New-Firm Survival: Industry versus Firm Effects

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Abstract

Recent studies show that the likelihood of survival differs significantly across firms. Both firm and industry characteristics are hypothesized to account for this heterogenity. Using a longitudinal database of manufacturing firms we investigate whether firm or industry characteristics dominate. Our evidence suggests that both firm- and industry-specific characteristics shape new-firm survival during the first years subsequent to entry. However, in the longer run, most of the industry factors have little influence on the likelihood of survival, but firm-specific characteristics still exert a considerable influence in shaping firm survival rates.

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1 Introduction

A recent wave of studies has emerged consistently showing that the likelihood of firm survival tends to increase along with the age of the firm.[1] This finding holds across different sectors, time periods and even countries. Still, even after controlling for firm age, considerable heterogeneity with respect to the likelihood of survival exists across firms. Part of this heterogeneity has been explained by characteristics specific to the industry, such as the relative importance of innovation and technological change, importance of capital intensity and sunk costs, and by characteristics specific to the firm, such as size, capital intensity and ability to finance growth. At the same time, there is growing disagreement about the relative importance of characteristics specific to the firm and to the industry in explaining firm heterogeneity with respect to survival rates. The purpose of this paper is to explicitly compare the impact of firm-specific characteristics with industry-specific characteristics on the likelihood of new-firm survival. This has important policy implications. If most of the heterogeneity across firms is attributable to factors specific to the industry, there is little that public policy can do in reducing firm failure rates. On the other hand, if firm-specific factors result in heterogeneity with respect to survival rates, an important implication is that public policy can have a positive impact in reducing the likelihood of failure.

2 Measurement

The ability to analyze firm heterogeneity with respect to the likelihood of survival depends upon access to a longitudinal data set containing observations tracking firms over time. Such data bases have now been used to study the likelihood of survival of

[1] See the collection of country studies contained in the special issue of the *International Journal of Industrial Organization* on „The Post-Entry Performance of Firms“ (Audretsch and Mata (eds.), 1995).

manufacturing firms in the United States, Germany, Canada, Portugal and Italy.[2] However, these data sets suffer from severe drawbacks. The USELM file from the U.S. Small Business Administration provides only biennial observations on variables such as employment level and ownership status. It has been used for a series of studies on new-firm survival on the level of individual enterprises and establishments by Audretsch (1991 and 1995) and Audretsch and Mahmood (1995). Similarly, the longitudinal data base of the U.S. Bureau of Census (Dunne, Roberts and Samuelson, 1988) provides observations only at five-year intervals.

For our goal we need time series of considerable length. We use the longitudinal data base of manufacturing firms in the Netherlands from the Annual Production Statistics compiled at Statistics Netherlands. The Production Statistics contain detailed information on all firms in Dutch manufacturing. Data are available for each year between 1978 and 1992. In 1987 a structural change occurred in the sampling procedure: the Production Statistics until 1986 contain all establishments with at least ten employees, whereas data sets from the years after 1986 consist of all firms with at least twenty employees and only a sample of the firms with less than twenty employees. The percentage of firms dropping out of the data base because of this shift is only two.

A new firm is identified when it appears in the data file in year *t* but not in any of the years preceding *t*. The firm is considered to exit if it is present in the year *t* but not in year *t+1*, *t+2*,...1992. This longitudinal check is necessary, because in addition to a permanent closing down of its operations, a firm may not be in a particular year's data

[2] New-firm survival in the United States was studied by e.g. Audretsch (1991) and Dunne, Roberts and Samuelson (1988). An analysis of new German firms has been performed by Wagner (1994). Entry and exit of Canadian firms were studied by Baldwin and Gorecki (1991). Evidence for Portugal was supplied by Mata (1994). Research on Italian data was done by Arrighetti (1994).

base, because its employment level has temporarily dropped below the limit of ten employees. Following Wagner's (1994) recommendation that, „...conclusions should not be based on the analysis of data from a single cohort of entries", we extract four distinct cohorts of new firms from the data base to analyze the post-entry performance. These four cohorts consist of new-firm startups in each year between 1979 and 1982. Each enterprise is then tracked over the subsequent ten years.

To measure the separate impacts of firm-specific and industry-specific characteristics on the likelihood of new-firm survival, we decompose firm variables into two components. Consider, for example, the influence of the capital intensity of an establishment. To estimate the firm effect and the industry effect, we include both the capital intensity of the firm and the capital intensity of the industry in the analysis. This method precludes that the influence of a large capital intensity of a particular firm is used to measure the firm effect, while the actual reason could be the large capital intensity of the industry the firm is in.

3 Linking Survival to Firm and Industry Characteristics

Factors specific to the firm that are hypothesized to influence the likelihood of survival include (1) the *startup size*, defined as the number of employees in the year of entry, (2) *capital intensity*, measured as the share of production costs accounted for by energy and depreciation costs (which are assumed to be in fixed proportion to the variable firm capital intensity, which is not available in our data base), and (3) *debt structure*, defined as the interest paid on debts divided by the number of employees. Presumably different values of these three factors yield different likelihoods of survival.

Small firms that enter an industry are confronted with a size disadvantage. The larger the extent of scale economies in the industry, the greater is the resulting cost disadvantage for small entrants and the lower is the probability of their survival. Measures of economies of scale are average firm size and average capital intensity of the industry. Therefore, we expect that an increase in either *startup size* or *capital intensity* of the entrant results in a higher likelihood of survival given the scale of the industry, i.e., given the average firm size and the industry capital intensity. The firm's *debt structure* is hypothesized to have a positive influence on its chances of survival for at least two reasons. First, agency theory in finance (Jensen, 1986) suggests that a higher debt-equity ratio - and hence higher interest payments - limits the free cashflows available to the firm's managers, who may be inclined to invest these cashflows in dubious projects. Second, Caves and Porter (1976) argue that in the phase following the firm's entry, a high level of financial investment turns out to be a barrier against the entry of new competitors and simultaneously constitutes a high barrier to exit.

The literature (Audretsch, 1995) has made it clear that the industry environment within which the firm operates also shapes the likelihood of survival. Factors specific to the industry environment hypothesized to influence the likelihood of new-firm survival include (1) *average size*, (2) *industry capital intensity* and (3) *industry debt structure*, which are computed from the three firm-specific variables by aggregating them to the industry level. We also consider (4) the *price-cost margin*, which indicates industry profitability. It is measured as (Revenues-Costs)/Revenues, where Revenues equals value-of-shipments plus the margin on trading and other revenues, and Costs equals the sum of total consumption value, labor costs, interest expenses (less interest income), miscellaneous income (less expense) and depreciation costs on fixed assets. Furthermore, we take into account the possible impact of (5) *R&D*, measured as the share of total industry employment accounted for by employees involved in R&D, (6) *growth rate*, measured as the average of the annual industry growth rates between 1978 and 1991, and the (7) *entry rate*, measured as the number of new firms divided by the total number of firms in the industry, computed in the startup year. Finally, we also include three dummy variables representing the influence of the specific cohort to which the firm belongs. These dummy variables can be interpreted as reflecting the impact of omitted macroeconomic variables specific to the startup year.

The industry-specific variables *average size, industry capital intensity* and *industry debt structure* are included to accurately measure the corresponding firm effect. Next to this use as control variables, they are expected to have a direct impact on survival rates. The expected signs of *average size* and *industry capital intensity* are negative, because both variables can be seen as measures of economies of scale and a larger minimum efficient scale (MES) results in higher cost disadvantages for small firms. The *industry debt structure* can again be seen as a barrier to exit and is therefore expected to reduce the propensity to exit.

Weiss (1976) argues that the existence of small (sub-optimal) firms is promoted in industries where price is set above the MES level of average costs. Hence, we expect that survival rates are higher in industries with higher *price-cost margins*. The extent of innovative activity has been shown to be directly related to the amount of turbulence in an industry (Acs and Audretsch, 1990). While there is considerable entry into high *R&D* industries, many of those entrants are forced to an early exit. Furthermore, we expect a positive effect of the *industry growth rate* on new-firm survival rates. It seams easier for small entrants to grow and survive in an expanding industry than to gain market shares from competitors that may retaliate. However, a high growth rate can also be associated with young industries where turbulence (and hence uncertainty) is high. This also holds for the industry's *entry rate*. Moreover, this variable measures the competition an entrant experiences from comparable firms. For these two reasons it is hypothesized that high entry rates reduce the likelihood of survival for new firms.

4 Results

To test whether either the firm-specific or industry-specific characteristics have an impact on the likelihood of survival, we use a logit regression model where the dependent variable is assigned a value of one if the firm still exists and zero if it has exited. This model is estimated for different post-entry time intervals, varying between two and ten years. This enables to determine whether the impact of the firm- and industry-specific characteristics is constant over time. After estimating the model for each cohort separately, we were not able to reject the hypothesis that the regression coefficients of the variables differ across cohorts. We conclude that it is appropriate to pool the four cohorts together in estimating the model. Because for several variables the mean value was different for different cohorts, it was necessary in the pooled regression to work with standardized variables, i.e. from each variable we subtracted its cohort average.

The results for the even years are provided in Table 1. The coefficient of the firm-specific variable *startup size* is statistically significant for all estimated time periods. Its positive sign indicates that surviving is easier for firms that are larger at entry, given the industry's average firm size. The magnitude of this effect is decreasing over time. The *average size* in the industry does not seem to have a significant effect on the likelihood of survival. This holds for all considered time intervals.

Capital intensity has a positive influence on survival rates on the firm-level and a negative influence on the industry-level. As capital intensity is usually seen as a measure of economies of scale, these findings suggest that new-firm survival rates are lower in industries with substantial economies of scale and hence greater cost disadvantages for small firms. For a given scale of the industry, the firm can increase its chances of survival by increasing its own scale, but the effectiveness of this strategy is decreasing over time.

The impact of *debt structure* on the likelihood of survival becomes statistically significant in the sixth year subsequent to entry. Its negative sign contradicts the hypothesized positive effect. Apparently, the argument that managers spoil free cashflows and harm shareholders, does not apply to small firms, where ownership and management usually coincide. Also, the Caves and Porter (1976) hypothesis that a high level of financial investment forms a barrier to exit, may already be incorporated in the *capital intensity* variable. While not valid on the firm-level, both ideas do hold on the industry-level: the coefficient of the variable *industry debt structure* is positive, though never statistically significant.

The positive sign of the industry's *price-cost margin* supports Weiss' (1976) finding that survival is easier in industries where prices are set above the MES level of average costs. Interestingly, a high price-cost margin only helps in the short run, as can be seen from the magnitude of its coefficient. This coefficient is fading out when longer post-entry time intervals are considered. Moreover, the *t*-value indicates that the effect of the price-cost margin is only statistically significant up to a post-entry period of six years.

The impacts of the industry-specific factors *R & D, growth rate* and *entry rate* on the likelihood of survival are all negative. This supports the hypothesis that survival is more difficult for firms entering an industry with a high level of turbulence. High rates of innovation, growth and entry are characteristics of young industries with high levels of turbulence. Where the effect of R & D is never significant, the coefficient of the industry growth rate is significant only in the first six years and the impact of the entry rate is statistically significant for all considered time spans.

5 Conclusions

The empirical evidence provided in this paper suggests that while both firm- and industry-specific characteristics shape new-firm survival within the first several years subsequent to entry, in the longer run, most of the industry factors have little influence on the likelihood of survival, but firm-specific characteristics still exert a considerable influence in shaping firm survival rates. Heterogeneity of survival rates across firms is apparently more attributable to firm-specific characteristics than to industry-specific characteristics. This heterogeneity is one of the main engines of change in the industry. Furthermore, this heterogeneity with respect to survival rates implies that public policy can find instruments aiming at increasing the likelihood of survival.

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Table 1. Logistic Regression Results (*t* -statistics in parentheses)

	Age of cohorts				
Variable	**2**	**4**	**6**	**8**	**10**
Constant	2.194	1.093	0.540	0.288	0.076
	(16.470)	(11.570)	(6.340)	(3.480)	(0.930)
Dummy Cohort 1980	-0.045	-0.417	-0.219	-0.381	-0.502
	(0.250)	(3.140)	(1.770)	(3.140)	(4.120)
Dummy Cohort 1981	-0.158	-0.405	-0.211	-0.334	-0.396
	(0.830)	(2.910)	(1.620)	(2.620)	(3.110)
Dummy Cohort 1982	-0.569	-0.166	-0.156	-0.195	-0.409
	(3.190)	(1.160)	(1.200)	(1.530)	(3.200)
Firm effects					
Startup Size	0.042	0.021	0.011	0.012	0.011
	(5.990)	(5.440)	(3.650)	(4.010)	(3.750)
Capital Intensity	10.640	7.491	7.082	6.082	5.340
	(4.430)	(4.900)	(5.240)	(4.810)	(4.390)
Debt Structure	0.008	-0.016	-0.030	-0.018	-0.016
	(0.560)	(1.580)	(3.150)	(1.930)	(1.660)
Industry effects					
Average Size	-0.001	0.001	0.001	0.001	0.001
	(0.440)	(0.900)	(1.110)	(1.040)	(1.250)
Capital Intensity	-3.659	-3.694	-5.899	-4.913	-5.216
	(0.840)	(1.320)	(2.440)	(2.100)	(2.210)
Debt Structure	0.030	0.027	0.038	0.025	0.020
	(0.520)	(0.670)	(1.020)	(0.710)	(0.580)
Price-Cost Margin	5.267	5.164	4.357	2.366	0.730
	(2.040)	(2.800)	(2.600)	(1.510)	(0.480)
R & D	-4.172	-3.800	-2.435	-4.573	-3.988
	(0.850)	(1.000)	(0.690)	(1.350)	(1.180)
Growth Rate	-6.056	-6.600	-5.354	-2.497	0.526
	(2.360)	(3.400)	(2.940)	(1.400)	(0.290)
Entry Rate	-2.363	-2.507	-3.090	-3.552	-3.785
	(1.580)	(2.250)	(2.930)	(3.380)	(3.530)
Statistics					
No. of Survivors (out of 2017)	1730	1391	1199	1043	896
Survival Rate	0.86	0.69	0.59	0.52	0.44
Log Likelihood	-769	-1192	-1317	-1357	-1348
% Correct Predictions	86	70	62	56	59