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UNTANGLING THE RELATIONSHIPS AMONG GROWTH, PROFITABILITY AND SURVIVAL IN NEW FIRMS

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ABSTRACT

The performance of new firms is important for economic development but research has produced limited knowledge about the key relationships among growth, profitability, and survival for new firms. Based on evolutionary theory, we develop a model about how new firms resolve uncertainty about their ability to prosper in a market by monitoring changes in profitability. Our model predicts selection pressures to weed out underperforming firms and learning to allow survivors to improve performance and grow. We test our theory using a unique panel of knowledge-intensive new firms in Sweden. We find strong support for the notion that profitability enhances both survival and growth, and growth helps profitability but has a negative effect on survival. Implications are discussed.

1. INTRODUCTION

Despite the substantial interest in new firm growth, literature reviews have concluded that research still provides a limited understanding of the driving mechanisms behind how and when new firms grow (Davidsson, Achtenhagen, and Naldi, 2010; Gilbert, McDougall and Audretsch, 2006; Macpherson and Holt, 2007; McKelvie and Wiklund, 2010). This is a troubling observation given the importance of new firms for economic development, including the creation of jobs (Kirchhoff, 1988; 1994; Phillips and Kirchhoff, 1989).

One potential explanation for this limited understanding is the unclear relationship of firm growth to other tangential phenomena and performance metrics, such as profitability and survival (Davidsson, Steffens and Fitzsimmons, 2009; Shepherd and Wiklund, 2009). These concepts are important for a number of reasons in the context of explaining new firm growth. For instance, exit rates are especially high for new firms relative to incumbents, and the risk of exit may promote or hinder new firms from trying to achieve growth. Profitability may provide needed positive cash flow and access to resources to fuel growth, but sizeable profits may only come after growth has been achieved (Davidsson et al., 2009). Therefore, there appear to be important relationships concerning both the nature and the timing of growth in relation to profitability and survival that need to be better understood (Coad, 2010; Phillips and Kirchhoff, 1989). Indeed, these three central concepts (i.e. growth, profitability, survival) have been highly influential in theories of new firm growth, and industry evolution and dynamics (e.g. Kirchhoff, 1994; Penrose, 1959), but surprisingly little research has specifically addressed these issues in the same model (Coad, 2010; Davidsson et al., 2009).

There are several reasons for this current state of the literature. To begin with, empirical research has to date not been able to adequately mitigate the statistical problems arising from the heterogeneous and dynamic picture of growth (Coad, 2007). Relatedly, a lack of adequate data on new firms has prevented researchers from unearthing the relationship between growth and other performance outcomes such as survival and profitability (Headd and Kirchhoff, 2009; Kirchhoff, 1994; Kirchhoff and Greene, 1996). Hence, there is an apparent gap between the theoretical concept of growth and the empirical evidence (McKelvie and Wiklund, 2010). In this article, we seek to provide an enhanced understanding of firm growth and performance from new entry (Phillips and Kirchhoff, 1989). We present a theoretical framework based on evolutionary economics to untangle the endogenous and complex relationships among growth, profitability and survival,

Our evolutionary model builds upon the idea that new firms face uncertainty concerning market acceptance and competitive pressures. These pressures inform the firms' relative fit within the industry (Noteboom, 2009) and emphasize how new firms seek to improve performance in the face of uncertainty. This is a continuous process of creative destruction driven by two forces: First, idiosyncratic learning among firms leads to differences in competitive advantages. A key source of learning is feedback from recent performance (Jovanovic, 1982). Second, competitive selection among heterogeneous firms forces some to exit, and allows for growth of the fittest firms. Our model treats growth as a process where feedback from recent performance spurs firms to increase scale of operations if performance is positive, or exit if performance is negative (Dosi et al., 1995; Metcalfe, 1994; Nelson and Winter, 1982).

We draw upon a unique population-level dataset of knowledge-intensive firms in Sweden between 1995 and 2002. These data allow us to examine how new firms evolve over time and from their initial entry. We are therefore able to mitigate the survival bias inherent in many studies (Yang and Aldrich, 2012), which might otherwise risk overestimations of predictors such as profitability on growth (Heckman, 1979). This is imperative as, on average over our different cohorts, 44% of new firms disappeared within five years. Although this finding is in line with previous research on industry and firm dynamics (Headd, 2003;

Kirchhoff, 1994; Short, McKelvie, Ketchen and Chandler, 2009), exiting firms are seldom considered in research on firm growth. Our approach lessens problems of reverse causality and unobserved heterogeneity that has plagued prior research (Coad, 2007; Davidsson et al., 2010; Shane, 2003). In addition, we examine how the innovation intensity of the industry sector may affect these relationships. This factor is central to evolutionary economics (Winter, 1994) as well as industry dynamics (Audretsch, 1995; Spencer and Kirchhoff, 2006).

In doing so, this study makes several contributions to the literature on new firm growth and dynamics. Theoretically, our evolutionary perspective helps to provide predictions about the nature and timing of the relationships among our core variables. This helps provide a theoretical rationale as to why a small group of firms grow rapidly to a size where they can efficiently compete in their industry, but where most firms grow slowly or not at all. Our study provides insights into evolutionary selection mechanisms by explaining *why* these mechanisms are not as strong as theorized (Bottazzi et al., 2010; Coad, 2007; Dosi, 2007)) and offers a theoretical justification for previously unexplained empirical findings such as 'churning' whereby new entrants and exiting firms increase competition among small firms (Kirchhoff, 1989; Kirchhoff, 1994). Our model explains the relationships among survival, profitability and growth as a function of new entrants' unknown profitability upon entry. We also address how these relationships might be moderated by the innovation intensity of the industry sector, thus offering potential boundary conditions of such relationships.

Methodologically, our findings indicate an endogenous cycle of growth and performance that previous research has yet to fully unearth (Coad, 2010; Dosi et al., 1995). This shows the imperative for growth research to simultaneously measure growth, profitability, and survival in order to not confound these variables in explaining firm and industry evolution. Combined, the empirical results and theoretical reasoning help to buffer the seminal work by Professor Bruce Kirchhoff towards understanding industry dynamics and the role of new firm growth.

2. LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

Only a fraction of all new firms evolve into high-growth firms and the majority of small firms achieve limited or no growth (Autio, Kronlund and Kovalainen, 2007; Kirchhoff, 1988; Storey, 1994). Among the firms that do grow, some grow rapidly and have a strong impact on the economy (Headd and Kirchhoff, 2009). The importance of these new firms has greatly attracted the interest of policy makers who in turn have developed an important number of support mechanisms for growing firms, many times without considering the link of growth to profitability and survival (Autio et al., 2007; Kirchhoff, 1994; EU 2011a, 2011b).

Research has shown that there is an important puzzle in place in regards to the relationships among growth, profitability, and survival in new firms. For the most part, this puzzle has been informed by empirical research that has lacked a strong theoretical explanatory link. We first provide an overview of prior studies before turning our attention to our evolutionary interpretation of how these three concepts (growth, profitability, and survival) are related. These interpretations lead to the development of our formal hypotheses.

2.1. The empirical puzzle of growth, profitability, and survival

The relationship between growth and profit is at the heart of major theories in entrepreneurship such as those of Schumpeter (1934), Kirzner (1979) and Penrose (1959). However, empirical results on the relationship between profitability[1] and growth remain mixed and surprisingly scarce, especially for new firms (although there are some notable exceptions such as Coad, 2010, and Davidsson et al., 2009). Unfortunately, the studies have

[1] It is important to note the difference between two related although different concepts of profit (often used in economics modeling) and profitability (often used in management research). Both may occur simultaneously and arise due to factors such as market power and efficiency (Bloom, Sadun and Van Reenen, 2010). However, the focus of our evolutionary inspired model is on profitability as a function of efficiency, although we do note that total profit levels and profitability are likely highly related.

achieved mixed results. For example, in a study of French manufacturing firms with more than 20 employees, Coad (2010) finds a positive but weak relationship between profits and sales and employment growth. Similar results were reported in Bottazzi et al.'s (2010) study of French and Italian manufacturing firms measuring sales growth, in Roper's (1999) study of Irish manufacturing firms that were at least four years old and had ten or more employees also using sales growth, and in large American firms (based on a sample from the Fortune Reputation Survey; Cho and Pucik, 2005) using a composite measure of market capitalization, asset and sales growth. In contrast, Markman and Gartner (2002) study four cohorts of INC 500 firms (n=1,233) in the US and do not find a relationship between profitability and extremely high growth, measured in terms of sales and employment. Using a slightly different approach, Davidsson and colleagues (2009) examined Swedish and Australian firms in a longitudinal dataset and found a positive relationship between profitability and sales growth. Their approach involved categorizing firms at the beginning of the observation period in terms of growth and profitability achieved and then examining the probability of individual firms moving from one category to another. This approach was subsequently espoused by Brännback et al. (2009) who analyzed 336 Finnish life science firms. They find profitability to be positively associated with sales growth, but not the reverse. However, Cho and Pucik (2005) actually found a recursive association from growth to profitability when using a structural equation modeling approach. Taken together, these studies provide inconsistent empirical results on the nature of the relationships.

From a broader perspective, most of these studies find that differences among firms' profitability and growth tend to be fairly stable over time. But these differences are especially noticeable as transitioning from a non-profitable to a profitable firm is relatively rare. This confirms empirical findings in organizational economics of the persistence in profitability and growth differentials between firms (Bloom et al., 2011; Dosi et al., 1995). This also highlights the limits of neoclassical models to explain firm growth differentials. In such models, those differentials should be eroded by competition over time as markets reach equilibrium. Consequently, studies of the profitability-growth relationship need to assess alternative frameworks than neoclassical economic ones to account for important heterogeneity among firms and for the potential of unobserved differences in these relationships. This is the motivation behind our evolutionary model of firm growth.

2.2. Evolutionary processes and new firm growth

Empirical research has struggled to understand how the variation in firm evolution comes about (Coad et al., 2012; Geroski, 1995; Headd and Kirchhoff, 2009; Kirchhoff and Greene, 1996). A number of theoretical arguments have attempted to account for new entry, exit, and firm heterogeneity in growth. In all theories, profits are seemingly central, but the theories otherwise fall into two main groups. The first group assumes some form of neoclassical equilibrium; the second pledges a more evolutionary perspective where innovation is endogenous to the growth process and markets are in disequilibrium. What the two groups have in common, aside from a strong focus on industry dynamics, is how entrepreneurs use profitability to learn about the efficiency or fit of their firm to the market, and how firms use this learning to decide whether to grow, stay the same, or exit an industry. Information about the efficiency of the firm is assumed to be uncertain or unknown at the time of entry.

The first group of theories discusses the role of profitability for firm dynamics assuming some form of equilibrium. Jovanovic (1982) explains the evolution of industries and differences in size among firms as a result of gradual stochastic convergence towards optimal productivity of firms entering under imperfect information. New firms enter the industry but with unknown productivity functions. As the efficiency of the production function is discovered, firms invest in growth or exit. Hopenhayn (1992) builds on this work to explain that entry and exit is possible under equilibrium. Later work by Spulber (2009) and Jovanovic and MacDonald (1994) incorporate innovation in their models, building on the work of Schumpeter (1934). These developments in the literature notwithstanding, neoclassical models do not account for the endogenous nature of growth (Metcalfe, 1994), nor do they account for persistence in profitability and growth differentials between firms. This is because in equilibrium models, those differentials should be eroded by competition (Bloom et al., 2011; Dosi et al., 1995).

The second group of theories of firm growth builds upon evolutionary thinking. This thinking departs from the assumption that markets are in equilibrium. In evolutionary models, the active production and use of new knowledge and innovations is seen as the basis for competitive advantage (Metcalfe, 1994), thereby permitting explanations of enduring differences in performance between firms. A primary explanation in these models is that learning and innovation is endogenous rather than exogenous to the industry, and also idiosyncratic to the firm (Coff, 2003; Dosi et al., 1995). The ability to learn and innovate is based on the competence the firm embodies, on internal and external knowledge they can apply and the routines by which they do it (Dosi, 1988; Teece et al., 1993). In evolutionary models, innovation rates in industries and in particular firms can be modeled as path-dependent processes, where firms that invest in innovation achieve longer-term competitive advantage and thus are able to exhibit higher performance than other firms (Nelson and Winter, 1982). This process is dependent on variation, selection, and retention mechanisms where firms compete for limited resources and market demand. How the firms, and especially new firms, compete for these resources and market demand is defined by the industry logic of competition.

The process of entry, growth, and exit is a function of variation, selection and retention of firms that reflects ‘fit’ with prevailing industry conditions (Dosi, 2007; Metcalfe, 1994). The process of *variation* determines the range of innovations and new business practices introduced in the economy. *Selection* alters the relative economic importance of the competing alternatives, determining the retention within firms and imitation between firms of successful innovations and business practices (Aldrich and Ruef, 2006). Selection is a function of the firm's efficiency in competition with other similar (incumbent and new) firms. The most efficient (profitable) firms are retained, allowing them to reproduce their business activities via growth. *Retention* means that firms better 'fit' for the prevailing market conditions are more likely to grow and survive, while less viable firms lose returns and disappear. This notion of differing chances of growth or "growth of the fitter" is a central feature of Nelson and Winter's (1982) classical work.

Fit and efficiency are to a large extent determined by the logic of competition of an industry, where fit is likely to change as the competitive landscape shifts (Winter, 1984). Some industrial contexts are more beneficial to new firm growth and survival than others (Audretsch, 1995). This means that new firms' likelihood of ensuring growth, survival, and profitability depends on structural differences in a particular industry's evolution (Klepper, 1996) and to differences in the innovation intensity of an industry (Peneder, 2010). Hence, innovation intensity is an important contingency to consider when investigating the relationship between new firm survival, growth and profitability.

Innovation intensity is similar to Winter's (1984) concept of 'technological regimes', where industries differ in how firms innovate and compete. Winter's conceptualization focuses on whether a technological regime is predominantly 'entrepreneurial' or predominantly 'routinized'. Peneder's (2010) recent work extends the thinking of technological regimes to also incorporate the distribution of types of firms within industries. Using a variety of data sources on the industry and national levels, Peneder developed integrated taxonomies of the innovation intensity of an industry. The taxonomies capture many of the factors Winter and other technological regime scholars have investigated, including the opportunity cost of entering the market, the availability and appropriateness of novel ideas and growth opportunities (Saemundsson, 2005), and the cumulative nature of knowledge within that industry. The benefit of Peneder's taxonomy is the ability to capture the entire distribution of firms types within an industry, as opposed to a mean score based on industry averages. For instance, a heavy R&D-based industry contains various types of firms. Some firms invest significantly in internal R&D and seek to patent their inventions, while others acquire knowledge from elsewhere and ignore patents; and others simply act as market followers by adopting and duplicating other firms' knowledge and strategic behavior. Peneder's (2010) work looks at the entire distribution of firm's innovative behaviors in an industry, as opposed to the average firm's innovative behavior.

Our theoretical arguments for growth, profitability, and survival based on evolutionary economics takes into consideration that (i) at entry, there is uncertainty about the productivity of a new firm, (ii) productivity leads to higher profitability and opportunities to grow; (iii) profitability and growth depend on competition; (iv) competition is industry specific and (v) the innovation intensity of an industry is an important contingency of the relationship between competition and new firm survival, growth, and profitability. Competition leads to profitability and growth for firms that demonstrate efficiency and fit with the environment, and leads to exit for those that are not. New firm growth and profitability are enhanced in sectors where innovation is an important source to competitive advantage.

2.3. Hypothesis development

The relationship among growth, profitability, and survival. From an evolutionary perspective, entrepreneurs introduce new variations to the market by configuring different resources into a new market proposition (Romanelli, 1999; Schumpeter, 1934). Firms compete with one another for those same resources, but because different combinations can be achieved with the same set of resources, firms can differentiate themselves and reach diverging performance

(Metcalfe, 1934). The efficiency of any new combination is unknown *ex ante* to the entrepreneur and can only be resolved by market feedback (Jovanovic, 1982). The notion of profitability is central because it conveys feedback on how well the firm is responding to competitive pressure and market demands. Profitable firms are more likely to survive, since they are more able to generate needed positive cash flow and begin to accumulate slack resources (Dosi et al., 1995; George, 2005; Geroski, 1995). Increasing profitability also demonstrates useful effectiveness of the operations of the new firm, where a matching between cost structures and market acceptance of prices is a further reflection of fit. As such, firms with increasing profitability are less likely to be pressured to exit for financial reasons. Therefore we predict:

Hypothesis 1*. Increases in profitability will increase the likelihood of firm survival.*

We are interested in new firm dynamics as a function of selection and learning mechanisms nested in market competition. Similar to the argument that profitability reflects positive feedback, growth, and sales growth in particular, also signals the achievement of a superior market position, with an increasing demand for the firm's output. Growth is an indicator of both larger size and past successful performance (Coad et al., 2012). We argue that this past success indicates a better fit with the environment. Growth therefore is likely to lead to increased survival. In general, larger firms are more likely to survive than small firms because they are closer to the minimum efficient scale, are more cost efficient, and have better access to capital to weather turbulent times compared to smaller firms (Geroski, Mata and Portugal, 2010). New firms tend to be smaller than incumbents in terms of employees and sales levels, because they are likely to enter with more modest means and sales levels to begin to learn about their fit in a particular industry. They adjust their scope of operations based on lessons from performance feedback (Jovanovic, 1982). Achieving sales growth suggests a new firm has reached a certain environmental fit where the market has accepted the products and services that are being offered (Mitchell, 1994) and implies that there is in growing demand for what the firm has to offer (Romanelli, 1989). Having achieved sales growth allows firms to be able to earn positive returns to create future resource buffers in case of increased competition, waning demand, or be used to create new combinations for subsequent expansion (Wiklund and Shepherd, 2003). Sales growth therefore indicates having achieved a certain level of success and should therefore increase the likelihood of survival. We therefore predict that:

Hypothesis 2. *Increases in growth will increase the likelihood of firm survival.*

The relationship between profitability and growth. Our evolutionary perspective suggests two main reasons for why firms grow: First, because of high uncertainty, new entrants may prefer to enter with a small initial investment to limit sunk costs while at the same time gain knowledge about the market (Audretsch, 1995). If feedback is positive, the new firm needs to scale up its investment to take better advantage of the opportunity exploited and the knowledge that has been acquired. Second, because strategic advantages or the development of competitive abilities are primarily a function of firm size (Bradley et al., 2011; Barnett and McKendrick, 2004), ensuring survival of the firm is a primary motivation for very small firms to engage in growth. Hence, new firms may need to grow to reach a size where they can cater to a larger market base or different customer segments and gain economies of scale and scope – and profitability allows them to achieve this. Specifically, more profitable firms may have higher potential to grow, since they have already shown a greater fit with the environment and may be are able to fund future competitive actions (such as growth) with their own cash flow. Profitability thereby limits the risk related to acquiring and relying on external resources of financing but also displays a satisfactory level of market demand. Consequently, profitability becomes an important *resource* for growth (Macpherson, 2005). We therefore predict that:

Hypothesis 3. *Increases in profitability will increase firm growth.*

The relationship between growth and profitability. While profitability may lead to growth, growth may also lead to higher profitability. This indicates the potential for a reverse causal relationship or even a recursive relationship between growth and profitability. Growth is seldom a goal in itself for new firms but more often a means to secure profitability and sustainability (Delmar & Wiklund, 2008). It is however risky and costly. Growth requires up-front investments, changes in the organizational structures, alterations to cost and revenue drivers, and often delays positive cash flow streams (Davidsson et al., 2009).

However, rapidly achieving a certain size might be the best way to reduce the uncertainty involved in determining productivity, cost structures, or capacity. Hence, small size may be a barrier to achieving the profitability that new firms need (Reichstein et al., 2010). This means that while growth is risky due to the uncertainty of positive outcomes from investment made (Coff, 2003), for small firms, growth may be necessary to achieve profitability because larger firms will be operating closer to the minimum efficient scale and become more cost efficient. Our final direct effects hypothesis thus posits:

Hypothesis 4. *Increases in growth will increase profitability.*

The moderating role of innovation intensity. Fundamental in evolutionary economics is that industries differ in their disposition to adopt new knowledge as a way for firms to build competitive advantages (Malerba and Orsenigo, 1993). Hence, growth processes are not symmetrical across industries but vary with the innovation intensity of a specific industry sector (Audretsch, 1995; Peneder, 2010) a cornerstone of what is theorized as ‘technological regimes' (Nelson and Winter, 1982; Spencer and Kirchhoff, 2006). This suggests that our previous predictions might also be moderated by the competitive logic of the firms' industry (Dosi, 2007; Klevorick et al., 1995; Winter, 1984).

Differences in innovation intensity across industries affect a number of factors. First, these differences affect how easily the application of new knowledge leads to performance improvements (Dosi et al., 1995; Thornhill, 2006). A second is the appropriability conditions or how effectively innovations can be protected from imitation by competitors (Klepper, 1996). A third is how many different knowledge bases are available to a firm to create a productive routine (Sarkar et al., 2006) and a fourth is the magnitude of resources a firm needs to commit for a typical project to succeed (Agarwal et al., 2002). The final part of our model hence theorizes that the strength of our hypothesized relationships are contingent on the innovation intensities in which new firms operate.

Audretsch (1995) found that firms in highly innovative environments are more likely to fail, but also more likely to grow if they survive. He concludes that the ability for new firms to adapt quickly and offer viable products is especially important in innovative environments as this ability will ultimately increase firms' profitability, and thereby also increase both survival and growth. As the innovation intensity of an industry essentially suggests different modes of competing, we therefore expect there to be moderating effects of innovation intensity on the core relationships we outline above.

We first address the effect of innovation intensity on the relationships between growth and profitability on survival. Firms need to grow and to be profitable in order to survive, but attempts to increase growth and profitability are costly and uncertain. In highly innovative industries there is greater uncertainty about future fit. Firms in these environments need to continuously invest resources into developing future alternative strategic actions (Wiklund and Shepherd, 2003). Firms that have not increased growth or profitability in highly innovative intense environments are more likely to exit. For example, Audretsch (1991) shows that firms that are not able fund growth are more likely to exit in more highly innovative environments. As such, we hypothesize:

> ***Hypothesis 5a.*** *The innovation intensity of the environment moderates the impact of increases in profitability on firm survival: The higher the innovation intensity, the greater the impact of increases in profitability on firm survival.*

> ***Hypothesis 5b.*** *The innovation intensity of the environment moderates the impact of increases in growth on firm survival: The higher the innovation intensity, the greater the impact of increases in growth on firm survival.*

Further, growth is a resource intensive process. Increasing profitability leads to more resources as new firms are increasingly able to self-finance further growth, as described above. In evolutionary thinking, profitability is an outcome of heterogeneous firm learning and innovation, where accumulated resources enhances new firms' potential to fuel further growth (Augier and Teece, 2008). In industries that favor rapid innovation as a competitive advantage, it is likely that there is a stronger association between profitability and growth (Thornhill, 2006). We therefore predict that:

> ***Hypothesis 5c.*** *The innovation intensity of the environment moderates the impact of increases in profitability on firm growth: The higher the innovation intensity, the greater the impact of increases in profitability on firm growth.*

Finally, achieving growth indicates good market fit (Covin, Slevin and Heeley, 2000). In highly dynamic industries, market fit may be fleeting and investments into new knowledge such as through R&D are risky endeavors (Klevorick et al., 2005). Increasing growth in more innovative environments suggests that the firm has received positive feedback on its technological advances. These advances often are costly and difficult to imitate; as such they can form the basis of more long-term competitive advantages (Bottazzi et al., 2010; Klepper, 1996; Roberts and Amit, 2003). As many technological advances tend to be risky but have higher profitability, having achieved growth often leads to higher profitability over time for two reasons. The first is the proven demand for the innovation as indicated by sales growth. The second is that the firm also learns how to better exploit the value of its innovations. Basically, with increasing learning and experience, the new firm's cost for a particular output should decline. This leads to our final prediction:

> ***Hypothesis 5d.*** *The innovation intensity of the environment moderates the impact of increases in growth on firm profitability: The higher the innovation intensity, the greater the impact of increases in growth on firm profitability.*

3. DATA AND METHODS

The data in this paper originate from a longitudinal database maintained by Statistics Sweden: RAMS, which provides yearly data on all firms registered in Sweden. With RAMS, we sample all incorporated firms started between 1995 and 2002 in the knowledge-intensive sector. This sector covers 44 two-digit industry codes, comprising roughly 33% of all employment and over 40% of GDP for Sweden. This sector therefore is vital for economic development, especially in post-industrial economies such as Sweden (Davidsson, Kirchhoff, Hatemi-J and Gustavsson, 2002). The selection of knowledge-intensive sectors follows Eurostat and OECD's classification which is based on the ratio of R&D expenditure to GDP or R&D intensity (Götzfried, 2004). Sampling R&D intensive industries is motivated by modern growth theory stressing the commercial use of new knowledge coming from research and development as an elementary driver of economic growth (Kirchhoff, Newbert, Hasan and Armington, 2007; Romer, 1990) as well as the role of diffusion of new knowledge that might spur later growth (Acs et al., 2009; Kirchhoff et al., 2007). In addition, this sector is highly dynamic and therefore allows us to uniquely capture the necessary variance in new entry, exit, and growth as part of our modeling (Armington and Acs, 2004; Short, McKelvie, Ketchen and Chandler, 2009). As part of this, these industries are home to some of the highest growth firms in an economy (Delmar et al., 2003). New ventures are heterogeneous, ranging from 'mom and pop' retail stores to venture capital-backed start-ups in the high tech sector. While the knowledge-intensive sectors include both service and manufacturing firms, the former type predominates. This is imperative since service-based firms comprise a significant and growing proportion of all new firms, and the entry and expansion of such firms is an important driver of economic growth and change (Armington and Acs, 2004). The number of start-ups in the service industries in the US and most other industrialized nations outnumber manufacturing start-ups roughly 8 to 1 (Kim et al., 2006). Finally, our choice of sampling only knowledge-intensive sectors is motivated by a need to limit unobserved heterogeneity plaguing many studies of entrepreneurship (Shane, 2003). Together, these reasons suggest the knowledge-intensive sector to be theoretically relevant and practically important.

The data come with some notable merits: First, we investigate a panel of the full population of firms within this sector based on high-quality, register data. Problems related to inferences and internal validity are reduced, since our estimates are not based on a limited sample of firms (Shane, 2003). Furthermore, we can take better advantage of our data as many previous studies often rely on (pooled) cross-sectional approaches (Wooldridge, 2002). A common problem in studies of new firm dynamics is the change in the firm identifier code when the ownership, industry classification, or regional affiliation of a firm changes (Kirchhoff and Phillips, 1992). This makes some on-going firms appear to terminate and later to re-emerge as new firms that are in reality the same firms. We separate genuinely new start-ups from other sorts of entrants, such as mergers, acquisitions, renamings, subsidiaries, and those that move across industries (Davidsson et al., 1998). We overcome these problems by not accepting a single identifying code as the tracking criterion. We track firms by combining data from the tax authorities with identity codes from Statistics Sweden. We use this identifier to ascertain the independence of a firm in the year of entry and therefore ensure it is not a subsidiary (Davidsson et al., 1998). To avoid problems with firms renaming or changing legal form, we also make certain that all firms are independent by confirming that the majority of employees were not working at another firm in the previous year. These conditions provide a robust identification of new independent firms. A new firm in our study is therefore defined as an independent new legal entity not in existence in this industry or any other industry prior to the first observation. Statistics Sweden assigns all legal entities with a unique identifier.

Normally, accounting data for new unlisted firms are difficult to access because entrepreneurs are hesitant to share this information (George, 2005). The Swedish tax authorities provided all financial information which is included in RAMS. In Sweden, incorporated firms have to be audited by law. This makes for more reliable accounting data for these types of firms than, say, partnerships or sole proprietorships (Bradley et al., 2011). Further, the capital requirement of 100,000 SEK[2] as part of incorporating helps eliminate part-time or hobby firms from our population study. This choice also increases the likelihood of examining firms with the potential to accept risk and pursue growth, and thus further increases the theoretical relevance of our sample. Previous research has shown that other legal forms in Sweden (e.g. partnerships or sole proprietorships) exhibit no or very limited growth (Delmar et al., 2005; Davidsson, Kirchhoff, Hatemi-J and Gustavsson, 2002) and would therefore not fit within our theoretical framework.

We analyze the growth of each independent incorporated firm with one or more employees. Since we use panel data analysis, the unit of analysis constitutes firm-year observations. We observe 25,923 new entries, varying from 2,466 entries in 1996 to 3,632 in 2000. In our multivariate analysis, the number of firm-year observations in these descriptive statistics are reduced since we are using lagged performance variables based on two years of performance (e.g. in the growth models in Table 5, profitability at year t-2 is used to predict

[2] During the time of study, the exchange of 1SEK fluctuated between 0.134 and 0.154 USD, with an average of 0.140. This suggests a minimum capital requirement of approximately $14,000.

exit and growth at year t-1, which is used to predict the dependent variable). Since all independent and control variables are lagged compared to the dependent variable, we only use firms that have performance data for at least two years. This excludes observations for all firms entering and exiting in the first year (N=5,342) and the first year performance data for each firm, leaving us 13,153 new firms or 35,050 firm-year observations.

3.1 Variable description

Formal descriptions and mathematical calculations for all the variables used in this study can be found in Tables 1a (dependent, independent, and control variables) and 1b (moderator variable). In order to minimize problems with reverse causality, the dependent variable was lagged one year after all independent and control variables (Hamilton and Nickerson, 2003). We are thus able to better understand the causal structure and temporal process of the set of relationships among profitability, growth, and survival. The profitability variable (ROA), the sales growth variable, and the robustness variable (EBIT/sales) were corrected for inflation by discounting by the yearly consumer price index until the year 2002, using the annual inflation rate provided by Statistics Sweden (2012).

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INSERT TABLES 1a AND 1b HERE

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3.2 Dependent variables

We employee three key dependent variables in this study: growth, profitability, and survival. These variables are also used as independent variables when we examine their effect on another dependent variable.

3.2.1 *Growth.* In this study, we focus on sales growth as the most appropriate growth variable for two reasons: First, we investigate new firm dynamics as function of selection and learning mechanisms nested in market competition. In line with previous research in this area, we use sales growth as outcome variable (Bottazzi et al., 2010; Coad, 2007). Second, sales growth is the most commonly espoused measure of growth, and is argued to be of general relevance in studies of new firms, regardless of industry (Delmar, 1997; Shepherd and Wiklund, 2009; Short et al., 2009). Sales growth reflects the firm's capacity to sell its products or services, and thus strongly indicates market presence and activity. Since the magnitude of sales and sales growth differ across industries, we use the relative ratio of sales growth for each firm using the difference in sales (logarithmic values) between the past and the current year (Reichstein et al., 2010).

3.2.2 *Profitability.* As discussed, economic and management theories alike tend to posit profitability (in the sense of the efficiency of the firm) as an important predictor of growth. Similar to Davidsson et al., (2009), we operationalize profitability by the most generally employed measure: Return on Assets (ROA). This measure overcomes variations based on size in terms of total profits. Yet, as noted earlier in a footnote, profitability can differ substantially from economic profit, and may rise due to market power rather than efficiency (Bloom, Sadum and Van Reenen, 2010). In the context of new independent firms, this is less of a problem as these firms rarely, if ever, are able to exert market power. To validate this variable, we also use a second profitability measure, Earnings Before Interest and Taxes (EBIT) divided by sales. This measure has also been used in some studies (Brännback et al., 2009; Kwoka and Ravenscraft, 1986), but less often so than ROA. EBIT has been argued to be relevant to business managers as it is less likely to be influenced by low asset bases, as is common in the service sector (Kviluoto, 2011; Wennberg et al., 2011). Both sales growth and the profitability measures are subjected to severe outliers. To mitigate this problem, we used a

Winsoring technique to truncate the extreme values to the minimum and maximum values at the 1st and 99th percentiles, respectively.

3.2.3 Survival. The exit of a firm from the market is the indication of whether or not a firm survived. There are numerous reasons for exit, and embracing the multi-faceted approach of exit is important for understanding industry dynamics. Statistics Sweden tracks three forms of exit: exit by closure, exit by split, and exit by merger. Closure is by far the most common cause (3,729 firms, or 93.13% of the firms exiting in our population). In this case, the firm and its establishment(s) cease to exist in the industry and all employees migrate to other establishments. With exit by split, the firm is split into at least two new legal entities. If any entity remained in operation at the same address with a majority of employees, we did not code this as an exit. With exit by merger, the firm is acquired by or merged with another firm (125 firms, or 3.12%). Divesting of their business to a larger firm may be seen as a successful outcome rather than an exit for many firm founders (Wennberg et al., 2010). Since we are interested in the evolution of independent new firms we excluded firms that were acquired or merged from our survival analysis and treated these firms as censored. In the survival analysis, firm exit is coded as 1 the year it is terminated and 0 otherwise.

3.3. Moderating variable

Our theory suggests that new firm growth, profitability and survival are highly dependent on industry context (Reichstein et al., 2010) and context defines the competitive logic. We focus on the *Innovation intensity* (Peneder, 2010) of industry sectors. This classification is based on cluster analysis of innovation differences using Community Innovation Survey (CIS) data for 21 European countries (including Sweden) in 1998–2000. This provides very detailed data on innovation intensity of individual industry sectors. Peneder's analysis renders a classification at the two-digit industry level with five different rankings ranging from one (low innovation intensity) to five (high innovation intensity). This variable is time invariant, but firms can change industries during their lifetime. We use the variable as the basis for the moderator variable to test Hypotheses 5a–5d. This variable is described in greater depth in Table 1b.

3.4. Control variables

Consistent with our evolutionary framework stressing firm variation, selection, and retention, we employ four types of control variables from different levels of analysis: firm, industry, and year. Further information on these variables, including mathematical calculations, can be found in Table 1a.

At the firm level, both *Firm size* and *Firm age* have been shown to affect both the probability of survival and growth due to potentially having stronger market positions, access to resources, and the development of structures and routines such as budget and control systems (Barnett and McKendrick, 2004; Davidsson et al., 2009; Phillips, Kirchhoff and Brown, 1991; Storey, 1994). Since we are interested in knowledge-intensive firms, we also control for *Employee human capital* as this has been known to benefit the development of such firms (Phillips, Kirchhoff and Brown, 1991). We capture this as the percentage of employees with a university education in science or technology (minimum three years of study). Since new firm growth, profitability and survival are associated with endogenous but unobserved characteristics of new firms – such as productivity and an entrepreneur’s ability and motivation to achieve superior performance levels – models of growth are at risk to suffer from an endogeneity bias (Hamilton and Nickerson, 2003). In our growth models, we therefore include a lagged dependent variable (*Past sales growth*), thereby controlling for unobserved factors that co-determine firm growth and profitability (Wooldridge, 2002).

At the industry level, in addition to the measure of industry innovativeness (see moderating variable explanation above) we control for five other industry variables: The *Herfindahl concentration index* is used to control for industry concentration and was calculated by the sum of the squared share of sales across the industry (Acar and Sankaran, 1999). *Minimum efficient scale or size (MES)* represents the smallest size or output level necessary for a firm in a particular industry where the long-run average costs are at a minimum (Audretsch, 1995). We measure industry MES as the medium firm size in the industry, based on employment (Reichstein et al., 2010). *Market and industry instability* is measured using the Hymer and Pashigian (1962) approach by summing the absolute changes in market shares by the three digit industry code. The less concentrated the market is, the easier it is for new firms to survive and grow, because they have more ample access to resources (Kato and Honjo, 2006). We control for *Industry growth* by measuring the differences in industry sales over time. This variable is known to have a positive effect on firm growth and survival (Audretsch, 1995). Finally, four industry-level dummies control for central industry characteristics in evolutionary economics under the umbrella term 'technological regime' (Winter, 1984; Peneder, 2010): *Entrepreneurial industries with growing population, Entrepreneurial industries with balanced population* (also used as an instrument in our sample selection model), *Routinized industries with balanced population,* and *Routinized industries with declining population.* For brevity and increased simplicity in reading the results, the year and the 'technological regime' industry dummies are suppressed from the presentation of the results.

3.5. Analytical methods

The empirical analysis proceeds in five steps: First, we examine determinants of new firm survival where survival is a function of previous growth and profitability, so as to construct a survival correction variable. Second, we analyze growth as a function of survival and profitability. Third, we investigate profitability as a function of previous growth and survival. Fourth, we introduce the moderator variable. Fifth, we run a number of robustness tests.

We use Cox's semi-parametric survival regression to investigate survival. The Cox model does not necessitate assumptions regarding the shape of the hazard rate, which allows us to investigate the effect of the specific variables we are interested in without imposing pre-determined specific assumptions regarding hazard rates. This model is also used to construct our correction for survival bias. This correction variable (Lambda) uses Lee's (1983) generalization of the Heckman selection model.

Since there is little convergence in opinions on how best to model firm growth (Beck et al., 2008), we use several different models as robustness checks. We test all hypotheses using fixed effects panel regressions to take full advantage of our panel data. Panel regressions are useful as it allows for consideration of omitted variables that differ between firms but are constant over time, allowing for more consistent estimates on the effect of the observed explanatory variables (Wooldridge, 2002). To avoid multicollinearity, the industry-level moderator variables were introduced stepwise. We use likelihood ratio tests to compare each type of model and estimate the contribution of including another predictor to the model.

4. RESULTS

4.1. Descriptive statistics

Table 2a presents life tables showing the yearly entry and survival of firms for the full period 1995 to 2002. We find that, on average, 86% of all firms survive from the first to the second year. In year five, 56% of all firms remain, and in year eight, only 35% remain. This is comparable to previous studies on new firm survival, and indicates that survival is important to account for in the analysis of firm growth (Phillips and Kirchhoff, 1989; Levie, Don and Leleux, 2011; Short et al., 2009). Table 2b shows the development in sales and employment of firms for each year of investigation. On average, with age surviving firms grow considerably in both sales and number of employees.

Table 3 shows the descriptive statistics and correlation table for the variables included in the analysis. In order to ease the readability of the tables, we suppress the effect of cohort year. When comparing the distribution of the variables, we see that taking the logarithm for almost all our variables positively affects their distributional properties. The correlation table does reveal some interesting information. Noteworthy is that the correlation between growth and profitability is low; specifically the correlation between sales growth and ROA is 0.06.[3] It is also important to note that the average annual sales growth rate is close to zero (logged value mean=0.97; s.d. 0.19) indicating very little actual sales growth occurs. Similarly, the average ROA is 3.87% but with high standard deviation (s.d. 33.82) for the firms included in our growth analysis (n=23,382). This is still substantially higher than the average ROA (mean=0.16%; s.d. 39.82) for the firms included in the survival analysis (n=35,050), as exiting firms are likely to have lower ROA. This mean difference in ROA between surviving firms and all firms (including exiting firms) offers preliminary support for our notion that survival, growth and profitability are linked. Next, we present the results for our three dependent variables.

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INSERT TABLE 2a, 2b, AND 3 HERE

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4.2. Survival analysis

Model 1a and 1b in Table 4 display the results of our hazard rate model allowing us to test Hypotheses 1 and 2. After fitting an unreported base model with only control variables, model 1a introduces the profitability measure and Model 1b introduces the innovation intensity moderator allowing us to test Hypotheses 5a and 5b. Hypotheses 1 and 2 are tested against the fully saturated model (model 1a). As predicted, profitability (ROA) has a strong negative effect on the likelihood of exit[4], which means that it has a strong positive effect on survival

[3] A similar correlation (0.08) was found in the robustness models where ROA was replaced with EBIT / sales.
[4] Note that the negative coefficients in this model signify an increase in likelihood of survival.

(β=−0.008, $p < 0.001$). This indicates that more profitable new firms have a higher likelihood of surviving. More specifically, a 1% increase in ROA decreases the probability of exit by 1%. A likelihood ratio test between the unreported base model containing only the control variables and model 1a suggest a strong improvement of the model (χ^2= 187.40, $p < 0.001$) when including only ROA. These results support Hypothesis 1 that increasing profitability increase chances of survival.

Hypothesis 5a suggests that innovation intensity moderates this relationship where the higher the innovation intensity, the greater the impact of changes in profitability on survival. We find the opposite effect in Model 1b. The interaction between ROA and innovation intensity is positive (β=−0.001, $p < 0.001$). An examination of the marginal effect shows that the lower the innovation intensity, the greater the impact of changes in profitability on survival. This means that firms in industries that are low in innovation see increased benefits from increasing profitability. However, the difference among industries is relatively minor: the difference between the lowest and highest industry is less than 0.5% per ROA change.

Hypothesis 2 predicted that higher growth will lead to greater likelihood of survival. However, contrary to this prediction, we observe a statistically significant and positive effect of growth on the likelihood of exit (β= 0.773, $p < 0.001$). More specifically, a 1% increase in sales increases the probability of exit by 21%. This is a rather high and negative rate. A likelihood ratio test between the unreported base model containing only the control variables and Model 1a suggests a moderate improvement (χ^2= 24.69, $p < 0.001$) when including the growth variable. This indicates that higher levels of growth in the previous year actually increase the likelihood of exit. This result is in the opposite direction of Hypothesis 2 and challenges some of the prevailing theories that young growing firms are more resilient (Audretsch, 1995; Phillips and Kirchhoff, 1989). However, this result is consistent with some evolutionary theorizing that argues that growth is a risky endeavor that may not enhance the chances of survival, at least in the short-term (Delmar and Wennberg, 2007; Dosi et al., 1995) or that growth can be depicted as a 'random walk' (Coad et al., 2012; Geroski, 2000). Hypothesis 5b predicts the innovation intensity of the industry to moderate this relationship. We do not find support for this hypothesis.

The firm level control variables behave as expected based on precedent in the literature. Both firm age ($\beta = -0.127$, $p < 0.001$) and firm size ($\beta = -467.698$, $p < 0.001$) diminish the probability of exit. If we compare the standard coefficients (Z), we find that firm size is the most influential variable in the model ($Z = -9.24$), followed by profitability ($Z = -6.24$) and firm age ($Z = -3.70$). These are important results. Of note is that the effect of size is important. A 1% increase in size reduces the probability of exit by 12%. It offsets, but only partially, the greater risk associated with growth. Our theory suggests that growth is vital as it leads to greater size. Hence, growth – at least in terms of sales growth – might have a negative direct effect on survival, but a positive one when captured by firm size. A growing firm will acquire greater accumulated resources and it is this stock of resources that affects survival (Coad et al., 2012).

We use the fully saturated Model 1b in Table 4 as the basis to construct our selection correction variable Lambda. A good selection model necessitates at least one variable that predicts survival but neither growth nor profitability (Delmar and Shane, 2003). We find that being in an entrepreneurial industry with a balanced population predicted survival but not profitability or growth.

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INSERT TABLE 4 HERE

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4.3. Growth analysis

Columns 2a and 2b in Table 4 show models where we examine the relationship between profitability and firm growth. After fitting an unreported base model with only control variables, Model 2a introduces the profitability variable (ROA), and Model 2b introduces the industry innovation contingency. Model 2a shows that increases in profitability are associated with subsequent growth (β= 0.001, $p < 0.001$), which supports Hypothesis 3. More precisely, a 1% increase in ROA increases sales by about 0.1%. A likelihood ratio test between the unreported base model and model 2a (χ^2= 80.44, $p < 0.001$) shows the inclusion of our profitability variable leads to a significantly stronger model. We also find that the lagged dependent variable of past sales growth is positive and statistically significant (β=0.112, $p < 0.001$), indicating the persistence in growth differentials between firms (Bloom et al., 2011; Dosi et al., 1995). Hypothesis 5c predicts the relationship between ROA and growth to be moderated by industry's innovation intensity. We do not find support for this prediction.

If we compare the standard coefficients (Z), we find the most influential variable in Model 2b to be firm size (Z= −19.19), followed by ROA (Z= 6.98) and firm age (Z= −6.50). Model 2b's goodness-of-fit amounts to an F-value of 42.45 ($p < 0.001$). The within variance R^2 value is 4.6%. This relatively low R^2 result is common in samples with significant heterogeneity in the outcome variable, as is common in studies of firm growth (Coad, 2007; McKelvie and Wiklund, 2010; Phillips and Kirchhoff, 1989; Shepherd and Wiklund, 2009). It should be noted that the R^2 value in fact only measures how significantly the slope of the fitted regression equation differs from zero, which is not the same as a goodness of fit (e.g., Willett and Singer, 1988). As such, relatively low R^2 statistics in regressions are not uncommon (especially in the new venture performance context) and are not sole reflections of goodness of fit (Woolridge, 2002, p.44), especially in the context of time series analyses where firm, industry, and random (error term) variance is likely to change with time. An alternative goodness of fit statistic is the F-value, which takes into consideration changes (not absolute numbers) to the R^2 statistic based on the inclusion of a new factor. As can be seen in Models 2 and 3 in Table 4, our F-statistics are above 45.09 ($p < 0.001$) for the effects of profit on sales growth and 62.52 ($p < 0.001$) for the effects of sales growth on profit. This shows that there is practical importance to including these variables into our fixed effect regressions.

4.4. Profitability analysis

One empirical contribution of this paper is to overcome the common issues of possible reverse causality in performance-related variables and their effects on firm growth. We therefore also model firm profitability (ROA) to test the robustness of our results and investigate the potential of reverse causality, where growth might lead to subsequent profitability, as posited in Hypothesis 4. Models 3a and 3b in Table 4 show the results of predicting profitability using the same variables as in the growth analysis. The variables predicting growth are also significant predictors of profitability. Model 3a shows previous sales growth to be significantly associated with subsequent ROA, (β= 26.691, $p < 0.001$). More precisely, a 1% increase in sales increases next year's ROA by 27%. This supports Hypothesis 4, showing a positive relationship between growth and profitability. This association is stronger than the relationship between survival and profitability on growth. A likelihood ratio test between the unreported base model and model 3a (χ^2= 72.70, $p < 0.001$) shows that the inclusion of growth in Model 3a is important. Hypothesis 5d predicts the relationship between growth and profitability to be moderated by the innovation intensity of the industry. We do not find support for this hypothesis.

The lagged dependent variable ROA is also positive and significant (β=0.147, $p <$ 0.001), indicating the persistence in profitability differentials between firms (Bloom et al., 2011; Dosi et al., 1995). Comparing the standard coefficients (Z), we find that the most influential variable in model 2b is firm age (Z= −16.36), followed by the lagged ROA (Z=

14.93) and firm growth (Z= 6.15). Model 3b's goodness-of-fit amounts to an F-value of 62.52 ($p < 0.001$). The within variance R^2 value is 6.2%.

In sum, our multivariate analyses without a moderator demonstrate that profitability leads directly to survival and growth. Previous sales growth has a statistically significant effect on future sales growth and profitability, and also has a negative effect on survival. Growth is predicted by previous profitability, past sales growth, and indirectly by survival. Growth has a further benefit as firm size has a significant impact on survival and profitability. Table 5 summarizes the hypotheses and our results.

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INSERT TABLE 5 HERE

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4.5. Robustness tests

To ensure the reliability of our panel models, a number of robustness tests were performed:[5] First, we estimate models exchanging our profitability measure of ROA with EBIT/ sales. We find the same direct effects for profitability as in previous models. Sales growth becomes insignificant in the survival model, but we observe the same direct effects in the other models. The moderating effect becomes even weaker than previously reported. Overall, we find results consistent with our main model.

Second, we split our population into different industries as classified by their two-digit industrial classification codes and reran our analyses. Two things are important to note. First, the explained variance in our models increased in most industries as we diminished the number of firm observations. Second, we find varying sector differences. Profitability leads to more growth for firms operating in the knowledge intensive market services industry, which

[5] The results of these robustness tests are available from the authors upon request.

represents the most common type of new venture founded (Kim et al., 2006), as compared to firms in manufacturing-based industries.

Third, we estimated our models using pooled OLS regressions instead of fixed effect regressions. Once more, we increased the explained variance (R^2) of our models. These models yield some different coefficient sizes from the fixed effect regressions showed here. For example, while profitability (ROA) has a positive and significant effect on survival and growth in both the OLS and fixed effects models, the coefficient sizes are smaller in the fixed effects regressions. Hence, OLS tends to overestimate the effect of profitability on firm growth, providing support for the deeper insights gleaned from our fixed effects modeling.

Fourth, we performed Hausman tests to investigate the differences between fixed effect and random effect models. We find strong support for the fixed effect model approach, even if there is an important amount of between (cross-sectional) variance in the models. Suppressing the between-case variance in our independent variables still yielded the same results. Hence, while firms differ substantially cross-sectionally, changes in profitability and sales growth lead to important changes in the outcome variables. This highlights the theoretical notion that profitability and growth differences among firms tend to be fairly stable over time, but that a transition from a non-profitable to a profitable firm is relatively rare (Brännback et al., 2009; Coad, 2010). This highlights the importance of controlling for the potential of unobserved differences in studies of firm growth.

Fifth and finally, we re-ran our fixed effect models without our survival correction variable Lambda. Our results indicate important difference in coefficients, especially in the models predicting profitability but less so in the models predicting growth. Overall, the inclusion of a survival indicator is important to our models.

5. DISCUSSION

This paper takes stock of the accumulated research on new firm growth since the early work on new firms' contributions to society emerged in the late 1970s and 1980s (Audretsch, 1989; Birch, 1979; Phillips and Kirchhoff, 1989). A pivotal reason for the lack of consensus on the reasons, sources, and patterns of firm growth is to be found in the endogenous nature of growth and other performance variables such as profitability and survival. To guide our analysis, we adopted an evolutionary perspective to explain the role of profitability for firm growth and survival. In the face of uncertainty, entrepreneurs use profitability to learn about their productivity and as an internal resource for investing in growth. Our theorizing suggested that profitability and growth depend on industry specific competition. Specifically, industries' innovation intensity was expected to be an important contingency of the relationship between competition and new firm survival, growth, and profitability.

Our analyses clearly show that firm profitability greatly enhances survival, and also enhances growth. Specifically, a 1% increase in profitability is associated with a decrease in the probability of exit by 1%. We know that on average there is a 14% chance for exit in the first year of life (age 1) to a 6% chance for in the last year of our study (age 8). This suggests that increasing profitability – even marginally – is important for survival, especially if we know that the average ROA of all firms is close to zero. We also find that profitability has an important impact on sales. A 1% increase in ROA is linked to sales growth of approximately 0.1%, adjusted for inflation. Considering that the average firm also has no sales growth, increasing sales even marginally is noteworthy for several reasons. While growth is associated with a decrease in the likelihood of survival (a 1% increase in sales increases the probability of exit by 21%), it serves to enhance future growth and profitability. Sales growth eventually translates into greater size, and size diminishes the risk of exit. A 1% increase in size is linked to a decrease in the probability of exit by 12%. And because growth is a process, surviving another year decreases the likelihood of exit by 16%. The process of growth is also a reinforcing process, where previous growth to a certain extent leads to future growth (a 1% increase in previous sales increases sales growth by about 0.1%), but more importantly, it increases profitability (a 1% increase in sales increases ROA in the next year by about 27%). Considering the average ROA for surviving firms is 3.8%, this predicts an increase to approximately 4.8% in the following year.

We also find the relationship between profitability and survival to be moderated by industry-level factors represented in the innovation intensity of the industries, but contrary to our prediction. Specifically, we found that in industries with low innovation intensity, the relationships between profitability and survival were stronger than in industries with high innovation intensity. The economic effect is however quite marginal with a 0.5% difference between the highest and lowest value. We do find a direct effect of the innovation intensity on sales growth, suggesting that firms operating in less innovative industries have higher growth. Overall, our findings lend support to our theory of entrepreneurs using performance feedback to guide their behavior in an evolutionary manner, but that the innovation intensity of the industry has a limited role in moderating core relationships among our variables under study. Growth is, however, directly impacted by innovation intensity.

These results lead us to conclude that the untangled puzzle among our core concepts is that profitability leads to survival and growth leads to profitability, conditional on survival. But, growth generally hurts the likelihood of survival while improving profitability. The finding of the negative direct relationship between growth and subsequent survival is important as growth generally is seen as reflecting good fit within evolutionary models and previous studies have found positive relationships (e.g. Phillips and Kirchhoff, 1989). Additionally, growth is oftentimes equated with positive new firm performance – and in fact sales growth is the most commonly espoused measure of new firm performance (Shepherd and Wiklund, 2003; Short et al., 2009). This finding is also contrary to recent research such as

Coad et al. (2012) who find that growth enhances survival. Comparing these two studies is difficult as Coad et al. did not measure survival on an annual basis. It is possible that there are important time lags where growth has a short-term negative effect due to the need for adaptation, but a longer-term positive effect.

5.1. Theoretical contributions

Our research provides three theoretical and empirical contributions to evolutionary models of entrepreneurship and research on new firm growth and survival. First, our results indicate that selection forces might be asymmetric, and not symmetric as suggested by current theory (Metcalfe, 1994). Theory suggests a symmetric selection force where unfit firms get eliminated and fit firms grow. Our results, based on a population of new Swedish firms, do not show such a symmetrical pattern. The selection mechanisms put forth in our theory, that unfit firms get eliminated, are rather strong. In year five, 56% of all new firms remain active, and lack of profitability is the strongest predictor of firm exit aside from firm size. However, the selection mechanisms pushing firms to grow, thus forcing non-growing firms to exit from the market, are not equally strong. Even if we find profitability to be the strongest predictor of sales growth (aside from size), the actual correlation is low (r=0.06). Our finding of lesser growth forces is in line with empirical research examining the ‘growth of the fittest’ hypothesis in evolutionary thinking (Bottazzi et al., 2010; Coad, 2007; Dosi, 2007) conducted on French and Italian manufacturing firms. Further, the results show competitive pressures to be fairly effective in terms of eliminating ‘unfit’ firms, but not necessarily in rewarding growing firms with survival, even if the basic mechanisms described in the theory seem to hold. We suggest various explanations for why growth might have a negative impact on survival. First, in an evolutionary framework characterized by market frictions, adaptation in terms of growth may be both costly and uncertain (Eliasson, 1996). Further, it is likely that the relationships between growth and survival are mediated by new firm’s strategic orientation in terms of pricing strategies, willingness to invest, to expand, or to engage in various strategic alliances (Wiklund and Shepherd, 2003). Moreover, many new firms are characterized by satisfying behavior in that they are reluctant towards growth, despite being profitable (Wiklund et al., 2003). High degrees of freedom in strategic choice coupled with satisfying behavior among entrepreneurs would allow firms to survive, but not grow, as there little competitive pressure to do so (Bottazzi et al., 2010).

Our findings that growth may have a negative impact on survival suggests that evolutionary models must consider entrepreneurship as new firm entrants not only as a way to introduce variation in the economy (the trials-and-errors of entrepreneurial market activities), but also as a mechanism that allows for greater retention of value created from these activities (Aldrich and Ruef, 2006; Spencer and Kirchhoff, 2006). Theoretically, well-functioning selection mechanisms lead to unprofitable entrepreneurial efforts being disbanded while successful entrepreneurs are able to appropriate value from their efforts. Without such symmetric selection mechanisms, there will not be an incentive structure to encourage new market initiatives, nor role models to prove that such initiatives – albeit risky – can still be perceived as attractive. The search for successful variation is often a process of trial-and-error. Trials are costly and involve risk, and entrepreneurs are typically not rewarded for the most creative failures (Romanelli, 1999). Consequently, entrepreneurs need to believe that discovering successful variation is worthwhile if economic development based on new firm growth will be seen as important (Kirchhoff, 1988; Phillips and Kirchhoff, 1989).

Second, this paper contributes by offering a rather unique application of an evolutionary perspective where the recursive nature of firm profitability, survival and growth is explained and tested. Our results indicate an endogenous cycle of performance-related variables where firms learn from performance feedback, but where changes are small and slow. This cycle is not necessarily linear or even strictly causal in nature (Davidsson et al., 2009), but nevertheless shows the imperative nature for research on firm growth to simultaneously measure growth, profitability and survival in order to not confound the nature of these variables for firm evolution. Further, changes are small and slow. Small changes support the notion of performance differences in profitability to be rather persistent over time (Dosi, 2007), and where profitability has a rather weak effect on sales growth. However, these changes are slow. We observe these relationships to be mediated over time, as growth affects size, and growth affects further profitability. This suggests that while we observe firm's performance to be rather persistent over two years of observation, radical changes in performance should be possible over longer periods of time. The "life cycle" properties of new firms and their industries require much longer observation periods (Klepper, 1996). Evolutionary theory provides little guidance in how much time is needed for selection to be effective despite the notion that change and/or selection might be slow to occur, which is an important topic for further research.

Third, existing theoretical models of entrepreneurship and growth have tended to focus on the behaviors, motives, and strategic actions of individual entrepreneurs (Wiklund and Shepherd, 2003), especially when it comes to the relationship between profitability and growth (Davidsson et al., 2009). While we do not address the role of strategic choice or growth motivation in our analyses, our results show that it cannot be assumed that all entrepreneurs opt for growth. The results indicate that potential reasons for choosing growth or refraining from growth can be based on low competitive selection pressure and potentially satisfying behavior. New firm growth is a risky option where pursuing growth may also lead to short-term firm failure just as much as it leads to long-term success via achieving larger size. In this regard, viewing new firm growth as a potential outcome of entrepreneurial risk-taking may be similar to the recent findings within the study of the Entrepreneurial Orientation of firms, where the proactive, innovative, and risk-taking behaviors have been linked to both firm failure and differential firm performance (Wiklund and Shepherd, 2011). Hence, many new firms may deliberately choose not to seek growth due to the potential threats to survival. This implies an important self-selection of firms into growth (Delmar and Wiklund 2008). Our paper highlights the notion that while entrepreneurs' decisions to grow constitute deliberate choices (Saemundsson, 2005), they may also a function of satisfying behavior and the competitive intensity of industries.

5.2. Methodological contributions

Our research also provides some important methodological contributions. The overall results verify the stark differences between using models that rely on asymptotical normal distributions, models assuming cross-sectional distributions versus panel data methods, and models accounting for the great heterogeneity in growth. Growth studies are plagued by methodological challenges and the choice of a model needs to be both empirically and theoretically informed (Delmar, 1997), especially when interested in causality (Coad, 2010). One minor empirical contribution of this paper is a step towards alleviating the common issues of possible reverse causality in performance-related variables and their effect on firm growth, as well as controlling for survival bias. Table 4 clearly shows that the same variables predicting growth also predict survival. Hence, controlling for survival bias is warranted when examining new firm growth. Models 3a and 3b in Table 4 show that the causation between profitability and growth is more valid than a potential reverse causality. This is in addition to our temporally lagged dependent variables. The risk of reverse causality highlights the need for theories of new firm growth to allow researchers to derive a model where hypothetical "thought experiments can be conducted to examine the effects of changes in parameters and constraints on outcomes" (Heckman, 2000, p. 46). The evolutionary theory presented represents an attempt at such theorizing, which allows for the simultaneous consideration of a number of performance-related variables, and how they are jointly determined during the early stages of a new firm's life.

Finally, we contribute to public policy by showing that research on firm growth is likely to be severely limited unless controls for firm heterogeneity and survival bias are accounted for. Interest among policy makers and educators in the determinants and the nature of firm growth cannot be sufficiently underlined (Kirchhoff, 1988; Phillips and Kirchhoff, 1989). Our results reveal the importance of considering the interrelationship between growth and other variables such as survival and performance. Methodological approaches that are better able to separate effects in a highly heterogeneous population are likely to yield more valid results, and to provide insight to better evaluate the effect of policy changes.

5.3. Limitations

Our study also comes with limitations, several of which offer intriguing avenues for future research. First, our evolutionary theory allows for the simultaneous consideration of a number of performance-related variables, the empirical application of this also means that we are not able to fully address the heterogeneity in the causes, restrictions and opportunities for growth faced by high- and low-growth firms (Cooper et al., 1994). These are left unexplained as our fixed effects design focuses on within-firm variation (longitudinal) rather than between-firm variation (cross-sectional). Future research might take advantage of this heterogeneity by modeling growth of firms based on different thresholds in growth patterns, or focus specifically on fast-growth vs. slow-growth firms (Stam and Wennberg, 2009).

Second, we have examined one aspect of growth, namely sales growth. While this is the most frequently used growth measure (Shepherd and Wiklund, 2009) other measures might also be useful to study. For instance, employment growth may be relevant as this involves a more permanent commitment of resources to the firm (Chandler, McKelvie and

Davidsson, 2009) and may also help address the strong effect of firm size on all of our three dependent variables. Future research may better address these issues.

6. CONCLUSION

In this paper we have attempted to address the nature of the relationships among three key aspects of new firm development (growth, profitability and survival), thereby addressing the importance of industry dynamics and firm growth and building upon the seminal work of Professor Bruce Kirchhoff (Kirchhoff, 1988; Phillips and Kirchhoff, 1989; Kirchhoff, 1994; Kirchhoff and Greene, 1996; Kirchhoff et al., 2007; Headd and Kirchhoff, 2009). There was a lack of consensus in the literature about the reasons, sources, and patterns of firm growth, and part of this can be found in the interrelationships among firm growth, profitability and survival. Our evolutionary perspective helps explain the theoretical underpinnings relating those core concepts. Our model and empirical results help to reveal that profitability helps firms survive and grow, thus mitigating competitive pressures. Growth has a negative effect on survival but a strong effect on profitability, suggesting that enhancing operations as a ways to increase profitability or reduce uncertainty may be a rewarding strategy – but fraught with risk. Finally, we show that only one relationship (between profitability and survival) was altered when considering the nature of the innovation intensity of the industry but that there was a direct effect of innovation intensity on sales growth, providing some support for the general importance of industrial context for understanding new firm performance (Cooper et al., 1994; Spencer and Kirchhoff, 1996). Our paper helps to untangle the complicated web of relationships among growth, profitability, and survival of new firms.

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Table 1a: Definition of variables

Variable	Description	Calculation
Dependent variables:		
Growth: Sales growth	Firm sales growth (FS) Year t– Year t-1	*(log(FSijt) − log(FSijt−1))*
Profitability: Return on Assets (ROA)	ROA in Year for Firm i	*ROAij*
Survival	Year of final exit from panel	*Not applicable*
Control variables:		
Lambda	Selection correction for survival using Lee's (1983) generalization of the Heckman selection model	*See Table 2 predicting survival for specification*
Firm Size	Logarithm of firm size in terms of Year t-1 sales in thousands of Swedish Crowns	*(log(FSij))*
Firm Age	Logarithm of firm age	*(log(Year t – establishment year)*
% of employees with university degree	Proportion of employees (Emp ST) with a 3 year or higher university degree in science and technology in firm i in year t	*Emp ST it/Emp total it*
Firm concentration	Herfindahl concentration index, calculated by the sum of the squared share of sales across the industry.	$\sum_{i=1}^{n}\left[FS\ \frac{if}{\sum_{i=1}^{n} FSij}\right]^2$
Industry instability	Sum of absolute changes in market shares by the three digit industry codes (Hymer & Pashigian, 1962).	$\sum_{i=1}^{n}\left\|(FSijt/\sum_{i=1}^{n} FSijt) - (FSij/\sum\right.$
Industry minimum efficient scale (MES)	Industry minimum efficient scale of production measured by medium sized firms in the industry, based on employment statistics.	*Mean(Indsit)*
Industry growth	Growth of the industry measured by the differences in the logarithmic industry sales (IndS) for year t-1 to t, using a three digit industry level of aggregation.	*(log(IndSit) − log(IndSit−1))*
Technological regimes		*Industrial codes included in each category*
Entrepreneurial industries with growing population	Industries where firm turnover is high and population rather mutable, implying that incumbent firms find it difficult to defend against new entrants. Net entry of firms is growing and so is the net output. This allows high price-cost margins to be maintained despite more firms and low productivity.	Post and telecommunications (64); Computers and IT (72); Business services (72-74); Real estate (70)
Entrepreneurial industries with balanced population	Same as above, but with no population growth population. Profits are above average despite low growth in productivity. Entry costs are likely to be low explaining a high level of entrepreneurial activity, but most new firms are small.	Retail and machinery services (50-51, 71); Social and personal services (90-93)
Routinized industries with balanced population	Characterized by low rates of firm turnover, since high cost of experimentation confine the competitive threat of novel entrepreneurs and give a competitive edge to established business. No growth in the population. Profits are low; there is intense cost competition and limited scope for market expansion. Firm	Pharmaceuticals (24-23); Medical precision and optical instruments (33); Education (80)

	performance depends on technical efficiency of operations.	
Routinized industries with declining population	The same as the above but with a declining number of firms in the population. Profits are low and there is little demand growth but enduring productivity growth.	Transport equipment (35); Financial intermediations excl. pension and insurance (65)
Other industries	Industries not positioned around the two clustering dimensions of opportunity incentives and cost of experimentation.	Chemicals (24); Machinery and equipment (29); Transport and storage (60-63); Financial services (67); R&D (73); Health / social work (85)

Table 1b: Definition of industry-level moderating variables (from Peneder, 2008; 2010)

Variable	Description	SIC-2 Industries
Innovation intensity industries		
5. High Innovation intensity	Sectors are characterized by a high share of creative firms focused on product innovation and many firms performing high intramural R&D. Typically, the appropriability regime depends on the use of patents and knowledge is highly cumulative.	Computer and related activities (72); Research and development (73); Machinery and equipment (29);
4. Intermediate to high innovation intensity	Industries with intermediate share of creative firms involved in process innovations, and with many firms performing R&D, albeit expenditures are less than 5% of turnover. Cumulativeness of knowledge is high or intermediate and patents are often used for appropriation.	Post and telecommunications (64); Chemical and chemical product (24)
3. Intermediate innovation intensity	The most heterogeneous group, but all sectors share a large number of firms pursuing opportunities through the acquisition of external innovations. Accordingly, appropriability measures are relatively weak, with some importance ascribed to strategic means.	Business sector services (74); Financial intermediates (65;67)
2. Intermediate to low innovation intensity	Industries with a high share of firms with adaptive behavior, pursuing opportunities through the adaptation of new technology. Accordingly, the prevalent mode of innovation is the acquisition of new technology. For most firms the appropriability conditions are weak and the cumulativeness of knowledge low.	Air transportation (62); Electricity and gas (40-41); Insurance (66)
1. Low innovation intensity	A homogenous group of industries defined by firms pursuing opportunities not based on new technologies. Innovation is not pursued and there is no accumulation of knowledge	Whole sale trade (50-52)

Table 2a: Entry and survival of firms in each cohort (1995 to 2002)

Year /Age	1	2	3	4	5	6	7	8
1995	3,091	2,492	2,023	1,737	1,521	1,362	1,213	1,081
1996	2,466	2,064	1,777	1,570	1,392	1,225	1,087	
1997	2,942	2,609	2,237	1,929	1,688	1,469		
1998	2,650	2,334	2,086	1,852	1,613			
1999	2,648	2,427	2,054	1,752				
2000	3,632	3,089	2,583					
2001	2,998	2,566						
2002	2,496							
No. of firms:	22923	17581	12760	8840	6214	4056	2300	1081
1995	100%	81%	65%	56%	49%	44%	39%	35%
1996	100%	84%	72%	64%	56%	50%	44%	
1997	100%	89%	76%	66%	57%	50%		
1998	100%	88%	79%	70%	61%			
1999	100%	92%	78%	66%				
2000	100%	85%	71%					
2001	100%	86%						
2002	100%							
Total:	100%	86%	73%	64%	56%	48%	42%	35%

Note: Percentages in lower part of table reflect average yearly survival rates across cohorts

Table 2b: Development of firm sales and employment by age (1995 to 2002)

	Sales (millions of SEK)			Employees			
Age	**Mean**	**S.D.**	**Max**	**Mean**	**S.D.**	**Max**	**N**
1	1.56	19.20	2.06	2.65	7.18	499	25,957
2	3.61	35.00	3.97	4.55	28.34	3,197	19,994
3	5.18	52.10	5.23	5.71	30.70	2,365	14,705
4	5.98	49.70	4.32	6.78	39.05	2,455	10,315
5	7.26	50.60	2.65	7.61	44.57	2,313	7,326
6	7.48	39.90	1.61	8.10	44.65	1,718	4,864
7	8.99	74.00	3.00	8.59	55.28	1,790	2,838
8	10.20	67.60	1.76	10.44	72.76	1,847	1,367
Total	4.35	41.20	5.23	5.12	31.65	3,197	87,366

Table 3: Descriptive statistics and bivariate correlations

	Variable	Mean	Std. Dev.	1	2	3	4	5	6	7	8	9	10	11
1	Sales Growth[a]	0.966	0.192											
2	ROA	3.782	33.819	0.085										
3	Lambda	0.849	0.673	–0.012	–0.160									
4	Sales Growth[a]	10.016	0.054	–0.030	–0.007	0.033								
5	Firm Size[ao]	13.996	1.222	–0.048	0.044	–0.102	0.291							
6	Firm Age[a]	0.001	0.000	0.023	–0.009	–0.098	–0.228	0.079						
7	% Science/Engineers	0.000	0.000	0.010	0.028	–0.009	–0.004	–0.009	–0.009					
8	Herfindahl	0.000	0.000	–0.010	0.003	–0.119	0.029	0.055	–0.071	0.003				
9	Instability index	–0.002	0.002	–0.030	–0.023	–0.170	0.054	0.096	–0.177	0.075	0.208			
10	MES	0.002	0.002	–0.012	–0.064	–0.067	0.049	0.155	0.023	0.009	0.230	0.223		
11	Industry growth	0.000	0.001	0.001	–0.004	0.044	0.019	0.012	–0.038	0.010	0.155	0.058	–0.031	
12	Innov. Type	3.524	0.921	–0.025	–0.022	–0.015	0.058	0.144	–0.023	0.102	0.246	0.291	0.265	0.041

Notes: Firm-year observations=23,382. **[a]** = Values are on a logarithmic scale; [o] = Dependent variable is lagged two years after this variable, all other variables are one year before dependent variable. All correlations above 0.017 are significant at $p < 0.001$.

Table 4: Regression to predict firm performance, 1995-2002

VARIABLES	Model 1a Exit	Model 1b Exit	Model 1c Exit	Model 2a Sales Growth	Model 2b Sales Growth	Model 3a ROA	Model 3b ROA
ROA	–0.005***	–0.008***	–0.005***	0.001***	0.000	0.147***	0.147***
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.010)	(0.010)
Sales Growth	0.769***	0.773***	0.746+	0.112***	0.112***	26.935***	26.691**
	(0.198)	(0.199)	(0.437)	(0.031)	(0.031)	(4.378)	(9.977)
Lambda				–0.000	–0.000	–1.254***	–1.254***
				(0.002)	(0.002)	(0.280)	(0.280)
Firm Size	–0.125***	–0.127***	–0.125***	–0.061***	–0.061***	–1.819***	–1.818***
	(0.014)	(0.014)	(0.014)	(0.003)	(0.003)	(0.360)	(0.360)
Firm Age	–465.498***	–467.698***	–465.517***	–27.735***	–27.790***	–10,081.792***	–10,081.590***
	(49.772)	(49.751)	(49.773)	(4.268)	(4.268)	(616.410)	(616.475)
% Science/Engineers	–56.133	–58.690	–56.110	10.911	11.291	171.722	171.330
	(59.292)	(59.252)	(59.293)	(16.972)	(16.972)	(2,371.336)	(2,371.457)
Herfindahl index	353.659+	322.570+	353.346+	–10.368	–12.388	4,779.119+	4,777.524+
	(187.080)	(187.454)	(187.153)	(18.002)	(18.043)	(2,625.777)	(2,626.521)
Instability index	–35.542***	–36.404***	–35.535***	–2.121+	–2.141+	–206.446	–206.380
	(10.338)	(10.337)	(10.338)	(1.230)	(1.230)	(177.949)	(177.971)
MES	–3.128	–2.912	–3.157	2.941	2.911	–204.390	–204.412
	(14.145)	(14.113)	(14.155)	(2.467)	(2.467)	(364.867)	(364.880)
Industry growth	18.368	17.744	18.357	1.669	1.727	–561.018+	–560.941+
	(23.050)	(23.082)	(23.051)	(2.313)	(2.313)	(329.403)	(329.426)
Innovation type	–0.002	0.007	–0.008	–0.021**	–0.021**	0.447	0.377
	(0.021)	(0.021)	(0.109)	(0.008)	(0.008)	(1.172)	(2.828)
ROA* Inno. type		0.001*			0.000		
		(0.000)			(0.000)		
Sales* Inno. type			0.006				0.069
			(0.107)				(2.553)
Constant				1.737***	1.738***	–1.133	–0.896
				(0.048)	(0.048)	(4.799)	(9.969)

Observations	35,050	35,050	35,050	23,242	23,242	25,601	25,601
Unique firms	13,153	13,153	13,153	9,192	9,192	10,322	10,322
Failures	3,620	3,620	3,620				
R^2 within %				4.6	4.6	6.2	6.2
F test model				45.09	42.45	66.69	62.52
P-value of F model				***	***	***	***
LR Chi^2	522.11	527.40	522.11				
Change in LR Chi^2	212.09***	217.3***8	212.09***	108.50***	112.94***	443.74***	443.74**
Change in LR $Chi^2$from previous model	187.40***	5.29*	-5.29	80.44**	4.44	371.04***	0

Notes: *** p<0.001, ** p<0.01, * p<0.05, + p<0.10. Cox regression on firm exit (Models 1a to 1c). Fixed effects (FE) panel models on sales growth in new firms (Models 2a and 2b). Fixed effects (FE) panel models on ROA in new firms (Models 3a and 3b). Year and technological regime dummies suppressed for brevity.

Table 5: Summary of Hypotheses and Results

Hypothesis	Result and statistical significance	Expected direction	Practical significance
Survival			
Hypothesis 1. Increases in profitability will increase the likelihood of firm survival.	*B*=-0.008, *p*<:001	Yes	A 1% increase in ROA is related to a *decrease* in the probability of exit by 1%
Hypothesis 2. Increases in growth will increase the likelihood of firm survival.	*B*=0.773, *p*<.001	No, opposite direction	A 1% increase in sales is related to an *increase* in the probability of exit by 21%
Growth			
Hypothesis 3. Increases in profitability will increase firm growth.	*B*=0.001, *p*<.001	Yes	A 1% increase in RoA is related to an *increase* in sales by about 0.1%
Profitability			
Hypothesis 4. Increases in growth will increase profitability.	*B*=26.691, *p*<.01	Yes	A 1% increase in sales is related to an *increase* in ROA in following year by about 27%
Moderating effects			
Hypothesis 5a. The innovation intensity of the environment moderates the impact of increases in profitability on firm survival: The higher the innovation intensity, the greater the impact of increases in profitability on firm survival.	*B*=0.001, *p*<.05	No, opposite direction	The higher the innovation intensity, the *lower* the relationship between profitability and firm survival. There is 0.5% difference between the lowest intensity and highest intensity environments.
Hypothesis 5b. The innovation intensity of the environment moderates the impact of increases in growth on firm survival: The higher the innovation intensity, the greater the impact of increases in growth on firm survival.	B=0.006, n.s.	No	No
Hypothesis 5c. The innovation intensity of the environment moderates the impact of increases in profitability on firm growth: The higher the innovation intensity, the greater the impact of increases in profitability on firm growth.	B=0.000, n.s.	No	No
Hypothesis 5d. The innovation intensity of the environment moderates the impact of increases in growth on firm profitability: The higher the innovation intensity, the greater the impact of increases in growth on firm profitability.	B=0.069, n.s.	No	No