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THE TIMING OF COMPETITIVE MARKET ENTRY: AN EXPLORATORY STUDY OF NEW INDUSTRIAL PRODUCTS*

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In a dynamic, competitive environment, the decision to enter the market should be timed to balance the risks of premature entry against the missed opportunity of late entry. Previous research has mainly focused on the strategic aspects of the entry-time decision. In this paper we review the literature and develop a set of propositions about the timing of new product entry. Then we empirically test the relationship between the market-entry time and the likelihood of success for new industrial products.
(COMPETITIVE MARKET ENTRY; NEW PRODUCT PLANNING; MARKOVIAN DECISION MODEL)

1. Introduction

The choice of market-entry time is one of the major reasons for new product success or failure (Hopkins and Bailey 1971; Crawford 1977; Booz, Allen and Hamilton 1982). The risks and opportunities of a new product vary due to changes in the general economy, changes in customer preferences, and evolution of the industry's life cycle. The R&D and marketing investments also change the level of the opportunities and risks of the new product. For example, a late entry may allow for more investments for designing a better product, providing appropriate engineering support, and/or developing an effective marketing program, which will reduce the risk of failure. Thus, the decision to enter the market should be timed to balance the risks of premature entry (entry too early) and the problems of missed opportunities (entry too late).

In §2 of this paper, we review the economic and marketing literature and develop a set of propositions about the timing of new product entry. In §3, using a French data base, we examine the relationships between various entry-time measures and a long-term performance measure for new industrial products. In §4, we discuss directions for future research. In an appendix we suggest a markovian decision framework through which an appropriate entry time for a new product can be calculated.

2. Research on the Timing of Market Entry

The timing of market entry is a quantitative, tactical decision as well as a qualitative, strategic decision (Exhibit 1). The qualitative decision is typically addressed as an entry-strategy problem: Should a firm try to be a pioneer or a follower? The tradeoff between the advantages and disadvantages of being the pioneer or the follower is the major issue for this entry-strategy decision. The quantitative decision is typically addressed as an entry-time problem: When should a new product enter the market? A potential pioneer must determine its entry-time so as to balance the opportunities/benefits with an innovation and the risks/costs associated with product development and marketing. A potential follower must consider not only the marketing activities of the early entrants and the evolution of the industry but also the competition of other potential entrants.

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In this section we review the literature and develop propositions about the relationship between the entry-time decision and the market performance of new products.

2.1. *Qualitative Decisions: Pioneering or Following*

Advantages and Disadvantages of Pioneering. The pioneer sees both advantages and disadvantages by being the first in the market (Porter 1985). On the demand side, the first entrant can gain recognition and establish reputation in the marketplace, which will generate word-of-mouth effects. Bain (1956) indicated that existing products have an advantage because of consumer traits that lead to stable preference patterns. Once buyers use the first entrant's product, they tend to be willing to pay more for it than for other new products (Lane and Wiggins 1981; Schmalensee 1982). The pioneer can also occupy the preferred market position (Urban, Carter and Gaskin 1986). On the cost side, production costs for the pioneer tend to be lower than those for later entrants (Abell and Hammond 1979; Robinson 1988a). This so-called experience curve effect increases the first entrant's cost advantage and profit potential. The pioneer, however, has to bear most of the costs and risks of developing the product and the market for the product. The first entrant must also absorb the risk that imitators may copy the innovation in a short time and with less costs (Mansfield, Schwartz, and Wagner 1981).

The tradeoff between the advantages and disadvantages of being the pioneer can be summarized as:

PROPOSITION 1. *The pioneer sees the advantages of building reputation and capitalizing cost dynamics, but also sees the disadvantages of absorbing the risks and costs associated with product and market development.*

Pioneering and Market Performance. Several empirical studies have been reported about the impact of pioneering on new product performance. Biggadike (1976) studied 40 industrial product entries and found that pioneering entrants generally maintained their market share advantage. Dillon, Calantone and Worthing (1979) reported in their study of 174 industrial products that pioneering was one of the major determinants of long-term success of a new product. Robinson and Fornell (1985) found that pioneers tend to have higher quality products, broader product lines, and stronger distribution supports.

In a cross-sectional study of 129 successful consumer products, Urban et al. (1986) reported that second entrants obtained, on average, only about three quarters of the market share of the pioneer, and that later entrants were able to capture progressively smaller shares. In a time series analysis of sales in the prescription drug industry, Bond and Lean (1977) found that the first firm to offer a new product received a substantial

EXHIBIT 1

Entry-Time Decisions: Problems and Determinants

	Qualitative Decisions	Quantitative Decisions
Decision problems	Should we be a pioneer or a follower?	When should we enter the market? (a) as a pioneer? (b) as a follower?
Determinants of the decisions	Pioneer's or follower's advantages and disadvantages	1. R&D competition 2. Entry competition 3. Product competition 4. Demand potential 5. Market evolution 6. Marketing rivalry

and enduring sales advantage. However, later entrants who offered therapeutic novelty also achieved substantial sales when the entry was backed by heavy promotional expenditures. A study of the cigarette market by Whitten (1979) reported that the brand that entered first received a substantial sales advantage in six out of seven cigarette market segments. She also observed, however, that later entries in rapidly growing markets or entries that were significantly differentiated from existing products could gain substantial shares or even oust the first entrant from its dominant position. Findings about the relationship between the choice of pioneering or following and the market performance of a new product can be summarized as:

PROPOSITION 2. *If a new product performs well, the pioneer is more likely to see a larger market share than the followers who enter the market later.*

PROPOSITION 3. *Followers are most successful when they develop superior products and support them with strong promotional spending and aggressive pricing.*

2.2. *Quantitative Decisions*

2.2.1. *Entry Time of the Pioneer.*

Competition in R&D. Many R&D decision models in the economic literature have addressed the uncertainty and competitive nature of new product development. Kamien and Schwartz (1972) developed an R&D decision model for a situation where an innovation needs a fixed amount of investment to complete and the first innovator is rewarded by all the benefits of the innovation. They showed that (a) the speed of a potential pioneer's innovation first increases and then decreases as the intensity of rivalry increases, and (b) both the prospect of large rewards from innovation as well as the fear of large losses from failure to innovate accelerate product development. Fethke and Birch (1982) reported that a greater incentive for early innovation exists when the intensity of rivalry increases over time.

Game theoretic models by Loury (1979), Lee and Wilde (1980), Dasgupta and Stiglitz (1980), and Reinganum (1981) examined the relationship between competitive R&D spending among potential pioneers and the level of socially optimal R&D investment. Deshmukh and Chickte (1977) developed a markovian R&D decision model where the terminal reward of a new product was defined as a function of its relative quality. The analysis of the optimal stopping time with this model suggested that the lower the level of competition, the lower the interest rate, and the greater the firm's financial resources, the higher the level of resulting product quality, and the longer the delay of market entry.

A common premise of the entry timing models in the economic literature has been as follows:

PROPOSITION 4. *If a pioneer's market entry creates a new product class, entry too early may push an underdeveloped product into the marketplace; however, if entry is delayed too long, the firm may sacrifice the benefits of being first with a new product or technology.*

Demand Potential. The level of market potential at the time of entry is an important factor for the pioneer's success. Abell (1978) stated that "there are only limited periods during which the 'fit' between the key requirements of a market and the particular competency of a firm competing in the market is at an optimum." (p. 21) He argued that the entry of a new product should be timed to coincide with periods during which such a "strategic window" is open. Bucknell (1982) discussed three cases of the window timing situation in terms of the existence of demand: when the window is ready (optimal entry), when the window moves (poor timing), and when the window does not exist (improper market assessment). Jones (1985) reported several cases of late market entry that doomed products financially because of the loss of demand potential even though the products

were at least on a technical par with the competition. Such failures were most likely to occur when the product life cycle was short.

The discussion of "strategic window" in terms of the demand potential suggests:

PROPOSITION 5. *Success or failure of the pioneer depends on the level of demand potential at the time of entry, a quantity that is not easily predicted correctly at an early stage of the product development.*

2.2.2. *Entry Time of a Follower.* The timing of entry into a market having existing competitors should consider various market uncertainties associated with entry competition, industry evolution, R&D capability, and competitive marketing responses.

Entry Competition. When the existence of demand for a new product is proved by a pioneer, other firms are attracted to enter the market as followers. The likelihood of competitive entry depends on the attractiveness of the market (expected rate of return or market growth, for example) and the entry barriers that must be overcome by followers. Empirical studies have reported that other things being equal, earlier market entry is rewarded with higher market share. Urban et al. (1986) found that the earlier the brand's order of entry, the greater is that brand's long-term market share. Yoon and Lilien (1985) reported that for imitative new industrial products, short-term market share performance decreases with delay of market-entry time. Jones (1985) discussed examples of *successful* programs, including IBM's "crash" program, Boeing's "get-it-right" strategy, and Hewlett Packard's "quantum-jump" strategy. Barriers to market entry often make a new entrant less profitable than the established firms in the industry (Bain 1968; Stigler 1968; Ferguson 1974). Entry barriers may originate from economies of scale, experience curve effects, proprietary technology, patent protection, or other advantages of the pioneer discussed in §2.1.

The empirical findings about the effect of entry time and entry barriers on the performance of a new product suggest:

PROPOSITION 6. *The earlier the entry of a follower, the better the performance of that product.*

PROPOSITION 7. *The entry-time decision of a follower is driven by how quickly and effectively the follower can overcome entry barriers.*

Market Evolution: Stage of the Life Cycle. Decisions of entry time relate to the growth of market demand over time—i.e. the product or market life cycle. Levitt (1965, 1966) compared the entry strategy of the originator, who creates an introduction stage by launching an entirely new product, with that of the imitator, who enters the market in the growth or later stage of the market. He recommended a long-range product/market development plan for the originator and an "innovative imitation" strategy for the late entrant. Capon (1978) discussed four different entry strategies: "pioneer" in the introduction stage, "follow-the leader" in early growth, "segmenter" in late growth, and "me too" in maturity. Any of these strategies may lead to success, but each requires different capabilities. Pioneers must invest heavily in R&D to develop products as perfect as possible. Follow-the-leader companies must invest heavily in product and market development. Segmenter companies need to commit substantial resources to market research and product design to identify and satisfy specific needs of particular segments. Me-too companies must promote and price their products aggressively against entrenched competitors.

Schnaars (1986) examined the association between new product performance and entry-time strategy in terms of the product-lifecycle stage at the time of market entry for twelve consumer products. Finding that no one entry strategy was best in all situations, he developed the following strategic suggestions: (a) pioneers must be willing to commit

a great deal of investment to identifying consumer needs, developing new products, building production facilities, and educating consumers; and (b) when the product form changes rapidly and standardization has not been achieved, later entrants may be able to leapfrog earlier entrants by introducing superior products if those products are backed by heavy marketing investment. Biggadike (1976) reported that an entry either into the introductory or mature stage was associated with a negative return on investment for at least the first two years. Robinson and Fornell (1985), in a study of the PIMS data for 371 consumer goods business units, observed that, by the mature phase of the product life cycle, pioneers had, on average, a 29 percent market share, early followers a 16 percent share, and later entrants an 11 percent share. Shaw and Shaw (1986) examined the experience of 13 major firms in the West European synthetic fibers industry and found that, in each case, early entrants who established major market shares early in the growth phase of the product life cycle maintained that leadership nearly 20 years later. In contrast, late entrants not only failed to achieve significant market shares, but also accounted for seven out of the nine market withdrawals seen during the difficult market condition between 1974 and 1981.

The empirical results relating entry time to life-cycle stage and the product's market share performance suggest:

PROPOSITION 8. *Early followers that enter the market in the introductory or growth stages are likely to obtain greater market performance than later entrants.*

PROPOSITION 9. *Later entrants require special circumstances (e.g., rapid technological evolution) and resources (e.g., heavy marketing investments) to gain a jump on competition against earlier entrants.*

R&D and Product Competition. A number of empirical studies have reported that the degree of product newness or uniqueness is often a key factor affecting the success of new products (Calantone and Cooper 1981; Cooper 1985; Lilien and Yoon 1989). Rogers (1983) suggested that "newness" can have positive or negative effects on sales performance, depending on the demonstrability of the new product's usefulness to customers. In a study with a data base of small, technology-based firms, Meyer and Roberts (1986) reported that higher levels of product newness were related to higher levels of sales growth. Kalish and Lilien (1986) developed a market diffusion model for a new technology in which the entry time affects the quality (performance and reliability in particular) of the new product. Their analysis of a problem facing the photovoltaic program of the Department of Energy quantified the penalties that may be associated with entering a market either too early or too late.

The empirical relationship between a firm's R&D investment and its entry-time decision suggests:

PROPOSITION 10. *If the quality of a follower's new product can be easily improved relative to that of the existing products, then a delay of market entry may lead to a better market performance.*

Marketing Competition. Marketing support for new product entry includes market research and planning, consumer education, development of channel relationships, and promotion plans for launching the new product. Goldish (1982) discussed three stages of promotion efforts required for the diffusion of a new technology: concept promotion, product promotion, and brand promotion. Early market entry requires more investment for concept and product promotions and less investment for brand promotion; this relationship is reversed for later entry. He predicted that projections of large sales may entice the innovator to "get in early," but an understanding of required investment may lead to a (more appropriate) delay. More (1984) examined the timing of market research

expenditures in 112 new industrial product situations. He found that the total spending of the companies was consistent with the levels of the risk and uncertainty involved; that is, managers did more research in situations involving new customers and uncertain adoption process. Urban et al. (1986) reported that later entrants could reduce the market share penalty of late entry by supporting the new product with aggressive advertising. Robinson (1988b) and Gatignon, Anderson, and Helsen (1989) examined the competitive responses of the existing firms to new entry, and found that the reaction patterns (in terms of the degree of reaction and the marketing mix employed for reaction) are highly heterogeneous across industry and market situations.

The literature about the relationship between entry timing and marketing support suggests:

PROPOSITION 11. *The marketing effort required to introduce a new product into the marketplace depends on the stage of the life cycle at the time of market entry as well as the degree of familiarity customers have with the technology and the level of competitive responses.*

The propositions we have developed above are summarized in Exhibit 2. Clearly many factors influence the entry-time decision. Yoon and Lilien (1986) integrated several of these factors by developing a new product launch-time decision model that considered the interactions between R&D spending, marketing investment, and demand potential. That model suggested that, in a dynamic, competitive environment, the decision to enter the market must be timed to balance the risks of premature entry against the problems of missed opportunity. The complex interaction between the choice of entry time and the market performance of a new product suggests that both researchers and practitioners dealing with this question must (a) identify key time-varying factors affecting the entry decision, (b) determine the interactions between those factors, and (c) calculate the best entry time.

While there exists considerable conceptual support for many of the propositions developed here, the level of empirical support is quite low. In the next section we employ a data base developed in France to examine how to measure some entry-time variables and how the empirical results can be integrated into a new product entry-timing model.

3. An Exploratory Analysis of Entry Time and New Product Success

3.1. *The Data Base*

The data base used here contains 112 new industrial products (or 91 products excluding those products with incomplete information) from 52 French firms. The products represent a convenience sample from a list of 500 industrial firms registered in France, drawn randomly from a national directory in proportion to the importance of top priority sectors for French national policy. Firms were interviewed in a three-step procedure: (1) a telephone interview, checking whether they had introduced a new product in the last five years, (2) a telephone contact, requesting to participate in the project, after receiving a statement of the project objectives (the acceptance rate was 83% or 52 firms), and (3) a personal interview, collecting the data. Each product had the following information available: (a) R&D financing and spending, (b) product/market entry strategy and related marketing spending, (c) level of competition and market growth, and (d) product performance in terms of the product's market share, sales, and projected long-term product/market development. We have reproduced the industrial sectors represented by the data base in Exhibit 3. The electronics and scientific instrumentation area is well represented, reflecting the high level of innovation. The miscellaneous sector includes a heterogeneous set of industrial products, ranging from computer software to tank engines. Although those products were developed by European companies, they are marketed in most of

EXHIBIT 2

Propositions on Entry Time and New Product Performance

Qualitative Decisions: Pioneering or Following

[Advantages and Disadvantages of Pioneering]

PROPOSITION 1. *The pioneer sees the advantages of building reputation and capitalizing cost dynamics, but also sees the disadvantages of absorbing the risks and costs associated with product and market development* (Bain 1956; Abell and Hammond 1979; Lane and Wiggins 1981; Schmalensee 1982; Porter 1985; Robinson 1988).

[Pioneering or Following and Market Performance]

PROPOSITION 2. *If a new product performs well, the pioneer is likely to see a larger market share than the followers who enter the market later* (Biggadike 1976; Bond and Lean 1977; Dillon et al. 1979; Whitten 1979; Urban et al. 1986).

PROPOSITION 3. *Followers are most successful when they develop superior products and support them with strong promotional spending and aggressive pricing* (Bond and Lean 1977; Whitten 1979; Urban et al. 1986).

Quantitative Decisions: When to Enter the Market?

1. Entry Time of the Pioneer

[R&D Competition]

PROPOSITION 4. *If a pioneer's market entry creates a new product class, entry too early may push an underdeveloped product into the marketplace; however, if entry is delayed too long, the firm may sacrifice the benefits of being first with a new product or technology* (Kamien and Schwartz 1972; Deshmukh and Chickte 1977).

[Demand Potential]

PROPOSITION 5. *Success or failure of the pioneer depends on the level of demand potential at the time of entry, a quantity that is not easily predicted correctly at an early stage of the product development* (Abell 1978; Bucknell 1982; Jones 1985).

2. Entry Time of a Follower

[Entry Competition]

PROPOSITION 6. *The earlier the entry of a follower, the better the performance of that product* (Yoon and Lilien 1985; Urban et al. 1986).

PROPOSITION 7. *The entry-time decision of a follower is driven by how quickly and effectively the follower can overcome entry barriers* (Bain 1968; Porter 1985).

[Market Evolution]

PROPOSITION 8. *Early followers that enter the market in the introductory or growth stages are likely to obtain greater market performance than later entrants* (Biggadike 1976; Shaw and Shaw 1986).

PROPOSITION 9. *Later entrants require special circumstances (e.g., rapid technological evolution) and resources (e.g., heavy marketing investments) to gain a jump on competition against earlier entrants* (Levitt 1965; Capon 1978; Schnaars 1986).

[R&D and Product Competition]

PROPOSITION 10. *If the quality of a follower's new product can be easily improved relative to that of existing products, then a delay of market entry may lead to a better market performance* (Cooper 1979; Kalish and Lilien 1986; Meyer and Roberts 1986; Lilien and Yoon 1989).

[Marketing Competition]

PROPOSITION 11. *The marketing effort required to introduce a new product into the marketplace depends on the stage of the life cycle at the time of market entry as well as the degree of familiarity customers have with the technology and the level of competitive responses* (Goldish 1982; More 1984; Robinson 1988; Gatignon et al. 1989).

EXHIBIT 3

Industrial Sectors Represented in the Data Base

Industrial Sector	# of New Products	% of Total
Electronics, electrical equipment, scientific instrumentation	43	38.4
Chemistry, biochemistry	17	15.2
Construction, earth moving	15	13.4
Transport, services	11	9.8
Metal processing, metallurgy	10	8.9
Food, agriculture	9	8.0
Miscellaneous	7	6.3
Total	112	100.0

the major industrial countries, including the United States. (See Yoon and Lilien 1985 for a more complete discussion of the data base.)

3.2. *Variables*

From these data we identified three key entry-time correlates that relate to the market success of a new product: (a) order of entry, (b) stage of the product life cycle, and (c) product development time prior to market entry (Exhibit 4). The order of entry was measured by the number of competitors at the time of a product's market entry. It indicates the level of market opportunity associated with a particular entry time: for example, relatively larger opportunities are available for earlier entries. The stage of the product life cycle represents the level of market development: for example, an entry in an earlier stage of the product life cycle faces more uncertainty about the expected market response, but sees potentially higher growth. The stage of the product life cycle at the time of a product's market entry was identified as introduction, growth or maturity. The life-cycle stage was confirmed by the average annual growth rate of the market sales during the five years preceding the introduction of the new product (Polli and Cook 1969; Lilien and Yoon 1988). The product development time prior to introduction of a product innovation was measured by the duration (in quarters) between the firm's decision to develop a product and the market entry of the product. We also identified three measures of R&D and marketing effort that vary over entry time: (a) expertise in R&D-production, (b) expertise in marketing, and (c) marketing efficiency.

The success of a new product (given market launch) was measured by a dichotomous variable: whether or not the product grew into a product group for the firm that developed the product. This variable is particularly useful because a firm might base a new product's entry time not only on projections of the product's short-term performance (market share or profit), but also, either on its long-term projected impact on the company's product portfolio or on the possibility that the new product will open a new product category or a new market for the firm (Cooper and Kleinschmidt 1986).

3.3. *Analysis Results*

3.3.1. *Entry Time and Long-Term Performance.* Exhibit 5a displays the data on the long-term success rate of new product (or percentage of the new products that have grown into a product group for the company, i.e., GRPGR = 1 in Exhibit 4) for different stages of the product life cycle and order of entry. Three life-cycle stages (introductory, growth, and maturity) and six entry orders (from the first to the sixth entrant) were compared. It shows that the likelihood of success was higher when the product was introduced into an early lifecycle-stage market and when the order of entry was third to fifth. We statistically test the association of the success likelihood with the product-lifecycle

EXHIBIT 4

Variable Descriptions

Entry-Time Variables

ORDER (order of entry) was measured by asking: "How many competitive products were present in the same market (or as substitute) before launching this new product?"

STPLC (stage of the product life cycle) was measured by asking: "At which stage of development do you think the market was at the year of entry of this product: introductory, growth, maturity, or end of maturity?"

PDVTM (product development time) was measured by asking: "What was the approximate duration (in quarters) between the time the decision was made to proceed with product development and its introduction into the market place?"

Other Explanatory Variables Related to Entry Time

GRWTH (market growth rate) was measured by asking: "What was the average annual growth rate (in % per year) of the market during the five years preceding the introduction of 'this product'?"

EXPPR (expertise in R&D/production) and
EXPMK (expertise in marketing) were measured by asking: "What levels of expertise does your (new product development) department have concerning the product activities below?":

	excellent						poor
Marketing	1	2	3	4	5	6	7
R&D and Production	1	2	3	4	5	6	7

MKTEF (marketing efficiency) was measured by the average value of the answers to the question: "If you compare the following elements of marketing strategy for 'this product' to those of your main competitor, is your strategy much more efficient (=1) or much less efficient (=7), or between (2, 3, 4, 5, or 6): Advertising, Advertising-distribution support, Sales force, Technical service, Trade shows or Expositions, and Distribution?"

Measure of (Long-term) Product Success

GRPGR (growth to a product group) was measured by asking: "Did this new product lead to development of a product group for your company?" (GRPGR = 1 if yes, 0 otherwise)

Source: Novaction Company, 1980.

stage in Exhibit 5b and with the market-entry order in Exhibit 5c (Snedecor and Cochran 1980, pp. 124–130). The overall likelihood of long-term success in this study (63.7% or 58 out of 91 cases) is somewhat lower than the probability of economic success given commercialization (74%) reported by Mansfield and Wagner (1975) in their study of new industrial products.

The results of the χ^2 tests in Exhibit 5b suggest that (a) the likelihood of success was about the same between the introductory stage (65.6%) and the growth stage (68.4%) ($\chi^2 = 0.0601$, two-tail $p = 0.8065$), and (b) the likelihood of success during either the introductory or the growth stage tends to be higher than during the maturity stage (52.4%) ($\chi^2 = 0.9531$, one-tail $p = 0.1645$ in case of introductory vs. maturity stage, and $\chi^2 = 1.5314$, one-tail $p = 0.1080$ in case of growth vs. maturity stage).

The results of the χ^2 tests in Exhibit 5c suggest that (a) the likelihood of success for the first and second entrants (50.0%) tends to be lower than that for the third and fourth entrants (76.0%) ($\chi^2 = 2.4806$, one-tail $p = 0.0577$), and (b) the likelihood of success for the third and fourth entrants tends to be higher than that for the fifth and sixth entrants (55.6%) ($\chi^2 = 1.9175$, one-tail $p = 0.0831$). Exhibit 5c′ shows that this nonlinear relationship between the order of entry and the likelihood of new product success is more strongly supported when the χ^2 test is conducted only for the products that entered early lifecycle-stage markets, i.e., in the introduction or growth stage.

EXHIBIT 5

Long-term Success/Failure of New Industrial Products

EXHIBIT 5a

Data Base: Classification and Success Rate (Success Rate, %)[a]

Product-Lifecycle Stage (STPLC)[b]	Order of Entry (ORDER)[c]							
	1st	2nd	3rd	4th	5th	6th	7th & over (7–156)	Total
Introduction	50 (6)	50 (4)	75 (4)	100 (4)	50 (2)	40 (5)	86 (7)	66 (32)
Growth	(0)	0 (1)	75 (4)	86 (7)	67 (3)	67 (6)	65 (17)	68 (38)
Maturity	(0)	100 (1)	100 (3)	0 (3)	100 (1)	0 (1)	50 (12)	52 (21)
Total	50 (6)	50 (6)	82 (11)	71 (14)	67 (6)	50 (12)	64 (36)	64 (91)

( ) indicates the number of new product cases for each cell.

[a] Success Rate = # of cases for GRPGR = 1/# of cases for GRPGR = 0, where GRPGR = 1 (or 0), if a new product has (or has not) grown into a product group.

[b] STPLC: stage of the product life cycle of the entered market.

[c] ORDER: order of entry in the relevant industry.

EXHIBIT 5b

Product-Lifecycle Stage and New Product Success Rate (# of Cases)

Success/Failure	Product-Lifecycle Stage (STPLC)			
	Introduction	Growth	Maturity	Total
Success (GRPGR = 1)	21	26	11	58
Failure (GRPGR = 0)	11	12	10	33
Success rate (%)	65.63	68.42	52.38	63.74

Results of chi-square tests:

(1) The hypothesis that the likelihood of success was not different between introductory and growth stages is not rejected. ($\chi^2 = 0.0601$, two-tail $p = 0.8065$).

(2) The hypothesis that the likelihood of success during growth stage was higher than that during maturity stage is barely accepted. ($\chi^2 = 1.5314$, one-tail $p = 0.1080$).

(3) The hypothesis that the likelihood of success during introductory stage was higher than that during maturity stage could be accepted, but at a quite low significance level. ($\chi^2 = 0.9531$, one-tail $p = 0.1645$).

EXHIBIT 5c

Order of Entry and New Product Success Rate (# of Cases)

Success/Failure	Order of Entry (ORDER)				
	1 & 2	3 & 4	5 & 6	7 & over	Total
Success (GRPGR = 1)	6	19	10	23	58
Failure (GRPGR = 0)	6	6	8	13	33
Success Rate (%)	50.00	76.00	55.55	63.89	63.74

Results of chi-square tests:

(1) The hypothesis that the likelihood of success for the first and second entrants was lower than that for the third and fourth entrants is not rejected. ($\chi^2 = 2.4806$, one-tail $p = 0.0577$).

(2) The hypothesis that the likelihood of success for the third and fourth entrants was higher than that for the fifth and sixth entrants is not rejected. ($\chi^2 = 1.9175$, one-tail $p = 0.0831$).

EXHIBIT 5c'

Order of Entry and New Product Success Rate (For products that entered the market during the introduction or growth stage of the product life cycle) (# of Cases)

	Order of Entry (ORDER)				
Success/Failure	1 & 2	3 & 4	5 & 6	7 & over	Total
Success (GRPGR = 1)	5	16	9	17	47
Failure (GRPGR = 0)	6	3	7	7	23
Success Rate (%)	45.45	84.21	56.25	62.96	67.14

Results of chi-square tests:

(1) The hypothesis that the likelihood of success for the first and second entrants was lower than that for the third and fourth entrants is not rejected. ($\chi^2 = 4.9827$, one-tail $p = 0.0129$).

(2) The hypothesis that the likelihood of success for the third and fourth entrants was higher than that for the fifth and sixth entrants is not rejected. ($\chi^2 = 3.3315$, one-tail $p = 0.0344$).

EXHIBIT 5d

Order of Entry, Stage of Product Life Cycle, and New Product Success Rate (# of Cases)

	Order of Entry (ORDER)				
Success/Failure	1 & 2	3 & 4	5 & 6	7 & over	Total
Introduction Stage					
Success (GRPGR = 1)	5	7	3	6	21
Failure (GRPGR = 0)	5	1	4	1	11
Success Rate (%)	50.00	87.50	42.86	85.71	65.63
Growth Stage					
Success (GRPGR = 1)	0	9	6	11	26
Failure (GRPGR = 0)	1	2	3	6	12
Success Rate (%)	—	81.82	66.67	64.71	68.42
Maturity Stage					
Success (GRPGR = 1)	1	3	1	6	11
Failure (GRPGR = 0)	0	3	1	6	10
Success Rate (%)	—	50.00	—	50.00	52.38

No interaction was detected between the order of entry and the stage of the product life cycle, although there is a possibility that the penalty of late entry (in terms of the likelihood of new product success) was lower during the growth stage than during the introduction stage.

In summary, the results of χ^2 tests in Exhibit 5 support some of the propositions discussed in §2 as follows:

Result 1. Success is higher when a new product is launched during the introduction or growth stage of the product life cycle, and lower when it is launched during the maturity stage. This result supports Propositions 6 and 8.

Result 2. Success is lower for first and second entrants; higher for third and fourth; and again lower for fifth and sixth, and subsequent entrants. This result supports Propositions 4 and 10, at least indirectly.

We could not detect any interaction between stage of the product life cycle and order of entry, although there is a possibility that the penalty of late entry (in terms of the likelihood of success) was smaller during the growth stage than during the introduction stage (Exhibit 5d). (To test this interaction hypothesis we need more samples than available in our data base.)

EXHIBIT 6

Two-group Mean Test of PDVTM[a] between Successful and Unsuccessful Products

	Mean (and Sample Size)		Probability[b] that the Two Means are Equal
	Successful[c] Products	Unsuccessful[c] Products	
Total Sample	8.84 (58)	5.47 (33)	0.004
Introduction	9.62 (21)	5.45 (11)	0.048
Growth	8.14 (26)	5.58 (12)	0.216
Maturity	9.00 (11)	5.37 (10)	0.079

[a] PDVTM is the duration (in *quarters*) between the development decision and the market launch of a new product, i.e., product development time.

[b] The probability is based on the assumption that the variances are unequal between the two means.

[c] GRPGR = 1 (or 0) is considered as successful (or unsuccessful) product in the long-run as defined in Exhibit 4.

3.3.2. *Dynamics of New Product Success Determinants*. Exhibit 6 compares the product development time between successful and unsuccessful products. It shows that development time was longer for successful products than for unsuccessful products, particularly if the products were launched in the introductory or the maturity stage of the product life cycle. An implication of this finding is that a delay of market entry to develop a higher quality product or a more efficient marketing program enhances the likelihood of success with the new product.

Exhibit 7 confirms that an innovating firm's R&D/production expertise with a new product was consistently higher when the product development time was longer. It also shows that a firm's marketing expertise and the competitive efficiency of its marketing program for the new product increase as the market entry-time is delayed, particularly during the maturity stage of the product life cycle. Since a firm's R&D/production expertise, marketing expertise, and the competitive efficiency of its marketing program for the new product are major determinants of new product success (see Appendix A), the results imply that likelihood of success may increase with entry time delay, or:

Result 3. Success is higher when the time lag between the development decision and market entry is longer. The result supports Propositions 4 and 10.

Result 4. Delay of entry accompanies greater production and marketing expertise. The result supports Propositions 10 and 11.

EXHIBIT 7

Correlation[a] between PDVTM[b] and Entry-time Correlates

	Production Expertise[c]	Marketing Expertise[d]	Marketing Efficiency[e]
Total Sample	0.41 (0.00)	0.17 (0.11)	0.06 (0.63)
Introduction	0.38 (0.03)	0.12 (0.51)	0.19 (0.38)
Growth	0.37 (0.02)	0.13 (0.45)	0.23 (0.22)
Maturity	0.56 (0.01)	0.44 (0.05)	0.57 (0.03)

[a] Pearson correlation coefficient; the value in ( ) is the probability that the correlation coefficient is equal to zero.

[b–e] Are as defined in Exhibit 4.

3.4. *Managerial Implications*

These empirical results support a general premise on the entry-time decision: the decision to enter the market should be timed to balance the risks of premature entry against the problems of missed opportunity. They also suggest several policy implications for alternative entry strategies, particularly for the pioneer, early follower, and late follower.

(1) A potential pioneer in industry should spend time to build its expertise in R&D, engineering, production, and marketing before entering the market: the marginal return of those R&D and marketing efforts appears to be high enough in general to offset the risk of being caught by rival innovators.

(2) An early follower who intends to enter the market in the introduction or growth stage of the product life cycle should hasten its new product entry, unless its expertise in R&D-engineering-production can be significantly enhanced by a short delay of entry time. In many situations the benefit from market development by the pioneer can be easily and quickly capitalized, whereas the additional return from further R&D and marketing effort is not very high.

(3) A late follower that imitates early entrants during the late growth or the maturity stage of the product life cycle should enter the market as early as possible: the benefit from further market development becomes marginal and the penalty for late entry increases rapidly.

The entry time decision is a balancing act, however. The propositions and empirical results outlined here are guidelines. When to enter the market depends on a firm's ability to comprehend and integrate these results into an analytical decision framework, that considers these general results along with firm and market-specific measures of success rate, costs, marketing efficiency, and the like. (A markovian decision framework is illustrated in the Appendix B.)

4. Conclusion

A review of the literature reveals that the timing of market entry is a strategic, qualitative decision as well as a tactical, quantitative decision. The strategic choice between pioneering and following is a problem of balancing the advantages and disadvantages of the pioneer and the follower. The tactical decision of entry time is a problem of balancing the risks of premature entry and the missed opportunity of late entry. An empirical analysis of a French data base confirmed several managerial guidelines on entry timing, including (1) enter earlier when the expected return is higher, (2) enter later when the market is evolving more rapidly: the first entrant sees high returns if he is successful, but bears the risk of lower likelihood of success than later entrants.

This work has several limitations that suggest the need for future research. With respect to the empirical study, we need to develop a larger, more homogeneous data base to confirm the dynamic structure of the entry-time measures and their relationships with new product performance. That data base should include more observations on particular products over time and observations in different countries. We also need more continuous measures of the entry-time and performance variables that would allow stronger statistical tests than the correlation and group-mean analyses conducted in this study. A richer data would allow us to investigate the relative importance of the key factors affecting the entry-time decision and interactions between those factors. Future research should also jointly consider the decision variables of market entry and investments in marketing expertise.[1]

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Appendix A. Determinants of New Product Success/Failure: A Discriminant Analysis Model

We estimated linear discriminant functions to examine the joint impact of the key entry-time correlates on a new product's long-term success. The key variables that distinguish new products that have grown into product groups (GRPGR = 1) from those that have not (GRPGR = 0) are shown in Exhibit A.1. For original new industrial products that have undergone major technological changes in new markets, we found that, (a) the firm's marketing experience or expertise (EXPMK), (b) competitive efficiency of the firm's marketing program (MKTEF), and (c) stage of life cycle of the entered market (STPLC) are important for a new product's success. For reformulated new industrial products that have undergone major modifications on the firm's existing products, potential buyers' attitude toward (or satisfaction with) the firm's existing products (ATTRL) is also important for a new product's success, while stage of life cycle and marketing efficiency are less important. When estimating the discriminant functions, we employed stage of the life cycle (STPLC) rather than order of entry (ORDER) as a measure of entry time because order of entry is nonlinearly related to new product success, GRPGR, as we have seen in §3.3.1. For both original and reformulated products, more than 90 percent of the products in the data base could be correctly classified.

The results can be summarized as: A product's long-term success is closely related to (a) the firm's marketing expertise, (b) efficiency in marketing program, and (c) stage of life cycle of the entered market. Potential buyers' attitude toward the firm's existing products is also important for reformulated new industrial products. These results support Propositions 8 and 11 in Exhibit 2.

Appendix B. An Entry-Time Decision Model

We introduce a markovian decision model to illustrate how we can calculate the optimal entry time for a new product in a dynamic, competitive environment. The model draws on the results of our empirical work in §3 that showed (a) how new product success rates are related to the stage of market development and (b) how marketing expertise accumulates with increased delay of entry time.

An Illustrative Problem

Consider the following decision problem. At the start, assume that the market is empty, so that if we were to enter with a new product, we would be a pioneer. At any point we can "Enter the Market" ($k = 1$), "Delay

EXHIBIT A1

Estimation of Linear Discriminant Functions for New Product Success/Failure

Original New Products[a] (# of cases analyzed = 18)

$$\text{GRPGR} = 5.65 - 2.88\ \text{STPLC} - 0.29\ \text{EXPMK} - 0.24\ \text{MKTEF}$$

(% of cases properly classified = 94.4%)

Reformulated New Products[b] (# of cases analyzed = 22)

$$\text{GRPGR} = 1.86 - 0.07\ \text{STPLC} - 0.42\ \text{EXPMK} - 0.05\ \text{MKTEF} - 0.38\ \text{ATTRL}$$

(% of cases properly classified = 91.3%)

[a] Products that have undergone important technological changes that permit them to be competitive in new markets, or have applied a technology that has never before been part of the value of the product.

[b] Products that have undergone important modifications which affect their use, lower their prices, or make them more durable.

Variable definitions are the same as those given in Exhibit 4 except for ATTRL:

$$\text{GRPGR} = \begin{cases} 1, & \text{if a new product has grown into a product group, and} \\ 0, & \text{otherwise} \end{cases}$$

STPLC = stage of product life cycle at the product's market entry. 1 = introduction, 2 = growth, and 3 = maturity.

EXPMK = the firm's expertise in marketing activity. 1 = strong, 2 = average, and 3 = weak.

MKTEF = competitive efficiency of the firm's marketing mix. 1 = much more efficient, . . . , 7 = much less efficient.

ATTRL = buyer's attitudes towards the firm's existing products. 1 = completely satisfied, . . . , 7 = totally dissatisfied.

EXHIBIT B1

State Definitions for Markovian Decision Problem

State #	Marketing Expertise (ME)	Market Development (MD)*
1	1	P
2	1	EF
3	1	LF
4	2	P
5	2	EF
6	2	LF
⋮	⋮	⋮
13	5	P
14	5	EF
15	5	LF

* P = Pioneer. EF = Early Follower. LF = Late Follower.

1 Period" ($k = 2$), or "Quit" ($k = 3$), where k is a decision (and action) indicator. If the decision is to delay ($k = 2$), the levels of our marketing expertise and the stage of market development will change during the delay period according to a set of transition probabilities. A "period" in this formulation is a time period in which investments are made in marketing and therefore during which the level of marketing expertise might rise to a higher level.

To keep the problem simple, let us assume that there are five levels of *marketing expertise* (ME: 1 to 5) and three levels of *market development* for a potential entrant (MD: P for pioneer, EF for early follower, LF for late follower) as in our data base. Then, the product/market situation can be in one of 5×3, or 15, possible states. To characterize our entry decision problem as a markov process, we define the states in Exhibit B.1. The definition of this state space can be easily expanded to incorporate the effects of order of entry or levels of R&D/production expertise. If other firms exist when we consider entry, the state space will be truncated depending on the initial state.

Transition Probabilities

For each of these states we define a set of transition probabilities for the delay decision ($k = 2$):

$P_{ij}(k = 2)$ = probability of moving from state i to state j under action $k = 2$ in a single time period.

Note that

$$P_{15,15}(k) = 1, \quad \text{and}$$

$$P_{ij}(2) = 0 \quad \text{for} \quad j < i.$$

These data could be based on an historical analysis of the industry, supplemented by managerial judgement.

Costs/Rewards

We assume that by entering the market ($k = 1$), certain costs and returns are seen. They are state-specific as:

NPV_i = monetary return if the product were successfully launched from state i,

C_i = cost of entering market from state i,

q_i = probability of successful entry from state i, and

U_i = cost of 'quitting' from state i.

Note that q_i is the likelihood of success of a new product launched at the levels of marketing expertise and market development discussed in §3, while the other data should be available from the firm.

Then, we can define the reward associated with the decision at state i as:

$$R_{ik} = \begin{cases} q_i \text{NPV}_i - C_i & \text{if enter} \quad (k = 1), \\ -D_i & \text{if delay} \quad (k = 2), \\ U_i & \text{otherwise} \quad (k = 3), \end{cases} \tag{1}$$

where D_i is the cost associated with a delay of entry decision at state i. This cost includes the continued R&D, organizational, and other expenses associated with the efforts needed to bring the new product to the next level of marketing expertise.

A Markovian Decision Model

Derman (1970) has shown that the optimal decision rule in this markovian decision problem is of the form $\{V_{ik}\}$ where $V_{ik} = 1$ implies taking action k at state i. The $\{V_{ik}\}$ can be derived from the solution to the following linear program:

$$\begin{aligned}
&\text{Find } \{x_{ik}\} \\
&\text{to maximize} \quad \sum_{i=1}^{15}\sum_{k=1}^{3} R_{ik}x_{ik} \\
&\text{subject to:} \quad \sum_{k=1}^{3} x_{jk} - \sum_{i=1}^{15}\sum_{k=1}^{3} P_{ij}(k)x_{ik} = 0, \qquad j = 1, \ldots, 15, \\
&\qquad\qquad \sum_{i=1}^{15}\sum_{k=1}^{3} x_{ik} = 1, \\
&\qquad\qquad x_{ik} \geqq 0, \qquad i = 1, \ldots, 15; \qquad k = 1, 2, 3.
\end{aligned} \tag{2}$$

If we assume that we were to consider launching many new products, we could interpret x_{ik} as the long-run fraction of decision epochs when the product/market situation is in state i and action k is made. The V_{ik} can be obtained as follows:

$$V_{ik} = \frac{x_{ik}}{\sum_{j=1}^{3} x_{ij}}, \qquad i = 1, \ldots, 15.$$

The objective function of the linear program is the (maximized) long-run average reward of the new product, while the first set of constraints represent balance equations. (Those products getting into a state and those leaving must cancel.) The second constraint requires that the sum of the fractions x_{ik} must be equal to 1 (i.e., that actions are taken) and the last set of constraints represent nonnegativity conditions for the decision variables.

Optimal Solution and Sensitivity Analysis

An optimal solution of the entry timing decision problem can be found by applying the simplex method to the linear program (2). The problem can also be solved through the policy iteration method or dynamic programming method (Derman 1970; Tijms 1986).

The linear programming approach also allows the use of sensitivity analysis options available with most computer codes. To run a sensitivity analysis we can restate the reward function of the markovian decision problem in equation (1) as:

$$R'_{ik} = \begin{cases} q_i(\text{NPV}_i/D_i) - (C_i/D_i) & \text{if enter,} \\ -1 & \text{if delay,} \\ U_i & \text{otherwise,} \end{cases} \quad \text{or} \tag{3}$$

$$R'_{ik} = \begin{cases} q_i\text{NPV}'_i - C'_i & \text{if enter,} \\ -1 & \text{if delay,} \\ U_i & \text{otherwise,} \end{cases} \tag{4}$$

where $\text{NPV}'_i = \text{NPV}_i/D_i$ and $C'_i = C_i/D_i$.

Now, if we let $\text{NPV}'_i = (1 + \Delta_i)\, C'_i$, we get:

$$R'_{ik} = \begin{cases} q_i(1 + \Delta_i)C'_i - C'_i & \text{if enter,} \\ -1 & \text{if delay,} \\ U_i & \text{otherwise.} \end{cases} \tag{5}$$

Using the reward function, R'_{ik}, of equation (5) we can perform a post-optimality analysis on the linear programming solution of the markovian decision problem in equation (2). Sensitivity analysis can show how the entry time decision varies as Δ_i varies. In these sensitivity analyses, Δ_i can be interpreted as the rate of return a firm can achieve by entering the market in state i. (Details of the model and numerical examples are available upon request to the authors.)

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