Relatedness and Market Exit

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Keywords: Relatedness, Entry, Exit, Sunk cost, Real option, Resource redeployment

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 conventional 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 immense 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; Mahoney and Pandian, 1992; 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, because their cost of redeploying resources from failed entry to alternative uses within the firm is lower, and the likelihood of successful redeployment is higher. 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 cost of redeploying resources within the firm makes maintaining the abandonment option less valuable but the switching option more valuable. Together, these effects imply that higher relatedness should increase the rate of exit.

Our theory offers a perspective on the role of relatedness that extends real-options-based logic on switching flexibility (Anand, Oriani and Vassolo, 2007; Kogut and Kulatilaka, 1994; Oriani, 2007) and research on resource redeployment (Anand and Singh, 1997; Capron, Mitchell, and Swaminathan, 2001), and is distinct from, yet complementary to, the conventional view of promoting competitive advantage through contemporaneous sharing of resources. Our central hypothesis is that related entries are more likely to be abandoned because they involve lower sunk costs due to a more valuable option to switch resources to alternative uses within the firm. Our emphasis is consistent with the call by Helfat and Eisenhardt (2004: 1217) to move beyond static considerations of "contemporaneous sharing" and better attend to the benefits a firm can derive from "redeployment of firm resources between businesses over time". Our theoretical and empirical models give consideration to how relatedness affects the sharing of resources as well as their redeployment over time. The models also provide an approach for diagnosing the divergent effects of these two influences on exit. In a sample of over 1,200 entries in the U.S. telecommunications sector, we find strong support for our hypothesis that relatedness increases exit because of lower sunk costs of switching, while also confirming that relatedness reduces exit because of contemporaneous resource sharing.

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 abandonment option and the potential for 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]

[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

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 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 business 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. All entry decisions involve some degree of 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.

[INSERT FIGURE 1 ABOUT HERE]

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

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.

referred in the literature).[2] The combination of sunk costs and uncertainty explains why a business is not immediately abandoned when 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, Relatedness, and the Multi-Business Firm

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

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

[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.

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 firms will have lower entry costs in related domains, and therefore be more likely to enter; and it suggests that related diversifiers should benefit more from economies of scope, and therefore be more profitable.

The context of the multi-business firm also invites further consideration into the role of sunk costs in exit decisions. Multi-business firms may be different from the generic firm described in the previous section, which merely evaluated whether to abandon or not, given the level of sunk costs (k) required to re-enter later. Multi-business firms have an additional option to exit by switching resources to another business at some cost, s, and if prospects later improve in the market, can redeploy them back to the original business (at some cost, s').[5] One example of this type of redeployment involves 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 other businesses.[6] Whether it chooses to abandon a business entirely, or retrench (switch) resources to other businesses depends on the relationship between k and s. Relatedness alters this relationship by lowering s, making exit through retrenchment more likely.[7]

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[5] While resource-based theory traditionally argues that relatedness lowers switching costs, it is important to emphasize that the view is typically concerned with the marginal cost of employing resources at a single time to allow contemporaneous sharing. Consistent with Helfat and Eisenhardt (2004), we emphasize that relatedness also lowers the marginal cost of redeploying resources multiple periods for as long as the resource exists. Helfat and Eisenhardt (2004) emphasize entry and re-entry costs, but 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.

[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-)

Switching costs are higher for unrelated diversifiers, whose resources are less likely to be candidates for retrenchment to other business units. In fact, as relatedness decreases, the switching option will become less pertinent and the exit decision will hinge on the sunk costs of re-entry. This suggests that less related entrants will have lower performance thresholds – they will accept lower levels of performance before exiting, because the sunk costs of re-entry are higher. Alternatively, more related entrants require higher levels of performance to persist, because the sunk costs of switching and re-entering are low. This implies that related diversifiers will be more likely to exit for the same level of performance.

In summary, several interesting insights fall out of our model for multi-business 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. In contrast to the conventional view, 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 higher-valued switching option. Maintaining the related business is less valuable 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 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 more negative returns required to reach the

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.

As mentioned previously, a number of empirical studies have found a relationship between exit and sunk costs. There is, however, surprisingly little evidence around the relationship between market exit and business relatedness. 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 exit and relatedness. 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.[8] 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 surprising given the conventional 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 effect of relatedness on market exit.

[8] 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.

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

There are at least two reasons why prior studies have found little connection between relatedness and exit. It may be that the conventional resource-based theory and our alternative theory yield opposite predictions. Under the conventional 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 option to switch. The mechanisms corresponding to the theories may, on average, cancel out, leading to the absence of any net effect. In the section immediately below, we develop hypotheses that distinguish the two theories' empirical predictions on the relationship between "relatedness" and exit.

A second potential explanation is that prior studies diagnose how relatedness affects exit without adequate consideration that exit is endogenous to entry (i.e., samples are subject to selection bias). By modeling exit with only entered firms, one may draw erroneous conclusions about the determinants of exit. The magnitude of the endogeneity problem differs for each predictor variable, depending on whether the variable is related to the selection function, in this case, entry. Relatedness should suffer from self-selection because both theories predict that greater relatedness should lead to higher rates of market entry. RBV implies relatedness should increase the likelihood of entry because, other things equal, it decreases entry costs and increases expected profitability. Our alternative 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 how relatedness affects entry, albeit based on different mechanisms. In our description of our empirical model, we describe how we control for endogeneity.

Identifying Alternative Predictions of Theories

Our approach to these challenges is as follows (leaving details for the next section on research methods). Our telecommunications sector 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:

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

E(P_{ji}) is the expected profit from firm *j*'s entry into market *i*, and is tied to economies of scope through contemporaneously sharing resources between businesses. L_{ji} is the exit threshold for firm *j* in market *i*, and is tied to the values of the abandonment and switching options, which are a function of the sunk costs required to re-enter over time. 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 exit threshold; β_1 and β_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 exit threshold. Using a discrete choice model, it is possible to test the propositions that $\beta_1 - \beta_2 > 0$ or $\beta_2 - \beta_1 > 0$. However, it is not possible to refute the underlying hypothesis that $\beta_1 > 0$ (relatedness raises expected profits) and $\beta_2 > 0$ (relatedness raises exit threshold). 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 exit threshold were valid.

One way to disentangle the effect of relatedness is to derive separate measures of relatedness for E(P) and L.[9] 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 (e.g., Teece, et al., 1994). We will call this type of relatedness *synergy*, because it approximates the potential synergy, or contemporaneous sharing of resources between two businesses. As we have argued, relatedness might raise the exit threshold, L, if it increases a firm's ability to redeploy its resources back to other businesses of the firm over time. 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 exit 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.

[9] 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 exit threshold 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.

The second hypothesis is the main test of our real-options-based theory focusing on sunk costs, whereas the first hypothesis is consistent with the conventional emphasis of contemporaneous sharing in resource-based theory. We do not mean to suggest that the theory we propose is not already resident in resource-based theory. However, existing theoretical and empirical treatments do not fully capture the dynamic advantages of relatedness, including their full implications for exit.

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.

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 often 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 U.S. telecommunications sector between 1989 and 2003. The data source is the CorpTech Directory's 'Who Makes What' directory, covering 10,500 private firms and 631 public firms in seventeen technology industries in the United States.[10] This directory, published annually starting in 1986, provides detail on firms' product and service offerings, including a relatively fine-grained classification system 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 have 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

[10] 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.

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 codes. In one industry relevant to our sample, the SIC code 7372, "Prepackaged Software," alone corresponds to 324 CorpTech codes. Second, the CorpTech data include both private and public firms, which enable us to develop a comprehensive pair-wise "similarity" index (described below) that is the basis for our measurement of relatedness. In contrast, Compustat includes only public firms, which represent a small proportion of all active business entities. Finally, the CorpTech classification system is frequently updated, reflecting the rapid pace 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 sampled our risk set based on the following criteria: a firm has at least nine consecutive years of listing in the CorpTech directory under the telecommunications and the internet industry with at least one product. The requirement of a nine-year minimum consecutive listing allows us to comprehensively construct a firm's event history of market entry and exit for an extended period of time. The sample is then restricted to public firms that can be matched with Compustat to generate a comprehensive set of control variables such as research and development expenditures, net sales, profitability, etc. In our risk set for entry, 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 starts with the 1,719 entries. They remain at risk until they exit product markets or until the end of the observation period in 2003. The sample was reduced to 1,662 because 57 were exited through change of ownership, where resources could not be redeployed back to the selling firm. In addition, 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.[11] These remaining entries were involved in 9,141 firm-market-year observations, including 494 exit events.

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 2003. The estimated hazard of exit is the probability of firm *n* exiting 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

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

(based on the number of common digits in SIC codes), is that it does not assume a fixed degree of relatedness for each pattern of overlapping SICs.[12] The ability to distinguish between degrees of relatedness is central for understanding whether firms can redeploy resources across markets, particularly over time. 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.

[12] Our findings are robust when we use traditional measures of relatedness by assuming that, the more a pair of product codes overlaps, the more related the products are in the CorpTech classification system. This approach is consistent with prior research that follows Caves (1981) whereby the number of common digits between a pair of SIC codes is used to infer relatedness. 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. In comparison, Lemelin (1982) measured inter-industry relatedness as the correlation coefficient across input structures taken from the input-output tables.

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. Potentially, the ability to retrench is only possible beyond a certain level of relatedness. Our alternate measure is the count of products in firm *n*'s portfolio, where the similarity index with respect to *x* is greater than zero. For robustness check, we test the sensitivity of our results to the threshold level we set in defining the alternate measure, above which we consider a product to be related.

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" if the entry mode was through internal development.[13] 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

[13] 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.

firm's primary business domain. This variable controls for the extent that there may be discontinuities associated with business activities dictated as "non-primary."

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 among the risk set 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.[14] 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

$$y_{kmt} = b_1 s_{t-1} + b_2 r_{t-1} + b_3 x_{t-1}, \qquad \text{(Eqn. 5)}$$

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 ($\lambda(t)$) is defined as

$$\lambda(t) = \lim\left[q(t, t+\Delta t/\Delta t), \Delta t\right] \longrightarrow 0, \qquad \text{(Eqn. 6)}$$

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

$$\log \lambda(t) = a(t) + b_1 s + b_2 r + b_3 x + b_4 m \qquad \text{(Eqn. 7)}$$

[14] The impact of selection biases on coefficients is most pronounced when key independent variables influence the selection criteria. Firms with low relatedness (high sunk costs) have lower expected profitability on average, thus high entry threshold. If firms with low relatedness choose not to enter, their lengths of stay in the market is not observed. Not observing samples with retrenchment scope below entry threshold leads to biased estimates. At its extreme, this bias may lead to the conclusion that retrenchment scope has no effect on exit, when in fact it does. Even if retrenchment scope 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 *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

Bivariate Analysis

Table 1 presents the means of our variables across the samples used in our analysis. The bottom of the table also reports the means of synergy and retrenchment scope across products that were exited versus not exited. The bivariate analysis reveals that synergy is higher for firms choosing not to exit compared to those exiting. This result is consistent with Hypothesis 1, and expectations from RBV. The analysis also reveals that retrenchment scope is lower for firms exiting compared to those not exiting. This result is inconsistent with Hypothesis 2, derived from our alternative theory. Of course, it does not control for effects that may systematically influence the effect of this variable, such as the fact that businesses with larger retrenchment scope are more likely to enter. Finally, we can also begin to draw inferences about the relative impact of retrenchment scope on exit across different entry modes. The impact seems to be larger when entries occur through internal development. In the next section, we report results from multivariate analysis that controls for sample selection.

[INSERT TABLE 1 ABOUT HERE]

Table 2 presents pair-wise correlations. Our main and alternate 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.

[INSERT TABLE 2 ABOUT HERE]

Multivariate Analysis

Table 3 shows the regression results from the first-stage model. The entry probability increases when a market is inside a firm's primary business domain, when a firm is more profitable, when a firm has previously entered more markets, when markets are more dense with other firms, when a market is newer, and is inversely related to the number of market exits. As expected, synergy and retrenchment scope have a separate and positive effect on entry, consistent with the expectations from RBV and our alternative theory. Moreover, the findings for retrenchment scope are robust to different operationalizations.

[INSERT TABLE 3 ABOUT HERE]

Table 4 shows the regression results from the second-stage model on exit. Model 4-1 shows the control variables, including the inverse Mills ratio generated from the entry equation which suggests that selection effects are significant. There are effects of control variables on exit that are also noteworthy. Exit is more likely if firms have more net sales, smaller product portfolios, and when markets have a higher density of firms.

[INSERT TABLE 4 ABOUT HERE]

Synergy and retrenchment scope are added in Model 4-2. Likelihood ratio tests confirm that the addition of both significantly contribute to model fit. Both are significant in the directions predicted in Hypotheses 1 and 2. Exit is negatively related to synergy and positively related to retrenchment scope.

Hypothesis 3 predicts that the effect of retrenchment scope on exit will hold for the sample of internal development entries, but not for the sample of acquisition entries. Models 4-3 and 4-4 test for differences across the mode of entry. These models reveal that 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. Thus, consistent with Hypothesis 3, the estimated effect for retrenchment scope is smaller for entries made via acquisition than internal development. 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.

[INSERT FIGURE 2 ABOUT HERE]

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 operationalization 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 above which we consider a product to be related. 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.

[INSERT TABLE 5 ABOUT HERE]

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 exiting new businesses. Empirically, we compare this perspective with the conventional 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 rates of exit. 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. Thus, we obtain results for both entry and exit that are consistent with both theories, but divergent in important ways. We believe this paper inspires and demonstrates new insight into the way relatedness influences exit.

Our central theoretical result, that relatedness increases the likelihood of exit because it enables a firm to more flexibly retrench, is derived from real options theory. Prior applications of real options have illuminated the importance of how re-entry sunk costs influence the exit decision, but have not yet been applied to the multi-business firm. Such a context opens up consideration that there is dynamic value associated with the potential to switch resources between businesses over time. While such flexibility may be inherent in resource-based theory, existing treatments focus on contemporaneous sharing of resources. Our extension of resource-based theory makes explicit this dynamic flexibility (c.f., Galunic and Eisenhardt, 1996, 2001).

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 contemporaneous 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.

Our work also emphasizes the importance of controlling for sample selection bias when testing for how relatedness affects exit. This issue is of both theoretical and empirical importance. Theory that does not consider selection biases may produce expectations that are not representative of true effects. Our implementation of a Heckman model to control for entry is one way to capture the true effects of relatedness on exit. It requires a more significant burden on researchers to observe entry events and track them over time. The consequences seem to be quite important, however, as our models with and without the selection coefficient are substantially different. This selection bias is particularly important for estimating the effect of relatedness on exit because relatedness is a key variable that influences the selection criteria.

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 dynamic processes of resource reconfiguration. There are two prevailing views in this literature. Drawing from the concept of scale economies, the resource reconfiguration view argues 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 this view, divestiture is part of a consolidation process that helps firms gain scale economies and improve performance when they acquire overlapping assets, leading to an intensification of focus (Anand and Singh, 1997). 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). The resource reconfiguration view parallels our study in terms of the dynamics of business entry and exit by diversified firms. Nevertheless, it focuses almost exclusively on acquisitions. In comparison, 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.

The managerial implication of our study is that, in a context where relatedness reduces the sunk costs required to enter the new market, opportunities for redeploying resources upon exit should be a factor of consideration in making entry and exit decisions. Through the lens we develop, managers could view market entry as a form of experimentation by the firm in an uncertain environment. The potential for resource redeployment helps determine the firm's optimal policy with respect to such experimentation. Greater potential for resource redeployment reduces the sunk costs of entry and should induce firms to be less conservative in their entry decisions, thereby leading them to experiment more and take greater risks. While the existing managerial literature on diversification has been mainly informed by the RBV on the link between synergy and performance, our theory suggests that sunk costs and resource redeployment are important factors in informing entry and exit decisions under uncertainty.

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:

$$S_{ix} = \frac{P_i \bullet P_x}{|P_i||P_x|} = \frac{\sum_{m=1}^{M} P_{im} P_{xm}}{\sqrt{\sum_{m=1}^{M} P_{im}^2} \sqrt{\sum_{m=1}^{M} P_{xm}^2}} \qquad \text{(Eqn. A1)}$$

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

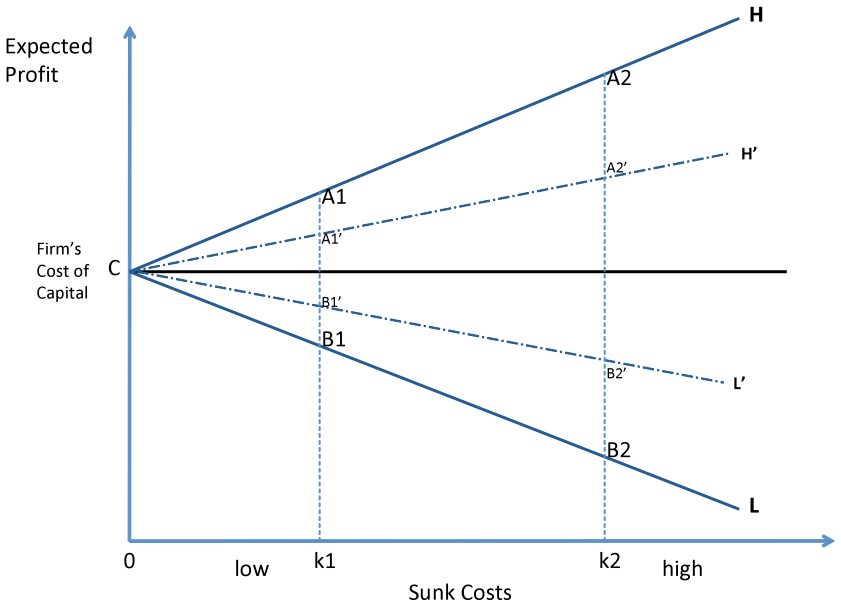

FIGURE 2

Estimated hazard rate of exit as a function of relatedness

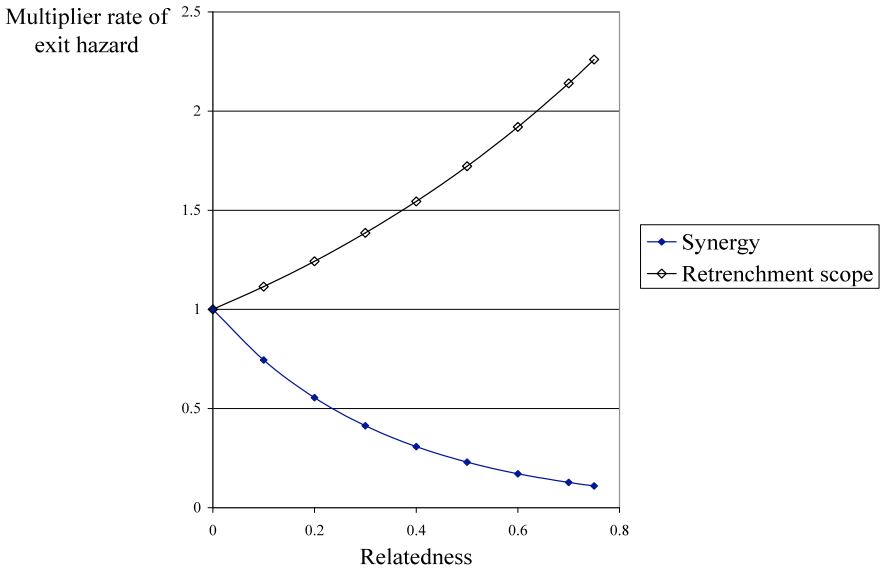

TABLE 1

Descriptive statistics for various samples

Variables	Stage 1 sample considering Entry		Stage 2 sample considering Exit - all entry observations		Stage 2 sample considering Exit – only entry observations through internal development		Stage 2 sample considering Exit – only entry observations through acquisition	
	(1)		(2)		(3)		(4)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Synergy	0.05	0.07	0.11	0.11	0.11	0.11	0.12	0.11
Retrenchment scope	0.05	0.18	0.19	0.35	0.17	0.33	0.27	0.38
Retrenchment scope, alternate measure	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 by Acquisition			0.20	0.40				
Inside/outside primary business domain[a]	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 ($000)	4996	19739	8588	20208	7374	20154	13315	19723
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[a]	10.48	13.19						
Count of firms entered per market[a]	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
Observations	106212		9141		7272		1869	
Number of Entries	9141		9141		7272		1869	
Number of Exits	0		494		359		135	
Synergy: exit			0.084		0.082		0.086	
Synergy: no exit			0.119		0.116		0.127	
Retrenchment: exit			0.143		0.149		0.125	
Retrenchment: no exit			0.238		0.211		0.333	
Retrenchment alternate: exit			2.95		2.98		2.83	
Retrenchment alternate: no exit			4.49		4.07		5.96	

[a] These variables affect only entry decision, but not firm *n*'s exit rate in market *x*. Used to distinguish the covariates used in stage 1 vs. 2.

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)	(16)
(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	1

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**	-2.942**	0.547	-3.449**	0.729
		(0.618)	(0.726)	(1.094)	(0.707)	(1.081)
Retrenchment scope		0.645**	1.087**	-0.802	0.872**	-1.075+
		(0.218)	(0.206)	(0.539)	(0.207)	(0.555)
Selection bias correcting factor						
Inverse Mills ratio	0.585**	0.559**	0.562**	0.462**		
	(0.090)	(0.094)	(0.115)	(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*	-0.189**	-0.138+	-0.308*	-0.321**	-0.496**
	(0.063)	(0.066)	(0.075)	(0.150)	(0.070)	(0.126)
Net sales	0.157**	0.155**	0.174**	0.208+	0.205**	0.275**
	(0.029)	(0.030)	(0.036)	(0.109)	(0.035)	(0.105)
R&D intensity	0.116	0.060	0.165	-0.452	0.136	-0.410
	(0.114)	(0.113)	(0.143)	(0.290)	(0.148)	(0.277)
Profitability	0.015	0.140	-0.796	3.092	-2.006	2.589
	(0.983)	(0.983)	(1.324)	(1.991)	(1.335)	(1.934)
Q	-0.020	-0.019	-0.049+	-0.020	-0.046+	-0.023
	(0.017)	(0.016)	(0.027)	(0.047)	(0.026)	(0.047)
Market-level control variables						
Count of firms exited per market	0.037	0.031	0.002	0.239+	0.003	0.214
	(0.036)	(0.037)	(0.044)	(0.131)	(0.044)	(0.134)
Market density	0.203**	0.176**	0.135*	0.266*	0.097+	0.262*
	(0.050)	(0.050)	(0.059)	(0.108)	(0.059)	(0.105)
Market newness	0.127	0.142	0.401*	-0.434	0.284+	-0.550
	(0.157)	(0.155)	(0.175)	(0.373)	(0.171)	(0.378)
Time trend	-0.125**	-0.122**	-0.107**	-0.133**	0.0004	-0.037
	(0.027)	(0.027)	(0.032)	(0.051)	(0.023)	(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%