High-Tech Business Survivorship: An Analysis By Organization Type

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ABSTRACT

Previous studies have shown that organizational and environmental factors such as start-up size, number of establishments, start-up year, geographic location, and industry are all significant determinants of a business's survival rate. However, the link between survival rates and the legal structure of businesses has not been established. This analysis of new and existing high-tech businesses between the years of 1998 and 2009 reveals that given the same organizational characteristics and environmental factors, businesses legally structured as sole proprietorships and partnerships had significantly lower survival rates than did businesses structured as corporations or other organization types. Corporations had the lowest mortality rate among all groups. In comparison, partnerships exited at a 50 percent higher rate than did corporations, while sole proprietorships exited at twice the rate of corporations. This paper models hazard rates over the lifetime of a business and shows that businesses tend to have the highest mortality rates in their second and third years of operation, after which exit rates decrease at a logarithmic rate. Sole proprietorships, however, do not follow this trend as their mortality rate was highest in their first year of operation. In addition, impacts on survivorship of high-tech businesses due to start-up size, number of establishments, industry, and location are measured and compared with findings from previous studies.

Keywords: Business Survival; Organization Type; High-Tech

I. INTRODUCTION

Understanding the factors which affect survival rates for businesses is crucially important to entrepreneurs, business owners, lenders, and investors. Previous studies have analyzed how the survivorship of businesses is related to size class, the number of establishments, the industry, and other firm level characteristics. Yet none of these studies have examined how the organization type, or legal structure, of a business affects its survivorship. The existing literature shows that larger start-up firms and firms that operate in multiple locations have better chances of survival. In addition, corporations which have larger start-up sizes and multiple offices tend to outlive sole-proprietorships, which have smaller start-up sizes and operate in only a single location. What remains unclear is whether corporations survive longer due to start-up size or other characteristics. In addition, none of these studies has focused on the high-tech sector, which is renowned for not only harsher competition and lower survival rates but also for its great importance to the overall U.S. economy in terms of jobs, wages, and the products and services it produces.[2]

Using micro-data from the Bureau of Labor Statistics (BLS) for eight Western States of the United States and for the years of 1998 to 2009, this paper addresses gaps in the existing literature by evaluating how organization type affects the survivorship rate of high-tech industry firms. A variant of the Kaplan-Meier (Kaplan & Meier, 1958) nonparametric maximum likelihood estimator for incomplete observations is used to derive the survivorship rate function for high-tech firms. The analysis also uses a semi-parametric proportional hazard model (Cox, 1972) to

[1] Any opinions expressed are those of the authors and do not necessarily reflect views of the Bureau of Labor Statistics
[2] In 2008, 7.0 million jobs were in the U.S. high-tech sector, which paid out 584 billion dollars in wages.

estimate the effect of organization type on firm survival rates while controlling for firm and environmental characteristics. In addition, impacts on survivorship from start-up size, number of establishments, industry, and location are measured and compared with findings from previous studies.

This paper is organized as follows: Section II briefly summarizes previous studies on the effects of various characteristics on business survival rates. Sections III and IV describe the dataset and estimation techniques used for the survival analysis. Sections V and VI explore how hazard rates vary with the age of a firm and across different organizational and environmental characteristics. Finally, section VII investigates how hazard rates differ by organization type while controlling for organizational and environmental covariates. Section VIII summarizes and concludes the results of this study.

II. LITERATURE REVIEW

Previous studies have found, in general, that survival rates over a finite period tend to increase with the age of a firm (Evans, 1987), (Evans, 1987), (Popkin, 2001). Furthermore, a vast pool of literature shows that survival rates are sensitive to a variety of firm and environmental characteristics. Many have found that larger start-up size tends to increase the survival rates of firms (Mahmood, 1991), (Popkin, 2001), (Audretsch & Manmood, 1994), (Audretsch & Mahmood, 1995). However, Agarwal and Audretsch show that this relationship deteriorates for technologically intensive industries (Agarwal & Audretsch, 2001). Popkin also finds that multi-establishment firms had higher survival rates than single-establishment firms. Others also find that the survival rates vary across industries (Shane, 2008), (Audretsch & Mahmood, 1995). In particular, firms in manufacturing industries have relatively higher rates of survival.

Survival rates of business vary from study to study, depending on the cohort and observed years. Some estimate that about half of businesses survive past four to five years (Phillips & Kirchhoff, 1989), (Shane, 2008), (SBA report- Office of Economic Research, 2009). While another study found that that about half of business survive about three years (Knaup, 2005).

III. DESCRIPTION OF DATA

The analysis in this paper uses an extract of BLS Quarterly Census of Employment and Wages (QCEW) longitudinal database from the first quarter of 1990 to the second quarter of 2009 for eight western states in the US. These monthly data are compiled on a quarterly basis for State unemployment insurance tax purposes and are edited and submitted to the Bureau of Labor Statistics. The QCEW program is a Federal-State cooperative venture between the Bureau and the State Workforce Agencies. The program collects information from approximately 98 percent of nonfarm payroll businesses in the United States.

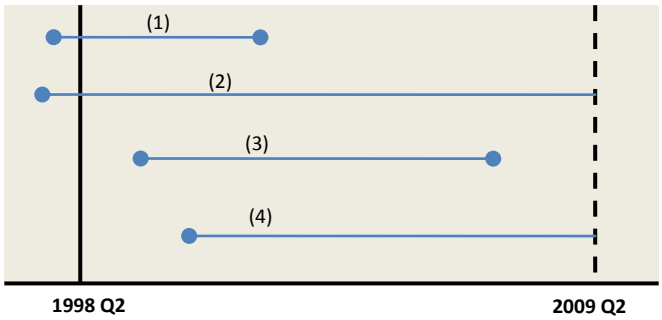
The original data extract contains 4.4 million observations and 77 variables over eight western states between 1990 and 2009. Each observation is an individual business establishment in a certain year and quarter. This extract contains over 169,000 businesses in both private and public sectors. Only private sector firms are used in this paper. Unique identifiers for each business allow us to track each business across time, observing time-varying and time-invarying firm-level characteristics. The dataset includes firm and time specific variables such as entry and exit dates, number of employees, industry, and geographic location. The length of a firm's survival is derived from the initial and end dates of liability and initial and end dates that a particular firm shows up in this database. Firms that were born and died before 1990 are not captured in this database, however firms that started before 1990 but survived until or past 1990 are captured in this database with the length of survival identified.

The analysis provided in this paper uses a subset of the original data extract. Due to the unavailability of organization type data before the second quarter of 1998 and the unavailability of organization type for some observations, about half of the number of firms in the original database remains usable for the analysis. Of these usable observations, new businesses (as of the second quarter of 1998) consist of 38 percent. Moreover, firms that have merger and acquisition activity were dropped from the analysis, accounting for roughly 1.5 percent of all observed firms. Survival rates derived using the Kaplan-Meier estimator take advantage of the full usable dataset, including both existing and new businesses (as of the second quarter of 1998). Proportional hazard models presented

in this paper are restricted to new businesses only.

Observations in this dataset can be categorized into four groups: (1) firms that started before 1998 Q2 and died before 2009 Q2, (2) firms that started before 1998 Q2 and are still surviving in 2009 Q2, (3) firms that started after 1998 Q2 and died before 2009 Q2, and (4) firms that started after 1998 Q2 and are still surviving in 2009 Q2. Type (3) and (4) firms are considered "new" firms. Firms in groups (2) and (4) are "right-censored", while those in (1) and (2) are "left-truncated", although for left-truncated observations, the start-date is observed. 32,074 firms are in the first group, 18,702 in second, 16,483 in third, and 15,233 in the fourth. (see Figure 1). See Appendix A for data details.

Figure 1. Types of observations



IV. METHODOLOGY

Due to incomplete observations, techniques for survival analysis of censored/truncated data are used. The analysis provided in this paper uses a nonparametric maximum likelihood estimator and a semi-parametric proportional hazard model to derive, estimate, and compare survival (or hazard) rates.

Survival function

The cumulative survival function for businesses is derived using a variation of the Kaplan-Meier estimator. The product-limit (PL) estimate, a nonparametric maximum likelihood estimator, is used to estimate the cumulative survival function of high-tech businesses. The cumulative survival function or the probability that a business survives past time *t* is given by:

$$P(t) = \Pr(T > t).$$

The PL estimate, $\hat{P}(t)$ is given by:

$$\hat{P}(t) = \prod_{t_i \le t} \frac{n_i - \delta_i}{n_i},$$

where n_i is the number of firms that are "at risk" at time *t*, and δ_l is the number of deaths at time *t*.
The number "at risk", n_i is defined as:

$$n_i = s_i + \beta_i - \gamma_i,$$

where s_i is the number of firms that survived the previous period. β_i is the number of firms that became available to be considered "at risk", such as in cases (1) and (2). A firm whose birth is before 1998 Q2 becomes "at risk" when *t* is greater than the length from its birthday to 1998 Q2. γ_i is the number of losses or censored cases, such as in cases (2) and (4). This occurs when a firm is censored at 2009 Q2 and *t* is equal to or greater than the age of a firm.

The estimated survival rate, $\hat{S}(t)$, over a finite period, at a given time is simply:

$$\hat{S}(t) = \frac{n_i - \delta_i}{n_i},$$

The mean estimated lifetime, $\hat{u}$, is defined as the mean of the PL estimate of the distribution:

$$\hat{\mu} = \int_0^{\infty} \hat{P}(t)dt$$

$\hat{P}(t)$ is not determined everywhere, but for cases where the probability of an indeterminate result is small, $\hat{P}(t)$ and $\hat{\mu}$ are practically unbiased.

For discrete and equal time-intervals, $\hat{\mu}$, is approximated by:

$$\hat{\mu} \approx \sum_{t=0}^{T} \hat{P}(t),$$

Where *T* is the last period observed.

The variance of $\hat{P}(t)$ is estimated by

$$\widehat{Var}\left[\hat{P}(t)\right] = \hat{P}^2(t) \sum_{t_i \leq t} \frac{\delta_i}{n_i(n_i - \delta_i)}$$

Proportional Hazard Model

To investigate how survival rates of firms vary as a function of organization type, firm characteristics, and environmental conditions, the Cox proportional hazards model is used. This model assumes an unknown (but to be estimated) constant hazard rate. The hazard function is modeled by

$$\lambda(t, \boldsymbol{x}) = \lambda_0(t)e^{\boldsymbol{x\beta}},$$

where $\boldsymbol{\beta}$ is a vector of unknown parameters and λ_0 is an unknown function (having an underlying exponential distribution), giving the hazard function for the standard set of conditions x=0, i.e., a reference point that depends on time. This assumes an underlying exponential distribution.

The hazard function that estimates the effect of organization type while controlling for covariates is given by:

$$\lambda(t, \boldsymbol{o}, \boldsymbol{x}) = \lambda_0(t)e^{\boldsymbol{\theta O + X\beta}}$$

Three models for the hazard function are specified: (1) hazard rate as a function of as organization's legal structure (no covariates), (2) adding organizational characteristics as covariates, (3) adding both organizational characteristics and environmental conditions as covariates. Organizational characteristics include both start-up size and type of establishment. Environmental conditions include geographic area, industry, and birth year.

V. MORTALITY RATES AND AGE OF BUSINESS

According to conventional wisdom and much of the previous literature, businesses face high mortality rates (low survival rates) in their first year and have lower mortality rates as they age. The analysis will now test these beliefs and show how mortality rates change over the lifetime of high-tech businesses. In addition, the results of this analysis will be compared with those from previous studies to better understand the nature of a firm's lifecycle.

Mortality rate decreases with the age of a firm after three years. Using the Kaplan-Meier estimator described in the previous section, the mortality rate that a high-tech business faces generally decreases with the age of a firm. (See Chart 1) Businesses generally face a lower mortality rate in the first year. The estimator also shows that a high-tech business has the highest chance of exiting in its second and third years. After the first three years have passed though, the estimated mortality rate decreases rapidly. In the following years, the mortality rate continues to decline, but at a slower rate. Hazard rates after age three can be effectively estimated by a logarithmic function. After applying a logarithmic transformation to the survival time, the yearly hazard rate function is estimated by ordinary least squares:

$for\ t > 3,$

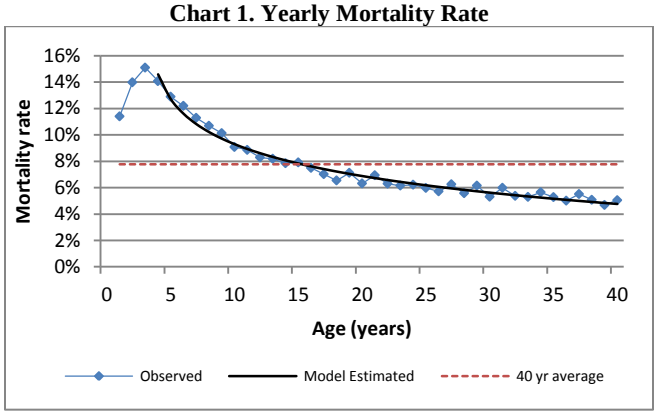
$$mortality\ rate_t = .146 - .027\ ln(t-3)$$

where *t* is the age of the firm in years.

The above parameter estimate for the model is statistically significant, indicating that a constant mortality rate would not sufficiently capture the nature of the mortality rate function. Furthermore, the R-squared coefficient is .98. This indicates that the estimated function is an excellent model for mortality rates of high-tech businesses. The R-squared coefficient means that 98 percent of the variation in the observed mortality rates (as derived using the Kaplan-Meier estimator) is explained by the model and only 2 percent cannot be explained.

The results of the model are similar to those found by Evans and Popkin, who also found that mortality rates generally decrease with the age of a firm. One notable difference, however, is that the data used in this analysis show an increase in mortality rates in the second and third year of business. One explanation for the lower mortality rate in the first year is that businesses are able to survive on initial resources (Brüderl, Preisendörfer, & Ziegler, 1992). Firms have little risk of failure because they can draw on their initial stock of assets which they typically acquire at founding. Furthermore, the liability of adolescence argument cited in earlier studies predicts firm mortality rates to have an inverted, U-shaped relationship with age (Bruderl & Schussler, 1990) (Fichman & Levinthal, 1991), an argument which is also supported by the results of this model. Finally, the results found here for high-tech businesses run contrary to the *liability of obsolescence* argument, which predicts higher mortality rates with age as aged firms tend to become highly inertial and unable to adapt to changing business environments (Baum, 1989) (Barron, 1994).

Chart 1. Yearly Mortality Rate

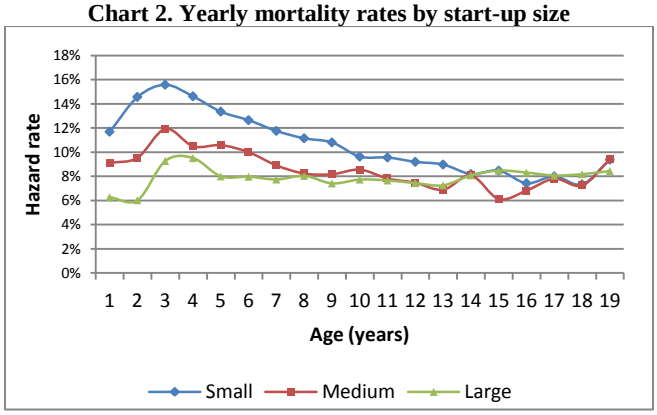


VI. ORGANIZATIONAL AND ENVIRONMENTAL FACTORS

As previously mentioned, other studies have examined how certain organizational and environmental characteristics such as start-up size, establishment type, location, industry, and birth year are correlated with mortality rates. This section examines these factors and compares our findings with those from other studies. In the next section, these organizational and environmental factors will be used as covariates for estimating the effect of organization type on mortality rates.

Mortality rates decrease with start-up size. Our analysis shows that mortality rates decrease with larger start-up size. This result is consistent with previous findings, Mahmood (1991) and Popkin (2001). The mortality rates for medium and large start-up firms are much lower than for small start-up firms. Our findings for high-tech industry firms dispute those of Agarwal and Audretsch's (2001) who concluded that the relationship deteriorates for technologically intensive industries. The difference in mortality rates of different start-up size firms comes primarily during the first fifteen years of operation. Across all start-up sizes, businesses generally face the highest mortality rates in their third year of business. Among all size classes, small start-up high-tech businesses have the highest mortality rates at 16 percent during the third year of operation. Unlike medium or small startups, large startup firms actually have their lowest mortality rate, at 6 percent, in the first two years of their existence. By the sixth or seventh year, the mortality rate for small and medium high-tech businesses drops below the rate seen during the first year of existence. The rate for small and medium-sized businesses then continues to decrease until it converges at around 8 percent mortality per year. In general, large startup businesses converge to the 8 percent per year rate by the fifth year, medium ones by the eighth year, and small businesses by the fourteenth year. Convergence of hazard rates across all size classes suggests that start-up size affects survival rates for up to 15 years, and then becomes a non-significant determinant of differences in survival rates. (See Chart 2)

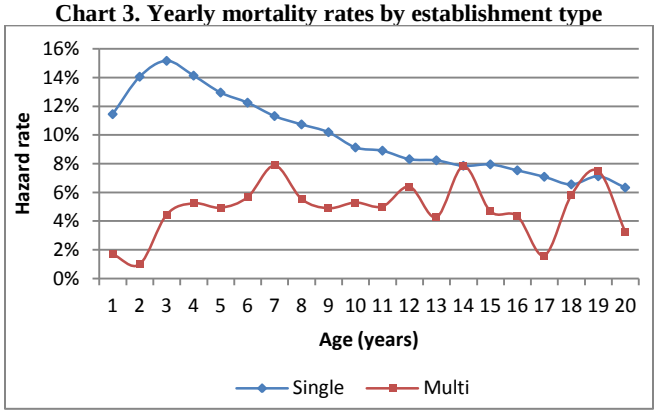
Chart 2. Yearly mortality rates by start-up size



Note: Hazard rates limited to 19 years due to unavailability of data

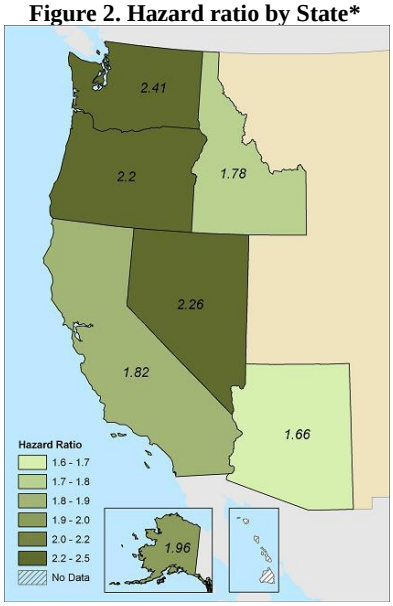
Multi-establishment firms have greater survival rates. Similar to Popkin's findings, multi-establishment businesses, or businesses that operate in multiple locations, tend to survive longer than did single establishment businesses. Multi-establishment firms tend to have very low initial hazard rates and maintain low rates over their lifetimes. Single-establishment firms tend to have much higher initial hazard rates, which decrease with age. Cox regression results show that over a lifetime, a multi-establishment firm is less than half as likely to exit in a given period as a single-establishment firm. (See Chart 3)

Chart 3. Yearly mortality rates by establishment type



Survival rates vary by location. The geographic location of high-tech businesses has a significant impact on survival rates, as some states tend to have firms with significantly lower or higher average survival rates than other states, for examples, businesses in Washington tend to have relatively lower survival rates while those which are located in multiple states tend to have relatively higher survival rates. Note that other factors such as differences in industry composition may partially explain the observed differences in survival rates across various states – that is, states with higher concentrations of industries which have lower survival rates would lead to lower survival rates in the state as a whole. (See Figure 2)

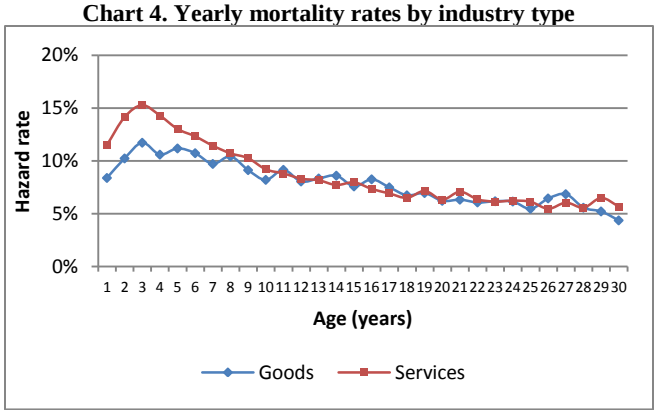
Figure 2. Hazard ratio by State*



* relative to hazard rates of business that operate in multiple states

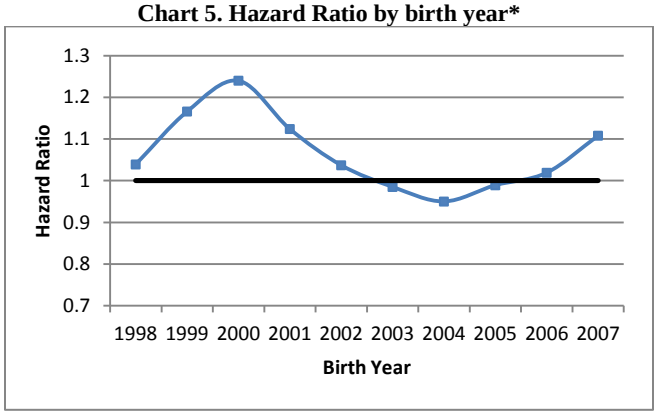
Goods producing firms have lower rates of mortality. Previous studies have shown that manufacturing businesses tend to have lower mortality rates than do firms in other industries. Kaplan-Meier estimates for this dataset also show that goods producing businesses have lower mortality rates than service providing businesses. A plot of hazard rates shows that the primary difference in exit rates comes during the first 10 years, when service-providing firms have mortality rates which are up to 4 percent above those of goods-producing firms. After the first 10 years, rates for both goods-producing and service-providing high-tech businesses converge. Cox regression results also show that over a lifetime, the mortality rate for service-providing firms is roughly 30 percent higher than for goods-producing businesses. (See Chart 4)

Chart 4. Yearly mortality rates by industry type



Mortality rates are sensitive to birth year. Birth year also has a significant impact on mortality rates. Compared to 2008 and 2009, business born in between 1999 and 2001 tend to have lower survival rates (higher hazard ratio), as expected due to the 2001 recession. Meanwhile, businesses born after the 2001 recession tend to have relatively higher survival rates. (See Chart 5)

Chart 5. Hazard Ratio by birth year*



* relative to 2008-2009 birth year

VII. SURVIVAL ANALYSIS BY BUSINESS ORGANIZATION TYPE

In general, compared to other organization types, sole proprietorships tend to have the lowest survival rates, followed by partnerships among high-tech businesses. Corporations tend to have the highest survival rates. (See Chart 6). Cox regression results (without covariates) show that sole proprietorships and partnerships tend to have significantly higher hazard rates (hazard ratio of 1.79 and 1.41 respectively) than other[3] organization types, while corporations tend to have similar hazard rates as other organization types. (See Table 1). However, other firm level and environmental factors may be correlated with both organization type and survival rates and may bias these estimates. This section addresses these potential issues.

The specifications in this paper use covariates to reduce the bias in estimating the effect of organization type on survival rates. Businesses with a larger start-up size tend to have higher survival rates; at the same time, corporations tend to have larger start-up sizes than sole proprietorships or partnerships, hence it is not that surprising that they would also have relatively higher survival rates. Corporations also tend to have multiple establishments, a characteristic which is also associated with greater survivability. Furthermore, some states may have higher concentrations of certain organization types and other systematic effects due to economic policies which could also potentially bias the survivorship estimates for businesses in an area. Moreover, some industries such as manufacturing tend to have more corporations than sole proprietorships or partnerships, and since survivorship varies greatly by industry, taking industry effect into the analysis reduces the potential bias. These confounding effects may bias the estimation of organization type on survival rates. Specifications (2) and (3) as given in the methodology section control for all of the above-mentioned time-invariant covariates in estimating the effect of organization type on survival rates.

Cox Proportional Hazards Model Results

After controlling for organizational characteristics and environmental conditions, corporations have the highest survival rates. The next highest survival rates are found in organizations classified as other, followed by partnerships, and finally, sole proprietorships, which have the lowest survival rates. Ceteris paribus, partnerships and sole proprietorships have hazard rates of 2.0 and 1.5 times that of corporations, respectively. Sole proprietorships have a hazard rate of 1.3 times that of partnerships. Without controlling for covariates, the hazard ratio is larger for sole proprietorships, partnerships, and corporations, relative to the other organization category. (See Chart 7 and Table 2)

[3] "Other" includes Co-ownership, bankruptcy, association, limited liability company, liquidation, estate administration, trusteeship, joint venture, receivership, and other

Chart 6. Cumulative survival rates by organization type (without covariates)

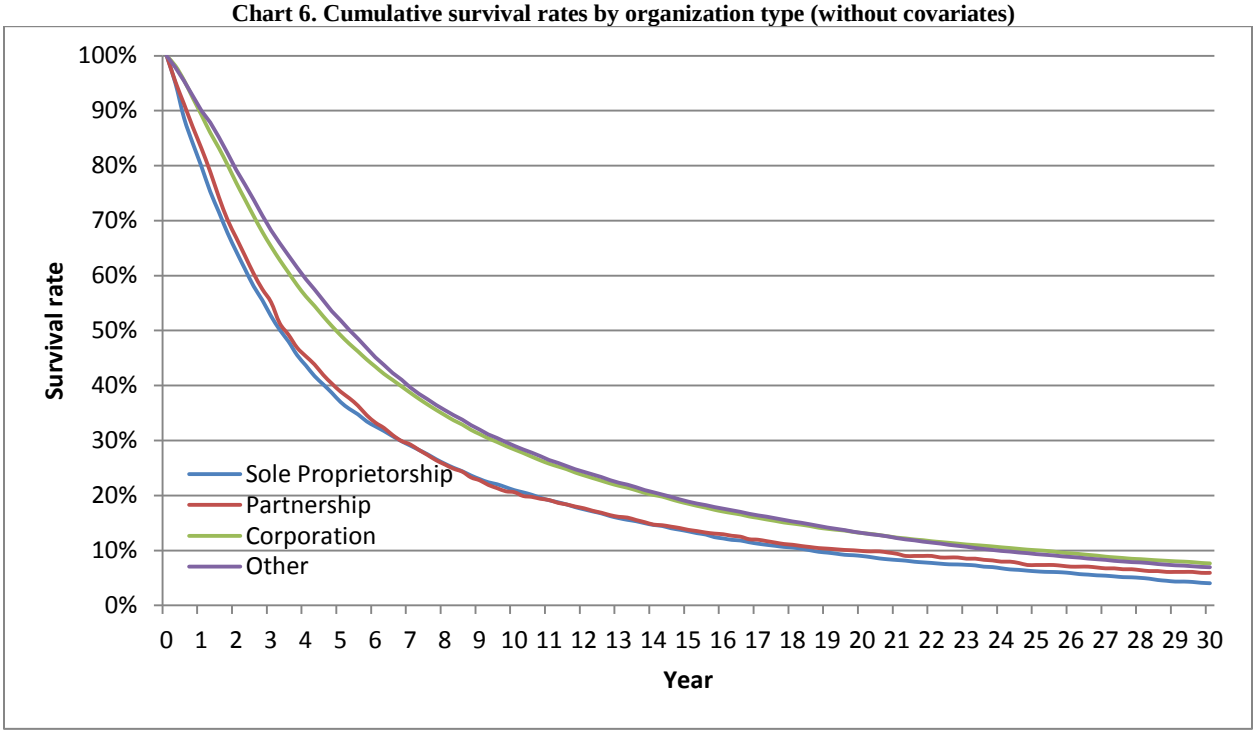
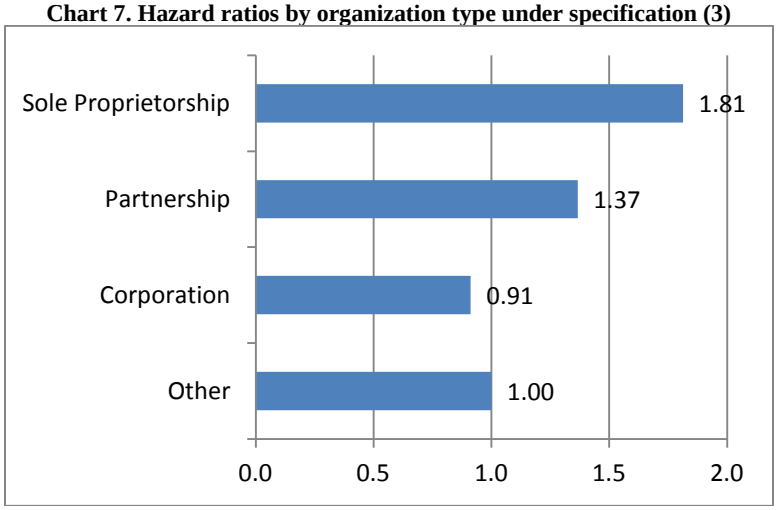


Chart 7. Hazard ratios by organization type under specification (3)



In specifications (1) and (2), the hazard rate of corporations is not significantly different from that of other organization type. However, including environmental fixed effects to the model as in specification (3), corporations are found to have a significantly lower hazard rate than businesses in the other organization category. This suggests that differences in environmental conditions between corporations and businesses in the other category attenuate the effect of organization type on hazard rates. In this case, the environmental conditions assumed by corporations are correlated with higher hazard rates, while the conditions assumed by the other organization type are correlated with lower hazard rates. Correcting for these effects reveals that independent of organizational and environmental conditions, corporations have lower hazard rates than other organization type. (See Table 1)

The parameter estimates (or the hazard ratios) and the significance of these estimates do not vary significantly across the three specifications for sole proprietorships and partnerships. These results indicate that the covariates are not strongly correlated with organization type and survival rates for these two types of organizations.

Table 1. Model results

	Specification (1): no covariates			**Specification (2): with organizational characteristics**			**Specification (3): with organizational characteristics and environmental conditions**		
	Parameter estimate	*Hazard ratio*	*Signif.*	*Parameter estimate*	*Hazard ratio*	*Signif.*	*Parameter estimate*	*Hazard ratio*	*Signif.*
Sole prop.	.58	1.79	***	.55	1.73	***	.59	1.81	***
Partnership	.34	1.41	***	.34	1.40	***	.31	1.37	***
Corporation	.00	1.00		-.01	0.99		-.09	0.91	***

Note: . significant at the 10% α level, * significant at the 5% α level, ** significant at the 1% α level, *** significant at the 0.1% α level

The relationship between hazard ratio and parameter estimate is given by the following:

$$hazard\ ratio = exp\ [parameter\ estimate]$$

Table 2. Hazard ratios by organization type under specification (3)

	Sole prop.	**Partnership**	**Corporation**	**Other**
Baseline: Sole prop.	-	0.75***	0.50***	0.55***
Baseline: Partnership	1.33***	-	0.67***	0.73***
Baseline: Corporation	1.99***	1.50***	-	1.10***
Baseline: Other	1.81***	1.37***	0.91***	-

Note: * significant at the 5% α level, ** significant at the 1% α level, *** significant at the 0.1% α level

Using results from specification (3) (see Appendix B), the hazard rates of businesses with different characteristics can be compared. For example, consider two firms: Firm A is a sole proprietorship start-up which is small, located in Washington, and in the internet, telecommunications, and data processing industry; and Firm B is a multi-establishment corporation start-up which is large, located in California, and in the architecture and engineering services industry. Using the parameter estimates (or hazard ratios) from specification (3), we calculate the hazard ratio of firm A to firm B:

$$\frac{1.81 * 1.46 * 2.92}{.91 * .57 * .88 * .99 * 1.57} = 11.0$$

This indicates that Firm A is 11 times more likely to exit in a given period than Firm B.

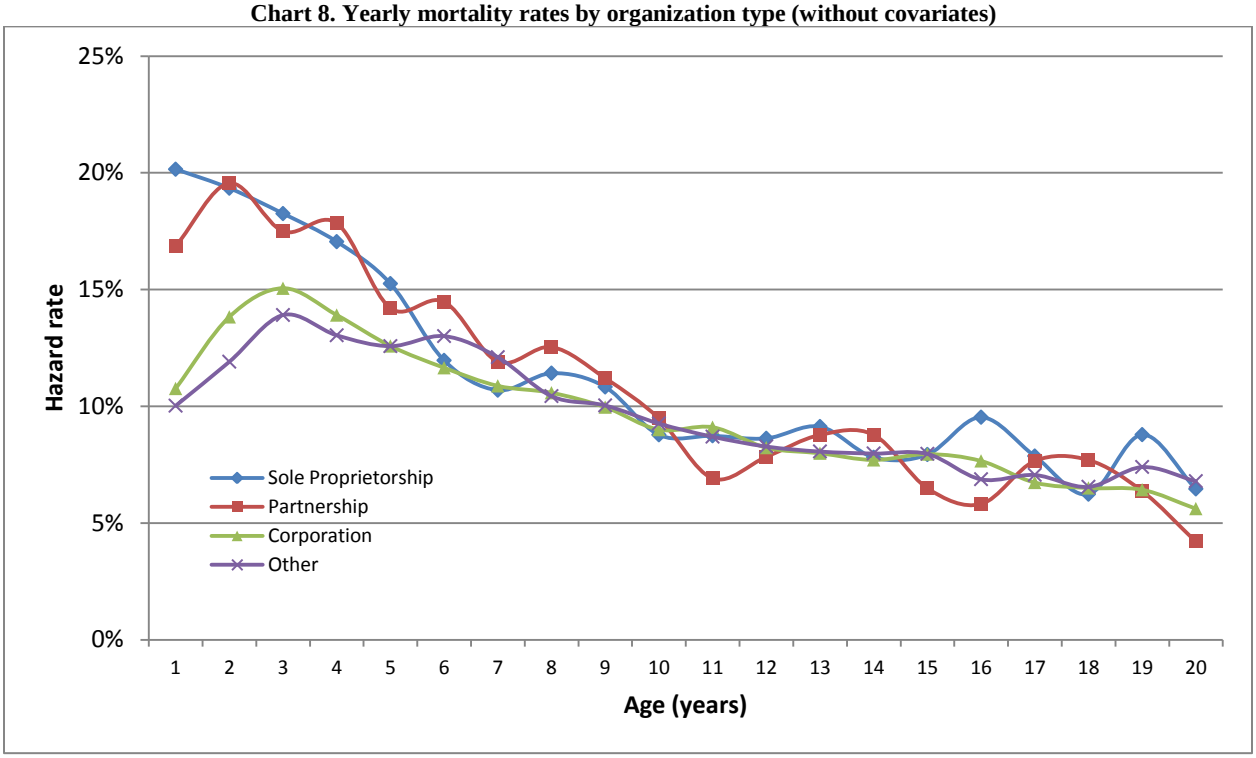
Survival rate differences over time

Proportional hazard models show that corporations tend to have the best survival rates of all organization types while sole proprietorships tend to have the worst survival rates. However, a closer examination of exit rates for each organization type over time reveals that time effects vary across organization type. In the first few years of business, corporations have the lowest mortality rates. After around age 6, however, mortality rates of all organization types converge. This result is similar to the one found earlier on the effect of start-up size on mortality rates. Not until after about age 20, do rates diverge again with corporations again having the lowest mortality rate while sole proprietorships have the highest.

For all organization types except sole proprietorships, hazard rates are highest in the second or third year of operation. A unique feature of sole proprietorships is that its worst year is its first year. One explanation for this is sole proprietorships tend to have lower initial resources, a characteristic which suppresses their chances of survival.

The exit rate of sole proprietorships in the first year is twice that of corporations. Between ages 6 and 20, hazard rates are not significantly different among all organization types. In other words, once a business has made it beyond the fifth year, organization type has little effect on its survival; however, after 20 years, corporations emerge again as leaders in survival due to their organizational nature. Sole proprietorships are linked to individuals, whereas corporations are their own entity, hence the lifespan of a person may become the limiting factor in the survival of a sole proprietorship, whereas corporations may survive indefinitely. (See Chart 8)

Chart 8. Yearly mortality rates by organization type (without covariates)



VIII. CONCLUSION

The results of this paper confirm that high-tech businesses which have larger sizes when they start up and which have multiple establishments generally have higher survival rates than smaller start-ups and single-establishment businesses. These findings are similar to those found in previous studies. In addition, survival rates tend to vary based on location, industry, and year of birth.

The analysis presented in this paper also shows that survival rates of businesses differ significantly based on how a business is organized. Over the lifetime of a business, sole proprietorships have the highest mortality rates, followed by partnerships. Corporations tend to have the lowest mortality rates and have the longest lifespan. Ceteris paribus, sole proprietorships generally have exit rates which are double those of corporations, while partnerships have exit rates which are 50 percent higher than those of corporations. The primary difference in exit rates arises in the first 5 years and after 20 years of operation. Corporations, and to a lesser extent, partnerships, tend to have lower mortality rates initially, a finding which is explained by relatively higher levels of initial investment. Having fewer initial resources, sole proprietorships have the highest mortality rate in their first year. During the period examined for the Western U.S., 1 in 5 high-tech sole proprietorships exited in the first year, while only 1 in 10 high-tech corporations exited during their first year. By age 5, over half of corporations and more than 60 percent of sole proprietorships and partnerships had failed.

While the empirical evidence presented in this paper provides new insights as to the role of varying business characteristics on survivorship, more detailed longitudinal data sets would enable one to better link other business characteristics to organization type or legal structure and survival rates. The findings in this paper do provide a foundation for future research into additional factors which affect the life-cycle of businesses and, in particular, those in high-tech.

ACKNOWLEDGEMENTS

The authors thank economist Richard Cerri and others of the Division of Federal/State Cooperative Programs for help in obtaining and understanding the dataset; David Talan for his edits and comments; and Richard Holden, Regional Commissioner, all with the Bureau of Labor Statistics.

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APPENDIX A- DATA NOTES

Variable	Number of observations		Description
	All Businesses	*New Businesses*	
Duration of business	-	-	Duration for which a business is open; derived from the initial and end (if applicable) dates of a business
Right-censored	-	-	Indicator of whether a business is still in business in 2009 Q2
Organization type			Legal/tax structure of business
Sole proprietorship	7,654	1,663	Individual owner
Partnership	2,810	1,349	General partnership, limited partnership, and limited liability partnership
Corporation	45,395	23,874	Corporation
Other	26,635	4,830	Co-ownership, bankruptcy, association, limited liability company, liquidation, estate administration, trusteeship, joint venture, receivership, and other
Start-up size			Employment size in the first month of business
Small	58,074	28,846	1-4 employees
Medium	6,516	2,269	5-19 employees
Large	2,513	601	20 or more employees
Establishment			Number of locations that a firm operates
Single	81,979	31,572	1
Multiple	515	144	2 or more
State			
Alaska	353	319	
Arizona	8,979	5,693	
California[1]	34,498	429	
Hawaii	0	0	
Idaho	3,090	2,091	
Nevada	5,397	4,063	
Oregon	9,764	6,071	
Washington	19,893	12,862	
Multiple States	520	188	
Industry[2]			High-tech industry, NAICS[3] CODE:
Pharmaceutical and medicine mfg	550	112	325400
Computer and peripheral equipment mfg	765	78	334100
Communications equipment mfg	746	78	334200
Semiconductor and electronic component mfg	2,441	239	334400
Electronic instrument mfg	1,869	218	334500
Aerospace product and parts mfg	1,139	169	336400
Software publishers	3,933	1,810	511200
Architecture and engineering services	26,295	8,505	541300
Computer systems design and related services	29,062	13,914	541500
Scientific research and development services	5,079	1,726	541700
Internet, telecommunications, and data processing	8,554	4,273	517100, 517900, 518000, 516000, 517300, 517500, 519130
Multiple industries	2,061	594	
Start-up year			Year in which a firm is born
1998	4,404	2,506	
1999	3,181	3,181	
2000	3,750	3,750	
2001	2,889	2,889	
2002	2,497	2,497	
2003	2,440	2,440	
2004	2,590	2,590	
2005	2,919	2,919	
2006	2,961	2,961	
2007	2,841	2,841	
2008 and 2009	3,142	3,142	
Total # Of Observations	82,494	31,716	

[1] In California, the identification of organization type was virtually eliminated after 1998, hence the significant drop in the number of usable observations.

[2] 11 industries have been identified as high-tech using the 2007 North American Industry Classification System (NAICS) codes. An industry is considered high-tech if "technology-oriented workers" within an industry, as identified by occupational staffing patterns, account for approximately 25 percent or more of total jobs within the selected industry(Hecker 2005).

[3] NAICS or the North American Industry Classification System groups establishments into industries based on the activities in which they are primarily engaged.

APPENDIX B- TABULATED RESULTS

Cox regression results from specification (3)

Variable	*Parameter Estimate*	*SE*	*P-value*	*Hazard Ratio*
Organization type: Sole	0.59	0.04	<.0001	1.81
Organization type: Partnership	0.31	0.05	<.0001	1.37
Organization type: Corporation	-0.09	0.02	0.0002	0.91
Start-up size: Medium	-0.33	0.03	<.0001	0.72
Start-up size: Large	-0.57	0.06	<.0001	0.57
Establishment: Multi	-0.13	0.20	0.506	0.88
State: Alaska	0.28	0.19	0.1451	1.32
State: Arizona	0.08	0.17	0.6235	1.09
State: California	-0.01	0.18	0.9371	0.99
State: Idaho	0.14	0.17	0.4181	1.15
State: Nevada	0.36	0.17	0.0326	1.43
State: Oregon	0.26	0.17	0.1194	1.30
State: Washington	0.37	0.17	0.0249	1.46
Industry: Pharmaceutical and medicine mfg	0.82	0.15	<.0001	2.28
Industry: Computer and peripheral equipment mfg	0.67	0.17	0.0001	1.96
Industry: Communications equipment mfg	0.84	0.18	<.0001	2.31
Industry: Semiconductor and electronic component mfg	0.67	0.12	<.0001	1.95
Industry: Electronic instrument mfg	0.58	0.12	<.0001	1.79
Industry: Aerospace product and parts mfg	0.57	0.13	<.0001	1.78
Industry: Software publishers	0.89	0.08	<.0001	2.43
Industry: Architecture and engineering services	0.45	0.07	<.0001	1.57
Industry: Computer systems design and related services	0.88	0.07	<.0001	2.42
Industry: Scientific research and development services	0.77	0.08	<.0001	2.17
Industry: Internet, telecommunications, and data processing	1.07	0.07	<.0001	2.92
Birth year: 1998	0.11	0.07	0.0985	1.12
Birth year: 1999	0.21	0.06	0.0012	1.23
Birth year: 2000	0.26	0.06	<.0001	1.30
Birth year: 2001	0.17	0.06	0.0091	1.18
Birth year: 2002	0.12	0.07	0.0668	1.13
Birth year: 2003	0.05	0.07	0.4247	1.05
Birth year: 2004	0.01	0.07	0.8988	1.01
Birth year: 2005	0.04	0.07	0.5783	1.04
Birth year: 2006	0.04	0.07	0.5226	1.04
Birth year: 2007	0.13	0.07	0.0663	1.14

NOTES

