SPILLBACK EFFECTS OF EXPANSION AND NONEXPANSION WHEN PRODUCT-TYPES AND FIRM-TYPES DIFFER

Abstract

This paper examines the effects of expansion into a new business on continued market share and survival in a firm's traditional business within the same industry. In general, firms which expand achieve better subsequent performance in their traditional businesses than firms which do not expand. Some effects vary, depending on whether the new goods substitute for the old and whether the firm is a generalist or specialist participant in the industry.

Introduction

Most analyses of related diversification have focussed on the success or failure that expanding incumbents achieve in a new business (Rumelt, 1974, 1982; Montgomery, 1985). Mitchell and Singh (1990), though, predicted and found that the effects of expansion into new businesses may spill back into a firm's traditional business. Industry incumbents which expand into emerging technical subfields of their industry tend to survive longer and gain greater market share in their base businesses within the industry than firms which do not expand out of their base businesses.1

In our earlier study (Mitchell and Singh, 1990), we did not distinguish between different types of new products and different types of established firms. In this paper, we argue that the effects of expansion and nonexpansion on performance in an established business will tend to be different if the new products substitute for existing goods than if the new goods are neutral with respect to the old. Moreover, we expect that firms which offer several product lines will experience different effects than incumbents which offer a single product line. We present several hypotheses and research questions concerning the interaction between product-type and firm-type. We test our predictions by examining performance of incumbents of the American market for medical diagnostic imaging equipment following the emergence of five new technical subfields during the past 35 years.

Spillback Effects On A Base Business

The effects of a firm's expansion on its existing business, which we refer to as spillback effects, may be major. 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).

Consider, for example, industries within the consumer electronics sector. The emergence of video cassette recorders, quadrophonic stereo systems, compact disk players,

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1 We define an industry as a group of firms which manufacture goods having "reasonable interchangability of use or cross elasticity of demand" in production or use (U.S. Supreme Court, 1964: 76). A technical subfield of an industry Mitchell (1989) is a set of products which draw on a distinct knowledge base (Nelson and Winter, 1982).
and high definition television each presented challenges to industry incumbents. Incumbents which expanded risked investing in products which failed completely, such as quadrophonic stereo, or making the wrong technical choice, such as investment in beta format VCRs. Incumbents which 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.

We develop these arguments in the context of low-transilience innovation (Abernathy and Clark, 1985), that is, innovation which involves significant changes to core products but only incremental change to supporting assets such as reputations and distribution systems. Transilience is defined as "leaping or passing across" (Kirkpatrick, 1983: 1371); hence, low-transilience innovation does not leap across existing supporting assets, while high-transilience innovation requires extensive development of new supporting assets. In low-transilience cases, industry incumbents will have significant advantages in the new product area. In addition, improvements and extensions of supporting assets that are needed for participation in the new product area will often be useful for the established business.

Simple Expansion

Spillback benefits in low-transilience cases can be attributed to several factors, including volume economies, product improvement opportunities, and competition advantages. Volume economies may arise through economies of scale, scope, or learning (Porter, 1980; Teece, 1980; Amit, 1986). Firms which expand are more likely to be able to incorporate design and manufacturing advances from the new products into the older goods (Nelson, 1959; Wheelwright, 1985). Exposure to more competition, meanwhile, may provide greater competitive information (Kamani and Wemerfelt, 1985) or may make the firm a leaner, more effective competitor (Leibenstein, 1966).

Although there may be spillback disadvantages of expansion, including sales cannibalization and organizational confusion, the net advantages of expansion often will be the greater when transilience is low. But products and firms differ, and it is likely that the costs and benefits of expansion and nonexpansion will differ across them. In the following sections, we discuss product-type and firm-type differences.

Substitute Versus Neutral Products

Although most new goods introduced into an industry will at least partially substitute for established products, some goods will substitute more directly than others. Mitchell (1989) showed that industry incumbents are more likely to expand into a new subfield if the new products substitute directly. If a new product completely dominates the old, so that sales of the old good dry up, a firm which expands into such a new subfield is likely to exit from the base subfield. When sales of the old products continue, although perhaps at a reduced growth rate, there may be spillback benefits of expansion that support continued participation in the base subfield, gained from reputational spillback, increased understanding of customer demands, and other supporting asset symmetry.

An alternative hypothesis regarding substitutive products is that cannibalization will lead to reduced performance of expanding firms, even when sales of the old products continue, rather than increased market share and longer survival in the base business. When the established products continue to be sold, however, we expect that the alternative
logic will not apply. Instead, firms which participate in the new subfield will be able to spill benefits back into the older business, through volume economies in production and distribution. This alternative hypothesis provides an empirical issue for the analysis section.

Specialists Versus Generalists

Although there may be benefits to expansion, not all firms will be able to realize the benefits and not all firms will incur the same costs of nonexpansion. In particular, we expect specialists and generalists to face different expansion-nonexpansion tradeoffs. We operationalize specialists as firms which operate in only one technical subfield of an industry and generalists as firms which participate in more than one technical subfield.

To motivate this discussion, we draw on studies which have examined the effects of changing a core business on failure rates in the same businesses. Some such studies have found little impact of major change on the failure rate (Singh, House, and Tucker, 1986; Kelly and Amburgey, 1989; Delacroix and Swaminathan, 1989). Others, though, have found that major changes may increase the failure rate (Miner, Amburgey, and Stearns, 1989; Baum, 1989; Amburgey, Kelly, and Barnett, 1990).

Relative to generalists, specialists are likely to have less industry-related slack and fewer industry-related resources with which to support existing and new operations (Hannan and Freeman, 1977). Therefore, the stress created by expansion may well be felt strongly throughout the established business of the specialist. We expect this stress to be felt whether the specialist is a single-product company, or a large multi-industry firm with operations in a single technical subfield of the expanding industry. Single-product firms will have few extra resources, while operations within diversified companies will have few industry-related resources on which to draw if problems arise during the expansion. The multi-industry diversified firm may also face problems of low corporate commitment and incur the risk of being divested if the expansion runs into unexpected problems.

In addition to different expansion benefits and threats, specialists and generalists may face different threats if they do not expand. The success of generalists typically stems from offering a broad range of products. If a generalist firm does not expand, it risks reducing or losing reputational, distribution, and other spillback benefits. Specialist success flows from focusing on a single set of products, however, so that the negative effects of not expanding into a new subfield are likely to be less, as long as products in its focal subfield continue to be sold.

As in the case of substitutive and neutral products, an alternative logic may apply to the generalist-specialist distinction. It is possible that all firms, whether specialists or generalists, find it difficult to expand into new businesses and to realize potential spillback benefits. If so, the distinction may not differentiate between success in the base business. This issue also presents an opportunity for empirical investigation.

Product-Type And Firm-Type Interactions

We expect to find significant interactions between product-types and firm-types. Expansion by a generalist into a substitute product area, for instance, may have different spillback effects than expansion by a specialist into the same product area. We will consider the eight possible three-way interactive categories that arise from our expansion-nonexpansion, substitute-neutral, and generalist-specialist classifications. Some of the interactive effects will be derived as hypotheses, while others will be presented as empirical research questions.
In order to present concise discussion and hypotheses, we introduce several terms. We refer to firms which 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". A "substitute subfield" is a new subfield in which products tend to substitute for goods in an established subfield, while a "neutral subfield" is a new subfield in which products do not substitute significantly for goods in an established subfield.

First, let us consider expansion by a generalist pre-introduction incumbent into a substitute subfield. Because expansion by generalist firms and expansion into substitute subfields each were predicted to lead to positive spillback effects, we predict that the three-way interaction will be positive. We predict, too, that the effect of nonexpansion in such cases will be negative, owing to the lost technical and market opportunities.

Hypotheses 1a and 1b. Generalists which expand into substitute subfields will achieve greater performance in their base businesses. Generalists which do not expand into substitute subfields will achieve poorer performance in their base businesses.

Second, we take up the case of expansion by a generalist pre-introduction incumbent into a neutral subfield. Our earlier arguments held that expansion in the neutral case would provide fewer spillback benefits than into a substitute subfield, but we expect that the positive effects of expansion and generalist status will outweigh the neutral product factor. Similarly, the overall spillback effect of nonexpansion in the generalist-neutral case is likely to be negative. The impact of the generalist-neutral combinations may be less than in the generalist-substitute case, but we will leave that for empirical investigation rather than present it as an ex ante hypothesis.

Hypotheses 2a and 2b. Generalists which expand into neutral subfields will achieve greater performance in their base businesses. Generalists which do not expand into neutral subfields will achieve poorer performance in their base businesses.

Third, consider expansion by a specialist pre-introduction incumbent into a substitute subfield. Here, the expansion and substitute product-type interaction is likely to be positive, but the specialist-expansion interaction is not. Our initial estimate is that the overall positive influence of expansion will dominate, so that the interactive effect of expansion, product-type, and firm-type will be positive and the effect of nonexpansion in the same combination will be negative. Again, the impact of the effect may be less than in the generalist-substitute case.

Hypotheses 3a and 3b. Specialists which expand into substitute subfields will achieve greater performance in their base businesses. Specialists which do not expand into substitute subfields will achieve poorer performance in their base businesses.

Finally, let us pick up the case of expansion by specialist pre-introduction incumbents into neutral subfields. Expansion by specialists and expansion into neutral subfields were predicted to generate relatively few spillback benefits. We can raise no strong prior case for whether the overall expansion effect will outweigh the product and firm-type interaction. Therefore, we present the effects of the expansion and nonexpansion combinations as a research question, rather than hypotheses.

Research question 1. Will specialists which expand or do not expand into neutral subfields achieve differential performance in their base businesses?
Methods

Data

We examine the performance of firms operating in four base subfields of the medical diagnostic imaging industry between 1953 and 1989. This industry consists of firms which manufacture equipment used by physicians and other health care workers to nonintrusively examine organs and physiological activity within live beings. Since the early 1950s, as listed in Table 1, several new technical subfields of the imaging industry have emerged to substitute for and complement earlier x-ray imaging products. 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.

<table>
<thead>
<tr>
<th></th>
<th>U.S. introduction</th>
<th>1988 U.S. sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional x-ray imaging</td>
<td>1896</td>
<td>$600</td>
</tr>
<tr>
<td>Nuclear medicine</td>
<td>1954</td>
<td>$200</td>
</tr>
<tr>
<td>Ultrasound</td>
<td>1957</td>
<td>$500</td>
</tr>
<tr>
<td>Computed tomography</td>
<td>1973</td>
<td>$500</td>
</tr>
<tr>
<td>Magnetic resonance imaging</td>
<td>1980</td>
<td>$500</td>
</tr>
<tr>
<td>Digital radiography</td>
<td>1981</td>
<td>$400</td>
</tr>
</tbody>
</table>

In defining the sample and collecting data, 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. 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. To reduced potential bias introduced by this choice, we distinguished between exit by acquisition and exit by dissolution.

The data were gathered from an extensive archival search of academic, industry, and government sources, supplemented by interviews with industry and academic participants. 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. 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. Analyses were carried out for the full pool of 371 incumbents. We checked for bias introduced by the pooling (Tuma and Hannan, 1984), finding little.

Variables

Dependent variables. Performance was defined as both continued participation and subsequent market share. Continued participation was measured as the number of years that a firm continued to participate in the base business after the emergence of a new subfield. 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. A 0-1 dummy variable
recorded which firms continued to participate at the end of the study. In the analysis of exit by acquisition and dissolution, each type was treated as a censored case in the analysis of the other (Freeman, Carroll, and Hannan, 1983). When we examined influences on the length of participation before exit by dissolution, for example, we recorded firms which exited by acquisition as censored cases, just as we recorded firms which continued to participate at the end of the study as censored cases.

The market share variables were arbitrarily defined as the market share in the base business held by a pre-introduction incumbent during years 4, 8, and 16 after the emergence of a new subfield. 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. Only firms which survived at least 5, 9, and 17 years were included in the market share analyses.

Expansion variables. To test the hypotheses, we defined eight mean-effects dummy variables. These resulted from the three-way interactions between the expansion-nonexpansion, substitute-neutral products, and generalist-specialist firm 0-1 dummy variables. Consistent with Mitchell (1989), substitution was judged to be significant for the CT new subfield with respect to the x-ray and nuclear base subfields, and for the magnetic resonance and digital radiography new subfields with respect to the x-ray and CT base subfields. As we noted above, we defined a firm which participated in only one subfield when a new subfield emerged as a specialist and a pre-introduction incumbent of more than one subfield as a generalist.

Control variables. We defined several control variables. These included (1) prior industry and (2) prior base subfield market share, measured during the year before the emergence of a new subfield; (3) firm size, measured as the log value of corporate sales ($ million deflated by the Producer Price Index, 1967=1); (4) a missing size indicator variable, for cases in which size was estimated; (5) a U.S. majority ownership dummy variable; (6) a variable which recorded the introduction year of the relevant new subfield; and (7) a set of four mean-effects base subfield dummy variables.

Statistical Methods

We used accelerated event-time regression (Kalbfleisch and Prentice, 1980; Cox and Oakes, 1984) to estimate the effects of expansion on survival performance and conventional regression to examine the market share effects. We specified log-linear accelerated event-time models, using the logistic distribution as the baseline parametric assumption. Using the accelerated event-time method in this case permits us to incorporate the information that the length of continued participation for some firms was right-censored (Mitchell, 1991), that is, they had not exited the base subfield by the end of the study. With the conventional regression models, we specified linear normally-distributed models. All models were estimated with maximum likelihood procedures of the PROC LIFEREG procedure of SAS (SAS Institute, Inc., 1985).

Results

The results of the tests are displayed in Table 2. We will first discuss the effects on the length of continued participation and next examine influences on market share. We will then briefly review the firm-level and subfield-level control effects.

The reported positive expansion and negative nonexpansion influences on overall length of participation are generally consistent with the hypotheses. In addition, as suspected, expansion by generalists into substitute subfields is somewhat more positive
than the other expansion effects. The converse does not hold, however, as nonexpansion in
generalist-substitute cases is no more negative than all but specialist-substitute
nonexpansion. In the specialist-neutral case, which was the subject of research question 1,
it appears that the expansion and nonexpansion influences overwhelm any differential
product-type and firm-type effects.

Table 2. Influences on length of continued participation and subsequent market share

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Continued participation</th>
<th>Subsequent market share</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All exits</td>
<td>Acquired</td>
</tr>
<tr>
<td><strong>Expansion mean effects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generalist-Substitute</td>
<td>.85***</td>
<td>-.08</td>
</tr>
<tr>
<td>Generalist-Neutral</td>
<td>.39#</td>
<td>-.07</td>
</tr>
<tr>
<td>Generalist</td>
<td>1.81***</td>
<td></td>
</tr>
<tr>
<td>Specialist-Substitute</td>
<td>.49#</td>
<td>.56</td>
</tr>
<tr>
<td>Specialist-Neutral</td>
<td>.58*</td>
<td>.45</td>
</tr>
<tr>
<td><strong>Nonexpansion mean effects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generalist-Substitute</td>
<td>-.61**</td>
<td>-.69*</td>
</tr>
<tr>
<td>Generalist-Neutral</td>
<td>-.99***</td>
<td>-.59*</td>
</tr>
<tr>
<td>Specialist-Substitute</td>
<td>-.13</td>
<td>-.78**</td>
</tr>
<tr>
<td>Specialist-Neutral</td>
<td>-.58***</td>
<td>-.76***</td>
</tr>
<tr>
<td><strong>Firm-level effects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prior industry market share</td>
<td>.03#</td>
<td>-.03</td>
</tr>
<tr>
<td>Prior subfield market share</td>
<td>-.02**</td>
<td>-.01</td>
</tr>
<tr>
<td>Log sales</td>
<td>.03</td>
<td>.01</td>
</tr>
<tr>
<td>Missing size</td>
<td>-.01</td>
<td>.42#</td>
</tr>
<tr>
<td>U.S. ownership</td>
<td>-.54***</td>
<td>-.21</td>
</tr>
<tr>
<td><strong>Subfield effects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X-ray base</td>
<td>.38*</td>
<td>.04</td>
</tr>
<tr>
<td>Nuclear base</td>
<td>.05</td>
<td>.02</td>
</tr>
<tr>
<td>Ultrasound base</td>
<td>.26#</td>
<td>-.17</td>
</tr>
<tr>
<td>CT base</td>
<td>-.70***</td>
<td>.11</td>
</tr>
<tr>
<td>New subfield intro year</td>
<td>-.05***</td>
<td>-.01</td>
</tr>
<tr>
<td>Intercept</td>
<td>6.22***</td>
<td>4.85***</td>
</tr>
<tr>
<td>Loglogistic scale parameter</td>
<td>.63</td>
<td>.69</td>
</tr>
<tr>
<td>Normal scale parameter</td>
<td>3.85</td>
<td>4.54</td>
</tr>
<tr>
<td><strong>Model χ²</strong></td>
<td>132.6***</td>
<td>58.6***</td>
</tr>
<tr>
<td>Degrees of freedom</td>
<td>(16)</td>
<td>(15)</td>
</tr>
<tr>
<td>Incumbents (exited)</td>
<td>371(187)</td>
<td>387(81)</td>
</tr>
</tbody>
</table>

* p<.10, ** p<.05, *** p<.10 (two-tailed tests); # p<.10 (one-tailed tests)
1 Figures in the market share columns report number of pre-introduction incumbents surviving in the base subfield 5, 9, and 17 years after the emergence of a new subfield.

The acquisition and dissolution exit results differ somewhat. In both cases, nonexpansion is usually associated with shorter survival. Expansion, however, leads to significantly longer participation before acquisition only by generalists and longer
participation before dissolution only by specialists. It appears that firms which operate in more than one subfield tend to be acquired when they encounter difficulty, while specialists tend to shut down the operations.

In the market share analyses, the nonexpansion influences tend to take the predicted negative direction, although the effects become more variable in the longer-term estimates. There are few significant differences among firm- and product-types in the nonexpansion cases. As suspected, though, nonexpansion by specialists into neutral product areas is consistently less harmful than most other nonexpansion cases. Similarly, nonexpansion by generalists into neutral product areas has, at most, weakly negative or no significant influence on subsequent market share.

The effects of expansion on subsequent market share are more varied. As suspected, generalists with expand into substitute product areas receive the greatest benefit in their base businesses, although the benefit disappears by year 16. Specialists which expand into substitute subfields, meanwhile, tend to fare relatively poorly in their base businesses. Specialists which expand into neutral subfields and survive, though, receive strong spillover benefits. It is possible that substitute expansion causes confusion on the part of a specialist’s customers, while neutral expansion provides an opportunity to develop new market niches without disrupting established focused operations.

Among the control variables, the only consistent effects on subsequent market share were prior industry and subfield market share. Both tended to be positive, with industry share having the greatest and longest lasting influence. The most consistent influences on survival were prior market share, U.S. ownership, and new subfield introduction year. The negative influence of prior subfield market share was predicted and found in our earlier study. The prediction was based on the difficulty of expanding from a strong specialist position, controlling for prior industry market share. The control influences on survival apply almost entirely to exit by dissolution, with few significant effects emerging in the acquisition model.

Discussion And Conclusion

As expected, spillover effects into an established business vary with the types of firms which might expand and the types of new subfields into which they might expand. Most predictions were supported in the overall exit analyses, although the results apply most strongly to exit by acquisition and more weakly to dissolution. Most predicted nonexpansion effects on subsequent market share were found, although some expansion influences on market share were counter to those expected.

Perhaps the most interesting of the distinctions that arises from the analysis is the differential influence of the expansion strategy followed by specialist firms following the emergence of substitute and neutral subfields. Refer first to the specialist-substitute cases. Here, the differential effects of expansion and nonexpansion are small. Specialists which expand survive slightly longer than those which do not, at least before exiting by acquisition. Specialists which survive, meanwhile, receive only short-term relative market share benefits from expansion; only for year 4 market share is nonexpansion into a substitute subfield associated with significantly less market share than expansion. In general, a specialist is at risk following the emergence of a substitute subfield. Its market share tends to decline and its continued survival is, at best, average.

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2 Only the overall generalist expansion effect is reported in the acquisition model, because estimates which distinguished between expansion into substitute and neutral subfields would not converge.
Notice, though, that generalists do gain market share advantages through expansion into substitute subfields. This likely occurs because their broader product scope leads to more joint purchases by a single buyer of products in several technical subfields. For instance, a hospital may decide to purchase CT scanners, x-ray equipment, and MRI instruments from a single buyer.

Now note the effects on a specialist of expansion strategy following emergence of a neutral subfield. This environmental change presents both a threat and an opportunity. Specialists which do not expand fare poorly. They tend to have shorter continued participation and, at best, only maintain their relative market share. Specialists which expand into neutral subfields, however, may realize significant spillback benefits. They achieve moderately longer survival and strikingly greater market share in their base businesses. The market share benefits, indeed, appear to be even larger than those realized by generalists which expand into neutral subfields. This last result may imply that generalist status confers declining spillback benefits. The first successful expansion from a specialist core appears to provide substantial benefit to the base business; subsequent expansions provide lesser, but still positive, advantages.

When a new technical subfield of an industry emerges, industry incumbents face significant strategic challenges. Because many new products fail, an incumbent's tendency typically is to wait for the new products to prove themselves technically and in the market. If the new products appear to be succeeding, however, an incumbent which wishes to continue to participate in the industry will usually have to expand. If it does not, it is likely to exit from its base business. However, different types of products present different challenges to different types of firms. Broad-scope incumbents tend to face the greatest risks of nonexpansion. Single product-line firms, meanwhile, receive significant benefit from expansion into a neutral subfield but little from expansion into a substitute subfield. Deciding whether and when to expand, therefore, is a critical issue for firms operating in evolving industries. Resolving the issue requires understanding the attributes of the new products, the uses to which their buyers put them, and the specific competences of the firms which might offer them.

References