CHAPTER 4
Company Survival Rate as Function of Age

Mateusz Codogni

AGH University of Science and Technology in Krakow, Poland; ORCID 0000-0002-3775-1567

Summary. New organizations are more likely to terminate their operations than older ones. This assumption about company mortality does not seem to be very controversial – it is widely held true. Also, a body of empirical research supports it. The aim of this chapter is to test the prevalent assumption that company mortality decreases as function of the company age. The dataset used in the study is Eurostat online database on survival rates of newly established companies in the first five years of operation. The sample is defined as "business economy except activities of holding companies" (NACE sections B to N except K462). Time span of 2007–2016 (five age cohorts of companies, established in years 2007–2011) has been included in the analysis. The analysis has been performed for twenty countries. The method employed is analysis of trends in time series of data on average business survival. The results indicate that in some countries the hazard does not monotonously decrease with age, but rather increases in first years of operation and then starts to decrease. The implications of these results are discussed in the chapter. The implications of the company survival dynamics can impact the research areas of entrepreneurship and public policy on entrepreneurship.

Keywords: company survival, firm death, firm age

1. Introduction

Survival is the most fundamental aim of companies. It can also be considered the most basic, Darwinian measurement of their success. As such it is the central aspect in the measurement of organizational development – it precedes growth, profit, return on investment or any qualitative OD measurement. Survival is a product of maintaining the precarious state of equilibrium in turbulent environment. Being one of the principal aims of management[1],

[1] It could even be very plausibly argued, following C.I. Barnard, that survival is the only sign of organizational success (O'Connor, 2016).

business survival has attracted interest of numerous scholars. One of widely held assumptions is that new organizations are more likely to die than old ones. This assumption does not seem to be very controversial. Also, a body of empirical research supports this claim.

The rest of the chapter is organized as follows. Simple model of company mortality is presented based on the literature of the subject. Empirical studies supporting this model are also presented. Then data on company mortality available in Eurostat database is used to calculate patterns of mortality in twenty European countries, which are then compared to the model. Discussion of the results follows. The chapter ends with conclusions and suggestions of future research.

2. Simple model of company mortality

Construction of a mathematical model of company mortality can be based on a model of death rates in human populations. Such a model proposed by Gompertz states that in adult human populations death rates rise monotonically with age. In population of companies the opposite is roughly true – death rates decline monotonically with age. In order not to imply that the death rate eventually becomes essentially zero, which would suggest the virtual immortality of very old companies, it makes more sense to assume that death rates decline toward some positive asymptote. Makeham's modification of Gompertz formula, which takes into consideration some base mortality ratio that is not connected to age, after the appropriate change of sign for company mortality, is as follows (Freeman et al., 1983, p. 696):

$$r(u) = \alpha + \beta e\gamma(u),\ \gamma < 0 \tag{1}$$

"The parameters of the model in can be interpreted as follows. Setting $u = 0$ gives the mortality rate at birth: $r(0) = \alpha + \beta$. Setting $u = \infty$ gives the asymptotic death rate, the rate that applies to very old organizations: $r(\infty) = \alpha$. Thus β tells the amount by which the infant death rate exceeds the asymptotic death rate. Finally, γ governs the speed at which the death rate falls with age, the rate at which the liability of newness wears off. Large negative values of γ imply that the liability of newness diminishes rapidly". (Freeman et al., 1983, p. 696).

Numerous explanations of this shape of company mortality function are offered. "Stinchcombe argued that new organizations suffer a liability of newness, a greater risk of failure than older organizations, because they depend on the cooperation of strangers, have low levels of legitimacy, and are unable to compete effectively against established organizations" (Freeman et al., 1983, p. 692). Falk (2013, p. 378) and Geroski link company survival increasing over time to company-level learning process. "The data suggest that experience may be crucial determinant of survival rates, but that it is not quickly acquired" (Geroski, 1995, p. 424). Geroski draws attention to turbulence of environment posing especially high demands on speed of learning. Mata et al. offer an explanation connected with scale: "new firms enter typically below the minimum efficient scale in the industry. Therefore, they are confronted by a cost disadvantage vis a vis their efficiently scaled competitors, which makes their survival more difficult. However, for those that are nevertheless able to survive, the need to reduce this cost gap provides a strong incentive to grow. [...] A consequence of this story is that, because growth reduces average costs, firms should be less likely to exit after having grown" (Mata et al., 1995, p. 460).

All the above-mentioned theoretical models support the hypothesis, that with every year of operation the likelihood of company survival increases monotonically. Therefore, the greatest percentage of newly formed companies end their existence during the first year, of those that survived the first year a smaller percentage fail during the second year, and so on – in every birth cohort, company mortality ratio in year $n + 1$ is smaller than in year n.

This hypothesis finds corroboration in numerous empirical studies. For instance, in a study by Freeman et al., conducted on three populations of American organizations (1159 semiconductor companies from late 1950s to 1979, 476 national labor unions in years 1860–1980 and 2768 local newspapers in years 1800–1975) the authors found the proposed pattern of mortality to be true (as illustrated in Figure 1).

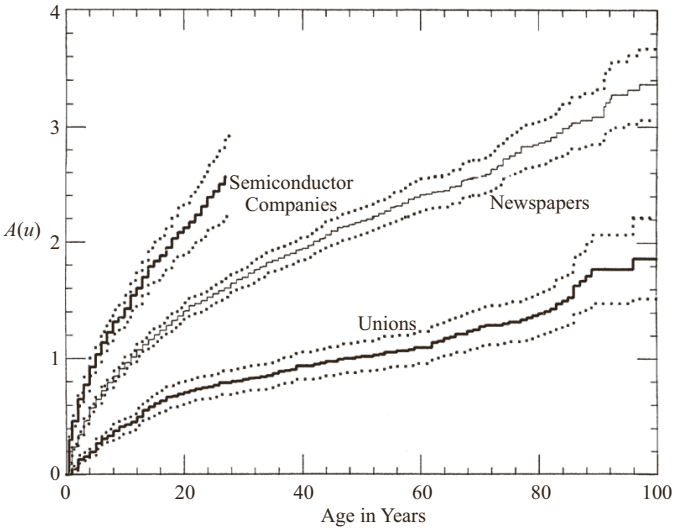

Fig. 1. Integrated hazard functions by age.
A(u) – for the unit of measurement calculation details see: (Freeman et al., 1983, p. 701)

Freeman et al. interpret the functions as follows: "each of these functions is nonlinear – the slopes decrease with age. This suggests that mortality is age dependent for each kind of organization" (Freeman et al., 1983, p. 701). Also Geroski, based on own empirical research, and on research by Evans, Hall, Audretsch and Mahmood, Dunne et al., Mata and Portugal, Wagner, and others, states that there is clear positive correlation between survival rates and both age and firm size for small firms (Geroski, 1995, p. 435). Ortiz-Villajos and Sotoca cite similar correlation in research by Sutton and by Cefis and Marsili (Ortiz-Villajos & Sotoca, 2018, p. 1419).

Similar conclusions can be drawn from the data published by US Small Business Administration on mortality of US companies established in years 1994–2013. As Figure 2 indicates, on average 21.5% of newly formed American companies end their operations in the first year. Of those that have survived the first year, 14.39% end their activity in the second year. This trend is continued throughout the whole presented period of the first ten years of operation – the average likelihood of company death decreases every year, reaching 6.61% by the tenth year of operation.

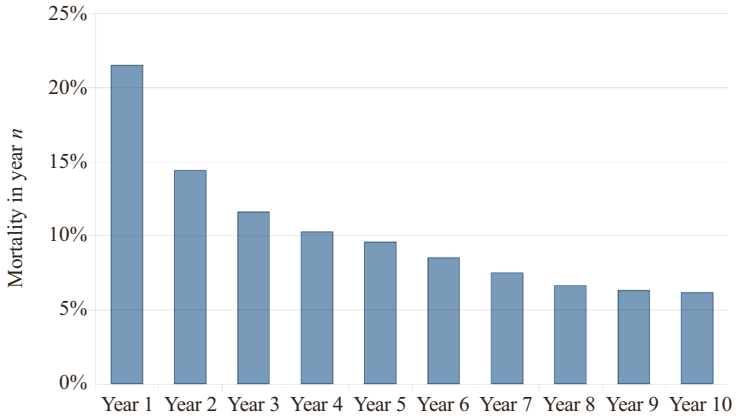

Fig. 2. Average mortality of American companies established in 1994–2013

Source: own calculation based on: Survival rates and firm age, US Small Business Administration, https://www.sba.gov/advocacy/small-business-facts-and-infographics [28.12.2018]

Eurostat online database contains data on survival rates of newly established companies in the first five years of operation. Group of organizations defined as "business economy except activities of holding companies" (NACE sections B to N except K462) has been analyzed. Time span of 2007–2016 (five age cohorts of companies, established in years 2007–2011) have been included in the analysis. Data on average company mortality in Germany, Spain, Czechia, Bulgaria, Lithuania, Slovakia and Hungary, presented in Figure 3, corroborates the hypothesis on monotonically decreasing company mortality.

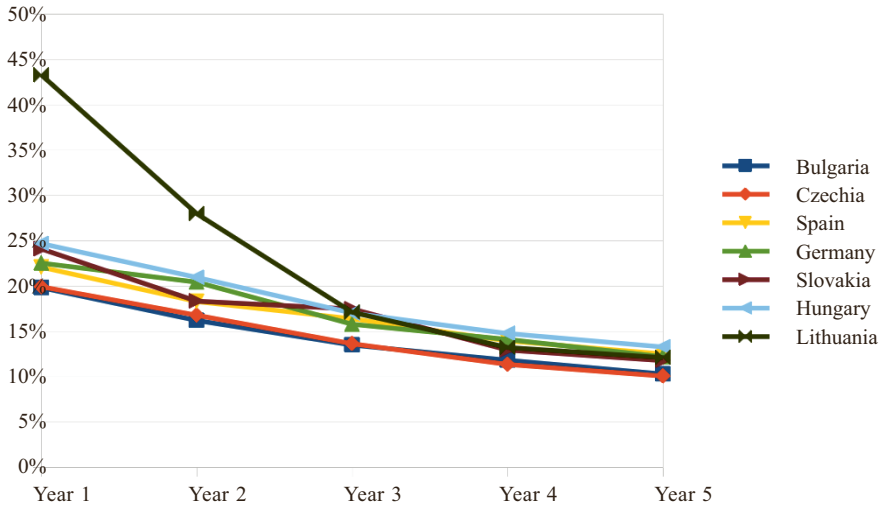

Fig. 3. Average mortality of German, Spanish, Czech, Bulgarian, Lithuanian, Slovak and Hungarian companies established 2007–2011, in first five years of operations

Own calculation based on Eurostat database: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=bd_9bd_sz_cl_r2&lang=en [28.12.2018]

The prevailing opinion seems to be that the monotonous decrease of company mortality is a universal pattern. For instance, Gregg and Parthasarathy, citing Bates, Cressy, Dunne et al., Mata and Portugal, state that "entrepreneurship research has consistently shown that firms tend to have a high failure rate during the first few years in operation and this failure rate decreases as firms age" (Gregg & Parthasarathy 2017, p. 409). Geroski states in his highly influential 1995 article "What do we know about entry?" that company age (along with its size) is correlated with its survival and growth (Geroski, 1995, p. 434). Similarly Box, upon literature review, states that "it seems to be a pervading idea that firms and organizations are subjected to such circumstances[2] irrespective of time and of place" (Box, 2008, p. 381). Also the theoretical model presented above is consistent with this view.

3. Company mortality in Poland and selected European countries

Closer scrutiny of data on survival of German, Spanish, Czech, Bulgarian, Lithuanian, Slovak and Hungarian companies reveals that the pattern of mortality is not uniformly monotonous. Some age cohorts (2007 German and Lithuanian cohorts, 2009 and 2010 Slovak cohorts) exhibit slight deviations from the model. Upon further investigation, the database of European newly established companies reveals some much deeper anomalies. In nine countries (Norway, Austria, Italy, Portugal, Finland, Luxembourg, Latvia and France) average company mortality reached its maximum in year 2, and then dropped steadily. In five countries (Poland, Great Britain, Sweden, Cyprus and Slovenia) average company mortality increased steadily in years 1–3, and then dropped steadily in years 4–5. Mortality pattern of Polish companies is illustrated in Figure 4.

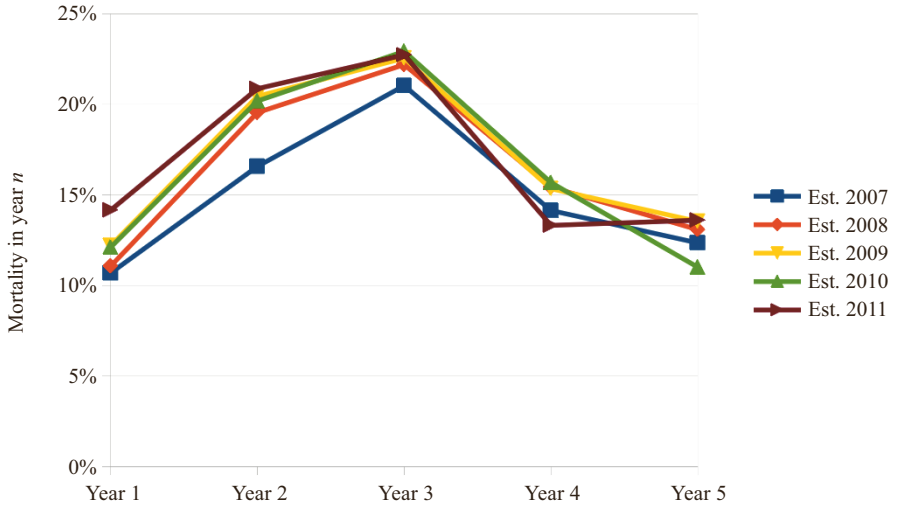

Fig. 4. Mortality of Polish companies established 2007–2011, in first five years of operations

Source: own calculation based on Eurostat database: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=bd_9bd_sz_cl_r2&lang=en [28.12.2018]

[2] That is: liability of smallness and liability of newness.

In every age cohort of the Polish companies the same inverted-U mortality pattern appeared, so it does not seem to be due to some external shock, but rather a relatively permanent feature of Polish newly-formed companies. Also, data from other countries implies that this phenomenon is not purely specific to Poland.

Ortiz-Villajos and Sotoca state that "business survival has been found to be influenced by many factors, such as the characteristics of the market [...], the industry life cycle [...], the sector's technological intensity [...]" (Ortiz-Villajos & Sotoca, 2018, pp. 1419–1420). Geroski and Audretsch state that industries are less varied by barriers to entry and more by barriers to survive (Audretsch, 1995, p. 444; Geroski, 1995, p. 424). "The lower variance in entry rates than survival rates across industries is consistent with Geroski's observation that, "In fact, most of the total variation in entry across industries and over time is 'within' industry variation rather than 'between' industry variation". By contrast, while the propensity for new firms to enter is relatively more constant across manufacturing industries, the likelihood of those firms' surviving over one decade varies considerably more. Thus, while Geroski's conclusion that "entry appears to be relatively easy, but survival is not", not only is true, but apparently the degree to which the likelihood of survival varies across industries is substantial and greater than the degree to which entry varies across industries. Barriers to survival appear to be more severe than barriers to entry" (Audretsch, 1995, p. 444). "If one accepts the proposition that the barriers to entry facing small entrants are generally rather modest, then these observations suggest the existence of substantial 'barriers to survival' of some type" (Geroski, 1995, p. 424). In view of these remarks, data on Polish companies has been analyzed separately for different industries. The results are presented in Figure 5.

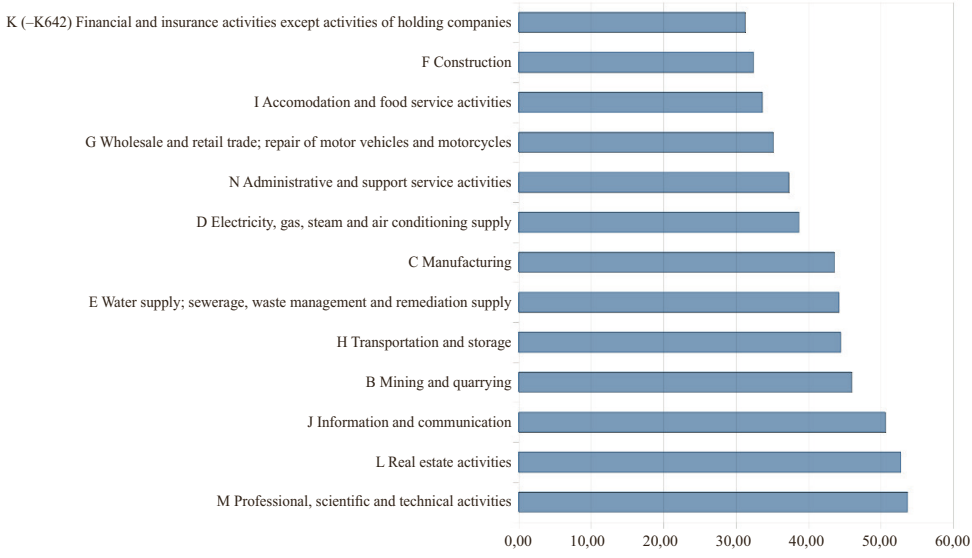

Fig. 5. Proportion of companies established in Poland in 2011, that have survived first five years of operation [%]
Source: own calculation based on Eurostat database: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=bd_9bd_sz_cl_r2&lang=en [28.12.2018]

In case of Polish companies established in 2011 in different NACE sections, it can be concluded that the proportion of companies that have survived until 2016 in the "safest" section (professional, scientific and technical activities) is over 1.7 times higher than in the "most dangerous" section (financial and insurance activities). On more detailed level of NACE groups one can notice even greater differences – retail sale via stalls and markets, call center activity or renting of video tapes and disks bore three times more risk of ending operations within five years of establishment, than legal practice, accounting or veterinary activities. So, the Eurostat dataset does seem to corroborate the claims made by Audretsch and Geroski concerning the differentiation of barriers to survival by industry. But the overall shape of mortality pattern is not very varied by industry. Of the 146 analyzed Polish industries, 109 followed the abovementioned mortality pattern (inverted-U, maximum in year 3) exactly. Further 12 industries exhibited inverted-U pattern, but with maximum in year 2, 1 industry exhibited inverted-U pattern, but with maximum in year 4. In 24 industries the mortality pattern did not follow inverted-U shape, of which only one (water transport) followed the theoretical, monotonous decrease pattern.

4. Discussion and conclusions

The patterns of company mortality observed in Eurostat data sample in substantial part do not conform to the basic company mortality model. Similar nonconformity has been also observed by some authors in studies using different data samples.

Holmes et al. have analyzed a sample of 931 manufacturing firms in the Wearside area of England which were newly-established over the period 1973–1994. Their conclusions suggest roughly the same (inverted-U) shape of mortality ratio that appears in Eurostat dataset: "the analysis here suggests that for both micro-enterprises and SAMEs there is an increased likelihood of death in each subsequent period of the early years after establishment, but that there is then a turning point such that firms which survive beyond this point are then less likely to die in each subsequent period. From the figures it can be seen that for both types of firms the turning point occurs after approximately 12 years" (Holmes et al., 2003, p. 16). Also Wagner, having researched small firms that entered German manufacturing industries between 1979 and 1982 and monitoring their performance till 1990, has concluded that hazard rates tend to increase during the first years and to decrease afterwards (Wagner, 1994). Box, having researched 2154 Swedish joint-stock companies founded in seven separate points in time between 1899 and 1950 (1899, 1909, 1912, 1921, 1930, 1942, 1950) and monitoring their performance until 1999 has produced results shown in Figure 6. Overall shape of the function in the initial seven years of operation seems to resemble to a much greater degree the inverted-U pattern than the theoretical, monotonous decrease pattern.

The prevailing opinion seems to be that the monotonous decrease of company mortality is a universal pattern. The presented Eurostat data and also works of Holmes et al., Wagner, and Box suggest that it is not universal. Considering the variety of researched time periods (2007–2016 in Eurostat dataset, 1973–1994 in Holmes et al., 1979–1990 in Wagner, 1899–1999 in Box) and countries, the inverted-U pattern of company mortality in the first years of operations seems to be a constant phenomenon, not a unique exception to the rule.

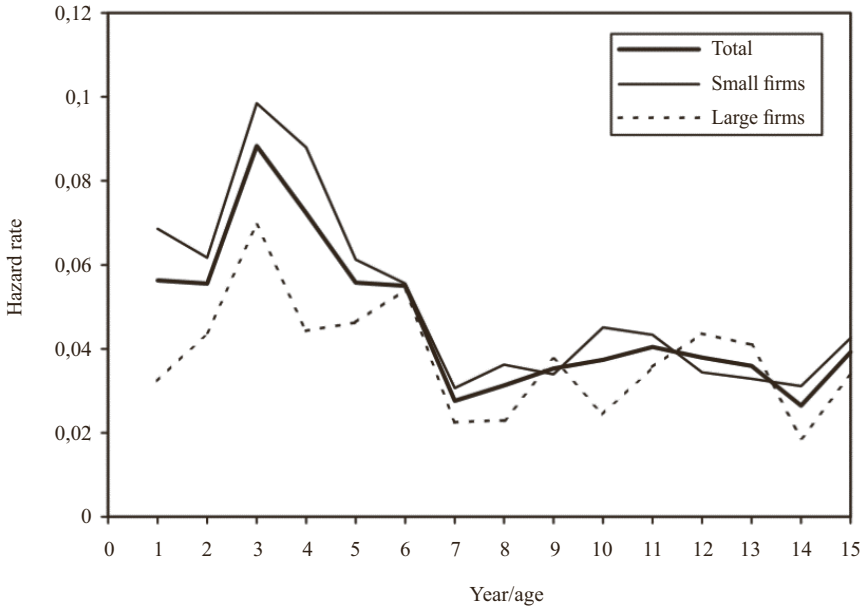

Fig. 6. Accumulated hazard rates over 15 years in seven cohorts

Source: (Box, 2008, p. 386)

Since this finding does not seem to be entirely consistent with the dominant theory of company survival, and also does not seem to be merely a local anomaly limited in time, future research is needed to further analyze the forces at play in the initial years of company operations, that modify the effect of the liability of newness. Some explanations are proposed in literature. For example Cressy suggests that one possible explanation of the initial increase of exits is due to depletion of initial financial resources (Cressy, 2006, p. 114). But that would mean that the greater the initial financial resources, the longer companies can operate purely on them. So the maximum death rate should occur later in richer countries. Which does not explain the comparison between, for example, Poland and USA company mortality data. Possibly the intercultural differences in risk aversion or willingness to accept initial losses might explain these differences better. This seems to be a promising avenue of future research.

The implications of the company survival dynamics can impact the research areas of entrepreneurship and public policy on entrepreneurship. Practical implications of this risk pattern may affect those businesses, that to some extent rely on assumptions concerning the dynamics of risk of new business ventures, such as seed capital and business angels. The exact dynamics of company survival may also be of interest to policy-makers. For example, as Schwartz puts it, start-up incubators are "policy-driven instruments to respond to the liability of newness" which is based on the assumption that "start-up exit dynamics are characterized by a hazard rate that is highest immediately after market entry but decreases monotonically over time" (Schwartz, 2013, p. 304). Possibly different empirical dynamics of market exit may suggest different timing or duration of incubator intervention.

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