Do Market Pioneers Maintain Their Innovative Spark Over Time?

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Series No. MKTG 97.095
July, 1997
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ABSTRACT

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While a market pioneer often starts a new market with a very innovative product, is their spark for product innovation typically maintained over the decades? Product innovation strategies below compare market pioneers to late entrants. Across 1822 mature businesses in the PIMS (Profit Impact of Market Strategies) data, market pioneers have a higher probability than late entrants of investing in product innovation. In this sense, market pioneer's maintain their historic strategy of investing in product innovation. Even so, for businesses that invest in product innovation, late entrants have almost twice the level of new product sales as a percent of total sales. Because new products represent the highest degree of product innovation in the PIMS data, market pioneers no longer excel in terms of introducing major product innovations. The empirical evidence below indicates that for both the R&D and non-R&D component of major product innovations, various forces have extinguished the market pioneer's innovative spark.
Do Market Pioneers Maintain Their Innovative Spark Over Time?

A market pioneer often starts a new market with a major or even a radical product innovation. Even though some early followers and late entrants start with an innovative product, it is typically less innovative than the pioneer's initial product. For example, across a sample of start-up ventures, only 9% of the later entrants report entering with a major product advantage versus 33% of the market pioneers (Robinson 1990, p. 1287).

Over time, does the market pioneer continue to introduce the most innovative products? While some market pioneers such as Sony and 3M continue to innovate, others such as Apple Computer seem to have lost their way. For example, the Wall Street Journal (1997, p. B1) says, “Apple Computer, once the master of innovation, hasn’t introduced a really inventive product in a long time.”

Research has examined various advantages to market pioneering. Examples include long-term market share advantages and being perceived as the industry standard. Market pioneer disadvantages include market uncertainties, technological uncertainties, and being challenged by an established giant in a related market. Research though has not yet examined the sustainability of a market pioneer’s product innovation strategy. This paper intends to fill this void. (For literature reviews on market pioneers, see Lieberman and Montgomery 1988, Kerin, Varadarajan, and Peterson 1992, and Robinson, Kalyanaram, and Urban 1994).
Is a market pioneer's product innovation strategy sustainable for literally decades? On the one hand, a market pioneer's historic culture can motivate more frequent investments in product innovation and these investments should emphasize major rather than minor innovations. On the other hand, first-mover advantages with current customers, historic R&D skills, and a higher market share can motivate a pioneer to emphasize minor innovations.

Across 1822 mature markets in the PIMS (Profit Impact of Market Strategies) data below, we find that market pioneers are more likely than later entrants to invest in product innovation. These results are consistent with a pioneer's historic corporate culture that supports innovation and risk taking. In contrast to their historic strategy, for businesses that invest in product innovation, market pioneers have only about half the rate of major innovations as late entrants. Competence enhancing investments in the pioneer's historic R&D appear to yield minor product innovations at the expense of major innovations. Even when product R&D is held constant, market pioneers have roughly the same rate of major product innovations as late entrants. Thus, while market pioneers continue to invest in product innovation, their strategic emphasis shifts away from major innovations.
MODEL SPECIFICATION

The hypotheses below are linked to the following model specification. The independent variables highlight the testable implications. In model estimation, additional variables are added to reduce model specification error.

(1) \[ P(R&D/S_{t-1} > 0) = \beta_{0,1} + \beta_{1,1} \text{Market Pioneer} + \beta_{2,1} \text{Early Follower} + \beta_{3,1} \text{Market Share}_{t-1} \]

(2) \[ P(NP/S_t > 0) = \beta_{0,2} + \beta_{1,2} \text{Market Pioneer} + \beta_{2,2} \text{Early Follower} + \beta_{3,2} \text{Market Share}_{t-1} \]

(3) \[ R&D/S_{t-1} = \beta_{0,3} + \beta_{1,3} \text{Market Pioneer} + \beta_{2,3} \text{Early Follower} + \beta_{3,3} \text{Market Share}_{t-1} + \epsilon_{1,3} \]

(4) \[ NP/S_t = \beta_{0,4} + \beta_{1,4} \text{Market Pioneer} + \beta_{2,4} \text{Early Follower} + \beta_{3,4} \text{Market Share}_{t-1} + \beta_{4,4} R&D/S_{t-1} + \epsilon_{4,4} \]

\[ + \beta_{5,4} \text{Market Pioneer} \times R&D_{t-1} \]

\[ + \beta_{6,4} \text{Early Follower} \times R&D_{t-1} + \beta_{7,4} \text{Market Share}_{t-1} \times R&D_{t-1} + \epsilon_{1,4} \]

where:

P(R&D/S_{t-1} > 0) = the probability that a business invests in product R&D as a percent of sales in year t minus one,

P(NP/S_t > 0) = the probability that a business has new product sales as a percent of total sales in year t,

R&D/S_{t-1} = for a business that invests in product R&D, their R&D spending as a percent of sales in year t minus one,
NP/S_t = for a business that has new product sales, their new product sales as a percent of total sales in year t,

Market Pioneer = 1 if the business is a market pioneer, 0 otherwise,

Early Follower = 1 if the business is an early follower, 0 otherwise, and

Market Share = a business's market share as a percentage of sales in year t.

In the equations above, the \( \beta \) terms are unknown parameters and the \( \varepsilon \) terms are random errors. Product R&D spending and new product sales are expressed as 1) a probability and 2) on an absolute level for businesses with positive R&D spending and positive new product sales. This is done both for model estimation purposes and to provide additional insights into product innovation strategies. See Cohen, Levin, and Mowery (1987). To highlight order of entry effects, the dummy variables compare market pioneers versus late entrants.

In the new product sales equations (equations 2 and 4), lagged R&D spending estimates the impact of R&D spending on new product sales\(^1\). As discussed below, market share proxies competitive advantages that can be leveraged in the new product development process. Lagging market share avoids the modeling bias problem that arises from the reverse impact of current new product sales on current market share.

The PIMS data classifies a product innovation as either a product improvement, product line extension, or a new product (PIMS Data Manual 1978, p. 3-8). A product improvement replaces an existing product with a small, incremental change. A product line extension extends an existing product line with a minor
product change. In the hypotheses below, product improvements and line extensions are \textit{minor product innovations}.

New products are \textit{major product innovations}. While a new product can replace an existing product or extend the product line, it requires a greater investment than a product improvement or line extension. This is because new products have "relatively long gestation periods, major changes to the manufacturing facilities, separate promotional budgets, or separate product management" (PIMS Data Manual 1978, p. 3-8). Thus, a new product calls for a significant investment in terms of time, money, or both. The data section below discusses key strengths and weaknesses for both product innovation measures.

It is important to recognize that product R\&D includes spending on both minor and major product innovations. In contrast, new product sales only include major innovations. Thus, the primary reasoning behind the product R\&D interaction term in the new product sales equation is that minor product innovations are included in product R\&D spending, but excluded from new product sales.

For example, if a market pioneer’s product R\&D budget emphasizes minor innovations, then the impact of the market pioneer and product R\&D interaction term on new product sales ($\beta_{7,4}$) should be negative. This is because R\&D spending on minor innovations has no influence on new product sales. A similar rational motivates the market share and product R\&D interaction term.
HYPOTHESES

In the hypotheses, a market pioneer's product innovation strategy is compared to late entrants along two key dimensions. Figure 1 shows that the first dimension is the probability of investing in product innovation. I.e., having positive product R&D spending or having positive new product sales. The second dimension indicates whether these investments emphasize major product innovations, minor product innovations, or both.

Four hypotheses describe various forces that influence a market pioneer's product innovation strategy. To simplify the hypotheses, market pioneers are only compared to late entrants. The results section below examines early followers. Because it is difficult to predict change and there are many costs associated with strategic change, the null hypotheses predict that market pioneers continue their historical product innovation strategy. In Figure 1, this strategy has 1) a higher probability of investing in product innovation with 2) investments that emphasize major rather than minor innovations. Alternative hypotheses describe various forces that motivate a pioneer to break from their tradition of innovation.

The Probability of Investing in Product Innovation

Do market pioneers have a higher probability than late entrants of investing in product innovation? Pioneering a new market typically requires a corporate culture that supports innovation and risk taking. Because it is difficult to change a corporate
culture, a culture that supports innovation and risk taking can be enduring over time. For example, see the *Wall Street Journal* (1996). Moreover, a successful culture is especially likely to persist. Market pioneers in the data below have been successful in the sense that they helped pioneer a new market and survived to market maturity. Thus, a market pioneer’s corporate culture should increase the probability that a pioneer will continue to invest in product R&D and new product sales.

In contrast, a late entrant’s corporate culture is more likely to support product imitation. A successful product imitation strategy can arise when a late entrant emphasizes a low price based on low manufacturing costs (Crawford 1994, p. 79) or when “advertising and distribution are most important” (Schnaars 1994, p. 224). When a late entrant follows a product imitation strategy, they are less likely to invest in ongoing product R&D and new product sales.

Finally, research indicates that market pioneers often start a new market with superior R&D skills. Lieberman and Montgomery (1988, p. 54) say “Firms whose . . . new-product R&D are excellent will tend to find first-movership attractive.” See also, Lilien and Yoon (1990) and Robinson, Fornell, and Sullivan (1992). Historical investments in R&D should motivate future investments to at least maintain the pioneer’s core competency in R&D. This yields:

\[ H_1: \text{A pioneer’s corporate culture and historical core competency in R&D both increase the probability that a market pioneer invests in product R&D (} \beta_{1,1} > 0 \text{) and new product sales (} \beta_{1,2} > 0 \text{).} \]
$H_1$ describes the direct impact of market pioneering on the probability of investing in product innovation. An indirect impact can also arise through market share. While the magnitude of the pioneer’s market share advantage versus late entrants is controversial, empirical research concludes that for survivors, market pioneers have a higher average market share than late entrants. For alternate views, see Golder and Tellis (1993), Schnaars (1994), and Kalyanaram, Robinson, and Urban (1995).

Does a higher market share influence a product innovation strategy? In Henderson’s (1993) summary of the economics literature, competitive advantages (market power) that increase market share can often leverage the product innovation process. Examples include leveraging superior product quality, a strong brand name, or manufacturing scale economies. In the product innovation process, these competitive advantages can increase marginal revenues and decrease marginal costs. This yields:

$H_2$: By leveraging competitive advantages, increasing market share increases the probability of investing in product R&D ($\beta_{3,1} > 0$) and having positive new product sales ($\beta_{3,2} > 0$).

An alternative hypothesis ($H_{2a}$) arises from either the fear of cannibalization or the opportunity to rapidly imitate a competitor’s product innovation. Henderson
(1993) describes how cannibalization is a legitimate concern when investments in product innovation accelerate or increase the degree of cannibalization. If an innovation is inevitable at a given point in time, the fear of cannibalization should be dismissed. This is because if a firm does not introduce an innovation, it will be introduced by a competitor.

How important is the fear of cannibalization? Note, the PIMS sample below covers mature markets and innovation in mature markets is often incremental and predictable. More often than not, this is an "inevitable innovation". Hence, the fear of cannibalization should not be a key factor.

In contrast, the opportunity for a high share business to rapidly imitate a competitor's new product can be a key factor. This is because when a high market share business has the luxury of rapid imitation, it deadens the incentive to innovate. For example, Scherer and Ross (1990, p. 635) report "the frequently observed tendency for market dominating-firms to be slow in developing important new products, but to roar back like tigers when smaller rivals . . . . challenge their dominance." Overall, it is an empirical issue whether a) the positive impact of leveraging competitive advantages associated with a high market share is more important than b) the negative impact of cannibalization and rapid imitation.

Major versus Minor Innovations

For businesses that invest in product innovation, do market pioneers tend to emphasize major innovations, minor innovations, or possibly both? Note, the
hypotheses make two key assumptions. First, because strategic change is costly, the null hypotheses assume that historical strategies are maintained. If so, market pioneers continue to introduce more major innovations and late entrants continue to introduce more minor innovations.

Second, a major product innovation typically generates higher R&D expenses than a minor innovation. This reflects a cost-benefit tradeoff where a major innovation has higher costs, but also has higher potential sales than a minor innovation. Empirical research supports the assumption that market pioneers tend to enter the market with costly, product innovations. For example, in the first two years of commercialization, Robinson, Fornell, and Sullivan (1992, p. 620) define intensive R&D spending as exceeding 50 percent of sales. In their sample of start-up ventures, 50 percent of first entrants report intensive R&D versus 26 percent of the other market pioneers. This compares to 11 percent for early followers and 9 percent for late entrants.

If historical product innovation strategies and spending patterns are continued, we have:

H₃: For businesses that invest in product R&D, market pioneers tend to emphasize major product innovations. This yields higher product R&D spending ($β_{1,3} > 0$) as well as a positive impact of the pioneer and product R&D interaction term on new product sales ($β_{3,4} > 0$). For businesses with
new product sales, holding product R&D constant, market pioneers tend to have greater new product sales as a percentage of sales ($\beta_{1,4} > 0$).

The first alternative hypothesis addresses the R&D component of innovation ($H_{3a}$). Scherer and Ross (1990, p. 653) say, "new entrants without a commitment to accepted technologies have been responsible for a substantial share of the really revolutionary new industrial products." By emphasizing revolutionary new products, Scherer and Ross's observation applies to entrants that pioneered new markets.

In mature markets, does a similar lack of technological commitment permit late entrants to introduce the most innovative products? This can happen when historical R&D skills that originally produced a major innovation evolve over time to produce minor innovations. This evolution occurs because a competitive advantage typically arises from a "routine, predictable change that is a logical extension of existing knowledge" (Henderson 1993, p. 251). While a routine and predictable change is the driving force behind a learning curve advantage, it should yield a minor rather than a major product innovation.

If market pioneer R&D spending emphasizes minor innovations at the expense of major innovations, then two of $H_3$'s predictions should be reversed. This is because pioneer R&D spending should be lower rather than higher ($\beta_{1,3} < 0$). Also, by emphasizing minor innovations, the impact of the market pioneer and R&D interaction term on new product sales should be negative rather than positive ($\beta_{5,4} <$
0). Recall, this is because minor innovations are included in product R&D, but are excluded from new product sales.

The second alternative hypothesis addresses the non-R&D component of innovation (H3b). It is based on a broad array of pioneer first-mover advantages with existing customers. For example, Schmalensee's (1982) theoretical model predicts that existing customers who are familiar with the known pioneering brand are often reluctant to try a later entrant's unknown brand. Carpenter and Nakamoto's (1989) award winning research concludes that when product quality is subjective, the pioneering brand can shape consumer tastes toward its own. Hauser and Wernerfelt (1990) and Kardes et al. (1993) describe how the pioneering brand is included in the consumers' consideration set more often. Kardes and Kalyanaram (1992, p. 356) find that more information on the pioneering brand leads consumers to have "more extreme and confidently held judgments" that benefit the pioneer.

Does this broad array of first-mover advantages with existing customers motivate the pioneer to emphasize major or minor product innovations? Christensen and Bower (1996 p. 199) say, "whether sufficient impetus coalesces behind a proposed innovation is largely determined by the presence or absence of current customers who can capably articulate a need for the innovation in question." Because it is often difficult for current customers to articulate a need for a major innovation, strong links with current customers should encourage minor innovations. Christensen and Bower (1996, p. 198) conclude this reduced attention to
major product innovation "lies at the root of the failure of many once-successful firms."

If strong links to existing customers motivate minor innovations at the expense of major innovations, then the impact of market pioneering on new product sales should be negative rather than positive ($\beta_{1,4} < 0$). In addition, market pioneer product R&D spending should be guided towards relatively inexpensive minor innovations ($\beta_{1,3} < 0$ and $\beta_{5,4} < 0$).³

The final hypothesis addresses market share. As discussed above, Henderson’s (1993) survey concludes that leveraging competitive advantages associated with a higher market share should motivate both major and minor product innovations. If both types of product innovation are encouraged, then product R&D spending and new product sales should both increase.

The sign of the market share and product R&D interaction term on new product sales should be largely determined by the relative influence of major versus minor innovations. Because a minor innovation is more likely to arise from leveraging a competitive advantage, the relative influence should shift towards minor innovations. This yields:

$H_4$: Because leveraging competitive advantages should increase investments in both major and minor product innovations, the impact of market share on product R&D and new product sales are positive ($\beta_{3,3} > 0$ and $\beta_{3,4} > 0$). Because leveraging competitive advantages should increase minor
innovations more than major innovations, the impact of the market share and product R&D interaction term on new product sales equations is negative ($\beta_{7,4} < 0$).

An alternative hypothesis ($H_{4a}$) is that the fear of cannibalization and the ability for rapid imitation reduce investments in both major and minor innovations ($\beta_{3,3} < 0$ and $\beta_{3,4} < 0$).

**DATA**

The PIMS (Profit Impact of Market Strategies) data at the Strategic Planning Institute describe business units. Each business forms a data gathering team composed of marketing, manufacturing, finance, and R&D managers. To correspond to earlier studies of market pioneers, the sample only covers mature markets that manufacture consumer and industrial goods ($n = 1822$). See Robinson and Fornell (1985) and Robinson (1988).

Across these mature markets, the average market age is 37 years. 68% of the businesses primarily sell industrial goods and 32% consumer goods. 72% invest in product R&D, which is defined as being greater than one-tenth of one percent of sales. This is close to the 76% frequency reported by Cohen, Levin, and Mowery (1987, p. 551) across the Federal Trade Commission’s Line of Business Data.
44% of the PIMS sample report positive new product sales during the three preceding years, which is defined as being greater than one percent of total sales. While 44% may seem low, the sample only covers mature markets. In mature markets, line extensions and product improvements are relatively important, but they are excluded from new product sales.

The data are from the SPI4 database, which yields the largest sample from the various PIMS databases. The SPI4 data cover four years. For variables that are updated annually, a beginning value averages years one and two and an ending value averages years three and four. To generate the time lags in the model specification above, new product sales use the ending value while product R&D spending and market share use the beginning value. (Because new product sales cover the three preceding years, the average time lag is one year instead of two.) Many variables are only measured once, such as order of market entry. For these variables, the beginning and ending values are identical.

While PIMS data limitations are well known, they should be recognized in the context of this study. First, PIMS businesses are self-selected with most belonging to Fortune 1000 firms. While this is an important sample of U.S. businesses, it excludes thousands of small businesses that are an important source of innovation. For detailed insights into innovation in small firms, see Acs and Audretsch (1991).

Second, because each business reports confidential information, the business as well as the industry are anonymous. Thus, it is not possible to link the PIMS data to a specific business or industry.
Third, the PIMS data were typically gathered in the mid-1970's to the early 1980's. Some aspects of product innovation strategy are much different today, such as reduced new product cycle time. Even so, there is no reason to believe that the relationship between order of entry and product innovation strategies has dramatically changed.

**Measuring Product Innovation**

Product R&D and new product sales, both as a percent of total sales, have key strengths as well as key weaknesses. Product R&D, for example, is a relatively objective measure that is a key input in the product innovation process. In the economics literature, it is the most widely used measure of a product innovation input. See, Scherer and Ross (1990, Ch. 17).

Product R&D though can be devoted to product imitation or to defensive efforts that prevent competition from imitating an earlier innovation. For example, a defensive effort could generate a patent that prevents a competitor from imitating an earlier innovation. Probably the biggest drawback though is that a product innovation is a new, commercialized product. Thus, while product innovation is an output, product R&D is just one of many inputs into this process.

New product sales is the key PIMS measure of product innovation output. One strength is that new product sales assess the commercial impact of new products. Commercial impact is not assessed by other output measures, such as the number of new patents or the number of new products introduced. Another strength
is that because product improvements and line extensions are excluded, new product sales are limited to projects that require a significant commitment in terms of time, money, or both.

Probably the biggest drawback with the new product sales measure is that "new" is new to the business. Because it is not necessarily new to the market, a new product could just be imitating a competitor's product innovation.

For both product R&D and new product sales, what are the hypothesis testing implications for not being able to distinguish product innovation from product imitation? First, product imitation is typically cheaper than product innovation. See, for example, Mansfield, Schwartz, and Wagner (1981). Thus, product imitation should yield relatively low levels of product R&D spending. Also, product imitation typically imitates a few big winners in the market. By imitating only a few big winners and considering the market share disadvantages of a "me too" strategy, a product imitation strategy should typically yield lower new product sales. Thus, a business that follows a product imitation strategy should typically report lower levels of both product R&D and new product sales, which is consistent with a reduced emphasis on product innovation.

Second, when a bias arises by counting a product imitation as a product innovation, is this bias more likely to arise for the hypotheses that examine market pioneering or market share? A popular product imitation strategy uses market power, it terms of say superior distribution or a respected brand name, to challenge the innovator (Schnaars 1994, Ch. 5). As discussed in the hypotheses above, this type
of product imitation strategy is usually associated with a high market share business. Because the key results below are associated with market pioneering, it seems unlikely that this measurement bias is driving the empirical results.

**DESCRIPTIVE STATISTICS**

Table 1’s descriptive statistics relate order of market entry to the two key measures of product innovation. Relative to late entrants, average product R&D spending for market pioneers is significantly higher at 1.6% versus 1.2% for late entrants ($t = 2.85$). Average new product sales though is significantly lower at 6.1% versus 8.5% ($t = -2.17$).

A closer correspondence to the hypotheses arises by decomposing each broad average into the percent investing in each area and the average level for those businesses who are investing. For example, 78% of the market pioneers invest in product R&D. For these investors, their average product R&D spending is 2.1% of sales. Note, multiplying 78% by 2.1% yields the sample average of 1.6%.

In Table 1, a significantly greater percentage of market pioneers invest in both product R&D and new product sales. For businesses with new product sales, market pioneers only have about half the new product sales of late entrants (12.4% versus 22.5%). Because market pioneers trail late entrants by a wide margin, there appears to be a fundamental shift away from the pioneer’s historic strategy of emphasizing
major product innovations. The reason or reasons behind this strategic change are examined below.

FULL MODEL SPECIFICATION

The full model specification includes additional variables that follow Cohen, Levin, and Mowery's (1987) model specification. Their model explains R&D spending as a percent of sales across the Federal Trade Commission's Line of Business data. Following Cohen, Levin, and Mowery's (1987) conceptual guidelines, product innovation is influenced by consumer demand, technological opportunity, and appropriability. To avoid excluding a relevant variable, the variables described below are added to each equation. Table 2 provides the variable definitions, means, and standard deviations.

For consumer demand, product R&D and new product sales are often driven by changing customer needs and wants. This is measured by a dummy variable that assesses whether or not the market has regular product line changes. Because new customers in the market often have different needs and wants, market growth should tend to increase product R&D and new product sales.

Increased technological opportunity should increase both product R&D spending and new product sales. Technological opportunity should be higher in markets that have experienced a recent technological change and in markets that make relatively complicated products, such as industrial capital goods. It should be
lower in markets that make relatively simple products, such as consumer nondurables, and as market age increases

Appropriating the benefits from innovation should increase a business's willingness to undergo the costs and risks of product innovation. Based on Levin, Klevorick, Nelson, and Winter's (1987, p. 794) survey, appropriability should be easier when a business has a product patent or trade secret or customer service is very important. Because of their limited scale, it should be more difficult for businesses in a fragmented market to appropriate the benefits from innovation. Following Parry and Bass (1992), a fragmented market arises when the sum of the market share levels for the business plus the three leading competitors is less than 55%.

MODEL ESTIMATION

Two logit regressions explain whether or not a business invests in product R&D or new product sales. For product innovators only, the equations that explain product R&D and new product sales use generalized least squares estimation. This is because White's (1980) test supports the presence of heteroscedasticity, which should be positively related to the expected value of each dependent variable. By specifying the variance of each random error term to be proportional to each dependent variable's expected value, Kmenta's (1986, p. 287) approach corrects this heteroscedasticity. Because the generalized least squares results are more efficient
and provide more conservative hypothesis testing results than ordinary least squares, they are reported below.

RESULTS

In Table 3, statistical significance uses conservative two-tail tests. For $H_1$, market pioneers have a higher probability of investing in product R&D and having positive new product sales. In both equations, the impact of market share essentially equals zero. This supports $H_1$'s prediction that a market pioneer's culture and historic investments in R&D motivate further investments in product innovation. It does not support $H_2$'s prediction that competitive advantages associated with a high market share encourage these investments.

For businesses that invest in product R&D, market pioneers appear to spend less than late entrants. (With a two-tail test though, the result is not statistically significant.) More important, the market pioneering and product R&D interaction term in the new product sales equation is negative and statistically significant at the 1% level. In addition, the total impact of the market pioneer's R&D spending on new product sales essentially equals zero (4.45 less 4.25).

One explanation for these results is that literally hundreds of market pioneers are systematically wasting their product R&D spending on major projects that do not yield new product sales. A more likely explanation is that the pioneers' product R&D spending emphasizes minor rather than major product innovations.
Are minor innovations emphasized because of competence enhancing investments in historic R&D ($H_{3a}$) or because of strong links with existing customers ($H_{3b}$)? If strong links to existing customers motivate minor innovations at the expense of major innovations, then the impact of market pioneering on new product sales should be negative. Because this estimate essentially equals zero, greater support arises for competence enhancing investments in historic R&D.

Because market share does not significantly influence either product R&D or new product sales, no support arises for market share influencing these investments ($H_4$). Also, in the new product sales equation, the market share and product R&D interaction term is not significant. By combining these results with the logit repression results above, market share does not significantly influence any key aspect of the product innovation strategy. Note, the economics literature reports a similar nonresult between market share and product innovation. For example, Henderson (1993) concludes, “Cross-sectional studies . . . have in general found no systematic relationship, . . . and theoretical work in the area has been similarly inconclusive” (p. 248).

What About Early Followers?

While the hypotheses compare market pioneers to late entrants, what pattern of results arise for early followers? For the probability of investing in product R&D and having positive new product sales, Table 3 shows that early followers are similar to late entrants.
Why do market pioneers invest in product R&D and have new product sales more often than both early followers and late entrants? As discussed above, a broad strategic distinction is often made between product innovation and product imitation. Because a market pioneer in the PIMS data is either the first entrant or among the first, it would be unusual for a pioneer to have an entry strategy that emphasizes product imitation. In contrast, a product imitation entry strategy is more likely to arise for an early follower or late entrant. This result can arise, therefore, from an enduring strategy that downplays product innovation.

For businesses that invest in product innovation, are early followers closer to market pioneers or late entrants? In Table 3, early followers closely resemble market pioneers. This is because similar results and nonresults arise for 1) product R&D cost savings, 2) the early follower and product R&D interaction term, 3) total early follower R&D spending on new product sales (4.45 - 3.57), and 4) early following on new product sales.

In total, early followers appear to have the least product innovation. This is because the probability of investing in product innovation trails the market pioneers. Also, similar to market pioneers, early follower R&D spending appears to emphasize minor rather than major innovations. To the extent that an early follower rushes to enter a new market, it is not surprising that they are not known for product innovation. This is because it is difficult to both excel in product innovation and to quickly enter a new market (Crawford 1994).
Why Do Market Pioneers Shift Away from Major Product Innovations?

The central empirical finding above is that market pioneer product innovation strategies shift away from major innovations. A key reason is that competence enhancing investments in R&D appear to yield minor innovations at the expense of major innovations. While this result explains the R&D component of a pioneer’s product innovation strategy, does the non-R&D component emphasize major or minor innovations?

Because the new product sales equation holds R&D spending constant, the non-R&D component is assessed by the market pioneering dummy variable. As mentioned above, this impact is essentially zero. A similar result arises in the descriptive statistics. This is because for businesses that have new product sales but do not invest in product R&D, new products average 3% of sales for market pioneers, early followers, and late entrants alike. (For businesses that invest in product R&D, the corresponding averages are 7%, 7%, and 12%.) These results consistently indicate that even outside of R&D, market pioneers no longer excel at commercializing major product innovations.

While the data can not explain why the non-R&D component does not emphasize major innovations, one explanation is that first-mover advantages with current customers just offsets a pioneer’s innovative tendency. (The alternative hypothesis above assumes that first-mover advantages more than offset a pioneer’s innovative tendency.) A second explanation is that superior marketing skills by late

SUMMARY AND CONCLUSIONS

If a market pioneer's historic product innovation strategy is maintained over time, it should motivate more frequent investments in product innovation. It should also encourage risk taking and investments in major rather than minor innovations. In contrast, early followers and late entrants should have less frequent investments in product innovation and a greater emphasis on minor innovations.

Are these historic product innovation strategies maintained over time? Across 1822 mature manufacturing businesses in the PIMS data, market pioneers are more innovative in the sense that they are 1) more likely to invest in product R&D spending and 2) more likely to have positive new product sales. Thus, the portion of a pioneer's historic strategy that motivates more frequent investments in product innovation is maintained.

A key portion of the pioneer's historic strategy though is lost. This is the portion that yields major product innovations, as measured by new product sales. (New products in the PIMS data are the most innovative category of product change.) To illustrate, for businesses that introduce new products, new product sales average 12% of total sales for market pioneers, 15% for early followers, and 23% for late entrants.
Why do market pioneers no longer excel at major product innovations? One explanation is that first-mover advantages with current customers encourage minor rather than major innovations. A second explanation is that the pioneer’s higher average market share discourages major innovations, perhaps because of the opportunity to rapidly imitate any threatening innovations. While compelling, these two explanations are not supported by the data.

A third explanation is that competence enhancing investments in a pioneer’s historic R&D yields minor innovations at the expense of major innovations. In contrast, late entrants who leapfrog the pioneer’s technology are more likely to introduce major product innovations. This explanation is supported by the data. This explanation is consistent with Ghemawat’s (1991) study of the private branch exchange industry. He reports “competitors that led in established product technologies lagged in adopting drastically new ones” (p. 163-164).

While this result addresses product innovation’s R&D component, how do market pioneers perform when product R&D is held constant? For product innovation’s non-R&D component, new product sales by market pioneers essentially equal those of early followers and late entrants. This indicates that a force or forces outside of R&D also contributes to market pioneers no longer excelling at major innovations. While the data analysis can not identify this additional force or forces, it could be related to the first-mover advantages with current customers described above or to superior marketing skills by late entrants.
Implications

Because product innovation is widely viewed as being a positive factor, is it a problem when a market pioneer's strategy shifts away from introducing major innovations? When this shift arises because a pioneer is building on their historic R&D, a pioneer is especially well suited to learn from their historic strengths. From this perspective, corporate profits should not suffer. This is because the pioneer is essentially leveraging their core competencies through a natural evolution of learning and experience curve effects.

While corporate profits should not suffer, does society as a whole suffer from this shift away from major innovations? When the pioneer is developing historic R&D and late entrants are trying to develop alternative technologies, society should typically benefit from multiple sources of innovation. An exception though can arise when entry barriers are high. In this situation, innovation can be stifled by a limited number of late entrants and a pioneer that relies on historic R&D.

Conclusion

In mature markets, product innovation strategies for early followers and late entrants are more heterogeneous than those for market pioneers. Market pioneers are more likely to invest in product innovation. Late entrants though that invest in product innovation are more likely to generate major innovations from their product R&D efforts. Thus, the greatest heterogeneity arises when late entrants either do not invest in product innovation or invest in major product innovations. Market
pioneers take the strategic middle ground by consistently investing in minor innovations. By investing in minor innovations, the pioneer’s historic strategy of emphasizing major product innovations is lost.
1 While the optimal time lag is not clear, earlier studies such as Cohen, Levin, and Mowery (1987) and Boulding and Staelin (1995) also use a one year lag. Because of the stability of R&D spending over time, the results should be robust to variations in the lag structure. For example, the Pearson correlation between average product R&D as a percent of sales in years 1 and 2 versus years 3 and 4 is .90.

2 The market pioneering interaction term could also be interpreted as measuring R&D productivity differences for pioneers versus later entrants. Even so, the strength of the empirical results below goes well beyond what one would expect for productivity differences. While the market share interaction term could be interpreted as a proxy for scale economies in R&D, the economics literature reports that scale economies in R&D are typically not present or have modest importance (Scherer and Ross 1990, Ch. 17).

3 H3a and H3b have substantial overlap in their empirical predictions. Both predict that product R&D spending should emphasize minor rather than major innovations. They differ in terms of the non-R&D impact of product innovation. When strong links with existing customers discourage major innovations (H3b), the impact of market pioneering on new product sales should be negative. Competence enhancing investments in product R&D (H3a) should not influence this non-R&D impact. Thus, if both the R&D and non-R&D impact support minor innovations, H3b is supported
and $H_{3a}$ can not be effectively tested. If only the R&D impact supports minor innovations, then $H_{3a}$ is supported.
REFERENCES


Figure 1
ORDER OF MARKET ENTRY AND PRODUCT INNOVATION

A Market Pioneer's Probability of Investing in Product Innovation Versus Late Entrants?

For Businesses Investing in Product Innovation, a Market Pioneer's Emphasis Versus Late Entrants?
### Table 1
**DESCRIPTIVE STATISTICS**

<table>
<thead>
<tr>
<th>Order of Entry</th>
<th>Average</th>
<th>% Investing in Product Innovation</th>
<th>Average for Those Businesses Investing in Product Innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Product R&amp;D/Sales ((n = 1822))</td>
<td>New Product Sales/Sales ((n = 1822))</td>
<td>Product R&amp;D/Sales ((n = 1317))</td>
</tr>
<tr>
<td>Market Pioneers</td>
<td>1.6%</td>
<td>6.1%</td>
<td>78%</td>
</tr>
<tr>
<td>Early Followers</td>
<td>1.2%</td>
<td>5.7%</td>
<td>69%</td>
</tr>
<tr>
<td>Late Entrants</td>
<td>1.2%</td>
<td>8.5%</td>
<td>61%</td>
</tr>
<tr>
<td>Variable</td>
<td>PIMS Definition</td>
<td>Mean</td>
<td>S.D.</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>Product R&amp;D/Sales</td>
<td>Product R&amp;D includes all R&amp;D expenses to improve existing products or services and to develop new products or services. It also includes expenses for improving packaging, product design, features and functions. It excludes expenses for process improvements and allocated expenses for corporate level R&amp;D.</td>
<td>1.43</td>
<td>1.96</td>
</tr>
<tr>
<td>P (R&amp;D/Sales &gt;0)</td>
<td>1 if the business’s product R&amp;D is greater than one-tenth of one percent of sales, 0 otherwise.</td>
<td>.72</td>
<td>.45</td>
</tr>
<tr>
<td>New Product Sales/Sales</td>
<td>New product sales arise from new products introduced during the 3 preceding years. New products differ from improvements and line extensions by having relatively long gestation periods, a major change in manufacturing facilities, separate promotional budgets, or separate product management.</td>
<td>6.44</td>
<td>13.44</td>
</tr>
<tr>
<td>P (New Product Sales/Sales &gt;0)</td>
<td>1 if the business’s new product sales are greater than 1% of total sales, 0 otherwise.</td>
<td>.44</td>
<td>.50</td>
</tr>
<tr>
<td>Market Share</td>
<td>The business’s dollar sales divided by total served or target market sales.</td>
<td>23.79</td>
<td>19.37</td>
</tr>
<tr>
<td>Market Pioneer</td>
<td>At the time this business first entered the market, was it: 1 = one of the pioneers in first developing such products or services, 0 = otherwise.</td>
<td>.51</td>
<td>.50</td>
</tr>
<tr>
<td>Early Follower</td>
<td>Same as above, except: 1 = an early follower of the pioneer(s) in a still growing, dynamic market, 0 = otherwise</td>
<td>.31</td>
<td>.46</td>
</tr>
<tr>
<td>Late Entrant</td>
<td>Same as above, except: 1 = a late entrant into a more established market situation, 0 = otherwise.</td>
<td>.18</td>
<td>.38</td>
</tr>
<tr>
<td>Pioneer * R&amp;D/Sales</td>
<td>The market pioneer dummy variable multiplied by product R&amp;D as a percent of sales.</td>
<td>.83</td>
<td>1.63</td>
</tr>
<tr>
<td>Early Follower * R&amp;D/Sales</td>
<td>The early follower dummy variable multiplied by product R&amp;D as a percent of sales.</td>
<td>.38</td>
<td>1.15</td>
</tr>
<tr>
<td>Market Share * R&amp;D/Sales</td>
<td>Market share multiplied by product R&amp;D as a percent of sales.</td>
<td>36.95</td>
<td>70.26</td>
</tr>
<tr>
<td>Variable</td>
<td>PIMS Definition</td>
<td>Mean</td>
<td>S.D.</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>Regular Product Line Change</td>
<td>1 if the typical practice for the business and its major competitors is to change all or part of the product line either seasonally or annually, 0 otherwise.</td>
<td>.06</td>
<td>.23</td>
</tr>
<tr>
<td>Market Growth</td>
<td>Average annual real market growth over the four preceding years.</td>
<td>2.74</td>
<td>9.42</td>
</tr>
<tr>
<td>Recent Technological Change</td>
<td>1 if there have been any major technological changes in the products offered by the business and/or its major competitors, or methods of production, during the last 8 years, 0 otherwise.</td>
<td>.23</td>
<td>.42</td>
</tr>
<tr>
<td>Industrial Capital Goods</td>
<td>1 if the business is best described as manufacturing industrial capital goods, 0 otherwise.</td>
<td>.16</td>
<td>.37</td>
</tr>
<tr>
<td>Consumer Nondurables</td>
<td>1 if the business is best described as manufacturing consumer nondurables, 0 otherwise</td>
<td>.19</td>
<td>.39</td>
</tr>
<tr>
<td>Market Age</td>
<td>The natural logarithm of the market's estimated age in years.</td>
<td>3.46</td>
<td>.60</td>
</tr>
<tr>
<td>Product Patent or Trade Secret</td>
<td>1 if the business benefits to a significant degree from product patents or trade secrets, 0 otherwise.</td>
<td>.17</td>
<td>.37</td>
</tr>
<tr>
<td>Customer Service Importance</td>
<td>1 if the installation, repair, customer education, and other product-related services provided to end users are of relatively great importance, 0 otherwise.</td>
<td>.24</td>
<td>.43</td>
</tr>
<tr>
<td>Fragmented Market</td>
<td>1 if the sum of the market share for the business plus the three leading competitors is less than 55%, 0 otherwise.</td>
<td>.26</td>
<td>.44</td>
</tr>
</tbody>
</table>

* See the PIMS Data Manual (1978) for additional insights into the variable definitions.
# Table 3
## EMPIRICAL RESULTS

<table>
<thead>
<tr>
<th>Variable</th>
<th>( P (\text{R&amp;D/Sales &gt; 0}) ) ( (n = 1822) )</th>
<th>( P (\text{New Products Sales/Sales &gt; 0}) ) ( (n = 1822) )</th>
<th>( \text{R&amp;D/Sales} ) ( (n = 1317) )</th>
<th>( \text{New Product Sales/Sales} ) ( (n = 797) )</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Constant</strong></td>
<td>1.80 (4.50)**</td>
<td>-1.01 (-2.63)**</td>
<td>3.88 (11.18)**</td>
<td>24.20 (6.59)**</td>
</tr>
<tr>
<td>R&amp;D/Sales (_{t-1})</td>
<td>.33 (4.36)**</td>
<td></td>
<td>4.45 (5.82)**</td>
<td></td>
</tr>
<tr>
<td>Market Pioneer</td>
<td>.68 (4.48)**</td>
<td>.68 (3.70)**</td>
<td>-.19 (-1.31)</td>
<td>-1.02 (-.57)</td>
</tr>
<tr>
<td>Early Follower</td>
<td>.24 (1.58)</td>
<td>.14 (.74)</td>
<td>-.23 (-1.60)</td>
<td>.10 (.05)</td>
</tr>
<tr>
<td>Market Share (_{t-1})</td>
<td>-.00 (-.50)</td>
<td>-.01 (-1.76)*</td>
<td>-.00 (-.11)</td>
<td>-.02 (-.45)</td>
</tr>
<tr>
<td>Market Pioneer * R&amp;D/Sales (_{t-1})</td>
<td>-.15 (-1.76)*</td>
<td></td>
<td></td>
<td>-4.25 (-5.10)**</td>
</tr>
<tr>
<td>Early Follower * R&amp;D/Sales (_{t-1})</td>
<td>.01 (-.13)</td>
<td></td>
<td></td>
<td>-3.57 (-3.91)**</td>
</tr>
<tr>
<td>Market Share * R&amp;D/Sales (_{t-1})</td>
<td>.00 (.05)</td>
<td></td>
<td></td>
<td>-.00 (-.33)</td>
</tr>
<tr>
<td>Regular Product Line Change</td>
<td>.87 (3.14)**</td>
<td>1.39 (5.67)**</td>
<td>-.08 (-.46)</td>
<td>12.04 (5.68)**</td>
</tr>
<tr>
<td>Market Growth</td>
<td>-.01 (-.96)</td>
<td>.02 (3.04)**</td>
<td>.01 (.243)</td>
<td>.06 (1.21)</td>
</tr>
<tr>
<td>Recent Technological Change</td>
<td>.13 (.91)</td>
<td>.48 (3.85)**</td>
<td>.10 (7.9)</td>
<td>2.16 (2.03)**</td>
</tr>
<tr>
<td>Industrial Capital Goods</td>
<td>.56 (2.89)**</td>
<td>.32 (2.06)**</td>
<td>.87 (5.39)</td>
<td>2.97 (2.23)**</td>
</tr>
<tr>
<td>Consumer Nondurables</td>
<td>-.29 (-2.12)*</td>
<td>.30 (2.23)**</td>
<td>-.38 (-3.84)</td>
<td>3.15 (2.47)**</td>
</tr>
<tr>
<td>Market Age</td>
<td>-.37 (-3.75)**</td>
<td>-.12 (-1.38)</td>
<td>-.60 (-7.20)</td>
<td>-4.34 (-5.21)**</td>
</tr>
<tr>
<td>Product Patent or Trade Secret</td>
<td>.12 (.72)</td>
<td>.47 (3.32)**</td>
<td>.47 (3.23)**</td>
<td>2.21 (1.82)**</td>
</tr>
<tr>
<td>Great Customer Service Importance</td>
<td>.71 (4.31)**</td>
<td>.28 (2.07)**</td>
<td>.37 (2.84)</td>
<td>2.16 (1.87)**</td>
</tr>
<tr>
<td>Fragmented Market</td>
<td>-.48 (-3.54)**</td>
<td>.44 (3.32)**</td>
<td>-.08 (-.74)</td>
<td>-.68 (-.61)</td>
</tr>
<tr>
<td>(U^2 \text{ or } R^2)</td>
<td>.07</td>
<td>.11</td>
<td>.16</td>
<td>.23</td>
</tr>
</tbody>
</table>

Note: The levels of statistical significance are based on two-tail tests with * = 10%, ** = 5%, and *** = 1%.
Please forward your requests for working papers to the following address:

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