Patterns of Performance in New Firms:
Estimating the Effects of Absorptive Capacity

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EFI THE ECONOMIC RESEARCH INSTITUTE

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PREFACE

This report is a result of a research project carried out at the Center for Entrepreneurship and Business Creation at the Economic Research Institute (EFI) at the Stockholm School of Economics.

This volume is submitted as a doctor's thesis at the Stockholm School of Economics. As usual at the Economic Research Institute, the author has been entirely free to conduct and present her research in her own ways as an expression of her own ideas.

The institute is grateful for the financial support which has made it possible to fulfill the project.

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Acknowledgements

Nothing shocks me. I'm a scientist.

Indiana Jones

The modern university traces its roots to the Middle Ages, as European civilization was struggling to emerge from the primitive Dark Ages. The academic life was a hard one; alchemists toiled for decades to attain their Magnum Opus by turning worthless matter into gold but came up with nothing but large surplus quantities of *aqua vitae* which apparently was a crucial input in the research process. Becoming a scholar was a lifelong undertaking requiring the total submittal of the student to esoteric and sectarian rites often involving gruesome displays of public humiliation by senior peers. Apart from the fact that we now have e-mail, I think that not much have changed since. Writing a dissertation is a peculiar undertaking that is as much an anthropological education in the behavior of researchers as it is an education in the craft of research and in both of these parallel processes I have been fully dependent on the gracious support of my advisors; professors Carin Holmquist, Frédéric Delmar, Gerry George, and to no small extent my colleague and more or less informal fourth advisor Karl Wennberg. According to the French philosopher Bernard of Chartres when it comes to acquiring and developing knowledge we are all dwarves standing on the shoulders of giants. For me it has been a much more rewarding experience talking to intellectual giants rather than standing on them and I am grateful for having had access to such a group of stellar researchers and advisors who each have contributed with their specific expertise to introduce me to theoretical perspectives, research skills and tactics, and have been very helpful in providing guidance for me in developing this line of work. Meaning also, of course, that I will do my best to attribute any strange assumptions and viewpoints to them.

Research is an often lonely job and would have been much more so without the company of colleagues such as Ingela, Anders, Anna & Karin, whom I have had the pleasure of getting to know during the professional neurosis that is normally referred to as Ph.D. programs. Leif L., Mikael S., Johan W., Alex McK., Karin H., and the people at EM Lyon have been very helpful in providing constructive

feedback which I have hope I have accepted gracefully. Rasmus, Nick, Dan, and the rest of the SSES team have been invaluable sources of practical experience and empowerment as they have let me loose to test my skills and ideas on their students. Svante, Niklas M. and Jesper E. – it's always nice to see other people in the office on Sundays.

Though writing a dissertation is a lonely job, it is by no means the product of my labor alone. As part of the research program on Entrepreneurial Processes in the Knowledge Economy (EPRO), it could not have been completed without the financial and technical support of a number of stakeholders and other supporters in addition to the other project participants; thanks to Handelsbankens Forskningsstiftelser, the Swedish Foundation for Small Business Research (FSF), the Swedish Agency for Innovation Systems (VINNOVA), the Swedish Institute for Growth Policy Studies (ITPS), the Swedish Agency for Economic and Regional Growth (Nutek), and Statistics Sweden (SCB). I am also indebted to the Swedish Council for Working Life Research (FAS) whose financial support has enabled me to present my ideas and findings at the leading international academic conferences in my field, and to Louis Fraenckel's Scholarship Foundation at SSE that made it possible for me to spend a valuable year at EM Lyon Business School, France.

Leading management researchers have long been critical of the inefficiencies that pervade in large organizations and nowhere are these more obvious than in the organizations that contain leading management researchers. An academic organization is a contradiction in terms that works only through the immense and often unacknowledged efforts by a large number of dedicated people. Thanks to Pär Å., Pär M., Hannes, Janne, Lennart, Berhanu, Peter F., Christian, Siw, and the other lovely ladies in the administration, all of whose work is a necessary prerequisite for the researchers and teachers at SSE in general and has been crucial for me in particular. Love and thanks to little sis for letting me crash in Paris whenever I needed to get away, and finally a word of comfort to my dear parents who have always been the main source of support in all forms: Yes – I have now finally finished school and hope to get a real job.

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1 Introduction: The Creation and Performance of New Firms

The important thing in science is not so much to obtain new facts as to discover new ways of thinking about them.

Sir William Bragg

This chapter provides the background of the research and introduces the main research issue and objectives. I explain the research issue and objectives, and specifically discuss the issues related with theories of firm performance in general and new firm performance in particular. I then detail the outline of the dissertation, briefly introducing and explaining each section. In the final part of this initial chapter I discuss the empirical setting and context of the research, which is Sweden during the full business cycle leading up to the stock market crash 1995-2002, and discuss the scope of the study as well as the delimitations made.

1.1 Background

Concerning economic growth, William Baumol has famously stated that the study of economic growth without including entrepreneurship is as watching Shakespeare's Hamlet without the Prince of Denmark (Baumol, 1968). Entrepreneurship is today recognized as a fundamental feature of economic development and growth, and it could be argued that entrepreneurship should be at the core of every analysis trying to make predictions on the subject (Johansson & Karlson, 2002). Unfortunately there is a fundamental feature of entrepreneurship that makes it the uninvited guest in most economic analyses; inherent is not only the factor of risk, but also that of uncertainty, which makes it difficult to include in any predictive or normative models (Arrow, 1951; Baumol, 2002; Knight, 1921). The approach taken to counter this problem by a majority of

neoclassical economists has previously been to simply exclude the concept of entrepreneurship from their theoretical frameworks altogether, which although providing some peace of mind when developing predictions has been shown to lead to serious flaws and gaps in the theories and recommendations that have been put forward (Kirzner, 1997; Nelson & Winter, 1974). One illuminating example of this attitude towards the phenomenon of entrepreneurship was the review of major textbooks in economics that found that of 23 definitions of economic entrepreneurship, none were included in the major college textbooks (Kent & Rushing, 1989). More disturbingly, in an updated survey a decade later entrepreneurship had still failed to become a central concept in the leading textbooks, thus potentially leaving economics students from that time with incomplete understanding of the process of entrepreneurial value creation (Kent & Rushing, 1999).

Increasingly, economic researchers have proceeded to focus their efforts on entrepreneurs and the new firms they create as increasing evidence has gone to show that it is precisely these individuals and firms that are responsible for the majority of radical innovations commercialized and new jobs created (Baumol, 2002). Contrary to previous common assumptions, it has been previously shown that the majority of new jobs in the United States were created by small- and medium sized companies, the majority of which were younger than four years of age (Birch, 1979). Following this discovery, studies of other industrialized nations have gone on to reveal similar patterns in the UK as well as in small countries with a large proportion of multinational firms such as Norway, Finland, the Netherlands, and Sweden (Broesma & Gautier, 1997; Davidsson, Lindmark, & Olofsson, 1994; Klette & Mathiassen, 1996; Storey & Johnson, 1987). David Birch not only pioneered empirical firm-level research on small firms, but also developed a taxonomy of small firms; so-called *mice* that remain small in terms of employment growth, and *gazelles* which are the small portion of firms which display high growth rates and thus are relatively more effective at job creation, as research indicates that it is not small firms *per se* that generate the largest portion of net job growth, but the young and fast-growing *gazelles* (Henrekson & Johansson, 2008). A

potential explanation to this phenomenon could be that the combination of decentralization in the economy and the rise of new forms of cooperation between firms have lead to an increase of the importance of small firms relative to that of large firms (Loveman & Sengenberger, 1991). From an innovation perspective, entrepreneurial firms have additionally been shown to be better at bringing radical new technologies to the market as opposed to established firms, who more often than not continue to invest in their existing technologies and products, and vigorously defend these against new competitors even when these clearly offer advantages both to producers and customers (Christensen & Bower, 1996; Cooper & Smith, 1996).

In conclusion, small and new firms are emerging as a more important complement to established and mature corporations, as the new firms as a group not only provide a larger net contribution to job creation, but also more often than established firms serve to disseminate new innovations and business models to the customer and capital markets (Audretsch, 1995). This has given rise to a considerable interest in new firms from researchers in management and strategy to examine what makes new firms more or less successful, and more importantly, if and how these insights and recommendations differ from those for larger established firms.

1.2 Research Issue and Objectives

This dissertation aims to improve the understanding and analysis of new firm survival and performance in knowledge-intensive industries through researching a core issue:

> *Does the absorptive capacity – the capacity of an organization to absorb and commercially exploit external technological knowledge – predict the survival and performance of new firms?*

To answer this question, we must first achieve the objective of creating relevant and useful operationalizations of absorptive capacity that can be used in empirical research on new and small firms.

Over the last couple of decades, researchers and practitioners of business and management have invested heavily in trying to develop understanding and knowledge of success factors for firms and corporations.

Firm performance is a central issue in studies focusing on venture creation or long-term competitive advantage and is, in different manifestations such as survival, superior rates of return, turnover growth or profit growth to name a few, one of the most common dependent variables in a wide variety of studies in multiple streams of research (Caves, 1984; Hansen & Wernerfelt, 1989; Miller & Shamsie, 1996; Peteraf, 1993; Porter, 1979). The concept of firm performance has been used as a normative output, i.e. it is implicitly assumed that strong performance in all its manifestations is unequivocally good for the firm, and positive economic performance measured by turnover or profit growth rates is often used normatively as a benchmark. Recently has the concept of performance measures and their relative correlation and impact been questioned and examined more thoroughly, highlighting the problem of comparing the results of studies on new firm performance that uses different dependent variables (Davidsson, Steffens, & Fitzsimmons, 2005b; Delmar, 2006).

Another aspect of separating survival and performance is that of risk. Comparing entrepreneurial outcomes normatively by positive performance measures is one-dimensional, and misses one of the fundamental characteristics of entrepreneurship, namely that of risk. According to fundamental principles in financial economics a higher potential economic payoff or performance is always accompanied by an increasing risk-level, implying that to provide a full and balanced picture, new firm performance can never be assessed in isolation but must always be analyzed in conjunction with new firm hazard rate; i.e. the risk of termination (Brealey & Myers, 2002). This risk-reward dynamic keeps the different investment objects more or less economically neutral compared to each other and do

not ascribe more or less positive characteristics to them according to their reward level, as the difference in performance is offset by the increasing risk-level. Similarly, considering that judging and managing risk is an inherent characteristic of entrepreneurship both in theory and practice, in the same vein one should assess the relative risk when comparing the performance outcomes of entrepreneurial ventures (Baumol, 2002; Knight, 1921). This is of special importance when studying entrepreneurship, as most studies on firm performance are conducted on existing firms, and when studying firm performance across populations it is common to suffer from sample selection bias by undersampling the failing firms, leading to positively relating risky behaviors to firm performance, even if this is not the case in the full population of firms (Denrell, 2004). Only when outcomes are adjusted by a risk measure can they be compared without ascribing positive or negative characteristics to specific behaviors, and only then can a more objective analysis take place. Thus, in order to make a balanced and objective analysis of drivers of entrepreneurial outcomes and performance, predictors need to not only have a positive impact on selected performance measures, but at the same time need to have a positive impact on firm performance; only when we know that a driver of performance does not also increase the risk or hazard rate do we know that it increases risk-adjusted performance. This research aims will attempt to provide a theoretical and methodological contribution by doing just that.

Economists have developed an impressive number of studies on the determinants of new firm creation and survival, but relatively less is known about the determinants of other aspects of new firm performance (Acs & Audretsch, 1989b; Audretsch & Mata, 1995b; Jovanovic & MacDonald, 1994). As research has established that many new firms do not survive, and the firms that do survive display heterogenous patterns of growth, the drivers of heterogeneous post-entry firm performance becomes an area of special interest to academics and policy-makers interested in entrepreneurship and economic growth. In the management field, a wealth of knowledge has been developed in academia and industry, specifically with regards to large firms. When it comes to new and small firms however, most of established theories have less application. Unlike for most

established firms, resource constraints is more or less an endemic situation for independent new ventures (Baker & Nelson, 2005; George, 2005). Thus organizational capabilities and the identification and exploitation of knowledge have become crucial determinants for new firm survival and performance in knowledge-intensive industries (Delmar & Shane, 2006; Kogut & Zander, 1996). Although research in this area has advanced, still little is known about what influences the ability of new firms to survive after entry, and even less is known whether this ability varies across different types of industries (Audretsch, 1991).

Mainly, the theories on why new firms are created, survive, and develop, have developed along two main routes; schools on external vs. internal factors and causes. Whereas the external schools mainly seek to explain entrepreneurship through the characteristics of the industry, market, or external environment, the internal schools focus on the characteristics of the individual entrepreneurs or firms. In this dissertation I will provide an overview of these different approaches and discuss why aspects of both approaches are relevant, and will also explain the primary focus on firm resources and capabilities, as new and small firms have a chronic lack of resources making them relatively more important than for established firms, and also the fact that new ventures face both external uncertainty in the marketplace as well as internal uncertainty as new firms often have not settled on a final business model and engage in continuous exploration thus making dynamic capabilities and the absorptive capacity to identify and assimilate crucial technological knowledge important factors of new firm survival and growth.

The lack of empirical entrepreneurship studies capturing this dynamic and evolutionary aspect will be discussed in detail in later chapters. There has been little research and comparisons of entrepreneurship and the relative effects of absorptive capacity in different segments of knowledge-intensive or technology industries. Previous studies either explicitly or implicitly focus on separate industry or segment (e.g. manufacturing or service firms) samples, or are based on firms that are active in different industries but that were incubated in the same environment. In addition, not only have

absorptive capacity been little applied to entrepreneurship issues, it has also suffered from sloppy definitions and applications overall (Lane, Koka, & Pathak, 2006). This dissertation seeks to contribute to research on new firm performance by developing new theoretical components and empirical measures of absorptive capacity that are suitable for small firms, and conduct a comprehensive study of a sample of start-up firms in knowledge-intensive industries, including both service and manufacturing firms to overcome the manufacturing bias that has been prevalent in empirical entrepreneurship research (Delmar, 2006). This research is aimed at adding to entrepreneurship literature by generating knowledge on the prediction of entrepreneurial outcomes and performance. In doing so, it positions itself in the stream of entrepreneurship research that focuses on the relationship between opportunity exploitation and multiple aspects of new firm performance (Acs et al., 1989b; Audretsch, 1991; Audretsch & Mahmood, 1995a; Audretsch et al., 1995b; Samuelsson, 2004; Shane, 2001a; Shane & Venkataraman, 2000a).

This dissertation also aims to make a methodological contribution to research on firm performance by elaborating on and measuring the theoretical construct of absorptive capacity in a better way for new and small firms in knowledge-intensive industries. As absorptive capacity is a capability of the firm that is embedded in the processes of the firm and is hard to appropriate by the firm, it has traditionally been measured as the proportion of research and development activity in a firm, a measure that has been found to reliably impact firm performance (Cohen & Levinthal, 1990; DeCarolis & Deeds, 1999; Zahra & George, 2002; Zheng, Liu, & George, 2005). This measure is based on the notion that an organization containing a larger proportion scientific human capital will have a stronger capability to assimilate and commercialize technological knowledge than an organization having a relatively lower proportion of such human capital. In this dissertation, I elaborate on the argument that organizational capabilities are not possible to measure directly but need to be measured indirectly through such proxies as mentioned above, and proceed to develop indicators grounded in theory that are more suitable for the measurement of absorptive capacity in new knowledge-intensive firms.

In the evolutionary view of the market, a fundamental feature of the market is the portioning of knowledge among individuals, such that no two individuals share the same knowledge or information about the economy. The key is that this knowledge is diffused in the economy and is not a given or at everyone's disposal. Hence, opportunities are not equally available and the value of a given opportunity is subjective. This asymmetric information generates another characteristic of technological opportunities; that they have a limited lifespan, and need be exploited before other people discovers them. This time-dependent characteristic highlights the need for longitudinal data when studying the value and exploitation of opportunity (Katila & Mang, 2003; Kirzner, 1997).The insight that the size distribution of firms in an industry differs both in scale and time, highlights the need for micro-level studies, using the individual firm as unit of analysis, and follow its' development over time. It is also imperative that one is able to relate the value of an individual innovation and firm to its' competitors in the industry. This follows the reasoning that entrepreneurship is about micro behavior with effects on a macro level, thus making the study of firms on an individual level a necessity (Davidsson, 2004). Furthermore, a micro-level approach is also a prerequisite to make detailed cross-industry studies, as we now know that technological and entrepreneurial opportunities are more prevalent in some industries compared to other ones (Klevorick, Levin, Nelson, & Winter, 1995).

This research utilizes a unique dataset on new firms in knowledge-intensive firms in both manufacturing and service industries in Sweden 1995-2002 to model and assess the impact of knowledge and capabilities, specifically absorptive capacity, on new firm survival and performance. In doing so, the construct of absorptive capacity is elaborated and deconstructed in a novel way to enable the empirical application to new entrepreneurial firms. By developing new measures of absorptive capacity and testing these on a several new firm performance metrics, this research hopes to provide a better understanding of the patterns of performance in knowledge-intensive new firms, thereby advancing research and practice on what characteristics makes new firms more or less successful in the market.

1.3 Outline of Dissertation

The outline of this dissertation is as follows: the rest of this chapter is dedicated to providing the reader with a brief introduction to the empirical setting and scope and discussing and detailing the delimitations made in the research project. Chapter 2 then provides an overview of the key concepts in entrepreneurship research and the theoretical context and previous research on new firm entry, exit, and performance. In chapter 3 I provide a literature review of the empirical research using absorptive capacity to analyze firm performance, and my own theoretical development is explained together with descriptions of newly developed estimators for absorptive capacity and a discussion on the nature and definition of new firm performance in chapter 4. Chapter 5 explains the method, which in the case of this study is multiple regressions on a panel dataset, and discusses the issues, limitations, and choices made with regards to research design. The chapter then details the dataset and variable development and definitions, and proceeds to develop testable hypotheses based on the propositions from the previous chapter. In chapter 6, I present descriptive statistics of the dataset and test my hypotheses through fitting a number of models to the data in three sequential studies. The model estimations are conducted using logistic regressions (logit) for new firm terminations and acquisitions, and multiple regressions for a variety of firm performance measures and the chapter also contains the analysis and theoretical discussion relating to the results. Finally, chapter 8 concludes the research findings and implications for future research in this area.

1.4 Empirical Setting

The empirical setting of this study is Swedish knowledge-intensive industries during the business cycle of 1995-2002. In order to understand the underlying dynamics of the study and additionally provide a foundation for discussing the reliability and generalizability of the estimated models, it is helpful to have some contextual background on the period of study. In the early 1990s, the Swedish economy had lagged significantly behind in

growth performance relative to other OECD countries due to weak economic performance for more than two decades. In 1992, economic output fell sharply for the second year in a row, interest rates skyrocketed, and unemployment reached levels not seen for half a century as a result of deregulated credit markets after 1985 that had stimulated a competitive process between financial institutions that encouraged risk-taking. Coupled with the Swedish government's expansive macro policy, this contributed to an explosion in asset prices and crisis was unavoidable when the highly leveraged private sector was hit by three major exogenous events: a shift in monetary policy with an increase in pre-tax interest rates, a tax reform that increased after tax interest rates, and the exchange-rate mechanism (ERM) crisis. Combined with significant overinvestment in commercial property, high real interest rates contributed to breaking the boom in real estate prices and triggering a downward price spiral resulting in bankruptcies and massive credit losses. In the end, the private banks had to be bailed out by the government issuing a general guarantee of bank obligations (Englund, 1999; Jaffe, 1994). After the government bailout of the banking system, the Swedish economy turned around in 1993–94. After that, Sweden's economic growth rivaled that of the 1960s and was very competitive in a European comparison. At the same time, this economic growth was not accompanied by corresponding job creation. In a longer perspective, aggregate employment in 2005 was 5% lower than its' 1990 level, in spite of the fact that the total population in Sweden increased more than 5 percent during the same period. (Davis & Henrekson, 2007).

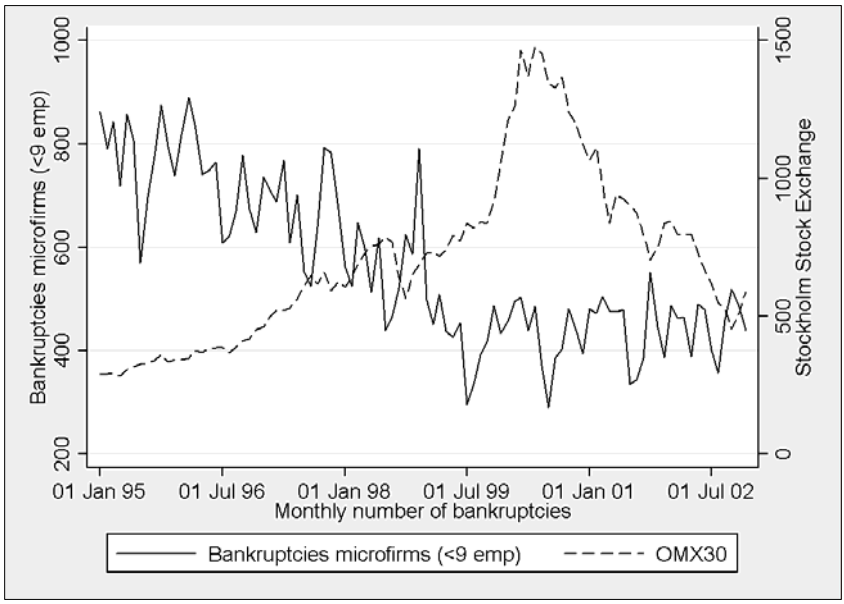
Depending on the classification of industries, Sweden could be seen as either following the general transformation from manufacturing to services where classical manufacturing industries were reduced from the largest industry sector covering 31% of the total value added in the Swedish economy in 1995 to 24% of the value added in 2005 (Persson, 2006). Or, as according to other researchers Sweden differed from other OECD-countries during this period as manufacturing industries grew more than service industries, in the years 1994-2004 manufacturing industries had an aggregated growth rate of 87% whereas service industries had a corresponding growth rate of 35%. However, it is important to note that the

specific manufacturing industries that were the main source of growth for the sector were primarily knowledge-intensive medium- and high-technology manufacturing industries such as telecommunications, automotive- and transport, and chemical industries, and the transformation of the Swedish economy from a low-technology capital intensive to a high-technology human capital intensive economy is evident (Davis et al., 2007; Götzfried, 2004). Financial assets as a percentage of GDP in the Swedish economy started to recover in 1995 and increased by 50% until the crash of the Internet Bubble in 2000. In the following period, from March 2000 to October 2002, the Stockholm Stock Exchange fell by -73%, and financial assets in the Swedish economy decreased by 4.5% (SCB, 2003).

The period of study thus covers a full business cycle, as the Swedish economy was rebounding from a real-estate crisis in the early 1990s, and then saw the rise and falls of the Internet bubble starting in 1999 and ending with a stock-market crash and related real economic effects in 2002. It could be argued that the time-period studied was extraordinary as it started just after a major financial crisis and ended with the unprecedented introduction of a perceived radical new industry and related speculative bubble. However, on the flip side it could also be argued that this is what makes the period of study specifically suitable as the rate of innovation is increasing, and the service industry significantly started to decouple from the manufacturing industry during this period, making similar environmental settings likely in the future and possibly increasing the generalizability and reliability of the results. It could also be added that albeit with other underlying drivers and dynamics, this boom-bust economic pattern seems to be recurring regularly throughout financial history and has even repeated itself just recently, thus implying that the setting and time-period for this study is a valid one (Shiller, 2000, 2008). Figure 1. provides an overview of the period of study for two economic indicators; the first is data from Statistics Sweden on the number of monthly bankruptcies for micro firms with less than nine employees, the second indicator being the weekly closing prices for the Stockholm Stock Exchange OMX30 market index for the thirty largest companies on the Stockholm stock exchange. Together, these two metrics provide a rough

indicator of supply- and demand-side economic sentiment during the period of study. As we can see from the figure, the trend of micro firm bankruptcies seem negatively correlated with the stock market; however we also see that there are large fluctuations in bankruptcy rates throughout the year.

Figure 1. Economic Sentiment Indicators 1995-2002



Source: Statistics Sweden and NASDAQ OMX

1.5 Scope and Delimitations

It is important to clarify that the purpose of this study is to examine what knowledge capabilities in the firm that cause specific patterns of performance and survival in independent new firms in knowledge-intensive industries[1]. The study specifically focuses on independent new ventures, which are new ventures that are not spun-off from an existing organization, as opposed to dependent new ventures that have formalized ties through

[1] The empirical definitions of knowledge-intensive firms and industries are described in detail in section 5.1.1.

ownership, alliances, or financing to established organizations. The selection of independent new ventures is to mitigate the fact that some ventures developed in larger organizations are spun-out into separate businesses but still operate with a relative comparative advantage relative to independent ventures with regards to their equity and strategic ties to their mother organizations. The study includes both manufacturing and service firms, and thus additionally serves to assess whether there is any differential dynamics of on new firm survival and performance across these two sectors, a question that is of interest but that has been only initially explored. Firms that are active in resource- and capital-intensive industries such as mining and forestry are of less interest in this study, as knowledge-based resources and capabilities can be assumed to play a comparatively minor role in the performance of those firms. The study only includes those firms that are registered in Sweden with employees domiciled in Sweden, thus effectively delimiting the study to the Swedish setting. It should be mentioned however, that these firms may still have international owners, and employees holding international passports. The Swedish limitation is by jurisdiction and not by implied ownership or ethnicity of entrepreneurs and employees. This chapter has given an introduction to the research issue, established some of the issues of entrepreneurship research, and explained the outline, empirical setting, and delimitations of this dissertation. The next chapter will give an overview of the theoretical foundations.

2 Theoretical Overview: Firm Entry, Exit, and Performance

If there are too many hatters in a city or in a street for the number of people who buy hats there, some who are least patronised must become bankrupt: if they be too few it will be a profitable undertaking which will encourage new hatters to open shops there and so it is that the undertakers of all kinds adjust themselves to risks in a state.

Cantillon (1755) Essay on the Nature of Commerce

This chapter begins with an overview of key concepts in entrepreneurship research. I then proceed to elaborate on the existing schools of thought of firm survival and performance showing how they relate to each other. Specific attention is given to the schools relating to resources and capabilities. The theories on firm performance have been clustered in two main groupings: (a) theories that focus on industry membership or characteristics, and other contextual factors, and (b) theories that focus on the internal characteristics – e.g. resources and capabilities – of the firm or organization. Historically, schools of thought have traditionally been grouped in supply- and demand-side theories based on the economic notion of a market consisting of supply and demand for entrepreneurship (Casson, 1995). Supply-side theories have focused on the traits and characteristics of the individuals and groups of individuals that create new firms, whereas the demand-side has focused on the context and setting of entrepreneurial activity. Although this classification and related criticism – e.g. supply-side perspectives have been widely criticized for lack of rigor and sampling on the dependent variable – closely match that of external and internal perspectives it should be noted that they are not interchangeable (Thornton, 1999).

In this chapter external and internal perspectives and related theories are described together with brief discussions on the main research question, strength, and issues with each perspective. I also provide examples of empirical research of relevance to the study of new firm creation, survival, and performance. The discussion provides the necessary foundation for the

model development for this study, which draws on aspects of all presented perspectives but mainly dynamic capabilities and absorptive capacity, as the external capabilities schools in general do not have an evolutionary or dynamic perspective, and the internal schools, except from absorptive capacity, are fundamentally tautological; meaning that they can only be used to explain outcomes *ex post*, but have limited predictive value; a simplified example of this is if one assumes that entrepreneurial individuals start successful firms and the only way of identifying entrepreneurial individuals is selecting those that have started successful firms one is facing a tautology – i.e. the statement only provides a repetition of meaning but can not be used to predict or provide a robust explanation. The discussion in this chapter is done in preparation of the following chapter where I previous empirical research on absorptive capacity in general and in relation to new firms in particular to assess the theoretical contribution of this dissertation. The integrative approach of this research is thus is in line with the empirical strand of research that aims to highlight the complementarities between the externally and industrially oriented and the internally oriented economic schools of thought. (Mauri & Michaels, 1998).

2.1 Key Concepts

There are a number of key concepts related to knowledge-based entrepreneurship that are used in this dissertation draw on all previously mentioned theories. As these concepts might have different meanings and loadings to researchers from different disciplines and backgrounds I have included a section that provides brief definitions, explanations, and elaborations of these concepts. When discussing entrepreneurship in the productive sense, it can be beneficial to distinguish between entrepreneurial potential, the entrepreneurial process, and entrepreneurial outcomes (Audretsch, Bönte, & Keilbach, 2008; Kirzner, 1997). The most common measure of entrepreneurship is that of new firms being created and entering into industries and the questions relating to new firms are: how they enter, why they enter, how they perform and why. Why new firms are created is discussed in the sections on opportunity and technology, and how they

enter and exit into industries and how this can be measured is covered in the corresponding sections. The module on key concepts is concluded with a discussion on the measurement of firm performance.

2.1.1 Entrepreneurship

Attempts at explaining and predicting economic activity and performance have been made at the system level, nation level, industry level, firm level and individual level (Becker, 1974, 1976; Mankiw, Phelps, & Romer, 1995; Nelson, 1995; Nelson & Winter, 1982b; Romer, 1986). One aspect of deriving predictive theories is that once you know what drives economic performance, it seems like it should be relatively easy and somewhat tempting to formulate normative theories. Looking at the plethora of theories and models that is available today and the normative precision of these models however, the only thing we know with certainty about economic development is that we do not know much with certainty about economic development (Hayek, 1974). The fundamental issue of predicting economic development can be traced to the concept of entrepreneurship.

Entrepreneurship is a fundamental feature of economic development and growth, and it could be argued that the concept should be at the core of every analysis trying to make predictions on the subject (Johansson et al., 2002). Unfortunately there is a fundamental feature of entrepreneurship that makes it the uninvited guest in most economic analyses; inherent to entrepreneurship is not only the factor of risk, but also that of uncertainty, which makes it difficult to include in any predictive or normative models (Arrow, 1951; Baumol, 2002; Knight, 1921). A basic tenet in neoclassical economics is that of the efficient market hypothesis, that all information in a market is freely and fully available to all actors and that asset pricing is transparent and efficient, and this then by definition also includes the information about opportunities to capture entrepreneurial rents (Fama, 1970; Kirzner, 1997; Shane, 2000). The role of the entrepreneur practically vanishes in neoclassical economics, and the notion of innovation and entrepreneurship is that they are external factors that disrupt otherwise stable equilibrium models (Arrow, 1951). In this view, the entrepreneur has no key role in creating economic growth, and it has been proposed that the

concept of entrepreneurship should be deleted from economic theory as the capabilities that constitute entrepreneurship can and should be bought and sold in the market and entrepreneurship in essence becomes a pricing activity (Fama, 1980; Foss, 1993). By contrast, the Austrian or evolutionary school proposes that it is the portioning and access to information about opportunities that is the key determinant of entrepreneurship and opportunity exploitation (Kirzner, 1997; Knight, 1921; Nelson et al., 1974). Thus despite the fact that the evolutionary perspective has it's foundations in natural science and has been widely adopted by population ecologists who take a deterministic positivist view on evolution, in the entrepreneurship field the evolutionary school has a strong cognitive approach in that it places heavy emphasis on the quantity and availability of information (Hannan & Freeman, 1977; Rosenkopf & Nerkar, 2001; Shane, 2000; Veblen, 1898).

Another aspect of the evolutionary school is the emphasis placed on knowledge and routines and the sometimes radical effects of new knowledge and routines which has been termed "creative destruction" (Aghion & Howitt, 1992; Schumpeter, 1935, 1947). The fundamental difference between the neoclassical school and the evolutionary school is that whereas the former considers innovation and technology an exogenous factor, the evolutionary school considers technology an endogenous factor of economic growth and indeed a critical factor of production that is both an input and an output of the value creation process (Nelson et al., 1974; Nelson, Winter, & Schuette, 1976; Romer, 1986, 1990b). Evolutionary routines and process that evolve and institutional pressures that have become an influential perspective on what affects the entrepreneurial climate (Baumol, 2002; Delmar & Shane, 2004; Hodgson, 1998). It has also become the predominant perspective when examining the entrepreneurship using knowledge as both a means and an output of production; what has been defined as technology entrepreneurship in this research (Acs & Audretsch, 1988, 1989a; Audretsch, 1991; Delmar, Davidsson, & Gartner, 2003; Shane, 2000, 2001a, b).

Entrepreneurship has intermittently been described among other things as an outcome, a theory, a field of research, and a nuisance (Fama, 1980; Kirzner, 1997; Marsili, 2002; Shane, 2001a; Shane et al., 2000a). In this thesis entrepreneurship is defined as the process of exploiting an opportunity through translating an innovation into a value proposition for customers in the pursuit of economic rents. Although talking of value creation, it is important to remember that this is directed towards customers and stakeholders in the entrepreneurial process. Conceptually, entrepreneurship is an activity that is fundamental to economic development, but one should take note that the term economic development covers both value creation and value destruction, both effects which are inherent in the concept of entrepreneurship (Aghion et al., 1992; Christensen, Suarez, & Utterback, 1998; Gans & Hsu, 2002; Schumpeter, 1947; Tripsas, 1997). Important characteristics of entrepreneurship is that it is a process that evolves over time, involving a number of activities that are interrelated in such a way that the process is non-linear; the relative feedback and timing of the different activities is not necessarily sequential (Samuelsson, 2004; Shane et al., 2000a). A fundamental assumption of entrepreneurship is that it is an activity that is directed to the generation of economic rents where no economic rents previously where assumed to exist (Samuelsson, 2004; Schumpeter, 1947). Thus a key component of the entrepreneurial process is that of discovery (Kirzner, 1997; Knight, 1921; Shane, 2000).

However, discovery alone is not enough to cover the activity of entrepreneurship, as the creative approach to a perceived opportunity constitutes basically the same process as that of innovation, and this also explains the common mixing of the two concepts. In order to qualify as an economic activity, the process by necessity has to include the exploitation of opportunity (Nerkar & Shane, 2003; Shane, 2000). By this definition, entrepreneurship is further distinguished from innovation, as innovation is often described as making an invention exploitable, where as in entrepreneurship the focus is on it actually being exploited. The term exploitation is here used explicitly in the economic sense, that is the capture

of economic rents (Aghion et al., 1992; Nelson et al., 1982b; Schumpeter, 1947).

Even though the *cause* of entrepreneurship is assumed to be primarily profit-seeking, the *motivation* of entrepreneurial action may differ; new firm creation can be either *opportunity*-motivated; with entrepreneurs starting firms to commercialize perceived attractive business opportunities, and *necessity*-motivated entrepreneurship; where new ventures are created as a means of survival, often in response to large-scale layoffs or in emerging economies where employment opportunities and alternative livelihoods are scarce (Reynolds et al., 2005). In terms of economic outcomes on an aggregated scale, entrepreneurship can be productive, unproductive, or destructive. Productive entrepreneurship is what is normally assumed, where economic value is created for the greater good of all through the introduction of new knowledge, products, innovation, and the lowering of production costs. However, a large portion of entrepreneurial activities are often rent-seeking; i.e. seeking to capture economic value to the detriment of others and thus resulting in the division and redistribution of economic value rather than economic value creation. This type of entrepreneurship can be categorized as being unproductive on an aggregated scale; even if some individuals are better off, other individuals in the economic system lose out and thus the collective economic value is unchanged. Finally, some types of entrepreneurial activity can be categorized as destructive, as they actually reduce the total economic value in society. Organized criminal activity is the common example used to exemplify typical destructive entrepreneurial activities (Baumol, 1990, 1996). It is important to note the distinction between Baumol's destructive entrepreneurship and Schumpeter's *creative destruction* which instead is the label of the economic process when new firms and technologies displace the old in the marketplace (Schumpeter, 1947). In creative destruction the value that is destroyed with the termination of firms and discontinuation of technologies will affect some actors, but as a whole over time the economy will benefit as more efficient organizations and processes come into existence.

2.1.2 Opportunity

A central and widely used concept in entrepreneurship is that of opportunity. Exactly what opportunities are and where they arise is the subject of much scholarly discussion, but it is generally agreed that the concept of opportunity is central to the study and understanding of entrepreneurship (Alvarez & Barney, 2007; Kirzner, 1997; Shane, 2000). This section will elaborate on the nature of opportunities by discussing what opportunities are and where they come from. On a general level there is a typology of four types of opportunity (Acs, 2002a):

a) Opportunities due to inefficiencies within existing markets due to (a) information asymmetries or (b) limitations in current technology in satisfying known but unfulfilled market needs.
b) Opportunities due to significant external changes in social, political, demographic or economic forces.
c) Opportunities due to the accumulated stock of knowledge that exists in society.
d) Opportunities due to inventions and discoveries that produce new knowledge.

According to these definitions, opportunities arise due to endogenous or exogenous factors, and seem to vary in degree and scale. Looking at the nature rather than the origin of opportunities, it is helpful to get a bit more specific and define opportunities as being either technological opportunities or venture opportunities. Though there is a conceptual link and not seldom an overlap between the two, whereas technological opportunities are defined as the set of possibilities for technological advance, venture opportunities are defined as the set of possibilities to create economic wealth by the acquisition and management of resources (Klevorick et al., 1995; Teece, Pisano, & Shuen, 1997). Venture opportunities can further be divided as being innovative or reproducing depending on whether they have a high degree of uncertainty in the outcome of the exploitation process or whether they are oriented around existing technologies, customer or complementary asset bases (Christensen et al., 1996; Samuelsson, 2004; Tripsas, 1997). Current entrepreneurship research has highlighted the need

for, and importance of, accentuating the different types and relative quality of opportunities in order to facilitate deeper knowledge generation around entrepreneurial outcomes based on these opportunities (Samuelsson, 2004; Shane et al., 2000a).

According to one definition, opportunities exist because "People perceive information about supply and demand differently from each other due to contextual factors, experience and knowledge differences" (Samuelsson, 2004). The prevalence of perceived opportunities has been shown to vary between different industries and technological regimes, but are remarkably similar within their respective technological regimes across countries (Klevorick et al., 1995; Malerba & Orsenigo, 1996). There is some debate on whether opportunities are discovered or created that can be traced to whether one views the model of economic progress through an equilibrium or evolutionary lens (Kirzner, 1997; Nelson, 1995).

The ongoing discussion relating to opportunity is whether opportunities objectively exist in the market and are discovered due to previous knowledge and experience, or if opportunities do not pre-exist but are unique and created as the result of the creativity and innovativeness of entrepreneurial individuals and firms (Kirzner, 1997; Shane, 2000). The conceptual created opportunity is often referred to as Schumpeterian opportunity, and the level of creativity is contingent on the level of previous knowledge in the firm and the ability of the firm to assimilate and recombine external and internal knowledge, a capability that in strategy research has been named absorptive capacity (Shane, 2000; Shane et al., 2000a; Zahra et al., 2002). Thus the level of creativity in, and thereby the characteristics of, an innovation responding to a technological opportunity is dependent on the level and type of previous knowledge (Alvarez et al., 2007).

2.1.3 Technology

Academics have agreed on the importance of creating a deeper understanding about the link between knowledge-based entrepreneurship and economic development. Technology entrepreneurship is the term

broadly used here to describe the discovery and exploitation of entrepreneurial opportunities based on new knowledge and technologies (Acs, 2002b; Shane, 2000; Shane & Venkataraman, 2000b). It is important to note that the word technology does not imply that an entrepreneurial venture has to be technical in nature *per se* with regards to product output; technology may also refer to processes and methods or the provision of professional services. The classical economic definition of technology is that of a collections of instructions for mixing together raw materials (Romer, 1990b). However, this research utilizes a more recent definition, that of a technological paradigm as similar to the Kuhnian scientific paradigm, and thus being a model and a pattern of selected technological problems based on selected scientific principles and on selected technologies. The technological trajectory then is the pattern of progress and knowledge evolution around a given technological paradigm (Dosi, 1982; Kuhn, 1996). Viewing technology this way helps interpret the existence of incremental and radical innovation as the two types of innovation can be viewed through a lens of normal knowledge evolution around a technological paradigm versus the emergence of a new technological paradigm (Gersick, 1991; Rosenkopf et al., 2001; Utterback, 1994). Throughout this dissertation, knowledge-based or technology entrepreneurship does imply that the context is saturated with new types of products, methods and processes and that the capability to understand and exploit these are key to firm performance.

Although the processes of innovation and entrepreneurship both focus on the discovery and exploitation of opportunity, a fundamental difference is that of the underlying opportunity: innovation is centered on technological opportunity and entrepreneurship is centered on venture opportunity. The similarity of the two activities and the lack of separation of the different types of opportunities has been the basis of much confusion. In this thesis they will be thoroughly defined, not the least because the focus of my research is on the area where they all intersect, where the underlying technological opportunity affects innovation, which in turn has an effect on the perceived venture opportunity and the outcome of the entrepreneurial process, here defined as knowledge-intensive entrepreneurship.

Due to the paradigmatic nature of new technologies, and the high risk of uncertainty inherent in them, it has been shown that technological opportunities are often commercialized through new firm formation as new ventures organized around an emerging opportunity are more suitable and likely to be less oriented towards exploiting or responding to their current asset or customer base than established firms (Gans et al., 2002; Tripsas, 1997). This pattern has been validated across a large number of industries and is especially prevalent in mature industries, thus making new firm performance a central issue for technology and knowledge-intensive entrepreneurship (Audretsch et al., 1995a; Christensen et al., 1996; Shane, 2001a, b; Tripsas, 1997).

On a macro level, scholars have discovered regularities in how industries evolve, and these regularities also determine the mode of entry and the number of new firms. To a large extent, these regularities have been shown to be a cause of the technological evolution in the industry, where in the early days of a technology the industry is characterized by fragmentation and high numbers of entry and exit, and trial and error activity patterns (Dosi, 1982; Klevorick et al., 1995). As any market grows in size, so do the numbers and size of firms active in the industry until what is called the dominant design emerges, along with the definition of the specialized resources and assets needed to commercialize that specific technology. This leads to the exit of those firms with competing or incompatible technologies and complementary assets, the establishment of barriers to entry, and the emergence of a relatively stable group of incumbent firms (Cooper et al., 1996; Teece, 1996). The incumbents will usually focus their innovative efforts on process improvements in what is a stable and concentrated industry environment until a new, disruptive technology is introduced, often through new firm creation, and the cycle starts anew. This theory of regularity and interconnectedness between technological cycles and industry structure has been shown to be valid in a large number of different industries in a host of studies (Gort & Klepper, 1982; Klepper & Graddy, 1990; Nelson, 1995; Suarez & Utterback, 1995; Utterback, 1994).

Other macro-level studies have validated the influence of technology as a determinant of new firm entry and performance patterns in an industry. Any given industry is characterized by technological regimes that are more or less suitable for different kinds of firm sizes, ages and types of innovation, and the technological regimes have been shown to differ between industries but have similar characteristics across countries (Audretsch, 1991; Malerba et al., 1996; Nelson et al., 1974, 1982b).

2.1.4 New Firm Entry

Firms can enter industries in a number of ways. Firms can be new ventures (*de novo*) meaning that they come into existence in the industry of their choice. A new venture can either be an independent new venture where the founders have little or no previous experience from the industry that the firm enters, or a spin-off from an existing firm, where the founders have previously worked in the same industry as they now are starting in. Second, a new entry can be a firm that is already present in one or more other industries or other geographical markets and has chosen to diversify into a new industry or market. The third variant of a new entry can be a firm that moves or migrates completely from one industry to another (*de alio*). It has also been established that new ventures are in general smaller than the other types of entries, and they are more likely to fail, as well as the fact that spin-offs are somewhat less likely to fail than genuine independent new ventures (Delmar, Wennberg, Wiklund, & Sjöberg, 2005).

The trappings that come with being part of a larger corporation, such as financial assets, and being able to draw on the resources, knowledge and network of a corporate parent normally confer significant competitive advantages to new firms. The type of entry determines survival and also growth rates, i.e. previous research has indicated that firms entering from closely related industries and firms that have a diversified portfolio of businesses grow faster than independent new ventures or specialized firms (Geroski, 1995b). The nationality of the parent company can have an effect on entry behavior and performance the post-entry behavior of foreign firms is quite different from that of their domestic counterparts, and has long-term performance effects for firms that persist long after the moment of

entry (Mata & Portugal, 2002). Also, market factors such as market structure characteristics and entry barriers have a strong impact on small-firm entry behavior and performance (Acs et al., 1989b). The focus of this dissertation is specifically new firm entry; that is firms that enter into an industry through formation and not as a spinoff or new venture from an existing domestic or foreign corporation.

2.1.5 New Firm Exit

When analyzing new firms, survival and exit are commonly focus areas. In the same way that firms can enter into an industry in different ways, there is a multitude of ways through which a firm can exit the industry. A firm can exit through being terminated, i.e. the firm does not generate any revenues and/or is dissolved. This is normally taken as an indication of that the business is not economically durable, but one must also remember that a large portion of firms are founded for other reasons than economic profits and thus will continue in business in spite of bad financial performance (Aldrich, 1999). In addition, empirical research has found that on some occasions, financially sound firms are terminated because the entrepreneurs have found more profitable opportunities elsewhere, thus calling into question a simple linear relationship between financial performance and new firm termination (Amit, Muller, & Cockburn, 1995). In any event, entry and exit rates seem to be correlated, implying that when large numbers of new firms enter into an industry, large numbers of firms also exit the industry – either failing new firms, or the incumbent firms that are being driven out of business and displaced by the new entrants (Geroski, 1995).

In addition to being terminated, a firm can exit through merger or being acquired by another company. If one does not discriminate between types of exits, it is easy to get a skewed picture of new firm survival, as e.g. acquired firms do exit the industry and disappear as independent entities, but not due to the fact that the quality of the firm or the business opportunity was untenable; quite the opposite – acquisitions or mergers usually happen because of the strength of the new firm business opportunity, market position, or resources. In addition, recent empirical

research has indicated that there are general typologies of exit route meaning that certain types of entrepreneurs or ventures are more likely to exit in certain ways (Wennberg, Wiklund, DeTienne, & Cardon, 2009) Thus, for assessing new firm survival and exit this has two implications. One, it is conceptually easier to measure events (exits) than non-events (survival; staying in business). This goes back to the fundamental methodological principle of the Black Swan utilized by both John Stuart Mill and Karl Popper to exemplify that proposition can never be proven true, only false; if you want to examine the hypothesis that all swans are white, it is not helpful to look for white swans – confirming the hypothesis – one should look for black swans – rejecting the hypothesis (Taleb, 2007). In a similar vein, the researcher who seeks to draw conclusions about new firm performance is better served to analyze the causes of new firm exits, and draw conclusions from those results, rather than trying to find support for why firms are still in business. There are also statistical issues involved here; primarily selection bias, and the proposition that it is easier to estimate models on events than on non-events, a discussion is elaborated in chapter 5: Method and Data.

2.1.6 New Firm Performance

One can view the firm as any organization that pursues specific business goals, a view that dates back to before the industrial revolution when companies where set up to pursue specific goals (e.g. trading companies) or markets (e.g. the East India Company). However, since the industrial revolution and the Companies Act of 1862 that signaled the birth of the modern joint-stock corporation it seems more relevant to adopt the modern capitalist approach of the company as a profit-maximizing entity that adapts according to new opportunities and fading old ones. In this approach, it does not seem the least odd that one of the world's largest mobile phone manufacturer Nokia used to be first in the paper and then in the rubber industry, or that the Minnesota Mining and Manufacturing Company (MMM or 3M) today has a multi-billion dollar turnover from making Post-it®notes and Scotch® transparent adhesive tape, as the evolution of the firm to accommodate and exploit new opportunities is seen as the very essence of what the firm is about, and thus making the capacity to exploit

new business opportunities a key element of success for the modern firm as well as for the market economy as a whole (Baumol, 2002; Micklethwait & Wooldridge, 2005).

When discussing the nature of the firm from an academic perspective, it is helpful to distinguish the question of *what* firms are from *why* firms are. The research area of why firms are, or theories of the firm, is a research field in its' own right and will only be briefly touched upon here. An attempt to provide a simplistic overview of the field can be summarized in the discourse between the contractual and the competence perspective of the firm (Foss, 1993). The contractual perspective is based in transaction cost economics, and advocates the view that the firm exists as a nexus of contracts in order to lower the transaction costs in a functioning and transparent market (Coase, 1937; Foss, 1993). This theory of the firm has a strong foundation in neoclassical economics.

As stated above, a fundamental entrepreneurial outcome is that of new firm creation. Thus, a central research question for entrepreneurship scholars becomes that of new firm performance, specifically other aspects in addition to new firm survival (Audretsch et al., 1995a; Davidsson, 2004). Most of the strategy literature on firm performance is focused on established firms, and focuses more on creating sustained advantage, barriers to entry and on exit avoidance rather than optimizing post-entry performance of new firms (Caves, 1998; Porter, 1996; Samuelsson, 2004). This can make it problematic when looking at new firms and their performance, as new firms do not have the same organizational experience and routines, and it can be argued, are not as accustomed to or have the same resources to handle institutional and environmental and competitive pressures. The existing research on new firm performance draws on the fields of industrial economics and entrepreneurship and is based on empirical results from both manufacturing and knowledge intensive industries (Acs et al., 1989b; Audretsch et al., 1995a; Audretsch et al., 1995b; Delmar et al., 2004; Gans et al., 2002).

2.2 External Schools: Industry and Contextual Factors

There are a number of contextual perspectives relating to the factors that exhibit an influence on the rates and conditions of new firm creation, survival, and other aspects of new firm performance. These have been grouped into (a) industry lifecycle, (b) industrial organization, (c) institutional theory, and (d) population ecology respectively, and research within each field with a focus on or of relevance to entrepreneurship researchers is introduced and discussed in the following sections. What is important to remember about the external schools of firm performance is that they do not all include macro type external factors such as economic cycles or crises, interest rates and exchange rates. Rather, they focus on conceptual external factors such as industry age, industry concentration and the actions of competitors. Thus, any criticism of an external school does not in any way imply that external factors *per se* are not important for new firm performance. The crucial role that external factors play in generating the opportunities that stimulate the creation of new firms was introduced in section 2.1.2.

2.2.1 Industrial Organization

Industrial organization is primarily concerned with the structure of markets and the strategic interactions of firms. The field draws heavily on the behavioral aspects of microeconomics as well as on labor economics and macroeconomics, and a normative outcome is that firms should strive for above-average economic profits by creating and defending monopoly or oligopoly in order to insulate the company against competition and exogenous shocks such as e.g. cyclical or seasonal variations in demand, customer preferences, and the threat of new firms entering (Caves, 1980; Caves & Porter, 1978). The turnover and competitive position of firms is largely decided by the relative size in the market, and industry factors such as market concentration, the existence and types of entry barriers, the size distribution of firms, and the relative importance of innovation and knowledge. The technology dimension plays a role also with regards to industry concentration, with the survival of new firms that introduce radical new technologies being dependent on the prevalence and responses of

competitors, rather than the objective quality and potential of the radical technology in itself (Nerkar et al., 2003). Small firms have a relative competitive advantage over large corporations in knowledge-intensive industries; those industries that are innovative, utilize a large component of skilled labor, and tend to be composed of a high proportion of large firms (Acs & Audretsch, 1987; Caves, 1998).

It is acknowledged that new firms in general are small at the time of entry into an industry even if there is substantial variation within and between industries. Even though this pattern is aligned with the structure of the industry entered and most new firms in an industry are of similar size at entry the majority of entry firms have similar size across industries (Mata & Portugal, 2004). Even though the likelihood of survival is usually attributed to the existence of entry barriers and the level of intensity of competition, it has also been found empirically that the survival of firms increased with their initial size (Audretsch et al., 1995a). Other academics have proposed that this is not to be interpreted that small firms fail because of a lack of resources *per se*. Entrepreneurs can be assumed to be rational but approach firm entry via real options reasoning. Since the entrepreneurs have no way of knowing the value of their business opportunity beforehand less confident or more risk-averse entrepreneurs are likely to start out small, incurring a unit-cost penalty but limiting sunk cost investment while they gather evidence of the value of the opportunity. Once and if feedback is positive, entrepreneurs can increase their investments; whereas if the feedback is negative they can exit at a limited loss. Smaller entrants would thus be expected to show higher exit rates. They may start small because they expect to have a high probability of failure, and consequently want to limit their investment but also display higher growth rates for survivors as they exploit more risky opportunities. More confident firm founders would then start larger in order to achieve an optimal size more rapidly (Caves, 1998; Jovanovic, 1982). This real-options reasoning additionally makes learning an implicit prerequisite for success.

Another important factor in industrial organization relating to the survival of new firms comes from the discipline of economic geography and is

related to the phenomenon of economic agglomeration: economic clusters (Acs, 2002a). The simple causal relationship between localization and new firm performance has been called into question by a number of empirical studies. A recent longitudinal study on 4,397 new firms in the telecom and consumer electronics, financial services, information technology, medical equipment, and pharmaceutical industries found empirical results that being located in a strong cluster resulted in stronger firm performance relative to new firms located outside economic clusters. However, the strength of these results varied depending on geographical aggregation level and agglomeration measure used (Wennberg & Lindqvist, 2008). Other recent research has additionally shown that regional determinants of firm formation differ between industries, and that even if location can be a determinant of the creation of new firms, it does not prevent the new firms from exiting (Nyström, 2007). It thus may be that agglomeration effects are less important for new firms than other forms of external economies such as labor market structure or social networks, and there is the possibility of reversed causality and interaction; that successful new firms have a positive effect on clusters as well as vice versa (Armington & Acs, 2002; Audretsch et al., 2008). It thus seems that the differential performance of firms located in clusters is more complex than due only to the benefits of geographic localization.

From Table 1. it is apparent that the majority of entrepreneurial studies in industrial organization have focused on new firm entry and survival and it is only just recently that new firm performance measures have come at the focus of attention. From a normative standpoint, industrial organization has been referred to as a school of positioning, as the criteria for success is determined by the position of the firm either geographically, relative to competitors, or in the value chain (Mintzberg, Ahlstrand, & Lampel, 1998). A critique against this is that under the assumption of rational actors, environmental analysis cannot be expected to improve the expectations of some firms better than others, and thus cannot be a source of more accurate expectations (Barney, 1986). This also ties into the critique of industrial organization with regards to new firms; it is posited that new firms enter or exit a market purely due to the rational analysis of whether it is cost-

efficient to be active in the market. Individuals are substitutable, and any agency with regards to the motivation and background of the individual entrepreneur does not exist. There are also some doubts on the predictive strength of the industrial organization approach to non-manufacturing industries, as entry barriers such as capital intensity and scale economies are crucial components of the approach.

Table 1. Empirical Industrial Organization Studies

	Context and sample	Dependent variables	Independent variables
Acs & Audretsch, 1989	247 US manufacturing industries 1978-1980	Small firm entry	(a) Industry entry barriers, (b) incumbent response to new entrants, (c) small firm innovative activity
Audretsch & Mahmood, 1995	12,000 US new manufacturing establishments 1976-1986	New firm survival	(a) Cost disadvantage relative to industry average, (b) technology regime (routine/innovative), (c) industry growth rate
Mata, Portugal & Guimaraes, 1995	17,612 manufacturing plants in Portugal 1983-1990	(a) New plant survival, (b) new plant growth	(a) Type of entry (de novo entry, experienced de alio entry, diversification de alio entry), (b) plant size at entry, (c) plant size given year, (d) industry entry rate, (e) industry growth
Mata & Portugal, 2004	Portuguese Ministry of Employment labor data 1982-1992	(a) Foreign market entry, (b) post-entry survival, (c) post-entry growth	(a) Domestic or foreign ownership, (b) new venture/acquisition
Nyström, 2007	All (200,000) Swedish non-financial new enterprises in the corporate sector 1996-2001	(a) New firm entry, (b) new firm exit	(a) Industry profitability, (b) industry growth rate, (c) tangible capital intensity, (d) intangible capital intensity, (e) scale economies, (f) industry concentration
Gilbert, MacDougal & Audretsch, 2008	127 US independent new ventures with IPO 1990-2000	(a) sales growth after IPO, (b) innovation after IPO	Cluster size at year of firm founding
Wennberg & Lindqvist, 2008	4,397 Swedish new firms in high-tech manufacturing industries 1993-2002	(a) New firm survival, (b) VAT payments, (c) average salary per employee	Cluster strength variable

2.2.2 Industry Lifecycle

One theoretical determinant of new firm performance is the lifecycle of the industry that the new firm enters. Empirical evidence suggests that new firm performance is more contingent on the lifecycle of the industry than cross-sectional differences between industries (Klepper, 1996). Research has also shown that the rate of new firm entry into an industry is closely related to the phase of the industry lifecycle (Gort et al., 1982). The generic co-variation between industry lifecycle and entry and exit patterns of firms can be described as follows: in the growth phase, an industry grows rapidly because new firms enter the industry in large numbers. Any existing incumbent firms also experience rapid growth on average. In the following phase, the industry growth rate usually declines drastically and large numbers of firms exit in what is often referred to as a shakeout. In these two initial phases, product prices are normally seen to decline. In the third phase, the industry matures and stabilizes, exhibiting lower and more stable entry and exit rates (Klepper et al., 1990)

In the industry lifecycles literature there is an intimate relationship with technology and technology cycles. Innovation or technological opportunities determines the rate of technological advance in a given industry, and these opportunities can arise from within the industry or have their source in other industries. Differences between industries regarding the strength and sources of technological opportunities is an important determinant of variations between industries regarding the intensity of research and development, as well as the rate of technological advances (Klevorick et al., 1995). Whole industries can be created or destroyed by the introduction of new technological paradigms or platforms (Dosi, 1982; Henderson & Clark, 1990). The dynamics of technological uncertainty and availability of innovation opportunities in an industry not only determines the number of new firms entering into the industry to exploit these opportunities, but also seem to have strong predictive power for industry exit rates (Anderson & Tushman, 2001; Jovanovic et al., 1994). Thus the timing and magnitude of innovation in the market and firm timing and

magnitude of adoption of new technologies are main explanatory variables within the framework of industry lifecycles (Sinha & Noble, 2008).

Empirical studies have shown that including technology as a dynamic variable in the modeling of firm survival and performance significantly increases the predictive accuracy of models (Suarez et al., 1995). At the same time, the industry lifecycle to a large extent determines the research activity and thereby the type of innovation brought to market by existing firms, thereby making technological knowledge a crucial – if implicit – component of firm performance (Christensen et al., 1996; Tushman, Anderson, & O'Reilly, 1996). Lifecycle theory is inherently evolutionary in that the time path of events determines both the development and performance of individual firms, but also the ultimate market structure in itself (Gort et al., 1982; Nelson et al., 1976). A weakness in lifecycle theory relating to entrepreneurship is that the implicit assumption is that of one-product firms in manufacturing fields. Life cycle theory seems to have found less application with regards to multi-business and pure service firms. The table below surveys some of the dependent and independent variables used in empirical research on industry lifecycles and firm performance. With regards to new firms, industry lifecycle research has mainly focus on new firm entry, and does not distinguish between industry entrants; there is no discrimination between industry entrants that are multinational enterprises previously active in a multitude of other industries and small independent new ventures.

Thus, in the industry lifecycle perspective, the concept of technological regimes offer the fundamental explanation for firm entry and firm survival (Lin & Huang, 2008; Marsili, 2002). At the same time, industry characteristics relating to economies of scale and capital intensity that are contingent on the technological regime seem to explain variations in new firm survival to a large extent (Audretsch, 1991). One of the main predictors of new firm performance then becomes the timing of entry relating to the lifecycle of the industry in general and the emergence of a dominant technological design in particular, as illustrated by studies on unrelated high- and low-technology manufacturing industries in Sweden as

well as the United States (Bayus & Agarwal, 2007; Dowell & Swaminathan, 2006; Karlsson & Nyström, 2003). Examples of empirical works related to firm entry and firm survival are given in Table 2.

Table 2. Empirical Industry Lifecycle Studies

	Context and sample	**Dependent variables**	**Independent variables**
Klepper & Graddy, 1990	Firms, output, and price for 46 new products 1904-1981	(a) Number of firms active in industry, (b) change in output, (c) change in price	Product lifecycle stage
Audretsch, 1991	11,154 US new manufacturing firms 1976-1986	New firm survival	(a) Technological regime, (b) extent of industry economies of scale, (c) extent of industry capital intensity
Jovanovic & MacDonald, 1994	US automobile tire industry 1906-1973	Number of firms entering industry	Availability of innovative opportunity
Suarez & Utterback, 1995	7 technological dominant designs in the US 1906-1971	Firm survival	Entry time into industry in relation to establishment of technological dominant design
Christensen & Bower, 1996	US disk drive industry 1974-198	(a) New firm entry, (b) incumbent firm survival	Emergence of radical technological innovation
Anderson & Tushman, 2001	16 technological discontinuities in the US cement, container glass, flat glass, and minicomputer industry 1888-1971	Firm exits from industry	(a) Industry demand changes, (b) technological discontinuities, (c) economic munificence, (d) economic complexity
Shane, 2001	1,397 MIT patents 1980-1996	New firm formation	(a) Age of the technical field, (b) market segmentation, (c) effectiveness of patents, (d) complementary assets
Nerkar & Shane, 2003	128 new technology companies 1980-1995	New firm survival	(a) Firm technological radicalness, (b) patent scope, (c) industry concentration
Karlsson & Nyström, 2003	56,000 Swedish new manufacturing plants 1990-1996	(a) New firm entry, (b) firm exit	Timing of entry related to product lifecycle
Dowell & Swaminathan, 2006	US bicycle industry 1880-1918	(a) New firm entry, (b) firm survival	(a) Timing of entry, (b) technological exploration, (c) adoption of dominant design

Bayus & Agarwal, 2007	US personal computer industry 1974-1994	Firm survival	(a) Pre-entry experience, (b) type of entry (independent/spinoff), (c) timing of entry relating to product technology
Sinha & Noble, 2008	1,127 UK firms in metal working and engineering 1981-1986	Firm survival	(a) Probability of radical technology adoption, (b) timing of radical technology adoption, (c) magnitude of radical technology adoption

Possibly due to the singular technology focus of industry lifecycle, empirical research with relevance for entrepreneurship has exclusively been conducted on manufacturing or intellectual-property based high-technology firms or industries. Another issue is that the majority of new firms studied are relatively large in terms of assets and size at startup, as well as that there is scant empirical research with regards to independent new ventures in service industries. In addition, there seems to be a lack of studies examining other aspects of new firm performance than survival.

2.2.3 Population Ecology

Population ecology differs fundamentally from industrial organization in that similarly to the industry lifecycle perspective is evolutionary; firm development is heavily path dependent, meaning that previous performance is determinant of future performance, thus making entry points and origins significant factors in the determinants of firm evolution and performance (Carroll, Bigelow, Seidel, & Tsai, 1996). Population ecology exhibits an even more direct influence from evolutionary theory, as it not only applies the methods from biological research to organizations, but also the language and fundamental assumption that environmental and inertial forces that shape competition and selection in populations of organizations has a better explanatory power than the adaptation perspective that is predominant in institutional theory (Hannan et al., 1977). In an representative empirical study of 19th century newspapers in Argentine and Ireland, environmental models were found to be predictive of quasi-cyclical patterns of firm founding's, whereas institutional changes and economic cycles were found to have no impact (Delacroix & Carroll, 1983).

Key concepts within population ecology are organizational niches and population density. Organizational niches are characterized by the resource requirements and capabilities of individual organizations and define the competitive environment and success criteria within narrowly defined segments of the overall population, and has been determined to be a major influence of the probability of entry in any given niche (Baum & Singh, 1994). Population density is a measure of the number of organizations of a particular type in the population as a whole or within an organizational niche. It is a measure of intensity of competition, and as such can have a negative impact on the survival chances of new entrants in the population, but at the same time has been shown to be source of legitimacy for new firms; a large number of similar firms coupled with embeddedness or relational density between new entrants and incumbent firms suggest that increased population density can have a significant positive impact on the survival and growth of new firms thus both providing normative advice for new entrants and proving the theoretic relatedness between population ecology and institutional theory. (Baum & Oliver, 1992).

Related to the relative differences between new and incumbent organizations is the concept of *liability of newness*, meaning that a new firm has a higher hazard rate precisely because it is new – it is easy to draw the biological analogy to a newborn infant. A new firm simply has not yet acquired the necessary knowledge, skills and resources to the same extent as established firms. This concept has been empirically tested with varying success, and there is an ongoing discussion as to whether liability of newness is a valid construct, or if it should be extended to a liability of adolescence as new firm mortality rates depend on the initial resources at startup and peak anytime from two to fifteen years after entry (Brüderl & Schüssler, 1990).

Another significant feature of population ecology that also draws heavily from the biological sciences is the assumption that firm exits are not incremental but periodical and occurring in large-scale industry shakeouts in between periods of relative stability (Gersick, 1991; Pierce, 2009). These shakeouts would incur similar effects as the introduction of revolutionary

technologies in industry lifecycle with respect to new firm entries and exits, but the underlying causes are fundamentally different; whereas revolutionary technologies are appearing - or at least having significant impact – depending on the adoption and diffusion of dominant designs, the ecological shakeouts are caused by population characteristics such as overcrowding or external shocks. A number of representative empirical studies with a primary focus on population ecology dynamics are displayed in Table 3. below; similarly to industry lifecycle the dominant outcomes have been and still are firm entry and exit on an aggregated level.

Table 3. Empirical Population Ecology Studies

	Context and sample	**Dependent variables**	**Independent variables**
Delacroix & Carroll, 1983	Newspapers in Argentina 1800-1900and Ireland 1800-1925	(a) Newspaper births, (b) newspaper deaths	(a) Population dynamics, (b) political turbulence, (c) economic cyclicality
Brüderl & Schüssler, 1990	171,000 West German new firms 1980-1989	New firm survival	(a) Firm age, (b) firm size, (c) legal form
Baum & Oliver, 1992	682 licenced day care centers in Toronto, Canada 1971-1989	(a) Organizational foundings, (b) organizational failures	(a) Industry density, (b) relational density
Carroll, Bigelow, Seidel & Tsai, 1996	2,197 US automobile manufacturers 1885-1981	(a) New firm entry, (b) firm exit	(a) Type of firm entry (de novo/de alio), (b) type of firm exit (de novo/de alio), (c) industry density, (d) industry density at entry, (e) firm size, (f) firm age in industry
Pierce, 2009	200,000 individual US car leases 1997-2001	Firm exit	(a) Major product redesign (dummy), (b) niche product market share, (c) niche product durability, (d) niche product profitability

The main critique aimed at population ecology is related to the argument that firm survival is determined by the density of the population of firms at the time of entry of the new firm, implying that new firms that enter in periods of increased competition will display higher exit rates than firms

that enter in periods of reduced competition. Some scholars, mainly those focused on industry lifecycle theory which is closely related population ecology in terms of assumptions and outcomes, have argued that population density and intensity of competition are merely reflections of unobserved factors such as technological change or regulation change, and that it is these underlying forces that ultimately impact industry structure and thereby new firm formation, survival and performance (Utterback & Suarez, 1993). Another criticism against population ecology is that an underlying assumption is that all firms are homogenous and that characteristics of individuals and firms can not be used as an explanatory variable (Thornton, 1999).

2.2.4 Institutional Theory

Institutional theory tracks its ancestry back to 19th century economist Thorstein Veblen who was the first social scientist to attempt to reconstruct economics from a strand of philosophy into a theory of economic and institutional development building on the Darwinian principles of evolution (Hodgson, 1998; Veblen, 1898). Although Darwinism in the social sciences is to this day plagued by controversies and misunderstandings, the primary tenet is that of causal relationships, explaining development and evolution through the concepts of variation, selection, and inheritance or retention of traits in organizations (Aldrich, 1999; Hodgson, 2003). With regards to the heritage of institutional theory, economists generally contend that institutions are the products of human design, implemented for the reason of reducing transactional uncertainty in the marketplace and thereby introducing constraints and guidelines regarding transaction costs, production costs, and acceptable behavior (North, 1991). On the other hand, sociologists contend that institutions could rather be the result of human action and thus the output of collective decisions and behavior rather than the guiding framework for the same. This sociological approach coincides with the evolutionary perspective of Nelson and Winter who view institutions as end products of random variation, selection, and retention rather than the outcome of rational foresight and directed action (Nelson et al., 1982b). Regardless of if the emergence of institutions is planned or unplanned; they can be generally divided into formal rules and norms

(laws, regulation) and informal constraints (cultural taboos, customs, traditions) on the behavior of individuals and organizations (Dewaelheyns & Van Hulle, 2008). These constraints provide a framework for organizations that causes isomorphism; the diffusion and conforming pressures for uniform practices and structures throughout the organizational and industrial landscape (DiMaggio & Powell, 1983). Current institutional theory is primarily concerned with the research issues of why and what makes organizations homogenous. It is argued that the behavior and actions of organizations are constrained and standardized by the institutions that constitute the operating environment (Scott, 2001). Institutions can be constituted by social frameworks consisting of norms, values, and implicit assumptions that guide acceptable behaviors and actions.

Although originating from evolutionary theory, institutional theory has been criticized as being to rigid and focusing more on the reinforcement and replication of existing institutions rather than the introduction of new behavior and institutions; in this regard entrepreneurial behavior – which by its very nature is often consisting of violating norms and customary behavior – is implicitly viewed as negative. This is addressed to some extent specifically in neo-institutional theory, where the concept of entrepreneurship is often used to connote the creation and introduction of new rules, practices, and norms rather than the creation and introduction of new firms and organizations, thus in this view the entrepreneur by this definition does not necessarily have to create a new venture *per se* (Croidieu, 2007).

The majority of empirical institutional research relating to new firm entry, exit, and performance has focused on the formal economic, political, and legal boundaries and restrictions that guide entrepreneurial outcomes, based on the argument that entrepreneurial activity is a constant and that policy-makers can more readily affect the outcomes of available entrepreneurial activity rather than have an impact on the actual supply of entrepreneurial activity in an economy, a hypothesis that has also been found to have empirical support across a multitude of time periods and economic systems (Baumol, 1990; Sobel, 2008). Institutional theory has found support in that

it has successfully been applied to explain the differences in national or historical outcomes when none would be expected, or explain the similarities in economic outcomes where it could be expected from using the tools and explanations from classical economic theory (North, 1994). It has also been demonstrated that differences in the formal institutions (capital markets, property regimes) to some extent can be offset or augmented by differences in other institutions (e.g. labor markets, work culture, educational systems). One of the main insights from institutional theory is that singular aspects of entrepreneurial or economic outcomes can not simply be compared between nations or markets without taking political and institutional factors into consideration; doing otherwise will generate severely biased and flawed conclusions (Hall & Soskice, 2001).

In its application to entrepreneurship, the institutional approach has been used to explain the emergence of different types of entrepreneurship under different institutional regimes, and also to determine the size distribution of firms in a given economy (Henrekson & Johansson, 1999; McMullen, Bagby, & Palich, 2008). Other research has shown that institutional factors not only serve to influence the economic conditions in a country, but also that the predictive strength of institutional factors differ between mature and emerging economies (Desai, Gompers, & Lerner, 2005). Similar to population ecology, also in institutional theory are new firms victims to liability of newness. Here however, the assumption is not that the new firm has a higher risk of termination due to lack of skills and resources, rather it is the lack of legitimacy. In order to survive in the marketplace, it is necessary but not sufficient for new firms to generate and capture economic rents, but in addition it is of vital importance to gain legitimacy and to be accepted by the stakeholders in their environment (DiMaggio et al., 1983). A vital strategy of new firm survival is then the pursuit of legitimacy in the eyes of these stakeholders (Aldrich & Fiol, 1994). For new firms, these activities could include providing a business plan and pursuing other actions that are more geared toward creating legitimacy than actually improving the operations of the company (Delmar et al., 2004). Table 4. below lists a number of institutional studies with a predominantly entrepreneurial focus.

Table 4. Empirical Institutional Theory Studies

	Context and sample	Dependent variables	Independent variables
Henrekson & Johansson, 1999	All Swedish firms in manufacturing 1968-1993	Firm size distributions	(a) Tax policy, (b) credit market policy, (c) labor security regulation, (d) wage formation, (e) large public sector employment
Delmar & Shane, 2004	223 Swedish new ventures 1998-2000	New firm survival	Legitimizing activities: (a) completing a business plan, (b) registering legal entity
Desai, Gompers & Lerner, 2005	394,000 European firms in 34 countries in 1998	(a) Rate of new firm entry, (b) rate of firm exit, (c) average firm size, (d) average industrial vintage, (e) distribution of firm sizes	Quality of legal and political institutions: (a) fairness index, (b) strength of property right protection, (c) formalism index, (d) index of interference of courts, (e) measure of start-up procedures
Mudambi & Zahra, 2007	51 UK international new ventures 1991-1996	International new venture survival	Perceived foreignness: Type of entry (de novo/de alio)
Dewaelheyns & Van Hulle, 2008	Belgian firms in manufacturing, construction, trade, and non-financial services 1986-2002	Small- and micro firm bankruptcies	New firm entry in relation to introduction of legal reform
McMullen, Bagby & Palish, 2008	Economic data (GEM) on 37 nations 2002-2005	(a) Rate of opportunity-based entrepreneurship, (b) rate of necessity-based entrepreneurship	(a) GDP per capita, (b) trade freedom, (c) fiscal freedom, (d) government intervention, (e) monetary freedom, (f) investment freedom, (g) labor market regulation, (h) property rights, (i) business freedom, (j) corruption

Sobel, 2008	All US States	Measures of productive entrepreneurship: (a) VC investment per capita, (b) patents per capita, (c) sole proprietorship growth rate; Measures of unproductive entrepreneurship: (a) lobbying organizations per capita, (b) frivolous legal activities	Institutional quality & economic freedom: (a) size of state government, (b) state subsidies, (c) taxation, (d) labor market freedom

Empirical institutional research has been primarily macro-level research focused on firm entries and exits in relation to formal institutions and regulation, few studies have focused on the micro-level activities undertaken to conform to "soft" institutional pressures such as legitimacy and perceived foreignness in the market, and meeting the expectations on order of actions and formalities from external stakeholders (Delmar et al., 2004; Mudambi & Zahra, 2007).

In summary, the external schools of new firm survival and performance might appear similar at first glance, but differ significantly in terms of underlying assumptions, drivers of firm entry, and performance. Industrial organization is based on neoclassical economics; making equilibrium and profit-seeking assumptions about the market and entrepreneurial firms in manufacturing industries; there is a cause of concern regarding the validity of the drivers of entry and exit, such as entry barriers, scale economies and capital intensity, for service firms. Industry lifecycle is an evolutionary theory with a clear focus on knowledge, as the main driver of both industry development and the survival and growth prospects of new firms is the phase and diffusion of underlying technology. The application of industry lifecycle to non-manufacturing industries is an open discussion, but to date no empirical research on this seems to have been undertaken. Population ecology is the approach borrowing most heavily from evolutionary theory, and empirical research has been conducted on both manufacturing and non-manufacturing industries, albeit on a highly aggregated level. Institutional theory also adopts an evolutionary approach where both firms and

institution are the result of continuous variation-selection-retention cycles. Additionally, institutional theory with its' mixed heritage drawing on both economics and sociology allows for a wider set of assumptions regarding entrepreneurial action, which in addition to economic motives can be driven by social needs or the quest for relative status (Aldrich, 1999; Podolny, 1991). All evolutionary schools place a heavy emphasis on path dependence, calling for longitudinal research designs.

2.3 Internal Schools: Resources, Postures, and Capabilities

In later years, internal factors of firm performance have received increased attention due to the empirical research that has indicated that internal factors such as firm resources and capabilities have approximately twice the explanatory value of variance in firm performance versus external factors such as industry positioning and competition. This is illustrated by empirical research findings that implies that there is greater heterogeneity with regards to performance between inter-industry group firms than between intra-industry group firms (Hansen et al., 1989; Rumelt, 1991). Additional studies have isolated firm-level effects as being more important than industry effects on the performance of firms (Mauri et al., 1998). A recent review of the studies made show that there is no academic consensus on the issue, but in the survey of empirical studies, the more recent ones seem to emphasize the predictive power of firm-level factors on performance (Caloghirou, Protogerou, Spanos, & Papagiannakis, 2004).

Not discarding the importance of industry and contextual factors, with regards to empirical entrepreneurship research firm-level factors such as resources and capabilities are of special interest due to three main reasons: (1) independent new and small entrepreneurial firms suffer chronically from the lack of resources; indeed some highlight the ability to create and construct resources from nothing as a core competence for entrepreneurial firms and individuals (Baker et al., 2005). The capability to learn and adapt to new situations is vital to new firms as (2) competition for limited resources is relatively tougher for independent new firms, and (3) they can

be assumed to be in a mode characterized by more exploration than established firms as it is likely that they still have not settled on their primary revenue model, product or service offering, internal processes and routines, and strategic direction (March, 1991). This would be especially pronounced for service firms who by definition have customer offer adaptation and packaging as a key component of their business model. It thus seems like the content of firms is of relatively more importance than the context of firms in explaining how firms can achieve sustainable competitive advantage, which is the overarching question in all strategic theories on firm performance. A number of related theories with applicability for the study of independent new ventures have been developed along this line of reasoning, and these are briefly covered below.

2.3.1 Resource-Based View of the Firm

The antecedents of the resource-based view (RBV) can be found in the work of Penrose on the theory of the firm, where she defined the firm as a collection of resources and viewed firm growth as the two-pronged process of exploiting these resources to generate economic rents from productive opportunities, and at the same time expanding and increasing the firm's asset base (Penrose, 1959). Later motivations for the RBV can be found in the critiques of the work in industrial organization that state that industrial organization research was preoccupied with the task of searching for monopoly even though a large number of other, potentially more interesting, research questions were left unanswered. The reason for this focus was stated to be primarily convenience – access to industry data greatly facilitated that kind of empirical work – and the desire of scholars to relevant to policy-makers and ensure access to research funds (Demsetz, 1973).

The resource-based view attempts to analyze differences in firm performance by looking at firms from the resource side rather than from the product or market side (Wernerfelt, 1984, 1995). From a normative perspective, recommendations focus on having firms creating imperfectly competitive product markets thereby increasing their own economic profits and competitive position. The resource-based view, in contrast, states that

the performance of firms can not only depend on these types of strategies, but need also consider the cost of implementation of strategies. These costs are determined by strategic factor markets; where resources needed for the implementation of strategies are acquired (Barney, 1986). Under the assumption that these strategic factor markets are incomplete and imperfect, strategic resources can be assumed to be accumulated as well as acquired (Dierickx & Cool, 1989).

Under these assumptions, four essential conditions underpin the sustained competitive advantage of the firm; (1) ownership of superior resources – meaning that the relative quality of resources differ between competitors, (2) ex ante and (3) ex post limits to competition – reinforcing the strategic importance of entry barriers, and finally (4) imperfect resource mobility – meaning that resources cannot be easily transferred or acquired by competitors (Peteraf, 1993). In order to be of strategic importance, resource-based view scholars often state that resources need to exhibit four characteristics: valuable (V), rare (R), inimitable (I), and non-substitutable (N), often abbreviated to VRIN. First, a resource has to be valuable in the sense that it enables the firm to create value relative to its' competitors (Barney, 1991). If a resource is valuable, it will be rare – a resource that everybody could access or acquire would by definition entail a lower value (Dierickx et al., 1989). The only way a resource can confer a relative advantage to a firm is if it is difficult to imitate by competitors (Barney, 1986). Following similar reasoning; if a resource was easy to imitate then by definition it would not confer any relative competitive advantage. The final aspect which complements the other three is that in order to be of strategic value, a resource has to be non-substitutable (Barney, 1991). The VRIN criteria can be considered to be the standard perspective even though more recent theorizing has proposed the separation of necessary and additional conditions for the expression of competitive advantage and argued that there are only two necessary conditions, namely uncertainty and immobility and that all other conditions are additional (Foss & Knudsen, 2003). Additional findings seem to indicate that it is not only the quality but also the quantity of resources that matter for firm performance; a longitudinal study of 900 privately held firms has found a positive influence

of resource slack and financial performance. It should be noted that these results indicatethat a combination of behavioral and resource constraint arguments are necessary to explain the slack-performance relationship (George, 2005).

Resources can be divided into two types of (a) property-based and (b) knowledge-based resources. This is proposed in one study of the US movie industry that discovered that property-based resources such as contracts with suppliers (actors) and distributors (theaters) had a positive impact on financial performance in stable predictable environments, whereas knowledge-based resources, in this access to case creative staff was more important in dynamic environments after the introduction of new technologies (Miller et al., 1996). These knowledge-based resources include human capital such as relevant education and experience that is assumed to help the individual entrepreneur better identify and exploit the opportunity. Human capital at time of startup has also been shown to positively impact the survival and growth chances of new ventures (Cooper, Gimeno-Gascon, & Woo, 1994). As resources need to be hard to imitate, theory states that firm-specific human capital should be of higher strategic value than generic human capital, a notion that also has some support in empirical results on firms in both manufacturing and professional service industries (Hatch & Dyer, 2004; Hitt, Bierman, Shimizu, & Kochhar, 2001). Procedural knowledge about the industry in which a firm competes and the business model it will use significantly improves new venture performance (West & Noel, 2009). Additionally, entrepreneurs whose human capital is composed of combinative industry experience from multiple industries as opposed to only one industry seem to improve new firm survival, at least in financial services (Wennberg, 2009). Additional approaches to measure the impact of human capital on the performance of new firms have been the size and composition of founding teams, and the number of management roles assumed by the CEO; where a large number of roles would be perceived as a weakness since this could indicate either that the firm has not been able to attract the required skills, that the entrepreneur is overworked or overcontrolling, but could also indicate the presence of a habitual entrepreneur adept at managing and juggling a

portfolio of parallel projects (Baum & Silverman, 2004). The argument can also be made that social networks would qualify as a strategic resource as they fulfill the VRIN-criteria (Raz & Gloor, 2007).

Even though the original definition of what constitutes resources in the resource-based view include both tangible and intangible asset such as knowledge and capabilities, it has later evolved an academic consensus that one should attempt a distinction between resources and capabilities, where resources are transferable and non-specific to the firm, and capabilities are firm-specific and used to mobilize and create resources (Amit et al., 1995). The discovery, creation and exploitation of opportunity is a function of previous individual and organizational experience and knowledge (Shane, 2000). Knowledge has been shown, in addition to being the most important factor for economic growth, to display increasing returns as opposed to the other factors of production (Romer, 1990b). Knowledge can be defined as being either explicit – identifiable, codifiable and transferable - or tacit – difficult to identify and transfer (Polanyi, 1966). Some have argued that precisely this abstract quality of tacit knowledge is what makes it the basis of relative competitive advantage (DeCarolis et al., 1999; Grant, 1996). Table 5. on the following page contains resource-based empirical studies with relevance for the study of new venture survival and performance. The papers cover a wide number of different industries and contexts.

Table 5. Empirical Resource-based View Studies

	Context and sample	Dependent variables	Independent variables
Cooper, Gimeno, Gascon & Woo, 1994	2,994 US entrepreneurs 1985-1988	(a) firm exit, (b) survival with low growth (c) survival with growth	(a) education level, (b) gender, (c) ethnic minority, (d) entrepreneur parents, (e) management experience, (f) use of professional advisors (g) financial assets
Hitt, Bierman, Shimizu & Kochhar, 2001	93 US law firms 1987-1991	Profitability	(a) Quality of law school, (b) aggregated tenure as partner at firm, (c) human capital leverage, (d) diversification measures

Baum & Silverman, 2004	204 Canadian biotechnology startups, 1991-2000	(a) Venture financing received, (b) revenue, (c) R&D spending growth, (d) R&D personnel growth, (e) patent applications, (f) patents granted	(a) aggregate number of alliances at startup, (b) patent applications at startup, (c) patents granted at startup, (d) size of top management team at startup, (e) number of roles assumed by CEO (f) number of CEO prior ventures (g) number of CEO current other ventures
Hatch & Dyer, 2004	25 semiconductor manufacturing facilities in the US, Europe, and Asia	Firm performance; product defect density	(a) Human resource selection, (b) human resource development, (c) human resource deployment, (d) inimitability
George, 2005	900 US privately held firms in both high- and low-technology industries	Firm performance: gross profit	(a) Resource slack, (b) firm age, (c) firm size, (d) industry complexity
Delmar & Shane, 2006	223 Swedish new venture teams in service & manufacturing industries 1998-2000	(a) New firm failure, (b) sales	(a) Previous industry experience in team, (b) previous entrepreneurial experience in team
Raz & Gloor, 2007	71 Israeli software startups 1997-2004	Firm survival	(a) Size of social network, (b) firm age, (c) firm size, (d) legal form, (e) industry category
West & Noel, 2009	177 US technology-based startup firms	Self-reported performance relative to competition	(a) Related industry experience, (b) previous startup experience
Wennberg, 2009(forthc.)	1,077 Swedish financial services ventures 1990-2002	New firm survival	Human capital: (a) finance industry experience, (b) technology industry experience, (c) combined industry experience

The resource-based view has gained immense popularity but also serious critique, the main points focusing on the tautological quality of the theory (Priem & Butler, 2001). The only way of determining whether a resource is

valuable is that it has created value, thus the definition of a valuable resource is always after-the-fact. This is a tautological argument that in addition has an inherent selection bias problem; if the only way of determining whether a resource is valuable is in retrospect, then it will be impossible to study anything but success cases, making for biased and potentially flawed results, as there may be in fact a number of failed companies with similar resource configurations that are excluded from the sample and therefore not studied and incorporated in the analysis (Denrell, 2004). In order to make sense and be a useful theory for entrepreneurship applications, what constitutes valuable resources must be possible to determine *ex ante*. Another argument against the resource-based view is that different configurations of resources could be aggregated to create the same value for different firms, thus violating the VRIN-criteria and undermining the role of resources to create a relative competitive advantage (Priem et al., 2001). With regards to empirical entrepreneurship research, a limitation of the resource-based view is its' perceived static quality, as evident in the fact that the impact of resources on the prospects of new firms have predominantly been assessed as initial endowments; i.e. it is the resources at time of startup that are the focal issue and less so the resource configurations in later stages and over time.

2.3.2 Entrepreneurial Orientation

Entrepreneurial orientation (EO) is a firm-level theory that intellectually could be said to stem from the individual-level research on entrepreneurial traits but was actually created out of the need for firm-level theories for entrepreneurship for established firms. The entrepreneurial orientation of the firm is said to be composed of three types of interrelated behaviors on the firm-level; (1) management or founding team risk propensity with regards to strategic investment or decisions under uncertainty, (2) extensiveness and tendency towards technological leadership as often measured by the frequency of product innovation, and (3) the pioneering posture of the firm, which is defined as the degree to which the firm acts proactively and aggressively with regards to its perceived competitors. The entrepreneurial orientation of the firm is usually assessed through questionnaires with forced choice statements relating to statements that

support or reject different elements of the entrepreneurial posture (Covin & Slevin, 1991). Recent empirical work has found support for the thesis that the knowledge-based resources needed for the discovery and exploitation of new opportunities have a positive effect on new firm performance and that the entrepreneurial strategic orientation (EO) of the new firm positively and significantly enhances this relationship (Wiklund & Shepherd, 2003b).

Essentially, entrepreneurial orientation is about the posture of the firm, rather than resources and capabilities, although recent theoretical developments indicate that entrepreneurial orientation may have a positive impact on firm performance through the interaction with resources and capabilities rather than having direct effects (Wiklund & Shepherd, 2005). As the core of entrepreneurial orientation is posture and positive attitude towards market expansion and research has shown that many entrepreneurs actually prioritize control and stability over increased performance and growth, studies measuring the willingness and aspiration to grow the firm are also classified under entrepreneurial orientation in this review (Wiklund, Delmar, & Davidsson, 2003a). Table 6. below details some studies of relevance to entrepreneurship researchers, they cover a wide range of empirical settings and firms in manufacturing, service, and retail industries.

Table 6. Empirical Entrepreneurial Orientation Studies

	Context and sample	Dependent variables	Independent variables
Smart & Conant, 1994	599 US independently owned apparel specialty retailers	Self-reported performance; e.g. (a) sales, (b) sales growth, (c) profitability, (d) overall success	(a) Entrepreneurial orientation, (b) distinctive marketing competencies
Wiklund, 1999	132 Swedish small firms in manufacturing, service, and retail 1996-1998	(a) Sales growth, (b) employment growth, (c) sales growth compared to competitors, (d) market value growth compared to competitors, (e) gross margin	(a) Entrepreneurial orientation, (b) entrepreneurial dynamism, (c) capital availability

Wiklund & Shepherd, 2003	384 Swedish small- and medium sized enterprises 1997-2000	Self-reported performance: (a) sales growth, (b) revenue growth, (c) employee growth, (d) net profit margin, (e) product/service innovation, (f) customer satisfaction	(a) Entrepreneurial orientation, (b) relative perception of employee motivation, skills, expertise
Keh, Nguyen & Ng, 2007	294 randomly selected small- and medium sized enterprises in Singapore	Self-reported financial and non-financial performance measures; (a) profitability, (b) sales growth, (c) market share, (d) satisfaction with company performance	(a) Entrepreneurial orientation, (b) marketing information utilization
Moreno & Casillas, 2008	434 Spanish firms 1998-2001	(a) Self-reported firm performance, (b) firm growth	(a) Entrepreneurial orientation, (b) strategy of the firm, (c) environment, (d) resources and capabilities
Stam & Elfring, 2008	90 open source software new ventures in the Netherlands 2005	Self-reported performance relative to competition	(a) Entrepreneurial orientation, (b) network centrality, (c) bridging ties

Although having large explanatory value and providing valuable insights in the motivations that drive entrepreneurial firm performance in both service and manufacturing industries, one issue with the entrepreneurial orientation approach is its reliance on subjective measures for firm performance which limits the reliability and generalizability of results over time and to other populations and contexts. It is evident that the postures and behaviors were developed for established and high-growth companies, and the relevance of the construct technological leadership and product innovation may be called into question for micro firms in low growth service industries.

2.3.3 Dynamic Capabilities

Dynamic capabilities as a concept was created as a reaction to the perceived static quality of the resource-based view, and is a synthesis of the evolutionary question of how firms change over time, the resource-based based view question of how firms are different, and the organizational learning question of how organizations develop new knowledge. If the

knowledge-based view can be said to focus on general creation, coordination, and transfer of knowledge, the fundamental research issue of dynamic capabilities is how firms use, continuously reconfigure, and create valuable resources in dynamic markets (Chong, 2004; Foss, 2003). The sources of competitive advantage are seen as the processes of coordination and combination that are molded by the firm's specific intellectual and complementary asset position, as well as the evolution of paths it has adopted or inherited in the specific market (Teece et al., 1997). This is coupled with the perspective that the emergence of resources is an evolutionary process that is defined by path-dependencies in innovation and knowledge exploration (Ahuja & Katila, 2004)

One formulation of dynamic capabilities is that of core competences which states that the sources of competitive advantage and by extension firm performance are to be found in management's ability to identify and consolidate technological knowledge and processes into competencies that enables the organization to adapt quickly to changing opportunities. The value of core competencies for the firm is not only to be found in the organization of work but additionally in the delivery of value. Thus, there are three tests can be used in order to identify and define what constitutes core competences in an organization. Primarily, a core competence should provide access to and applicability in a number of unrelated product-market spaces. Also, a core competence should provide a significant contribution to the perceived end-user benefits. And finally, a core competence should be hard to imitate for competitors, thus emulating the inimitability characteristic of strategic resources and clearly showing the intellectual kinship with the resource-based view of the firm (Prahalad & Hamel, 1990)

The dynamic capabilities literature posit that the knowledge capabilities of the management team in an organization is the main criteria that contributes to commercial success in complex and volatile markets such as emerging industries or high-technology (Teece et al., 1997). As such, dynamic capabilities seems well suited as a framework for analyzing entrepreneurial organizations and new firm performance (Zahra, Sapienza, & Davidsson, 2006). It is influenced by evolutionary economics, organizational learning,

and the knowledge-based view which states that knowledge resides with individuals and the role of the firm is coordination and exploitation (Grant, 1996; Kogut et al., 1996; Winter, 2002). Empirical organizational learning studies from such industries as retail hotel chains and commercial banking have shown that a firm's capability of learning from own and others' experiences not only can be a prerequisite of firm performance, but also help insulate the firm from external chocks and significantly improve survival chances (Baum & Ingram, 1998; Kim & Miner, 2007). This research has also highlighted the importance of defining and separating types of experience; as more proximate experiences in time and space have significantly stronger impact than other types of experiences.

Within this framework, knowledge and knowledge creation is assumed to reside with the individual members of a firm or organization. The firm is primarily viewed as an institution for integrating, coordinating and applying the knowledge of its members; sometimes referred to as the knowledge-based view or theory of the firm (Grant, 1996). Thus firms are entities that represent the contextual social knowledge of coordination and organization, rather than the contents of the knowledge itself. Firms can thus be viewed as social communities that are competitive because they are more effective in transferring and applying knowledge to commercial ends than either competitors, or simply acquiring the corresponding knowledge in factor markets. The economic argument would be that if it would be possible or more cost-efficient to assemble the equivalent aggregated knowledge through market transactions, the firm would not have an economic reason for existing (Kogut & Zander, 2002). A firm is distinctly different from a basket of transactions in the market because coordination, communication and learning are situated locally not only physically, but also mentally through the shared identity that arises in organizations. This identity by definition implies a moral order as well as rules of exclusion, thus becoming a norm for internal processes and therefore incurring both limitations and costs to relying upon a firm for exchange as opposed to the market (Kogut et al., 1996). A key component of organizational learning is experience, but also the fact that this experience has differential and non-linear effects on firm survival and performance. A seminal study of

Manhattan hotels found that organizational experience had a curvilinear effect on failure – for instance, experience acquired before founding was positively related to survival, but not experience acquired after founding. Additionally, it mattered if the acquired experience was local or non-local, thus illustrating the contextual nature of knowledge. A key conclusion from this study was the complexity and difficulty in applying experience to attempt to analyze and predict organizational failure (Baum et al., 1998)

Because the assembly of elements that compose an organization are subject to requirements of consistency, identities rule out potentially interesting avenues of innovation and creativity. The capacity of the firm for innovation is less affected by the external environment, as exemplified by a natural experiment of two Carl Zeiss companies, Zeiss Jena in the German Democratic Republic and Zeiss Oberkochen in the Federal Republic of Germany. Even though the socialist system led to political pressures on key firms to innovate "by plan", and failed commercially due to the lack of opportunity for unstructured development in the socialist system, Zeiss Jena still managed to develop significant technological competence (Kogut & Zander, 2000). The knowledge-based view could be argued to be more of a theory of the firm than a theory of sustained competitive advantage (Conner & Prahalad, 1996). Indeed, the criticism that has been put forward focus on knowledge-based view of the firm as being to abstract, and it's inner workings and causal relationship with firm performance as something of a black box. An additional argument is that the knowledge-based view of the firm is not coherent enough to be labeled and used as a theory, but is more akin to an umbrella term for related concepts such as dynamic capabilities, organizational learning, and absorptive capacity (Argote, 1999; Grant, 1996). The heterogeneity aspect of capabilities and experiences is also mirrored in the learning-oriented research on alliance portfolios, that suggest that the learning effects that occur from having a varied portfolio of international strategic alliances have a positive impact on the financial performance of the firm (Lavie & Miller, 2008). These positive learning effects on firm performance also occur in for new ventures the presence of partnerships, collaborations with universities or research institutes, memberships in industry- or venture capital associations, and other types of

formal sponsorships (Lee, Lee, & Pennings, 2001). Table 7. below provides some representative dynamic capabilities studies with regards to new firm survival and performance.

Table 7. Empirical Dynamic Capabilities Studies

	Context and sample	Dependent variables	Independent variables
Baum & Ingram, 1998	558 US (Manhattan) hotels 1898-1980	Firm survival	(a) Industry relationships, (b) market specific operating experience, (c) non-market specific operating experience
Lee, Lee & Pennings, 2001	137 Korean technology startup companies in 1998	Sales growth in first two years	(a) Number of R&D employees, (b) patents, (c) entrepreneurial orientation
Arthurs & Busenitz, 2006	268 US ventures with IPO 1990-1994	Post-IPO valuation after one year	Relative dynamic capabilities: VC-backing vs. no VC backing
Kim & Miner, 2007	2,696 US commercial banks 1984-1988	Firm exits from industry	(a) In-state operating experience, (b) out-of-state operating experience, (c) near-failure experience, (d) failure experience
Lavie & Miller, 2008	US software firms 1990-2001	Financial performance: return-on-assets (ROA)	Alliance portfolio internationalization: (a) cultural distance, (b) geographic distance, (c) economic distance; (d) foreign partnering experience

Dynamic capabilities is a useful concept that covers and integrates many of the other schools of internal drivers of firm survival and performance. The dynamic capabilities framework's primary weakness is in its' applicability for empirical entrepreneurship scholars as the majority of empirical papers on dynamic capabilities are limited in scope and have a descriptive rather than prescriptive research design. There is a lack of empirical papers relating the concept specifically to new firm performance (Zahra et al., 2006). Additionally, similarly to the critique against the resource-based view, it can be argued that the dynamic capabilities is a tautological and thereby self-verifying theory that also is hampered by the inherent selection

bias and risk of undersampling failed cases with the same setup of capabilities as the success cases (Denrell, 2003).

2.3.4 Absorptive Capacity

Absorptive Capacity (ACAP) as a concept was first established in the paper by Cohen and Levinthal in 1990, where they developed a model of how previous knowledge in a company combined with research and development activity could help a firm achieve positive performance over time (Cohen et al., 1990). The construct arose out of the study of what makes firms more successful in R&D-intensive environments and has been defined as the specific dynamic capability of a firm or organization to discover, assimilate/recombine, and exploit technological knowledge, thereby enabling it to commercially exploit advances in technological fields, thus being less plagued by tautology than dynamic capabilities as it specifies in more detail drivers of performance *ex ante* (Cohen & Levinthal, 1994; Zahra et al., 2002). ACAP differs conceptually from overall dynamic capabilities in that ACAP specifically focuses on the acquisition and recombination of technological knowledge external and internal to the firm, and not on the acquisition and development of general capabilities and business skills (Cohen et al., 1990; DeCarolis et al., 1999; Hansen et al., 1989; Teece et al., 1997; Winter, 2002). The construct has been used in more than 900 peer-reviewed academic papers, and it has been labeled "one of the most important constructs to emerge in organizational research in recent decades" (Lane et al., 2006).

ACAP is an organizational characteristic that determines the firm's search pattern in terms of explorative vs. exploitative behavior in relation to the firm's existing knowledge base, and thus acts as an important catalyst of a firm's ability to create economic rents through the transformation of knowledge into a commercial product or service (Katila & Ahuja, 2002; Rosenkopf et al., 2001; Simon, 1959). It thus integrates external and internal perspectives of firm performance. In relation to knowledge-based entrepreneurship, absorptive capacity could be argued to be a critical concept, as in knowledge-intensive fields, this catalytical capability is crucial for the determination not only of opportunity but also of what

constitutes a valuable resource as this is constructed conceptually in relation to the perceived opportunity (Baker et al., 2005). The concept has been extended to include two subsets of potential and realized absorptive capacity, where the potential absorptive capacity is the capability to acquire and assimilate knowledge and the realized absorptive capacity is the transformation and exploitation of the assimilated knowledge (Zahra et al., 2002). This reconceptualization has not seen much empirical application and testing, and has come under scrutiny and criticism highlighting ambiguities and omissions (Todorova & Durisin, 2007).

However, as argued by Lane, Koka and Pathak (2006) the ACAP construct has been the subject of reification; the mechanical application of the construct in a way that does not consider the underlying assumptions of the construct, which in the long-term can be damaging to the body of knowledge centered on the construct of Absorptive Capacity. In a recent assessment of 289 published papers in 14 leading academic journals, it was estimated that the absolute majority (77.9 %) used or related to the construct only superficially or as a minor citation, and only a miniscule minority (4 papers, or 1.4 %) made an attempt at contributing to theory by extending the definition or application of the construct. This is not made better by the fact that the established empirical measures for ACAP is R&D intensity measured as R&D budget/sales or as proportion of R&D-staff relative to the total number of employees (Cohen et al., 1990; DeCarolis et al., 1999). These measures are problematic for entrepreneurship researchers when applying the theory to examine the performance of new firms, as these firms very rarely have dedicated R&D departments or staff. Absorptive capacity thus presents the entrepreneurship scholar with a promising area of research but also with both a theoretical and a methodological challenge. These will be addressed in the following chapters.

2.3.5 Summary

There are a number of theoretical schools relating to the external and internal factors that drive firm survival, performance and growth. Although each of these schools provides important input for the construction of

models of new firm survival and performance, they also have their respective weaknesses. Of the presented schools, absorptive capacity seems the most promising with respect to integrating internal and external perspectives in an evolutionary framework.

Of the external schools, industrial organization is most closely related to economics with its focus on transaction costs and industry barriers, which has also been the main source of criticism. Another weakness of industrial organization with respect to this study is the lack of extensive empirical work on non-manufacturing industries; industrial organization scholars have focused almost exclusively on low- and high-technology manufacturing industries and firms. Industry lifecycle theory and population ecology are both heavily influenced by evolutionary theory introducing the concept of path-dependence – that the future of a firm is dependent on its past and can not be instantly changed or influenced by strategies or decisions. They differ in that industry lifecycle is mainly concerned with the actions of the firm in relation to an underlying technology and has, similar to industrial organization, exclusively focused on manufacturing technology firms whereas population ecology focuses on the impact of the lifecycle and characteristics of the industry – e.g. if it is mature and/or crowded or not. Institutional theory has primarily been concerned with the behavioral impact of formal and informal institutions ranging from laws and regulation to the political and cultural environment. Although inherently evolutionary, institutional theory has been criticized for being to rigid and focusing less on the individuals and firms that act in contradiction to institutions and more on the individual and firms that reinforce them. It is also worth remembering that for neo-institutionalists, the definition entrepreneurship can be used to define the introduction of new customs and institutions in addition to the activity of new firm creation. The overarching criticism against all external schools is against the underlying assumption that firms are homogenous; characteristics of individuals or firms have no real impact on firm performance or survival but it is instead the timing and context that decides whether firms prosper or die.

The internal approaches are related but differ in assumptions and application; the resource-based view is most closely related to economics and traces its heritage to industrial organization which exposes it to the same criticism of being to static in application; the studies on new firms have solely focused on initial conditions and resources and thus do not take into account post-formation developments and impact. Entrepreneurial orientation has contributed significantly to the study of entrepreneurship in that it introduced the posture and attitude as an important firm-level construct, thus greatly increasing the multitude of factors that drive the growth and performance of firms. The limitations of the EO approach come with the use of subjective constructs that may impact the generalizability and comparisons across samples and studies, and it the applications to micro firms.

Dynamic capabilities incorporate organizational learning approaches into an evolutionary framework developed as a reaction to the perceived static quality of the resource-based view. Essentially focusing on the capacity of a firm to create and recombine resources as an output of learning from own and others experiences, dynamic capabilities is evolutionary in that the changes in configurations over time are assumed to matter and be measured. Apart from entrepreneurial organization, the main critique leveraged against the internal schools is that they are tautological meaning that it is not evident beforehand which types of resources and capabilities that will confer strategic and performance advantages. One type of dynamic capability is absorptive capacity theory which integrates external and internal perspectives on firm performance with a focus on the normative positive impact of technological and scientific knowledge on performance, and thus can be deemed to have extra validity in the study of new firms in knowledge-intensive fields as well as circumventing the tautology trap. Absorptive capacity thus seems to be an approach that integrates most of the key inputs from many of the other external and internal schools of firm performance, but overcomes many of the theoretical and methodological issues of these. In particular, a strength of applying absorptive capacity is that it inherently calls for a longitudinal research design, both because new firm entry and performance is a continuous dynamic process that is hard to

capture and analyze with cross-sectional methods, and additionally because there is a lack of empirical longitudinal studies in the field of entrepreneurship (Chandler & Lyon, 2001; Davidsson, 2004). In the next chapter I provide a review of the absorptive capacity literature, specifically the empirical studies on firm performance, and discuss the potential positioning and contribution of this dissertation.

3 Previous Research on Absorptive Capacity

Research is to see what everybody else has seen, and think what nobody else has thought.

Albert Szent-György

In this chapter I present an overview of the published research on absorptive capacity going back to Cohen and Levinthal's introductory article originally published in 1990. I provide a brief description of the research, and then proceed to focus on the empirical research on absorptive capacity and firm performance. After presenting the papers that correspond to these criteria, I identify an area of contribution, as I only have been able to find one (1) empirical paper that uses a longitudinal research design to assess the effect of absorptive capacity on some aspect of new firm survival and performance. The chapter begins with a broad literature review, which is followed by a narrower review focusing on empirical papers, and is concluded with a discussion on absorptive capacity and new firms. This is done in preparation for the next chapter where I proceed to develop an absorptive capacity model of new firm survival and performance.

3.1.1 Literature Review

To examine the potential contribution of this dissertation I conducted a literature search for the 100 most cited articles with "absorptive capacity" included in the title or abstract in the Social Sciences Citation Index (SSCI). In addition, as citations lag the time of publication meaning that it takes a couple of years to build a number of incoming citations (Jaffe & Trajtenberg, 2002) complementary searches for more recent papers on "absorptive capacity" were made in ProQuest as well as the leading academic publications in the field; Academy of Management Journal, Academy of Management Review, Strategic Management Journal, Administrative Science Quarterly, Organization Science, Management Science, Research Policy, Small Business Economics, Journal of Business Venturing, and Entrepreneurship in Theory and Practice. This resulted in a total of 150 articles. Although the search could have been much wider, the

aim was to focus on the publications of the highest reputation and of most relevance to researchers in entrepreneurship. The 150 articles are presented in chronological and alphabetical order in Appendix 1.

Of the 100 most cited papers on ACAP it is interesting to note which publications are most represented. Strategic Management Journal represents almost one-fifth (19%) of the most cited papers, which clearly indicates the acceptance and definition of absorptive capacity as a strategic construct. Other publications with strong representation are Organization Science (6%), Academy of Management Journal (6%), Research Policy (6%) and Journal of International Business Studies (6%). Management Science (5%) follows, with Administrative Science Quarterly (2%) and Academy of Management Review (2%) trailing behind Organizational Studies (4%) and Journal of Management Studies (4%). Only two publications are found in focused entrepreneurship journals, one study examining the relationship between firm absorptive capacity and organizational responsiveness in the context of growth-oriented small and medium-sized enterprises (SMEs) in Entrepreneurship in Theory and Practice (Liao, Welsch, & Stoica, 2003), and a more recent paper outlining a research agenda for science parks and incubators in the Journal of Business Venturing (Phan, Siegel, & Wright, 2005).

3.1.2 Empirical Research on Firm Performance

Absorptive capacity is a multi-disciplinary construct that has been used by economists, sociologists and organization researchers, and it has been used on multiple levels and to measure a host of outcomes (van den Bosch, van Wijk, & Volberda, 2003). For the purposes of this research, this creates the need to narrow our search and selection criteria, and conduct a much more precise literature review. Selecting the empirical papers that had "firm" as unit-of-analysis (instead of industry, alliance or other) and had some aspect of "firm performance" as outcome (and not innovation, alliance characteristics, learning etc) resulted in 27 studies. Going through these papers it was determined that 15 were conventional firm performance studies; these are displayed in alphabetical order in table 8. on the following pages.

Table 8. Empirical Absorptive Capacity Studies

Study	Context and sample	Dependent variable	Independent variables	Control variables
Andersson, Forsgren, & Holm, 2001, 2002	97 subsidiaries of Swedish MNCs	(a) Profitability, (b) sales, (c) market share	External relationships	n/a
DeCarolis & Deeds, 1999	98 US biotech fims publicly listed after 1982	Financial value at IPO	(a) Geography, (b) R&D intensity, (c) new product development (NPD), (d) patents	(a) Market timing, (b) total assets
Freel, 2000	228 small manufacturing firms in the UK	(a) Sales growth, (b) employment growth, (c) profitability, (d) productivity, (e) export intensity	R&D intensity	n/a
*Lane, Salk & Lyles, 2001	78 Hungarian international jointventures in 1996 (resurvey from 1993)	Likert scale of learning and performance	n/a	n/a
Luo, 1997	cross-sectional data on 116 IJV operating in Jiangsu province 1988-1991	(a) return-on-investment (ROI), (b) local sales/total investment, (c) export/total investment	Percentage of professional and technical staff	(a) Equity owned by locals, (b) industry controls, (c) country of origin of investment
Rickne, 2006	73 science-based firms based in Sweden or the US	(a) Number of patents, (b) number of new products per year, (c) employee growth related to firm age	(a) Density of technology connectivity, (b) larger and/or more experienced founding team	(a) Firm age, (b) firm size, (c) application
Rothaermel & Thursby, 2005	longitudinal data 79 technology ventures incubated 1998-2003 at Georgia Tech	(a) Revenues, (b) funds raised, (c) venture capital raised, (d) survival and/or graduation from incubator	Backward patent citations to university research	(a) Firm size (employees), (b) industry effects (SIC), (c) time in incubator

Sarkar, Echambadi & Harrison, 2001	182 US firms with sales < MUSD 25	(a) Sales growth, (b) market share, (c) market development, (d) new product development	(a) Alliance proactiveness, (b) perceived environmental dynamism	(a) Industry, (b) number of alliances, (c) absorptive capacity surrogate
Sharma & Kesner, 1996	Diversifying entries made by Fortune 500 firms 1980-1982	(a) Survival, (b) sales growth, (c) market share growth	(a) Industry competition, (b) parent firm resources	(a) Ownership change, (b) parent size & liquidity, (c) parent diversity, (d) mode of entry
*Sorenson & Sørensen, 2001	152 US franchising chains observed between 1992-1998	Sales	(a) Number of units, (b) age, (c) number of states, (d) type of business, (e) industry	n/a
*Steensma & Lyles, 2000	135 Hungarian manufacturing international joint-ventures	Survival	(a) IJV learning, (b) parental conflict, (c) managerial support, (d) technical support	n/a
Stuart, 2000	150 international semiconductor firms 1985-1991	(a) Sales growth, (b) patent citations	Alliance partner characteristics	(a) Number of alliances, (b) firm size, (c) heterogeneity in propensity to patent
*Tsai, 2001	Two multinational corporations	(a) Innovation (new products), (b) profitability	R&D intensity	(a) Firm size, (b) local competition, (c) past innovation, (d) past performance
*Vermeulen & Barkema, 2001	1369 subsidiaries of 25 largest companies on the Amsterdam Stock Exchange 1966-1994	Survival (acquisition/ greenfield)	(a) Number of preceeding greenfields/ acquisitions, (b) preceeding greenfield in familiar/unfamiliar markets	(a) firm multinational diversity, (b) firm size, (c) profitability, (d) country cultural distance, (e) country level of economic development, (f) subsidiary jointly or wholly owned, (g) subsidiary firm effects

Zahra & Hayton, 2009	217 global manufacturing companies	(a) Return-on-equity (ROE), (b) revenue growth	R&D spending	(a) Firm age, (b) firm size, (c) slack resources, (d) liquidity, (e) innovativeness of country of origin, (f) industry type, (g) past industry performance, (h) industry-wide technological opportunities

Five of the 15 selected papers were among the 100 most cited papers on absorptive capacity, these are denoted with a (*), indicating the academic value of empirical work in this area. Of the 15 studies, one was conducted looking at several business units of two anonymous multinational enterprises (MNE:s), one petrochemical company and one food-manufacturing company. This study showed that absorptive capacity was a critical moderating variable for network centrality in explaining the innovative and business performance, measured as profitability, of these business units (Tsai, 2001). Eight of the papers examined dependent ventures; e.g. subsidiaries, joint-ventures or franchise businesses.

Two of these papers are based on the same study of 94 subsidiaries of 13 Swedish MNE:s, and develops the argument that technological embeddedness and absorptive capacity are strong predictors of market performance and can also be a strategic resource for the corporation (Andersson, Forsgren, & Holm, 2001, 2002). A survey of Hungarian international joint-ventures found that these ventures relative absorptive capacity in relation to their parent companies was crucial for the knowledge transfer between parent firm and joint-ventures, thereby having an impact on the market performance of these ventures (Lane, Salk, & Lyles, 2001). Similarly, Steensma & Lyles examined 121 Hungarian international joint-ventures in both manufacturing and service industries and found that absorptive capacity increased technological knowledge transfer between parent and joint-venture, thereby increasing survival, whereas only managerial knowledge transfer did not have this positive effect (Steensma & Lyles, 2000).

In a survey of 216 Fortune 500 firms conducting diversifying business entries in the period 1980-1982, Sharma & Kesner found that 26% of the variance in the performance of these new ventures could be explained by industry, firm, and relatedness variables, where absorptive capacity was a component of relatedness (Sharma & Kesner, 1996). Sorenson and Sørensen found absorptive capacity as organizational learning to be a double-edged sword in franchise chains; where absorptive capacity was high firms had better opportunities to learn through experimentation, at the same time the higher capacity for knowledge transfer both encouraged and facilitated the enforcement of centralized standards and procedures (Sorenson & Sørensen, 2001). In their assessment of subsidiaries of the 25 largest non-financial companies on the Dutch stock exchange, Vermeulen and Barkema found support for the hypothesis that acquisitions could improve the knowledge base and decrease the inertia of large companies, provided that they can absorb the relevant knowledge from their acquisitions (Vermeulen & Barkema, 2001).

Another seven papers used samples of small- and medium-sized enterprises (SME:s). DeCarolis and Deeds published a much cited study on the positive performance of absorptive capacity on the IPO performance of 98 listed US biotechnology companies (DeCarolis et al., 1999). Freel's study of 228 small manufacturing firms provided evidence that firms with higher levels of absorptive capacity and higher levels of innovation had significantly higher growth rates than their counterparts (Freel, 2000). In a comparison between 73 bioscience firms located in Sweden, Ohio, and Massachussetts in the United States, respectively, Rickne established a causal link between firm performance and connectedness and knowledge transfer from parent organization (Rickne, 2006). Assessing the relationship between alliance proactiveness and firm performance on a sample of 182 technology companies, Sarkar et al. found that absorptive capacity operationalized as proactiveness and knowledge transfer was positively related to the market performance of firms (Sarkar, Echambadi, & Harrison, 2001). A study by Stuart on 150 semiconductor companies found a similar relationship between alliances, knowledge access, and knowledge absorption, and firm performance (Stuart, 2000).

3.1.3 Positioning this Research

Although all the selected papers identify causal relationships between some measure of absorptive capacity and firm performance only one of the identified papers in the literature review explicitly examined the effects of absorptive capacity for the performance of independent new ventures. Rotharmael and Thursby tracked 79 firms that were incubated at Georgia Tech and found a similar positive relationship. Additionally, from a methodological perspective, it should be noted that of the 15 papers, only two of the examined papers utilized a longitudinal research design (Rothaermel & Thursby, 2005; Sorenson et al., 2001). Thus there seems to exist a need of further empirical longitudinal absorptive capacity studies assessing new firms. In particular, no identified studies include the parallel assessment of new firm survival and other aspects of new firm performance. In the next chapter, I elaborate on absorptive capacity to develop hypotheses and formal models relating to new firm terminations, acquisitions, and other aspects of performance.

4 Models and Hypotheses

Far better an approximate answer to the right question, which is often vague; than the exact answer to the wrong question, which can always be made precise.

J. W. Tukey (1962) Annals of Mathematical Statistics 33(1)

This chapter contains a theoretical elaboration on absorptive capacity in general and its application to entrepreneurship in particular. As organizational capabilities in general and absorptive capacity are difficult to measure directly, I proceed to develop measurable components of absorptive capacity that are theoretically and practically relevant for empirical entrepreneurship research. Two different aspects are delineated and propositions relating to the research issue are formulated. These and other theoretical aspects are discussed and then used to develop and specify a research model for the testing of the established hypotheses.

4.1 Theoretical Elaboration and Model

There has been a call for refined frameworks for new firm survival and performance (Zahra et al., 2006). This research seeks to address this gap by deconstructing the absorptive capacity construct into individual-level and organizational-level variables, as the argument has been put-forward that any firm-level model of entrepreneurship needs to be a multi-level model as firm performance arguably is a function of both individual-level and firm-level factors (Covin et al., 1991), and using these to empirically test hypotheses relating to the research question what, if any, differential effects absorptive capacity has on the performance of resource-constrained independent new ventures operating in two different industry logics; product manufacturing firms and service firms (Baker et al., 2005; Nerkar & Roberts, 2004). In formulating the foundations of entrepreneurial orientation, Covin and Slevin also have laid out the prerequisites and characteristics for creating relevant and meaningful models of entrepreneurship. They provide the following four characteristics; (1) the

model should have one or several aspects of firm performance as the dependent variable; although the motivations for entrepreneurial ventures may differ, the main outcomes of relevance for economic researchers is the survival and performance of new firms, either on the micro- or on the macro-level. (2) Any model should have clearly defined variables; which is not a prerequisite just for models of entrepreneurship, but for models in general. Clearly defined variables allow the results to be verified and measurements to be developed in further studies. As previously mentioned, (3) a model of entrepreneurship needs to include or incorporate aspects of environmental, firm-level, and individual-level variables to have a reasonable scope. As shown in the literature review on theories of new firm entry, exit, and performance in chapter 2, all of these factors and levels of analysis have been shown to influence the creation and evolution of new firms in multiple industries and settings. This multi-level approach also introduces the need for theoretically valid delimitations and tradeoffs between developing a parsimonious model that captures the essentials, and overfitting a model that tries to include every available variable. Finally, (4) a firm-level model of entrepreneurship must include both direct and moderator effects as the empirical research has progressed to the point where contingency and interaction models are the norm; models that capture main effects are necessary but not sufficient in advancing knowledge and theoretical development in entrepreneurship (Covin et al., 1991).

The main issue with researching absorptive capacity, similar to any dynamic capability, is the fact that it is basically not possible to measure organizational capabilities directly. As a capability is an ephemeral quality that confers competitive advantage to a firm, the only ways to define and measure it is either through outcomes, which then causes the problems of tautology and selection bias previously mentioned, or through breaking the construct down into components with measurable indicators (Denrell, 2003; Priem et al., 2001).The first step in order to develop a conceptual model that answers to the requirements postulated by Covin and Slevin (1991) is then to decompose absorptive capacity into individual-level and firm-level components. Absorptive capacity is a firm-level construct of the capability

of an organization to assimilate and exploit external knowledge. In the following sections I attempt to deconstruct absorptive capacity into working definitions that additionally will enable the empirical application and testing of the construct on new firms.

4.1.1 Individual-level ACAP: Scientific Human Capital

In entrepreneurship research, it has been argued that opportunity discovery is an individual-level activity (Kirzner 1997, Shane 2000). This calls for an individual-level operationalization of absorptive capacity, based on the assumption that knowledge and knowledge creation resides with individuals within the firm, rather than in the firm itself (Grant, 1996; Kogut et al., 1996). For new firms I posit that a higher level of technological knowledge in the firm enhances it's capability to assimilate new technological knowledge and to use this knowledge to perceive and exploit business opportunities. This is consistent with the original definition of absorptive capacity as contingent of previous related knowledge. The construct of absorptive capacity developed here also includes both two subsets of potential and realized absorptive capacity, where potential capacity covers knowledge acquisition and assimilation, and realized capacity covers knowledge transformation and exploitation (Zahra et al., 2002). This is in line with researchers who have called for a wider construct of absorptive capacity (Lane et al., 2006).

Drawing on the previous resource-based and dynamic capabilities research on new firm performance, human capital seems to be a relevant construct capturing the essence of individual-level absorptive capacity. Not only does human capital contribute to firm performance due to its characteristics as a strategic resource, it also captures the importance of individual knowledge and training. Human capital is defined as the investment an individual makes in his or her own education and training. It is considered similar to business investments in equipment, in that it is considered a rational choice made by an individual based on available information at the time in order to maximize future earnings and utility. In a seminal study, Becker examined the economic effects of investment in college and high school education. It is also useful to determine the relationship between on-the-job experience,

age, and earnings (Becker, 1993). In addition to returns for the individual, higher aggregated levels of human capital have been shown to positively impact economic development and growth (Romer, 1990b).

Previous studies that have related the impact of knowledge on the survival and performance of new firms have primarily examined the effects of initial human capital endowments of the founders. Studies have found that higher levels of human capital is a robust predictor of propensity for entering into entrepreneurship (Shane, 2000). At the same time, other researchers have found indications that venture capital investors overattribute the effect of human capital on firm performance in biotechnology (Baum et al., 2004). Human capital can be divided into general human capital – which is a measure of general level of academic knowledge – and scientific human capital – which is related to the firm or industry in knowledge-intensive fields. The effects general human capital is generally assumed to have a positive effect of both new firm survival and performance (Cooper et al., 1994) with research on specific human capital so far returning indicative but inconclusive results; some empirical studies indicating a positive effect with higher levels of firm- or industry-specific human capital clearly improving survival and performance for firm in knowledge-intensive industries (Hatch et al., 2004; Wennberg, 2009) and others finding support for a positive impact of general human capital on firm performance but none for specific human capital (Dimov & Shepherd, 2005). For the purposes of absorptive capacity model development, it is specifically the scientific human capital that can be assumed to enable the identification, assimilation and commercial exploitation of technological knowledge for the benefits of the entrepreneurial firm. As a point of definition, scientific human capital does not limit the individual-level absorptive capacity to technology-specific knowledge, but can also be assumed to apply to industry specific knowledge that is related to institutional issues such as regulation, marketing norms, and current affairs (Chatterji, 2008).

One limitation of human capital in entrepreneurship studies is mainly that although the existence and need for multi-level research designs is approved in entrepreneurship, when trying to understand new firm

performance there is a demand for an evolutionary perspective as well as utilizing firm-level theories, i.e. explaining outcomes that can be assessed by management and manipulated by the firm as an entity (Barnett & Burgelman, 1996a; Denrell, 2003; Dyer & Singh, 1998). Additional limitations to the application of human capital in the study of entrepreneurial firms is that it is often limited to the individual founder or entrepreneur, and used in a static way; that is, only measured at time of startup (Cooper et al., 1994; Gimeno, Folta, Cooper, & Woo, 1997).

When defining scientific human capital it is important to note that it is in this study connoted as specific of industrial and technological context, but not specific of the individual firm. Scientific human capital has previously been described as the sum of scientific, technological, and social knowledge, skill and resources with a particular individual (Bozeman, Dietz, & Gaughan, 2001). Normally both formal education and training, as well as social network and relations are included, although previously theory on human capital has developed separately from social capital (Bozeman & Corley, 2004). This specific human capital is a necessary prerequisite for vicarious organizational learning, meaning that the firm learns primarily from observing other firms operating in the same industry or in a similar phase, rather than learning primarily from own experience. As the experience accumulated in the industry offers more varied and aggregated knowledge, this can be a source of opportunities for the firm as this experience is not tied to the specific history, constraints, and path-dependence of any one organization, especially if the firm is new and does not have an internal stock of knowledge that can serve as the basis for organizational learning (Denrell, 2003; Ingram & Baum, 1997). The way scientific human capital is defined here is closely related to that of intellectual human capital; commonly defined as being tacit and characterized by natural excludability due to the complexity and specificity of the knowledge and its application. It has been argued that innovation should be viewed and analyzed as the preceeding excludable intellectual capital and requisite know-how that is retained in a small group of inventors or a tightly knit organizational team (Zucker, Darby, & Brewer,

1998). Table 9. provides illustrative examples of previous applications of scientific and technological human capital.

Table 9. Applications of Science and Technological (S&T) Human Capital

	Context and sample	Operationalization	Outcome
Colombo & Grilli, 2005	506 Italian manufacturing and service firms 1980-2004	(a) Years of technology and science education, (b) years of technology industry experience, (c) years of technical work experience	Firm growth measured as size
Corolleur, Carrere & Mangematin, 2004	132 founders in 62 French biotech SME:s 2001	(a) level of education (b) previous scientific work experience	Involvement in new firm creation
Allen, Link & Rosenbaum, 2007	1,335 US researchers at 150 universities	(a) faculty tenure (b) age	Patenting
Toole & Czarnitzki, 2009	213 academic entrepreneurs in the US SBIR program 1983-1986	(a) research productivity (b) academic funding success rate	Patenting

Using scientific human capital as individual-level absorptive capacity comes with a number of novel assumptions and applications: First, human capital is here assumed to have a dynamic quality, that is to say – the level and composition of human capital is not only important at the time of startup, but is expected to impact firm survival and performance over time. Due to the organizational learning aspect of absorptive capacity, the human capital is also expected to evolve over time. Also, here the human capital of all individual members of the firm is important. Even if some firms are started or initiated by individual entrepreneurs, it is common that firms are started by teams where a single entrepreneur can not be distinguished (Hellerstedt, Aldrich, & Wiklund, 2007). In a small new firm all individuals can be considered crucial, and as the new firm evolves and grows, it can additionally be assumed that the human capital configuration will evolve and the influence of individual members of the firm will diminish as new people are recruited. Finally, in order to be valuable and potentially strategic, an asset has to be non-substitutable and not readily available (Barney, 1991). Thus human capital can potentially be divided into specific and general, where specific human capital is relevant for the capacity of

improving survival and performance of the firm due to characteristics relating to the nature of the actual knowledge and experience, and where general human capital is imitable and available and therefore can not be assumed to confer a relative advantage or value for the firm. This reasoning leads us to formulate the following hypotheses:

> *Hypothesis 1. A relatively higher level of scientific human capital in the firm will lower the probability of new firm termination.*

Additionally, to enhance the results for firm survival, models for acquisitions will be tested as this is a form of firm exit that can be viewed positively for the entrepreneur and employees. Indeed, selling equity in the firm to another firm or external investors is seen by some as the primary motivation for rent-seeking entrepreneurs (Gompers & Lerner, 2002; Kaplan, Sensoy, & Strömberg, 2005). This is the basis for our second hypothesis:

> *Hypothesis 2. A relatively higher level of scientific human capital in the firm will have a positive impact on the probability of firm being acquired.*

According to the reasoning above, relevant human capital as a measure of absorptive capacity should improve the firm's capacity to exploit technological knowledge, thus our final proposition:

> *Hypothesis 3. A relatively higher level of scientific human capital in the firm will have a positive impact on new firm performance.*

Having developed a concept and hypotheses for individual-level absorptive capacity, I now proceed to develop a corresponding construct for organizational-level absorptive capacity.

4.1.2 Organizational-level ACAP: Organizational Tenure

On the other hand, absorptive capacity has been argued to be contingent of the firm's routines and processes (Dyer et al., 1998; Lane et al., 2001). The

current argument is that consistent ability of a firm of correct timing and learning creates performance differences even among firms with similar capacity endowments, building on the argument that processes are an organizational-level construct that is critical for opportunity exploitation (March, 1991; Zott, 2003). Here another challenge for new firms arise; very few ventures with a handful of employees and only a few years in existence can be credibly argued to have developed routines and processes in the sense they are referred to in previous research on larger and more mature organizations.

Routines and processes have become a central concept in the analysis of the processes of economic development and change in both individual organizations and economic systems as a whole (Nelson & Winter, 1982a). Despite the attention given to routines by scholars in the last 20 years, ambiguities and lack of consistent definitions still pervade the academic literature on the subject. On a general level, routines are processes that are defined by the following characteristics; (1) as routines are conceived as organizational regularities, they have been defined as *patterns* of organizational (a) activity, (b) action, (c) behavior, and (d) interaction. An important distinction to make with regards to the notion of regularities is the difference between cognitive regularities and patterns of consistent behavior in the firm, which are often confounded with great confusion as outcome (Cohen et al., 1996). (2) Another key characteristic of organizational routines is that of *recurrence*; if it refers to a singular pattern of behavior that is not expected to repeat itself, a defining characteristic of routines is absent. (3) As routines are *collective* in nature, it follows that they involve multiple actors or individuals. (4) Routines can be *triggered* by external cues or by actors involved in the routine, and as an evolutionary concept, routines are *path-dependent* by nature; they evolve from the feedback loop of action, but is constrained and determined by previous actions and outcomes. There is an ongoing academic discussion as to whether routines are followed tacitly, without the conscious effort of those actors involved, or if they are effortful accomplishments. Moreover, routines have a number of effects on organizations, primarily (1) the implicit or explicit coordination and control organization, more efficient

than formal contracts some argue (Langlois & Robertson, 1995). (2) Routines serve to reduce uncertainty, as they reduce the number of potential outcomes, (3) provide *stability* which is a necessary prerequisite for organizational learning, and (4) serve as a repository of both tacit and explicit knowledge (Becker, 2004).

In spite of being an interesting and relevant construct, routines have been plagued by measurement issues, which become even more pronounced in new firms. Routines are often approximated through the measurement of the size of related activities or departments such as research and development inputs and outputs, or joint-ventures (Cohen et al., 1990; Lane et al., 2001). For new firms this may pose some serious issues as the formalization of organizational roles and routines is generally assumed to occur in the post-startup phase, either when organizational stability occurs with regards to business model and work division, or because it is necessitated by firm growth, as the division of labor needs to be formally structured for managerial control, due to pressures from multiple external or internal stakeholders, or simply because the founding entrepreneur or entrepreneurial team simply cannot manage all the necessary roles and functions (Crossan, Lane, & White, 1999; Sölvell, 2008).

As new and micro firms in general lack the formalized organizations and structures necessary to approximate routines and processes the traditional way, we instead turn to the psychological literature on team socialization for guidance; here it is suggested that many of the characteristics that define routines, e.g. patterns of collective outcomes and consistent behaviors, arise within groups of individuals due to socialization processes (Feldman, 1976). The type and strength of these processes can often be derived by the absolute and relative shared experience that individual members of a group or organization share; defined as organizational tenure. Organizational tenure should deliver many of the same effects that are given by organizational routines, as teams with more aggregated organizational tenure have a higher tendency for coordinated action in pursuit of common goals, an effect that is especially pronounced in knowledge-intensive contexts and believed to be the function of increased intra-group working

relationships and communication (Reagans & Zuckerman, 2001; Sorensen, 1999). Other studies have found team age to positively impact the performance of firms, the argument being that the aggregated organizational tenure of individuals creates and strengthen organizational culture and the ability of individuals to interact in a strategic fashion beneficial for the firm (Carroll & Harrison, 1998; Pennings & Wezel, 2007).

There is also empirical support for the idea that lack of organizational tenure may impact firm performance negatively, investigations in the semiconductor industry has found support for the idea that companies with a high personnel turnover underperform the firms that have a lower rate of turnover, indicating that individuals with similar levels of human capital are not substitutable in an efficient market, and that firm-specific collective work experience manifested by organizational tenure has a strategic value to the firm (Barney, 1986; Hatch et al., 2004). This is in line with the reasoning of the firm as an entity for the coordination, application, and exploitation of knowledge, and could additionally be argued to be tacit in a way that makes it very hard to imitate and thereby a source of competitive advantage and firm performance (Grant, 1996; Kogut et al., 1996). Additional theory suggests that organizational tenure should have a relatively stronger positive effect on firm performance outcomes early in the life of a firm, and also that the positive effects should be stronger at relatively low levels of aggregated organizational tenure in the firm (Sturman, 2003). In conclusion, organizational tenure seems to display many of the defining characteristics of organizational routines, albeit in an informal manner, and seems to be a construct more suitable than routines for researching new and micro firms.Table 10. contains some illustrative examples of how organizational tenure has been operationalized and applied in empirical research.

Table 10. Applications of Organizational Tenure

	Context and sample	Operationalization	Outcome
Chatman, 1991	171 entry-level auditors in US accounting firms	(a) Social interaction with firm members during first year of employment, (b) interaction with mentor during first year of employment (c) formal training during first year of employment	Person-organization fit measured as: (a) job satisfaction (b) intent to leave organization
Finkelstein & Hambrick, 1990	100 US firms in the computer, chemical, and natural gas distribution industries 1987-1982	Top management team mean number of years of employment	(a) Strategic persistence, (b) strategic conformity, (c) performance conformity
Pennings & Wezel, 2009(forthc.)	676 Dutch accounting firms 1880-1986	(a) firm tenure of team members (b) local tenure	Team heterogeneity
Sørensen, 1999	All commercial TV stations in 15 US regional markets 1961-1988	Top management team tenure distributions	Growth rate measured as market penetration

Based on this summary, in this research I assume that the organizational tenure of the group of individuals working in the new firm is a firm-level construct that will have a positive impact on new firm survival and performance. Even though it could be argued that organizational tenure is in itself a form of human capital, it is a form of intellectual capital that is inherent of the firm and will evolve and change over time as members leave and enter the organization, thus mirroring the dynamic aspect of individual level absorptive capacity. Similar to the hypothesis based on individual-level absorptive capacity, we would expect this organizational-level absorptive capacity to have similar effects, and thus I formulate the following hypotheses:

> *Hypothesis 4. A relatively higher level of organizational tenure within the firm will lower the probability of new firm termination.*

Hypothesis 5. A relatively higher level of organizational tenure within the firm will have a positive impact on the probability of firm being acquired.

Hypothesis 6. A relatively higher level of organizational tenure within the firm will have a positive impact on new firm performance.

In summary, I have developed two measurable components of the absorptive capacity construct that are useful and relevant for investigating absorptive capacity effects in new and small firms. When taken together in a comprehensive model of new firm survival and performance, it integrates the resource-based view (scientific human capital component) with the dynamic capabilities view (organizational tenure component) in an evolutionary fashion (as both indicators are measured over time and not just at time of startup). This is the foundation of the model. Also, in addition to the individual-level and organizational-level absorptive capacity measured as scientific human capital and organizational tenure respectively, we could also expect to see an interaction effect from the two, thus our final hypothesis:

Hypothesis 7. There will be a significant interaction effect of individual-level absorptive capacity and organizational-level absorptive capacity.

That is, we would expect an interaction effect from individual-level and organizational-level absorptive capacity in addition to the separate effects of the components proposed in the previous hypotheses.

4.2 Model Specification

In this section, I develop the a functional model specification for the quantitative study, by discussing and adding dependent and independent variables, interaction effects, fixed and random effects, and control

variables. Considering that the normal case in applied social science research is that the investigator does not have full knowledge about the functional form of the model that is to be estimated it can be helpful to follow a set of principles to exclude those functional forms that do not follow these principles. After estimation a number of econometric and statistical tests can be undertaken to optimize the estimation for the sample included in the study (Kuenzle, 2005). In its simplest form, we are measuring the effect that individual-level absorptive capacity *(X)* and organizational-level absorptive capacity *(Z)* has on a firm-level outcome *(Y)*, which can be either new firm survival or some other aspect of new firm performance. For all purposes, our basic model can be stated in the following way;

$$Y = b_1 X + b_2 Z + u \qquad (4.1)$$

where (*b)* is the linear effect of each of the predictor variables on our investigated outcome and where *(u)* connotes the error term or disturbance. In the social sciences it is held for a statistical fact that regardless of how many explanatory variables that is included in a model, there will always exist factors that we cannot observe or include in the model but that will also have a significant effect on the dependent variable. In the model specification therefore, these are collectively included and termed *(u)* which stands for unobservable variables (Wooldridge, 2003).

A common statistical problem especially for the social sciences is that of structuring and interpreting models that incorporate interaction effects. Moderated multiple regression (MMR) differs from linear multiple regression in that it assumes more than an additive linear relationship between independent and dependent variables. Here, the moderating impact of industry membership (manufacturing or service) could be modeled as an additional categorical interaction variable, thus transforming the model specification to a moderated multiple regression (MMR). Moderated multiple regressions using categorical interaction or moderator variables have become an increasingly popular approach in the social sciences in recent years. However, there are also a number of issues to specifically

using categorical moderator variables. First, it is important to distinguish mediating effects from moderating effects; where mediating effects explain why or by what mechanism the dependent and independent variables are related, whereas moderating effects explain when and under what conditions dependent variables exhibit a causal relationship with independent variables (Frone, 1999). In this research, we are clearly interested in assessing the moderating effects of industry membership of new firms; whether they are manufacturing or service firms moderates the effect of absorptive capacity on their performance in any way. As I wish to measure the effects of absorptive capacity *(X)* and the moderating effect of industry membership *(Z)* on the survival or performance of the new firm. But my intention is not only to measure whether *(X)* and *(Z)* have linear and additive effects, but also to test the hypothesis that organizational-level absorptive capacity has a moderating effect on absorptive capacity.. In our previous formulation we are not measuring this effect, which implies that there should be a term for the interaction effect between *(X)* and *(Z)* to be included in the model specification (Aiken & West, 1991). Here the we assume and seek to test hypotheses based on the assumptions that the three predictor variables in the model have separate effects, but it is important to note that the model also fulfills the requirement of containing all constitutive terms of the interaction effect which is a requirement stated in recent literature on interaction models (Brambor, Clark, & Golder, 2006). This gives us the following model specification:

$$Y = b_1 X + b_2 Z + b_3 XZ + u \qquad (4.2)$$

Central to the notion of establishing causal relationships in empirical social science is the notion of *ceteribus paribus*; it is not enough to establish a relationship between our independent variables and dependent variables, we additionally need to ensure that we are holding all other relevant factors fixed thus isolating the relationship under examination and keeping all other conditions equal while we conduct our analysis. Any estimation (E) thus can be formulated as E*(y|x,c)*, where the expected value of dependent variable *(y)* is contingent both of the value of our independent variable *(x)* as well as the value of other relevant (control) variables *(c)* that we would

like to hold fixed to establish the magnitude of effect of *(x)* on the value of *(y)* (Wooldridge, 2002). This is especially important in estimations where we know from theory and previous research of numerous other influences on our outcomes, as in the case of new firm performance. We thus need to update any model specification to allow for this aspect:

$$Y = b_1 X + b_2 Z + b_3 XZ + c + u \qquad (4.3)$$

When specifying the functional form of the model we run two simultaneous and assymetrical risks: underspecifying the model means that we omit relevant variables from the model, whereas overspecifying or overfitting the model involves including irrelevant variables in the same model. It is a relatively smaller issue to overspecify the model; i.e. including unnecessary variables as these to not bias the least-squares estimators. However, this does not mean that overspecifying the model is harmless, as inclusion of the irrelevant variables may have unwanted impact on the variances of the least-squares estimators (Wooldridge, 2003). In addition, we have the two risks of endogeneity of one or more of the dependent variables, meaning that it is correlated with the error term *(u)*, and measurement error implying that the actual causal relationship includes variables that are unobservable to the researcher and essentially meaning that one or more of the independent variables does not measure what they are meant to measure (Baum, 2006). These final issues can be met through careful and rigorous development of variables.

In summary, in this chapter I have developed two components of absorptive capacity; individual-level scientific human capital and firm-level organizational tenure that together are suggested to account for the resource and capability aspects that define absorptive capacity. I have developed testable hypotheses regarding several measurable aspects of new firm survival and performance, including the probability of acquisition, as well as introduced the concept and moderating variable of industry membership; that is, if the new firm is active within a service or a manufacturing industry. In the next chapter, I introduce the data as well as elaborate on the model and research design.

5 Method and Data

The goal is to transform data into information, and information into insight.

Carly Fiorina

This chapter details the unit of analysis and research design and how the design relates to the goals of the study. I update the model specification to fit the data and methods used.

5.1 Research Design

Causal modeling in the social sciences is always a complex undertaking as the quantitative data available is by nature limited and may be lacking in validity, i.e. may not contain what we actually want to measure. As has been noted, while in the natural sciences one in general can assume that the influential variables and causal relationships are both observable and measurable, in the social sciences these indicators and mechanisms may never be fully known, available, or measurable. There is an increasing tendency among the social sciences to emulate the natural sciences with regards to methods but as Nobel laureate Friedrich Hayek has pointed out also emulating the same strict assumptions about observability and measurability will generate not so much actual knowledge as the pretence of actual knowledge (Hayek, 1974). The fallacy of naively equating economics and management science with the natural sciences is echoed by fellow Nobel laureate Herbert Simon who pointed out that most of the constructs which we measure are mental models designed by man, indicating that all social sciences are sciences of the artificial rather than a sciences of the natural (Simon, 1999). In conclusion, the reader is well served to keep in mind that the quantitative models presented here are my elaborate approximations of reality but not necessarily the definitive representation of it.

Also, it is important to realize the impact of time as a variable on modeling causality. Considering that a majority of models in research on firm performance and entrepreneurship imply causality, it is somewhat discouraging that they actually measure causality only to a lesser degree. To the extent that a model suggests causality between a predictor and outcome variable, if the data is cross-sectional the only thing measured is in fact co-variation between the two variables. One could argue that careful variable development grounded in theory and previous research is one remedy for this, and in fact it is the only argument underpinning the validity of a large portion of empirical research. The weakness in this argument is that the investigator then never actually tests the hypotheses but rather reinforces the presuppositions of previous research, which might be lacking in methodological rigor in turn. One indication of this is the fact that there is an academic tendency to ascribe strong firm performance to some characteristic or process related to one's own academic discipline while discarding alternative solutions (Rosenzweig, 2007). The research may contain the most rigorous regressions and the most advanced variables, here it is argued that the only way to test hypotheses and produce robust new knowledge on firm performance is to test the effect of independent variables over time; that is a longitudinal research design.

5.1.1 Longitudinal Design

A longitudinal research design is in line with research that has called for an evolutionary perspective on firm performance and evolution, pointing to the fact that many assume that empirical patterns will correspond to theory at any given time and conducting cross-sectional analysis at a single point in time, whereas when adopting an evolutionary perspective and tracking performance over time, one acknowledges the fact that the outcomes may fall within a range of states that are not predicted by a stationary model (Barnett et al., 1996a). A final and not insignificant effect of using a longitudinal research design on a sample that includes both surviving and exiting firms has the benefit of minimizing survival bias – measuring and drawing conclusions on only the surviving firms – that is a serious problem in much of existing research on firm performance and survival (Denrell, 2005; Rosenzweig, 2007).

5.1.2 Unit of Analysis

The unit of analysis in this study is the economic entity of the incorporated firm. The common definition of entrepreneurship also utilized in this dissertation is that of new firm creation, making it the natural choice (Thornton, 1999). Additionally, the firm is the most interesting unit of analysis from an economic investment perspective; however a large portion of entrepreneurship research has made no or little distinction between the entrepreneurial firm and the individual entrepreneur. As previously mentioned in this text, many firms are started by teams (Hellerstedt et al., 2007) and since knowledge-intensive firms in most cases are dependent on the input of all employees, it can be argued that the performance of the firm is contingent on a larger number of factors than the motivation, idea, and capability of the individual entrepreneur. The motivation and capabilities of the individual entrepreneur is often measured at the time of startup, which fails to capture dynamics of variables over time. The variables measured in this study is thus individual and organizational characteristics, but operationalized as firm characteristics.

5.2 Population and Sample

The data consists of a longitudinal matched employer-employee dataset assembled specifically for the research of the economic role of knowledge-intensive firms in Sweden (Delmar et al., 2005; Wennberg et al., 2009). The dataset contains all new incorporated firms in Sweden in this sector between 1995 and 2002. To reduce sources of heterogeneity, other legal forms are excluded. A firm is considered active and new when it has at least one employee and has not existed in the selected industries the previous year. The panel has been assembled and matched to firm financial data from the Swedish Tax Authority by the government agency Statistics Sweden. The dataset was created by combining data from various registers: Statistics Sweden has developed a number of longitudinal databases that enables the tracking of both individuals and firms between 1990 and 2002. Although the data would hypothetically allow for a longer period of study 1995 was chosen as start year primarily out of institutional and data issues;

(a) new rules for incorporating firms were introduced in 1995 – among other things the minimum equity requirement was raised from SEK 50,000 to SEK 100,000 reducing the validity of comparing firms incorporated before and after 1995, and (b) new accounting rules were introduced, leading to the fact that (c) the firm-level data that was available through Statistics Sweden was more complete after 1995. Tracking individuals is based on the individual person's identification number (the Swedish equivalent to the social security number), which remains unchanged during the life of an individual. The database LOUISE is an example of an individual register with a focus on education, income and labor. The life of each firm in the dataset used is partitioned into life-years, which is the standard approach in longitudinal social sciences (Tuma & Hannan, 1984).

The full population of firms was created through identifying relevant firms and individuals from the RAMS database at Statistics Sweden (SCB). RAMS contains information about individuals, firms and workplaces; individuals are considered employees of a firm if they got the majority of their economic income from that firm in any given year. All companies with registered employees in Sweden have income statements that are provided to the Tax Authority included in RAMS. There are a number of data issues to keep in mind when dealing with this data. First, the data is unstable in that some changes are dealt with in a naïve way; for instance a change in firm registration number is viewed as a new firm (Delmar et al., 2005). Additionally, an individual could be active in a number of firms, and the data does not capture other contractual relationships such as board memberships or consulting agreements. Finally, the firms are classified by industry codes (International Standard Industrial Codes: ISIC). It is important to remember that these codes are self-reported, and a firm can report any number of codes. For the purposes of its' databases, Statistics Sweden reports the firm under the industry code that is deemed to be the primary industry code, which in some cases means that the assignment is stochastic.

In addition patent data were added from the OECD Triadic Patent dataset which contains data on all patents granted in the three major (triadic)

jurisdictions: EU, US, and Japan, and thus can be assumed to cover all significant technological innovations and has been used in a number of studies (Dernis & Khan, 2004; Harhoff & Hoisl, 2004). The reason why Swedish national data from the Swedish Patent and Registration Office was not used was because they did not have their records in electronic format(!). The initial ambition was to use the OECD patent data on the firm level as a metric of knowledge-based resources created as a product of realized absorptive capacity. This ambition was later abandoned however; Statistics Sweden was tasked with the matching of patent data to the firm data. Out of 12,903 rows in the Applicant File (OECD Patent Data), organization numbers were determined for 7,390 rows. These 7,390 rows were subsequently identified as 1,544 unique Swedish firms holding a triadic patent in the period 1989-2002. These 1,544 firms were then matched against the dataset, but it was discovered that only 636 (41%) firms in the SCB data matched the 1,544 firms that were derived from the OECD patent data. Thus, 908 firms (59 %) that have patents and therefore might be characterized as knowledge-intensive are not included in our dataset that is defined as such based on standard industry codes. This result implies that selecting knowledge-intensive firms merely on the basis of industry codes might be insufficient, and that an alternative selection criteria for future research could be to select and categorize firms with patents as knowledge-intensive and high-technology firms and then assess their industry codes, rather than vice versa.

As the focus of this dissertation is independent new ventures, only *de novo* firms incorporated between 1995 and 2002 were selected and spin-offs and firms that entered into the sample but were previously active in other industries were excluded as a measure to try to reduce potential dependent new ventures in the sample. Additionally, in order to ensure the focus on independent new micro firms, the maximum size at startup was set at <10 people and larger startups were excluded, but of course these firms could grow beyond 10 employees during the period of study.

5.3 Statistical Methods and Issues

This section provides a description of the statistical methods used in this study together with a brief overview of the characteristics of longitudinal data studies. It also discusses some panel data issues.

5.3.1 Multiple Linear Regression Analysis

Multiple linear regression is used to study the linear relationship between independent and dependent variables and differs from bivariate regression in that the regression can include any number of independent variables. For the purposes of our study the multiple regression model can be written as follows:

$$Y = b_0 + b_1 X + b_2 Z + b_3 XZ + c + u \qquad (5.1)$$

Where (b_0) is the intercept, or constant, meaning the expected value of the dependent variable in the case that all the independent variables included in the model equal zero. It is to be expected that new firms survive or display positive firm performance even if our chosen predictors are zero.

5.3.2 Panel Data

As we are dealing with panel data our analysis by necessity becomes a time-series analysis. What differentiates time-series data from cross-sectional data where all observations are assumed to be active and observed in the same time-period is that it is temporally ordered. This means that we can model the effect of a predictor variable on an outcome over time, which addresses the issues of reversed causality and selection bias previously mentioned. It also means that our dependent and independent variables are measured by individual observation *(i)* and time *(t)*; in this case the value of each variable is observed for each firm every year. Similarly the control variables are included and measured per firm and year, whereas the individual effects are assumed to be measured only by individual observation: We thus update our model specification accordingly:

$$Y_{it} = b_0 + b_1 X_{it} + b_2 Z_{it} + b_3 XZ_{it} + c_{it} + u_{it} \qquad (5.2)$$

Where *(N)* is the number of individual firms and *(T)* is the number of periods of observation, in this case years, and $i = 1,\ldots, N$ and $t = 1,\ldots,T$.. There is another more complex issue that differentiates time-series data from cross-sectional data, which relates to the stochastic process. A theoretical consideration for panel data is that observations can rarely be assumed to be independent across time. It is a generally held phenomenon that economic time series are often related to their recent histories – so called momentum effects – a fact that has to be remembered in modeling and analysis of panel data (Wooldridge, 2003).

5.3.3 Censoring and Selection Bias

In econometric analysis it can be difficult to know when a failure occurs for each individual observation in the dataset. Right censoring is defined as when an event, e.g. failure of a firm, occurs in a firm that has survived beyond the period of study. In effect, the event is of interest for our study but the data does not provide us with the observation. Similarly, an event, e.g. new firm creation, can occur at some unknown time before the period of study, which then creates a similar related problem; left-censoring. In general, right censoring is considered a more common problem in social science as it is normally easier to control for right-censoring in data (Cleves, Gould, & Gutierrez, 2002). The data in this study is right-censored to a degree; the study tracks all new incorporated firms that are started in the period 1995-2002 and a portion of these firms survive and continue beyond the period of study. This introduces the risk of selection or survivor bias in our model estimation.

In firm performance studies, the firms available for observation at any given time will usually be the survivors of a larger population of firms that entered the industry at a previous point in time. This phenomenon of selection or survival bias has been found to be especially strong in industries after periods of shakeouts (Denrell, 2003; Gort et al., 1982). The concept can be generally applied to new firms as the majority of new firms that are started do not survive longer than 5 years (Mata & Portugal, 1994). This is a serious bias that can cause severely flawed analyses as illustrated

by the scenario where a number of firms that have similar combinations of a number of variables will either survive due to achieved performance thresholds and remain in the population, or fail and exit the population. After a period of time, if one samples the population and investigates causes of survival, one might be tempted to infer that the bundle of variables is conducive of performance when in fact both surviving and failed firms had the same setup. When analyzing firm performance the effects of selection or survivor bias become enhanced; consider a number of firms with resource and capability setup (a) that achieve either very strong or very weak performance resulting in firm failure, and a number of firms with resource and capability setup (b) that achieves medium performance. After a period of time when firms are sampled, the low-performing firms with setup (a) will have left the population, leaving only very successful firms with setup (a) and medium performing firms with setup (b) in the sample. It then becomes very easy for the investigator to assume that setup (a) is a recipe for success, when in fact it might be a more risky configuration and on average produces lower payoffs than setup (b). It is easy to see what negative effects selection or survivor bias can have on model estimation in firm performance research in general and entrepreneurship research in particular. There is only one generic strategy to counteract the detrimental effects of selection or survivor bias on new firm survival and performance that is used in this study; to conduct longitudinal population studies meaning that one follows all new entries over a period of time and includes both survivors and exits in the sample.

One problem that follows with studying determinants of the performance of new firms is that only those firms that survive are measured, and many new firms do not survive or exit the population for other reasons. Statistically speaking, the coefficients on variables that have a significant effect on both survival and other performance measures will be biased downward in regressions predicting those other performance measures than survival if only surviving firms are included in the sample and researchers do not correct for the selection bias. Sample selection bias can often arise from self-selection, or as in more likely in this case, that the firms that fail are more likely to have lower values in the predictor variables. To correct for

this problem, a selection correction variable was created using the Heckman selection model and using the hazard of exit during the 7 years of observation calculated from a Cox regression model to predict firm exit for the firms that have more than one spell to generate the selection correction variable lambda (λ) (Heckman, 1979). This variable was introduced into the models to obtain more precise estimates for the independent variables.

5.3.4 Multicollinearity

Multicollinearity means when the predictor and outcome variables are correlated to each other. If a variable is added to a linear regression that has a high correlation with the other variables a number of problems arise; the standard errors increase substantially, the coefficient magnitudes may shift, and coefficients may become insignificant even if the coefficient of determination *(R^2)* is high. It is often proposed that investigators mitigate the issue of multicollinearity through centering their data. Centering a variable is done through subtracting the mean from all variable values, thus creating a new variable that has lower correlation with its own squared values thus reducing multicollinearity in modelling, centering a variable is normally done with the following formula: [*variable–variable(mean)=variable(centered)*] (Hamilton, 2006). This strategy has been disputed as it is unclear whether it actually confers any increased value to the analysis whatsoever (Kam & Franzese, 2003). Intuitively multicollinearity could pose a problem in our model specification as the interaction effect by definition is correlated with the two independent variables of which it is the product. However, in multiplicative interaction model specifications, scholars have argued that the problem of multicollinearity is overstated (Aguinis, 2004). As opposed to linear additive model specifications, in interaction models the coefficients do not represent the average effect of their respective variables. This means that these coefficients will change with the introduction of an interaction term but this is to be expected and not interpreted as multicollinearity. It has been proposed that the benefits of including all constitutive terms outweigh any analytical drawbacks of multicollinearity, as the primary goal of interaction models is unrelated to the significance of specific model parameters (Brambor et al., 2006). In summary, in this study issues of

multicollinearity are assumed to be of little concern for the estimation and analysis.

5.3.5 Fixed and Random Effects

Panel data models propose another dimension that we need to include in our estimation; that of the nature of the unobserved effects *(u)*. The *(u)* variables in a model can be divided into individual observation effects (ε_{it}) and the general error or disturbance term *(u)*, and including the selection correction variable lambda (λ) our model estimation is modified and updated accordingly:

$$Y_{it} = b_0 + b_1 X_{it} + b_2 Z_{it} + b_3 XZ_{it} + c_{it} + \varepsilon_i + \lambda + u \quad (5.3.)$$

In this regression equation, the individual level effect (ε_{it}) can be either correlated or non-correlated with the dependent variables in the equation. In the case that it is uncorrelated with the dependent variables in the model, they are referred to as random effects (RE), because they are then considered to be additional random disturbances to the model. This is referred to as the strict exogeneity assumption. However, in time-series econometrics the fixed-effects approach is the dominant method for dealing with unobserved heterogeneity; unobserved firm level differences which might bias the duration dependence and potentially inflate the covariates' coefficients. If the unobserved effects are uncorrelated with the regressors they are classified as random effects, but if there is any assumed correlation between the unobserved effects and the independent or dependent variables they are classified as fixed effects. From a methodological point-of-view, this strict exogeneity assumption that is a prerequisite to use random-effects modeling rarely holds in models where the unobserved effect and explanatory variable are correlated, limiting the choice to a fixed-effects specification (FE), which seems to be the valid estimation approach for this study when possible (Wooldridge, 2002). Additionally, when estimating models, it is possible to fit models using both fixed and random effects specification and then conduct a Hausman test to examine the null hypothesis that the additional conditions required for the random-effects specification is valid. If the independent variables are correlated with the

individual-level effects, the fixed-effects specification is consistent but the random-effects specification is not. If the independent variables are not correlated with the individual-level effects, the fixed-effects specification is consistent but not efficient and the random-effects specification is both consistent and efficient (Baum, 2006).

5.4 Dependent Variables

Developing dependent variable in strategy research is reasonably straightforward for the investigator. The overarching goal for any organization is assumed to be sustainable profitable growth, which is commonly and satisfactorily measured through profitability or financial metrics such as return-on-assets, normally abbreviated to ROA (Barney, 1991; Porter, 1979). Dependent variable development in entrepreneurship research is unfortunately somewhat more complicated. Researching firm performance and researching new firm performance seems like two sides of the same coin, but there are a two major issues; theoretical and practical.

From the theoretical perspective, it should be noted that the assumption of sustainable profitable growth is undermined by recent empirical research on new firms. First of all, the majority of firms are terminated within a five-year period, making firm survival the more probable overarching goal of any new firm (Brüderl, Preisendörfer, & Ziegler, 1992; Delmar et al., 2004; Delmar et al., 2005). A large portion of firms are created for lifestyle reasons rather than economic opportunity (Aldrich, 1999). The purpose of this research is to explore the causal relationship between ACAP and new firm performance. When measuring firm performance in general, one can look at financial and non-financial measures. However, when looking at small and especially new firms, financial statements are often less reliable as performance measures. The reason is that many new firms have irregular turnover and profits. Moreover, many venture-capital backed firms make important initial investments with raised capital and do not show positive financial performance for a number of years (DeCarolis et al., 1999). In addition, the relationship between growth and performance is spurious, and

is not made clearer or easier by the discovery that not all entrepreneurs want to grow and some actively avoid measures that would stimulate growth (Davidsson et al., 2005b; Wiklund et al., 2003a). From a practical perspective, this means that we need to analyze survival and performance separately and concurrently. This dual approach additionally allows us to get an overview of the causal relationship between survival and performance, i.e. are there predictors of performance cannot be assumed to consistent if they do not also confer higher chances of survival. This risk-reward relationship has previously not been assessed in entrepreneurship research.

In order to get a balanced picture of new firm performance, a number of performance variables were developed in this chapter to mirror the multi-dimensional aspects of firm performance. When it comes to measuring the performance of new firms, one of the most commonly used metrics is growth. Recent empirical research relating to using growth as the primary performance indicator has some of the issues focusing on methodology; there is a multitude of indicators being used: e.g. sales, employees, market share, or a mix of the aforementioned. This can and has become an issue both because most empirical papers do not explicitly state which kind of performance metric they base or compare their assumptions and results with, and also because there is a fundamental issue relating to how growth is measured. Measuring growth in absolute or proportional terms may cause significant bias in results; for example, if a new firm increases sales with SEK 1,000,000 per year, in absolute terms growth is constant but in marginal terms growth decreases every year – conversely a firm that increases sales by 20% per year need to grow sales in absolute numbers exponentially. This is important both relating to how a growth metric is designed, but also in how results are reported and compared to previous and other studies (Delmar, 2006).

5.4.1 New Firm Termination

When examining the effect of an independent variable on the performance of new firms, survival analysis is a popular model specification. Survival analysis is an event-count model focused on analyzing the time to the

occurrence of an event, in the case of this study the failure of a new firm. It is a more suitable method for analyzing the time to the occurrence of an event due to the assumption of normality that underlies regressions. It is intuitive that the assumed normal distribution of time to the occurrence of an event is not reasonable. Even if issues of right-censoring could be overcome with other estimation methods, in any event, the distribution of time to occurrence of death in these cases is not normally distributed, thus the regular least-squares methods of regressions are not the ideal methods for model estimation. Statistically, survival analysis is essentially about substituting the normality assumption in OLS by something more fitting for the analysis at hand (Cleves et al., 2002).

Semiparametric analysis is also parametric to the extent that one assumes that the residuals still follow a distribution. Non-parametric methods do not make any assumptions about the impact of covariates or the distribution of failures in survival analysis. When covariates are qualitative or non-existing, non-parametric methods are preferred for the measurement for the estimation of survival or comparisons between groups. The Cox model is a proportional hazards model that builds on the assumption that the baseline hazard is left unestimated – no assumption about the parametrization is given – and is for, in this case, new firms affected by the multiplicative effects of the covariates (Cox, 1972). Mathematically, it additionally differs from linear regression in that it has no intercept, the baseline hazard is included and unidentifiable from the data itself, and the model estimates only the additional hazard.

For this study, survival analysis based on Cox regression is deemed less appropriate for two reasons. First, the Cox specification assumes that if censoring occurs, it occurs randomly, which is unrelated to the reason of failure. This assumption does not necessarily hold up theoretically in our study, as we assess the likelihood that firms survive or fail dependent on their characteristics. The data from Statistics Sweden has a dummy variable for a firm exiting the sample. Exits arise when the firm does not have any economic activity a given year, and is coded for terminations, acquisitions/mergers, firm splits, or if the firm exits the sample to enter into

another industry. The dummy variable for termination is used here as the dependent variable to measure firm survival, i.e. we conduct a reversed analysis; we test if the independent variables will have a positive impact on firm terminations, in which case we can conclude that they have a negative impact on new firm survival and vice versa. We will thus choose a logistic regression for our model specification, but as mentioned previously we need the Cox regression for the creation of the Heckman selection variable.

5.4.2 New Firm Acquisition

Mergers and acquisitions is the second largest form of firm exit with 15.8% of the firms being acquired in the manufacturing sample and 15.4% of service firms being acquired. Exits by mergers and acquisitions are an interesting form of new firm performance metric that has not received extensive attention in entrepreneurship research. In order to include and test the hypotheses regarding the probability for acquisitions, first I had to test the assumption that merged and acquired firms are actually sold as a positive exit by the owner, and not as an alternative to termination due to bad performance. I did this through comparing the mean and median values of some performance indicators of the firms at time of acquisition with the remaining firm-year observation including all observations of firms that were not acquired as well as the firms that were acquired but not in the year of merger or acquisition. For the firms in the sample that were acquired during the period of study, means were significantly higher than the rest of the sample for number of employees [$t(17,660)= -32.65$, $p<.001$], employee growth [$t(17,660)= -8.03$, $p<.01$], and sales [$t(17,660)= -17.71$, $p<.01$] in the year of acquisition. The t-test of means is based on the assumptions that variables are normally distributed. Even though this assumption is not critical, it might serve us to conduct an additional comparison based on medians (Hamilton, 2006). Thus an additional nonparametric K-sample test was conducted on the equality of medians. The acquired manufacturing firms had significantly higher median values for number of employees [$\chi^2(1)= 1500$, $p<.001$], (b) employee growth [$\chi^2(1)= 37.72$, $p<.001$], and (c) sales growth [$\chi^2(1)= 26.31$, $p<.001$] in year of acquisition for acquired firms. As both tests indicated that acquired firms at time of acquisition outperform both firms that are not acquired as well as themselves at other

points in time on a number of performance metrics I thus proceeded with the assumption that firms are merged or acquired as a positive exit or liquidity event.

5.4.3 New Firm Performance: Sales Growth per Employee

Sales in general and sales growth in particular is an intuitive and often used measure of firm performance, and different types of business volume measures have been found to be among the most valid with which to measure new venture performance (Chandler & Hanks, 1993; Chandler, McKelvie, & Davidsson, 2009; Sarkar et al., 2001). The firms in the sample start with different sizes, are active in different industries and product-market spaces, and can therefore be assumed to display heterogeneous growth rates. In order to get a comparable measure of firm performance I developed an outcome variable that is defined as the sales growth per employee. The sales growth per employee can not be assumed to be normally distributed, but should be skewed with extreme outliers and to avoid having skewed results I followed the normal procedure and used a natural log transformation (Box & Cox, 1964).

5.4.4 New Firm Performance: Average Salaries Paid

Many of the firms in the sample are active in high-technology and software industries, where venture capital is a common way to finance new ventures and attracting investors can be seen as a positive performance measure (Gompers et al., 2002). The contents of the data does not enable us to examine the sources of financing in our firms as this is not recorded centrally – the existence and structure of equity financing is a contract between firm and investor. However we can assume that a firm financed either internally or with venture capital that perceives growth will increase the salaries and bonuses paid even though sales growth rates are unaffected. If the new firm performs well, this will show up as fixed and performance-related compensation will increase as a reward to the members of the firm, and additionally to retain and attract talented individuals. In line with this reasoning, our second performance variable is average salaries paid by the firm. A caveat for the labor economists breaking out in a sweat while reading this: in labor economics, average salaries is traditionally considered

to be a input rather than an outcome variable, meaning that salaries is a tool that firms use in order to attract the best employees and partners, and therefore should be considered a predictor rather than a result of new firm performance. But new ventures are assumed to operate under resource constraints thus prohibiting them from competing in the labor market in this neoclassical fashion unless as a result of positive performance, and salaries have been used as a dependent variable in research on firm performance (Gambardella & Giarratana, 2007). For variable consistency I applied a natural log transformation of this variable also.

5.5 Independent Variables

Central to our study, and also an area of contribution is the development of independent or predictor variables that capture the theoretical constructs developed and are useful and sufficient for predicting the survival and performance of new firms.

5.5.1 Scientific Human Capital

Previously I have connected individual-level absorptive capacity to scientific human capital, which is human capital that is of particular importance regarding the identification and exploitation of technological opportunities and knowledge. To capture this dimension of specific knowledge, established measures of absorptive capacity have been R&D-intensity operationalized either as the proportion of R&D-investment relative to the turnover of the firm, or as the proportion of R&D-staff out of the total number of employees (Cohen et al., 1990; DeCarolis et al., 1999; Luo, 1997). In the case of knowledge-intensive entrepreneurship, these measures become problematic as most new and young firms do not have dedicated budgets and staff, as organizational form is fluid and organizational and structural boundaries have not been established. Even in the case that they have dedicated R&D-resources, these are often overlapping with other functions in the firm as new firms including those with venture-capital backing can be assumed to be operating under scarce conditions (Baker et al., 2005). We thus need to develop a variable that

captures this trait in a similar and sufficient way and is at the same time both intuitive and applicable for the study of new firms.

For the purposes of this research, I suggest using the proportion of employees with a university degree in technology or natural sciences as a proxy for the scientific human capital component of absorptive capacity detailed in section 3.1.1. The logic is that in a new firm with few resources and employees, it can be assumed that individuals with a university degree in technology or natural sciences have a high probability of filling a corresponding role to people assigned to a R&D-department in an established company, or in the case of a service company serve as a conduit for continuously adapting the service offering to commercialize the knowledge in the firm. This goes both to the fact that the nature of technology and science university education is focused on analyzing and assimilating technological knowledge, as well as the fact that individuals with these kinds of degrees have a higher probability of having previous work experience relating to this effect.

It should here be noted that scientific and technological (S&T) human capital has previously often been defined as individuals with advanced degrees – e.g. Ph.D. – in natural sciences and technological fields, whereas I use a lower level of education in order to allow for a greater selection and also because I assume that basic university education is enough for the identification, assimilation and exploitation of technological knowledge (Colombo & Grilli, 2005; Corolleur, Carrere, & Mangematin, 2004; Toole & Czarnitzki, 2009). The variable is dynamic and can change over time. A limitation of this operationalization is that it fails to capture personal relations, board members, consultants, and other networks that could be the source of absorptive capacity. This is however a limitation that this variable shares with the previous industry standard measures; R&D intensity and proportion of R&D staff.

5.5.2 Organizational Tenure

As previously mentioned, firms with higher turnover underperform those firms with a lower turnover of personnel (Hatch et al., 2004). Interpreting and inverting these results then should mean that the new firms with lower turnover and a higher degree of organizational tenure will display relatively better performance. Similar to the problem with previous measures of absorptive capacity and new firms, likewise with routines and processes there is a measurement issue. They are difficult to measure in new firms primarily because it is unclear whether the firm that is just a few years old even has developed routines and processes yet, and even if they have the classical metrics and indicators of routines and processes are hardly in place. The conclusion is that we need to develop an additional variable that proxies the effect of routines and processes but that is intuitive and applicable for the study of new firms.

I have previously mentioned the beneficial effect of organizational tenure on firm performance, and using this as a theoretical starting point, I propose using a simple measure of organizational tenure as an indicator of organizational routines and processes in the new firm. As the data is matched employer-employee data detailing which individuals were active in which firms in specific years, for every year *(t)* in the study I used the proportion of employees that were active in the firm year *(t-1)* as a measure of organizational tenure as a proxy for organizational-level absorptive capacity. There are some intuitive limitations related to using this variable; arguably the proportion of employees that were active in the firm year *(t-1)* would decrease if the firm experiences explosive growth and the firm gains new employees. However, this is logical as it can be argued that social interaction and communication is contingent on the collective experience that all team members have in the shared structure and the cohesion of a team is reduced regardless of whether through losing former members or gaining new members (Smith et al., 1994).

5.5.3 Interaction Effects

As both the proportion of employees with technology and science education and the proportion of individuals that stay in the firm from the previous year are argued to have separate positive effects, we can also argue that the interaction effect between these two constructs will have a compound effect that is more than the sum of the parts, thus adding three additional hypothesis to this study. The interaction effect is created by multiplying the number of individuals with technology or science university education and multiplying this with the proportion of employees that were with the firm the previous year. The implicit assumption is that if this metric is high, then the specific human capital also has a longer tenure within the firm.

5.6 Control Variables

It is well known that establishing and including the correct control variables is anything but easy in the social sciences, as many effects and relationships are unobservable (Wooldridge, 2002). It is imperative that we turn to theory and previous research to develop our control variables that can be assumed to have an effect on new firm survival and performance, and include them in the models to avoid skewed results and biased analysis. Based on our previous theoretical overview, the control variables are either internal or external to the firm. These are developed below, starting with general human capital.

5.6.1 General Human Capital

Previous studies that have related the impact of knowledge on the survival and performance of new firms have primarily examined the effects of initial human capital endowments of the founders (Cooper et al., 1994; Gimeno et al., 1997). However, in this study we are interested in examining the longitudinal effects of the knowledge of all employees and not just the initial endowment of the founder/entrepreneur. The concept of human capital which is derived from economic theory is an individual level theory that focuses on the investment in education by the individual and that has

been found to have firm-level and macro-level outcomes (Davidsson & Honig, 2005a; Romer, 1990a). Following the same logic as for our absorptive capacity measure, the existence of higher education per se is variable often used to measure the construct of human capital, the result of conscious investment in education that has been shown to have economic outcomes (Becker, 1993). Here we seek to discriminate between a generally well educated staff and a staff specifically oriented towards science and technology, or in other words; we need to make sure that it is the type of human capital, and not the general level that impacts new firm performance. In order to control for general human capital in our models we therefore include the proportion of employees with 3-year university education in firm staff (science and technology included). This study then will add to the discussion and previous work regarding the relative effect of general versus specific human capital (Dimov et al., 2005).

5.6.2 Industry

Industry logic has previously been established to have significant impact on patterns of new firm survival and performance, the two main reasons being the availability of opportunities and differences in entry barriers due to capital intensity of entry into the industry (Audretsch, 1991; Klevorick et al., 1995). But as evident in the theoretical reviews in chapters 2 and 3, any discussion on industry differences is virtually absent from the extant literature on new firm entry, exit, and performance. The differential effect of strategic capabilities such as absorptive capacity in different industry logics is an underdeveloped area as most studies either sample from a single industry or include multiple industries without explicitly addressing industry differences (Acs et al., 1989b; Steensma et al., 2000). Only recently has initial work controlling for industry differences or specifically examining this issue been produced (Zahra & Hayton, 2008). For entrepreneurship researchers, relevant results can be found in a recent study of 74 West German regions over a 10-year period it was found that for new firms in the service sector most variables worked in opposite directions in birth and survival rate models, which was not the case for new firms in the manufacturing sector (Brixy & Grotz, 2007). Additionally, macro studies on gross employment flows and industry evolution has confirmed that the

patterns of performance differ across the broad categories of service and manufacturing industries (Armington & Acs, 2004). Recent theorizing ascribes this difference to the higher differential impact and importance of resources – and specifically intangible resources such as intellectual capital and capabilities – in service firms over manufacturing firms, as illustrated by the empirical results from 285 established Australian firms active in both manufacturing and service industries (Galbreath & Galvin, 2008). To shed further light on this issue, a control variable for manufacturing industries was included in the model.

5.6.3 Size

The size of a firm at entry into an industry has been shown to have a reliable impact on the growth rates of the firm. The motivation for this can be found in several different schools of thought and ranges from e.g. legitimacy, resources, and the relative confidence in the prospective success of a venture. Regardless of which explanation is the most robust, we need to control for the effects of firm size at entry in our model estimations. Control variables for size at entry is included with respect to number of employees at startup including the entrepreneur as well as number of employees in any given year, and additional control variables relating to the assets of the firm and sales per year were also included.

5.6.4 Cohort Effects

The business cycle is widely believed to have an impact on the growth and performance of firms and industries. Additionally, regulation and other external shocks can bring about large numbers of entries or exits in an industry. In order to control for this, I include a variable for cohort effects in the analysis. A dummy variable for each of the years included in the study is included in the model estimations to control for any adverse or significant effects that can be adhered to the year of entry.

5.6.5 Intensity of Competition

In both institutional theory and industrial organization, the intensity of competition in an industry has been put forward as an important determinant of new firm survival, however the two perspectives also

present diametrically opposed predictions; where industrial organization predicts that intensity of competition will have a negative effect on new firm survival due to increased pressure from firms competing for the same customers, institutional theory proposes that the competition will increase new firm survival for the exact same reasons due to the legitimizing effect of the existence of similar firms. This means that we need to include a control variable for intensity of competition in our model estimations. The control variables will consist of (a) total employees, (b) industry mean turnover, (b) number of triadic patents in industry, and (d) industry aggregated mean and median turnover, all aggregated to the 5-digit ISIC industry level for fine-grained analysis. In the table below, the updated and detailed hypotheses are summarized.

5.6.6 Summary of Hypotheses

As two dependent variables were developed to measure new firm performance, the hypotheses relating to new firm performance were divided into (a) and (b) hypotheses. A summary of the hypotheses to be tested are found in Table 11.

Table 11. Summary of Hypotheses

	Hypothesis
H1.	A relatively higher level of scientific human capital in the firm will reduce the probability of new firm termination
H2.	A relatively higher level of scientific human capital in the firm will have a positive impact on the probability of firm being acquired.
H3a.	T A relatively higher level of scientific human capital in the firm will have a positive impact on sales growth per employee
H3b.	A relatively higher level of scientific human capital in the firm will have a positive impact on average salaries paid
H4.	A relatively higher level of organizational tenure within the firm will reduce the probability of new firm termination
H5.	A relatively higher level of organizational tenure within the firm will have a positive impact on the probability of firm being acquired.
H6a.	A relatively higher level of organizational tenure within the firm will have a positive impact on sales growth per employee

H6b.	A relatively higher level of organizational tenure within the firm will have a positive impact on average salaries paid
H7.	There will be a significant interaction effect from individual and organizational level absorptive capacity

5.7 Variable List

Table 12. Variable List

	Variable name	Description
1.	exit_term	Exit by termination (1/0)
2.	exit_merg	Exit by acquisition/merger (1/0)
3.	prop_stlf	The proportion of employees in the firm with science and technology university degrees
4.	prop_empcommon	Organizational tenure: the proportion of employees in year *(t)* that are the same as year *(t-1)*
5.	interaction	Interaction effect: the interaction term of (employees with science and technology education) * (prop_empcommon)
6.	prop_univ	General human capital: The proportion of employees in the firm with university degrees (including science and technology)
7.	manufacturing	Dummy variable (1/0) for firms active in medium- and high-technology manufacturing
8.	emp	Size of firm measured as employees in year *(t)*
9.	size_at_entry_emp	Size of firm at time of entry measured as employees
10.	sales	Sales in SEK
11.	size_at_entry_sale	Sales at time of entry in SEK
12.	ln_rel_sal_gro_emp	The natural logarithm of sales growth per employee year *(t)* compared to year *(t-1)*
13.	ln_average_salary	The natural logarithm of average salaries paid per employee
14.	age	Firm age in years
15.	sumassets	Firm assets in SEK
16.	nr_plants	Number of plants within the firm
17.	ind_sum_emp	Industry concentration variable: total number of employees in industry (5-digit ISIC)
18.	ind_sum_age	Industry concentration variable: the aggregated age of all firms active in industry (5-digit ISIC)
19.	Ind_sum_patent	Industry concentration variable: aggregated number of triadic patents granted by firms in industry (5-digit ISIC)
20.	ind_mean_tot_turnover	Industry concentration variable: mean sales of all firms in industry (5-digit ISIC) in SEK
21.	ind_median_tot_ turnover	Industry concentration variable: median sales in SEK of all firms in industry (5-digit ISIC)

6 Model Estimations and Analysis

The most exciting phrase to hear in science, the one that heralds new discoveries, is not Eureka! (I found it!) but rather "hmm.... that's funny...."

Isaac Asimov

The first section of this chapter will describe the sample that contains the full populations of knowledge-intensive manufacturing and service firms respectively. The selection criteria are described and descriptive statistics for the sample is given. In the following section, the models are estimated and the results are described together with regression diagnostics.

6.1 Descriptive Analysis

6.1.1 Firms and Industries in Sample

The sample consists of 6,159 independent (de novo) incorporated new ventures in medium- and high-technology manufacturing industries and knowledge-intensive business services. The selection of industries is made on the basis of industry codes (International Standard Industrial Classification: ISIC), and selected in accordance with the standard European Union classification scheme for knowledge-intensive industries (Götzfried, 2004). According to these definitions, manufacturing industries are classified in five categories according to their ratio of R&D expenditure to either GDP or R&D intensity; these five categories are high-and medium high technology manufacturing which can be divided into the following two categories (2) high-technology manufacturing, (3) medium high technology manufacturing. In addition, there are also (4) low technology manufacturing and (5) medium low technology manufacturing. Service industries have been ordered into two general categories based on their knowledge intensity; knowledge-intensive services (KIS) and Less Knowledge-intensive services. (LKIS). These two categories can additionally be divided into subgroups (e.g. financial services, market services) if required. The number of firms and industries (2-digit level

ISIC) included in the sample is listed in Table 11. below. Industries classified as medium- and high-technology manufacturing are denoted with an (*).

Table 13. Number of Firms and Industries in Sample

ISIC	Description	(n)	(%)
24	Manufacture of chemicals*	37	0.60
29	Manufacture of machinery & equipment*	56	0.91
30	Manufacture of computing machinery*	59	0.96
31	Manufacture of electrical machinery*	122	1.98
32	Manufacture of communication equipment*	99	1.61
33	Manufacture of medical instruments*	261	4.24
34	Manufacture of motor vehicles*	23	0.37
35	Manufacture of transport equipment*	25	0.41
64	Communications services (information & telecom)	156	2.53
72	IT and related services	4,851	78.76
73	Research and development	470	7.63
	Medium- and high-technology manufacturing firms*	682	11.07
	Knowledge-intensive service firms	5,477	88.93
	Total	6,159	100

Of the 682 manufacturing firms in the sample, 558 (81.81%) exited the sample during the period of the study; 401 (58.78%) were terminated, 109 (15.84%) were acquired or merged with another company, 27 (3.96%) exited through splitting up and 31 (4.55%) exited the sample by migrating to another industry. The sample has a somewhat higher exit ratio than the rest of the population of all new Swedish firms (Delmar et al., 2005). It should be noted that a small amount of firms display multiple exits during the period of study. The manufacturing firms consist of 2,247 firm-year observations. Of the 5,477 service firms in the sample 4,319 (78.86%) exited the sample during the period of the study; 3,186 (58.17%) exited through terminations, 844 (15.39%) through mergers or acquisitions, 168 (3.07%) were split up, and 151 (2.76%) firms exited the sample by migrating to another industry. The incorporated new service firms display higher exit ratios than the population of all new firms, and similarly a small number of firms display multiple exits; especially exit and re-enter the industry during the period of study. The service firms consist of 15,382 firm-year observations.

To check for similarities and differences between the manufacturing and service firms, Mann-Whitney two sample rank-sums tests on the different types of exits were conducted on manufacturing and service firms respectively. The Mann-Whitney rank-sum test is a non-parametric that is suitable for the comparison of independent non-matched samples from populations and compares the distribution of the samples, whereas the median test is a nonparametric test on the equality of medians in the samples (Acock, 2006). According to the tests, the manufacturing and service firms display almost similar patterns of exit; according to the rank-sum test they differ with regards to terminations and the median tests indicate that the samples differ regarding exits from the industry population. The Mann-Whitney test for similar distributions showed a significant difference between manufacturing and service firms with regards to exit through terminations (Z=3.365; p<.001). This difference lends support to the inclusion of the manufacturing dummy variable in the model estimations to assess whether there are fundamentally different dynamics or effects of absorptive capacity across manufacturing and service industries. It should be again noted that the data is population data; the different sample sizes are due to the fact that the samples represent the respective full populations of new Swedish firms in those industries during the period of study and this can not be assumed to impact the analyses negatively.

6.1.2 Descriptive Analysis

Here follows descriptive statistics of the sample, both at time of startup and of the full sample of firm-year observations. Extreme outliers and negative values likely due to data entry errors in the top and bottom 1% were adjusted. The correlation matrix is presented in Table 14. on the following page.

Table 14. Correlation Matrix

		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
1.	exit_term	1.000														
2.	exit_merg	-.113	1.000													
3.	prop_stlf	-.039	-.011	1.000												
4.	prop_empcommon	-.119	-.129	.048	1.000											
5.	interaction	-.085	.035	.486	.219	1.000										
6.	prop_univ	-.008	.018	.413	-.047	.144	1.000									
7.	manufacturing	-.028	-.013	-.072	.009	-.037	-.067	1.000								
8.	emp	-.106	.234	-.033	-.079	.392	-.055	.027	1.000							
9.	size_at_entry_emp	-.061	.220	-.045	-.075	.135	-.069	.022	.460	1.000						
10.	sales	-.092	.142	-.032	.034	.216	-.052	.045	.509	.304	1.000					
11.	size_at_entry_sale	.041	.105	-.021	-.084	.036	-.014	.053	.204	.444	.556	1.000				
12.	ln_rel_sal_gro_emp	.017	-.053	.004	.157	-.035	.005	-.010	-.152	-.160	-.018	-.038	1.000			
13.	ln_average_salary	-.108	-.010	.112	.234	.123	.016	-.104	.022	.023	.164	.088	.046	1.000		
14.	age	-.107	-.070	-.006	.599	.176	-.142	.059	.085	.010	.147	.009	.087	.152	1.000	
15.	sumassets	-.051	.136	.051	-.032	.240	.012	.046	.394	.208	.486	.284	-.045	.126	.065	1.000
16.	nr_plant	-.006	.016	-.004	.005	.049	-.006	-.015	.164	.075	.069	.016	-.010	.018	.021	.033
17.	ind_sum_emp	-.004	-.044	-.001	.139	.021	-.137	-.439	-.014	-.007	-.007	-.048	.007	.143	.112	-.084
18.	ind_sum_age	-.009	-.049	.003	.146	.022	-.117	-.457	-.029	-.022	-.016	-.050	.011	.141	.115	-.103
19.	ind_sum_patent	-.013	.024	.031	-.039	.022	.059	.228	.010	-.018	-.017	-.012	-.005	-.042	-.044	.083
20.	ind_mean_tot_turnover	.018	.014	-.041	-.028	-.030	-.026	.202	.038	.025	.044	.005	.001	-.033	-.016	.073
21.	ind_median_tot_turnover	.013	.008	-.039	-.016	-.019	-.025	.391	.037	.020	.082	.019	-.009	-.040	.020	.086
22.	cohort1995	-.038	.006	-.011	.076	.007	.104	.080	-.004	-.034	.031	.042	-.022	-.048	.262	-.039
23.	cohort1996	-.010	.001	-.021	.038	.004	.063	.035	-.007	-.053	.015	.039	.029	.010	.119	.013
24.	cohort1997	-.008	.009	-.025	.061	-.014	.055	.030	-.024	-.035	-.040	-.058	.063	.024	.085	-.015
25.	cohort1998	-.019	.010	-.015	.047	.020	.028	-.025	.028	.038	.056	.007	.012	.028	.004	.024
26.	cohort1999	.009	.018	.010	-.004	.023	-.049	-.026	.045	.004	.026	-.007	-.014	.006	-.080	.037
27.	cohort2000	.025	-.007	.028	-.047	.010	-.126	-.061	.021	.099	-.026	-.024	-.043	.014	-.182	.021
28.	cohort2001	.025	-.034	.046	-.112	-.026	-.088	-.050	-.044	-.004	-.047	.003	-.038	.010	-.217	-.027
29.	cohort2002	.038	-.024	.004	-.208	-.057	-.053	-.012	-.042	-.023	-.050	-.002	.001	-.085	-.169	-.024

		16.	17.	18.	19	20.	21.	22.	23	24.	25.	26.	27.	28.	29
16.	nr_plant	1.000													
17.	ind_sum_emp	.008	1.000												
18.	ind_sum_age	.008	.978	1.000											
19.	ind_sum_patent	-.011	-.223	-.262	1.000										
20.	ind_mean_tot_turnover	-.003	-.062	-.211	.193	1.000									
21.	ind_median_tot_turnover	-.002	-.200	-.234	.098	.217	1.000								
22.	cohort1995	-.007	-.206	-.189	.043	-.001	.032	1.000							
23.	cohort1996	-.005	-.121	-.107	.036	-.005	.017	-.185	1.000						
24.	cohort1997	-.001	-.055	-.052	.030	.015	-.003	-.218	-.182	1.000					
25.	cohort1998	.016	.051	.047	.026	-.011	-.021	-.192	-.160	-.189	1.000				
26.	cohort1999	.014	.088	.074	-.024	-.003	-.006	-.172	-.144	-.170	-.149	1.000			
27.	cohort2000	.000	.172	.149	-.059	-.009	-.014	-.189	-.158	-.187	-.164	-.148	1.000		
28.	cohort2001	-.015	.118	.115	-.056	.007	-.010	-.140	-.117	-.138	-.121	-.109	-.120	1.000	
29.	cohort2002	-.008	.028	.033	-.037	.015	-.003	-.078	-.065	-.077	-.067	-.061	-.067	-.049	1.000

As we can see in the correlation matrix, the only correlations are the intuitive ones; for instance sales, employees and sales and employees at start-up are correlated. Also, manufacturing industries have a high correlation with some industry concentration variables, e.g. aggregated number of employees and aggregated age of firms in the industry. I do not consider these correlations to be unexpected or impact the data and analysis in a negative way. Table 15 contains some descriptive statistics for the firms at time of start-up. As the reader might notice, 4,275 observations is less than the 6,159 firms included in the sample which is due to the missing data issue that is an unfortunate common side-effect of working with registry data.

Table 15. Descriptive Statistics at Startup (n=4,275)

		Mean	Std. Dev.	Min.	Max.
3.	Proportion science and tech. degrees	.170	.342	0	1
6.	Proportion University degrees	.166	.341	0	1
7.	Size: employees	2.004	1.628	1	9
8.	Sales (000,000)	1.294	1.659	0	13.700
12.	Firm assets (000)	1.339	2.410	193	28.300

Proceeding in Table 16. to look at the descriptive statistics for the full sample, that is, all firm-year observations, we find that as expected, many of the variables have higher mean values.

Table 16. Descriptive Statistics for all Observations (n=15,307)

		Mean	Std. Dev.	Min.	Max.
1.	Exit by termination	.188	.390	0	1
2.	Exit by acquisition/merger	.052	.223	0	1
3.	Proportion science and tech. degrees	.171	.331	0	1
	Employees from previous year	1.345	2.180	0	103
4.	Organizational tenure (prop/emp t-1)	.561	.445	0	1
5.	Interaction 3*4	.229	.670	0	14.171
6.	Proportion University degrees	.129	.298	0	1
	Manufacturing (dummy)	.131	.337	0	1
7.	Size: employees	2.597	3.179	0	139
8.	Sales (000,000)	2.413	3.733	0	25.70
11.	Firm age	2.698	1.662	0	8
12.	Firm assets in SEK (000,000)	2.090	4.188	193	31.20
13.	Industry employees (5-digit ISIC)	36,088.5	25,771.85	2	67,180.00
14.	Industry age (5-digit ISIC)	17,792.9	13,962.27	0	36,115
15.	Industry patents (5-digit ISIC)	4.854	21.475	0	234.093
16.	Industry mean sales (000,000)	37.60	165.00	.093	2,540.00
17.	Industry median sales (000,000)	1.327	1.927	.093	167.00
	cohort effects suppressed due to space				

6.2 New Firm Termination

In the first model estimation I aim to estimate the negative effect of absorptive capacity on the probability of termination for new firms. As previously mentioned, the nature of time-series analysis and the characteristics of our econometric data does not make it worthwhile to regress our predictors on survival, as right-censoring implies that a large portion of the observed firms actually survive longer than the period of study, but possibly fail after the period of observation. Any analysis on the effect of absorptive capacity on mere survival would thus be skewed. The best way to produce a reliable analysis in this case is deemed to estimate a model on the effects of absorptive capacity on the risk of new firm exits, as these are discrete measurable events within the period of study. Considering the format of the data, where exits are coded as terminations, acquisitions, splits, or *de alio*, Cox regression survival analysis are less suited as these focus on the survival of firms. Here my goal is to estimate the effects of the dependent variables on specific types of new firm exits from the population, thus making logistic regression more suited to the task. The data would not allow for model convergence using fixed effects estimation, so only random effects were allowed for the new firm termination estimations. Dummy variables for cohort years were included in the random effects estimation. The models were estimated through hierarchical regression with a baseline model including all control variables and then two additional models, the second estimation adding the scientific human capital component of absorptive capacity as dependent variable and the third estimation adding the organizational tenure component as well as the interaction term of the two absorptive capacity indicators. Take note that the results for survival are modeled with terminations as dependent variable, thus a negative correlation supports our hypotheses. The results are presented in Table 17.

Table 17. Termination and Merger/Acquisition Model Estimations

Dependent variable	Exit by termination			Exit by merger or acquisition		
	Model 1.	Model 2.	Model 3.	Model 4.	Model 5.	Model 6.
Firm fixed effects	n/a	n/a	n/a	Included	Included	Included
Year dummies	Included	Included	Included	Excluded	Excluded	Excluded
General human capital: Proportion employees with university degree	-.150 (.078)	.036 (.087)	.051 (.088)	.579 (.672)	.211 (.707)	.343 (.738)
Manufacturing industry dummy (1/0)	-.258** (.099)	-.313** (.100)	-.309** (.099)	-14.171 (2290.82)	-15.459 (4279.381)	-15.385 (3281.682)
Firm size: employees	-.274*** (.025)	-.282*** (.026)	-.307*** (.027)	.127 (.0674)	.134* (.068)	.112 (.074)
Size at entry: employees	.117*** (.025)	.110*** (.026)	.125*** (.026)	-1.427*** (.160)	-1.443*** (.162)	-1.457*** .162
Firm sales	.000*** (.000)	.000*** (.000)	.000*** (.000)	.000 (.000)	.000 (.000)	.000 (.000)
Size at entry: sales	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)
Firm age	-.146 (.077)	-.253** (.083)	-.154 (.083)	.000 (.000)	-.616 (.609)	-1.240 (.647)
Firm assets	.000 (.000)	.000 (.000)	.000 (.000)	.000** (.000)	.000** (.000)	.000** (.000)
Number of plants	.629* (.321)	.644* (.322)	.664* (.321)	-14.436 (676.064)	-15.899 (1255.733)	-15.1956 (1056.772)
Industry concentration: total number of employees	.000* (.000)	.000** (.000)	.000 (.000)	.000** (.000)	.000** (.000)	.000** (.000)
Industry concentration: aggregated age of firms	.000* (.000)	.000** (.000)	.000** (.000)	.000* (.000)	.000** (.000)	.000** (.000)
Industry concentration: patents	.000 (.000)	.002 (.001)	.002 (.001)	.001 (.001)	.001 (.001)	.001 (.001)
Industry concentration: mean total turnover	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)
Industry concentration: median total turnover	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)
Correction for self-selection: lambda (λ)	.011 (.234)	-.266 (.254)	-.221 (.251)	-5.976** 2.087	-5.865** (2.08)	-7.467*** (2.184)
Scientific human capital: Proportion of employees with science or technology degree		-.393*** (.083)	-.346*** (.104)		1.456 (1.040)	.532 (1.200)
Organizational tenure: proportion of employees from previous year			-.381*** (.076)			1.288*** (.367)
Interaction effect			-.052 (.084)			.305 (.285)
Number of observations	13,590	13,590	13,590	1,119	1,119	1,119
Number of groups	5,502	5,502	5,502	339	339	339
Wald χ^2	-	-	-	404.25	406.16	423.77

Significance levels: * $p<.05$, ** $p<.01$, *** $p<.001$

6.2.1 Results

The manufacturing industry dummy had significant negative impact in all models including the full model 3 (-.309, $p<.01$), indicating that firms active in manufacturing industries have lower hazard rates than new firms in service industries. Firm size measured as employees also had a significant negative effect on new firm terminations (-.307, $p<.001$), but interestingly firm size at startup measured as employees had a positive effect on terminations (.125, $p<.001$); thus indicating firms that start out relatively larger at startup had higher hazard rates, but relatively larger firms had lower hazard rates. This second finding is corroborated by the indication that the number of plants or sites of operations also had a significant positive effect thus increasing the likelihood of termination (.664, $p<.05$). General human capital did not have any significant effect on the probability of terminations for the new firms in the sample (.051, not significant) but as both our predictor variables had strong significant negative effects on new firm terminations this could be taken as signifying the impact and importance of absorptive capacity on new firm survival.

6.2.2 Analysis

An interesting result is that the initial size of the firm measured as number of employees increased the likelihood of termination whereas the number of employees any given year decreased the likelihood of termination and previous research in general indicates that size at startup has a positive correlation with new firm survival. A growing literature has examined the role of the aspiration levels of the individual entrepreneur in determining the survival and performance of new firms. That these subjective aspiration levels are a relevant factor is illustrated by entry into entrepreneurship by individuals that would earn more if they remained employed as well as the existence and persistence of underperforming firms that would exit if they operated on objective performance thresholds (Gimeno et al., 1997; Hamilton, 2000). The fact that the size at startup has a significant negative effect on the continuation of the new venture could be the result of entrepreneurial aspirations at the team level; one explanation could be that the team develops a shared performance aspiration and that this aspiration

and team cohesion supersedes firm performance, the people active in the firm are more willing to terminate the firm if performance thresholds are not met rather than replacing individuals (under the assumption that this is a feasible option). In any event, this is merely an initial explanation as aspiration levels is an unobservable factor in this study and needs to be explored and studied further. In analyzing the effects of absorptive capacity on the chances of survival of independent new ventures, I focused on estimating the effects on two types of exit; new firm terminations and new firm acquisitions. Examining new firm terminations, we find that the individual-level aspect of absorptive capacity - scientific human capital – had a significant negative impact on the likelihood of new firm termination thus implying that the existence of a high level of scientific human capital in a new venture in a knowledge-intensive industry increases the chances of survival. Regarding the routines and processes aspect of absorptive capacity operationalized as organizational tenure, this also had a significant negative effect on new firm terminations.

6.3 New Firm Acquisition

The acquisition models were estimated using hierarchical regressions with fixed-effects specification. Year dummies were excluded from the models due to reasons of collinearity.

6.3.1 Results

When assessing the effects of absorptive capacity on the probability of acquisition of new firms another pattern emerges. Here organizational tenure was a significant predictor of probability of acquisitions (1.288, $p<.001$) whereas the scientific human capital had no effect (.532, not significant) on the probability of acquisition. The size at start-up measured as employees had a negative impact on the probability of acquisitions (-1.457, $p<.001$). The manufacturing industry dummy did not have any impact on the probability of new firm acquisitions (-15.385, not significant). Similar to in the new firm termination models, in the

acquisition models the level of general human capital in the firms had no effect on the probability of acquisition (.343, not significant).

6.3.2 Analysis

Building on our previous reasoning in 6.2.2., if a firm is started with more resources it signals more confidence and additional resources that strengthen the firm's initial position. From an acquisition perspective this could either mean that the founders have no incentive to sell, alternatively that they hold off a sale of the equity in the firm until they have met their aspiration levels with regards to the price of the equity, which can be assumed to be a longer time-period on average than the period of study (7 years). This reasoning goes into the line of logic mentioned above, that a manufacturing firm on average can be assumed to be formed around commercializing a specific solution to a perceived opportunity rather than commercializing specific knowledge, which is why service firms are not similarly affected. This is also in line with recent research in financial economics on 49 venture capital-backed technology firms from birth to initial public offering (IPO) that indicates that the business lines of these firms are stable and cohere with the original business plan and that non-human capital aspects rather than the human capital of these firms that seemed to have a more significant impact on the financial valuation (Kaplan et al., 2005).

6.4 New Firm Performance: Sales Growth per Employee

The models for sales growth per employee were estimated through hierarchical regression using fixed effects specification. All new firm performance estimations are presented in Table 18

6.4.1 Results

For sales growth per employee I find that organizational tenure was the significant predictor when introduced in the model (.350; $p<.001$), scientific human capital had no effect (-.066, not significant), and general human capital had a negative effect on sales growth per employee in the full model

estimation (-.074, p<.01). Firm age had a negative impact on sales growth in all models including the full model (-.197, p<.001) and so did firm size measured as employees (-.21, p<.001).

6.4.2 Analysis

When looking at new firm performance measured through sales growth per employee, that firm age had a negative effect could possibly be explained through decreasing returns; even if a firm grows sales by the same absolute number every year, the proportional growth decreases every year. Similarly this could explain why the number of employees had a significant negative impact; for every employee that is added, sales per employee is halved. More interesting is the result that individual absorptive capacity measured as scientific human capital had no effect on sales growth per employee, but that organizational tenure was the independent variable with the single strongest positive effect; it thus seems that routines and processes are key for the commercialization of technological knowledge. Even though specific human capital had varying and weak effects in some models, one important conclusion from fitting the model is that the individual ACAP measure differed significantly from general human capital in all models, showing that technology and science university education differs in impact from general university education. General human capital even had a significant negative effect on average salaries for manufacturing firms and sales growth per employee for service firms. This result strengthens the idea that with regards to absorptive capacity, it is the type rather than the level of human capital which is of theoretical and empirical interest to researchers and practitioners. The results for our hypotheses are displayed the table below. The results are presented in Table 16.

Table 18. Sales Growth and Average Salaries Paid Model Estimations

Dependent variable	Sales growth per employee			Average salaries paid		
	Model 7.	Model 8.	Model 9.	Model 10.	Model 11.	Model 12.
Firm fixed effects	Included	Included	Included	Included	Included	Included
Year dummies	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded
General human capital: Proportion employees with university degree	-.020 (.027)	-.027 (.028)	-.074** (.028)	.086*** (.024)	.044 (.024)	.006 (.023)
Manufacturing industry dummy (1/0)	.308 (.188)	.309 (.188)	.327 (.182)	.000 (.000)	.132 (.164)	.156 (.157)
Firm size: employees	-.030*** (.003)	.030*** (.004)	-.021*** (.004)	.000*** (.000)	-.035*** (.003)	-.029*** (.003)
Size at entry: employees	-.007 (.015)	-.008 (.018)	.001 (.014)	.038** (.013)	.040** (.013)	.040*** (.012)
Firm sales	.000*** (.000)	.000*** (.000)	.000*** (.000)	.000*** (.000)	.000*** (.000)	.000*** (.000)
Size at entry: sales	-.000** (.000)	-.000** (.000)	-.000** (.000)	.000 (.000)	.000 (.000)	.000 (.000)
Firm age	-.161*** (.021)	-.159*** (.021)	-.197*** (.021)	.168*** (.018)	.180*** (.018)	.134*** (.018)
Firm assets	.000 (.000)	.000 (.000)	000 (.000)	.000*** (.000)	.000*** (.000)	.000*** (.000)
Number of plants	.163 (.083)	.161 (.083)	.124 (.081)	.267*** (.073)	.253*** (.073)	.219** (.070)
Industry concentration: total number of employees	-.000*** (.000)	-.000*** (.000)	-.000*** (.000)	.000** (.000)	.000** (.000)	.000** (.000)
Industry concentration: aggregated age of firms	.000*** (.000)	.000*** (.000)	.000*** (.000)	.000*** (.000)	.000*** (.000)	.000** (.000)
Industry concentration: patents	-.000 (.000)	-.000 (.000)	-.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)
Industry concentration: mean total turnover	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)	.000* (.000)
Industry concentration: median total turnover	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)	.000 (.000)
Correction for self-selection: lambda (λ)	-.580*** (.063)	-.573*** (.064)	-.525*** (.062)	.315*** (.056)	.358*** (.056)	.386*** (.054)
Scientific human capital: Proportion of employees with science or technology degree		.066 (.052)	-.066 (.052)		.407*** (.045)	.358*** (.045)
Organizational tenure: proportion of employees from previous year			.350*** (.016)			.344*** (.014)
Interaction effect			-.039 (.013)			.006 (.011)
Number of observations	13,584	13,583	13,583	13,590	13,590	13,590
Number of groups	5,500	5,500	5,500	5,501	5,501	5,501
Sum of squared residuals: R^2	.052	.052	.107	.099	.107	.178

Significance levels: * p<.05, ** p<.01, *** p<.001

6.5 New Firm Performance: Average Salaries Paid

Average salaries paid were estimated using hierarchical regression with fixed effects specification.

6.5.1 Results

When analyzing average salaries paid I find that general human capital had a slight significant positive impact (.086; $p<.001$) on average salaries paid in the baseline model, but that this effect disappears and is supplanted by a much stronger positive effect of scientific human capital (.407; $p<.001$) as soon as this is introduced in the estimation. The significant positive effect of scientific human capital remains (.358; $p<.001$) even as organizational tenure is introduced .344; $p<.001$). Firm age had a positive effect on average salaries paid (.134, $p<.001$) as well as number of plants or places of operation (.219, $p<.01$). The manufacturing industry dummy had no effect (.156, not significant) indicating that there was no difference across manufacturing and service industries. An interesting pattern that was repeated from the acquisition model was that firm size measured as employees had a negative effect (-.029, $p<.001$) on average salaries paid, whereas size at start-up measured as employees had a positive impact (.040, $p<.001$) on average salaries paid.

6.5.2 Analysis

One highly interesting result is that general human capital has a significant effect in the model that disappears as scientific human capital is introduced. This could be an indication that many studies that use general human capital in knowledge-intensive environments are in fact measuring the unobserved effect of the scientific human capital. An interesting result in comparison with the sales growth estimation is that scientific human capital had a positive effect on average salaries paid, but non on sales growth per employee. This could indicate that a higher level of scientific human capital is helpful in securing other sources of cash-flows and financing, e.g. venture capital, bank loans, etc., but is nothing we can examine within the boundaries of this research. The interaction term has no effect, indicating that the two absorptive capacity indicators have separate positive effects as

theorized.ith respects to average salaries paid, the two absorptive capacity variables where among the top three in significance for explaining the outcomes.

6.6 Regression Diagnostic

The lambda variable for correction for self-selection (λ) was significant in all models on (a) acquisitions (-7.467, $p<.001$), (b) sales growth per employee (-.525, $p<.001$) and (c) average salaries paid (.386, $p<.001$), confirming that its inclusion helped obtain more precise estimates. For the new firm acquisition models the Hausman statistic ($\chi^2(5)=13.45$, $p<.05$) rejected the null hypothesis that the random-effects estimator is consistent thus validating the choice of a fixed-effects specification. Similarly, the Hausman statistics for the sales growth per employee model estimations r was ($\chi^2(11)=198.66$, $p<.001$), and for the average salaries paid model estimations ($\chi^2(11)=172.06$, $p<.001$) thus for these model estimations rejecting the null hypothesis that the random-effects estimator is consistent. This confirms the validity of the fixed-effects specifications for the estimations as it indicates that the error term is correlated to the regressors in all estimations.

In addition, to validate causality for the model estimation paid, reversed regressions were tested with average salaries as dependent variable and employees with general or technical university education without any significant results thus confirming the one-way causality of the model estimates. The most common way of assessing the explanatory power of multiple regression models is through looking at the coefficient of determination or R-squared (R^2). What is a high versus a low R-squared is heavily dependent on both the topic and the data used. As a heuristic, for exploratory areas such as this, an R^2 of <.1 is normally considered weak, between .1 and .2 is a moderate R^2, and values surpassing .3 are considered strong. We can see that the predictor variables are significant inclusions in the estimations as the R^2 is doubled in both the sales growth per employee model from weak (<.1) to moderate (.1 - .2) and in the average salary paid

estimation from weak (<.1) to better than moderate (>.2), results which can be considered reasonably good considering the exploratory nature of the research and estimations (Acock, 2006).

6.7 Discussion of the Results

The results from the model estimations produced both expected and unexpected results. As expected, absorptive capacity had positive effects on various aspects of new firm survival and performance. Unexpected results were that the positive effects of absorptive capacity differed markedly over the different new firm performance indicators and that whether firms were active in manufacturing or service industries only mattered with respects to estimating firm survival but did not have any impact in any other model estimations. The results and their implications are presented in the table on the following page and alternative explanations are discussed in this section.

6.7.1 Summary of Results

I have thus estimated and tested all the hypotheses previously developed. In table 19. I provide an overview of the results.

Table 19. Summary of Results

a. A higher proportion of scientific human capital;	
H1: Reducing probability of new firm termination	Supported (-.346***)
H2: Increasing probability of acquisition	Rejected (n/s)
H3a: Increasing sales growth per employee	Rejected (n/s)
H3b: Increasing average salaries paid	Supported (.358***)
b. A higher level of organizational tenure;	
H4: Reducing probability of new firm termination	Supported (-.381***)
H5: Increasing probability of acquisition	Supported (1.288***)
H6a: Increasing sales growth per employee	Supported (.350***)
H6b: Increasing average salaries paid	Supported (.344***)
H7. Interaction effect (a*b); significant effect	Rejected (n/s)
(***) p<0.001, (**) p<0.01, (*) p<0.05	

7 Discussion and Conclusions

Science, in the very act of solving problems, creates more of them.

Abraham Flexner

This chapter summarizes and discusses the wider implication of the results of the model estimations in the previous chapter in light of the theoretical framework developed. I introduce and discuss potential alternative explanations for the outcomes, the reliability and validity of the results, and discuss the theoretical, methodological, and practical contributions of the dissertation. I conclude the chapter with a discussion of the limitations of the research and provide suggestions for further research on the issues introduced here.

7.1 Alternative Explanations

7.1.1 Red Queen Effect

One alternative explanation that could be claimed here is what in both naturalistic evolutionary research and strategy research is referred to as the Red Queen effect. The Red Queen effect is influenced by population ecology as well as organizational learning and is defined as the adaptive process between competing organizations in an evolutionary race where an action by a focal organization to improve relative performance will induce a strategic response from competitors to keep from losing relative performance which in turn will trigger new competitive responses and so on. If this was in effect, the higher levels of absorptive capacity could then be explained as the strategic response from firms to the actions by focal firms. However, there are both theoretical and empirical arguments against the Red Queen effect with regards to the study of independent new ventures. In our results, the firms with high absorptive capacity consistently outperform the firms with lower absorptive capacity. In a true Red Queen scenario, the lower performing firms would adapt and increase their absorptive capacity. Empirical studies for Red Queen effects have yet to be

done for high-technology or dynamic industries, previous studies focus on industries where 70% of sales were generated by publicly listed firms (Derfus, Maggitti, Grimm, & Smith, 2008), or on Illinois banks 1900-1993 (Barnett & Hansen, 1996b; Barnett & Sorenson, 2002).

A fundamental neoclassical assumption of Red Queen effects is that of zero-sum competition; that there is a fixed pie of economic rents and whenever one firm increases the value captured other firms lose out. It is a theoretical discussion going back to the nature of entrepreneurial opportunities as to whether zero-sum competition is valid for new firms, especially in our study that includes numerous different industries. Finally, the Red Queen effect does not guarantee positive outcomes, the results can be both adaptive and maladaptive and the presence of varied cohorts and large heterogeneity increases the likelihood of maladaptive effects (Barnett et al., 1996b). To say that there is a Red Queen effect that has positive effects for some firms and negative effects for some firms without offering any deeper explanation would be tautological. However, Red Queen effect is fundamentally based in game theory and there are some indications that industry concentration that reduces the heterogeneity in competition could be a prerequisite for Red Queen effects (Derfus et al., 2008). One important proposition is that Red Queen competition causes success bias as recent empirical results indicate that fast-growing firms have higher probabilities of both acquisition and liquidation as the variance in performance is higher than among slow-growing or non-growth firms (Barnett & Pontikes, 2008). If firms surviving Red Queen competition become more prone to both termination and acquisition, this could imply a slight "Red Queen bias" in the results from this study. This falls outside the scope of this dissertation but could be an interesting issue for future research.

7.1.2 Rational Agency

Another alternative explanation is a selection effect that can be inferred from human capital theory and economic rational agents; namely that smart people would simply choose to work and stay at firms with strong performance. I have argued against the idea of fully transparent and mobile labor markets previously in this dissertation, and would argue that the tests

for reversed causality where no causality between performance and absorptive capacity measured as human capital would seem to provide empirical evidence against that argument.

7.1.3 Legitimacy Effects

A final alternative explanation for the results could be that it is the level of scientific human capital and organizational tenure that increases survival and performance in new firms in knowledge-intensive industries; but not as I have argued because of increased absorptive capacity that allows the firm to identify and exploit technological knowledge and opportunities, but because these two metric increase legitimacy in the marketplace for new firms. It could be that a higher level of scientific human capital and higher organizational tenure respectively bestows new firms in knowledge-intensive industries with higher legitimacy with respect to customers, banks and other critical stakeholders and therefore increases chances of survival and performance for these firms, not because the level of absorptive capacity makes the firm better at providing value and quality to the customer, but because customers would rather be seen to do business with firms with higher levels of absorptive capacity for reasons both intrinsic and extrinsic. Even though I argue that absorptive capacity has a higher explanatory value across all tested aspects of new firm performance this alternative explanation is harder to dismiss as the current research design and data does not allow for benchmark studies, and further research would be needed to rule out legitimacy effects and settle this issue.

7.2 Reliability and Validity

7.2.1 Reliability

Reliability of results can be said to be consisting of two components; reliability of data and reliability of metrics (Maula, 2001). Regarding the reliability of data, Statistics Sweden is one of the oldest statistical institutions in the world and widely considered to produce reliable data. There are some issues regarding the data however that could impact reliability; for instance the industry codes are self-reported by firms and

multiple codes are allowed. In the occurrence of multiple codes, Statistics Sweden will report the primary code. This means that the industry membership for typical firms will vary widely, to provide empirical support for this a survey of Swedish venture capital firms was conducted and it was found that they were registered under 17 different 2-digit ISIC codes. The coding system is also revised regularly, the latest revision in Sweden being SNI 2007. In conclusion, reliability of data overall is judged to be high, but a caveat is made regarding the industry membership of firms as this is self-reported and subjected to a number of revisions over time and administration implying that the industry membership of firms alternatively industry boundaries may be less reliable. Reliability of metrics focuses on the extent to which the metrics are reliable. Since the metrics are constructed from secondary variables that are reliable, I consider reliability of metrics to be high.

7.2.2 Validity

Construct validity is the extent to which a metric measures what it is supposed to measure. In this study, metrics were developed from theoretic arguments and by using available variables in the dataset. Any source of discussion on construct validity in this study will have to focus on the theoretical arguments rather than the data. To this extent, construct validity can be considered to be very high if considers the theoretical arguments for choosing the variables to be robust.

7.2.3 Generalizability

Regarding generalizability of results, it is accepted knowledge that the sample size will have an impact on this aspect of results. For instance, too small samples will jeopardize the transferability of results, why it is recommended that samples include at least five times as many observations as there are independent variables in the model, which is the case for both samples in this study (Hair, Anderson, Tatham, & Black, 1998). Additionally, too large sample sizes might also affect the results, making the estimation overly sensitive. In this study I use a sample containing the full population of knowledge-intensive medium- and high-technology manufacturing firms in Sweden 1995-2002. The possibility of estimating

the models on the full populations is a unique opportunity, and I consider the value of having fully representative samples to be of more importance than risking overly sensitive models. Thus in one sense, one could say that the results are fully generalizable to the Swedish context, as the period of study is recent and many conditions could be assumed to be constant. The wide scope of the study and the theoretic generalizability of the metrics used should vouch for some generalizability of results to similar populations of firms in other countries and time-periods, even if normal caveats with regards to cultural and contextual differences would naturally apply.

7.3 Theoretical and Methodological Contributions

This study has made a first attempt to break down the theoretical construct of absorptive capacity into subcomponents approximated by (a) individual-level knowledge, and (b) organizational tenure. It is argued that standard measures of absorptive capacity were developed on and for established firms and not suitable for entrepreneurship research, and that this research has proceeded to develop variables that enable the longitudinal measurement of our constructs for new and small firms. That our absorptive capacity constructs have different effects and magnitudes which are evident in our summary of results above. This is an important contribution for researchers of knowledge-based entrepreneurship: that absorptive capacity and other dynamic capabilities might have differential impact in different industry settings is a realization that requires further study.

7.3.1 Contribution to the Literature on Entrepreneurship

The contribution of this study to the entrepreneurship literature is to add to the growing body of knowledge on frameworks for assessing new firm survival and performance. Many established frameworks suffer from neoclassical assumptions, lack of agency, or are tautological in that they do not predict *ex ante* the characteristics of successful new firms. In addition, the lack of small-firm relevant operationalizations and the static applications or bias towards focusing on the individual entrepreneur has

hampered the development of knowledge relating to how the dynamics of knowledge can affect the prospects of survival and performance of new firms. Knowledge-intensive industries are of increasing importance and interest to researchers as well as policy-makers, and empirical research further exploring the causes of survival and performance has been called for. This research contributes to the empirical entrepreneurship literature, building on the longitudinal work that is emerging. The longitudinal data and research design both allows for a more dynamic model than a cross-sectional panel, and provides more robust results due to the fact that it eliminates survivor bias which is a common flaw found in studies of successful new firms. One contribution of this dissertation is support to the notion that internal factors relating to the knowledge and capability seems to have more explanatory power for survival and performance than industry membership and external factors. This does not in any way reduce the validity of external or demand-side schools of new firm performance, but the results indicate that internal factors have relatively more predictive value.

By developing a model and finding robust results both relating to the initial hypotheses but also by showing that the effects of absorptive capacity and resulting patterns of new firm survival and performance are heterogeneous across performance metrics, this dissertation contributes to entrepreneurship research by opening up a number of avenues for future research incorporating parallel assessment of survival and other performance measures. By thus verifying that drivers of performance also reduce the risk of termination of new firms, this research contributes by challenging the widespread implicit assumption that strong performance is naively and normatively always a positive outcome for the new firm and calls for increased attention when comparing results from multiple studies of new firm performance. Declaring a driver of new firm performance without verifying that risk of new firm termination is also reduced can not be considered robust results.

7.3.2 Contribution to the Literature on Absorptive Capacity

This study also provides significant contributions to the literature on dynamic capabilities in general and absorptive capacity in particular. First, the issue of measuring strategic organizational capabilities directly in new firms has been largely overlooked and understudied. I address this by deconstructing absorptive capacity into measurable and valid components, thus extending and elaborating on absorptive capacity theory. Secondly, the absorptive capacity literature is plagued by a lack of empirical research and applications of the theory, especially with regards to small- and medium sized firms. This study contributes to the thin but growing body of empirical firm performance-oriented absorptive capacity research, additionally applying a longitudinal research design which is called for but rarely seen in research on strategic dynamic capabilities. Finally, by demonstrating that different components have differential effects on firm performance and that these effects differ between firms active within manufacturing and service industries respectively, both indicating the validity of absorptive capacity as a theory to explain multiple aspects of firm performance, and opening up new avenues of research in precisely how large these effects are for different types of firms and industries.

7.4 Implications for Practitioners

The practical implications of this study are foremost of interest to individuals working with entrepreneurship on an aggregated level such as policymakers and investors.

7.4.1 Implications for Policymakers

The value of specific human capital – in this study in the form of individuals with technology and science education – cannot be overestimated for new firms in knowledge-intensive industries. It is proven vital both for survival and financial performance. On the demand-side of human capital one can deduce the importance of new firms having the capability to attract and employ skilled individuals. This boils down to the

recommendation for policymakers to remove as many obstacles and minimize the costs of hiring and employing people for new and micro-sized firms (<10 individuals). In most jurisdictions, the rules and costs related to employees is the same for large and small firms. From the view of the employee this is logical as one should not expect to have different conditions of employment. In reality however, the reality is such that small firms will abstain from hiring people as the commitments and costs of an additional employee often can threaten the very existence of the firm. At the same time job creation is often at the very core of the policymaker's mission. From the results of this study, one generic recommendation is thus to view new and micro-sized firms through a different lens and introduce and experiment with minimizing costs and commitments associated with hiring, as the results likely will be more successful firms and more jobs created on the aggregated level.

7.4.2 Implications for Investors and Lenders

Bankruptcy/business failure prediction and business risk modeling has been a major research field within corporate finance and accounting the last decades. In a literature review of the dominant methodologies used the last 35 years to predict business failure, it was established that the classical cross-sectional statistical methods and multivariate discriminant analysis (MDA) using financial data, e.g. the Altman's Z-Score and ZETA methods have been the most popular. These methods have some major limitations; (1) they use a dichotomous dependent variable; however business failure is not a well-defined dichotomy. (2) The sampling method has some problems as there is a risk of using non-random samples and thereby oversampling the failing firms, (3) classical models can be criticized because of problems relating to non-stationarity and data instability; in classical models it is assumed that the relationships among the variables are stationary over time. (4) The use of accounting information can be questioned, especially with regards to small and/or new firms, as there are doubts that these statements give a fair view of the financial situation in the firm. Finally (5) the selection of independent variables is problematic as there is a general lack of theory regarding independent variable selection in accounting, and a

purely empirical selection of variables may lead to overfitting and thereby an unstable model (Balcaen & Ooghe, 2006).

So there are some issues with the established business failure prediction models in general, and these drawbacks become even stronger when looking at new and small firms in particular as new ventures have shaky accounting data and often do not show positive cash flow and revenues until several years after their formation. Add to this the previously mentioned prevalence of lifestyle entrepreneurship – that many new ventures are founded for other reasons than economic profits, and thus would be more persistent in spite of suboptimal financial performance – and the use of purely financial models to predict business failures and thereby assess credit risks in new firms loses some relevance (Aldrich, 1999). For instance, one empirical study of 20,000 observations of German SME:s' credit data found that in credit risk assessment decision models including qualitative factors such as quality of management measured as the education and industry experience of top and middle management, dominated a purely quantitative model purely based on financial ratios in predicting credit risk default; i.e. the delayed or defaulted payment of an interest due to business failure. It should be noted that the qualitative variables were based on the subjective judgment of credit officers (Lehmann, 2003).

Coupled with a review on the small firm failure prediction that found that statistical models using firm-level data better predicted the probability of firm closure than human decision makers using the same information, there is an identified the need to develop a quantitative approach for the incorporation of otherwise qualitative variables to improve credit risk assessment for new firms on an aggregated scale (Keasey & Watson, 1991). The results from this study could help inform new business failure assessment by providing a valid theoretic framework on new firm survival and performance, as well empirically tested metrics and development suggestions for improving decision-making processes related to the assessment of risk in new ventures. Models based on or including

absorptive capacity and human capital metrics as the ones in this dissertation can be assumed to produce more precise and reliable results.

7.5 Limitations of the Study and Directions for Future Research

In conclusion, it is hopefully the watermark of a solid study that one is left with more questions than answers. Rather than the conclusion of a research issue, this study is to be seen as a platform for future research and the results open up a number of avenues for further research. Like every other empirical study, this has limitations that could undermine the validity of the results. Even if the data are unique in the sense that I am dealing with a multi-industry population followed over a period of 8 years, the variables and analyses are could be additionally developed. Further research could conduct more fine-grained analysis looking at additional independent as well as dependent variables. An avenue of deepened analysis could be to examine what effects, in addition to education, the length and type of individual previous work experience has on new firm survival and performance. The theoretical contribution would be stronger if I proceeded to validate the absorptive capacity measures on samples containing established SME firms, which is another area for further research. Currently a linear relationship between absorptive capacity and new firm performance is assumed additional studies are needed to determine if the relationship is linear or potentially curvilinear, and whether there exists an optimum level of absorptive capacity, for instance it has been proposed that too much organizational tenure reduces information processing and willingness to take strategic risks in teams (Sorensen, 1999). Investigating this through measuring and plotting the marginal effects of absorptive capacity is likely to be met by a high level of interest.

With regards to the model and variables used, a limitation is that this study does not include social networks or business relations i.e. consultants, board members, active owners or advisors, which are other likely sources of specific human capital and absorptive capacity. The size of informal networks of entrepreneurs and management teams have been found to have

a significant impact on the performance of fast-growing firms (Raz et al., 2007). In addition, formal or advisory board members with industry-specific management experience can offset the lack of industry or entrepreneurial experience with the founding team and employees (Kor & Misangyi, 2008). These aspects can be assumed to be especially important in knowledge-intensive industries such as business services and medium- and high-technology manufacturing. Further research could both aim at incorporating social network aspects into the absorptive capacity construct, and aim at explaining the marginal effect of this aspect on new firm survival and performance.

Recent studies have found that technological knowledge spillovers positively impact new product development and are more common in firms located in clusters, and also suggest that these firms due to stiffer competition are faster at generating organizational routines and processes (Gilbert, McDougall, & Audretsch, 2008). In light of this, one potential research issue would be to assess whether location in, and also the relative position within, a competitive cluster could be a moderating variable of absorptive capacity; both with regards to whether location increases the development of absorptive capacity and also whether it moderates its effect – it could be argued that of two new firms with similar levels of absorptive capacity, this would benefit the firm located in a cluster where technological spillovers are prevalent more.

The theoretic elaboration of absorptive capacity into individual-level and organizational-level absorptive capacity can and hopefully will be expanded upon. With regards to the metrics used these can be further developed; specific human capital could include measures of length and type of previous work experience. Organizational-level absorptive capacity could be expanded with other measures such as memberships in industry associations or certifications. Additionally, the variable for organizational tenure could be developed, lagging over one or a couple of years to assess if there are any lingering effects or whether there is a time-lag before performance effects can be seen. On a general level, it would be theoretically interesting to separate the absorptive capacity of the founder

or founding team, and that of other employees. One contribution of this study is to measure the dynamic aspect of absorptive capacity of all the employees including founders in all years and thus not only at time of startup. In addition, it would be interesting to investigate whether the performance impact of the founder or founders is consistent over time or whether there is a vintage effects; i.e. the impact of the founder or founders is stronger at time of startup but is overtaken by the impact of the other employees after some time. As a bridge to other theories of new firm performance presented previously, it would be of interest to assess if there is any correlation between absorptive capacity and entrepreneurial orientation; specifically organizational tenure could be assumed to work as a moderator of entrepreneurial orientation as organizational tenure has been shown to be a predictor of strong corporate values in other empirical studies. (Gruys, Stewart, Goodstein, Bing, & Wicks, 2008).

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9 Appendices

8.1. Absorptive Capacity Literature Review

Year	Authors and publication
1990	Cohen & Levinthal , *Administrative Science Quarterly*
1994	Boyton, Zmud, & Jacobs, *MIS Quarterly* Carlsson & Jacobsson, *Research Policy* Cohen & Levinthal, *Management Science*
1995	Buzzacchi, Colombo & Mariotti, *Research Policy* Mowery & Oxley, *Cambridge Journal of Economics* Roth, Jackson, *Management Science*
1996	Fiol, *Academy of Management Review* Keller, *Journal of Development Economics* Mowery, Oxley & Silverman, *Strategic Management Journal* Sharma, Kesner & Idalene, *Academy of Management Journal* Szulanski, *Strategic Management Journal* Veugelers & Kesteloot, *Journal of Economics*
1997	Brown, *Information Systems Research* Liu & White, *Technovation* Luo, *Organization Science* Veugelers, *Research Policy*
1998	Cockburn & Henderson, *Journal of Industrial Economics* Glass & Saggi, *Journal of Development Economics* Koza & Lewin, *Organization Science* Kumar & Nti, *Organization Science* Lane & Lubatkin, *Strategic Management Journal* Linsu, *Organization Science*
1999	Arend, *Strategic Management Journal* Decarolis & Deeds, *Strategic Management Journal* Lewin, Long, & Carroll, *Organization Science* Shenkar & Li, *Organization Science* Van den Bosch, Volberda & de Boer, *Organization Science* Veugelers & Cassiman, *Research Policy*
2000	Anand & Khanna, *Strategic Management Journal* Barringer & Harrison, *Journal of Management* Braunerhjelm, Carlsson, Cetindamar & Johansson, *Journal of Evolutionary Economics* Carayannis, Alexander & Ioannidis, *Technovation* Freel, *Small Business Economics* Hitt, Dacin, Levitas, Arregle & Borza, *Academy of Management Journal* Inkpen, *Journal of Management Studies* Kamien & Zang, International, *Journal of Industrial Organization* Navaretti & Tarr, *World Bank Economic Review* Sen & Egelhoff, *IEEE Transactions on Engineering Management* Sivadas & Dwyer, *Journal of Marketing* Steensma & Corley, *Academy of Management Journal* Steensma & Lyles, *Strategic Management Journal*
2001	Ahuja & Katila, *Strategic Management Journal* Alvarez & Busenitz, *Journal of Management*

	Andersson, Forsgren & Holm, *Organization Studies*
	Bayona, Garcia-Marco & Huerta, *Research Policy*
	Lane, Salk & Lyles, *Strategic Management Journal*
	Oliver, *Organization Studies*
	Reid, Bussiere & Greenaway, *International Journal of Management Reviews*
	Sarkar, Echambadi & Harrison, *Strategic Management Journal*
	Sorenson & Sorensen, *Strategic Management Journal*
	Stuart,SMJ Tsai, *Academy of Management Review*
	Vermeulen & Barkema, *Academy of Management Journal*
	Yli-Renko, Autio & Sapienza, *Strategic Management Journal*
2002	Alavi & Tiwana, *Journal of the American Society for Information Science and Technology*
	Andersson, Forsgren & Holm, *Strategic Management Journal*
	Buckley, Clegg & Wang, *Journal of International Business Studies*
	Ireland, Hitt & Vaidyanath, *Journal of Management*
	Kaiser, *International Journal of Industrial Organization*
	Malecki, *Urban Studies*
	Martin, *Journal of Economics*
	Reuer, Zollo & Singh, *Strategic Management Journal*
	Zahra & George, *Academy of Management Review*
	Zahra & George, *Information Systems Research*
2003	Araujo, Dubois & Gadde, *Journal of Management Studies*
	Borgatti & Cross, *Management Science*
	Brown, Dev & Zhou, *Journal of International Business Studies*
	Cummings & Teng, *Journal of Engineering and Technology Management*
	Draulans, deMan & Volberda, *Long Range Planning*
	Filatotchev, Wright, Uhlenbruck, Tihanyi & Hoskisson, *Journal of World Business*
	Gittelman & Kogut, *Management Science*
	Griffith, Redding & Van Reenen, *Scandinavian Journal of Economics*
	Holmqvist, *Organization Studies*
	Ireland, Hitt & Sirmon, *Journal of Management*
	Liao, Welsch & Stoica, *Entrepreneurship Theory and Practice*
	Minbaeva, Pedersen, Bjorkman, Fey & Park, *Journal of International Business Studies*
	Nicholls-Nixon & Woo, *Strategic Management Journal*
	Pinch, Henry, Jenkins & Tallman, *Journal of Economic Geography*
	Reagans & McEvily, *Administrative Science Quarterly*
	Rondinelli & London, *Academy of Management Executive*
	Santos, *Technological Forecasting and Social Change*
	Song, Almeida & Wu, *Management Science*
	Sorescu, Chandy & Prabhu, *Journal of Marketing*
	Spencer, *Strategic Management Journal*
	Traore & Rose, *Research Policy*
	Uhlenbruck, Meyer & Hitt, *Journal of Management Studies*
2004	Bathelt, Malmberg & Maskell, *Progress in Human Geography*
	Dhanaraj, Lyles, Steensma & Tihanyi, *Journal of International Business Studies*
	Fichman, *Information Systems Research*
	Griffith, Redding & Van Reenen, *Review of Economics and Statistics*
	Hatch & Dyer, *Strategic Management Journal*
	Hitt, Ahlstrom, Dacin, Levitas & Svobodina, *Organization Science*
	Iwasa & Odagiri, *Research Policy*
	Jarzabkowski, *Organization Studies*
	Lenox & King, *Strategic Management Journal*
	Lim, RP Mayer & Argyres, *Organization Science*
	McEvily & Eisenhardt & Prescott, *Strategic Management Journal*
	McFadyen & Cannella, *Academy of Management Journal*
	McGrath & Nerkar, *Strategic Management Journal*
	Meyer, *Journal of International Business Studies*
	Negassi, *Research Policy*

	Nerkar & Roberts, *Strategic Management Journal* Oxley & Sampson, *Strategic Management Journal* Rothaermel & Deeds, *Strategic Management Journal* Simonin, *Journal of International Business Studies* Tallman, Jenkins, Henry & Pinch, *Academy of Management Review* Tijssen, *Research Policy* Wang, Tong & Koh, *Journal of World Business*
2005	Dushnitsky & Lenox, *Strategic Management Journal* Dushnitsky & Lenox, *Research Policy* Frost & Changhui, *Journal of International Business Studies* Haas & Hansen, *Strategic Management Journal* Hoang & Rothaermel, *Academy of Management Journal* Jansen, Van Den Bosch & Volberda, *Academy of Management Journal* Malhotra, Gosain & El Sawy, *MIS Quarterly* Penner-Hahn & Shaver, *Strategic Management Journal* Phan, Siegel & Wright, *Journal of Business Venturing* Rothaermel & Thursby, *Research Policy* Wright, Filatotchev, Hoskisson & Peng, *Journal of Management Studies* Zahra, *Journal of International Business*
2006	Berry, *Strategic Management Journal* Caro, Archontakis; Gutiérrez-Gracia & Fernández-de-Lucio, *Research Policy* Eun, Lee & Wu, *Research Policy* Hewitt-Dundas, *Small Business Economics* Lavie & Rosenkopf, *Academy of Management Journal* Mueller, *Research Policy* Phene, Fladmoe-Lindquist & Marsh, *Strategic Management Journal* Rickne, *Small Business Economics*
2007	Allen, Link & Rosenbaum, *Entrepreneurship Theory and Practice* Arbussà & Coenders, *Research Policy* Björkman, Stahl & Vaara, *Journal of International Business Studies* Garcia-Morales, Ruiz-Moreno & Llorens-Montes, *Technology Analysis and Strategic Management* Motohashi & Yun, *Research Policy* Mueller, *Small Business Economics* Nooteboom, van Haverbeke, Duysters, Gilsing & van den Oord, *Research Policy* Pacheco-de-Almeida & Zemsky, *Management Science* Salk & Lyles, *Journal of International Business Studies* Todorova & Durisin, *Academy of Management Review* Zhang, Baden-Fuller & Mangematin, *Research Policy*
2008	Bergh & Lim, *Strategic Management Journal* Escribano, Fosfuri & Tribo, *Research Policy* Gilsing, Nootebom, Vanhaverbeke, Duysters & van den Oord, *Research Policy* Knott, *Management Science* Ramani, El-Aroui & Carrère, *Research Policy* Spanos & Voudouris, *Research Policy* Tether & Tajar, *Research Policy* Zahra & Hayton, *Journal of Business Venturing*
2009	Gomez & Vargas, *Research Policy*

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