Small Bus Econ (2008) 31:379–393
DOI 10.1007/s11187-007-9061-2

The death of firms: exploring the effects of environment and birth cohort on firm survival in Sweden

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Received: 5 July 2006 / Accepted: 23 April 2007 / Published online: 7 July 2007

Abstract This paper investigates the death of firms and seizes a long-term perspective. It investigates the life spans of nearly 2,200 firms in seven birth cohorts of Swedish joint-stock companies, founded during seven separate years between 1899 and 1950. Research has traditionally emphasized individual- and micro-oriented factors in explaining post-entry performance, or has often focused on the influence of firm-specific structural factors (firm age and size). A less attended field recognizes environmental forces. This paper focuses on the interaction between the micro and macro levels, and combines structural and environmental factors. Employing a cohort approach, it relates firm survival to firm age and size, as well as to the effect of cohort affiliation and environmental change over time (period effects). During macroeconomic expansion, the risk of death decreases. Cohort effects are also evident. Firms founded during times of economic crisis exhibit lower survival rates. Consequently, cohort affiliation and environmental forces, i.e. period effects, can explain differences in death rates in different firm populations.

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Keywords Firm death · Firm survival · Firm size · Firm age · Cohort · Environment · Macroeconomic conditions

JEL Classifications L25 · L26 · M13

1 Introduction

Some key factors are acknowledged to broadly influence the post-entry performance of firms. One is individual-related: the entrepreneur's or business owner-manager's traits, motivation and capacity—along with other personality variables—are considered to explain a great part of why some firms fail while others survive and, perhaps, grow. Secondly, firm-specific structural factors, regularly the age and size of firms, are also considered to be significant. These variables systematically influence the probabilities for growth, as well as for survival. Low age and small size is generally positively correlated with high firm growth rates. And inversely, insignificant size and low age will also in general decrease the probability for survival. Finally, environmental forces and phenomena represent a third group that is recognized to explain post-entry performance, for example macroeconomic and institutional conditions and constraints. In spite of this, a relatively smaller number of studies have focused on these questions, particularly as concerns the influence of macroeco-

nomic, aggregate, conditions and fluctuations. Given the fact that entrepreneurship and small business issues have been given increasing attention in both policy and research over the past decades, this is quite surprising, especially if we bear in mind that it is regularly assumed that micro processes—the entry, growth and exit of firms—have aggregate economic and societal consequences. Here, it is often presupposed that more new, and hopefully growing firms are beneficial for the macro economy.[1] Even so, the opposite relationship in which the environment affects and constrains the individual business is a less investigated area. The macro-environmental problem, and the links between micro and macro processes and events, is therefore considered to be important for the development of the research area (Boeri and Bellmann 1995; Tveterås and Eide 2000; Aldrich and Martinez 2001).

This paper investigates the death of firms in seven separate birth cohorts, or generations, of firms over a long period of time. Its aim is to explore and to link the likelihood of death to structural and macro-environmental conditions. Each firm is traced at the micro level from its birth up to one and a half decade, given it survived for so long. The study comprises more than 20,000 observation years for a total of nearly 2,200 Swedish joint-stock companies followed longitudinally over a great part of the 20th century (1899–1965). The firms were thus born as well as lived under different economic, social and political conditions. The study investigates the influence of cohort effects as well as macroeconomic conditions, such as the business cycle. Therefore, it also examines the relationship between micro level events and macro, aggregate phenomena. It is found in the study that, while the likelihood of death generally increases with low age and small size—as often observed in previous research—there are also considerable environmental and generation effects. Macro-environmental fluctuations over time affect the likelihood of death. In periods of macroeconomic expansion, or in times when interest rates are low, the risk of death decreases. Considerable structural cohort effects are also apparent. A cohort of firms born during a period of economic crisis and depression exhibits structurally lower survival rates, even over longer periods of time, compared to a cohort born under relatively better conditions. The remainder of this paper is organized as follows. Section 2 discusses earlier research results as concerns the survival of (new) firms. Section 3 presents the overall research setting, as well as methodological and empirical (data) considerations. In Sect. 4, the paper's empirical results are presented. Sect. 5 concludes the paper.

2 Determinants of firm death: individual, structural, environmental

In earlier research, three main elements of explanation to business or organizational failure have been put forward. One explanation incorporates a personality-based perspective, such as competency and owner-manager or entrepreneurial characteristics. There is not enough room here to discuss the many various aspects of founder characteristics, traits, motivation, and so on that have been investigated in earlier studies. It is sufficient to conclude that this perspective has historically been exceptionally popular in the entrepreneurship and small business literature and in business studies in general, if not the most popular one. Individual-oriented explanations are important, but are not the only ones that influence entrepreneurial and business behavior, and they cannot solely explain why some firms fail while others succeed. As an example, Davidsson and Henrekson (2002) argue that much empirical research regularly has produced long lists of micro-level factors—psychological, sociological—that affect business behavior and entrepreneurship "while taking the broader institutional framework ('the rules of the game') as well as the aggregate outcome as given".[2]

Another main explanation recognizes key structural attributes of firms such as their age, size, and industry affiliation. Here it is assumed that, firstly, firms are subjected to a liability of newness. Young firms exhibit higher death rates. Accordingly, as time goes by the hazard of death successively falls. Some firms are also submitted to a liability of smallness;

[1] There has been some debate regarding the effects of increasing shares of new and small firms; see e.g. Birch (1979), Davis et al. (1996), Davidsson et al. (1998), and Schreyer (2000).

[2] Davidsson and Henrekson (2002, p. 81). See also Brüderl et al. (1992), and Anheier (1996) for overviews and discussions concerning different explanations.

those started on a small scale are imprinted with a disadvantage relative to larger organizations. Small firms are therefore generally facing higher death risks. It seems to be a pervading idea that firms and organizations are subjected to such circumstances irrespective of time and of place (Carroll and Hannan 2000). This does not mean that the assumptions of age and size liabilities have stood unchallenged. Wagner (1999) e.g. showed that only smaller shares of all business exits were in fact firms that were young: an absolute majority of the exits in his study were quite old and often larger than the exits of lesser age. Thus higher age and, possibly, larger size do not imply protection against death. Alternative research approaches—for instance, a longer time frame and different methods—can therefore challenge earlier assumptions. Other structural factors that are often accounted for in empirical studies are industry differences. For instance, firms in manufacturing and/or innovative or competitive industries are seen as more probable to grow, but also more likely to fail, in comparison with those founded or operating in less innovative business fields.[3] There have also been assumptions of structural generation effects. These relate to differences between generations of organizations or businesses that are assumed to interact with environmental conditions at the time of founding. For instance adverse founding conditions are believed to imprint firms in a generation with a permanent liability. At the same time, it has also been suggested that firms that survive such fierce processes and or negative conditions may have better survival chances in the longer run because that intrinsically weaker firms are selected more fiercely (Shane and Kolvereid 1995; Swaminathan 1996).

Consequently, a third explanation acknowledges environmental conditions for firms, for instance macroeconomic variations and institutional conditions. It is to some extent a matter of taste if technological and industry-specific characteristics should be viewed as structural or as environmental. But if environmental factors are thought of as macro or aggregate economic fluctuations, or institutional conditions that relate to, say, taxation and bureaucracy—phenomena which the absolute majority of firms, large or small, cannot control or influence, at least in the short run—then it is reasonable to consider particularly industry affiliation as structural rather than environmental.[4] And in that case it seems that environmental factors have received less attention in entrepreneurship and small business research.[5] Rather, the assumption in the general literature appears to concern more the economic and social effects of new and small firms entries, not the other way around. It is obvious that firms, new or old, do not exist in a vacuum; firms interact with their environments, and these environments provide both opportunities and constraints. Studies regarding the post-entry performance of firms have even so to a lesser extent considered the relation between firm survival and aggregate conditions or fluctuations. Therefore, the effects of macro or aggregate determinants are generally more neglected. For one thing, rather short time-periods are often studied, and sometimes they do not cover even a full business cycle (for a discussion, see Boeri and Bellmann 1995). Of course, it does not imply that the relationship between post-entry behavior and the environment has been ignored. For instance, Highfield and Smiley (1987) studied business start-ups and found that low macroeconomic growth rates, low interest rates and high unemployment led to increasing entry rates. Similar conclusions were also reached by Audretsch and Acs (1994). From this viewpoint, consequently, environmental conditions—including institutional conditions such as taxation and bureaucracy—impede as well as facilitate business-founding activity. Therefore, there has been growing academic interest for the institutional effects on new firm formation and growth (Henrekson and Johansson 1999; Davidsson and Henrekson 2002).

[3] For studies that have investigated and discussed the significance of structural phenomena on post-entry performance, see for instance Audretsch and Mahmood (1995), Audretsch (1995); Carroll and Hannan (2000); Dunne et al. (1988, 1989); Evans (1987); Storey (1990), and Wagner (1994). See also Starbuck (1971).

[4] Several studies that want to capture the dynamics of entry, growth and exit often employ industry-specific (and variable) indicators such as industry growth, industry life-cycle etc. These indicators can in many instances naturally be regarded as environmental. Examples here are Audretsch et al. (2000), Tveterås and Eide (2000), and Segarra and Callejón (2002).

[5] For instance, this stands out as quite clear in Audretsch (2003). A similar impression is given by the thorough overview by Caves (1998).

As concerns business death and survival in particular, researchers have pointed at the effects of both founding conditions, as well as changing conditions over time. Macro-environmental conditions at founding can, as discussed earlier, explain mortality rates, particularly differences between populations (Swaminathan 1996). Other results also point to the influence of varying environmental conditions over time and that these often interact with age and size. Audretsch and Mahmood (1995) used aggregate covariates such as the unemployment and interest rate level and their results were mixed—the interest rate level showed no correlation with termination rates of firms. This might be an effect of most new firms are not dependent on external capital, or that the observation period of 5 years was too short. The unemployment rate however had an effect on firm death, indicating that the risk for death increased in times of macroeconomic downturns. Everett and Watson (1998) came to similar conclusions. A large share of small business failures in their study was associated with exogenous economic factors (unemployment and inflation rates). Ilmakunnas and Topi (1999) investigated a large sample of entries and exits over a 6-year period and found that growth in real GDP and interest rates affected exits of firms. Mata et al. (1995) used market dynamic variables—market growth and industry entry rates—as well as a cohort approach in studying firm survival. Their study shows that the independent variables were statistically significant when analyzing the survival patterns in different generations of firms founded during seven consecutive years, but variations between cohorts were difficult to detect. Tveteråas and Eide (2000), furthermore, combined firm-specific variables (size and age) with structural and environmental ones in a long-term study, and found that different environments create different conditions for new firms. Tveteråas and Eide claim, correctly, that little consideration has been dedicated to the relationship between aggregate fluctuations and post-entry performance. A similar approach is found in the study by Audretsch et al. (2000)—in their longitudinal analysis of four birth cohorts of Dutch firms founded between 1979 and 1982, traced over 10 years (and in which no significant differences between cohorts appeared), they conclude that the likelihood of survival is shaped by the environment in which it operates. A comparable result, but where cohort differences as well as macroeconomic effects were evident, is found by Fotopoulos and Louri (2000) in an investigation of entry cohorts in Greece (see Appendix 1 for a summary of approaches and findings in earlier cohort studies). Correspondingly, research on the relationship between exits among larger, more established businesses and macroeconomic cycles has reached similar conclusions (Goudie and Meeks 1991; Bhattacharjee et al. 2002). Nonetheless, while there often is academic agreement on the influence of age- and size-specific variables on the survival of firms, the effects of macroeconomic or external variables have been viewed as less obvious.[6]

3 Research setting and methodological considerations

Even if environmental conditions often have been acknowledged as important, little empirical research has been carried out. It is essential that these relationships receive more attention, particularly when considering that scholars have called for an increased integration of different perspectives and approaches regarding the particular conditions under which firms are founded, developed and terminated. It is regularly asserted that the environment imprints and affects the actions and behaviors of micro units. Therefore, there is an interaction and relation between micro and macro events. Simplistic ideas of venture outcomes, such as successes and failures, can have different implications at the aggregate or national level. Success at the firm level can of course under certain circumstances, or during specific periods, result in negative outcomes at more aggregate levels and vice versa; economic crime is here an obvious example (Baumol 1990; Davidsson 2004). Thus, firm success could naturally translate into societal regress as well as success. And similarly, macro-environmental and societal conditions affect firm (micro) performance. The phenomena of process and context are interacting and drive business behavior. Therefore an integration of research lev-

[6] Some results point to the conclusion that there do not seem to be any relationships: in a cohort study covering a time-span of nearly 15 years, Boeri and Bellmann (1995) had the explicit aim to investigate firm terminations and the business cycle, but found no such relationships.

els—and of context and process—is by many considered as a major challenge. The relationship between micro and macro events and conditions has been identified as fundamental for advances in the area of entrepreneurship and small business (Aldrich and Martinez 2001; Davidsson and Henrekson 2002) as well as to combine different approaches in order to make both empirical and theoretical progression (see for instance Shane 2003, and Eliasson 2005). Unfortunately, and contrary to identified needs, it seems as the share of studies with a micro-to-macro approach has stagnated while there in fact have been an increase of micro-oriented research (Davidsson and Wiklund 2001). Another area identified as important, and that relates to cause and effect, are longitudinal studies. To collect empirical data over multiple time-periods, which would be characteristic for the longitudinal method, is intrinsically more time consuming than to gather cross-sectional data. In spite of this, many studies have used cross section data, which often are considered to be completely inappropriate in many instances—especially as concerns causal analyses (Chandler and Lyon 2001).

3.1 A cohort approach

This study integrates the micro and macro perspectives. As stated earlier, its aim is to explore and link the likelihood of death to structural and macro-environmental conditions. The study uses a unique data set in which not only the *age* of a particular firm can be identified, but also *when* in time it was founded and therefore, at what particular year the firm was founded (birth cohort) as well as terminated. Demographers and social scientists have employed the cohort method and demonstrated its advantages, especially in comparison to cross-sectional designs (Hagenaars 1990; Janson 2000). The cohort method facilitates the separation of cohort, period, and age effects, respectively, although a definitive separation is not entirely possible (the term cohort is hereafter and in accordance with the cohort method literature used in the meaning of *birth* cohort).[7] It is beyond the scope of this study to fully address the cohort approach. In short, some factors are time-varying; they are produced by influences associated with each period of time. Consequently, they represent period effects. Therefore period can clearly influence the conditions for the units of investigation, say firms, and it is equally clear that this particular effect cannot be fully addressed with cross section data, if addressed at all. Firms of different age, and therefore of different generations, are included in cross sections. We do not really know if a firm is terminated because of its low age (i.e. an age effect) or due to the fact that *this* firm—but not all firms in the sample—were active during a period of macro-economic crisis (period effect).

Consequently, it is more difficult to find out if this firm belonged to a cohort that in general was exposed to a higher death risk than another cohort that was born under different conditions, i.e. a cohort effect. A cohort effect is an effect on people's or organizations' lives that arise from the characteristics of the historical periods—not necessarily being exactly the same particular year, month or day—during which they experienced stages of life. Here, differences in the socialization and early formative experiences of cohorts, such as during their birth, are thought of as particularly interesting. Ideally, therefore, a cohort study or an investigation of cohort effects makes it possible to detect movements in the variable of interest that are exclusive to that particular cohort or group of cohorts. As an example, if unemployment is (structurally) higher for a particular birth cohort of people compared to another, the effect of cohort will, in this case, influence unemployment rates for the particular cohort over the whole period studied (see Glenn 1977). It is also an advantage to be able to follow cohorts longitudinally, at least if we are interested in causal analysis. In that, the analysis of multiple cohorts avoids to a greater extent the risk of cohort centrism—i.e. to assume that the experiences or 'behavior' of a given cohort can be generalized to all others. Furthermore, the use of prospective data, such as in this case, avoids survival bias to a greater extent compared to other approaches. Survival bias is naturally common in cross-sectional designs (meaning that not all research units are included because they have exited the population before the cross section sample is carried out), but it can also appear in longitudinal studies that are based on retrospective data collection (Menard 1991).

[7] Mata et al. (1995), Wagner (1999) and Tveteräs and Eide (2000) are specific examples of studies that, in different ways, analyze firm survival with a cohort or generation approach. See also Appendix 1.

Even if the empirical material employed in this study consists of longitudinal cohort data, it is naturally not flawless. Since the data is based on historical source materials—some more than 100 years old—and not official statistics, some measurements and variables are in some instances simple by their nature. Nonetheless, it also has some advantages. The database consists of the re-created life-histories of seven birth cohorts of firms founded as joint-stock companies in Stockholm in the years 1899, 1909, 1912, 1921, 1930, 1942, and 1950—totally 2,154 firms. The different founding years were signified by quite dissimilar macroeconomic and social conditions and the cohorts are specifically chosen because of this. In comparison to many other investigations, the empirical material is based on chiefly unprinted (unpublished) archival sources. From archives it has been possible to construct a longitudinal database, which in practice ends in 1999, on firm generations that totally contributed with more than 51,000 observation years. The database contains information on a firm's cohort affiliation, as well as its age in years when it was terminated (if this occurred; some firms are still active today). Business death could naturally take different forms such as bankruptcy, voluntary or involuntary liquidations, or mergers. No distinction between different types of business closure is made in this particular study. Of course, it is likely that a bankruptcy represents a more immediate or drastic type of death in comparison to, e.g., a planned merger, and that it also represents more of a 'genuine' business failure compared to other types of deaths. Nonetheless, it is probably too simplistic to view all deaths, or all bankruptcies, as real failures. A long-lived firm that, for some reason, goes bankrupt after several profitable decades cannot perhaps be compared with the early liquidation of a small, newly established business. There has been extensive academic debate concerning business failures and the many definitions (see e.g. Gratzer 2001; Headd 2003). The advantage of using death—the exit from a population—as a dependent variable, such as in this case, is that it opens up a possibility to measure the duration of a firm's life. Much research has used this broader approach when studying their ability to survive.[8]

[8] See for instance Evans (1987), Dunne et al. (1988, 1989), Audretsch (1995) and Wagner (1999).

Each firm's intended line of business, as well as its size at start can also be obtained from the database. Perhaps the two last variables need some clarification. The only indicator of size is each firm's stock capital at start (here deflated values, using the Consumer Price Index, CPI, from Statistics Sweden). Alternative size indicators are of course, at least in theory, possible to employ but they would demand much effort to collect. The results would, additionally, be fragmented and biased. This capital is in addition assumed to be constant over time for each firm. This was of course not the case, especially if firms survived for longer periods, but presently stock capital at start is the only available size measure. Furthermore, the intended line of business (industry) is based on the founder's or founding team's stated line of business when the firm was registered. It does not vary over time in the database. As mentioned, the source material is not derived from, or uses, any official definition of industry affiliation and it has in some instances been up to the researcher to assess this—in this case the three categories of services, trade, and manufacturing, respectively. It is the author's intention to further refine and extend the database in the future.[9]

4 Firm death in seven birth cohorts

Table 1 reports some basic data over the cohorts in the study. The oldest cohort, from 1899, originally consisted of 105 firms. Over time, and with excep-

[9] The preserved archives of the Swedish Patent and Registrations Office (*Patent- och registrerings-verket*, PRV) are the main source for the investigation. Stockholm has been used as a limit due to the potentially large number of firms that otherwise would have to be included each year. PRV became in 1897 responsible for registration and supervision of all joint-stock companies. Each company was assigned with a registration number, which was maintained throughout its active time. Each individual company can therefore be traced over time in various PRV archives. Since most firms were small, only a smaller share of them had (or reported) any employees. Thus, the 'best' or most comparable size-indicators are in this case financial variables (e.g. revenue, assets, stock capital). Nonetheless, for firms that were active for only a few years, asset and revenue data is often hard to obtain (these firms did not leave any artefacts). Hence, stock capital data is the most 'stable' size indicator, and it is also easily available in the PRV archives. See Box (2005), pp. 16–23, for a more detailed description.

Table 1 Seven birth cohorts of firms

		Cohort 1899	Cohort 1909	Cohort 1912	Cohort 1921	Cohort 1930	Cohort 1942	Cohort 1950	All Cohorts
Frequency	N	105	201	134	351	452	407	504	2,154
	(%)	(4.8)	(9.3)	(6.2)	(16.3)	(21.0)	(19.0)	(23.4)	(100.0)
Age (years)	P_{25}	2	3	2	2	3	10	10	4
	P_{50} (median)	9	8	7	5	12	24	20	14
	P_{75}	28	29	18	32	41	52	45	41
	Mean	24	22	16	18	24	27	24	23
Size (cum %)	−19	8	15	18	38	50	77	95	55
	20–49	16	39	45	66	70	88	98	71
	50–99	37	57	67	78	82	95	100	82
	100–499	76	90	92	98	96	99		96
	500–999	95	96	93	99	98	100		98
	1000+	100	100	100	100	100			100
Industry (%)	Services	25	38	28	35	31	26	46	32
	Trade	25	24	37	43	47	43	26	37
	Manufacturing	50	38	35	22	22	31	28	31

Frequency, age, industry, and size at start (stock capital, deflated values, 1930 = 100)

tions of cohorts 1912 and 1942, more firms were founded. The youngest generation, Cohort 1950, started with nearly five times more firms than the oldest one. It is reasonable to assume that it gradually became more common to start a new business in the form of a joint-stock company. The real cost for incorporating a business decreased significantly over time since the lowest nominal capital limit for joint-stock companies was 5,000 Swedish *Kronor* (kr.) during the entire period of investigation. The share of companies establishing as manufacturing firms declined, with some variation, over time. To some extent, this tendency can probably be linked to the gradually lower costs for incorporating a business; new entrepreneurs in less capital-intense small-scale industries, such as small retail services and trade, could increasingly afford to a form of business with limited liability.

Generally, firms were terminated at a young age—a quarter of the total population of 2,154 firms did not survive beyond the age of four (P_{25}, first quartile). Large differences nonetheless appear. Cohort 1912 exhibited the lowest average (mean) age, followed by Cohort 1921 and Cohort 1909. And by comparison, cohorts 1942 and 1950 showed a very different pattern. The large deviation in the age distribution between cohorts suggests that the cohorts exhibited dissimilar survival patterns over time. Clearly firms in Cohort 1921, for example, seem to have experienced a considerable fiercer selection process at young age than the cohorts of 1942 and 1950: the median age shows that fifty percent of the firms in the former cohort reached a maximum age of 5 years, while the corresponding figures for the latter cohorts were 24 and 20 years, respectively. Paradoxically—and in contrast to earlier research results—small firms thereby seem to have had better chances of survival on average than larger ones. This is because firms in older cohorts generally were larger (Table 1, 'Size') but had generally shorter lives (Table 1, 'Age'). This seems unreasonable; we can generally assume that small firms in fact have a higher risk for early termination. One explanation to the age-size relationship in Table 1 could be that stock capital is an inappropriate size-measure. This does not however seem likely: earlier studies have shown that different measures generally are correlated (c.f. Agarwal 1979). Therefore, stock capital is employed as an indicator of size. We can establish that firms' start-up size on average decreased over the period studied here. The question is rather if a small new firm in 1899 was considered to be a large new firm in 1950. More present-day data reveal for instance that the number of small firms in most developed economies,

including Sweden, has increased significantly over the past 30 years and that average firm size has decreased (Traù 2003).[10]

In solving this problem a period-specific size measure was employed: cohorts founded during the same period or era are assumed to share a common attribute. The cohorts from 1899, 1909 and 1912 were therefore defined as Prewar cohorts while the 1921 and 1930 cohorts were classified as Interwar cohorts. Finally, and although Cohort 1942 was founded during World War II, this and Cohort 1950 were defined as Postwar cohorts. After ranking each firm according to size, the largest third of firms in each of these three cohort categories were defined as large firms while the remaining two thirds were defined as small. Thus, a rather crude definition of start-up size is obtained. Naturally other criteria could be used. This procedure is a compromise and it can control that average founding size among new entrants actually decreased over time. Hopefully, it can also take into consideration that conceptions of 'small' and 'large' size may vary considerably over longer periods of time, such as in this case that has a nearly 70 year period of analysis. Figure 1 confirms the assumptions that the death risk was higher at low age and that insignificant size further increased this risk. The figure reports the hazard rates for small and large as well as for all 2,154 firms in the database ('Total'). The hazard is measured as the probability that an event will occur at a particular time to a firm, given that the firm is at risk at that time (Allison 1984). It can be concluded that particularly the first five to 6 years were more hazardous than the following years. After that, when firms matured, the hazards for both small and large firms became approximately comparable.

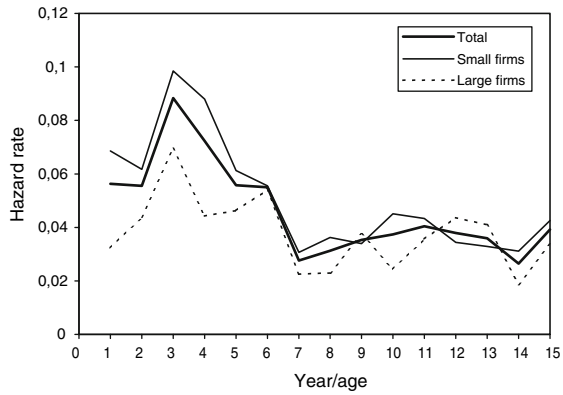

Fig 1 Accumulated hazard rates over 15 years in the seven cohorts

The cohorts can also be analyzed separately; the main interest here lies in observing any differences in survival rates over time. The firms faced different founding conditions. For Cohort 1899, the first 2 years were signified by economic expansion. A recession occurred in 1901–1902, but the economy soon recovered and the upswing lasted another 6 years. Inversely, the new firms in Cohort 1909 first faced a macroeconomic slump, but the economy soon improved and expanded some years into the First World War (1914–1918; Sweden did not participate in any of the two World Wars). Cohort 1912, therefore, experienced a period of economic expansion during its first years in life. The last war years were however overheated, as were the two following inflation years in 1919 and 1920. A severe economic depression therefore hit the newborns of Cohort 1921. The economic fall was however rather short. Nonetheless, the price level was falling and the financial sector had rigorous problems. The remaining years of the 1920s were even so generally signified by recovery. Similar to many other countries, another deep recession occurred in the early 1930s. The firms in Cohort 1930 initially faced a macroeconomic fall, but the Swedish recession was in fact comparably short; the economy improved already in the early 1930s. This period was also the beginning of a more active financial and monetary policy in Sweden. The remaining years up until the outbreak of World War II (1939–1945) were expansive. The war brought about several regulations of business activity, which remained even after the peace. Thus, the firms in Cohort 1942 were born into times of regulations, and

[10] The conceptions of small, medium and large firms probably vary significantly both over time and across economies. For instance, in the European Union today a micro firm has 0–9 employees, and a small firm has 10–49 employees. Medium-sized firms employ 50–249 persons, while large firms have 250 or more employees. Sweden had previously other classifications: a small firm were traditionally defined as having zero to 200 employees, and a large business as 500 or more; Lundström et al. (1998, pp. 25–27). As another example, in the 1960s the Federation of Swedish Industries seems to have viewed medium (manufacturing) firms as having up to 1,000 employees (*Sveriges Industriförbund* 1961). This differs significantly from the more present-day definition of 50–249 employees.

after a first drawback and fall in aggregate demand in 1940 and 1941 the macro economy was recovering. The post-war years were an economic boom. Particularly from the mid-1950s, consumption and investments rose significantly. Hence, Cohort 1950 was founded in the beginning of an extraordinary economic expansion with few slumps in the business cycle. This was an expansion that did not weaken until mid-1960.[11]

Based on this brief description of the Swedish economic development, it comes as no surprise that the survival rates also varied between cohorts. Figure 2 shows the cumulative survival ratio for each cohort during its first 15 years. It stands out as clear that the postwar cohorts (1942 and 1950) differed significantly from the others since their survival ratios were high even at young age. It does not seem likely that a liability of newness played a role in the case of these two cohorts. This conflicts with previous research results. In particular, the firms in Cohorts 1942 and 1950 had a small actual start-up size compared to older generations. Neither a liability of newness nor of size seems to have been present in these two cases. This falsifies the hypothesis that young firms regularly—regardless of time and place—exhibit excessive mortality rates due to low age, and that small size further enhances this risk. Thus, separate populations can reveal different levels of hazard when in the same age. Taken together, these differences imply that not only age and, possibly, size are important elements in explaining both why, when and to what extent firms survive. Some cohorts continued to have comparably high hazard rates at a fairly mature age (1912 and 1921) while for others the hazard decreased as they grew older (cohorts 1899, 1909 and 1930). For one thing, Cohort 1912 had in fact the third highest survival rate during the first 2 years, but the First World War, particularly the initial war years, seem to have increased the cohort's mortality rates significantly. Cohort 1921, furthermore, displayed a nearly permanent liability in comparison to other cohorts—throughout almost the entire observation period it displayed the lowest survival ratios. Hence, low age and negative period effects coincided for these two cohorts.

[11] For a more thorough study of the Swedish economic development, see Schön (2000).

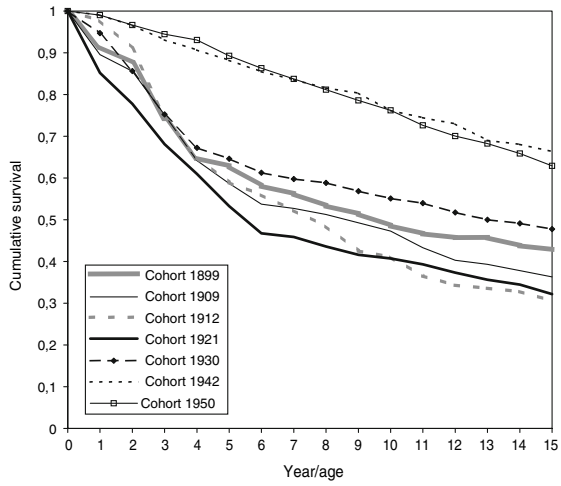

Fig 2 Cumulative survival over 15 years in the seven separate cohorts

4.1 Firm death, environment, and cohort

The seven birth cohorts displayed very different survival patterns. Consequently it seems that conditions at founding, i.e. cohort effects, were influential. Secondly, death rates among firms varied over time, meaning that there probably were period effects. In order to test these assumptions, an event history approach seemed reasonable, employing a Cox proportional hazards model with time-varying covariates. This is a widely used semi-parametric and flexible model, and is the most traditional one in event history analysis (Box-Steffensmeier and Jones 2004). Here, an interest lies in testing the hazard for an event at a certain point in time, or rather, at a certain firm age. In this case, an event is the death of a particular firm at a particular age. Two main groups of covariates are included in the test. One group represents the business environment and period specific conditions—more specifically the business cycle, the discount rate level, as well as the two World Wars. It is assumed here that a macroeconomic recession in general leads to deteriorated conditions for firms. Periods of negative or low economic growth involve decreasing consumption and investments and therefore a decline in aggregate demand. This can lead to intensifications of the death rates of firms, while times of economic expansion generally are assumed to improve the survival chances of firms. Here, yearly growth rates of the

Gross Domestic Product (GDP) 1899–1965, taken from Edvinsson (2005), are used as a business cycle indicator. Additionally, the Swedish Central Bank's real discount rate is used as an indicator for credit conditions. High interest rate levels might cool off investments and negatively affect firms with high burdens of debt. It can create uncertainty for economic decisions, and firms could get into financial distress. A high discount rate level might therefore, it is assumed here, decrease firms' survival chances.[12] The variable 'War' simply indicates the presence or absence of war (i.e. 1914–1918; 1939–1945 = 1, yes, and 0 otherwise). It is not unreasonable to assume that survival chances were affected by the particular conditions that prevailed during the two World Wars.

Another group of covariates is defined as structural. Generation, i.e. cohort affiliation, is one, using the three categories of Prewar (1899, 1909, 1912), Interwar (1921, 1930) and Postwar (1942, 1950) cohorts. Admittedly some analytical depth and detail is lost with this course of action. On the other hand, it facilitates an interpretation of the regression results, and the procedure may still tell if there are any general—or broad—effects of generation (the Postwar cohort is the reference category). Industry affiliation is another structural variable. This variable is employed in order to investigate if firms in manufacturing were more exposed to a higher death risk or not (1 if manufacturing; 0 otherwise, i.e. services or trade). Finally, firm size as defined above is also utilized as a structural variable, coding small firms as 0. In total, the model comprises nearly 24,000 observations. The event history results are presented in Table 2, and include four different models with both main and interaction effects. As concerns the latter, it is assumed here that structural factors such as firm size can co-vary with environmental change. Small firms exist closer to the edge, and larger firms can continue operations over longer periods before they, perhaps, disband. An unsystematic shock that is only a minor problem for a large firm can prove to be fatal for the smaller business (Hannan et al. 1998). Therefore, the interaction variables are employed to measure if period-specific variables (here: business cycle and discount rate) had a different impact on small and large firms, respectively.

Overall it can be established that the environmental variables significantly affected the firms' survival chances (models [1] to [4]; see Appendix 2 for correlations, means and standard deviations). A period or year of macroeconomic contraction increased the probability for death. Similarly, higher discount rates implied increased risk. Thus, when the economy was expanding, or when the discount rate level was low, firms in general faced lower hazards. The negative coefficient of the war-variable, furthermore, indicates that the hazard decreased during times of war. As mentioned earlier, Sweden did not participate in any of the two major wars of the 20th century, and the economy was protected and regulated in many instances—especially during World War II. Particularly Cohort 1942 showed evidence of a very low hazard during its first years (compare Table 1). Many of the structural variables exhibited significant effects on firms' survival ability. Firm size showed a negative effect, confirming many earlier results that have claimed that firms of small size have higher hazards than larger ones. Firms starting in manufacturing gave however no evidence of being exposed to a higher risk (models [3] and [4]). Although the coefficients were positive, indicating a higher risk for manufacturing firms, they were nonetheless far from significant. Thus, in this particular study, there were no discernable structural differences between industries. The coefficients for the cohort-variables confirm in many instances what already had been suspected, namely that there were considerable generation effects. The hazard was structurally higher for firms in the Prewar cohorts compared to the ones in the Postwar cohorts (reference group). The risk for death was even higher for the Interwar cohorts. Almost certainly, this effect came mainly from the 1921 cohort, which experienced high death rates for a long period of time. It is thus likely that the generations were imprinted with conditions at founding.

There were also apparent interaction effects in some cases, showing a smaller sensitivity among firms of larger size. The interaction between firm size and the business cycle, i.e. GDP growth (models [2] and [4]), shows that large firms were relatively less

[12] This discount rate data has been assembled by Edvinsson (2006) and concerns the nominal level. It has been adjusted for inflation by the author, using the CPI from Statistics Sweden.

Table 2 Cox regression results

	[1]	[2]	[3]	[4]
GDP growth	−0.087 ***	−0.098***	−0.069***	−0.078***
	(0.008)	(0.010)	(0.008)	(0.009)
Discount rate	0.061***	0.064***	0.035***	0.037***
	(0.004)	(0.005)	(0.005)	(0.006)
War	−0.197**	−0.184**	−0.637***	−0.636***
	(0.092)	(0.092)	(0.101)	(0.101)
Firm size		−0.391***	−0.403***	−0.460***
		(0.091)	(0.067)	(0.090)
Manufacturing industry			0.096	0.092
			(0.066)	(0.066)
Prewar cohort			0.871***	0.866***
			(0.092)	(0.092)
Interwar cohort			0.904***	0.900***
			(0.079)	(0.079)
Firm size × GDP growth		0.036**		0.031*
		(0.017)		(0.017)
Firm size × Discount rate		−0.010		−0.009
		(0.009)		(0.009)
−2 log likelihood	20,504.20	20,473.40	20,332.49	20, 328.08
Chi-square	382.13***	444.60 ***	554.22***	590.82***

Firm death and covariates

Beginning Block −2 log likelihood = 20,798.67

Total number of cases (observations) = 23,727

*, ** and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively

Standard errors in parentheses

vulnerable to negative environmental pressures.[13] However, one interaction term was statistically significant at 'only' the 10 percent level. The coefficient that represents the interaction between interest rate and firm size also shows that larger firms were relatively less sensitive, but this was not statistically significant. These observed relationships nonetheless calls for further investigation. For instance, and even if some studies have assumed somewhat other relationships (Audretsch and Mahmood 1995 e.g. presume that at least new firms are less dependent on external capital) it is not unreasonable to imagine that small firms are relatively more sensitive to higher interest rates. This can be seen as a credit-crunch for smaller firms and indicates deteriorated lending conditions. If small firms' credit costs rise, highly mortgaged or marginal firms may have to exit.

5 Conclusions and discussion

Even if it is logical to assume that firms interact with their environments, much research has remained at the micro level and has often investigated personality-based factors as regards entrepreneurship and small business activity. Not disregarding that numerous valuable insights and important results have come

[13] This might perhaps seem counter-intuitive at first since the coefficient for the interaction term *Firm size* × *GDP growth* in models [2] and [4] is positive. Nonetheless, the 'main-effect' of the GDP growth covariate is negative (c.f. model [1]) which means that the interaction in question shows that large firms were *less* sensitive relative to small firms (i.e. had lower hazards). Separate regressions for small and large firms also confirm this.

from this stream of research, some scholars have nonetheless emphasized the need for more micro-to-macro studies. They have also claimed that more longitudinal research is needed. Issues that relate to business growth and survival commonly concern causality. In many instances cross-sectional designs—but also too short panels—may be unsuitable for such questions. This is particularly evident if we want to relate business behavior (growth, death, etc.) to business *environment*. Thus, the length of the study as such is of importance: to employ a data set of firms that covers a short period of time may give important insights as concerns *some* questions, but not other ones. This study has traced individual business firms for, at most, one and a half decade. It has also covered a long period of time—nearly 70 years—in 20th century Sweden. The study has integrated the micro and macro perspectives and investigated the relationship between the death of firms, their environment, and structural factors. Additionally, it has contributed with historical insights as regards firm behavior. Many studies do not go beyond the 1970s. Even if this has not been the overall aim, the importance of this historical dimension should not be neglected—for one thing, it is of scientific interest, both empirically and theoretically, to investigate if earlier periods exhibit similar or diverging patterns. And some differences were detected. Firms generally displayed higher hazard rates at young age, and small firms moreover displayed higher hazards than large firms. So far, this confirms prior research results. Nonetheless, the comparative approach of this cohort study has clearly showed that different cohorts may display different hazards. The liability of newness, for instance, was hardly in force when it comes to the two youngest cohorts in the study (1942 and 1950). The prior assumption that claims that there is a liability of newness regardless of time and place must be considered to be falsified, and should be investigated more in future studies.

Two other, and related, conclusions can be drawn from the results generated here. Firstly, the institutional dimension, which admittedly has not been considered here to any particular extent, is important to investigate in the future. The two youngest cohorts operated under quite rigid institutional constraints and heavy regulations—particularly the one from 1942. And both cohorts displayed high survival rates. Evidently there was a clear connection between institutional conditions and survival ability. Secondly, the results show that macroeconomic conditions at founding as well as over time—cohort and period effects, respectively—influenced the survival ability of firms. For instance, it is not unlikely that firms in different cohorts were imprinted with a permanent high, or low, liability, determined by the specific macroeconomic conditions at founding (compare e.g. Cohort 1921 with Cohort 1950). As has been argued in the study, these effects can hardly be separated or be accounted for with other research designs. Earlier studies on post-entry performance have also been somewhat ambiguous as regards cohort effects. One explanation is perhaps that these studies often have investigated cohorts born in consecutive years, meaning that the time-span between them is 'too' short and that they almost belong to the 'same' generation. This study has on the other hand employed a nearly 70 year-perspective in which the age difference between the oldest and the youngest cohort is 50 years. Aggregate conditions and fluctuations over time influenced post-entry performance. Periods signified by less benign or by worsened credit conditions, or by low or negative macroeconomic growth also implied that the survival ability of firms on average declined, particularly as concerns small firms. For that reason, the results in the study confirm the assumption of aggregate economic environmental effects on micro (firm) behavior—and in that case, the results can also in a broader sense be connected to questions that relate to macroeconomic policy.

Acknowledgments The article is a revised version of some parts of my doctoral dissertation (Box 2005). The database in the article has been widely extended and refined: new data and variables have been added, and new methods of analysis are employed. I am grateful for comments from Niclas Berggren, Andreas Bergh, Dan Johansson and Henrik Lindberg. Stig Blomskog has been most helpful with methodological issues.

Appendix 1 Earlier cohort studies—approaches and findings

	Audretsch et al. (2000)	Boden and Nucci (2000)	Boeri and Bellmann (1995)	Dunne et al. (1988)	Fotopoulos and Louri (2000)
Approach/ method	Four cohorts of start-ups. Logit model	Two cohorts of business startups. Maximum likelihood model	Two entry cohorts, OLS regression	Four entry cohorts (and exits)	Three entry cohorts. Cox regression analysis
Period/years	1978–1992, each cohort followed longitudinally for 10 years	Cohorts founded 1980–82 and 1985–87, respectively. Followed for 4–6 years	Cohorts founded 1979 and 1982, each followed to 1992	Cohorts founded 1967, 1972, 1977, and 1982. Traced between 1967 and 1982	Firms established in 1982, 1983, and 1984, followed up to 1992
Country	The Netherlands	USA	West Germany	USA	Greece
Findings, variables etc.	Likelihood of survival lower in R&D intense industries and for young/small firms. Tests, but finds no support for effects of industry and firm debt structure on survival	Business owner characteristics; tests for gender and economic/social effects. Higher education and/or previous (managerial) experience and gender (males) increase survival chances. Macroeconomic differences found (but not specifically tested)	Age, size and industry effects on likelihood of survival. Macroeconomic conditions tested but firms show little cyclical sensitivity	Focuses on entry and exit patterns across industries and over time, as well as on post entry size and on market share diversification. Diversifying and/or larger firms less likely to fail. Substantial heterogeneity across industries as concerns entry and exit patterns	Firm-specific, sectoral and cyclical variations. Larger size at founding and high profitability increase likelihood for survival; sectoral effects (high entry levels and lower sunk costs) increase hazards; macroeconomic and cohort effects evident—firms entering closer to economic downturns more prone to fail
	Fritsch and Weyh (2006)	Mata et al. (1995)	Segarra and Callejón (2002)	Tveterås and Eide (2000)	Wagner (1994)
Approach/ method	Eighteen start-up cohorts	Seven entry cohorts. Cox regression	One entry cohort. Cox regression	Ten entry cohorts. Cox regression	Four entry cohorts, PROBIT analysis
Period/years	Firms established between 1984 and 2002 (18 years)	Cohorts established 1983–1989	Cohort founded 1994, followed to 1998	Period investigated 1977–92	Cohorts founded 1979–1982, period of analysis 1979–1990
Country	(West) Germany	Portugal	Spain	Norway	West Germany
Findings, variables etc.	Analysis of the cohorts' gross employment effects. Employment in each cohort declines over time. Age effects apparent (high selection at young age). Job generation effect among new firms is small	Size-effects apparent. Novelty on market and past growth has effects on survival. New plants more likely to live longer in growing industries or in industries with little entering activity	Industry growth-effects tested; Gibrat's law falsified. Insignificant size and innovative environment increase hazard rates	Structural differences between new and existing firms and between industries. Age and size effects on survival chances. Capital intense sectors and high investment rates lower hazard rates	Age effects on hazards. No clear-cut nexus between start-up size and survival. No industry effects discernible

Note: Several studies do not use the term cohort in the meaning of an entry (e.g. birth) cohort, but rather as an age cohort. In the latter case, the firms are homogeneous as concerns *age* (i.e. as a panel), but heterogeneous concerning their *generation/cohort* affiliation). Other studies employ an even more general or unspecified definition of the term. In these cases, 'cohort' simply seems to mean a population or a sample. The table above specifically excludes such studies. It moreover focuses solely on research on firm exits and survival

Appendix 2 Correlations, means (m) and standard deviations (s.d.)

		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	m	s.d.
[1]	GDP growth	1.00	0.22	−0.22	−0.01	0.00	−0.09	−0.15	0.22	0.48	0.13	3.42	3.52
[2]	Discount rate		1.00	−0.32	0.02	0.02	−0.02	0.30	−0.27	0.12	0.60	1.41	7.19
[3]	War			1.00	0.04	−0.02	0.09	0.06	−0.13	−0.08	−0.20	0.18	0.38
[4]	Firm size				1.00	0.18	0.05	0.05	−0.08	0.60	0.18	0.35	0.48
[5]	Manufacturing industry					1.00	0.08	−0.04	−0.03	0.12	0.04	0.30	0.46
[6]	Prewar cohort						1.00	−0.31	−0.46	−0.02	0.00	0.17	0.38
[7]	Interwar cohort							1.00	−0.70	−0.04	0.18	0.32	0.47
[8]	Postwar cohort								1.00	0.05	−0.17	0.51	0.50
[9]	Firm size * GDP growth									1.00	0.28	1.21	2.70
[10]	Firm size *Discount rate										1.00	0.58	4.40

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