FIRM GROWTH AND SURVIVAL FROM A 14-YEAR PERSPECTIVE: A COHORT ANALYSIS[1]

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ABSTRACT

This study examines whether early growth is important for the short- and long-term survival and development of new firms. The study exploits registry data for a specific cohort of Swedish firms that tracks their development until their exit, or up to 14 years, at which point only 8% of the firms remain. We find growth to be associated with increased survival of the firms, that the number of employees (in the previous year) is positively correlated with survival in following years and somewhat surprisingly, we found subsidiaries to face a significantly larger hazard of closure than independent firms.

INTRODUCTION

Given the necessary role of innovation and productive entrepreneurism in economic growth, successful start-up firms are considered indispensable for a country's economy (Baumol, 2002). Firms that exhibit high rates of growth and succeed in maintaining this growth over a longer period of time are seen as especially valuable. When this happens, a country enjoys numerous socioeconomic benefits from their efforts, such as jobs and marketable innovations (Haltiwanger et al., 2013). For this reason, newly started firms have attracted much attention to discern what factors underlie their emergence and survival (Reynolds & Miller, 1992; Davidsson & Klofsten, 2003; Wiklund & Shepherd, 2003). However, previous research has shown that most firms fail to survive over the long term and that only a fraction of the survivors can be considered high-growth firms (Storey, 1984; Autio, 2007). There is thus a need for more research qualifying the factors benefitting growth and survival.

In general, research on firm growth can be divided into two perspectives. One perspective is the link between growth, profitability and survival, where findings, however, diverge (e.g., Davidsson, 2005; Sapienza et al., 2006). For instance, Délmar et al. (2013) admit to the positive interactions between growth and profitability, they claim that growth is not necessary for survival - only profitability. The second perspective is whether one can find structural explanations in quantitative analysis or whether one has to kneel before randomness (Geroski et al., 2002). With somewhat different results, Daunfeldt & Elert (2013) and Coad et al. (2013) find support for the random walk hypothesis, observing that new firms which have survived their first five years may follow any one of numerous growth paths with nearly equal probability. However, chance was not the only determinant in survival; the growth path itself and the process of resource acquisition along this path will have substantial influence. Coad and his colleagues (2013) also found that underlying performance factors may have roots that reach deep into a firm's history; more commonly discussed aspects like sources of counselling and founder characteristics such as age, gender, prior experience and education are of lesser importance - especially when performance is considered from the viewpoint of financial metrics (ibid).

Other studies have observed a dependent relationship of growth and survival with contextual factors such as market structures; local market concentrations - and the nature and intensity of the competition they engender - are particularly influential. Too rapid growth, suggest Aviad et al. (2016), can be costly, and depending on market structure, may well be detrimental to survival (c.f. Pierce & Aguinis, 2013; Probst & Raisch, 2005). Their model of growth rate versus failure for a new market participant is curvilinear and supports the idea that the structures of local economic activity and competition are determinants of the growth-survival relationship. Continuing along contextual lines, Dosi et al. (2017) analyze early-stage growth by focusing on associations between market rewards to start-up firms and firm profitability and productivity. They found that variations in market selection according to sector; start-ups had higher concentrations in low-technology, services, and under-concentrated sectors. They also noticed that selection based on growth to occur in terms of productivity, and seldom profitability. Thus, it is changes in the relative productivity of a firm that appear to drive selection, contrary to the principle of "growth of the fitter" (ibid: p. 3).

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Other researchers, however, are critical of such survival theories, which operate on the underlying assumption that business owners and managers hold survival as the aim and failure as the ultimate outcome to be avoided (Josefy et al., 2015). Certain entrepreneurs may have as their goal to exit the market through an acquisition or a sale of their firm as soon as possible; statistics would most likely list such an incident as a failure. Thus, they propose a multi-faceted model with three dimensions: solvency, operations, and ownership. The lens that these dimensions provide helps clarify reviews of the literature and adds an understanding that improves research on new-firm failure and survival (ibid).

AIM AND SCOPE

Previous studies, like Coad et al. (2013) have observed that survival is closely linked with growth path and that when controlled for lagged size, results show that survival factors also include length of growth lag and start-up size. The extensive search to explain the "when" and "why" behind new-firm growth has yielded only modest progress in our understanding of new-firm survival. More mature firms undergo dynamics that are no less important to understand, but they are of a different nature (Davidsson & Klofsten, 2003; Haltiwanger et al., 2013). Our starting point is to employ established methods and models but limiting our analysis to a single cohort of start-ups - specifically a subset of this cohort - in order to address the issues of randomness and heterogeneity. A single cohort limits heterogeneity to the set of new ventures with a more even distribution of market experience. Our data allows us to divide this set of start-ups into sub-sets, thus limiting heterogeneity further. For instance, we contrast manufacturing firms with professional services firms and the general population of new ventures. We are thus able to perform analysis on start-ups with similar initial conditions, thereby addressing the common problems of selection bias and accounting for many unobservable confounding factors (Carpenter & Lynch, 1999; Hyytinen, Pajarinen & Rouvinen, 2015).

This study is based on the notion that growth is the driver of a self-perpetuating cycle where firms that retain resources can leverage these to continue growing, and that innovative firms which have succeeded in generating and using their profits to survive and grow can only be identified retrospectively. This study explores which common denominators are inherent in new-firm growth processes and how growth paths affect survival. Specifically, the present study asks how important growth is for *(i) the short-term survival and development of new firms? and (ii) the long-term survival and development of new firms?*

METHOD AND DATA

Prior research has emphasized the importance of the time dimension when studying firm growth (Box, 2008). A "major limitation" among previous empirical studies is the lack of longitudinal perspective (Daunfeldt & Halvarsson, 2011: p. 9), as panel data are preferable to cross-sectional samples when conducting causal analyses (Wooldridge, 2002). For this reason, we use data that follows start-up firms over an extended time period, an approach that is "uniquely well-suited to study these issues" (Haltiwanger et al., 2013: p. 347). To mitigate concerns of selection bias, our sample comprises an entire cohort of firms, which we use to identify determinants of new firm survival (Macdonald, 2012). We proceed to study the consequent development of the cohort with a focus on their age and the relationship between survival and growth (Agarwal & Audretsch, 2001; Hölzl, 2014).

We retrieved the data used in this paper from databases maintained by Statistics Sweden, specifically FAD (data on founding, restructuring, closure, employees, and workplaces), FEK (accounting data from financial statements), and RAMS (employee data from labor market statistics) which provide annual, comprehensive, and reliable data for registered Swedish firms (Wennberg et al., 2016). It covers the full cohort of firms founded in Sweden in 1997 (83 842 firms), which helps address the issue of survivor bias (Denrell, 2003). Furthermore, the time frame of 14 years is long enough to cover several business cycles, which should decrease the risk of isolated trends excessively affecting the data. As 1997 was not a year marked by extreme macroeconomic shocks or investment booms in Sweden, we see it as sufficiently representative with respect to the number and nature of firms that were established.

Hereby, we limit our analysis to firms founded as "genuinely" new firms, since the rich and detailed data allows us to distinguish between restructurings - like mergers, acquisitions, and spin-offs - on the one hand, and truly new entrants on the other (Davidsson et al., 1998). We only look at limited companies (leaving 19 156 firms as the object of study), as we interpret incorporation (with the associated capital requirements) as a signal of intent to grow in the long run. Thus, we hope to exclude "part-time or hobby firms" from the analysis (Délmar et al., 2013: p. 282). Furthermore, since Swedish incorporated firms need to be audited by law, this also serves to further increase the reliability of the accounting data, which is administered and verified by the Swedish tax authorities (ibid.). Finally, as in previous studies of firm growth, we limit our scope to organic growth (Coad, 2007), which excludes corporate measures like mergers and acquisitions. With this in mind, our empirical analysis is structured

as follows: First, we provide a descriptive analysis of the firms. We then conduct a logistic analysis to identify determinants of firm survival, both by pooling the firms and by treating it as panel data. Finally, as a robustness check, we conduct a duration analysis by employing a Cox proportional hazards model. All models include control variables based on prior literature (Coad, 2007; Manjón-Antolín & Arauzo-Carod, 2008).

To be sure, there are several approaches available for statistically analyzing the survival of firms. Here, "discriminant and logit analyses have been the most popular approaches," but there are quite a few other approaches available, such as survival analysis and hybrid models (Gepp & Kumar, 2008: 13). This study will use two approaches that show considerable promise. Firstly, we will make use of the widespread (Lin & Huang, 2008) logistic approach since it, along with probit models, has been shown to "identify failing firms more accurately than discriminant analysis" (Lennox, 1999: 347). In addition to the logistic analysis we will perform a duration analysis (also known as survival or hazards analysis), which is a widespread practice in the literature on firm survival (Cader & Leatherman, 2011; Giovannetti, Ricchiuti & Velucchi, 2011; Suárez & Utterback, 1995). Compared to binary choice models like logit and probit analyses, duration analyses have the advantage that they account for right-censoring in the data (i.e. firms that survive the entire period of analysis) as well as the duration of the firms' survival (Esteve-Pérez, Sanchis-Llopis & Sanchis-Llopis, 2004; Geroski et al., 2010). This means that they also account for explanatory variables that are time dependent. Put differently, it estimates the conditional probability that a firm will survive a given period $t + \Delta t$. Specifically, this study employs a semi-parametric duration model, namely Cox's (1972) proportional hazards model, since it is the one that is most prevalent in analyses of business survival (Anavatan & Karaöz, 2013). It offers the advantage of not imposing distributional assumptions and being able to address censoring and truncation in the data (Datta, Satten & Williamson, 2000; Shen, 2011; Tveterås & Eide, 2000).

ANALYSIS AND RESULTS

The study finds that among the cohort of 19,156 "genuine" start-ups only 1,515 firms (i.e. 8%) survive until the end of the 14-year period. An overview of the firms' establishment and attrition rates shows that less than 8% of the firms in the initial 1997 cohort remain intact until 2011. Almost 75% were liquidated, while approximately 12% (mergers) and 6% (splits) were restructured (Table 2). The large number of exits in the first few years shows how a firm is subject to the strongest forces of market selection and adversity in the first three or four years of its life in terms of survival chances. We also find that the surviving firms still exhibit growth 10 years after their establishment.

Table 1 Development of the 1997 cohort of new firms

				Closed firms			
Year	*Established*	*Closed*	*Remaining*	*Liquidations*	*Mergers*	*Splits*	*Others*
1997	19 156	507	18 649	507	0	0	0
1998		7 877	10 772	6 482	971	424	0
1999		2 733	8 039	2 139	403	191	0
2000		1 724	6 315	1 345	291	88	0
2001		1 152	5 163	894	182	76	0
2002		780	4 383	627	91	62	0
2003		660	3 723	537	65	58	0
2004		470	3 253	360	61	33	16
2005		375	2 878	292	43	40	0
2006		313	2 565	245	42	26	0
2007		270	2 295	209	43	18	0
2008		261	2 034	212	34	15	0
2009		197	1 837	174	9	14	0
2010		199	1 638	154	28	17	0
2011		123	1 515	95	14	7	7
Total	*19 156*	*17 715*	-	*14 310*	*2 295*	*1 087*	*23*

Analogously to previous studies (e.g. Audretsch et al., 2000; Bates, 1990), our multivariate logit regression model uses a binary coding for the dependent variable - it is set to equal one if a firm is still operative in the present year and otherwise takes the value zero. As is commonly done, we calculate a given firm *i*'s growth rate at time t as the log-differences of firm size between times t and t-1 (Bernard, Massari, Reyes & Taglioni, 2014; Colombelli, Haned & Le Bas, 2013). Furthermore, building on Geroski's (1995) stylized facts, we control for firm and industry characteristics when analyzing potential determinants of survival.

Besides lagged growth rates (1- and 2-year lags, c.f. Coad & Hölzl, 2010 and Davidsson & Wiklund, 2013), which are the variables of interest, we control for additional dimensions by including them as covariates in the models. Firstly, we include firm size measured as number of employees (Koch, Späth & Strotmann, 2013; Lööf & Nabavi, 2014), firm age (Délmar et al., 2013; Hölzl, 2014), and firm profitability measured as return on assets (Délmar et al., 2013; Wennberg et al., 2016). Furthermore, we include geographic expansion (Barringer & Greening, 1998) proxied by the number of firm offices, a dummy variable indicating if the firm is a subsidiary (Harhoff, Stahl & Woywode, 1998), export orientation measured as the export share of sales (Giovannetti et al., 2011), and the firm's indebtedness measured as the equity share of total assets (Halldin, 2010). In addition, we control for physical capital, measured as investment expenditures (Coad, 2009; Spiezia & Vivarelli, 2000), human capital, measured as the share of employees with tertiary education (Halldin, 2010; Délmar et al., 2013), and the share of female employees (Halldin, 2010). We lag all control variables by one year in order to account for reverse causality (Coad, 2016; Hamilton and Nickerson, 2003). Finally, we control for the respective average industry growth (Hölzl, 2014; Wennberg et al., 2016) and include dummies for industry and region (in the duration analysis) as well as current year (in the logistic analysis). Following the results from a Hausman test, the pooled logistic regression employed fixed effects, while we found support for employing a random effects approach in the panel model, owing the low variation in the independent variables between years. We conduct these analysis for the entire cohort, as well as the individual industries to account for potential heterogeneity (Halldin, 2010; Saridakis et al., 2007).

Table 2 Number of firms by aggregated industry

Industry	**Number of Firms**
Agriculture and natural resources	627
Construction	1 539
Logistics and facility management	5 402
Manufacturing	1 684
Motor vehicle repairs	4 917
Professional services	4 987
Total	**19 156**

Given the model specifications, growth does indeed appear to be positive and highly significant for firm survival. In other words, the results suggest that growth in the preceding year is associated with a higher likelihood of survival in the current year. The interpretation of the coefficients is quickly exemplified here. To obtain the odds ratios, we transform the log odds for survival to an odds ratio:

$$odds(survival) = {}^{p}/_{1-p} = {}^{0.313}/_{1-0.313} = 0.456 = 45.6\%$$

Thus, holding the other independent variables constant in Model 1, a one-unit increase in the logarithmized growth rate (as defined in this study) in year t-1 is likely to lead to an increase in the odds of survival by 45.6% in the year t. Similarly, the results from the duration analysis indicate that following a one-unit increase in the logarithmized growth rate in the year t-1, the risk (or hazard) of closure for a given firm would decrease to 75.0% of its initial value (i.e. decrease by 25.0%) in the following year t, keeping the other covariates constant.

Overall, we find that the three models generally provide comparable results. Testing for joint significance of the growth variables also shows that growth in two consecutive years significantly increases the chances of survival in all three models. Turning to the results for the control variables, we find that firm size (i.e. number of employees) and being a subsidiary are the only one significant variables with a magnitude that is comparative to the growth covariates, whereby size appears to promote survival, while, somewhat surprisingly, subsidiaries appear to be less prone to survive. While the positive effect of profitability and the adverse effect of a higher share of female employees are both statistically significant, the estimates have a negligible magnitude.

Analyzing the separate industry groups separately, the results for the three models remain comparable, with the positive effect of growth in the previous year and firm size being the most consistent results. However, the positive effect of growth two years prior is no longer significant for several segments, such as "agriculture and natural resources" and "manufacturing," and in line with prior research (Hölzl, 2013), several industries such as logistics and motor vehicle repairs exhibit higher mortality rates with increasing age.

Finally, we estimated the three models using 3- and 4-year lags for the growth rates and limiting the sample to the first five years of the time period, i.e. 1997-2002, thereby evaluating the importance of growth in the firms' first two years following inception. While the results are once again largely comparable to the main models, growth in the first year (i.e. lagged by four years) is not significant (although it is jointly significant with the 3-year lagged variable) and geographic expansion has a significant negative effect on survival. Remaining variables are either not statistically significant, or negligible in terms of the magnitude of the effect.

Table 3 Results from regressions to predict firm survival

Variable coefficient (robust standard errors in parentheses)	**Model 1** **Pooled Logistic, FE** (log-odds, survival)	**Model 2** **Panel Logistic, RE** (log-odds, survival)	**Model 3** **Cox Prop. Hazards** (hazard ratio, exit)
growth (1-year lag)	0.313*** (0.0554)	0.419*** (0.102)	0.750*** (0.0242)
growth (2-year lag)	0.126** (0.0434)	0.173* (0.0748)	0.882*** (0.0297)
firm size (employees)	0.159*** (0.0221)	0.314*** (0.0459)	0.8674*** (0.0171)
firm age (years)	-0. 320 (0.192)	-0. 865* (0.414)	(omitted)
return on assets (net profit/total assets)	0.00470** (0.00148)	0.00560* (0.00282)	0.999955*** (0.0000168)
expansion (number of offices)	-0.137 (0.0723)	-0.222 (0.200)	1.1530* (0.0810)
subsidiary (dummy variable)	-0. 222* (0.110)	-0.356 (0.184)	1.2155* (0.1155)
export orientation (export share of sales)	-0.0174 (0.0125)	-0.0572 (0.0316)	1.0114** (0.0043)
firm indebtedness (equity share of total assets)	-0.000644 (0.000949)	-0.000728 (0.00127)	0.999984* (0.00000738)
physical capital (net investments)	0.0000226 (0.0000157)	0.0000447 (0.0000427)	0.999981 (0.0000129)
human capital (share of employees with tertiary education, %)	0.000713 (0.000682)	0.00172 (0.00147)	0.999340 (0.000593)
female employees (share of female employees, %)	-0.00230** (0.000710)	-0.00559*** (0.00157)	1.00195** (0.000610)
average industry growth	- 0.00278 (0.0192)	0.00747 (0.0351)	1.001228 (0.016486)
constant	2.709*** (0.439)	6.610*** (1.161)	
Number of observations	17 744	17 744	17 744
Number of groups (companies)		6 901	6 901
Prob > chi^2	<0.0000	<0.0000	<0.000
Pseudo R^2	0.0380		

Unless otherwise noted, all independent variables are lagged by one year with respect to the dependent variable.

Dummy variables for year (models 1 and 2), industry and region are included in the estimations, but results are suppressed for brevity.

$*\ p < 0.05$, $**\ p < 0.01$, $***\ p < 0.001$

CONCLUSIONS AND IMPLICATIONS

The present study corroborates previous findings that growth is a good predictor of new-firm survival. Earlier studies using similar methods have also observed this pattern (Ha, 2013; Hao & Naiman, 2007). Despite the limitations of definitions and measures, our findings lend support to the stylized fact that growth improves the chances of survival for young firms. Early growth is important for both short- and long-term survival, and growth

in later developmental stages is also associated with greater chances of survival (Coad et al., 2013; Mata et al., 1995). Similarly, limiting our analysis to the first five years of life of the study cohort still yields an association between growth and higher survival rates. Although this relationship is not as robust when estimations focus on a sector analysis, there is still a clear tendency for growth to be followed by survival. A second finding is that the number of employees in the preceding year correlates positively with survival in following years. This mirrors results from earlier studies of new-firm survival, implying that firms with a higher number of employees stand a higher chance of surviving (Bates, 1995; Brüderl et al., 1992). Thirdly, and somewhat surprisingly, we found that subsidiaries seem to face a significantly larger risk of closure than independent firms. While confounding factors or moderators may interfere with this result, the finding has also emerged in previous literature. For instance, Audretsch and Mahmood (1995: p. 101) find that "the hazard rate is significantly higher for establishments which are a branch or subsidiary of an existing enterprise than for new independent enterprise." Bradley et al., (2011) propose that the relative independence of a small firm may influence its performance and survival. Specifically, "subsidiaries are likely to take on the characteristics, routines … and orientation of their parent organizations, thus undercutting the adaptive potential of the organization" (ibid: p. 506). Though subsidiaries are initially somewhat protected from competition, the fiercer pressures from selection may in fact strengthen the "resourceful capability development" of independent firms which have no such shield. As in prior literature (Coad, 2009; Hoogstra & van Dijk, 2004; Marsili, 2001), our estimations exhibit low explanatory power, which low R^2 values evidence. While not the only criterion for evaluating models, low R^2 values point up the elusiveness of measuring early firm dynamics, and illustrate why firm growth is often considered predominantly random and driven by stochastic shocks.

As Davidsson and Klofsten (2003) note, the additive models used in quantitative research explain only a partial outcome variance in assessments of new, small-firm health. Holistic methods that are quantifiable and generalizable are still lacking. Present holistic approaches lean toward the qualitative with unknown generalizability. While our analysis looked to account for the most important aspects affecting firm survival, prior literature identifies several other factors that the present study was unable to assess: the nature venture idea (Klofsten, 2005); owner and founder characteristics (Dencker et al. 2009; Klotz et al., 2014); funding characteristics (Coad et al. 2013, Frankish et al., 2012) and sources of capital (Saridakis et al., 2007); patents (Wennberg et al., 2016); strategic variables, such as price competition strategy and product innovation; (Saridakis et al., 2007); and risk preferences (Wennberg et al., 2016). Networks (Watson 2006), clusters (Chung & Kalnins, 2001), and agglomeration effects (Wennberg & Lindqvist, 2010) have also been suggested to play a role in firm survival. Possible fruitful paths for future research include studies of market selection processes and of determinants of long-term sustainability in firm survival. For instance, the question remains: Aside from mere short-term resilience to market selection, under which circumstances do the resources of a parent company actually benefit the long-term survival of their subsidiaries?

From a critical standpoint, our aim in this paper – to determine the importance of early growth for short- and long-term new-firm survival, or in other words, predict the future – is challenging. Several studies have shown that new-firm assessments designed to indicate future growth and survival prospects, and allow time to introduce measures for improving these probabilities, seldom fulfil their mission. Early-stage firms generally find themselves in a volatile environment, where short-term decision-making leaves little time for considering any fundamental weaknesses in their situation (Hall, 1995: Davidsson & Klofsten, 2003). But this does not prohibit us from determining that an important implication of our paper is how small-business policy interventions which ignore the role of firm age may have little effect on new-firm development (cf. Haltiwanger et al., 2013). Business dynamics and market failure must be better understood for interventions to have the desired effect. Our analysis only explores the first. While market failure underlies the obstacles that firms face in early development processes, well-designed policies may help support dynamic young firms and boost their early development overall. Our findings suggest that targeting firm size, and ignoring age, may render small-business policies ineffectual in pinpointing real needs in new-firm support (Klofsten & Jones-Evans, 1996).

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