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Predicting order and timing of new product moves: the role of top management in corporate entrepreneurship

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Abstract

In this study, we focused on new product move as a form of corporate entrepreneurial activity. We developed hypotheses relating the characteristics of the top management team (TMT) to the order and timing of new product moves made by firms. We analyzed 223 new product introduction moves from the personal computer, long distance telecommunication, and brewing industries from the period of 1975–1990. We found that firms with larger TMTs were more likely to be first movers. The hypothesis that firms with larger TMTs are more likely to respond quickly to new product moves received marginal support. The hypothesis that TMTs more heterogeneous in terms of organizational tenure of executives are more likely to be first movers as well as earlier in the order of new product moves received marginal support. We found contradictory results with TMT organizational tenure and TMT educational background heterogeneity as predictors of order and timing of new product moves. Subsequently, we conducted industry-wise analysis that revealed important differences in this new product entrepreneurial activity across the three industries.

Keywords: Top management team; Corporate entrepreneurship; Organizational tenure

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1. Executive summary

New product innovation is an important mechanism for firms to achieve competitive advantage. For example, the introductions of the disposable razor and personal computer have had powerful impacts on transforming markets. As an indicator of the importance of this form of entrepreneurial activity, the U.S. Department of Commerce reported that the number of new products introduced into the U.S. economy doubled from 1980 to 1990, growing from fewer than 3000 to more than 6000 per year.

Certainly, new product innovation continues to play a vital role in today's competitive business environment and is considered to be a key driver of firm performance, especially as a significant form of corporate entrepreneurship. A particularly interesting issue within this domain concerns the factors that determine when firms undertake new product moves. This is important because the difference in terms of order and timing of new product moves among industry rivals can have a varying impact on firm performance. Indeed, moving first or imitating quickly new product innovations relative to later entrants presents numerous potential competitive advantages, such as scale, experience, and reputational effects.

In general, innovativeness and risk-taking are associated with entrepreneurial activity and, more importantly, are considered to be important attributes that impact the order and timing of new product innovations. To a great degree, a firm's tendency toward entrepreneurial innovation and risk-taking is reflected in the top-level decision-makers' approach toward these two behaviors. Theory and practice would suggest that the characteristics of top management teams (TMTs) should provide a solid basis for predicting whether firms will introduce new product innovations and how quickly they will react to the new product moves of the first mover.

To study these issues, we drew new product introduction data from the personal computer, long distance telecommunication, and brewing industries from the period of 1975–1990. Specifically, we examined four characteristics of TMTs: expertise, experience, diversity, and magnitude of cognitive resources, as indicated by demographic characteristics, to predict new product moves in terms of order, timing, and likelihood of being a first mover versus imitator. We found that firms with larger TMTs were more likely to be first movers. The hypothesis that larger TMTs are more likely to respond quickly to new product moves received marginal support. The hypothesis that TMTs more heterogeneous in terms of organizational tenure of executives are more likely to be first movers as well as earlier in the order of new product moves received marginal support. We found contradictory results with TMT organizational tenure and TMT educational background heterogeneity as the predictors of order and timing of new product moves.

To resolve the apparently contradictory results, we conducted industry-wise analysis that revealed important differences in this new product entrepreneurial activity across the three industries. We reason that in a high-velocity environment, such as the personal computer industry, the expertise and knowledge that emerge as a function of experience appear to stimulate innovation and the benefit of knowledge acquired through longer tenure outweighs the inertial effects of tenure. On the other hand, in the case of an industry, such as brewing,

that operates in a relatively stable environment, longer tenure may lead to complacency and cognitive inertia. These results suggest that there is no single set of managerial characteristics leading to order and timing of new product moves and that industry characteristics act as important boundary conditions.

2. Introduction

Jennings and Lumpkin (1989, p. 489) defined corporate entrepreneurship as "the extent to which new products and/or new markets are developed." Similarly, several other researchers have also emphasized new product innovation as an important activity in corporate entrepreneurship (e.g., Miller, 1983; Schollhammer, 1982; Shane and Venkataraman, 2000; Zahra, 1995). Consistent with the above stream of research, our paper focuses on a firm's new product move as a significant form of corporate entrepreneurial activity.

New product move is an important mechanism for a firm to achieve competitive advantage and is considered a key driver of firm performance (Capon et al., 1990; D'Aveni, 1994). For example, the introductions of the disposable razor and personal computer have had powerful impacts on transforming markets (Grimm and Smith, 1997). As an indicator of the importance of this form of entrepreneurial activity, the U.S. Department of Commerce reported that the number of new products introduced into the U.S. economy doubled from 1980 to 1990, growing from fewer than 3000 to more than 6000 per year (Grimm and Smith, 1997). In addition, a number of empirical studies have linked the introduction of new products to wealth creation for stockholders indicated by positive stock market returns (Chaney et al., 1991; Eddy and Saunders, 1980; Lee et al., 2000).

The first-mover literature (Kerin et al., 1992; Lieberman and Montgomery, 1988) ascribes numerous potential advantages to moving first with new products. These include scale effects, experience effects, asymmetric information about product quality, differences in marginal effects of advertising between first and later entrants, reputational effects, and uncertain imitability. At the same time, other researchers (Baldwin and Childs, 1969; Drucker, 1985; Wernerfelt and Karnani, 1987) have suggested some potential first-mover disadvantages or imitation advantages. These include greater market uncertainty and risk in being first to market and the ability of imitators to learn from the first mover's experience, such as reducing or avoiding development and testing costs and pricing mistakes. However, a meta-analysis of determinants of new product performance (Henard and Szymanski, 2001) concludes that the order of entry has a positive effect (average r=.42) on new product performance.

The first-mover research has also identified innovativeness and risk-taking as important attributes of first movers. Lumpkin and Dess (1996) argued that proactiveness, a key entrepreneurial characteristic related to new product introduction, must be treated as a continuum. Therefore, we focus not just on first movers but also on later entrants in terms of their order (e.g., first, second, third) and timing (e.g., number of days after the first mover) of new product moves. Our argument is that differences across firms in terms of order and timing of product moves indicate differences in their approach toward entrepreneurial

innovation and risk-taking (Lumpkin and Dess, 1996). The differences in order and timing of new product moves also have varying impact on firm performance (Lee et al., 2000).

We follow the strategic choice perspective (Child, 1972) to argue that the characteristics of top-level decision-makers should predict the timing and order of the firm's new product moves. Indeed, the importance of top management in corporate entrepreneurship has been highlighted by Morris and Paul (1987) who defined entrepreneurial orientation as a propensity of a company's top management to take risks, to be innovative and to be proactive. All these characteristics of top managers, that is, their risk-taking ability, innovativeness, and proactive stance impact whether their firms will introduce products first or earlier in the order and how quickly they will react to the new product moves of the first mover.

Given the established importance of new product innovations in corporate entrepreneurship, positive performance consequences of moving first with new products, and the importance of top management for new product moves, there has been a call for research that identifies the factors determining whether firms move first, fast, or late (Chen, 1996; Kerin et al., 1992). In addition, some researchers have directed particular attention to studying the role of top management in new product innovations (Brown and Eisenhardt, 1995; Hitt et al., 1999). However, researchers have so far not examined the characteristics of top management that could be related to new product introduction, in general, and to the order and timing of new product moves, in particular.

Building on previous work (e.g., Mitchell, 1989; Murthi et al., 1996) to determine why and when a firm will move first or fast with new products, the present research studies the extent to which the characteristics of the organization's decision makers, that is, TMT will predict new product moves. We draw from the literature on upper echelon theory and innovation to develop a set of hypotheses linking the experience, expertise, and heterogeneity of the TMT to the order, timing, and likelihood of moving first versus imitation.

In conducting this research, we hope to advance the corporate entrepreneurship literature by exploring the top management factors that explain why firms differ in the timing and order of new product introductions. This would add to our understanding of why some people, and not others, discover and exploit opportunities—a fundamental question in the entrepreneurship research (Shane and Venkataraman, 2000). We expect to contribute to the new product literature by examining two important dimensions of new products, i.e., order and timing of moves. In the next sections, we review the previous literature and develop our hypotheses.

3. Literature review

In addition to the prominent focus on performance outcomes associated with first movers (Kerin et al., 1992), one important stream of first-mover literature has also focused on predicting the timing of first moves (Lieberman and Montgomery, 1988; Moore et al., 1991). For example, Teece (1986) theorized that owning a full set of complementary resources enables firms to enter markets early and outperform late movers. These complementary resources might include marketing services, manufacturing equipment,

and service capabilities. Moreover, there is conceptual support for the idea that firms with reputation, costs, and capital advantages are more likely to achieve first-mover benefits (Wernerfelt and Karnani, 1987).

Within the domain of new product introductions, researchers have also explored the organizational factors that specifically explain the timing and order of new product moves. For example, Mitchell (1989) argued that the relative resource position of firms would affect the speed with which they react to new entrants. Robinson et al. (1992) empirically linked different organizational skills and abilities to move order. They argued that R&D skill would be necessary for successful first-mover actions, whereas manufacturing capability would be critical for fast followers. Market abilities were thought to be critical for late movers. These authors found some support for their hypotheses, namely, that marketing and manufacturing skills were important for late movers.

Among the organizational factors, researchers have also recognized the specific role of top managers in new product introduction. Amit et al. (2000) proposed that firms that possess entrepreneurial management would successfully implement first-mover strategy (e.g., to create new products more quickly) and obtain economic rents. This entrepreneurial management promotes an empowering corporate culture, enabling firms to develop individuals to think and act with entrepreneurial autonomy. Similarly, Miles et al. (2000) suggested that top management must develop and institute a strategic vision for promoting product or process innovations and entrepreneurial activity for all employees. Pisano (1996) emphasized the important role of top managers in developing technological capabilities for new products. Verona (1999) presented a resource-based view of product development in which he argued that product development capabilities originate from organizational agents including top managers. Mitchell (1989) contends that managers make decision on the timing of their actions based on relative resource advantages vis-à-vis rivals. For example, he notes the closer the new product to existing products, the greater will be the threat, and earlier will be the response to the new product introduction. In related research, Chen et al. (1992) found that the greater the threat presented by a rival's action, the more likely and the faster a firm would respond. Thus, perception of external threat and internal assessment by top management are likely to influence the order and timing of the firm's new product moves. Thus, top managers are recognized as key entrepreneurial resources of the firm (Penrose, 1959) that influence the order and timing of new product moves.

Within the domain of the research on the role of top management in new product moves are researchers who have argued that top management support to new product development teams is particularly important for innovation. In a review of product development literature, Brown and Eisenhardt (1995) identified the significant role of top management in the product development process. The authors argued that although the product development process may be delegated to a cross-functional project team, the top management support is critical for timely and successful introduction of a new product. Some studies have also found empirical evidence for importance of top management support and monitoring in the effectiveness (Hitt et al., 1999) and innovativeness (Sethi et al., 2001) of cross-functional new product teams. Similarly, Cooper and Kleinschmidt (1994) also recognized the importance of top management support for the timeliness of new product introduction. In a more recent meta-analysis of

the determinants of new product performance, Henard and Szymanski (2001) found that senior management support has a positive relationship (average r=.31) with new product performance. The top management support could be in the form of presenting a vision for the future, communicating a distinctive product concept, giving the approval to the project team to go ahead with a new idea, and providing the necessary resources.

Based on the above research, there seems to be a widely shared belief that top management plays a key role in new product introduction. However, in terms of identifying the specific characteristics of top managers that could influence the order and timing of new product moves, there has been limited empirical effort. A notable exception is the study by Murthi et al. (1996) that measured managerial efficiency with respect to marketing and production areas and linked it to order of entry. Using PIMS database, they found pioneers to be more efficient in the marketing area and later entrants to be more efficient in the production area. However, in addition to the functional (e.g., marketing, production) skills of top management, there could be other important characteristics of top management, such as their experience, expertise, and cognitive diversity, that could affect their innovation and risk-taking capabilities and influence the order and timing of new product moves of their firms. Accordingly, our study aims to examine the effects of these TMT characteristics on the order and timing of new product moves.

We build on the previous research (Finkelstein and Hambrick, 1990; Jackson, 1992; Wiersema and Bantel, 1992), which has demonstrated that the skills, market knowledge, and background of the decision maker influence strategic choices. We follow the logic that an entrepreneurial activity, such as a new product introduction, requires a strategic decision, and it is the top management of the firm that makes the choice of whether and when to introduce a new product. As discussed earlier, although the degree to and the stage at which top management gets involved may vary among firms, they clearly have a significant influence on the new product introduction process (Li and Calantone, 1998). Thus, we expect characteristics of TMT to be related to decisions regarding the order and timing of new product moves. We also expect these characteristics to predict whether the firm will be a first mover or imitator.

In addressing this question, we draw on a rich literature on TMT research. Hambrick and Mason (1984) encouraged the study of top management demography to infer managerial attitudes and beliefs. This upper echelon perspective led to extensive research linking top management demography to several important outcomes, such as strategic change (Grimm and Smith, 1991; Wiersema and Bantel, 1992), firm performance (Finkelstein and Hambrick, 1990; Smith et al., 1994), and innovation (Bantel and Jackson, 1989).

Our advance is to link TMT demography to the order and timing decisions of new product moves. As mentioned earlier, we expect top management attitudes and beliefs toward innovation and risk-taking to be important in explaining when a new product introduction will occur. As such, top management's attitudes and beliefs serve as hypothetical (unmeasured) constructs in this paper. Because first and early movers with new products will face uncertain, turbulent environments, where the rules have not been established, we expect that managers of such firms will have greater innovation and risk-oriented attitudes. In contrast, late and slow movers will be less innovative and more likely to be risk averse.

4. Hypotheses

In the following hypotheses, TMT demographic variables predict the new product moves. We examine three measures of TMT demography: education, tenure, and heterogeneity. As argued later, we use these measures to capture the expertise, experience, and cognitive diversity of the TMT. We also measure TMT size to reflect the magnitude of cognitive resources available with the team. Our research examines three related but different dependent variables to capture decision options of the TMT with regard to new product introduction. These three dependent variables are the following: the order of new product moves—more specifically, introducing a new product first versus later relative to other firms that introduce the same product; the timing of new product moves—that is, introducing the product fast versus slow relative to the first mover or in other words, the time lag with respect to the first mover; and finally, the likelihood of being a first mover versus an imitator. Although interrelated, these three dependent variables convey different pieces of information about new product moves. *Order* indicates whether a firm waits for competitors to introduce a new product before launching its own product. *Timing* indicates how fast a firm is able to respond to rivals. *Likelihood of a firm being a first mover* treats first movers as a distinct category as argued in the first-mover literature (Kerin et al., 1992).

4.1. Education

Education of the TMT is defined as the average number of years of education of the TMT members. A person's education is a reflection of one's personality, cognitive style, and values (Holland, 1973). Becker (1970) was one of the early researchers to link a higher level of education to greater receptivity to innovation. Likewise, Kimberly and Evanisko (1981) demonstrated a positive link between the formal education of top managers and the extent of innovation in their organizations. Hambrick and Mason (1984) argued that educated managers would have greater capability and expertise in information search activities. Similarly, Wiersema and Bantel (1992) suggested that a higher level of education is associated with higher information-processing capability and the ability to discriminate among alternate stimuli. Bantel and Jackson (1989) argued that higher levels of education of the TMT will lead to more comprehensive decisions, leading to greater innovation. Shane and Venkataraman (2000) argued that discovery of opportunities is dependent on the possession of prior information necessary to identify an opportunity and cognitive abilities of individuals.

Following the above arguments, we expect that TMTs with higher levels of education will possess greater capabilities in innovation and creativity and will also ascribe a greater value to innovation in their firms. As such, we hypothesize:

Hypothesis 1: The higher the average education level of the TMT, (a) the earlier the order of the new product move, (b) the faster the timing of the move, and (c) the greater the likelihood of the firm being a first mover versus an imitator.

While we hypothesize a positive effect of average education of top managers on corporate entrepreneurial activity, it is important to point out that the prediction may not be the same for individual entrepreneurial activity. There are mixed findings with respect to the role of education and most researchers have compared the effect of low versus intermediate levels of education (e.g., Robinson and Sexton, 1994; Reynolds, 1997). In addition, there are gender differences across studies and the relationship between education and individual entrepreneurial activity varies across industries (Hisrich, 1990). More than 20 years ago, Brockhaus (1982) found that entrepreneurs tend to be better educated than an average person in the society but less educated than managers. In a more recent study in another capitalist economy, Sweden, Honig and Davidsson (2000) found only a weak relationship between the level of formal education and entrepreneurial success. Interestingly, attending business classes was not associated with successful business path for an individual entrepreneur.

4.2. Organizational tenure

Tenure is defined as the average number of years the TMT members have spent with a focal firm. Schwenk (1993) presented arguments on both sides, negative and positive, about the impact of organizational tenure of top managers on firm performance. He argued that a team whose members have a longer tenure would be able to formulate more effective strategies because experience would result in deeper understanding of their company. On the flip side, Schwenk argued that executives with long tenure may develop strategies based on outdated assumptions of the environment leading to poor performance. This reflects the decision-making bias that the past is a good prediction of the future (Tversky and Kahneman, 1974). Information processing may become programmed into a set method that does not encourage seeking new information or new ways of doing things. Finkelstein and Hambrick (1990) argued that executives with longer tenure possess a greater firm-specific human capital, making it less likely for them to take risks and compromise on the comfortable status quo. The authors found support for a relationship between long organizational tenure and conformity to industry performance norms. Wiersema and Bantel (1992) found that short organizational tenure was positively related to strategic change. Bantel (1994) found that short organizational tenure was positively related to strategic planning openness. The executive succession literature also shows that entry of top executives from outside the firm—that is, lower average tenure of TMT—is positively related to strategic change and innovation (Kesner, 1994). Therefore, all these studies provide support for the argument that longer organizational tenure leads to commitment to the status quo, reduced information processing, risk aversion, and rigidity. Accordingly, we make the following hypothesis:

Hypothesis 2: The longer the average organizational tenure of the top managers of a firm, (a) the later the order of the new product move, (b) the slower the timing of the move, and (c) the lower the likelihood of the firm being a first mover versus an imitator.

4.3. Team size

Hambrick and D'Aveni (1992, p. 1449) argued, "At a basic level, the resources available on a team result from how many people are on it." The group dynamics literature contains several studies that found a positive relationship between group size and group performance (e.g., Campion et al., 1993; Magjuka and Baldwin, 1991). Eisenhardt and Schoonhoven (1990) found that bigger team size of founders of a firm was associated with sales growth in new semiconductor firms. Hambrick and D'Aveni (1992) found that firms on the verge of bankruptcy had smaller teams than the better performing firms. Haleblian and Finkelstein (1993) hypothesized that the more turbulent the environment, the greater the information-processing requirements, and consequently, the greater the need for larger teams to cope with environmental unpredictability. The authors argued that a large TMT provides more capabilities and positively influences the growth of a firm. As Damanpour (1991) argued, slack resources allow an organization to be proactive by exploring new ideas in advance of an actual need. A larger TMT size could also indicate more extensive interfirm network of the top management and a greater extent of involvement in and monitoring of the new product development process. Larger teams also have potential for greater volume of idea generation, an important component of innovation process.

Conversely, it has also been suggested that larger TMTs generate more discussion, which can reduce the speed of decision making and result in disharmony (Weinzimmer, 1997). Empirical support, however, shows that the size of a TMT is positively associated with organizational growth (Cooper and Bruno, 1977). Teach et al. (1986) found a positive association between the size of TMTs and the success of high-tech organizations. Damanpour (1987) found that a large proportion of managers in an organization facilitated innovation. Meyer (1982) found that organizations with slack resources respond faster and in a more effective manner to environmental crisis than do organizations that have limited resources, such as fewer top managers. Therefore, the size of the TMT is likely to enable a firm to be more innovative and enhance the firm's risk-taking propensity.

Hypothesis 3: The larger the size of the TMT of a firm, (a) the earlier the order of the new product move, (b) the faster the timing of the move, and (c) the greater the likelihood of the firm being a first mover versus an imitator.

It is noteworthy that the importance of TMT size in the context of corporate entrepreneurship is clearly in direct contrast to individual entrepreneurship where the person is characterized as independence-seeking individual with high need for achievement, personal (family) network, and risk-taking ability (Hisrich, 1990).

4.4. TMT heterogeneity

There are several kinds of team heterogeneity or diversity variables. One of the dimensions of classifying diversity variables is the extent to which these variables are related to team tasks on hand (Pelled, 1996). Our research defines heterogeneity in terms of educational

background and organizational tenure of TMT because these variables are high in terms of task relatedness (Pelled, 1996). Diversity variables, such as age, gender, and race, on the other hand, are low in terms of their relatedness to team tasks. In the group dynamics literature, two types of intragroup conflict have been identified (Jehn, 1997). Cognitive conflict is task oriented, that is, team members differ in their perceptions of how the task must be performed. Affective conflict deals with interpersonal clashes among team members. Jehn (1997) cited past empirical evidence to assert that cognitive conflict is useful for team performance whereas affective conflict is detrimental to team performance. Pelled argued that the heterogeneity variables that are task related have a direct positive effect on cognitive conflict and these variables have a weak, if any, effect on affective conflict. Thus, greater heterogeneity in terms of TMT educational background and organizational tenure is likely to increase the task-related conflict thereby improving team performance. This is in line with Hoffman and Maier (1961) who proposed that diversity enhances the range of perspectives and overall problem-solving capacity of the group.

In the TMT literature, Hambrick et al. (1996) associated both positive as well as negative outcomes with team diversity. They suggested that heterogeneity would offer the benefit of a large breadth of perspectives but at the same time would also introduce potential for lack of consensus and inefficiency. With multifaceted backgrounds and orientations, heterogeneous TMTs can observe more opportunities, threats, and be sensitive to stimuli on multiple fronts and thus, have a broader repertoire for generating actions. At the same time, because of its diversity, the heterogeneous team may experience internal conflict and strains that could result in slow decisions. However, as stated earlier, if the focus is on educational background and organization tenure related diversity alone, chances are that one will observe only the positive outcomes.

Eisenhardt et al. (1997) proposed that lack of consensus, that is, conflict, can actually serve a valuable purpose. Their arguments follow from the pioneering study of Janis (1972) who observed that vigilant, conflict-oriented group interactions were associated with effective senior teams in the government. In contrast, he also found that a lack of conflict, termed ‘‘groupthink,’’ was a primary causal factor in major debacles (e.g., Bay of Pigs invasion, Pearl Harbor). Schweiger et al. (1986) found that high conflict led to the consideration of more alternatives, better understanding of the choices, and, overall, significantly more effective decision making. Higher creativity and innovation have also been shown to be associated with higher group heterogeneity (Bantel and Jackson, 1989; Katz, 1982; Wanous and Youtz, 1986), resulting from the ability of team members to challenge each other.

Jackson (1992) proposed that heterogeneity has benefits for unstructured, novel tasks, but homogeneity is better for routine tasks. To be a first mover, a firm must initiate and invent to create the move (MacMillan, 1982) and so, new product introduction is clearly an unstructured and novel task. Thus, according to Jackson’s argument, TMT heterogeneity would be related to early entry of a company with a new product. Hambrick et al. (1996) argued that in comparison to launching initial actions, responding to an adversary’s act does not require as much ability to scan broadly and create wide-ranging alternatives. The

adversary's action provides a template, thereby minimizing the degree to which a response requires new design capabilities.

Specifically, in the context of competitive actions, such as new product introductions, Hambrick et al. (1996) found that heterogeneity was positively related to the tendency to undertake competitive initiatives. Secondly, heterogeneity was also related to the magnitude of competitive actions. They found consistent evidence across several measures that heterogeneous teams were bolder in competitive actions than homogeneous teams. They also found evidence that homogeneous teams were most likely to respond to their adversaries' initiatives rather than initiate action. In other words, heterogeneity was related to early entry while homogeneity was related to later entry.

The above arguments are summarized in the following hypotheses:

Hypothesis 4: The greater the heterogeneity of the TMT of a firm in terms of the diversity of educational background and organizational tenure of managers, (a) the earlier the order of the new product move, (b) the faster the timing of the move, and (c) the greater the likelihood of the firm being a first mover versus an imitator.

5. Method

Our research examined new product introduction in three separate industries: personal computer, long distance telecommunication, and brewing. The new product introductions were drawn from the period of 1975–1990. In selecting our sample to study, we examined a number of alternative industries in terms of the frequency of new product introductions and imitations. We then selected these industries because new product rivalry played a significant role in each industry. For example, the 1975 to 1990 period witnessed the emergence of the long distance telecommunications and personal computer industries, and brewing industry migrated from being a commodity to a brand-driven industry. Other important reasons why we selected these industries are because firms in these industries were fairly undiversified in nature and because these industries have significant media coverage enabling us to identify the new product introductions and imitations. Our study examines 223 new product introduction moves of which 37 are first moves and the remaining are imitations. Table 1 provides summary information on the sample characteristics.

Table 1
Sample characteristics (period = 1975–1990; number of new product moves = 223)

	Personal computer industry	Long distance telecommunications industry	Brewing industry
Number of firms	40	14	10
Number of new products introduced	20	8	9
Number of imitations	125	31	30

5.1. Data collection

5.1.1. New products

The new product introductions and each imitation to the new product were identified from a structured content analysis of *Predicasts F&S Index United States*. A "new product introduction" was defined as a product or service category that was not in existence before the date of announcement. Some examples of new products from the three industries are IBM PC Compatible, fiber optic cable, and packaged draft beer. The firm cited in the first article reporting the introduction of a new product was considered the first-mover firm. The dates of subsequent articles that reported the introduction of the same or imitative product were used to keep track of the timing and order of each sequence of new product moves. A first move and subsequent imitations define an event. The unit of analysis in our particular study is the specific new product move, either first move or imitation within a specific event.

5.1.2. TMT demographics

The source of data was the *Dun and Bradstreet Reference Book of Corporate Managements*. All managers at the level of Vice President and higher were defined as members of the TMT. This is consistent with the definition of TMT adopted by several researchers (e.g., Keck, 1997; Wagner et al., 1984; Wally and Becerra, 2001).

5.2. Dependent variables

5.2.1. Order of new product moves

The firms were arranged in the chronological order of their new product introduction/imitations within each event and assigned a value in terms of the rank order of their new product moves within the event. For example, the first-mover firm was ranked "1," the second mover was ranked "2," and so on.

5.2.2. Timing of new product moves

Timing was measured with reference to the date of the first new product move and the date of the imitation for a focal firm within the event. The first-moving firm was assigned a value of "1" (Day 1) and the date of the imitation for each of the subsequent movers was recorded. The timing of new product moves then represents the elapsed time in days between the date of the first move and the imitation by a focal firm. In the case of first movers, the day the new product introduction was reported was considered "Day 1" and the score for timing equaled 1. In the case of a competitor imitating the first mover on the 30th day, the timing variable was assigned a value of 29 (days) for that competitor.

5.2.3. Likelihood of being a first mover

First movers were assigned a value of "1" and the other firms were assigned a value of "0".

5.3. Independent variables

5.3.1. Organizational tenure

The organizational tenure of TMT was defined as the average of the number of years each of the TMT members had spent in the organization. TMT size was defined as the number of managers at the level of Vice President and above who were listed in the *Dun and Bradstreet Reference Book of Corporate Managements*. Education level was measured by number of years of total education. A Bachelor's degree was treated as the equivalent of 16 years and was given a value of 16. A Master's degree was given a value of 18 and a doctoral degree was assigned a value of 22.

5.3.2. Heterogeneity

Heterogeneity related to organizational tenure was measured by coefficient of variation (Smith et al., 1994). Coefficient of variation is the standard deviation divided by the mean. Heterogeneity related to educational background discipline was calculated by Blau's (1977) heterogeneity index. Blau's index is $(1 - \Sigma P_k^2)$ where P_k denotes proportion of managers in the category k (e.g., Engineering, Business, Law, for education discipline).

5.4. Control variables

Our study accounted for the variation in industry context through two variables: sales growth and profitability. Sales growth was measured as the percentage change in industry gross sales with respect to the previous year's gross sales. Profitability was the percentage of total industry net income to industry gross sales for each year. Annual data for each of the three industries were collected from various sources: BAR/LNA Multi-Media Service ADD $ Summary, Federal Communications Commission (FCC) records, FCC News, Statistics of Communications Common Carriers, Standard and Poor's Industry Surveys, Standard and Poor's Marketing Services Department, and Standard & Poor's Predicasts' Book.

6. Results

The means, standard deviation, and correlation matrix of all variables are shown in Table 2. The industry control variables were not related to either order or timing of new product moves. TMT size and organizational tenure had a correlation of .39 that was worth examining further for possible adverse effects of multicollinearity.

The multiple linear regression models with order and timing of new product moves as dependent variables, and a logistic linear regression model with "first-mover odds ratio" as the dependent variable are shown in Table 3. First-mover odds ratio indicates the likelihood of a firm being a first mover versus imitator.

With regard to Hypothesis 1a–c, TMT education was not a significant predictor of any of the dependent variables. Thus, beyond some threshold of education, the differences in level of

Table 2
Descriptive sample statistics and correlations ($N = 223$)

Variable	Mean	S.D.	1	2	3	4	5	6	7	8	9
Industry sales growth	43.73	188.16	1.00								
Industry profitability	7.26	3.36	.18**	1.00							
Education	17.48	.65	− .07	− .03	1.00						
Organizational tenure	14.58	7.22	.05	− .18**	− .11*	1.00					
TMT size	14.43	10.53	.02	− .05	.05	.39**	1.00				
Educational background heterogeneity	0.58	0.14	.09	.18**	.13*	.11	.21**	1.00			
Organizational tenure heterogeneity	0.50	0.25	− .03	− .07	.04	− .15*	− .18**	.03	1.00		
Order of new product move	11.13	15.34	− .08	− .06	.06	− .20**	− .11	− .14*	− .05	1.00	
Timing of new product move	857.13	1041.29	− .08	− .08	.00	.11	− .03	.10	.05	.28**	1.00

*$P < .01$ (one-tailed).
**$P < .05$ (one-tailed).

TMT education do not seem to account for the differences in the order and timing of new product moves.

Concerning Hypothesis 2b, and as predicted, TMT organizational tenure had a significant, positive relationship to the timing of new product introductions ($b = 19.00$, $\beta^{c} = .13$, $P < .05$). This implies that firms with TMTs with lower levels of company experience are more likely to introduce their new products early. Surprisingly, the relationship between organizational tenure and the order of new product moves was negative and significant ($b = -0.41$, $\beta = -.19$, $P < .01$). This result contradicted Hypothesis 2a. In other words, the results for Hypotheses 2a and b implied that experienced TMTs introduce their product with a shorter time lag vis-à-vis first movers but later in order than rivals. We further explored this interesting but surprising finding and will report our analysis subsequently. Organizational tenure had no significant relationship to the likelihood of a firm being a first mover. Thus, Hypothesis 2c was not supported.

Hypothesis 3 concerned the expected negative relationship between TMT size and new product introduction. We did not find support for Hypothesis 3a as team size was not related to order ($b = -0.05$, $\beta = -.03$, n.s.). Overall, the size of the TMT was marginally and negatively related to timing of new product moves ($b = -10.16$, $\beta = -.10$, $P < .10$). Thus,

[c] β is the standardized coefficient. Tables 3 and 4 report unstandardized regression coefficient, b for the dependent variables *order* and *timing* of new product moves.

Table 3
Results: TMT demographics and new product introductions—order, timing, and likelihood of being a first mover ($N = 223$)

	Order of new product move[a]	Timing of new product move[b]	First mover likelihood (odds ratio), logistic regression model: first mover = 1	
	Unstandardized regression coefficient b (standard error in parenthesis)		B (standard error in parenthesis)	Exp (B)
Industry sales growth	− 0.004 (0.005)	− 0.48 (0.38)	0.002* (0.001)	1.00
Industry profitability	− 0.32 (0.31)	− 21.03 (21.97)	0.02 (0.06)	1.02
TMT education	1.14 (1.60)	− 2.68 (110.49)	− 0.21 (0.32)	0.81
TMT organization tenure	− 0.41** (0.16)	19.00* (10.87)	0.02 (0.03)	1.02
TMT size	− 0.05 (0.11)	− 10.16^{+} (7.40)	0.04* (0.02)	1.04
TMT education background heterogeneity	− 11.34^{+} (7.91)	961.79* (544.67)	− 0.74 (1.38)	0.48
TMT organization tenure heterogeneity	− 5.44^{+} (4.17)	180.70 (287.15)	1.23^{+} (0.80)	3.41
R^2	.07*	.05^{+}		
Adjusted R^2	.04	.01		
F	2.35*	1.43^{+}	χ^2	11.33^{+}

[a] Negative sign of the relationship between order of new product move and the corresponding variable indicates that the higher the value of the variable, the earlier the firm is in the order of new product moves.

[b] Negative sign of the relationship between timing of new product move and the corresponding variable indicates that the higher the value of the variable, the faster is the timing of the firm in new product moves.

*$P < .05$ (one-tailed).

**$P < .01$ (one-tailed).

$^{+}$ $P < .10$ (one-tailed).

larger TMTs are more likely to be faster in their response to the first movers. This provided partial support ($P < .10$) for Hypothesis 3b. TMT size was a significant predictor of likelihood of a firm to be a first mover. Thus, Hypothesis 3c was supported.

With regard to Hypothesis 4, we found that the heterogeneity of the TMT in terms of their educational background discipline was related to the order and timing of new product moves. In case of order, the direction of relationship to educational background heterogeneity was consistent with Hypothesis 4a (order: $b = -11.34$, $\beta = -.10$, $P < .10$). That is, the greater the educational heterogeneity of the TMT, the more likely the firm would be early in the introduction of new products. However, in the case of the timing of new product introductions, the result contradicted Hypothesis 4b (timing: $b = 961.79$, $\beta = .13$, $P < .05$). More specifically, the greater the educational heterogeneity of the TMT, the slower the firm was in its response to new product moves. Educational background heterogeneity did not predict the likelihood of a firm to be a first mover.

We also measured heterogeneity of the TMT in terms of organizational tenure. Consistent with Hypothesis 4a, organizational tenure heterogeneity of TMT was marginally and negatively related to the order of new product moves ($b = -5.44$, $\beta = -.09$, $P < .10$). Taken

together with the effect of educational background heterogeneity, there was reasonable support for Hypothesis 4a. Organizational tenure heterogeneity was not related to the timing of new product introductions. Organizational tenure heterogeneity of TMT was marginally and positively related to the likelihood of a firm being a first mover. This provided some support for Hypothesis 4c.

To address the potential problems of multicollinearity because of a correlation of .39 between TMT organizational tenure and TMT size, we computed variance inflation factor (VIF) for the independent variables. Belsley et al. (1980) proposed that VIFs should be less than 10 to avoid harmful effects of multicollinearity. All the VIFs were just over 1 in value and thus, not a cause for concern. We also conducted separate regression analysis taking either one of the two variables at a time along with other predictors. In general, we found that the significance level of certain coefficients changed (increased or decreased) somewhat. However, the direction of relationship of each of the variables with the dependent variable remained the same as reported earlier and the magnitudes of standardized regression coefficients also did not change significantly.

As discussed earlier, TMT organizational tenure presented surprising findings where it was negatively related to timing of moves but positively related to order of moves. Accordingly, we explored in more detail the relationship between average organizational tenure of TMT and the timing and order of new product moves. To do so, we carried out a series of post hoc analyses identical to those reported in Table 3 but conducted separately for each industry. This allowed us to investigate whether pooling the data was masking specific industry effects. The results are summarized in Table 4.

An examination of the industry-specific regressions indicates that organizational tenure was negatively related to order in personal computer industry ($b = -0.41$, $\beta = -.18$, $P < .05$). In contrast, it was positively related to order in brewing ($b = 0.17$, $\beta = .33$, $P < .05$) and long distance telecommunication industries ($b = 0.18$, $\beta = .25$, $P < .1$). Thus, there were important industry differences that were masked by pooling the data. More specifically, high levels of organizational tenure were associated with early order of moves in the personal computer industry, whereas the relationship was in the opposite direction in the telecom and brewing industries.

The relationship of organizational tenure to timing was significantly positive in brewing industry ($b = 181.20$, $\beta = .55$, $P < .01$), marginally positive ($b = 66.84$, $\beta = .28$, $P < .1$) in long distance telecom industry, and not significant in personal computer industry ($b = -7.11$, $\beta = -.09$, n.s.). This pattern was similar to the relationship of order of new product move with organizational tenure as shown in Table 4. Therefore, there was no apparent contradiction in the relationship of order and timing with TMT organizational tenure when we conducted the analysis for each industry; yet, there were important industry differences in the direction and level of significance. Other post hoc industry-wise analysis did not produce insightful results.

It may be noted that the adjusted R^2 values in Table 4 were zero and even negative for personal computer and long distance telecommunications industry because very few predictors were statistically significant and also, because of the reduced sample size for the industry subset.

Table 4
Industry-wise results: TMT demographics and new product introduction—order and timing[a]

Variables	Order			Timing		
	Personal computer	Long distance telecommunication	Brewing	Personal computer	Long distance telecommunication	Brewing
Education	3.05 (2.523)	− 1.05 (1.03)	0.45 (0.76)	49.41 (90.25)	129.94 (357.46)	− 227.64 (476.15)
Organization tenure	− 0.41* (0.21)	0.18^{+} (0.13)	0.17* (0.09)	− 7.11 (7.6)	66.84^{+} (45.35)	181.20** (55.86)
TMT size	− 0.15 (0.14)	− 0.04 (0.12)	0.06 (0.07)	− 4.74 (5.11)	− 10.53 (41.88)	22.20 (46.22)
Education background heterogeneity	− 5.89 (10.4)	− 10.58 (10.2)	− 1.23 (8.43)	238.17 (372.49)	− 943.24 (3709.56)	− 6376.57 (5279.89)
Organization tenure heterogeneity	0.10 (5.95)	− 0.13 (3.83)	− 2.90* (1.71)	148.13 (213.06)	586.44 (1391.09)	− 1180.52 (1071.38)
R^2	.07*	.13	.24*	.03	.06	.30*
Adjusted R^2	.04	.00	.13	.00	− .08	.20
F	2.14*	0.95	2.13*	0.97	0.45	2.88*
n	145	39	39	145	39	39

[a] Unstandardized regression coefficients reported; standard errors are in parentheses.
*$P < .05$ (one-tailed).
**$P < .01$ (one-tailed).
$^{+}$ $P < .10$ (one-tailed).

7. Discussion

This research focused on new product move as a form of corporate entrepreneurial activity. Following the arguments in corporate entrepreneurship literature (e.g., Morris and Paul, 1987; Lumpkin and Dess, 1996), we suggested that firms would vary in terms of their entrepreneurial activity as indicated by their innovativeness and risk-taking. We argued that firms that rank earlier in order and faster in timing of moves are more innovative and risk-taking than those that follow later in order or are slower in timing. We examined whether TMT characteristics can be used to predict new product moves of firms in terms of order, timing, and likelihood of being a first mover versus imitation. We conceptualized the key characteristics of top management in terms of their expertise, experience, diversity, and magnitude of cognitive resources. We followed the "upper echelon theory" of Hambrick and Mason (1984) to identify the demographics that correspond to the key top management characteristics. Hambrick and Mason (1984) advocated study of "observable characteristics" of managers as indicators of what a manager brings to a business situation. Accordingly, we used the education level of TMT to indicate its expertise, the tenure of top managers in the organization to indicate the team's average experience, and educational and tenure heterogeneity of the team to indicate cognitive diversity. In addition, we used TMT size to represent the magnitude of the cognitive resources available for decision making.

We examined the relationship of these top management demographic characteristics across three industries: personal computer, long distance telecommunications, and brewing. In the overall analysis with 223 new product moves, we found strong results for the effect of shorter organizational tenure of top management on the early order and faster timing of new product move. However, as explained later, the relationship of organizational tenure with order and timing differed with respect to each industry. We found marginal support for greater organizational tenure heterogeneity favoring early order and likelihood of being a first mover. TMT size strongly predicted the likelihood of being a first mover versus imitator. Thus, overall, we found moderate support for the effects of TMT experience, diversity, and availability of cognitive resources on entrepreneurial activity of new product moves.

Our research built on the earlier work of Murthi et al. (1996) and Robinson et al. (1992), who found that pioneering firms possessed managerial skills different from those of the later entrants. These scholars measured managerial skills in terms of efficiency of operations and functional skills. Hambrick and Mason (1984) would argue that the TMT demographic characteristics are closer to the intrinsic skills of top managers than the outcome measures, such as operational efficiency or financial control. Thus, building on the work of scholars in the new product literature, we empirically illustrate the role, although moderate, of top management characteristics in predicting the order and timing of new product moves, and the likelihood of a firm being a first mover. Our study is also an initial response to the call for research on the relationship between top management and new product development raised by Brown and Eisenhardt (1995) in their review of product development literature.

Our post hoc industry analysis provides perhaps even more important insight. For example, in the personal computer industry characterized by a high-velocity environment, the expertise and knowledge that emerge as a function of experience, appear to stimulate

innovation. We found that in high-tech industries, the benefit of knowledge acquired through longer tenure outweighs the inertial effects. This is consistent with the role of market knowledge identified by Li and Calantone (1998) as crucial for new product advantage in the software industry. On the other hand, in the case of an industry, such as brewing that operates in a stable environment, longer tenure may lead to complacency and cognitive inertia. Hambrick and Mason (1984, p. 200) argued that "years of inside service by top managers will be negatively related to strategic choices involving new terrain, for example, product innovation and unrelated diversification." We found this proposition to be echoed in our results for the brewing industry, a representative context of the period when Hambrick and Mason advanced their theory. With the advent of high-velocity and knowledge-rich industries, such as computers, we may need to revisit the propositions of upper echelon theory and much of the research in this area as indicated by our differing results across industries.

The between-industry differences emphasize that there is no single set of managerial characteristics leading to new product development success in all contexts. The varying industry effects have implications for entrepreneurial activity literature in that it may limit the generalizability of any single theory or in other words, industrial characteristics may be important boundary conditions. Our findings point out that the previous research in first mover and new product streams on TMTs using pooled data across industries may have masked important industry effects.

We found that the variance in the order and timing of new product moves explained by the top management characteristics varied across industries (see Table 4). An examination of the values of R^2 reveals that the explanatory power of TMT characteristics is highest for brewing industry (R^2=.24, order of move as the dependent variable) and appears to differ significantly from the variance explained in the order of new product moves in long distance telecommunication (R^2=.13) and personal computer (R^2=.07) industries. This suggests that the extent to which the TMT plays a role in the new product introduction decision may vary by industry. The results are strongest for brewing industry, which, in general, is likely to witness fewer new product introductions compared to the personal computer and long distance telecommunication industries.

With firm performance as the outcome, Finkelstein and Hambrick (1996) listed several external factors that could affect the managerial discretion, or latitude of action. They argued that the extent to which managers make a difference to firm performance would vary depending on the industry structure, market growth, degree of product differentiation, nature of competition, and the regulatory environment. With order and timing of new product moves as the outcome, the identification of the relevant industry characteristics to explain effects across industries was beyond the scope of the current paper, but this is an important direction for future research.

We started this research with the goal of improving our understanding of how TMT strategic choices, proxied through demography, impact a specific form of entrepreneurial activity, the order and timing of new product moves. We found that TMT characteristics affect the order and timing of new product moves but the effect is not strong. For example, TMT education did not show even one significant result. Organization tenure was by far the most

relevant predictor with significant or marginally significant results in seven of the nine regressions.

It is important to acknowledge certain limitations of the study. Researchers (e.g., Priem et al., 1999) have noted the limitations of studying top managers through their demographic characteristics. According to these authors, the demographic characteristics tell us little about the psychological characteristics of the individual executives. Moreover, it is difficult to conclude that all the top executives listed in any public source actually work as a team. While it is indeed desirable to have more direct measures (e.g., through interviews and surveys) of TMT dynamics, for a study that examines a 15-year long period, such an approach is not practical. In addition, in defense of demographic characteristics, one might argue that these are observable characteristics and therefore, competitors and analysts might be able to improve their predictions of market actions through their knowledge of TMT characteristics.

In terms of implications, we would conclude that TMT demographics have only a limited effect on the new product moves. This also indicates that there are several unexplained factors that affect the order and timing of new product moves. Because order and timing of new product moves are important areas of corporate entrepreneurship, discovery of their antecedents is a recommended line of future research. In addition to the top management characteristics, several other organizational factors (e.g., culture, employee skills, organization structure, and strategy orientation) might also be important.

Future research might find stronger effect by using more direct measures of TMT expertise, experience, cognitive diversity, and resources and examining intervening process variables related to strategic decision making. It may also be useful to examine the relationship between TMT characteristics and new product performance. Our post hoc industry-wise analysis suggests that the impact of TMT characteristics on entrepreneurial activity of new product moves is more complex than initially expected. As such, it is deserving of more research.

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