Relatedness and Market Exit

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Abstract

Researchers in corporate strategy have long argued that resource "relatedness" contributes to a firm's competitive advantage. One implication is that entries made by a firm into businesses that are closely related to the firm's existing businesses should have higher survival rates than entries by the firm into unrelated businesses. In contrast to this traditional view, we offer a distinct perspective in which relatedness increases a firm's likelihood of abandoning new businesses. Using a sample of more than 1,200 market entries in the U.S. telecommunications sector during 1989-2003, we show that the rate of market exit increased with the relatedness of the new business to the firm's existing businesses.

I. Introduction

The concept of *relatedness* has had a tremendous impact on our understanding of market entry and growth of the firm. The central insight from a long stream of literature is that the incentive to expand a firm is linked to the ability to profitably employ its underused resources (Penrose, 1959; Montgomery, 1994). The “more a firm has to diversify, i.e., the farther from its current scope that it must go, *ceteris paribus*, the larger will be the loss in efficiency and the lower will be the competitive advantage conferred by the factor” that is shared with the new market (Montgomery and Wernerfelt, 1988: 623).

In this paper we extend this theory by considering entry as an uncertain experiment undertaken by the firm in a context where relatedness reduces the sunk costs required to enter the new market. Firms whose existing businesses are closely related to the new business are likely to have more opportunities to redeploy the assets of the new business if the entry fails. In this sense, we expect related diversifiers to have lower sunk costs. This has two effects that have not been previously diagnosed by theory. First, the lower sunk costs associated with more relatedness serve to reduce the threshold level of expected profit required for entry, which makes the firm less conservative. As a consequence, the firm attempts more entries, the average quality of the entries is lower, and the average probability of success of the entries is also lower (holding the distribution of entry opportunities constant). And second, the lower sunk costs associated with more relatedness lead the firm to abandon entries sooner when their initial performance falls below expectations; this is because low sunk costs make it less valuable to maintain the abandonment option. Together, these effects imply that higher relatedness should increase the rate of exit.

We believe our theory offers a perspective on the role of relatedness that is distinct from the role of promoting competitive advantage. Our central hypothesis is that relatedness leads to a higher likelihood of abandoning new businesses. Another contribution we make is to simultaneously model both entry and exit, which allows us to effectively assess the role of relatedness on market exit, after factoring out its effect on entry. We find support for this hypothesis in a sample of over 1,200 entries in the U.S. telecommunications sector.

In Section 2, we discuss the theory around sunk costs and exit, and we review the empirical literature supporting this theory. Sections 3 and 4 link the concepts of sunk cost and relatedness, and we develop specific hypotheses regarding market exit. Our empirical methods are presented in Section 5. We test our hypotheses and show our empirical results in Section 6. Finally, we discuss our findings and conclude in Section 7.

II. Sunk Costs and Exit

It is well documented that firms keep their businesses going for lengthy periods while absorbing operating losses, and even withstand prices substantially below average variable costs. While a number of explanations have evolved to explain this phenomenon, following several authors (Dixit, 1989; Krugman, 1989) we will argue that a great deal of inertia is optimal when decisions involving sunk costs are being made in an uncertain environment. Sunk costs occur when "an expenditure … cannot be recouped if the action is reversed at a later date" (Dixit, 1992: 108). In the absence of sunk costs – i.e., with costless entry and exit – firms could close operations immediately to avoid losses imposed by price or cost fluctuations, and re-enter as soon as conditions enable profitable operation. In the presence of sunk costs, managers tolerate some operating loss to avoid exiting and re-incurring sunk entry costs if they later recognize abandoning the business was a mistake. Persisting with the business keeps alive the option of future profitable operation. Maintaining this option has the effect of lowering the trigger point of exit – firms are willing to accept lower levels of performance before they exit.

Following this logic, the most persistent businesses will be the ones with the highest sunk costs, and those with the lowest sunk costs will be the least persistent businesses. These theoretical expectations have received some empirical support. Ansic and Pugh (1999) used laboratory experiments with students to confirm Krugman's (1989) central hypothesis that sunk costs reduce exit from foreign markets, and Campa (2004) found evidence that Spanish exporters were less inclined to exit markets with higher sunk costs. Bresnahan and Reiss (1994) found that the minimum price that triggers entry by rural dentists is strictly higher than the maximum price that induces exit, and inferred that this revealed the effect of sunk costs. Similarly, Roberts and Tybout (1997) observed that Colombian firms are more likely to remain in the export market than to enter the market. O'Brien and Folta (2009) found that business units with higher technological intensity were less likely to be divested, presumably because they have higher sunk costs. In sum, there is some compelling empirical support for the relationship between sunk costs and exit, but it is less conclusive than theory.[1]

To make the logic more precise, consider a firm with cost of capital, *C*, facing an entry decision in the absence of both sunk costs and uncertainty. In this case, the decision rule is very simple: enter if the expected profit is greater than *C.* Even in the presence of uncertainty, if sunk

[1] There is other empirical evidence on the importance of sunk costs. Dunne and Roberts (1991) and Fotopoulos and Spence (1998) found capital requirements are barriers to exit, but others (Rosenbaum, 1993; Roberts and Thompson, 2003) find no relationship between capital requirements and exit. Gschwandtner and Lambson (2002) have shown that sunk costs relating to capital expenditures are a significant determinant of the variability of the number of firms in a number of developed and developing countries. Ghosal (2003) finds that higher sunk costs together with uncertainty reduce the number of firm in the US industry, leading to a less skewed firm size distribution for high sunk costs industries.

costs are zero, the same rule applies: enter if expected profit exceeds the cost of capital, and exit if a post-entry discovery reveals that profits in the new venture are below *C*.

Now, consider an entry decision involving sunk costs corresponding to k_1 in Figure 1, where there is also uncertainty about the profitability of the new business. The combination of sunk costs and uncertainty gives rise to an entry threshold defined by the line, *H*, as shown in the figure. With sunk costs k_1 a firm enters only if expected profit falls above the threshold defined by the point, A_1, which exceeds the cost of capital. If greater sunk costs corresponding to the level indicated by k_2 are required for the new business, a higher threshold of expected profit, corresponding to the point, A_2, will be required to induce entry. The degree of uncertainty around the opportunity defines the slope of the entry threshold. There will always be some uncertainty about market demand, price, technology, and cost. Even if uncertainty is resolved over time through exogenous shocks or learning, there will always be some residual level of uncertainty. Lower uncertainty reduces the slope of the entry threshold (e.g., *H'*, making entry more likely), and with no uncertainty it will be horizontal at the cost of capital.

After entry, a firm may revise profit expectations based on better information on costs and market demand associated with the new business. If the revised profit level falls below B_1, a firm will exit in the low sunk costs case (k_1); and if the revised profit level falls below B_2, exit will occur in the high sunk costs case (k_2). The wider band between A_2 and B_2 (high sunk costs) compared to the band between A_1 and B_1 (low sunk costs) implies that more negative information is required to induce exit when sunk costs are higher. Thus, entries with higher sunk costs will have more persistence, or "hysteresis", as commonly referred in the literature.[2] The combination of sunk costs and uncertainty explains why a business is not immediately abandoned when

[2] Assuming that the rate at which expected profit is revised over time is unrelated to sunk costs

expected returns fall below the cost of capital, since there is always some chance that conditions will turn out better, with profits higher, than the current expectation. Decision makers thus take into account the value of real options.

Over time, decision makers may resolve some of the uncertainties facing the new business. As a result, the exit threshold shifts closer to the cost of capital, say from L to L'.[3] Thus, strictly speaking, the exit thresholds defined by B_1 and B_2 apply only in the initial period after entry. Even so, it will always take a more negative value of expected profit to induce exit from a business with higher sunk costs. Therefore, firms will persist longer in a business with higher sunk costs, holding the rate of learning constant.[4]

In the next section, we will apply our model to the case of diversified firms with multiple entries. In doing so, we will argue that related businesses are less likely to persist than unrelated ones, because relatedness lowers the extent of sunk costs.

III. Sunk Costs and Relatedness

Economies of scope form the justification for the existence of diversified firms. Studies within the resource-based view (RBV) argue that such economies are greatest when firms

[3] This view of learning is similar to Jovanovic's (1981) model where entrants learn about match with the environment.

[4] Note that the model of entry and exit represented by Figure 1 goes beyond the standard Marshallian model on the shutdown point of the firm that is described in every microeconomics textbook. In the Marshallian model, firms are myopic; there is no uncertainty, and there are no sunk costs. (More specifically, the distinction between fixed costs and sunk costs is ignored). Firms merely respond to current price and shut down if that price falls below the minimum point of their average variable cost curve. The Marshallian model fails to describe what happens to the firm's capacity, which may lie dormant until price rises again to cover variable cost – i.e. there is a Marshallian theory of shutdown but no theory of exit. If price rises further to exceed firms' average total cost, new entry will occur. Thus, there is a gap between the entry and shutdown points in the Marshallian model that is similar to the real options model. However, by ignoring the time dimension of investment and hence uncertainty and sunk costs, the Marshallian model understates the extent of hysteresis.

diversify into domains that require resources that are closely related to the firms' existing resources (Chang, 1996; Farjoun, 1994; Lemelin, 1982; MacDonald, 1985; Montgomery and Hariharan, 1991). This is because the value of a resource is thought to diminish as it is leveraged into more distant domains. This logic suggests that related diversifiers should benefit more from economies of scope, and therefore be more profitable. Recently, however, some have noted that relatedness might influence not only entry decisions and subsequent profitability, but also have a separate effect on exit decisions because it influences the sunkness of investments in a business (O'Brien and Folta, 2009). Diversified firms that exit related markets not only have the usual choice of dispersing assets to third parties, but also the choice of reallocating assets to other internal business units.

Firms entering related markets can utilize existing knowledge or capabilities if those resources have few capacity constraints. This means that resource fungibility not only raises the potential for economies of scope, but also lowers sunk costs required to enter related markets (Folta, Johnson, and O'Brien, 2006).[5] Firms entering related markets encumber low sunk costs, because upon exit they can redeploy those resources to their other businesses. Consider, for example, the global telecommunications giant Mitsubishi Electric. Upon exit from the cell phone handset market in early 2008, Mitsubishi Electric repositioned approximately 600 employees, including those in R&D, manufacturing and sales divisions, into the firm's strategic businesses.[6]

Moreover, if prospects later improve in the market from which a firm has exited, it may be able to re-allocate these resources back to the market without re-incurring all of the initial

[5] Helfat and Eisenhardt (2004) make a similar point about how relatedness reduces entry costs, but they do not stress the importance of sunk costs. Neither do they emphasize how sunk costs affect exit.
[6] See "Mitsubishi to pull out of saturated handset market," *The Nikkei Weekly*: March 10, 2008; and http://www.cellphones.ca/news/post002958/. Another example, provided in Helfat and Eisenhardt (2004) is that many ski areas redeploy their facilities and staff every summer for warm weather mountain activities, and then shift these resources back to the ski business in the winter.

sunk costs required for entry.[7] In contrast, firms entering unrelated markets cannot internally redeploy resources upon exit, and if they later want to re-enter the exited market, they must re-incur all the necessary sunk costs.[8]

In summary, several interesting insights fall out of our model for diversified firms:

- Firms are more likely to “experiment” in markets that are more related to their existing businesses. Specifically, firms are more likely to enter these markets (as compared with less related markets) because they have lower entry thresholds due to lower sunk costs. Note that this explanation for preferring more related business expansion is not based on the pursuit of economies of scope and superior profit.
- Given the relatively lower threshold of expected profit required to induce related entry, the average quality of related entries is lower, and the average probability of success of the entries is also lower. Therefore, we expect exit rate to increase with relatedness.
- A second reason firms should be more likely to exit related businesses is their lower-valued abandonment option. It is less valuable to maintain the related business because firms can more easily redeploy resources upon exit to their other businesses. In addition, firms may be able to reverse the process and re-enter the business if market conditions improve.
- For entries unrelated to firms’ existing businesses, our model predicts a wide gap between the level of expected profits required to induce entry, and subsequent returns that are poor

[7] Re-entry may be more commonly considered by related diversifiers. Upon exit from the personal navigation device market, telecommunications firm JVC’s Bill Turner, Vice President of Mobile Entertainment, stated, “Primarily because the portable navigation business has turned into a price-only market with numerous new competitors entering almost daily, we opted to focus our business on the in-dash market instead.” He added, “We continue to study the portable navigation market and may re-enter it once we identify stabilization with regard to price points. Right now, too much volatility exists with regard to pricing and brand recognition isn’t a key component” (Gilroy, Amy. JVC exits PND market, TWICE: 5/17/2007, http://www.twice.com/article/233989-)

[8] Because resources from unrelated businesses cannot be redeployed internally, firms must accept the salvage value offered in the market.

enough to convince the firm to abandon the new business. Therefore, we expect a lower rate of exit from firms' less related market entries, due to higher sunk costs. Moreover, the higher exit threshold explains why firms are more likely to persist with their "bad" (unrelated) diversification moves.

This reasoning allows us to predict that the likelihood of market exit increases with the degree of relatedness between the new business and the firm's other businesses.

There is surprisingly little evidence around the relationship between relatedness and market exit. Most of the existing studies suggest little connection, although comparisons are difficult because authors often fail to distinguish whether firms entered via internal development or acquisition. Sharma and Kesner (1996) found no relationship between relatedness and exit. Chang and Singh (1999) found that regardless of entry mode, market relatedness had no effect on exit from the business. By comparison, O'Brien and Folta (2009) found that after controlling for business unit profitability, firms were more likely to exit less related businesses, although this effect was reversed under conditions of high uncertainty.[9] Chang (1996) also found firms more likely to exit less related businesses. Other studies that have examined how relatedness influences the divestiture of acquired business units have found little or no effect. Kaplan and Weisbach (1992) found that divestiture rates are similar whether acquirers and targets share (55.6%) or do not share (60.2%) a common two-digit SIC code. Shimizu (2007) found that business unit relatedness has no effect on exit from acquired businesses. In sum, most prior studies have found that relatedness has either a negative or no effect on exit. The null effect is

[9] Consistent with our theory, they found that firms were more likely to divest related businesses under higher uncertainty, presumably because they had lower sunk costs.

surprising given the traditional resource-based explanation for exit and the strong evidence around relatedness and performance.

In the next section, we reconcile this empirical literature with our expectations of a positive relationship between relatedness and market exit.

IV. Challenges in Predicting the Relationship Between Relatedness and Market Exit

One reason why prior studies have found little connection between relatedness and exit may be that the traditional resource-based theory and our alternative theory yield opposite predictions. Under the traditional theory, relatedness raises its odds of survival because it increases performance. By comparison, our alternative theory implies that relatedness lowers the odds of survival because it encourages more experimentation and earlier exercise of the abandonment option. The mechanisms corresponding to the theories may, on average, cancel out, leading to the absence of any net effect.

Note that in contrast with these predictions regarding exit, both theories predict that greater relatedness should lead to higher rates of market entry. The traditional theory implies relatedness should increase the likelihood of entry because, other things equal, it raises expected profitability. Our alternate theory predicts that relatedness increases the likelihood of entry because it induces lower profit thresholds. Thus, the two theories reinforce each other's predictions with respect to entry rates, albeit based on different mechanisms.

To distinguish the two theories and test their predictions empirically presents a series of challenges. One is to devise a way to identify the alternative mechanisms of the theories, both of which connect market "relatedness" to rates of entry and exit. Another challenge is to deal with problems of sample selection and endogeneity that may bias the empirical results. A third challenge is to find a data sample, containing a large number of market entries and exits, where the degree of "relatedness" to firms' existing businesses can be adequately characterized.

Identifying Alternative Predictions of Theories

Our approach to these challenges is as follows (leaving details for the next section on research methods). Our telecommunications industry sample includes information that allows us to characterize multiple dimensions of relatedness, and we observe both entry and exit over a considerable span of time. Accordingly, our two-stage approach allows us to estimate rates of market entry and subsequent exit, although the latter is our primary focus.

As we have already discussed, a firm will exit a market under the following conditions:

$$Exit\ if:\quad E(P_{ji}) < L_{ji}, \qquad \text{(Eqn.1)}$$

where $E(P_{ji})$ is the expected profit of firm *j* in market *i*, and L_{ji} is the abandonment threshold for firm *j* in market *i*. The key point is that the exit decision depends on the relationship between $E(P)$ and L, and so attempts to predict exit must take both into account. If relatedness influences both $E(P)$ and L we can estimate both such that:

$$\begin{aligned} E(P_{ji}) &= \beta_1 R_{ji} + v \\ L_{ji} &= \beta_2 R_{ji} + u \end{aligned}, \qquad \text{(Eqn. 2, 3)}$$

where R_{ij} is relatedness of business *i*, thought to influence both expected profits and the abandonment threshold; $ß_1$ and $ß_2$ are coefficient vectors; and *v* and *u* are normally distributed random variables. (Note that we could add vectors of variables that influence $E(P)$ and L but have left them out in this illustration to simplify our point). After substituting into equation 1, the probability of exit becomes

$$\Pr(E(P_{ji}) < L_{ji}) = \Pr(v - u) < \Pr(B_2 R_{ji} - B_1 R_{ji}). \qquad \text{(Eqn. 4)}$$

Hypotheses regarding exit can then be based on the signs and relative magnitudes of the coefficients $ß_1$ and $ß_2$ rather than on the values of E(*P*) and *L*.

The resulting model is amenable to a qualitative choice estimation technique such as a logit or probit, where variables are regressed on exit. However, since R_{ji} is the same across models, only the difference between $ß_1$ and $ß_2$ can be identified. Consider our main proposition that relatedness will increase expected profits and increase the point of abandonment. Using a discrete choice model, it is possible to test the propositions that $ß_1 - ß_2 > 0$ or $ß_2 - ß_1 > 0$. However, it is not possible to refute the underlying hypothesis that $ß_1 > 0$ (relatedness raises expected profits) and $ß_2 > 0$ (relatedness raises the abandonment trigger). Thus, a finding that relatedness lowers exit or has a null effect on exit could, in principle, obtain even if the separate hypotheses that relatedness raises expected returns and the abandonment trigger were valid.

One way to disentangle the effect of relatedness is to derive separate measures of relatedness for E(*P*) and *L*.[10] Scholars exploring how relatedness influences E(*P*) have focused on the degree of commonality between pairs of activities (Bryce and Winter, 2009), leading them to measure inter-business relatedness between the target business and a firm's closest connection

[10] Another potential way to disentangle these effects is through a censored regression approach allowing one to estimate the effects of relatedness on expected profits and abandonment value separately. Such an approach requires data on expected business unit profits, which is quite difficult to obtain. Some scholars have approximated for expected profits through actual profits, but these are unavailable for our sample.

(Teece, et al., 1994).[11] We will call this type of relatedness *synergy*, because it approximates the potential synergy between two businesses. As we have argued, relatedness might raise the abandonment threshold, *L*, if it increases a firm's ability to redeploy its resources back to other businesses of the firm. A firm with more businesses near the focal business has more potential for resource redeployment than a firm with only one business nearby. We will call this type of relatedness *retrenchment scope*, because it approximates a firm's scope to retrench by the opportunities available for resource redeployment. After controlling for how relatedness influences entry, we offer the following hypotheses that enable us to distinguish the effects of relatedness on expected performance and the abandonment threshold.

Hypothesis 1: The higher the synergy, the less likely firms will exit a market.

Hypothesis 2: The larger the retrenchment scope, the more likely firms will exit a market.

The second hypothesis is the main test of our real-options-based theory focusing on sunk costs and uncertainty, whereas the first hypothesis supports the traditional resource-based theory.

Mode of Entry as a Boundary Condition

So far, we have ignored the question of whether entry takes place through acquisition or internal development. The mode of entry is important for our theory in several respects. First, it is likely to affect the profit uncertainty of the new business. Businesses acquired through acquisition have an established track record, so their profitability is more certain than for entries made through internal development. Lower uncertainty reduces the entry and exit thresholds and makes sunk costs less relevant.

[11] Caves (1981) used the SIC system to identify a hierarchical measure of relatedness, where units within the same 3-digit SIC but different 4-digit SICs were 1 unit apart, units within the same 2-digit SIC but different 3-digit SICs were 2 units apart, and so forth. Lemelin (1982) measured inter-industry relatedness as the correlation coefficient across input structures taken from the input-output tables.

Second, mode of entry affects the way that a business's resources are redeployed if a firm chooses to exit from the business. If "synergy" falls below expectations, businesses entered via acquisition are likely to be spun off fairly intact through sales to outside parties. This is because acquired businesses tend to be self-contained, enabling them to be transferred to a new buyer relatively easily. It is often more difficult to integrate the resources from failed acquisitions directly into the organization of the acquirer; indeed, integration problems are commonly cited as the reason why "synergy" between an acquirer and its acquired business proved smaller than expected (Datta, 1991; Graebner, 2004; Larsson and Finkelstein, 1999). Many factors serve as impediments to transfer, including differences in culture, differences in operating systems, and the fact that employees in the acquired business lack experience working with those in the acquirer. In contrast with entries made via acquisitions, whose "foreign" grafts are commonly rejected, entries made via internal development emerge organically from the parent company with which they share fundamental organizational characteristics. Hence their resources and capabilities may be relatively easier to redeploy.

For these reasons, the degree of "retrenchment scope" between the new business and the parent firm is likely to matter much less for acquisitions than for internal development entries. In essence, our real-options-based theory is most applicable to entries made via internal development. Hence we have a third hypothesis:

Hypothesis 3: The impact of retrenchment scope on firms' likelihood of market exit will be mitigated when the market was entered via acquisition.

V. RESEARCH DESIGN

Sample

Our sample tracks new market entries and subsequent exits by firms active in the telecommunications industry between 1986 and 2000. The data source is the CorpTech Directory's 'Who Makes What' index, covering 10500 private firms and 631 public firms in seventeen technology industries in the United States.[12] This directory, published annually starting in 1986, provides detail on firms' product offerings, including a relatively fine-grained classification scheme for product codes developed by CorpTech. It is accumulated from a number of sources, including press releases, industry trade organizations and magazines, directories, web sites, customers, economic development organizations, and competitive intelligence. Foreign firms were included in the sample if they had an operating unit selling products in the United States.

For the purposes of studying how relatedness influences entry and exit, the CorpTech data has a number of attractive qualities. First, the CorpTech product and service classification system depicts a very rich picture of each industry segment, which allows for an effective characterization of relatedness and the detection of unique market entries. For example, compared to the SIC classification system, which offers 218 unique codes at the 4-digit level, CorpTech has 2,991 unique product codes. In one industry relevant to our sample of cohort, the SIC code 7372, "Prepackaged Software," alone corresponds to 324 CorpTech product codes. Second, the CorpTech data includes both private and public firms, which enables us to develop a comprehensive "similarity" matrix (described below) that is the basis for our measurement of

[12] CorpTech industries include factory automation, biotechnology, chemicals, computer hardware, defense, energy, environmental, manufacturing equipment, advanced materials, medical, pharmaceuticals, photonics, computer software, subassemblies and components, test and measurement, telecommunications and internet, and transportation.

relatedness. Compustat includes only public firms, which is only a small proportion of all active entitities. Finally, the CorpTech classification system is frequently updated, reflecting the rapid increase in innovations across these technology industries. For example, between 1989 and 1999, 429 new product codes related to telecommunications and the internet were added.

We constructed our risk set for entry based on the following criteria: a firm has at least one product at least one telecommunications product. at leastpublic ownership; non-missing data around research and development expenditures, revenue, and other control variables; and at least nine consecutive years in the CorpTech directory. A focus on public firms enables us to match our firms with Compustat to generate a comprehensive set of control variables. A requirement for nine consecutive years of data centers around our interest in observing changes in product portfolios over time, and this requirement. In our risk set, there are 163 public firms and 657 markets, comprising 107,091 firm-market pairs. After excluding firm-market pairs existing prior to the observation period, there are 106,212 observations, of which, 1,719 are entries and 104,493 are non-entries. These were used to model the first stage entry decision.

Our risk set for exit includes the 1,719 entries. They remain at risk until they exit product markets or until the end of the observation period in December 2000. The sample was reduced to 1,662 because 57 were exited through sale - motivations for exiting through a change in ownership may be different from those for exiting through elimination of products, since some products may be sold as part of a bundle when the entire business unit is sold to another firm.[13] These remaining entrants were involved in 9,141 firm-market-year observations, including 494 exit events.

[13] Our findings are robust when sample restrictions on exit mode are relaxed.

Measures

Dependent variables

The market entry event indicator is a binary variable that takes the value of "1" if firm *n* entered market *x* during the entire period of observation, and "0" otherwise. Entry is observed if product code *x* appears in firm *n*'s portfolio for the first time. The market exit event indicator is a binary variable that takes the value of 1 if firm *n* exited market *x* in year *t*, and "0" otherwise. Exits are observed by tracking product code *x* in firm *n*'s portfolio annually until it no longer appears or until the end of the observation period in year 2000. The estimated hazard of exit is the probability firm *n* exits from market *x* in year *t*, given that it hasn't exited in year *t-1*.

Independent variables

The key theoretical construct in our study is relatedness. We develop our measures of relatedness by constructing a pair-wise similarity index for which products co-occur in firms' product portfolios. Specifically, our similarity index measures the likelihood a firm operating in market *w* will also offer a product in market *x,* after correcting for the degree of similarity that would be expected if diversification were purely a random process. Higher similarity values suggest higher degrees of relatedness between two product markets. This approach to measure relatedness was first suggested by Teece et al. (1994), and has been implemented by a number of recent studies, including Folta and O'Brien (2004), Folta, Johnson, and O'Brien (2006); Lee (2007, 2008, 2009), Bryce and Winter (2009), O'Brien and Folta (2009), and Lee and Lieberman (2010). One advantage of this approach, relative to traditional measures of relatedness based on differences in SIC codes, is that it does not assume the same degree of relatedness between all pairs of SICs. The ability to distinguish between degrees of market relatedness is central for understanding whether firms can redeploy resources across markets. Our similarity index differs from that developed by Teece et al. (2004) in that it uses the CorpTech data, rather than Compustat data. By using data with both public and private firms, we are able to develop a more complete index. It also differs in that we recreate the similarity index each year, so that it varies over time. Appendix A describes the calculation of this index.

Using our similarity index, we create measures of relatedness intended to capture the potential for *synergy* and *retrenchment scope* between the firm's existing businesses and its new business. The empirical tests in our study are based on the assumption that our measures can denote, at least roughly, the difference between these two dimensions of business relatedness. These dimensions are far from orthogonal, and hence even perfect measures are likely to be highly correlated. Nevertheless, our hypotheses can be tested if our retrenchment scope measure picks up differences in sunk costs that extend beyond those associated with conventional economies of scope that enhance the profitability of the new business.

We measure *synergy* as the distance between market x and firm n's most related business – the maximum value of firm n's similarity index with respect to market x. It is captured one year prior to the entry event. This measure is based on the idea that a firm's capacity for sharing resources with the new business and hence enhancing the profitability of that business, is best reflected by the closest connection between the new business and the firm's existing businesses.

Our measure of *retrenchment scope* is a proxy for a firm's ability to redeploy resources from the new business to its existing businesses. Since we expect retrenchment scope to be larger when a firm has more opportunities to internally redeploy assets, our measure captures relatedness beyond its most similar business. Retrenchment scope is measured as the sum of firm *n*'s similarity index between *x* and *j* where *j* is an element in firm *n*'s product portfolio, excluding the maximum value captured by *synergy*. By excluding the maximum value we eliminate the most likely candidate for retrenchment, but prefer this conservative approach because we can distinguish from effects attributed to synergy. We report the two measures' convergent and discriminant validity in the results section. We also develop alternative measures of retrenchment scope based on the number of products in the portfolio that exceed certain thresholds of relatedness. Potentially, the ability to retrench is only possible beyond such thresholds.

Control variables

We use three levels of control variables in our estimation: firm-market level, firm level, and market level. Our first control at the firm-market level is for firm *n*'s mode of entry into market *x*. We code *entry mode* as "1" if a new product code can be traced to a corporate ownership change, namely that the product is acquired from an incumbent; and "0" otherwise.[14] As argued earlier, one would expect entries through acquisition to be poorer candidates for retrenchment. A second control is added through a categorical variable indicating whether product market *x* is inside a firm's primary business domain. This variable controls for the extent that there may be discontinuities associated with business activities dictated as "primary."

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[14] Our study improves upon prior work by identifying entry events and their mode of entry with higher precision. We identify entry via acquisition under a strict condition that an acquirer's new product code in the year of entry can be traced to an acquiree's product listing in the year prior to the acquirer's entry event. The detailed tracing is possible because the product classification system we use is much more fine-grained than the SIC system. In comparison, some studies suffer from an "all or nothing" bias where all diversification moves under one SIC code are assigned to either acquisition or internal expansion arbitrarily (Chatterjee, 1990). Others suffer from another type of aggregation bias where the entry mode is measured as a continuous variable indicating the dominance of one mode in sales contribution over an arbitrary time period, as opposed to the mode of entry specific at the firm-market level (Chatterjee and Singh, 1999). If we observe that a firm's existing business adds the same product code as acquired units in the year of acquisition, we make a conservative assumption to favor false negatives and code the case as entry as internal development. The results are robust when the observations under the special case are recoded as missing or as all acquisitions.

We also control for firm-level factors that may influence entry or exit. A measure of product portfolio size is developed by counting firm *n*'s product codes that are classified at the most fine-grained level. We also control for firm *n*'s annual net sales, R&D expenditures, profitability (return on sales), and Tobin's q (market-to-book value). Finally, we control for firm *n*'s experience with market entry, by measuring the total number of markets entered by firm *n* prior to entry into market *x*. Prior work has demonstrated that firms with more entry experience are more prone to entry.

Controls are also included for environmental conditions specific to a market that might influence entry or exit. Markets with more entry or exit should be more prone to further entry or exit, perhaps because of low entry or exit barriers. We consider this by counting the total number of firms that entered market *x* in the year prior to an event, and the total number of firms that exited market *x* in the year prior to an event. Markets with higher density might encourage entry because they are viewed to be more legitimate. To measure market density we take the natural log of firm count in *x* in the year prior to an event. Newer markets might systematically influence rates of entry and exit, and so we control for this by developing a categorical variable equal to "1" if market *x* emerged in the 1990s; 0 otherwise. Finally, we implement year controls to capture macroeconomic factors that might explain entry or exit behavior.

Regression Models

Testing the effect of relatedness on market exit by multi-business firms requires attention to challenges pertaining to sample selection bias. An examination of how relatedness influences exit is conditioned by whether a firm entered a market (i.e., they were selected in). Since relatedness is predicted to have a strong effect on entry, the selection bias may profoundly influence any conclusions about how relatedness influences exit.[15] We cope with the aforementioned challenge in two ways. First, we only consider market exit decisions when we can also observe their prior entry decision. Second, we use a two-stage procedure, estimating a market entry equation in the first stage, and incorporating the inverse Mills ratio from these estimates in a second stage exit regression.

In the first stage we estimate the determinants of entry using a probit regression, such that

$$y_{kmt} = b_1 s_{t-1} + b_2 r_{t-1} + b_3 x_{t-1}, \qquad \text{(Eqn. ?)}$$

where y is the binary indicator for entry into market m by firm k, s is synergy with market m, r is retrenchment scope with market m, x is a vector of control variables, and b_1-b_3 represent coefficients. Robust standard errors are estimated and firm-level clustering is applied because firm-market observations are not independent.

In the second stage we estimate the hazard of exit from product markets. This is done through a Cox (1972) proportional hazard model where we track the market entries and observe the firm's presence in that market over annual spells. This specification has the advantage of a baseline hazard that takes no particular functional form. The hazard rate (λ(t)) is defined as

$$\lambda(t) = \lim\left[q(t, t + \Delta t / \Delta t), \Delta t\right] \longrightarrow 0, \qquad \text{(Eqn. ?)}$$

[15] The impact of selection biases on coefficients is most pronounced when key independent variables influence the selection criteria. If firms with low relatedness choose not to enter, their lengths of stay in the market is not observed. By modeling exit effects with only entered firms, the distribution of relatedness falls within a narrower range, creating effects that are less significant. At its extreme, this bias may lead to the conclusion that relatedness has no effect on exit, when in fact it does. Even if relatedness did significantly influence exit, a self-selection bias can attribute smaller effects than the variable's true effects, or it can yield effects opposite from their true effects.

where q is the discrete probability of exit between time t and $t+\Delta t$, conditional on the history of the process up to time t. The model we use is

$$\log \lambda(t) = a(t) + b_1 s + b_2 r + b_3 x + b_4 m \qquad \text{(Eqn. ?)}$$

where $a(t)$ can be any function of time, s is synergy, r is retrenchment scope, x is the vector of control variables, and m is the inverse mills ratio from the first stage entry equation, and b_1-b_4 represent coefficients. Robust standard errors are estimated and firm-market-level clustering is applied because firm-market-year observations are not independent. Finally, to ensure proper causal inference, time-varying variables are lagged by one year.

VI. RESULTS

Table 1 presents the summary statistics of the samples used in our two-stage model. As shown in Table 1-1, our sample of 657 markets mainly located outside firms' primary business domain (84% of stage 1 firm-market pairs); our sample of 163 firms entered an average of 10 markets, and the average number of entries per market was 3 during the 15-year period. Our sample of 1,662 entries was made mainly via internal development (76% of entry mode). Between the two entry modes, the fraction of entries that were subsequently exited has a significantly higher mean when entry mode is acquisition (the failure rate is 34% and 28% of entries made via acquisition and internal development, respectively). In addition, compared to entries made via internal development, entries made via acquisition have a significantly larger mean and narrower range of retrenchment scope, but no significant difference in synergy. This could reflect the fact that acquisitions tend to be made by larger firms with more business units;

firms' product portfolio size exceeded 26 on average in the subsample where entry mode is acquisition, as compared with 15 in the subsample where entry mode is internal development. As shown in Table 1-2, synergy and retrenchment scope are higher in firm-market pairs with entry than pairs with no entry in stage 1; synergy and retrenchment scope are lower in firm-market pairs with exit than pairs with no exit in stage 2.

Table 2 presents pair-wise correlations. The two measures of retrenchment scope are correlated at 0.66 (stage 1 in Table 2-1) and 0.78 (stage 2 in Table 2-2). The high correlation suggests that these two approaches of operationalizing retrenchment scope are consistent and have convergent validity. By contrast, the correlation between synergy and either measure of retrenchment scope is lower (0.54 and 0.55 in Table 2-1 and 0.43 and 0.62 in Table 2-2) than the correlation between measures of retrenchment scope (0.66 and 0.78). The difference suggests that the measure of synergy is distinct from the measures of retrenchment scope and have discriminant validity.

Table 3 shows the regression results from the first-stage model. The entry probability of firm *n* into market *x* increases when market *x* is inside firm *n*'s primary business domain. Of the 1,662 entries, 69% are inside firm *n*'s primary business domain. Entry probability also increases with firm *n*'s profitability and the number of markets entered by firm *n*. In addition, the entry probability increases with the number of entries in market *x*, the density of firms in market *x*, and when the market is newly emergent. By comparison, the entry probability decreases with the number of firms exiting from market *x* and is lower during the later years.

As shown in Table 3, the estimated coefficient of synergy is statistically significant and has a positive sign. It suggests that firm *n* is more likely to enter market *x* as synergy increases between *x* and the product most related to *x*. Moreover, the estimated coefficient for retrenchment scope is statistically significant and has a positive sign. It suggests that firm *n* is more likely to enter market *x* as retrenchment scope increases between *x* and the *n*'s product portfolio. This finding is robust to different operationalization of retrenchment scope (Models 3-4 and 3-6).

Table 4 shows the regression results from the second-stage model. Once entered, firm *n* is more likely to exit from market *x* when firm *n* has more net sales and market *x* has a higher density of firms. By comparison, firm *n* is less likely to exit from market *x* when firm *n* has a larger product portfolio size and during the later years. In addition, the estimated coefficient of inverse Mills ratio is statistically significant, suggesting that the procedure we applied is appropriate for correcting selection bias. We show in Models 4-5 and 4-6 the results when selection bias is not corrected. When selection bias is not corrected, the estimated coefficients for synergy and retrenchment scope, although significant, are both smaller (probability of exit is lower). As the comparison between Models 4-3 and 4-5 suggests, the coefficients are smaller by 17% and 20% for synergy and retrenchment scope, respectively.

As shown in Table 4, the estimated coefficient of synergy is statistically significant and has a negative sign (Model 4-2). It suggests that firm *n* is less likely to exit market *x* as synergy increases between *x* and the product most related to *x*. Our Hypothesis 1 is supported. This finding is consistent with the traditional argument on how synergy enhances performance. In contrast, the estimated coefficient of retrenchment scope is statistically significant and its sign is *positive*. It suggests that firm *n* is *more* likely to exit market *x* as retrenchment scope increases between *x* and firm *n*'s product portfolio. This is consistent with the idea that retrenchment scope allows firm *n* to redeploy assets from market *x* to its other businesses, thus reducing sunk costs.

Our Hypothesis 2 is supported. Everything else being equal, as retrenchment scope increases, exit becomes more likely.

However, the effects of relatedness (both synergy and retrenchment scope) are significant only in the subsample where entry mode is internal development, but negligible in the subsample where entry mode is acquisition (Model 4-3 vs. 4-4). Consistent with our Hypothesis 3, the estimated effect for retrenchment scope is smaller for entries made via acquisition than internal development. Moreover, we find that entries made via acquisition have higher hazard rate of exit (Model 4-2). One reason is that firms exit from products that they acquired as part of a bundle but do not want to keep. In general, it is clear from Table 4 that our hypothesized links between relatedness and market exit mainly apply to entries made via internal development.

In interpreting our findings, we plot the multiplier of hazard rate as a function of relatedness based on Model 4-3. As shown in Figure 2, the impact of synergy on market exit has a negative slope. As synergy increases, the multiplier decreases. In contrast, as retrenchment scope increases, the multiplier increases. The multiplier is set at 1 for firms with zero relatedness, the base case. For firms with a mean level of synergy, the multiplier is 0.72, suggesting that their exit rate is 28% lower than that of the base case. A one-standard-deviation increase in synergy corresponds to a 28% decrease in exit rate. For firms with a mean level of retrenchment scope, the multiplier is 1.20, suggesting that their exit rate is 20% higher than that of the base case. A one-standard-deviation increase in retrenchment scope corresponds to a 43% increase in exit rate.

Robustness Checks

Table 5 shows the robustness of our finding on the link between relatedness and market exit to different operationalizations of retrenchment scope. The comparison between Models 5-2 and 5-3 shows that each operationalization of retrenchment scope has a stand-alone effect. In addition, the comparison between Models 4-3 and 5-4 shows that our results are not sensitive to which alternate measure is used, but the alternate measure has a stronger effect. For firms with a mean level of product count with the threshold of relatedness set at zero, the multiplier is 1.41, suggesting that their exit rate is 41% higher than that of the base case. A one-standard-deviation increase in the alternate measure of retrenchment scope corresponds to a 54% increase in hazard rate of exit. By contrast, as discussed previously, a one-standard-deviation increase in the main measure of retrenchment scope corresponds to a 43% increase in hazard rate of exit. Moreover, the comparison between Models 4-5 and 5-5 shows that, when the selection bias correcting factor is removed, our results are robust. When the correction factor is introduced, the estimated effects of relatedness become larger (Models 5-4 vs. 5-5). Finally, we check how sensitive our results are to the threshold of relatedness. In Model 5-6, we present the regression result where the threshold of relatedness is set at sample mean (0.11). As shown, our findings remain robust.

VII. DISCUSSION AND CONCLUSION

This paper develops a conceptual model as well as an empirical test that allow us to overcome challenges in assessing the relationship between relatedness and market exit. Conceptually, we offer a distinct perspective in which relatedness increases a firm's likelihood of abandoning new businesses. Empirically, we compare this perspective with the traditional view in which relatedness enhances the survival of new businesses. Based on a sample from the U.S.

telecommunications sector over a 15-year period, we find that all three hypotheses in our study are supported. Greater synergy between the firm and the new business decreases the likelihood of subsequent exit, whereas greater retrenchment scope increases it. The larger a firm’s scope for redeploying resources from a venture in case of failure, the more likely it would exit. Moreover, these findings hold for entries made via internal development, but not for entries made via acquisition. This implies an important boundary condition for our theory. Although not included as part of our formal hypotheses, we also find that the probability of market entry increases with both synergy and retrenchment scope, as predicted by the underlying theories.

These findings support our real-options-based theory, as well as the traditional resource-based theory of competitive advantage and relatedness. The two theories provide independent explanations of market entry and exit, which complement each other. The resource-based theory implies that the firm is likely to face better entry opportunities in markets that are more closely related to the firm's existing businesses. This suggests that the distribution of potential entry opportunities is more favorable (e.g., the mean expected profit is higher) across markets that are more closely related to at least one existing business of firm. On the other hand, our real-options-based theory operates by defining entry and exit thresholds, taking the distribution of entry opportunities as given. Hence, our theory can be regarded as an overlay on top of the traditional theory.

An empirical challenge in our study is to construct measures that truly separate synergy from retrenchment scope as distinguished dimensions of relatedness. In their pure form, these dimensions capture the concepts of scope economies and sunk costs, respectively. We have argued that our synergy measure -- based on similarity between the new business and the closest existing business within the firm -- is a good measure of the synergy concept and is consistent with prior work in the literature. By comparison, our measures of retrenchment scope are more novel. They reflect the number and degree of connections between the firm and the entered market, beyond the link associated with the closest business. One might argue that our retrenchment scope measures are likely to contain a large element of synergy, and this is certainly true, as the two sets of measures are highly correlated. However, the synergy measure serves as a control for this common element in the exit regressions. Although not shown in the tables, we also experimented with modified versions of our retrenchment scope variables that contain only components orthogonal to the synergy measure; these gave similar results to the full measures shown in Tables 4 and 5. In general, our results show considerable robustness across alternative specifications of retrenchment scope, which suggests that the measures are effective in capturing the degree of sunk costs. Even so, it seems plausible that the estimated coefficients for retrenchment scope may be biased downward by a component of synergy that is beyond what is captured by our synergy measure.

This paper contributes to strategy research by offering an integrated perspective that encompasses the literatures on business diversification, market entry, sunk costs, real options, and the resource-based view of the firm. Within this vast landscape our study connects most closely with a number of areas of research. Most fundamentally, our study adds to the long line of literature on how relatedness shapes the growth of firms as they diversify. Our theory of how sunk costs influence market experimentation by the firm is quite distinct from, but complementary to, the prevailing resource-based theory. This paper's primary contribution has been to introduce our complementary theory and demonstrate its relevance.

Our study also connects to a more specific body of work focusing on resource redeployment, reconfiguration, and asset divestiture as dynamic processes of resource reconfiguration. The resource redeployment view argues, based on scale economies rationales, that post-acquisition resource redeployment leads to asset divestiture from the business that receives the redeployed resources, but not from the business that contributes the new resources. (Capron, Mitchell, and Swaminathan, 2001). In contrast, the resource appropriation view argues that acquirers will divest remaining target assets after capturing valuable target resources (Duhaime and Grant, 1984; Hitt, Hoskisson and Ireland 1990). This work on resource redeployment, reconfiguration, and asset divestiture parallels our study in terms of the dynamics of business entry and exit by diversified firms. Nevertheless, the former body of work focuses almost exclusively on acquisitions, whereas we have shown that our model is most relevant for entries made via internal development. Even so, the two research streams may be seen to complement each other in explicating dynamic processes of market entry and exit.

Moreover, our study extends to the field of strategic management ideas on sunk costs and real options developed originally within the field of economics. Prior studies by economists have shown that the concepts of entry and exit thresholds introduced theoretically by Dixit (1989) and others have empirical validity, particularly in the context of international trade. We have shown that these concepts are also applicable in the context of corporate diversification, where the sunk costs of market entry vary with the degree of business relatedness. Our work helps to elaborate the findings of studies such as O'Brien and Folta (2009) which connect real options to strategic management in the context of market entry and exit.

Appendix A

To create the pair-wise similarity index for each year, we start with a Q by M matrix, where Q is the number of products produced by a population of M firms in year t. Let P_i, a row vector in the Q by M matrix, indicate the presence or absence of product i across M firms in year t (for ease of notation, subscript for year is not used). Also, let P_x, a row vector in the Q by M matrix, indicate the presence or absence of the focal product x across a population of M firms in year t. The similarity index in year t, S_{ix}, is a measure of product i and product x's frequency of joint occurrence within a firm. S_{ix} is derived as the angular separation between the two vectors:

$$S_{ix} = \frac{P_i \bullet P_x}{|P_i||P_x|} = \frac{\sum_{m=1}^{M} P_{im} P_{xm}}{\sqrt{\sum_{m=1}^{M} P_{im}^2}\sqrt{\sum_{m=1}^{M} P_{xm}^2}} \qquad \text{(Eqn.5)}$$

S_{ix} is equal to 1 when i and x have identical patterns of joint occurrence across M firms. S_{ix} is 0 when i and x do not co-occur at all. Put differently, the similarity index is the normalized count of firms that produce both product i and product x. The higher the similarity index is between i and x, the more similar are the two products. We use this index to develop measures of relatedness corresponding to a firm's potential for synergy between two products and its potential for retrenchment scope among its other products.

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FIGURE 1

Trigger points for entry and exit

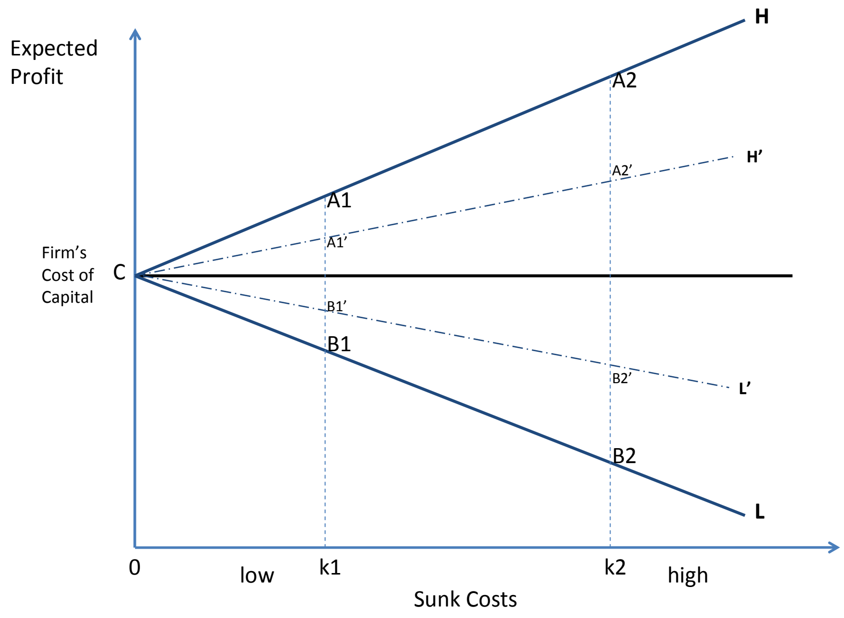

FIGURE 2

Estimated hazard rate of exit as a function of relatedness

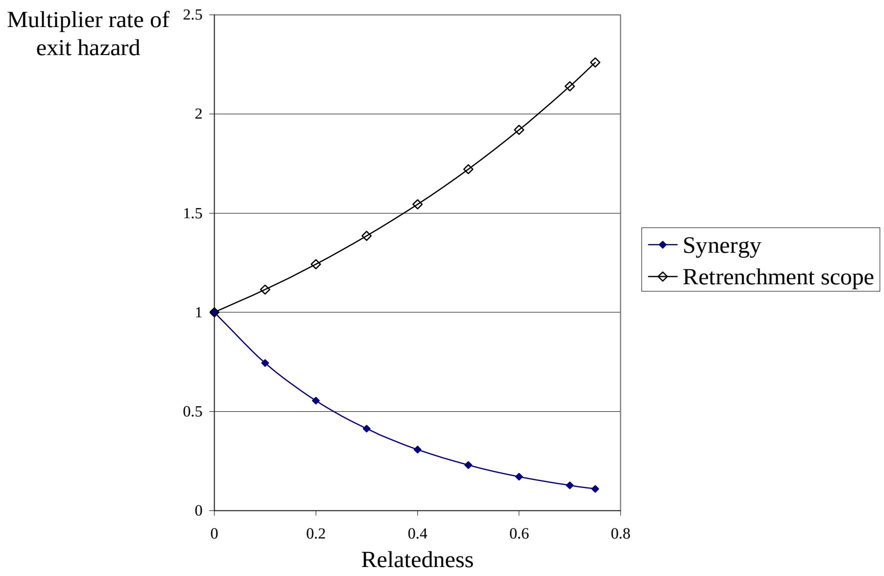

TABLE 1

Summary statistics

Table 1-1: All variables	Stage 1		Stage 2 – all entry observations (a)		Stage 2 – entry mode is internal development		Stage 2 – entry mode is acquisition	
Observations	106,212		9,141		7,272		1,869	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Synergy – proximity to the most related product	0.05	0.07	0.11	0.11	0.11	0.11	0.12	0.11
Retrenchment scope – proximity to product portfolio, excluding the most related product	0.05	0.18	0.19	0.35	0.17	0.33	0.27	0.38
Retrenchment scope, alternate measure – count of related products	1.12	1.58	3.46	4.24	3.22	4.09	4.40	4.69
Inverse Mills ratio			0.89	0.77	1.04	0.71	0.80	0.78
Entry mode: 1 if acquisition, 0 if internal development			0.20	0.40				
Inside/outside primary business domain (b)	0.16	0.37						
Size of product portfolio	7.10	6.03	17.34	17.01	15.02	14.04	26.38	23.34
Net sales (thousand USD)	4,996	19,739	8,588	20,208	7,374	20,154	13,315	19,723
R&D intensity (%)	22.76	16.14	9.92	14.17	10.12	13.46	9.14	16.63
Profitability	-1.16	10.63	0.05	0.05	0.06	0.05	0.04	0.04
Q	2.69	2.50	2.33	2.90	2.35	2.84	2.22	3.09
Count of markets entered per firm (b)	10.48	13.19						
Count of firms entered per market (b)	2.60	2.58						
Count of firms exited per market	8	40	11	55	11	57	9	46
Market density	2	1	47	202	47	204	45	190
Market newness	0.18	0.39	0.12	0.33	0.12	0.32	0.15	0.36
Time trend	2002	2	1998	3	1998	3	1998	3

NOTE a: entry mode is either internal development or acquisition

NOTE b: These variables affect only entry decision, but not firm *n*'s exit rate in market *x*. We use these to distinguish the covariates used in stage 1 vs. 2.

Table 1-2: Measures of relatedness		Percentile				
	Mean	10th	25th	50th	75th	90th
Stage 1						
Synergy: entry	0.108	0	0.03	0.08	0.16	0.26
Synergy: no-entry	0.046	0	0	0.03	0.07	0.12
Retrenchment: entry	0.210	0	0	0.06	0.25	0.58
Retrenchment: no-entry	0.035	0	0	0	0.03	0.10
Retrenchment alternate: entry	4.03	0	1	2	6	10
Retrenchment alternate: no-entry	1.05	0	0	0.77	1.45	2.61
Stage 2: all entry observations/ subsample where entry mode is internal development						
Synergy: exit	0.084/ 0.082	0/ 0	0/ 0	0.06/ 0.06	0.13/ 0.13	0.20/ 0.20
Synergy: no-exit	0.119/ 0.116	0/ 0	0.04/ 0.04	0.09/ 0.09	0.17/ 0.17	0.28/ 0.27
Retrenchment: exit	0.143/ 0.149	0/ 0	0/ 0	0.02/ 0	0.19/ 0.19	0.41/ 0.44
Retrenchment: no-exit	0.238/ 0.211	0/ 0	0/ 0	0.08/ 0.07	0.32/ 0.25	0.67/ 0.55
Retrenchment alternate: exit	2.95/ 2.98	0/ 0	0/ 0	2/ 1	4/ 5	8/ 9
Retrenchment alternate: no-exit	4.49/ 4.07	0/ 0	1/ 1	3/ 2	6/ 5	11/ 10

TABLE 2

Pair-wise correlations

Table 2-1: Stage 1	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15
(1) Entry =1	1														
(2) Synergy	0.27	1													
(3) Retrenchment	0.44	0.55	1												
(4) Retrenchment alternate	0.33	0.54	0.66	1											
(5) Inside/outside primary business domain	0.05	0.09	0.08	0.14	1										
(6) Count of markets entered per firm	0.16	0.33	0.31	0.35	-0.06	1									
(7) Count of entries per market	0.13	0.07	0.11	0.32	0.15	0.00	1								
(8) Size of product portfolio	0.13	0.33	0.33	0.46	-0.06	0.79	-0.01	1							
(9) Net sales	0.03	0.09	0.06	0.13	-0.07	0.21	0.00	0.21	1						
(10) R&D intensity	-0.04	-0.08	-0.08	-0.06	0.07	-0.23	0.00	-0.22	-0.11	1					
(11) Profitability	0.01	0.04	0.02	0.04	-0.02	0.08	0.00	0.08	0.03	-0.29	1				
(12) Q	-0.01	-0.07	-0.03	-0.03	0.07	-0.14	0.00	-0.11	-0.12	0.42	-0.61	1			
(13) Count of firms exited per market	0.02	0.00	0.02	0.10	0.13	0.00	0.12	0.00	0.00	0.00	0.00	0.00	1		
(14) Market density	0.06	0.04	0.07	0.33	0.23	0.00	0.47	0.00	0.00	0.00	0.00	0.00	0.47	1	
(15) Market newness	-0.01	-0.07	-0.03	-0.06	0.00	0.00	-0.08	0.00	0.00	0.00	0.00	0.00	0.30	-0.02	1
(16) Time trend	-0.36	-0.37	-0.20	-0.27	-0.05	-0.13	-0.10	-0.10	-0.09	0.02	-0.01	0.02	0.01	-0.09	0.08

Note: Count of markets entered per firm and size of product portfolio have high correlations exceeding the threshold of .70. In addressing colinearlity among control variables, we verified the robustness of our results by either dropping highly correlated variables from the model, or apply an orthog transformation to remove common components from them.

Table 2-2: Stage 2	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) Exit = 1	1														
(2) Synergy	-0.06	1													
(3) Retrenchment	-0.03	0.62	1												
(4) Retrenchment alternate	-0.03	0.43	0.78	1											
(5) Entry mode	0.04	0.04	0.11	0.11	1										
(6) Inverse Mills ratio	0.03	-0.27	-0.28	-0.15	-0.06	1									
(7) Size of product portfolio	-0.02	0.26	0.42	0.51	0.23	-0.31	1								
(8) Net sales	0.05	0.01	0.06	0.11	0.12	0.08	0.16	1							
(9) R&D intensity	-0.02	0.01	-0.06	-0.06	-0.03	0.07	-0.18	-0.10	1						
(10) Profitability	-0.03	0.11	0.09	0.07	-0.13	-0.14	0.06	-0.01	-0.03	1					
(11) Q	-0.01	0.02	0.02	0.03	-0.02	0.08	-0.02	-0.06	0.19	0.37	1				
(12) Count of firms exited per market	0.03	0.01	0.03	0.09	-0.02	0.10	0.04	0.09	0.04	0.01	0.10	1			
(13) Market density	0.01	0.05	0.07	0.15	0.00	0.11	0.01	0.03	0.04	-0.02	0.08	0.73	1		
(14) Market newness	0.00	0.01	-0.02	0.00	0.04	0.07	0.01	0.11	0.01	0.02	0.14	0.27	0.24	1	
(15) Time trend	0.04	0.05	0.11	0.19	0.03	0.35	0.33	0.03	0.05	0.03	0.13	0.16	0.12	0.12	1

Note: Count of firms exited per market and market density have high correlations exceeding the threshold of .70. Our results are robust when we either drop these variables from the model or apply an orthog transformation to remove their common component.

TABLE 3

Stage 1 - Estimating entry probability (PROBIT)

(Robust standard errors in parentheses)

	(3-1)	(3-2)	(3-3)	(3-4)	(3-5)	(3-6)
			Retrenchment scope – proximity to product portfolio, excluding the most related product		Retrenchment scope, alternate measure – count of related products	
Synergy		5.190** (0.299)		1.516** (0.506)		3.967** (0.321)
Retrenchment scope			2.167** (0.248)	1.850** (0.294)	0.229** (0.026)	0.172** (0.023)
Firm-market-level control variable						
Inside/outside primary business domain	0.445** (0.067)	0.277** (0.057)	0.211** (0.054)	0.190** (0.054)	0.315** (0.066)	0.209** (0.059)
Firm-level control variables						
Size of product portfolio	0.313** (0.072)	0.209** (0.072)	0.072 (0.078)	0.070 (0.077)	-0.009 (0.092)	-0.020 (0.091)
Net sales	0.047 (0.044)	0.025 (0.049)	-0.003 (0.055)	-0.004 (0.055)	0.082+ (0.049)	0.061 (0.050)
R&D intensity	-0.001 (0.047)	0.020 (0.053)	0.001 (0.055)	0.005 (0.056)	0.005 (0.060)	0.020 (0.061)
Profitability	2.757** (0.756)	2.759** (0.798)	2.407** (0.782)	2.438** (0.780)	2.638** (0.777)	2.632** (0.790)
Q	0.015 (0.040)	0.025 (0.042)	0.005 (0.045)	0.008 (0.044)	-0.021 (0.043)	-0.008 (0.041)
Count of markets entered per firm	0.182** (0.039)	0.180** (0.039)	0.160** (0.044)	0.163** (0.043)	0.197** (0.052)	0.194** (0.048)
Market-level control variables						
Count of firms exited per market	-0.033** (0.012)	-0.090** (0.020)	-0.048** (0.018)	-0.060** (0.019)	-0.023+ (0.013)	-0.063** (0.019)
Market density	0.213** (0.025)	0.329** (0.021)	0.226** (0.025)	0.252** (0.026)	0.043 (0.027)	0.165** (0.020)
Market newness	0.196** (0.051)	0.188** (0.051)	0.237** (0.046)	0.233** (0.047)	0.267** (0.049)	0.253** (0.050)
Time trend	-0.276** (0.022)	-0.256** (0.022)	-0.262** (0.024)	-0.258** (0.024)	-0.259** (0.025)	-0.249** (0.024)
Count of firms entered per market	0.192** (0.010)	0.185** (0.010)	0.162** (0.010)	0.164** (0.010)	0.128** (0.012)	0.142** (0.011)
Constant	546.417** (43.928)	506.666** (43.307)	518.800** (46.907)	511.273** (46.952)	513.006** (49.095)	492.698** (47.096)
Observations	106212	106212	106212	106212	106212	106212
Log pseudolikelihood	-4781	-4152	-3752	-3729	-4184	-3890
Wald statistics	794**	1546**	1080**	1384**	755**	1257**
Pseudo R-squared	0.46	0.53	0.57	0.58	0.52	0.56

+ significant at 10%; * significant at 5%; ** significant at 1%

TABLE 4

Stage 2 - Estimating exit hazard as a function of relatedness (STCOX)

(Robust standard errors in parentheses)

	(4-1)	(4-2)	(4-3)	(4-4)	(4-5)	(4-6)
Synergy		-2.195** (0.618)	-2.942** (0.726)	0.547 (1.094)	-3.449** (0.707)	0.729 (1.081)
Retrenchment scope		0.645** (0.218)	1.087** (0.206)	-0.802 (0.539)	0.872** (0.207)	-1.075+ (0.555)
Selection bias correcting factor						
Inverse Mills ratio	0.585** (0.090)	0.559** (0.094)	0.562** (0.115)	0.462** (0.168)		
Firm-market-level control variable						
Entry mode: 1 if acquisition, 0 if internal development	0.736** (0.107)	0.722** (0.108)	Subsample: Internal development	Subsample: Acquisition	Subsample: Internal development	Subsample: Acquisition
Firm-level control variables						
Size of product portfolio	-0.152* (0.063)	-0.189** (0.066)	-0.138+ (0.075)	-0.308* (0.150)	-0.321** (0.070)	-0.496** (0.126)
Net sales	0.157** (0.029)	0.155** (0.030)	0.174** (0.036)	0.208+ (0.109)	0.205** (0.035)	0.275** (0.105)
R&D intensity	0.116 (0.114)	0.060 (0.113)	0.165 (0.143)	-0.452 (0.290)	0.136 (0.148)	-0.410 (0.277)
Profitability	0.015 (0.983)	0.140 (0.983)	-0.796 (1.324)	3.092 (1.991)	-2.006 (1.335)	2.589 (1.934)
Q	-0.020 (0.017)	-0.019 (0.016)	-0.049+ (0.027)	-0.020 (0.047)	-0.046+ (0.026)	-0.023 (0.047)
Market-level control variables						
Count of firms exited per market	0.037 (0.036)	0.031 (0.037)	0.002 (0.044)	0.239+ (0.131)	0.003 (0.044)	0.214 (0.134)
Market density	0.203** (0.050)	0.176** (0.050)	0.135* (0.059)	0.266* (0.108)	0.097+ (0.059)	0.262* (0.105)
Market newness	0.127 (0.157)	0.142 (0.155)	0.401* (0.175)	-0.434 (0.373)	0.284+ (0.171)	-0.550 (0.378)
Time trend	-0.125** (0.027)	-0.122** (0.027)	-0.107** (0.032)	-0.133** (0.051)	0.0004 (0.023)	-0.037 (0.034)
Observations	9141	9141	7272	1869	7272	1869
Number of entry events	1662	1662	1268	394	1268	394
Number of exit events	494	494	359	135	359	135
Log pseudo likelihood	-3258	-3252	-2262	-691	-2271	-694
Wald statistics	176.47**	184.40**	133.34**	100.85**	108.66**	93.22**

+ significant at 10%; * significant at 5%; ** significant at 1%

TABLE 5

Robustness checks

Stage 2 - Estimating exit hazard as a function of relatedness (STCOX)

(Robust standard errors in parentheses)

	(5-1)	(5-2)	(5-3)	(5-4)	(5-5)	(5-6)
Synergy	-1.289* (0.628)			-2.337** (0.722)	-3.126** (0.688)	-2.832** (0.862)
Retrenchment scope – proximity to product portfolio, excluding the most related product		0.541** (0.167)				
Retrenchment scope, alternate measure – count of related products			0.084** (0.017)	0.106** (0.018)	0.078** (0.016)	0.154** (0.039)
Entry mode: Internal development subsample only						
Selection bias correcting factor						
Inverse Mills ratio	0.464** (0.112)	0.664** (0.113)	0.936** (0.128)	0.816** (0.130)		0.733** (0.123)
Firm-level control variables						
Size of product portfolio	-0.084 (0.073)	-0.101 (0.074)	-0.086 (0.075)	-0.127+ (0.076)	-0.386** (0.072)	-0.036 (0.075)
Net sales	0.188** (0.035)	0.169** (0.034)	0.131** (0.036)	0.139** (0.037)	0.199** (0.035)	0.156** (0.036)
R&D intensity	0.256+ (0.147)	0.242+ (0.139)	0.130 (0.143)	0.095 (0.145)	0.120 (0.148)	0.133 (0.156)
Profitability	-0.902 (1.315)	-0.907 (1.314)	-0.257 (1.285)	-0.157 (1.298)	-1.933 (1.332)	-0.455 (1.290)
Q	-0.052* (0.027)	-0.054+ (0.028)	-0.048+ (0.027)	-0.044+ (0.026)	-0.044+ (0.026)	-0.048+ (0.026)
Market-level control variables						
Count of firms exited per market	0.004 (0.042)	0.009 (0.043)	-0.013 (0.052)	-0.012 (0.052)	0.010 (0.043)	-0.016 (0.051)
Market density	0.159** (0.059)	0.160** (0.057)	0.095 (0.063)	0.054 (0.066)	0.029 (0.066)	0.155** (0.059)
Market newness	0.381* (0.174)	0.423* (0.174)	0.492** (0.176)	0.457* (0.178)	0.277 (0.172)	0.468** (0.176)
Time trend	-0.081* (0.032)	-0.127** (0.032)	-0.183** (0.033)	-0.161** (0.034)	-0.007 (0.023)	-0.132** (0.032)
Observations	7272	7272	7272	7272	7272	7272
Number of entry events	1268	1268	1268	1268	1268	1268
Number of exit events	359	359	359	359	359	359
Log pseudo likelihood	-2271	-2270	-2257	-2251	-2269	-2259
Wald statistics	118.02**	126.89**	132.64**	145.00**	122.27**	128.20**

+ significant at 10%; * significant at 5%; ** significant at 1%