WHEN IS MORE BETTER?
THE IMPACT OF BUSINESS SCALE AND SCOPE ON LONG-TERM
BUSINESS SURVIVAL, WHILE CONTROLLING FOR PROFITABILITY

Janet Bercovitz
The Fuqua School of Business, Duke University
Box 91020, Durham, NC 27708-0120
Phone: 919.660.7993
Fax: 919.681.6244
Email: janetb@duke.edu

Will Mitchell
The Fuqua School of Business, Duke University
Box 91020, Durham, NC 27708-0120
Phone: 919.660.7994
Fax: 919.681.6244
Email: Will.Mitchell@duke.edu

October 17, 2002
WHEN IS MORE BETTER?
THE IMPACT OF BUSINESS SCALE AND SCOPE ON LONG-TERM BUSINESS SURVIVAL, WHILE CONTROLLING FOR PROFITABILITY

Abstract

Empirical research shows that larger businesses tend to survive longer than smaller companies. Little research, though, shows whether size confers survival advantages independent of profitability. Moreover, no prior research attempts to disentangle the benefits of scale from those of greater business scope. Thus, we lack a conceptual understanding of the underlying benefits of business size for long-term survival. We develop arguments that demonstrate independent survival benefits of both business scale and business scope, where we conceptualize scale in terms of annual sales revenue and scope in terms of product line breadth within a related business context. First, we argue that greater business scale and business scope both enhance long-term survival, independent of profitability, owing to greater availability of financial resources, organizational routines, and external ties. Second, we argue that the benefits of scale are greatest for multi-product businesses, stemming from positive interactive effects of breadth and depth. We find support for these hypotheses with data from 618 firms that operated in the U.S. medical sector between 1978 and 1995.
WHEN IS MORE BETTER?
THE IMPACT OF BUSINESS SCALE AND SCOPE ON LONG-TERM BUSINESS SURVIVAL, WHILE CONTROLLING FOR PROFITABILITY

Two decades of research in organizational ecology and related theories shows that larger firms and businesses tend to survive longer than smaller companies (Aldrich and Auster, 1986; Mitchell, 1994). Little research, though, has dug down to figure out how greater size might confer survival advantages. One concern is that size, which is often measured as sales levels, might simply be picking up an effect of profitability, which tends to correlate with sales but which few survival studies control (Silverman, Nickerson, and Freeman, 1997; Barnett and Freeman, 1987). If so, it is possible that the survival benefits of size per se might be greatly overstated. A second concern is the failure to disaggregate the independent scale and scope effects underlying the size-survival relationship. Greater size might simply mask survival benefits of greater related business scope, which also tends to correlate with size (Karim and Mitchell, 2000). The lack of separation of business scale and scope raises intriguing questions, because some theories attribute a greater chance of survival to greater scope (e.g., Dowell, 2000), while others predict that greater scope may detract from performance and lead to failure. A third concern is that the scale benefits might be contingent on business scope, such that businesses with different scope might realize differential survival benefits from greater scale. Together, these issues raise a fundamental conceptual question concerning the long-term business size-survival relationship: what underlying contributions of business scale and scope might confer competitive advantages or, conversely, create disadvantages?

This paper takes a multi-disciplinary approach to investigate the impact of profitability, scale, and scope on long-term business survival. We combine insights from traditional economics, organizational ecology (Hannan and Freeman, 1989), evolutionary economics (Nelson and Winter, 1982), and the resource-based view of strategy (Penrose, 1959). We argue that three related attributes of scale and scope together create long-term survival advantages for larger businesses, even controlling for profitability. The attributes are financial resources, organizational routines, and external ties. We predict that greater scale and scope provide financial resources, routines, and ties that contribute to longer survival. We also predict that the three attributes together create a moderating effect, in which the benefits of scale apply primarily
to multi-product businesses. We test the predictions in the context of publicly traded U.S. medical sector businesses from 1978 to 1995.

THEORY

Four underlying concepts are central parts of our discussion of long-term business survival: businesses, long-term survival, scale in terms of sales revenue, and scope in terms of product lines. In our terms, a business is the commercial activity of a firm within a given industrial sector. A business is equivalent to a firm if a company participates in a single industry. In parallel, a business is a subunit of a multi-industry company. Studying businesses is useful because it allows us to examine both single-business and multi-business commercial activity within industrial sectors, which typically have both types of participants.

In turn, long-term business survival is the length of time following a baseline period before a business shuts down. Long-term business survival is an important phenomenon because it addresses how long a business is able to draw on the resources that are available to it at a point in time. For a single-business firm, shutting down is equivalent to corporate failure. By contrast, multi-business firms may continue to operate as active corporations, even if they shut down a particular business. We consider both types of business dissolutions to be business failure, whether closure of a single-business firm or dissolution of a focal business by an ongoing corporation. By contrast, we do not view the sale of a business to a new owner (whether sale of an entire corporation or divestiture of a focal business) as a business failure.

Long-term survival is a meaningful performance measure for multiple stakeholders in a business. Survival is valuable to shareholders to the extent that dissolution costs create substantial financial losses. In addition, business survival and failure affect other stakeholders, including employees, suppliers, distributors, and communities, who make dedicated investments in a particular business. Thus, it is useful to develop a deeper understanding of what factors make a business more or less likely to survive for extended periods.

The other two concepts are business scale and scope, which we conceptualize in terms of sales revenue and product lines. Business sales are the value of goods that a business provides to its customers in a given period. Sales, which reflect commercial success, provide a common conceptually-appropriate measure of business scale because they reflect current resources with realizable value. Other measures of size include assets, capacity, and employment. These alternative measures are less appropriate conceptually for studies of long-term survival: asset and
capacity size may reflect prior investment in obsolete resources, while greater employment may reflect business inefficiencies. Product lines are the different types of physical goods and non-physical services that a businesses sells to consumers. Product lines provide a common measure of business scope. In essence, the product line scope of a business provides an accurate measure of related diversification, because we are focusing on product line proliferation within a specified industrial sector. Together, scale and scope comprise key dimensions of business size that previous research does not disaggregate.

**Profitability: Benefits of Financial Strength**

We start with the straight forward prediction that firms with greater current profitability will survive longer than less profitable firms. The relationship between profits and survival is fundamental to traditional economics. Simply put, firms will tend to exit a market if the risk-adjusted rate of return falls below costs (Besanko, Dranove, and Shanley, 2000). The strongest argument applies to exit by dissolution, rather than to cases in which a business is sold to new owners, because divestiture may happen for many reasons other then low profitability (Ravenscraft and Scherer, 1987). While organizational theorists tend to adopt a more tempered view of the selection environment, arguing that non-economic ties and other factors may buffer unprofitable firms, they generally concur that lack of profits is a fundamental driver of organization mortality (Levinthal, 1991; Carroll and Harrison, 1994). Organization theory, to the extent that it makes a distinction between types of exits, also views the profitability-survival relationship more in terms of dissolution than divestiture. Thus, the following baseline hypothesis draws from both economic and organizational logic, focusing specifically on avoiding dissolution (i.e., we exclude divestiture from the definition of business failure).

**H1.** The more profitable a firm, the longer a business will survive.

This baseline profitability prediction is intuitive. Nonetheless, few studies of business survival have directly investigated the profitability-mortality link because of the significant challenges of collecting longitudinal profitability data and of distinguishing business dissolutions from divestitures in historical data. Instead, most survival analyses have focused on the impact of size, using various measures of size including sales, assets, capacity, and employment, consistently finding that larger firms and businesses are less likely to exit. These studies include Star and Massel (1981), Small Business Administration (1983), Aldrich and Auster (1986), Evans (1987), Barnett (1990), Delacroix and Swaminathan (1991), Baum and Oliver (1991),
Baum and Mezias (1992), Carroll and Swaminathan (1992), Barron, West, and Hannan (1994), and Mitchell (1994). Although many of these studies pool dissolutions and acquisitions as forms of exit, which creates some ambiguity in interpreting the results, the basic size-survival relationship appears to be robust at both the corporate and business level.

Despite the robust size-survival findings, the underlying causality of the result may be problematic, because profitability tends to correlate with size (Scherer and Ross, 1990; Szymanski, Bharadwaji, and Varadarajan, 1993). Therefore, the size-survival relationship might simply be a proxy for an underlying profitability-survival relationship. The baseline profitability hypothesis provides a first step in segregating specific profitability effects from the size effects that we discuss next.

**Scale: Benefits of Greater Sales**

Even controlling for profitability, we believe that greater business scale will lead to longer business survival. We will focus on three related benefits that greater scale will provide, which include the availability of financial resources, routines, and external ties. First, consider the financial benefits that accrue to scale. At any given level of return, larger businesses will have access to more extensive financial resources. For example, the flow of cash moving through a business with $100M in sales and 10% margin will be much greater than the flow moving through a $10M business with the same 10% margin. Given some flexibility in the allocation of this cash flow, larger businesses will have a greater opportunity to accumulate stocks of firm-specific assets that provide competitive advantage and subsequently reduce the mortality hazard (Barney, 1986; Levinthal, 1991). Specifically, greater day-to-day spending on R&D activities and/or marketing and sales activities in support of business operations can provide the seeds for long-term advantage by building knowledge stocks and brand identity. This sustainability advantage will increase further if asset mass efficiencies operate, that is, if the incremental cost of adding to asset stocks declines as the existing base grows (Dierickx and Cool, 1989).

Second, in addition to financial resources, the routines associated with greater scale augment the survival benefit. With greater sales it is probable that a business will repeatedly employ a central set of operational and managerial routines. Repeated use of particular routines leads to refinements and efficiencies (Nelson and Winter, 1982; Hannan and Freeman, 1984; March 1991). Simply put, greater scale provides greater opportunities for “learning by doing” that can result in productivity gains (Argote, 1996). Simultaneously, the recurring utilization of a
set of routines limits costly knowledge depreciation and thus enhances operational effectiveness (Argote, Beckman, and Epple, 1990). As long as the external environment does not change drastically, the increased efficiency and effectiveness of organizational routines will enhance long-term business survival.

Third, greater scale tends to lead to deeper external ties. Given the costs of establishing new ties, businesses will tend to exploit existing ties more intensely before opting to pursue new external links. To avoid the performance risk and qualification costs associated with bringing a new supplier on-board, for instance, businesses generally prefer to ask proven suppliers to provide greater volumes to meet growing demand. Likewise, augmenting relationships with existing customers can provide a lower-cost source of revenues than starting the sales process from scratch to acquire a new customer. Given the non-proportional relationship between number of ties and sales, the external ties of larger businesses will tend to be deeper than the external ties of smaller businesses. Further, as the magnitude of the exchange increases, the level of interdependence between the business and its external constituents is likely to rise (Pfeffer and Salancik, 1978; Gulati, 1995). External players with vested interest in, and deep ties with, a focal firm have both opportunity and reasons to continue to support the focal business in times of crisis. For example, suppliers might find it in their best interest to extend payment deadlines or provide special volume discounts to assist key customers through rough financial periods. Similarly, key buyers may be willing to invest – through equity acquisition or collaborative ventures – to enhance the technology and thus the survival prospects of important suppliers. For instance, Nortel and Ericsson were able to negotiate favorable terms with their telecommunications customers when they faced financial difficulties in 2001 and 2002. In essence, strong relationships with dependent external players provide buffers that protect larger firms from survival-threatening shocks (Winter, 1987; Minor, Amburgey, and Stearns, 1990; Uzzi 1996).

These three intertwined characteristics of larger business scale – greater financial resources, more efficient routines, and deeper external ties – all have the potential to enhance business survival. As such, we hypothesize that scale will influence long-term survival even controlling for profitability.

**H2.** The greater a business’s sales, the longer it will survive, independent of profitability.
Scope: Benefits of Product Line Breadth

The second element in our argument links business scope to long-term business survival. We define business scope in terms of the firm’s variety of offerings (i.e., product-lines) within a business sector. The same three factors at the root of the scale-survival relationship – financial resources, organizational routines, and external ties – are also at the root of the scope-survival relationship. We argue that greater variety in any of these three factors provides survival benefits.

Consider first the business’s financial resources. Businesses with multiple product lines may benefit from two key portfolio effects: risk reduction and internal capital allocation efficiencies. Risk reductions obtain because when the cash flows of the different product lines correlate imperfectly, product-line breadth effectively reduces the variance, and thus the overall risk, of the business (Lubatkin and Chatterjee, 1994). While not generally a source of immediate shareholder value, such diversification can enhance business longevity by dampening the financial fluctuations that can push a business into insolvency. Internal capital allocation obtains because businesses with multiple product lines have the opportunity to move capital across lines. If the business has more complete knowledge about the merits of internal investment options within their related business activities than do external suppliers of capital, internal capital allocation offers efficiency advantages for the diversified business that, in turn, may contribute to the entity’s long-term survival (Williamson, 1975; Liebeskind, 2000).

Second, multi-product businesses also tend to have more diverse sets of organizational routines than do focused firms. Single product businesses generate a relatively specialized set of operating routines. By contrast, multi-product businesses must generate multiple sets of routines to develop, produce, and sell their goods as well as a set of coordinating routines to manage these activities within the business (Dowell, 2000; Karim and Mitchell 2000; Mukherjee, Mitchell, and Talbot, 2000). Routine variety provides survival advantages by supporting broader search and increasing routine recombination opportunities. When faced with a challenge, the span of problemistic search is determined in large part by the business’s existing organizational routines (Nelson and Winter, 1982; Dosi, 1988: Teece, Pisano, and Shuen, 1997). Those businesses having more diverse routine sets will be better positioned to identify a richer set of potential solutions and better endowed to more astutely evaluate the viability of these alternatives (Winter, 1987; Cohen and Levinthal, 1990). Further, businesses having more expansive routine sets will
also have greater opportunity to leverage and creatively combine existing routines to solve problems and create new opportunities thus enhancing the business’s survival chances (Penrose, 1959; Nelson and Winter, 1982; Fleming, 2001).

Third, the variety of external ties a business possesses will influence its mortality hazard. Similar to variety in internal routines, variety in external ties provides information access benefits as businesses often learn from those they interact with (Von Hipple, 1988). Being able to draw knowledge from a heterogeneous set of external ties allows the business to accumulate superior information for building and focusing internal capabilities to solve problems and/or exploit opportunities (Gulati, 1999; McEvily and Zaheer, 1999).

Thus, variety in financial resources, organizational routines, and/or external ties all have the potential to confer survival benefits in terms of business scope.

**H3.** The broader the business scope, the longer the business will survive, independent of profitability.

Hypothesis 3 might appear to conflict with arguments concerning business scope that arise in several literatures. Business expansion does not come without costs and, beyond some point, the costs may outweigh the benefits of greater breadth. For example, classical economists highlight how pursuing broad scope strategies may degrade performance by reducing a firm’s ability to take advantage of economies of scale (Lancaster, 1990). Similarly, ecological studies note the challenge of bounded rationality that constrains the size of operations and number of routines that firms can manage efficiently (Barnett and Freeman, 1997). The diversification literature, too, has used variables similar to the number of product lines as measures of over-diversification or high governance costs (e.g., Markides, 1992; Hitt, Hoskisson, Johnson and Moesel, 1996; Bergh and Lawless, 1998), arguing that firms with excess levels of diversification will suffer lower performance and will be more likely to spin off business or realize increased value when they spin off businesses. To the extent that that product line expansion represents over-diversification, then, we will not find support for our hypothesis.

For such over-diversification problems to lead to business failure, though, two factors would need to apply: first, firms would need to expand beyond their carrying capacity; second, they would then have to find it difficult to renarrow themselves to viable limits. These issues might well arise if one examines business scope at relatively high levels of aggregation, such as unrelated diversification across different industries. At more refined levels of scope, such as the product line level that we use in this paper, though, firms in developed markets regularly add
new product lines and typically are able to subtract obsolete or conflicting product lines without damaging their survival chances.

Indeed, when one considers increasing business scope within a related business area, we expect to find the benefits of greater scope that we discussed above. Opportunities for internal capital allocation, routine recombination, and ties with external constituents all are likely to arise frequently within a related business sector. Moreover, firms will tend to be better able to realize the opportunities that arise within a business sector than those that might potentially apply in cases of unrelated diversification, because they usually have greater immediate understanding of prospects and means of implementation in related activities than they do across diversified businesses. Consistent with our argument, we measure product lines at a much more refined level than prior studies, which tend to use business segments or four-digit SIC codes as measures of diversification.

At the same time, though, it is partly an empirical issue whether excessive scope creates systematic problems or, instead, whether firms usually can manage their product line scope effectively. In particular, if firms find it difficult to retrench from over-expansion, then scope might have a non-linear relationship with survival, first contributing and then detracting. We test for evidence of non-linearity in our analysis and discuss this issue in the results section.

**Scale and Scope: Moderating Interactions**

Our final hypothesis addresses the way in which business scope influences the scale-survival relationship. We predict a positive scale*scope interaction effect, such that the benefits of scale increase as product line breadth increases. Across each of the three operative components – financial resources, organizational routines, and external ties – we expect an increase in scope to enhance the survival benefits accruing to business scale.

First, consider how variety in financial resources contributes to the scale benefits. As we noted above, larger businesses generate greater cash flows that can be used to accumulate capabilities and enhance business survival. Increases in product line scope amplify the survival-related value of these financial resources by providing opportunities to allocate capital across product lines in a manner that enables the business to address the most pressing problems and build the most promising areas. Thus, businesses with more product lines will realize greater benefits from greater sales.
Second, with respect to organizational routines, scale imparts experience benefits. Specifically, by virtue of repeated use, larger businesses will develop more efficient organizational routines (Nelson and Winter, 1982). The survival benefits of these efficiencies further increases with scope as multi-product firms have greater opportunities to leverage established routines across the activities associated with multiple lines (Penrose, 1959; Prahalad and Hamel, 1990). Again, businesses with more product lines will gain greater benefits of increased sales.

Finally, the existence of deep ties with vested external constituents buffers large businesses from survival-threatening environmental shocks. Product-line breadth can augment this buffering effect in two ways. First, for a core set of suppliers and customers, related diversification (i.e., the offering of multiple product lines) by the focal firm serves to intensify the strength of existing ties by increasing the interactions between the players – as suppliers provide materials for multiple line and buyers purchase products from multiple lines. Second, the number and variety of external ties of the focal firm will also increase with increasing scope. The information gains from this variety can lead to capability refinement that makes the focal firm even more valuable to its external constituents. On both accounts, the incentive for the external players to support the focal firm to insure survival increases. Thus, the following hypothesis:

**H4.** The broader the scope of a business, the more that business scale increases long term business survival, independent of profitability.

In summary, we argue that business scale and scope provide long term business survival benefits, independent of profitability. The survival benefits stem from greater availability of financial resources, organizational routines, and external ties. We also predict that the benefits of scale apply most strongly to multi-product businesses, owing to moderating effects of financial resources, routines, and ties. Table 1 summarizes these theoretical arguments. We note that the three underlying contributors to the scale and scope benefits – money, routines, and ties – reflect both economic and organizational dynamics and that these attributes reinforce each other. Rather than disaggregate into separable effects, they provide an aggregate contribution that leads to longer survival, independent of current profitability.

********** Table 1 about here **********

**DATA AND EMPIRICAL APPROACH**

We test the hypotheses by examining a sample of firms that participated in the U.S. medical sector between 1978 and 1995. The data source that we use is *The Medical and
Healthcare Marketplace Guide (1975, 1978, 1983, 1986, 1989, and each year after until 1995). These guides identify virtually every firm of any appreciable size that was operating in the U.S. medical sector, including U.S.-owned and foreign-owned businesses. The guides provide extensive information regarding the firms’ medical sector product lines. The guides identify 258 product lines from five sub-sectors: medical devices (184 lines), dental devices (5 lines), ophthalmic devices (7 lines), pharmaceutical products (16 lines), and healthcare services (46 lines). These data provide an unusually fine-grained set of information about firms’ profitability, sales, product lines, and survival.

We construct the sample from all public firms operating in 1978 and 1983 and then examine their survival through 1995. We focus on two years of baseline activity to increase the number of firms that we can examine. The sample includes 618 firms, with 145 firms that were operating in 1978 and an additional 473 firms that entered the data set by 1983. Almost all the firms were based in the U.S. We focus on these years for two reasons. First, we choose 1978 as the base year because we were then able to use information from the 1975 guide to calculate control variables for ex ante business activity and industry growth. Second, focusing on these two baseline years provides a more consistent window over which to examine firm actions than if we include a greater number of years. We focus on public firms because profitability information is available in these cases.

Focal Variables

The dependent variable measures how long a firm survived after the baseline year in which the firm entered the data set. We treated firms that remained in the data set in 1995 as right-censored cases, as we will discuss in the methods section. In addition, we also treated firms that were acquired during the study period as right-censored cases because, as we noted earlier, acquisition is a conceptually different outcome from business failure. Within our 618 cases, 212 (34%) continued in 1995, 199 (32%) shut down before 1995, and 207 (33%) were acquired before 1995.

The primary independent variables are profitability, sales, and scope. We defined profitability as the firm’s reported return on total sales (PROFITABILITY) in the baseline year (1978 or 1983). We measured sales in terms of reported medical sector sales revenue in the baseline year (millions of 1982 dollars based on the Producer Price Index), taking the natural log in order to constrain the effect of outliers (LOGSALES_MEDICAL); we set the log(sales)
variable to zero for businesses with less than $1 million in annual sales. We measured scope as the number of medical sector product lines that the business offered in the baseline year (PRODUCT_LINES). The number of lines ranged as high as 56, but almost 60% of the businesses had only one or two lines. There were 223 single-line businesses (36%), 145 two-line businesses (23%), and 250 businesses with three or more lines (41%).

We also interacted the LOGSALES_MEDICAL variable with dummy variables denoting whether the businesses offered one line, two lines, or three or more lines during the baseline year, in order to test hypothesis 4. Thus, we created three interactions: sales of businesses with a single product line (SCALESCOPE_1LINE), sales of businesses with two product lines (SCALESCOPE_2LINES), and sales of businesses with three or more product lines (SCALESCOPE_3LINES+). The interaction variables equal zero for observations that do not equal the relevant number of lines. The effect of these interaction variables in the analyses, as we discuss in the results section, is to adjust (increase or decrease) the main effect of sales for businesses with the specified number of lines. We chose the three-plus product line cut-off based on the empirical distribution of the cases. Table 2 reports descriptive statistics for the independent variables.

********** Table 2 about here **********

Control Variables

We included a range of control variables at the business and sector level. We used two sets of variables at the business level, including age and non-medical sales. We defined a set of corporate age dummy variables, based on firm age in the baseline year: 1 to 3 years (AGE1), 4 years (AGE2), 5 to 8 years (AGE3), 9 to 14 years (AGE4), 15 to 21 years (AGE5), 22 to 29 years (AGE6), 30 to 55 (AGE7), 56 to 81 years (AGE8), 82 or more years (AGE9). We chose the age categories based on empirical distributions; the results were not sensitive to varying the cut-off points. Many studies find that older businesses are less likely to shut down (Mitchell, 1994), although sometimes with an increased risk of failure at extreme age (Barron, West, and Hannon, 1994). For the multi-business corporations in the data set, we measured non-medical sales (LOGSALES_NONMEDICAL) in order to determine whether sales benefits are sector specific, as we expect, or whether there is a more general effect of corporate size.

We defined two variables to measure sector effects. First, we include a variable to control for the effect of competition (COMPETITORS). This variable records the number of companies
that operate in each firm’s product lines. For companies that operate in more than one product line, we average the values across lines. Second, we measure market growth in the product lines that a firm operates by determining the change in the number of firms that participated in a product line in the previous period (PRODUCT LINE GROWTH). For firms that operate in multiple product lines, we take the mean number of competitors in each line.

We also defined a dummy variable that distinguished between the businesses that entered the sample in 1978 and those that entered in 1983 (SAMPLE_1983). This variable helps determine whether there were systematic differences across the subsamples.

Statistical Methods

We tested the hypotheses using accelerated event-time regression (Kalbfleisch and Prentice, 1980; Cox and Oakes, 1984; Mitchell, 1989). The accelerated event-time method assumes that the event-times, which are survival durations in this study, distribute according to a parametric baseline distribution that would hold if all independent variables were zero. The procedure then estimates the effects of covariates as exponentially multiplicative accelerations or decelerations of the baseline distribution. The basic additive logarithmic form of the model takes the form: \( \ln T_i = b X_i + e_i \). In this equation, \( T_i \) is the observed event time of the \( i \)th case, \( X_i \) is a vector of intercept and covariates associated with the \( i \)th case, and \( b \) is a vector of coefficients associated with the independent variables. A positive \( b \) coefficient accelerates the baseline distribution of event times and a negative coefficient decelerates the distribution. The error vector \( e \) takes an assumed parametric distribution with a variance-related scale factor \( s \). A shape parameter also appears in some distributions, as we discuss below.

The accelerated event-time method suits the duration analysis of this study for two reasons. First, the method incorporates the information that some survival times are right-censored, that is, business dissolution did not occur before the end of the study period. Right censoring includes cases for which an event has not occurred by the end of the study period and cases that leave the sample before an event occurs, which in our sample includes businesses that continued in 1995 and businesses that were acquired before 1995. The accelerated event-time method uses the right-censoring information by including the value of a censored duration in the estimation of the survival function, which is the probability that an outcome will occur at some unknown time in the future. A noncensored case, meanwhile, applies to the probability density function, which is the probability that an outcome occurs at the observed time.
The second advantage of the accelerated event-time method is that it takes a flexible set of parametric distributions that can be used to distinguish between constant, monotonically declining or increasing, and nonmonotonically declining hazard rates. The one-parameter exponential distribution can estimate a constant hazard rate. The exponential nests arithmetically within the two-parameter Weibull distribution, which will describe a monotonically declining or increasing rate. The Weibull, in turn, nests within several three-parameter generalized gamma distributions, which will describe both monotonic and nonmonotonic rates. In addition to the gamma families of distributions, the two-parameter log-logistic distribution will take either a monotonic or nonmonotonic form. Together, the logistic and gamma-family distributions describe and estimate many common monotonic and nonmonotonic patterns of organizational outcomes.

We initially employed a gamma distribution for the analyses. The gamma distribution has the useful property that the shape parameter incorporates heterogeneity in a duration model (Greene, 1990). That is, the shape parameter controls for influences on the outcome distributions of different observations that the independent variables in the model do not explicitly measure. In addition, the gamma distribution will collapse to either a monotonic Weibull model or a nonmonotonic lognormal model if such heterogeneity is not present.

The gamma distribution reported by Greene (1990: 319) has a hazard function, \( h(t)_{\text{Gamma}} \), which breaks into the following two multiplicative components

\[
(2) \quad h(t)_{\text{Gamma}} = S(t)^q \times h(t)_{\text{Weibull}}, \quad \text{where}
\]

\[
(2a) \quad S(t)^q = \left[1 + q(Lt)^p\right]^{-1/q}
\]

\[
(2b) \quad h(t)_{\text{Weibull}} = Lt^p(Lt)^{-1}.
\]

Equations (2a) and (2b) introduce three parameters, \( q \), \( L \), and \( p \). The parameter \( q \) represents the shape parameter of the gamma distribution. As \( q \) goes to 0, the limit of \( S(t) \) goes to 1, so that \( h(t)_{\text{Gamma}} \) converges on the Weibull hazard function \( h(t)_{\text{Weibull}} \). The parameter \( L \) is a transformation of the reported intercept and covariate effects from equation (1), with values taken at the data means, such that \( L = \exp(bX) \). The parameter \( p \) represents a transformation of the reported scale parameter \( s \) from equation (1), such that \( p = 1/s \). The tables of results in this paper report the values of \( b, s, \) and \( q \) for the coefficients, scale parameter, and shape parameter.

As we noted above, the generalized gamma collapses to the simpler two-parameter Weibull or lognormal distribution if unspecified covariates do not have significant influences.
The lognormal distribution, which holds when the gamma shape parameter equals 0, will model cases in which there is an underlying nonmonotonic event rate such that events at first occur slowly, then quickly, and then decline again. The Weibull, which holds when the gamma shape parameter equals 1, is appropriate for monotonically decreasing rates. The Weibull in turn collapses to the exponential distribution if event rates are constant, that is, the Weibull scale parameter equals 1. Thus, the gamma distribution encompasses a general set of underlying distributional patterns.

Based on assessment of the models, we found that the gamma analyses would collapse to the more parsimonious Weibull without losing statistical fit. We compared the initial gamma distribution estimates to the nested Weibull and lognormal distributions. We found that the gamma shape parameter was not significantly different from 1, indicating that the Weibull provides an equivalent fit (but differed strikingly from the lognormal); moreover, the Weibull produced an equivalent statistical fit to the gamma. In addition, the coefficients in the gamma and Weibull estimates were materially equivalent. We also tested the Weibull against the constant-rate exponential distribution that nests within it, finding that the Weibull produced a significantly better statistical fit than the exponential (the Weibull scale parameter differed from 1). Therefore, we settled on the Weibull distribution for the analyses that we report here.

Accelerated event-time regression provides a robust technique for estimating influences on the duration before an event takes place, allowing the inclusion of right-censored cases. The generalized gamma distribution and the distributions that nest within it provide a particularly flexible family of accelerated event-time regression models because they estimate monotonic and nonmonotonic underlying event rates as well as testing for the influence of omitted effects.

RESULTS

Table 3 reports the results of the accelerated event-time regressions. We follow a hierarchical estimation procedure adding independent variables one at a time building to the saturated model in column 4a.

Model 1, our baseline model, includes all the business and sector level control variables plus the profitability independent variable. In support of H1, we find that firm profitability leads to long-term business survival. As predicted, more profitable businesses survive longer than less profitable businesses.
The regression equation in Model 2 adds medical sector sales, our measure of business scale (LOGSALES_MEDICAL). As H2 predicts, we find that, even controlling for profitability, greater scale positively and significantly contributes to long-term survival. The change in the log-likelihood $\chi^2$ statistic between Model 1 and Model 2 is also significant. In addition, the finding of independent and significant effects for profitability and sales on long-term survival highlights the necessity of including both variables in the estimation. Indeed, failure to account for profitability greatly inflates the sales-survival link. In our dataset, we calculated sensitivity analyses that omitted the profitability term, finding a 100-fold increase in the magnitude of the coefficient on sales.

H3 predicts that increasing scope will have a positive effect on long-term business survival. Consistent with this hypothesis, the coefficient on the product-line variable introduced in Model 3 is positive and significant (PRODUCT_LINES). With the addition of this scope variable, Model 3 offers a significant improvement over Model 2.

In sum, the results support H1, H2, and H3. We find significant and positive main effects for each of the key independent variables – profitability, scale, and scope. Increases in any one of these three attributes enhance long-term business survival.

Model 4a adds the interaction terms necessary to complete the analysis and to test H4. With the interaction terms, we investigate whether (and how) scope moderates the impact of sales on long-term business survival. First, the regression analysis indicates that the addition of the Scale*Scope interaction terms provides a statistically significant improvement in model explanatory power (SCALESCOPE_1LINE, SCALESCOPE_2LINES). Further, the significant coefficients on the interaction terms support H4. Using the omitted term (SCALESCOPE_3LINES+) as the point of reference, the interaction terms show that as scope narrows – from businesses with three or more product-lines to businesses with two product-lines to single product-line businesses – the beneficial main effect of sales declines. As predicted, we find that for businesses of a particular scale, the positive contribution to long-term survival will be greatest for those firms having broader scope. Model 4b reinforces this conclusion. Model 4b parallels Model 4a, omitting the scale variable rather than the three-line*sales interaction term in order to identify the main effects of the three Scale*Scope interactions. The significant, positive, and increasing coefficients on the interaction terms highlight how increasing product-line breadth augments the long-term survival gains that accrue from greater scale.
The business level control variables also show significance in the full Models (Model 4a and 4b). First, we find a strong relationship between long-term business survival and business age. Our results are indicative of a “liability of adolescence” pattern (Bruderl and Schussler, 1990; Fichman and Levinthal, 1991). As compared to AGE9 businesses (businesses 82 years or older in the baseline year), long-term survival is shorter for businesses that were 14 years or younger in the baseline year (AGE1-AGE4), with AGE2 businesses showing the greatest survival vulnerabilities indicating that the survival threat is greatest for young businesses that have run through their initial capital. Second, we find a negative and weakly significant relationship between the level of non-medical sales and long-term business survival. It appears that increased activity in unrelated sectors may effectively divert management attention (or dilute corporate focus) to a degree that is detrimental to the long-term survival of the medical sector business. Interestingly, competitive intensity associates positively with long-term business survival. One interpretation of this seemingly counter-intuitive result is that competitors flock to munificent sectors – sectors where demand is great enough to support multiple players. Finally, we find a positive relationship with long-term survival for businesses that entered the sample in 1983 as compared to those that entered the sample in 1978.

To confirm the robustness of the scale and scope effects, we conducted two sensitivity analyses. First, we explored the potential non-linearity of scope by adding the squared term – (number of product-lines)^2—to the model. The resultant coefficient on this variable was insignificant and inclusion of this term does not significantly increase model explanatory power. As such, we find no evidence that long-term business survival suffers due to “over-diversification.” We do not interpret these results as discrediting arguments that point to substantial costs of over-expansion. Rather, we infer from this analysis that the firms in our sample rarely expand and maintain lines past their product-line carrying capacity. As Karim and Mitchell (2000) document, medical sector firms do undertake significant product-line reconfiguration – both in the addition and in the deletion of lines. Over-expansion, when it occurs, will not greatly threaten long-terms survival as long as firm can correct such mistakes, with limited risk, by divesting non-core lines (Carroll, 1993). Second, to ensure that using firm rather than business unit profitability measures did not introduce bias, we ran the full model using a dataset that included only firms that have all their sales within the medical sector. Results from this restricted sample did not differ significantly from those that Models 4a-4b report.
In addition, we conducted sensitivity analysis to investigate the effects of employment, an alternative measure of scale, on long-term survival. We argued earlier that employment is not a conceptually appropriate size measure in our context, because it may reflect inefficiencies as well as greater resources. We found only a moderate correlation between number of employees and annual sales revenue in the subset of our sample for which we could obtain employment data (about 85% of the sample). We found no relationship between employment and long-term survival, whether we introduced employment as an additional variable in the full model or whether we substituted employment for the sales measure. This finding is consistent with our belief that sales provide a more valid measure of the key attributes of scale than employment in studies of long-term survival.

**DISCUSSION AND CONCLUSION**

This study makes two unique contributions that extend our understanding of the long-term survival benefits that arise from business size. First, unlike previous studies, our analysis disaggregates profitability, scale, and scope effects. We find individual, positive, effects for all three of these attributes. Thus, we demonstrate that scale and scope confer survival advantages independent of profitability. Second, our analysis explores the interplay between business scale and business scope. As hypothesized, our results show that the long-term survival benefits of business scale are contingent upon business scope with the positive impact of size on survival being greatest for multi-product businesses.

These results are important because they dig down into the underlying causes of a broadly-accepted relationship – the positive impact that greater size has on business survival – and suggest that the reasons stem from a broader conceptual basis than traditional theories provide. We demonstrate that survival does not stem simply from economic profitability. Moreover, we argue, scale and scope provide benefits via a combination of factors that one might think of as primarily “economic” and others that are more “organizational” in nature. The benefits of financial resources align with traditional economic arguments, while the benefits of routines and external ties add organizational components to more economic arguments. Thus, we provide a more integrated theory of business performance than arguments that rely primarily on either economic or organizational premises.

At the same time, the results provide a base for continuing research. We consider our first finding – that scale and scope confer survival advantages independent of profitability – a
call for more detailed investigations into the root factors underlying the scale/scope – survival link. In developing our hypotheses, we leveraged existing theory to identify what we believe to be the three key attributes of scale and scope that create long-term survival advantages. These are financial resources, organizational routines, and external ties. Our current data set does not allow us to directly test the survival contributions of these individual factors. Further research to separate the influence of each of these attributes on business survival would be valuable. Specific questions to consider include: What are the relative contributions of financial resources, organizational routines, and external ties to long-term business survival? With respect to each of these factors, does depth or breath confer more survival value? How does environmental stability or turbulence effect this ordering? By answering questions such as these will we be able to further advance theory and provide actionable recommendations for management.

Our second finding – that scale-survival effects are greatest for multi-line businesses – also provides a springboard for additional theory development and empirical research. In terms of survival, the evidence suggests that a related diversification strategy will trump a pure focus strategy within a business context. Many questions remain regarding the firm-specific factors and expansion modes that support and/or constrain the concomitant growth in business scale and business scope necessary to optimize long-term business survival. In our sample, we found that the majority of businesses were quite focused, with 60% offering only one or two product-lines. Given the direct and indirect benefits of scope, what explains the failure of these firms to add additional product-lines? Can we conclude that these decisions reflect rational choices based on variations in carrying capacity across similarly-sized firms? If so, what factors are at the root of this variation in carrying capacity, organizational structure, capabilities mix, or diversification experience? Or, contrary to arguments that decry the empire-building tendency of management, is this lack of product-line expansion an indication of managerial inertia and/or myopia? If so, how might the adoption of alternative expansion modes – in-house development, strategic alliances, or acquisition – moderate such inertia? Karim and Mitchell (2000) find evidence that acquisition leads to greater product-line reconfiguration, with much of this reconfiguration occurring through the addition of lines. They stop short, however, of connecting acquisition activities to long-term business survival. Based on our findings, we would hypothesize a positive relationship between acquisition activity and survival. This prediction offers an intriguing base
for research, particularly because it flies in the face of popular belief and conceptual arguments that emphasize the negative aspects of acquisitions.

In sum, this study helps enhance our understanding of the link between size and long-term business survival by disaggregating the effects of profitability, scale, and scope. In and of itself, this contribution is substantial. In addition, these findings regarding the intricacies of the size-survival relationship draw attention to the next layer of questions that need to be explored in order to further clarify of this link.
ENDNOTES

1 Silverman, Nickerson, and Freeman (1997) do control for profitability, finding that exit declines with sales while controlling for return on sales, but do not separate dissolutions and acquisitions as exits.

2 The value of scale is likely to be strongest in environments characterized by continuous or incremental innovation as all three factors enhance survival in this context. By contrast, the survival contributions of efficient routines and deep external ties may degrade in business environments punctuated with disruptive or radical innovations. Nonetheless, routines and ties provide value even in such environments because some routine-based operational efficiencies may transfer to the new environment and some external ties may actually prove instrumental in buffering the firm as it adapts to new conditions. The beneficial influence of financial resources will, of course, remain in all environments. In our empirical context, we will examine an environment that primarily involved continuous changes, with a few discrete alterations.

3 Karim and Mitchell (2000) use a related data set to examine a different issue: whether product line overlap at acquirers and targets affected post-acquisition product line retention.

4 Ideally, we would measure business unit profitability for the multi-business corporations in our data set, but business line profitability data do not exist. Corporate profitability is a meaningful measure of profitability even for examining sub-units of a multi-business firm, however, because corporate wide profits provide resources that can be used to maintain any business unit within the company. We include a control variable for non-medical sales levels of the multi-business corporations. In sensitivity analyses that restricted the sample to single-business firms, we found similar results to those that we report in this paper.

5 We tested whether further refining the categorization would improve the analysis, finding no significant difference in the analyses between a three-line category (79 businesses; 13%) and a four-plus category (171 businesses; 28%).

6 Ideally, we would like to measure change in total product line sales in the market, but data do not exist at that level of disaggregation. The growth in the number of firms is a reasonable alternative measure of whether a product area is growing or declining.
REFERENCES


Table 1: Survival Contributions of the Three Key Attributes of Scale and Scope

<table>
<thead>
<tr>
<th></th>
<th>Financial Resources</th>
<th>Organizational Routines</th>
<th>External Ties</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scale</strong></td>
<td>Accumulation of firm-specific assets</td>
<td>Efficiency gains from repeated use (experience effects)</td>
<td>Buffer from external shocks</td>
</tr>
<tr>
<td><strong>Scope</strong></td>
<td>Portfolio benefits:</td>
<td>Diverse routine sets:</td>
<td>Variety of ties provides information access</td>
</tr>
<tr>
<td></td>
<td>1. Risk reduction</td>
<td>1. Broader search</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Capital allocation efficiencies</td>
<td>2. Recombination opportunities</td>
<td></td>
</tr>
<tr>
<td><strong>Scale &amp; Scope</strong></td>
<td>Financial effectiveness</td>
<td>Recombination efficiencies</td>
<td>Buffered and informed</td>
</tr>
</tbody>
</table>