DEATH OF THE LETHARGIC: EFFECTS OF EXPANSION INTO NEW TECHNICAL SUBFIELDS ON PERFORMANCE IN A FIRM'S BASE BUSINESS*

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This paper finds that industry incumbents that do not expand into new technical subfields tend to fare poorly in their established businesses, even if the market for the established products continues to exist. Firms that expand from their established businesses survive longer and achieve greater subsequent market share than competitors that do not expand. By some measures, however, a failed attempt to expand into a new subfield may be even more harmful to a base business than nonexpansion. The study employs conventional and accelerated event-time regression models to analyze market share and survival. The sample, which includes 371 incumbents in four base subfields of the medical diagnostic imaging industry between 1953 and 1989, examines performance following the emergence of five new technical subfields of the industry. (RELATED DIVERSIFICATION; ORGANIZATIONAL SURVIVAL; TECHNOLOGICAL CHANGE; INDUSTRY EVOLUTION)

Introduction

Whether firms should and will pursue potentially profitable new opportunities are issues that receive much attention. In the managerial and strategy literatures, much time is devoted to urging managers to take quick advantage of opportunities (Foster 1986) and to examining the relative success of new related and unrelated diversification ventures (Rumelt 1974, 1982; Montgomery 1985). In the organizational and economic literatures, meanwhile, much thought is devoted to explaining why firms often are slow to react when presented with new opportunities. Explanations range from inertia induced by bureaucracy (Cozier 1964), age (Stinchcombe 1965), size (Blau and Scott 1962, Scherer 1965, Blau and Schoenherr 1971), or focus on existing products and operations (Schumpeter 1942); to fear of reducing sales of existing products (Reinganum 1983, Tushman and Anderson 1986). Traditionally, most attention has been paid to the success of new ventures when firms expand and the opportunity costs when they do not, rather than to the effects on an existing business of new ventures seized or forgone.

Although the issue has received relatively little empirical attention, the choice of whether or not to expand will often have important effects for a firm's established businesses. Expansion may disrupt successful routines in an existing business (Cyert and March 1963; Hannan and Freeman 1977, 1984; Nelson and Winter 1982). At the same time, continued success in a traditional business may require technical or market know-how gained from expansion into a new business (Mitchell 1989). When a new technical subfield of an industry emerges, for instance, what will happen to industry incumbents that do not expand into it? And what will happen to the traditional businesses of incumbents that do expand but do not succeed in the new subfield?

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In this paper, we draw on several theoretical and empirical perspectives to raise possible answers to these questions. We argue that firms operating within an industry undergoing major product change face conflicting risks, which will be particularly strong when new goods draw on new knowledge bases and so form a new technical subfield within an industry (Mitchell 1989).1 Firms that do not expand into the new technical subfield risk losing their positions in their traditional businesses. But those that do expand, and fail, may also suffer in their established businesses.

Consider, for example, industries within the consumer electronics sector. The emergence of video cassette recorders, quadraphonic stereo systems, compact disk players, and high definition television each presented challenges to industry incumbents. Incumbents that expanded risked investing in products that failed completely, such as quadraphonic stereo, or making the wrong technical choice, such as investment in beta format VCRs. Incumbents that waited to see if a new product would succeed, however, risked both being locked out of the new area once it proved to be successful and knocked out of their core business because of market or technical complementarities among the old and new goods. The RCA Corporation, for instance, was slow to introduce commercial VCRs to the consumer market, then was unable to expand successfully once Matsushita and others had established strong positions, and eventually exited from the television business.

In the following section of the paper, we briefly describe the medical diagnostic imaging industry, which provides the empirical base for the study. We next draw from organizational and economic literatures to identify advantages and disadvantages of expansion. We then propose hypotheses concerning expected effects of expansion or nonexpansion into a new technical subfield on a firm’s existing business. In the subsequent sections, we describe the data and research methods used to test the hypotheses. We then review the results of the tests.

**Diagnostic Imaging Industry**

We test a series of predictions by examining the performance of firms operating in four base subfields of the medical diagnostic imaging industry between 1953 and 1989. This industry consists of firms that manufacture equipment used by physicians and other health care workers to noninvasively examine organs and physiological activity within live beings. The roots of the medical diagnostic imaging industry can be traced to Roentgen’s 1896 discovery of X-rays, which established the feasibility of “seeing” inside the body for diagnosis.

**Industry Description**

As listed in Table 1, several new technical subfields of the imaging industry have emerged since the early 1950s to substitute for and complement earlier x-ray imaging products. Commercial prototypes of nuclear medical imaging instruments were introduced about 1954 and were followed by ultrasound imaging commercial prototypes in 1957. Computed tomography (CT) in 1973 represented the next major development in the industry. Nuclear magnetic resonance (NMR, also known as MRI or Magnetic

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1We define an industry as a group of firms that manufacture products having “reasonable interchangeability of use or cross elasticity of demand” (U.S. Supreme Court, 1964, p. 76). This definition encompasses both direct substitutes and products that are not direct substitutes but that enjoy purchase complementarity, that is, are linked in buying habits. The “Brown Shoe” Supreme Court decision cited above used the latter criterion to find that men’s shoes and women’s shoes were in the same market. Similarly, magnetic resonance and x-ray imaging equipment are not exhaustive substitutes in use, but a buyer’s experience with x-ray equipment is likely to influence the decision to purchase magnetic resonance imaging devices. A technical subfield of an industry (Mitchell 1989) is a set of products that draw on a distinct knowledge base (Nelson and Winter 1982).
Resonance Imaging) and digital radiography emerged in 1980 and 1981, respectively. Despite the introduction of the new products, sales of the established devices in the base subfields continue to be significant as shown by the 1988 sales estimates recorded in the table.

Annual imaging system sales in the U.S. market grew from about $30 million during the early 1950s to about $3 billion by the late 1980s. Because substantial sales of products in each subfield continue in 1990, and continue to grow in many cases, exit from a subfield represents at least some degree of organizational failure; no firm has been forced to exit because a subfield disappeared.

The sales and technical growth of the industry have attracted many new participants, particularly when new subfields have emerged. In addition to new entrants, many industry incumbents have expanded into the emerging subfields, while others have avoided expansion. This variation, coupled with the market-related yet technically distinct characteristics of the subfields, makes the medical diagnostic imaging industry appropriate for the present study.

About a quarter of the firms that were participating in the diagnostic imaging industry when new subfields emerged expanded into the emerging subfields, while the others had not expanded by the end of the study. We examine each incumbent's performance in its base subfield or subfields after the emergence of a new set of products, by comparing the subsequent market share and survival of firms that expanded into new subfields with the performance of those that did not expand. The study provides an inclusive review of about 35 years of industry history.

**General Context**

This study applies to a particular context of innovation. Although the core imaging products have changed radically, each new type of product has primarily been used within the relatively stable radiology market. The supporting assets required to commercialize the products, including distribution and service systems, incremental R & D capabilities, and reputations with users, have changed only incrementally. Therefore, the industry provides a frame in which to examine variations in expansion strategy and success in cases of relatively low-transience major product innovation (Abernathy and Clark 1985), that is, core product changes that do not “leap across” (Kirkpatrick 1983, p. 1371) existing supporting assets. Such cases occur when core products change discontinuously (Tushman and Anderson 1986), but the specialized supporting assets needed to secure their commercial value (Teece 1986) retain much of their utility as the products change. The hypotheses and analyses in this paper will be conditioned on this context.

The context of discontinuous core product change and stable supporting asset evolution is common but not descriptive of all innovation. New products often create
new markets or otherwise change the basis of competition among firms. In such high-translissence contexts (Abernathy and Clark 1985), the supporting assets needed in the established industry may have little value in the new subfield and the incentives for expansion are likely to differ. An incumbent will have few advantages in the new subfield relative to a new firm and may have disadvantages brought on by the presence of skills, attitudes, and assumptions suited only to the old environment (Cooper and Schendel 1976). Nonetheless, even in the high-translissence case it may be necessary for an incumbent to expand into the new subfield in order to protect its established business. Cooper and Schendel (1976) found that most of 22 major players in 7 industries expanded into new technical subfields; many continued to fare well in the traditional businesses, even though none became a long-term leader in the new areas.

Background

An industry incumbent faces a strategic challenge when a new technical subfield first emerges. Does it expand to exploit new opportunities, introduce new product lines, preempt competitors, and utilize old assets in a new business? Or does it wait to see how the technical and market characteristics of the new subfield develop, delaying expansion to avoid the associated risks? Many of these issues have been addressed, particularly in the context of the effects of diversification on over-all firm performance. Financial event studies and longer-term analyses typically find that acquiring a new business has little positive effect on the financial performance of the acquiring firm (Jensen and Ruback 1983; Ravenscraft and Scherer 1987; Bradley, Desai, and Kim 1988). Studies that have differentiated among related and unrelated diversification have found that new ventures undertaken in fields having little relationship to a firm’s existing businesses often perform poorly (Rumelt 1974, 1982; Bettis 1981). On the other hand, expansion into related fields, which is a form of logical incrementalism (Joyce 1986), may lead to strong performance in the new business (Rumelt 1974, 1982; Montgomery 1985; Ramanujam and Vardarajan 1989). Rather than examine performance in the new field or the combined performance of the new and old businesses, however, the focus of this paper will be on what we refer to as spillback effects—the effects of expansion into a new technical subfield on performance in a firm’s existing business.

Spillback Advantages of Expansion

Expansion into new businesses offers several potential advantages for established operations. The advantages will be particularly strong when key supporting assets require only incremental change and so retain their utility as core products change discontinuously, because refining the supporting assets for use with the new products can provide leverage for sales of established products. In the consumer electronics sector, for instance, the incremental R&D capabilities and product distribution systems that are required to support the production and sale of televisions retain their value if a firm introduces VCRs; as a firm gains experience with VCRs, improvements in the supporting capabilities and systems can be used to improve its established television operations. The following discussion of spillback advantages will focus on such cases of stable supporting asset evolution.

Among the key benefits for the old business of expansion into new technical subfields of an industry are cost reductions achieved through volume economies, which include economies of scale (Porter 1980), scope (Teece 1980), and learning (Amit 1986). Creating economies of scale, that is, reducing average fixed cost by using the same physical and knowledge-based assets to produce more of the same good, is
possible when expanding into a new product line provides new customers for existing
products. The scale opportunities will be reduced if the new products substitute for
the old, but may be significant if a market for the older goods continues to exist.
Economies of scope, which arise from reducing average fixed cost by using the same
assets to produce more goods, may be achieved in R&D (Kamien and Schwartz
1982), manufacturing (Panzar and Willig 1977), distribution, or elsewhere within a
business. A further source of scope economies arises from the added knowledge
gained of rivals by competing against them in multiple product lines (Porter 1980;
Karnani and Wernerfelt 1985). Learning economies, the reduction of average variable
cost as cumulative production increases, may be transferred back from new goods to
older products. Scale, scope, and learning economies may be substantial when there
is overlap between the technical subfields in the nature of the products, manufactur-
ing technologies, marketing systems, or service systems.

As well as cost-reduction, expansion into new technical subfields may also lead to
product improvement in the original business. Serendipitous or programmatic ad-
ances in R&D (Nelson 1959) or manufacturing capability (Wheelwright 1985) that
occur because a firm has expanded into a new technical subfield may be passed back
to incrementally advance products in the old business. Increased understanding of
user needs and demands in the new subfield may also spill back and lead to product
redesign in the established business. Much of the technical and market information is
likely be tacit know-how (Polanyi 1967, Alchian and Demsetz 1972, Teece 1981,
Nelson and Winter 1982) that would remain beyond the firm's reach if it attempted to
acquire it externally, rather than participate in the new subfield.

In addition to volume economies and product development benefits, expansion into
new technical subfields may provide other financial and organizational advantages to
improve performance, or mask its decline, in the existing subfield. Exposing the firm
to greater competition may improve overall firm efficiency (Leibenstein 1966, Shelton
1967) and, therefore, the quality of its performance in its traditional subfield.
Improving organizational adaptability, and developing the sophisticated structure and
control systems required to manage participation in more than one environment, may
enhance overall performance (Chakravarthy and Lorange 1984, Lorange 1986). Par-
ticipating in subfields at different life cycle stages may stabilize overall earnings and
thus mediate the effects of earnings variability and decline in the traditional subfield.

Expansion into a new technical subfield of the diagnostic imaging industry may
offer many of these general financial and organizational benefits. In addition, the
potential for volume economies and product improvement in the established imaging
equipment business may be significant. Volume economies arise through both scale
and scope opportunities. Because the imaging devices are not complete substitutes in
use but often enjoy purchase complementarity, offering a new device may increase a
firm's sales of some older products if buyers link purchasing decisions across the two
types of goods. Even if the firm does not increase its absolute sales of the established
product, expansion into a new subfield may limit the decline of sales of established
products. Scope economies arise because products in several imaging subfields use
overlapping sets of components, employ similar manufacturing systems technologies,
and can take advantage of the same distribution and service systems (Emmitt 1980;
McKay 1983). Moreover, key rivals often participate in several subfields, so that
multiple-subfield competition provides essential competitive knowledge (Diagnostic
Imaging Scan 1990).

In addition to scope economies, the shared design, manufacturing, and distribution
systems may lead to diagnostic imaging product improvement, by using product and
market knowledge gained in one area for the benefit of another. For instance, the
shared radiology market allows transfer of customer knowledge between subfields.
Expansion into a new subfield also signals that the firm intends to remain in the industry, which is important because the imaging industry has been characterized by frequent exit (Mitchell 1991), with customers often being left with out-of-date equipment (Frost and Sullivan 1974, Drew 1987).

Carried to the limit, the above argument would indicate that all firms will participate in all technical subfields of an industry in which supporting assets can be used across product areas. In 1988, however, only 11 of 135 imaging incumbents operated in as many as 3 of the 7 diagnostic imaging industry technical subfields. Therefore, there must be limits to the benefits of expansion and concomitant disadvantages of cross-subfield operations.

**Spillback Disadvantages of Expansion**

Some potential disadvantages of expansion are primarily economic. For one, the existence of economies of scale relative to the size of the market may limit the number of participants (Bain 1956). For another, participation in one subfield may cannibalize sales of substitute products in other subfields (Reinganum 1983). Problems encountered during expansion may reduce product sales in the existing subfield even when no direct product substitution takes place, if the difficulties in the new business affect the firm's reputation and so harm performance in the existing subfield (Leonard-Barton 1985). Thus, a firm expanding into a new subfield to exploit its assets may instead find itself engaged in competence destroying activity (Abernathy and Clark 1985, Tushman and Anderson 1986) that adversely affects base subfield performance. Although a firm may be forced by its competitors to expand (Mitchell 1989), the expansion may lead to decline of the earlier business.

An additional economic problem is similar to the cannibalization issue. In all but the most resource-rich or slack-abundant organizations, the resources required for commencing and maintaining operations in a new and sophisticated subfield are likely to reduce the resources available for the existing business. Thus, necessary investments that otherwise would have been undertaken in the existing business may be forgone as a result of the expansion into a new subfield.

Beyond the relatively narrow economic issues of scale economies, cannibalization, and use of financial resources are several organizational factors. Many organizations, constrained by bureaucratic and structural inertia, find the challenge of managing competently across different technical or market environments to be challenging and perhaps impossible (Chandler 1962, Crozier 1964, Nelson and Winter 1982, Starbuck 1983). Attempting to adapt to the dictates of the new environment might result in maladjustment to the original environment (Hannan and Freeman 1977, 1984, 1989). This could saddle the firm with a dominant logic that hinders effective performance in specific subfields (Prahalad and Bettis 1986).

Similarly, the need to manage the more complex operations will limit the managerial attention that can be allocated for each area and may disrupt the attention that is allocated. The costs of governing the more complex hierarchy and of establishing boundary spanning activities between the units of the firms are likely to constrain managerial and financial performance (Williamson 1975, 1985; Tushman 1977). Exposure to multiple environments can also severely disrupt the shared meanings and processes that are critical to organizations, with negative effects on performance (Gray, Bougon, and Donnellon 1985). Frequently, operations in the base subfield will receive the shortest shrift, owing to the need to attend to the growth of the new business and the greater interest in working in the new area.

Expansion, therefore, has real costs in addition to potential benefits. The spillback effects are limited in the medical diagnostics imaging industry by the size of the
imaging market; there is only so much room for broad-scope participants. Moreover, much of the technical knowledge and, to a lesser degree, market knowledge that is gained by participation in a new subfield is unique to that subfield, thereby limiting the potential product improvement and economies of scope.

Nonetheless, the opportunities to spill resources back into established diagnostic imaging businesses are significant. We predict that the spillback benefits of expansion are large enough that imaging equipment manufacturers that do not expand into emerging subfields of the industry will tend to suffer in their base businesses. The context for this prediction is the continued utility of many supporting assets, such as design, manufacturing, distribution, and service systems. In addition, technical evolution within each product area has been influenced by advances in other subfields.

**Measures of Performance**

Choosing an optimal measure of performance is a controversial topic, with profitability, market share, and survival, at least, each having proponents. Moreover, none of these three measures is unidimensional; profit, for instance, could be operationalized in terms of several different criteria, including return on assets, equity, investment, and sales (McGuire, Schneeweis, and Hill 1986). We see no particular need for the controversy. Each measure offers independent information and is individually useful. Therefore, in this study, we utilize multiple measures of performance.

We would like to examine spillback effects on some measure of profitability, but are unable to do so. Part of the problem stems from the longitudinal nature of the study; it is difficult to compare profitability at different times and in different contexts. In addition, many of the businesses in the sample are either privately held companies or divisions of large firms. Hence, we cannot obtain profitability estimates for many of the players. We do, however, examine both market share and survival.

Market share is a relatively conventional measure of performance. Although several studies have demonstrated that market share may not be directly related to contemporaneous profitability (Woo and Cooper 1981; Prescott, Kohli, and Venkatraman 1986), the measure is commonly used because it often is available and may influence long-term profitability or survival. We examine levels of a firm’s market share in its base imaging business or businesses at several intervals after the emergence of a new technical subfield of the industry.

An alternative to using absolute market share as a performance measure would be to examine change in market share. Many of the inferences would be similar, but there is an important difference; absolute market share measures how well a firm is performing, while change in market share reveals how much better the firm is performing. Consider two firms, one with 20% market share in both year 0 and year 4, and the second with 1% share in year 0 and 5% share in year 4. The first would score well in an absolute measure of year 4 market share but poorly in a change measure. The second, meanwhile, would score poorly on the absolute measure but well on the change measure. Because our primary interest lies in absolute performance, we prefer the absolute measure.

In addition to market share, we examine the length of a firm’s continued participation in the base subfield, which we refer to as survival. This represents a departure from the more traditional measures used in diversification studies. Although survival may not be perfectly correlated with profit-maximization (Schaffer 1989) or market share (Mitchell 1991), we employ the survival measure for several reasons. In longitudinal studies, survival tends to be more tractable and less ambiguous than financial performance. It avoids the complexities of determining financial performance in privately-held firms and individual divisions of multi-business corporations,
and of choosing among alternate accounting criteria. Although some researchers would define survival as inertia rather than performance, other academic analysts regard it as one important type of performance, often containing information that differs from measures of market share and profitability. In addition, survival is of independent interest to managers, other employees, competitors, communities, and shareholders (Barnard 1947, pp. 44, 251; Hannan and Freeman 1989).

One element of ambiguity that enters into survival analysis is the definition of exit. We have measured survival at the parent-firm level of analysis. That is, if an organizational subunit such as a division is sold as an ongoing operation, we have recorded this as an exit. If we lowered the level of analysis to the organizational subunit, however, no exit would have been recorded. Although the organizational subunit level may appear to be attractive, subunit-level survival is difficult to operationalize accurately. When, for instance, does a divested division become a new operation—when it changes its name, when the original employees leave, when it is merged operationally with another organization, or when some other event takes place? Often, there is no one identifiable event that defines the exit. Therefore, we believe the parent-level is the most appropriate for this study.

To reduce ambiguity, we distinguish between exit by dissolution and exit by acquisition, similar to Freeman, Carroll, and Hannan's (1983) distinction between dissolution and merger. Acquisition and dissolution represent distinct types of exit, and are likely to result from different influences. Being acquired may be a sign that a firm possesses a successful line of products, but lacks the organizational resources to commercialize them further. Dissolution, on the other hand, is more likely to be a measure of overall failure (Mitchell 1990).

If an imaging operation was shut down, either through a firm failing or dropping the product line, we recorded the exit as a dissolution. If the operation was acquired by another firm and continued to manufacture imaging equipment, we recorded the exit as an acquisition. Each type of exit was treated as a censoring case in the analysis of the other (Freeman, Carroll, and Hannan 1983), a procedure we will discuss in the methods section.

The use of survival as a performance measure is equivalent to the use of failure rates by some organizational analysts (e.g., Carroll and Delacroix 1982, Hannan and Freeman 1989), because the length of survival of an individual firm is an inverse function of the failure rate among a group of firms. Any difference between the measures lies at the intuitive level. Examining failure rates is intuitively appealing for studying groups of organizations, while length of participation is a more obvious measure when studying individual organizations.

Hypotheses

The discussion so far has outlined the advantages and disadvantages for industry incumbents of expansion into new technical subfields. When key supporting assets retain their value as core products change, and when a significant market for the established products continues to exist, we expect that the positive spillover effects of expansion frequently will be great enough to offset the adverse effects. The following hypotheses apply to this context.

To simplify the language used in the hypotheses, we introduce two terms. We refer to firms that are industry incumbents when a new technical subfield emerges as "pre-introduction incumbents". We refer to the market share attained in its base subfield by a pre-introduction incumbent after the emergence of a new subfield as "subsequent market share".
Benefits of Expansion

Expansion by a pre-introduction incumbent into a commercially-successful new subfield will tend to enhance its performance in the base subfield, given the context of low-transilience innovation discussed above. Such performance is likely to be reflected in longer survival in the base business and greater subsequent market share.

Hypothesis 1a. A pre-introduction incumbent that expands into the new subfield will have longer survival in its base subfield than firms that do not expand.

Hypothesis 1b. A pre-introduction incumbent that expands into the new subfield will attain greater subsequent market share in its base subfield than firms that do not expand but survive.

Effects of Pre-Introduction Positions

The reasoning underlying Hypotheses 1a and 1b assumes that the benefits gained from expansion are responsible for the greater performance of firms in the established businesses. An alternative explanation is that successful firms in the existing industry are likely to expand into new subfields. This perspective holds that a more able firm improves its performance by evolving on the basis of superior competence (Nelson and Winter 1982). Success could result from the possession of specialized assets, industry and market knowledge, economies of scale and scope, reputation, and managerial talent (Porter 1980, Nelson and Winter 1982, Teece 1986, Barney 1986).

Industry Strength. If past success drives both the choice of expansion and realization of future success, it will be possible to predict the performance of expanding firms by measuring their pre-introduction market shares. The dominant firms in the industry are most likely to possess qualities that will enhance their survival and market shares in their existing subfields as they face the challenge of expansion into new subfields.

Hypothesis 2a. The greater the industry-wide market share held by a pre-introduction incumbent, the longer its continued survival in its base subfield.

Hypothesis 2b. The greater the industry-wide market share held by a pre-introduction incumbent, the larger its subsequent market share in its base subfield.

Subfield Strength. Although pre-introduction industry-wide market share may lead to greater subsequent performance, the same argument may not hold for firms that possess high market share in a single subfield. While focusing operations on one area may enhance performance within it, this concentration may deprive such specialists of the broad experience and skills necessary to cope successfully with the challenges of a radically changing industry. For this discussion, we draw most heavily on the logic of population ecology theory.

Population ecology theorists have predicted that specialist organizations will be best-suited to environments in which change is uncertain, happens frequently, and swings back and forth between repeated noncompatible states. Generalists, on the other hand, will be suited to environments in which change is infrequent or states are compatible (Hannan and Freeman 1977, Brittain and Freeman 1980). Compatibility here refers to the usefulness of resources in different environmental conditions.

A preliminary reading of the theory might suggest that specialists are suited to industries in which new technical subfields emerge, if this is taken to represent reasonably frequent moves into new states that are not technically compatible with the old. However, two aspects of the nature of the changes works against specialists and in favor of generalists. The first factor is the issue of compatibility. Although the devices in the new subfields draw on different technical knowledge than those in the
old, and so in some real sense are not compatible with them, the supporting systems
needed for their commercialization retain their value. Thus, the emergence of new
technical subfields coupled with continued importance of existing supporting assets
represents noncompatibility at the product level, but compatibility at the supporting
asset level.

The second factor is the nature of the changes that have taken place in the imaging
industry, which have been sequential rather than the repeating iterations discussed in
ecological theory. Specialists may prosper in changing states if the environment
returns to conditions in which they fit, such as cyclical fluctuation in demand for their
products. An example is the cyclical demand for pork, beef, chicken, and other meat
products. In such environments, specialist producers often thrive.

Many changes take place as a sequential series of new states, however, rather than
as repeated pendulum swings among a constant set of states. For instance, no swing
back to demand for mechanical adding machines occurred after electronic calculators
emerged. Although technical and market environments that affect the calculator
industry continue to change rapidly, the progression has been a sequential introdution
of new generations of electronic devices, rather than a return to the mechanical
era. Any specialist manufacturer of mechanical devices that waited for the demand
for its product to return has long since failed.

When change is sequential, the environment does not return to a state to which the
specialist is suited. Therefore, an industry in which new technical subfields tend to
emerge in an uncertain stream of nonrepeating states will favor firms that have
strength across the industry, because they possess a broader set of resources that can
be brought to bear in the new environments. Mitchell (1991) found that greater
market share in the diagnostic imaging equipment industry was associated with
achieving greater market share in each new subfield. Similar effects are likely to be
found for continued performance in base subfields. Even when older products are not
overwhelmed by emerging goods, participants with focussed product lines will find it
difficult to cope with changing demands from users of the established goods.

Perhaps counterintuitively, the strongest specialists are the most at risk of exiting,
because of their high profile. Low-share specialists may be able to adapt their niche
operations to a changing industry and market or, in some cases, to ignore the
changes. A firm that specializes in manufacturing dedicated ophthalmic ultrasound
systems and so possesses small market share in the ultrasound subfield, for instance,
is not likely to be threatened by the introduction of general-purpose computed
tomographic imaging equipment. Similarly, a tire manufacturer that specializes in
tires for heavy-duty agricultural machinery, and so is a small player in the traditional
bias-ply tire industry, may be relatively unaffected by the introduction of radial tires.
A firm that dominates a subfield but does not participate beyond it is threatened by
emerging subfields, however, because the new products are likely to compete with at
least one of the key products manufactured by the subfield leader.

Using Chakravarthys's (1986) term, subfield followers may be successful adaptive
specialists. High-share subfield specialists, however, are likely to face strong pressure
either to expand both incrementally within the subfield and radically across subfields,
or to retreat from the business. If they attempt to expand, they will face the risks
associated with expansion. If they do not expand, they will face diminishing sales and
may choose to exit the base business rather than attempt to retrench. In either case,
their survival in the base business will be relatively short.

Hypothesis 3a. Controlling for industry-wide market share, the greater the subfield
market share held by a pre-introduction incumbent before the emergence of a new
subfield, the shorter its continued survival in its base subfield.
Although they may be more likely to exit, high-share specialists that do survive are likely to retain significant market share within their base business, relative to surviving low-share specialists.

_Hypothesis 3b._ Controlling for industry-wide market share, the greater the subfield market share held by a pre-introduction incumbent before the emergence of a new subfield, the greater its subsequent market share in its base subfield.

_Risks of Expansion_

Notwithstanding the advantages of related diversification, expansion into emerging technical subfields within an industry is not a risk-free proposition. The costs associated with failed expansion—lost investments, outstanding liabilities, damaged reputation, and organizational effects—may be so great as to extend beyond failure in the new subfield and spill back into the established business. Here, the relevant comparisons are of failed expansion to both incumbents that expand successfully and those that do not expand at all. We consider expansion to have failed if the firm withdraws from the new subfield.²

_Hypothesis 4a._ A pre-introduction incumbent that expands into a new subfield and must exit from it will have shorter survival in its base subfield than pre-introduction incumbents that expand and do not exit.

_Hypothesis 4b._ A pre-introduction incumbent that expands into a new subfield and must exit from it will have lower subsequent market share in its base subfield than pre-introduction incumbents that expand and do not exit.

Indeed, the costs of failed expansion may be so great as to overwhelm the benefits of expansion. As an initial expectation, therefore, we predict that firms that expand unsuccessfully will fare poorly relative to incumbents that never expand.

_Hypothesis 4c._ A pre-introduction incumbent that expands into a new subfield and must exit from it will have shorter survival in its base subfield than pre-introduction incumbents that do not expand.

_Hypothesis 4d._ A pre-introduction incumbent that expands into a new subfield and must exit from it will have lower subsequent market share in its base subfield than pre-introduction incumbents that do not expand.

The spillover effects may also depend on the timing of expansion into new subfields. Mitchell (1991) found that the later a pre-introduction incumbent expands into a technical subfield in which supporting assets retain their value, the longer the firm participated in the new subfield. Entrants hoping to capture first-mover advantages expose themselves to unexpected technical, market or competitive shocks that reduce survival in that subfield. The impact of these shocks is also likely to be transferred back to performance elsewhere, so that very early expansion into an emerging subfield will be associated with shorter survival in the base subfield.

This prediction is conditioned by the context of an industry in which first-mover advantages are not overwhelming. Lieberman and Montgomery (1988) identified three major categories of advantage. In the imaging equipment industry, as in many

²It is likely that the spillover effects will also be influenced by how long a pre-introduction incumbent survives in the new subfield and what market share the firm attains in it. Analysis of these influences, however, would introduce the complication of right-censoring of the independent variables. That is, we would be unable to record the length of participation or future market share of firms that continued to participate in a new subfield at the end of the study. Although measures for the right-censored covariates could be obtained by extrapolation estimates, we prefer to leave such work for future research.
others, first movers have little chance of gaining significant product or process leadership, rarely lock up key resources, and cannot immediately impose large buyer switching costs. Hence, firms that expand later may avoid many early mistakes and so enjoy longer survival.

Hypothesis 5a. The earlier a pre-introduction incumbent expands into a new subfield, the sooner after its expansion it will exit from its base subfield.

Firms that are very late to expand, however, also face risks. Early or middle-range mover advantages may exist even if first-mover advantages are not significant, so that firms that expand very late may find it difficult to break in successfully. Product lines will be set and buying patterns established, so that the laggards will frequently find it difficult to gain the spillback benefits of expansion.

Hypothesis 5b. The later a pre-introduction incumbent expands into a new subfield, the sooner after its expansion it will exit from its base subfield.

Together, Hypotheses 5a and 5b imply that firms that enter during the middle-range will be the most successful in terms of survival. We will test the predictions jointly, using main and squared measures of expansion waiting periods. We expect to find positive main effects and negative squared effects. Such signs are consistent with relatively short survival of early and late entrants.

The predictions of waiting period effects on market share performance are based on a different logic than the hypotheses concerning survival. Mitchell (1991) found that early entrants that did survive gained long-term market share advantages in new subfields. It is possible that the market share benefits of early expansion into a new subfield will also spill back into the established business. A possible reason for the spillback is that buyers in the new subfield may link their purchase decisions for new and established devices. Thus, early expansion may be associated with greater subsequent market share in the base subfield, opposite to the shorter survival effect of early expansion. Unlike the survival case, we do not expect squared effects of late expansion to be found, that is, we do not predict that late expansion will be associated with greater market share. The same influences that lead to shorter survival for late expanders are likely to lead to smaller market share.

Hypothesis 5c. The later a pre-introduction incumbent expands into a new subfield, the smaller its subsequent market share in its base subfield.

Learning from Expansion

Finally, spillback benefits will tend to increase as a firm and its managers learn how to realize them. Each time a firm successfully expands, it is likely to develop new routines for incorporating benefits across businesses in multiple subfields. This argument is related to those developed by Hedberg (1981) and by Nelson and Winter (1982).

Hypothesis 6a. The more times a pre-introduction incumbent has expanded in the past, the longer its post-expansion survival in its base subfield.

Hypothesis 6b. The more times a pre-introduction incumbent has expanded in the past, the greater its subsequent market share in its base subfield.

In this section of the paper we have presented a series of hypotheses concerning the effects of expansion and nonexpansion on survival and market share performance in an incumbent’s base subfield. In the next section, we describe the data gathered to test the predictions.
Data

Concepts and Definitions

To conduct the study, it was necessary to define the product and geographic scope of the diagnostic imaging equipment market, identify analytic periods, and choose a level of analysis. We omitted component suppliers, treated the U.S. market as the geographic limit, used calendar years as the measure of participation, and dated expansion as the year when a firm began to manufacture imaging systems in the new subfield. All firms manufactured equipment for the human diagnostic medical field; manufacturers of dental, veterinary, chiropractic, and therapeutic equipment were excluded. As we discussed earlier, we conducted the analysis at the parent-firm rather than the organizational subunit level of analysis, owing both to difficulty in assigning subunit level exit dates and to the presence of potential parent-level influences on strategy and performance (Scott 1984).

Sample

The data were gathered from an extensive archival search, supplemented by interviews with industry and academic participants.\(^3\) The sample includes all firms participating in the x-ray, nuclear, ultrasound, and CT subfields when new subfields emerged. Because magnetic resonance and digital radiography emerged within a year of each other, we omit the one incumbent of the magnetic resonance subfield that was operating when digital radiography was introduced in 1981. As listed in Table 2, comparison of 14 base subfield-new subfield pairs produced 371 base subfield incumbents, 100 of which expanded into emerging subfields. Of the pre-introduction incumbents, 187 had exited from the base subfields by the end of the study, with 81 exiting by acquisition and 106 by dissolution.

The pool included 151 distinct firms, because many were incumbents of more than one subfield. The incidence of sequential expansion allows us to test Hypotheses 6a and 6b, which address the effects of learning from past expansion. Such corporate-level duplication might produce a bias, if expansion decisions and performance are influenced by idiosyncratic firm-specific tendencies. In part, we control for the potential problem with the learning hypothesis and with the prediction that pre-introduction industry market share will have positive influences on performance, because firms possessing high prior market share will tend to be those operating in more than one subfield. We do not include individual firm identification variables, owing to the reduction in the degrees of freedom. We believe the actual bias is not extreme, however, because the reported results are robust to significant deviations in model specification unless otherwise noted.

\(^3\) The archival sources included reports conducted by government agencies, studies published by market analysis firms, corporate annual 10-K reports, and articles in the business press. Market share estimates for the 1970s and 1980s were generally available from multiple sources, owing to the growing incidence of publications by industry analysts and government agencies. For the 1950s and 1960s, though, it was often possible to obtain estimates from only single sources, either corporate annual reports or people who had participated in the industry during those decades. Given the ambiguity involved in estimating market share—including different estimates of market size, different methods of computing sales by individual firms, different market definitions, and different memories of past events—any claim to have measured market share requires some audacity. We believe, however, that the trends in our market share data are accurate. This belief is supported by consistency in the results of disaggregated analyses. We found similar results when we examined the effects of expansion into the CT, NMR, and digital radiography subfields (which emerged during the 1970s and 1980s, when market share data are generally reliable), and the nuclear medical and ultrasound subfields (which emerged during the 1950s and 1960s, when the market share data tend to rely on single-source estimates and participant memory).
TABLE 2  
Number of Incumbents of Four Base Technical Subfields, Number Which Expanded into New Technical Subfields, and Number Which Exitd from Base Subfield, 1954–1989

<table>
<thead>
<tr>
<th>New subfield</th>
<th>X-ray</th>
<th>Nuclear</th>
<th>Ultrasound</th>
<th>CT</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear</td>
<td>13 (6)</td>
<td>3 (0)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ultrasound</td>
<td>14 (6)</td>
<td>18 (7)</td>
<td>31 (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CT</td>
<td>29 (8)</td>
<td>23 (6)</td>
<td>61 (7)</td>
<td>11 (6)</td>
<td></td>
</tr>
<tr>
<td>Magnetic resonance</td>
<td>29 (12)</td>
<td>26 (10)</td>
<td>73 (12)</td>
<td>12 (9)</td>
<td>371 (100)</td>
</tr>
<tr>
<td>Digital radiography</td>
<td>113 (40)</td>
<td>70 (23)</td>
<td>165 (22)</td>
<td>23 (15)</td>
<td></td>
</tr>
</tbody>
</table>

Exit-type          | Number of incumbents which exited base subfield |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquired</td>
<td>26</td>
</tr>
<tr>
<td>Dissolved</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
</tr>
</tbody>
</table>

Methods

**Variables**  

**Dependent Variables.** The dependent variable for the analyses of the survival of all pre-introduction incumbents (Hypotheses 1 to 4) was defined as the number of years an incumbent participated in its base technical subfield or subfields after the emergence of a new subfield. The count started at 1 for firms that exited a base subfield during the year in which a new subfield emerged. For example, the survival of each firm participating in the x-ray or nuclear base subfield during 1956, the year before the commercial introduction of diagnostic ultrasound equipment, was clocked until its exit from its base subfield. Those remaining in the base subfields at the end of the study were coded as being right-censored, that is, having unobserved exit dates. All analysis was conducted at the subfield level, so that spillback effects were computed for each subfield in which a firm participated when it expanded into a single new subfield.

In the survival analyses that distinguished between exit by dissolution and exit by acquisition, we treated each type of exit as a censoring case in the analysis of the other. When we examined influences on exit by dissolution, for example, we recorded firms that exited by acquisition as censored cases, just as we recorded firms that continued to participate at the end of the study as censored cases. The participation duration of the censored acquisition cases was set equal to the period between expansion and the year of exit by acquisition. This procedure controls for the effects of each type of exit on the risk of the alternate type of exit (Kalbfleisch and Prentice 1980, pp. 163–167; Yamaguchi 1991, pp. 169–171).

For the tests regarding subsequent market share, we recorded the subfield dollar revenue market share held by a pre-introduction incumbent during years 4, 8, and 16 after the emergence of the new subfield. The choice of the periods was arbitrary; we expected them to be long enough for mid-term and long-term effects to be identified. The 4- and 8-year measures apply to all base and emerging subfields; the 16-year market share measure does not apply to base subfield performance following emergence of the magnetic resonance and digital radiography subfields, which have not
reached 16 years of existence. For each measure, we limited the analyses to pre-introduction incumbents that survived at least 5, 9, and 17 years, respectively. Thus, the market share tests contain a survivor bias, and must be interpreted in the context of the survival analyses.

For the analyses of the survival of pre-introduction incumbents that expanded (Hypotheses 5 and 6), the dependent variable was defined as the length of participation in the base subfield after the firm's expansion into a new subfield. The change in the point for starting the survival count (from subfield introduction date to firm expansion date) was made in order to avoid reverse causation problems when testing Hypothesis 5, which predicts that length of the waiting time before expansion will affect performance in the base subfield. If the subfield introduction date were used to start the survival count for the waiting period test, the results would be confused with the possibility that firms that expanded late were those that enjoyed longer survival in the base subfield. The same 4-, 8-, and 16-year market share measures employed for the earlier tests were used for the market share variants of Hypotheses 5 and 6.

Analyses were carried out for the full pool of 371 incumbents reported in Table 2. Such pooling permits conciseness of reporting and, when relatively few exits occur in a categorical variable of interest, produces estimates that could not be obtained with base-subfield-level subsamples. The pooling runs the risk that differences in the performance variances within the underlying x-ray, nuclear, ultrasound, and CT base subfields will bias the results (Tuma and Hannan 1984). When we analyzed each of the four base subfields separately, we found that the survival variances of the x-ray and ultrasound subfields were similar, but that the nuclear and CT subfield variances were significantly smaller than in the other two subfields. The measures of the pooled effects of the independent variables, however, appear to be qualitatively unbiased. Effects that were found to be statistically significant in the pooled sample almost always took the same sign in the subfield-level subsamples; in such cases, a majority of the subfield-level coefficients appeared at significant levels.

**Covariates for Expansion Effects.** A 0-1 expansion effect variable was used to distinguish between the 271 incumbents that had not expanded into new subfields by the end of the study and the 100 that did expand. We also defined mean effect dummy variables to distinguish between firms that did not expand, expanders that had exited the new subfield by the end of the study, and expanders that continued to participate. Firms that had not expanded by the end of years 4, 8, and 16 were treated as nonexpanding cases for the analyses of the relevant market shares. A firm that expanded during year 6 and continued to survive during year 9, for instance, was treated as a nonexpander for the year 4 market share test and as an expander for the year 8 test.

**Covariates for Other Predicted Effects.** We defined independent variables to test the prior industry and subfield market share, new subfield survival, waiting period, and learning predictions. A pre-introduction incumbent's prior industry-wide market share was calculated as its percentage of overall industry sales during the calendar year before the emergence of the new subfield. Similarly, each incumbent's prior subfield market share was recorded for the year before the emergence of a new subfield.

The waiting period tests required estimation of both a main and a squared effect. How early a firm expanded into a new subfield was measured by the number of years between the emergence of the subfield and the expansion of the firm, with the count starting at 1 for firms that expanded during a subfield's first year. The waiting period was then squared, in order to test for middle-range effects. Finally, a variable recorded the number of times the firm had expanded in the past.
Control Variables. Variables were defined to control for firm size, nationality, year of new subfield introduction, and base subfield. Size, which sometimes has significant effects on the probability and timing of incumbent's expansion into new subfields (Mitchell 1989), was measured as the natural log of total corporate sales during the year before a new subfield emerged. Sales data were unavailable in a few cases, in which average size measures were assumed and a dummy variable was used to check for bias introduced by the assumption. A 0-1 indicator variable recorded nationality of firm majority ownership (247 U.S. incumbents against 124 others), in order to control for any advantages or disadvantages that American firms may hold relative to foreign competitors and for the differing strategies that foreign firms may pursue. Of the 151 firms in this study, 114 were American, 27 were based in western Europe, 6 were Japanese, and 4 were based elsewhere. To account for unmeasured differences among emerging subfields, a value equal to the introductory year of each emerging subfield minus 1900 was recorded in a new subfield effect variable. This variable, in addition to the right-censor modifier of the dependent variable, controls for possible shorter survival after the emergence of the newer subfields. Finally, a set of four mean effect dummy variables was defined to control for unmeasured differences among the four base subfields. Summary statistics and product-moment correlations among the variables are reported in Appendix A.

Statistical Methods

We used log-linear accelerated event-time regression analysis to test the survival hypotheses and conventional normal-distributed maximum likelihood linear regression techniques to test the market share performance predictions. The following functional forms were used:

\[ MS_i = \alpha_M + \beta_M X_i + \sigma_M \nu_i. \]  

(1)

\[ \ln T_i = \alpha_T + \beta_T X_i + \sigma_T \epsilon_i. \]  

(2)

In equation (1), \( MS_i \) represents market share achieved by firm \( i \); \( X_i \) is a vector of covariates associated with the \( i \)th case; while \( \alpha_M \) and \( \beta_M \) are a mean-related intercept and a vector of coefficients associated with the independent variables. The error vector \( \nu \) is distributed according to the assumed parametric distribution and is scaled by a variance-related factor \( \sigma_M \). We report the variance-related factor in the market share analyses (the scale parameter, which is computed in conventional regression techniques but typically not reported in published results) for completeness of comparison to the survival studies.

In equation (2), \( T_i \) is the observed duration of the \( i \)th case; \( X_i \) is a vector of covariates associated with the \( i \)th case; while \( \alpha_T \) and \( \beta_T \) are a mean-related intercept and a vector of coefficients associated with the independent variables. A positive \( \beta_T \) accelerates the baseline distribution of event times and a negative coefficient decelerates the distribution. The error vector \( \epsilon \) is distributed according to the assumed parametric distribution and is scaled by a variance-related factor \( \sigma_T \).

We will omit further discussion of the conventional maximum likelihood regression because it is commonly used in the organizational literature, but will introduce a brief discussion of accelerated event-time regression. Further details of the event-time

\^Age, which may influence an organization's internal functioning, responsiveness, and adaptability (Hannan and Freeman 1989), was also recorded but was too strongly correlated with size to produce independent information.
method can be found in Kalbfleisch and Prentice (1980) and Cox and Oakes (1984), where it is referred to as accelerated-failure time regression.\(^5\)

The principal advantage of the accelerated event-time method over more conventional regression techniques is its use of right-censored cases. In this study, about half the incumbents had not exited from the base subfields by the end of the study; in addition, with different observation periods for each of the four base subfields, incumbents had longer to exit the older subfields. If the only firms included were those that exited, the results would be seriously biased. Accelerated event-time analysis controls for variation across subfields because it incorporates the information that some incumbents had not exited.

The accelerated event-time method assumes that the event times (years of participation in this study) are distributed according to a parametric baseline distribution that would hold if all independent variables were zero. The effects of covariates are then estimated as exponentially multiplicative accelerations or decelerations of the baseline distribution. The additive logarithmic form of the model shown in equation (2) is most commonly used.

The accelerated event-time method assumes that the dependent variable is distributed according to a specified distribution that, in the absence of other influences, would be the distribution of the observed events. In practice, the generalized gamma families of distributions and the loglogistic distribution have been found to provide good fits to observed data (Kalbfleisch and Prentice 1980, Greene 1990). Through graphical analysis of residuals, the loglogistic distribution was found to provide the best fit for the survival data in the present study. This distribution has fatter tails than the Weibull and lognormal distributions, which nest arithmetically within the generalized gamma family, and often is suited to studies in which there is relatively high incidence of early and late events.

The loglogistic distribution can fit both monotonic and nonmonotonic distributions, depending on the parameters estimated. A scale parameter greater than or equal to 1 implies a monotonically declining exit rate. A scale parameter of less than 1 implies a nonmonotonic exit rate, first rising, then falling. In the present case, the residuals took on a nonmonotonic form. The size of the logistic scale parameter, which is less than 1 in each reported accelerated event-time model, implies the existence of an initial honeymoon period (Singh, House, and Tucker 1986; Carroll and Huo 1988; Fichman and Levinthal 1988; Baum 1989; Mitchell 1991) during which expansion had little influence on survival. The honeymoon was followed by a shake-out period of relatively high failure rates, during which the negative influences of expansion choices were felt most strongly. Firms that survived the shake-out then entered a period of relative stability, with declining exit rates and corresponding increasing survival durations.

Results

The results are reported in Tables 3 to 5. A loglikelihood \(\chi^2\) criterion was used to test each model for general explanatory power. This statistic is equal to twice the difference in the loglikelihoods of a model containing the specified variables and a model containing only intercept and scale terms, with degrees of freedom equal to the number of independent variables.\(^6\) The model \(\chi^2\) statistics were significant in all but one case.

\(^5\)The accelerated event-time models were estimated using the PROC LIFEREG procedure of SAS (SAS Institute Inc. 1985).

\(^6\)Interpolated mean-effect values, such as the value of the fourth base subfield effect, do not affect the degrees of freedom of the \(\chi^2\) statistic.
Expansion, Industry Market Share, and Subfield Share

Table 3 presents the results of the tests of Hypotheses 1 to 3. Hypothesis 1a predicts that a firm that expands into a new subfield will have longer continued survival in its base subfield than those that do not. As shown in Table 3 (columns 1 to 3), the expansion effect is strongly positive for each survival model: all exits, exit by acquisition, and exit by dissolution. The largest expansion effect appears in the acquisition case (column 2), where the absolute size of the coefficient is more than twice that found in the dissolution model (column 3).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Survival</th>
<th>Subsequent market share</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1) All exits</td>
<td>(2) Acquired</td>
</tr>
<tr>
<td>Intercept</td>
<td>5.118***</td>
<td>3.542***</td>
</tr>
<tr>
<td></td>
<td>(1.008)</td>
<td>(1.364)</td>
</tr>
<tr>
<td>Expansion effect</td>
<td>1.182***</td>
<td>1.779***</td>
</tr>
<tr>
<td></td>
<td>(0.221)</td>
<td>(0.416)</td>
</tr>
<tr>
<td>Prior market share effects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industry share</td>
<td>0.024*</td>
<td>-0.015</td>
</tr>
<tr>
<td></td>
<td>(0.018)</td>
<td>(0.028)</td>
</tr>
<tr>
<td>Base subfield share</td>
<td>-0.018**</td>
<td>0.011</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.019)</td>
</tr>
<tr>
<td>Firm-level effects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Firm size</td>
<td>0.012</td>
<td>0.015</td>
</tr>
<tr>
<td></td>
<td>(0.030)</td>
<td>(0.043)</td>
</tr>
<tr>
<td>Missing size</td>
<td>0.047</td>
<td>0.423*</td>
</tr>
<tr>
<td></td>
<td>(0.186)</td>
<td>(0.265)</td>
</tr>
<tr>
<td>U.S. ownership</td>
<td>-0.506***</td>
<td>-0.210</td>
</tr>
<tr>
<td></td>
<td>(0.159)</td>
<td>(0.230)</td>
</tr>
<tr>
<td>Subfield-level effects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X-ray base</td>
<td>0.553***</td>
<td>-0.026</td>
</tr>
<tr>
<td></td>
<td>(0.142)</td>
<td>(0.252)</td>
</tr>
<tr>
<td>Nuclear base</td>
<td>-0.067</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>(0.132)</td>
<td>(0.264)</td>
</tr>
<tr>
<td>Ultrasound base</td>
<td>0.087</td>
<td>-0.197</td>
</tr>
<tr>
<td></td>
<td>(0.116)</td>
<td>(0.232)</td>
</tr>
<tr>
<td>CT base1</td>
<td>-0.573***</td>
<td>0.219</td>
</tr>
<tr>
<td></td>
<td>(0.210)</td>
<td>(0.569)</td>
</tr>
<tr>
<td>New subfield</td>
<td>-0.038***</td>
<td>-0.008</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td>(0.170)</td>
</tr>
<tr>
<td>Introduction year</td>
<td>0.638</td>
<td>0.691</td>
</tr>
<tr>
<td></td>
<td>(0.039)</td>
<td>(0.066)</td>
</tr>
<tr>
<td>Model χ²</td>
<td>125.2***</td>
<td>54.9***</td>
</tr>
<tr>
<td>Degrees of freedom</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Incumbents (exited)2</td>
<td>371 (187)</td>
<td>371 (81)</td>
</tr>
</tbody>
</table>

*p < 0.10.

**p < 0.05.

***p < 0.01 (two-tailed tests).

*p < 0.10 (one-tailed tests).

The were no 16-year CT cases, because of the relative youth of the subfield.

The figures in the market share columns refer to the number of firms which survived in a base subfield for at least 5, 9, and 17 years after the emergence of a new subfield.
The difference in the expansion effect on the different types of exits is intriguing. If exit by acquisition is a sign that a firm possesses successful products but lacks organizational resources needed to commercialize them (Mitchell 1990), then at least two explanations are possible. Firms that expand may possess more organizational resources before expansion and so survive longer before being acquired. Alternatively, firms that expand may acquire organizational strength as a result of the expansion. To the extent that the prior market share measures are associated with prior organizational resources, and so control for the prior strength hypothesis, the second explanation is more likely. That is, when incumbents must acquire new organizational resources in order to undertake expansion, they often are able to spill the resources back into the established business.

Hypothesis 1b predicts that a firm that expands into a new subfield will attain greater subsequent market share in its base subfield than firms that survive but do not expand. As shown in Table 3 (columns 4 to 6), significant expansion effects are found for years 4, 8, and 16. In both survival and market share, therefore, pre-introduction incumbents that expanded outperformed those that did not.

Hypothesis 2a predicts that holding higher industry-wide market share when a new subfield emerges will lead to longer survival in the base subfield, whether or not an incumbent expands. The expected positive influence of industry share was found in the all-exit and dissolution exit models (columns 1 and 3 of Table 3), although only the dissolution case was strongly significant. The influence of prior industry share on subsequent subfield market share (columns 4 to 6), meanwhile, took the significant positive signs predicted in Hypothesis 2b.

A likely explanation for the lack of significant influence of industry market share on exit by acquisition, which took an unexpected negative sign, is that prior strength alone is not enough to prevent acquisition. Instead, a previously successful incumbent must expand in order to continue to compete in the evolving industry. If it does not expand, there is a significant probability that it will be acquired by another firm relatively soon.

Hypothesis 3a predicts that greater prior market share in the base subfield will be associated with shorter continued survival in the base subfield. The expected negative effect of base subfield share was found for all three exit models (columns 1 to 3). As in the industry market share case, however, the acquisition exit influence was not statistically significant.

The primary explanatory factor underlying exit by acquisition appears to be expansion. Incumbents that expand are often able to put off being acquired; those that do not expand tend to exit, no matter how strong the prior industry or subfield market position. Moreover, the relatively small absolute sizes of the industry and base subfield share coefficients in the all-exit and dissolution cases indicate that expansion and nonexpansion are likely to have greater influence on continued survival than will prior market share.

Hypothesis 3b, meanwhile, predicts that greater prior subfield market share will be associated with larger subsequent market share. The expected base subfield share result is found for years 4 and 8 (columns 4 and 5), with the largest effect in year 4. By year 16 (column 6), however, the influence has dissipated. It appears that subfields change enough over time that a firm's initial strength eventually wears off.

The influences of industry and base subfield market share on survival must be interpreted carefully, because there is a significant positive correlation between the two measures. For a firm with the same share in each subfield, and therefore in the industry, the positive and negative market share influences would tend to cancel out. When industry and base subfield shares differ, however, the predicted results will hold for dissolution exits—greater industry share leads to later dissolution after the
emergence of a new technical subfield, while greater base subfield share leads to earlier dissolution.

Success of Expansion

Table 4 reports the results of the tests of Hypotheses 4a to 4d. Hypothesis 4a predicts that a firm that expands into and subsequently exits from a new subfield will have shorter survival in its base subfield than those that expand and remain. The expected results were found in the all-exit survival model (Table 4, column 1), with positive mean effects of “expand and survive” and negative mean effects of “expand and exit”.7

The prior market share effects on all exits reported in column 1 of Table 4 are not consistent with those found in the earlier all-exit test of Hypotheses 2a and 3a (Table 3, column 1). The survival influences of prior industry share and base subfield share disappear, overwhelmed by the positive effects of successful expansion and negative effects of unsuccessful expansion. As was the case with the simple expansion analysis of acquisition exits, therefore, it appears that prior market share influences are less important than expansion effects.

Hypothesis 4b predicts that failed expansion will lead to lower market share in the base subfield. The expected negative results of “expand and exit” were found for years 4 and 8 (columns 4 and 5 of Table 4), but could not be estimated for year 16 because no incumbent that expanded and exited from a new subfield still participated in the base subfield during year 17. The prior market share effects found in the tests of Hypotheses 2b and 3b remain qualitatively unchanged.

Hypothesis 4c, which predicts that firms that expand and exit will have shorter survival in the base subfield than pre-introduction incumbents that do not expand, is rejected. The effect of “no expansion” is more strongly negative than that of “expand and exit”, rather than the reverse, although the difference is not statistically significant (Table 4, column 1).8 It appears that expansion, even if it later fails, may provide at least a temporary survival advantage in the base subfield.

This result must be interpreted carefully, however, because exit from the new subfield almost always led to eventual exit from the base subfield also. Of 25 pre-introduction incumbents that expanded into and exited from a new subfield, 84% (21 firms) no longer participated in the base subfield at the end of the study. Only 60% (163 of 271) of the nonexpanders, meanwhile, had exited. Firms that expand into a new subfield and then exit may tend to survive longer than those that do not expand, but the failed expanders are more likely to eventually retreat from their established business. Hence, failed expansion may provide a short-term benefit to an established business, but at long-term cost.

Hypothesis 4d predicts that firms that expand and exit will have lower subsequent market share in the base subfield than pre-introduction incumbents that do not expand. Hypothesis 4d is rejected for subsequent market share in year 4, but

7Because only 3 of 75 pre-introduction incumbents that expanded and survived subsequently exited from the base subfield, we do not report acquisition and dissolution results. The results that could be estimated were similar to those reported in Table 3.
8To check for possible bias introduced by the pooling of base subfields, we estimated all-exit models comparing the effects of failed expansion to no expansion for each base subfield. (Because few firms that expanded and survived in a new subfield exited from the base subfield, individual base subfield results for all incumbents could not be estimated.) In each base subfield of these models, as in the pooled all-exit analysis, nonexpansion was associated with shorter survival than failed expansion, although the difference was statistically significant only for the CT base subfield.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Survival</th>
<th>Subsequent market share</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All exits</td>
<td>4 years</td>
</tr>
<tr>
<td>Intercept</td>
<td>5.396***</td>
<td>8.045**</td>
</tr>
<tr>
<td></td>
<td>(1.098)</td>
<td>(3.252)</td>
</tr>
<tr>
<td>Expansion effects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expand and survive in new subfield</td>
<td>1.546***</td>
<td>4.053***</td>
</tr>
<tr>
<td>(75 expanded, 3 exited base)</td>
<td>(0.292)</td>
<td>(0.563)</td>
</tr>
<tr>
<td>Expand and exit new subfield</td>
<td>-0.564***</td>
<td>-1.489**</td>
</tr>
<tr>
<td>(25 expanded, 21 exited base)</td>
<td>(0.194)</td>
<td>(0.625)</td>
</tr>
<tr>
<td>No expansion from base subfield</td>
<td>-0.982***</td>
<td>-2.564***</td>
</tr>
<tr>
<td>(271 did not expand, 163 exited)</td>
<td>(0.187)</td>
<td>(0.459)</td>
</tr>
<tr>
<td>Prior market share effects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industry share</td>
<td>-0.001</td>
<td>0.347***</td>
</tr>
<tr>
<td></td>
<td>(0.021)</td>
<td>(0.063)</td>
</tr>
<tr>
<td>Base subfield share</td>
<td>-0.011</td>
<td>0.411***</td>
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<tr>
<td></td>
<td>(0.010)</td>
<td>(0.043)</td>
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<td>Firm-level effects</td>
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<tr>
<td>Firm size</td>
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<td></td>
<td>(0.031)</td>
<td>(0.104)</td>
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<tr>
<td>Missing size</td>
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<td>-0.768</td>
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<tr>
<td></td>
<td>(0.186)</td>
<td>(0.674)</td>
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<tr>
<td>U.S. ownership</td>
<td>-0.273*</td>
<td>-0.371</td>
</tr>
<tr>
<td></td>
<td>(0.165)</td>
<td>(0.509)</td>
</tr>
<tr>
<td>Subfield-level effects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X-ray base</td>
<td>0.530***</td>
<td>0.330</td>
</tr>
<tr>
<td></td>
<td>(0.145)</td>
<td>(0.442)</td>
</tr>
<tr>
<td>Nuclear base</td>
<td>-0.059</td>
<td>0.712*</td>
</tr>
<tr>
<td></td>
<td>(0.137)</td>
<td>(0.471)</td>
</tr>
<tr>
<td>Ultrasound base</td>
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<tr>
<td></td>
<td>(0.119)</td>
<td>(0.418)</td>
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<tr>
<td>CT base</td>
<td>-0.341**</td>
<td>-0.959</td>
</tr>
<tr>
<td></td>
<td>(0.226)</td>
<td>(0.767)</td>
</tr>
<tr>
<td>New subfield</td>
<td>-0.031**</td>
<td>-0.065*</td>
</tr>
<tr>
<td>Introduction year</td>
<td>(0.013)</td>
<td>(0.040)</td>
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<td>Scale parameter</td>
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<td>3.638</td>
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<td></td>
<td>(0.039)</td>
<td>(0.157)</td>
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<tr>
<td>Model $\chi^2$</td>
<td>158.0***</td>
<td>364.3***</td>
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<tr>
<td>Degrees of freedom</td>
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<td>11</td>
</tr>
<tr>
<td>Incumbents (exited)</td>
<td>371 (187)</td>
<td>268</td>
</tr>
</tbody>
</table>

* $p < 0.10$.
** $p < 0.05$.
*** $p < 0.01$ (two-tailed tests).
# $p < 0.10$ (one-tailed tests).
1 No firm which expanded and exited survived in the base subfield for 17 years.
2 The were no 16-year CT cases, because of the relative youth of the subfield.
3 The figures in the market share columns refer to the number of firms which survived in a base subfield for at least 5, 9, and 17 years after the emergence of a new subfield.
supported for year 8. By the latter year, firms that had retreated from an attempted expansion yet continued to participate in their base businesses were performing poorly relative to surviving firms that never expanded. This result bears out our earlier discussion of short- and long-term benefits and costs.

**Control Variable Results**

Although most other effects were nonsignificant, some of the control variables shown in Tables 3 and 4 also provide useful information. Larger firm size had no significant effect on either survival or market share. Most base subfield-level effects are nonsignificant, although survival in the x-ray base subfield tended to exceed the mean and in the CT base subfield tended to be shorter than average. Later “new subfield introduction years” were associated with shorter survival before exit by dissolution, but had no significant effect on acquisition or market share.

U.S. ownership, meanwhile, often produced a significantly negative effect on survival, particularly in the dissolution exit model, while having no significant association with subsequent market share. A possible reason for the survival result is that participation in the U.S. market by a foreign-owned firm requires greater commitment than that of a domestic company. In a market where expected commitment is important, this is an intriguing result, because it implies that buyers may have good reason to favor a foreign firm over a domestic player, unless the domestic company already has a strong position in the industry.

**Waiting to Expand and Past Success**

Table 5 reports the results of the tests of Hypotheses 5 and 6. Because the sample is now restricted to the 100 pre-introduction incumbents that expanded, the table reports models containing only the variables for which influences were predicted. When additional variables were included, particularly in the acquisition and dissolution models where relatively few exits are recorded, the estimated effects tended to lose strength.

Hypotheses 5a and 5b jointly predict that both short and long waiting periods before expansion will be associated with shorter survival in the base subfield. The predictions are supported for overall exit and exit by acquisition (columns 1 and 2). With positive main effects and negative squared effects, a middle-range waiting period is associated with longest survival.

The main and squared effects of the “wait before entry” variable were nonsignificant for the dissolution model (Table 5, column 3). When the squared effect is dropped, however, the wait before entry coefficient takes a significant positive sign (column 4) without significantly reducing the overall explanatory power of the model. (The incremental $\chi^2$ statistic for the dissolution models shown in columns 3 and 4 is 50.5 - 47.9 = 2.6, with 1 degree of freedom, which is not significant at conventional levels.) The longer a firm waits to enter a new subfield, therefore, the more it reduces the risk of early dissolution. A possible explanation for this result is that late entrants are relatively unlikely to make wildly incorrect product or market choices, because they have many successful and failed earlier entrants from which to learn.

The significance of the negative squared effects for the all-exit and acquisition models in columns 1 and 2 of Table 5 rejects a possible counterhypothesis for those cases—that late expanders are slow in general, so that late exit from the base subfield simply represents general lethargy. If this were true, the coefficient on the waiting-period-squared variable would be positive or nonsignificant, rather than negative. The counterhypothesis might hold, however, for dissolution exit in columns 3 and 4. This
TABLE 5
Logistic-distributed Accelerated Event-time and Normal-distributed Conventional Regression Estimates of Effects on Performance in Base Subfield after Expansion into New Subfield (s.e. in parentheses)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Survival</th>
<th>Subsequent market share</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1) All exits</td>
<td>(2) Acquired</td>
</tr>
<tr>
<td>Intercept</td>
<td>1.533*** (0.218)</td>
<td>2.491*** (0.525)</td>
</tr>
<tr>
<td>Waiting period effects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wait before entry</td>
<td>0.236*** (0.068)</td>
<td>0.187* (0.109)</td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>Wait squared</td>
<td>-0.008*** (0.127)</td>
<td>-0.007* (0.256)</td>
</tr>
<tr>
<td></td>
<td>(0.015)</td>
<td>(0.041)</td>
</tr>
<tr>
<td>Number of past</td>
<td>0.373*** (0.127)</td>
<td>0.356* (0.256)</td>
</tr>
<tr>
<td>expansions</td>
<td>(0.154)</td>
<td>(0.041)</td>
</tr>
<tr>
<td>Prior market</td>
<td></td>
<td></td>
</tr>
<tr>
<td>share effects</td>
<td>Industry share</td>
<td>0.032* (0.022)</td>
</tr>
<tr>
<td></td>
<td>(0.026)</td>
<td>(0.024)</td>
</tr>
<tr>
<td>Base subfield share</td>
<td>-0.014** (0.010)</td>
<td>0.023 (0.044)</td>
</tr>
<tr>
<td></td>
<td>(0.072)</td>
<td>(0.069)</td>
</tr>
<tr>
<td>Scale parameter</td>
<td>0.359 (0.063)</td>
<td>0.423 (0.143)</td>
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<td>(0.354)</td>
<td>(0.069)</td>
</tr>
<tr>
<td>Model $\chi^2$</td>
<td>45.3*** (5)</td>
<td>59 (6)</td>
</tr>
<tr>
<td>Degrees of freedom</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Incumbents (exited)$^1$</td>
<td>100 (24)</td>
<td>100 (6)</td>
</tr>
</tbody>
</table>

$^*$p < 0.10.
$^{**}$p < 0.05.
$^{***}$p < 0.01 (two-tailed tests).
$^*$p < 0.10 (one-tailed tests).

$^1$The figures in the market share columns refer to the number of firms which survived in a base subfield for at least 5, 9, and 17 years after the emergence of a new subfield.

would imply, however, that lethargy is more likely to lead to being dissolved than to being acquired, a result for which we have no ready explanation.

Hypothesis 5c concerning the effects of waiting periods on market share is also supported, although the significance of the coefficients is weaker (column 5 to 7 of Table 5). Longer "waits before entry" led to smaller market share in the base subfield. (Models that included squared effects did not produce significant result.) Hence, there appears to be a trade-off between survival and market share in the base subfield. Waiting to expand, at least until some middle-range, may enhance survival, but tends to result in reduced market share.

As predicted by Hypothesis 6a, the more times a firm had expanded in the past, the longer it survived after a current expansion (Table 5, columns 1 to 4). However, Hypothesis 6b was only weakly supported, because the number of past expansions had only nonsignificant association with greater market share (columns 5 to 7). The experience of successful expansion appears to provide organizational ability to weather the risks of future expansion, but provides little assistance in achieving base subfield market share.

As in most survival estimates shown in the preceding tables, industry and base subfield share take positive and negative coefficients, respectively, but are significant only in the dissolution case (Table 5, columns 3 and 4). Consistent with the prior market share effects shown in earlier tables, prior industry share has long-term association with subsequent market share in a subfield (columns 5 to 7), while prior
base subfield share has only shorter-term association with subsequent market share. Again, industry-wide strength offers a stronger base for long-term performance than does strength focused within a single subfield.

Discussion

This study examines the impact of expansion into new technical subfields on the market share and survival in an industry incumbent’s established businesses. The context for the study is the case of discontinuous change of core products, coupled with continued importance of existing supporting assets. Our predictions are largely supported. Industry incumbents that expand into commercially successful new technical subfields survive longer and achieve greater market share in their base subfield than incumbents that do not expand. Prior industry and base subfield market share sometimes produced the expected opposing influences on survival, but tended to be weaker than the expansion influences.

The results are consistent with our argument that expansion may create strong spillback benefits for an established business following low-transience innovation. However, the negative consequences of failed expansion may also spill back into the traditional business. Although a firm that fails in its expansion attempt may enjoy longer survival in the base subfield than firms that do not expand, it is more likely to eventually exit than those that do not expand.

Although expansion may be associated with superior performance, it may be better to delay expansion until first movers have identified unsuccessful paths, at least if longer survival is the primary goal of firm managers. However, delaying entry has at least two constraints. First, late expanders incur market share disadvantages in their base business. Second, a firm will not be able to expand successfully if it waits too long. Eventually, the earlier movers will gain enough technical leadership and establish strong enough reputations to dominate the market. Expansion timing, therefore, is a balance between letting uncertainty subside, and not letting competition rise too far.

We found that successful prior expansion was associated with the success of a current expansion. The implication of this finding is that organizations possess some degree of learning capability, consistent with adaptive perspectives of organizational change (e.g., Child 1972, Hrebiniak and Joyce 1985.) The adaptive capabilities are constrained, however, because subfield specialists often find it difficult to gain the initial expansion success needed to underlie future success. Past success in a single subfield, in fact, may make it more rather than less difficult to cope with new environments, possibly because the specialist is caught in a competency trap (Levitt and March 1988) or because the firm’s resources are too specialized to be applied in the new environment.

We have distinguished between exit by acquisition and exit by dissolution. The direction of the estimated expansion effects is the same for each measure of survival, although the magnitudes vary. However, the influence of prior market share on acquisition and dissolution clearly differs. Prior industry and subfield strength have significant impact on dissolution timing but little on acquisition, where the primary influence is whether an incumbent expands.

We found that influences of industry-wide strength on subsequent market share often extended to long after a new subfield emerged. In such cases, when many supporting assets retain their value despite major core product innovation, leading industry incumbents possess very strong advantages relative to newcomers, no matter how innovative. Incumbents will usually have the ability to adopt and develop new
devices in the emerging subfields, and will have time to do so before being displaced by new entrants.

Adaptive ability, therefore, appears to be related to the strength of the supporting assets possessed by a firm. This raises a key question. What is the core of a business? Is it the products it sells, or is it the seemingly peripheral assets that support the commercialization of the products? The results in this paper are most consistent with the second answer. Consistent with Abernathy and Clark (1985) and Prahalad and Hamel (1990), our results support the view that a firm is not so much defined by a particular set of goods as it is by its capability to develop and sell an emerging stream of goods.

The generalizability of the study is limited to related expansion within a market that continues to value existing supporting assets. Investigation of the same effects in noncontiguous fields would provide additional useful information on the adaptability of organizations. Nonetheless, related examples are common enough that the study has independent value. Our earlier example of the consumer electronics sector is directly analogous. An analysis of the auto industry would probably reveal similar results—incumbents that ignored the small car segment that emerged during the 1960s and 1970s, for instance, are now suffering in their large car businesses.

Several aspects of this study could usefully be extended. In addition to survival and market share, it would be valuable to measure spillover effects on profitability. Even if firms that do not expand into new businesses survive in their base businesses, they are likely to suffer declining returns. In the auto industry example just cited, for instance, few incumbents have exited but many have faced severe financial pressure. It would also be useful to distinguish among firm-types and product-types. We suspect that specialist and generalist firms will experience different spillover effects. We also expect that expansion will have different effects when products substitute directly for established goods than when new products are largely neutral.

Follow-up research might also examine the spillover effects of the form of expansion undertaken, which may range from partial commitment through component sales or licensing, to establishment of full manufacturing facilities. Moreover, the decision to expand and the mode of expansion will be affected by the riskiness of the new subfield, so that examining the effects of expansion into commercially unsuccessful technical subfields would complement the present study. Finally, although examining the outcomes of expansion and suggesting possible reasons for these outcomes, this study does not examine the methods by which a firm realizes the spillover benefits of expansion. Process-oriented research into how firms adapt to expansion would be useful.

The implications of this study are significant. Firms that, due to managerial inertia or resource nonavailability, do not expand when successful new products emerge within their industries face severe competitive difficulty in their base businesses. Even when the market for products in the established business continues to exist, lethargic incumbents are likely to be replaced by new participants. At the same time, however, firms that expand and fail may face even more serious threats to their continued viability. After two decades of slow reaction by North American corporations to rising global competition, the importance and generality of these findings should be obvious. Industry incumbents must react to innovative competitors, and must react capably, or they will cease to be incumbents.

Acknowledgements

We greatly appreciate the thoughtful advice provided by the Editor and three Organization Science reviewers. We also appreciate comments from participants of the 1991 Meetings of the Administrative Sciences Association of Canada.
### Appendix A

**Product-moment Correlations and Summary Statistics**

<table>
<thead>
<tr>
<th></th>
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<th></th>
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<td><strong>Product moment correlations</strong></td>
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<td>0.70</td>
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<td>0.21</td>
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<td>0.76</td>
<td>0.32</td>
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<td>0.03</td>
<td>0.08</td>
<td>0.06</td>
<td>-0.22</td>
<td>0.19</td>
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<td>-0.16</td>
<td>-0.09</td>
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<td>-0.06</td>
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<td>0.41</td>
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<td>-0.20</td>
<td>-0.11</td>
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<tr>
<td></td>
<td>16</td>
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<td>0.52</td>
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<td>0.11</td>
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<td>0.14</td>
<td>-0.00</td>
<td>0.21</td>
<td>0.16</td>
<td>-0.19</td>
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<td>-0.06</td>
<td>0.11</td>
<td>0.04</td>
<td>0.10</td>
<td>-0.19</td>
<td>0.15</td>
<td>-0.21</td>
<td>-0.08</td>
<td>-0.03</td>
<td>0.20</td>
<td>371</td>
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<td>0.47</td>
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<td>9.00</td>
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<td></td>
<td>9</td>
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<td>0.01</td>
<td>0.29</td>
<td>-0.15</td>
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