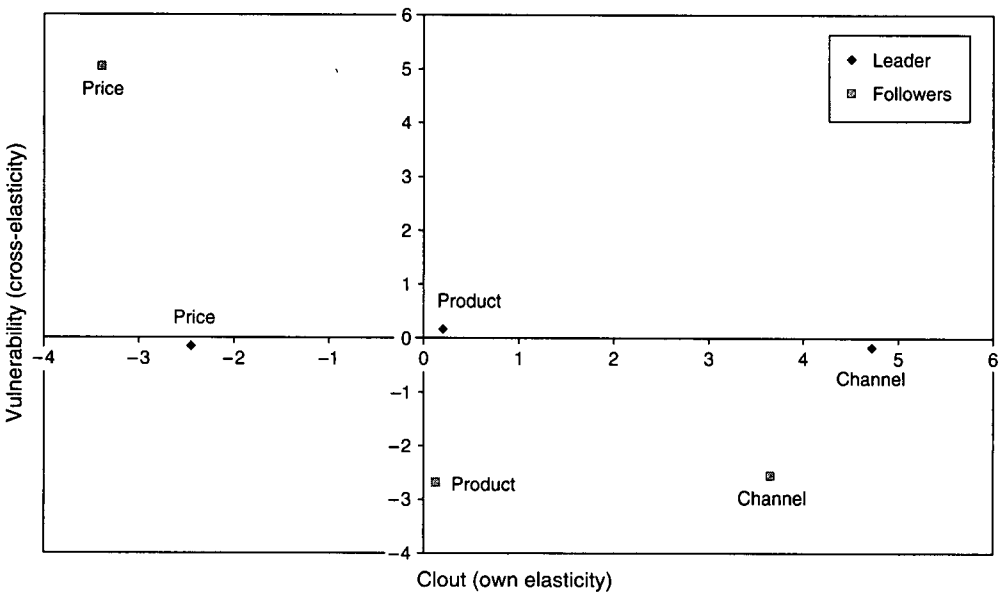


the sample size, predicted the actions of all the firms for the remaining one-third of the sample (holdout sample) using the parameter estimates, and compared the forecasts with the actual actions. The average correlation between predicted and actual actions across product line and other marketing variables and firms was very high at 88% (for HP, the average was 92%).

Second, to evaluate the significance of simultaneously estimating models in product line and other marketing variables, we estimated a restricted model in which competitor action in only the same marketing variable was included. We compared our and the alternative model in their ability to predict the direction and magnitude of changes in product line and other marketing actions of each firm. Our model was superior—it predicted an average of 84% of the direction changes across variables and firms (versus 46% for the restricted alternative model), and the magnitudes were significantly closer to the actual actions (average of 10% tolerance versus 26% tolerance for the restricted alternative model).

Third, to assess the significance of the decomposition of a marketing action into reaction and anticipation components, we compared our model with a benchmark model without the anticipation component. Our model performed substantially better on forecast errors (average of 10% versus 19%), direction of changes in marketing actions (average of 84%

Figure 3 Clout vs. Vulnerability



versus 67%), face validity of own and cross-elasticities of demand (0 versus 5 wrong signs), and model fit (average correlation of 88% versus 71%).

Fourth, we test the stability of the structural parameters through a split-half analysis. We split the sample into two halves and examined the parameter estimates in both the subsamples. The parameters were highly stable with 93% of the parameters having the same signs and significance in both the subsamples. Finally, we validated the LEAD or the leadership variable in product line and other marketing actions by empirically identifying them from the data through a Granger test of causality, consistent with Roy et al. (1994).

5.5. Results Summary

To summarize our results and answer our research questions: firms constantly engage in complex and hybrid actions involving product line (about 48% of the actions in the market analyzed). A firm is more likely to engage in product line actions when its competitors changed their product line length in the past, when the firm is large, when its price is high, and when it changed its own product line length in the past. The domain, competitive stance, elasticities, and determinants of product line actions and of actions in other marketing variables, however, are asymmetric across firms. The market leader tends to adopt hybrid and complex, product proliferation, and channel encirclement strategies. It rarely fights on price. In contrast, market followers most often practice a price-fighting strategy. Furthermore, the leader's product line actions are positively influenced by market size and market growth and are unrelated to leadership in product line, whereas the product line actions of the market followers are negatively related to market size and market growth, but positively related to product line leadership. The elasticities of product line and other marketing variables can be decomposed into anticipation and reaction elasticities and estimated using our methodological approach. The reaction and anticipation elasticities are asymmetric among themselves and across market leader and followers. Unlike market followers, the market leader has reaction elasticities that are generally higher than its anticipation elasticities. For the leader, product product and product price reaction elasticities are higher than those for the followers. These actions are explained by more favorable own and cross-product-line demand elasticities of the leader relative to followers.

6. Contributions, Implications, Limitations, and Future Research

The results offer methodological and managerial contributions. From a methodological viewpoint, this paper offers a rigorous yet practical approach to identify reaction and anticipation elasticities in product line and other marketing variables for multiple competitors in the same framework. The approach allows for asymmetries across competitors and product line and other marketing variables, while modeling the simultaneity of demand and supply. From a managerial standpoint, the results offer strategic insights. The results show that managers should generally expect a high level of complex and hybrid actions and plan product line actions accordingly. They also provide insights into the reaction and anticipation elasticities of product line and other marketing variables.

Based on the results, market leaders may want to initiate actions in product line or distribution or both to gain a jump over followers. Because the own product line and distribution elasticities of demand are generally high, these actions would enhance the leader's demand. At the same time, competitor reactions to the leader's product line and distribution moves would typically be highest in price. Because price cuts by competitors do not affect the market leader (insignificant cross-price elasticity), overall, competitor reactions may not have a strong effect on the leader. Similarly, if the leader wants to strategically react to actions by its followers without provoking a strong future reaction by them, it should avoid price because competitors' action is strongest in price when they anticipate a reaction by the leader (see Table 8). Instead, the leader may want to consider reaction in product line or channels because competitor action to an anticipated reaction by the leader in distribution is somewhat lower than that in the case of price (see Table 8). Thus the market leader can judiciously use product line strategies.

The results also have important implications for managers of follower firms. In some cases, an increase in new products may also benefit follower firms. Although the leader's product product reaction elasticity is high, its other reaction elasticities are low, so a follower's product line action may not evoke strong reactions in distribution from the leader (see Table 7). These elasticities might explain why Lexmark, a market follower, thought it appropriate to introduce many new models in late 1999 (*The Wall Street Journal* 1999). By knowing that the leader does not seriously consider the anticipated reaction of the other firms (see Table 8), these managers can focus on the leader's reaction tendency to their moves. A move to increase channel coverage is less likely to draw response from the leader than a move in the other variables (see Table 8). Furthermore, own distribution elasticity of demand is somewhat high for the followers, while the cross-distribution effect on the leader's demand is significant (see Table 9).

The model offers guidelines for the development of a decision support system (DSS) for market leader and followers. Leaders can estimate firms' product line reaction and anticipation elasticities using our model based on historical data and use the results for future actions through a DSS. To induce a competitor to respond or to prevent a competitor from acting in product line or other marketing variables, a leader can use the DSS to decide the appropriate product line and other marketing actions.

Our research has certain limitations that can be addressed by future research. First, our model is primarily a descriptive model with some predictive and normative implications. It could be supplemented by a normative model. Second, our empirical analysis is based on one industry. To enhance the generalizability, it could be replicated in other industries if appropriate data are available. Third, we did not consider firm-level advertising and promotion because it was not central to short- and medium-term competitor actions in the industry analyzed. It could be included in studies of markets where it is a critical part of competitor actions or in analysis of long-term actions. Fourth, our empirical analysis did not cover a market in its introduction or early growth stage. It would be interesting to extend the study to such markets. Fifth, a deeper analysis of the types of hybrid strategies (e.g., product line price hybrid and product line distribution) could provide further insights into this area. Sixth, product line length cannot be drastically changed in the short run because of the lead time involved in the translation of R&D efforts to market offerings. Although our model implicitly captures this constraint through the lagged product action variable, future research that explicitly includes this constraint in the model is desirable. Finally, firm-level analysis could be supplemented by brand-level analysis to gain further insights into product line strategies.

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