Most policy-makers and academics acknowledge that new firms are vital for the prosperity and renewal of economies and the generation of new innovations. However, scholars and practitioners alike still have limited knowledge about how new firms are able to develop and launch innovations. This is surprising given that innovation is an important means of competition and growth for new firms, especially in industries where customer demands and technology fluctuate frequently.

This dissertation examines why some new firms are able to innovate while others are not. In doing so, the study builds upon conceptual arguments concerning the absorptive capacity of firms (i.e. their knowledge acquisition, assimilation, transformation, and exploitation activities) and longitudinal empirical data from over 300 new firms in the Swedish TIME sector. The detailed findings help to open up the “black box” relationships among different capabilities and types of knowledge (e.g. market and technological) in order to explain innovation, as well as how growth willingness and environmental dynamism affect these relationships. The results thus shed light on central questions in Entrepreneurship research as well as how entrepreneurs can purposefully affect the innovative behaviour of their firms.
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ALEXANDER McKELVIE

Innovation in New Firms
Examining the role of knowledge and growth willingness
Innovation in New Firms: Examining the role of knowledge and growth willingness
JIBS Dissertation Series No. 038

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ISSN 1403-0470
ISBN 91-89164-75-X

Printed by ARK Tryckaren AB, 2007
Acknowledgements

In an almost ironic way, this book marks both a beginning and an end for me. After defending this doctoral dissertation in June, I will officially begin my research career as an Assistant Professor. This means a number of changes in my life and work situation, including the fact that I will move to Syracuse, New York to embark on this career. I look forward to the new adventures and further opportunities that await on the other side of the Atlantic.

However, this book also signals the end of my time in Jönköping. I have had the privilege of being at JIBS since the fall of 1999. After only a short time here, I realised that there was something special about JIBS. One thing that sticks out in my mind is that working at JIBS has provided a large number of opportunities for me that other business schools could not have offered. Included in this is the fact that many top international researchers find their way to JIBS. Thanks to these visits, I began collaborating on research projects and articles with many of the researchers that I first met at JIBS. This work has greatly influenced my thinking and writing. I have also made many friends during my years in Jönköping; it is not always easy being a foreigner in a new country. I cannot think of one person at JIBS who did not make me feel welcome however. For this, and other things, I am very grateful for all that JIBS has done for me.

I am further indebted to many people for their help and support while I worked on my dissertation. Leona Achtenhagen and Lucia Naldi formally provided me with valuable feedback during the earlier stages of my research project, but also informally during later stages. Karin Hellerstedt and Börje Boers provided constructive comments on my dissertation on a number of occasions. Anna Jenkins, Karl Wennberg, and Elin Mohlin helped with data collection in different ways. Steve Edelson and Jens Hultman offered moral and social support, including video games, unhealthy food, malt beverages, and helping to form my recent addiction to coffee. Steve also helped me with language issues. Dean Shepherd provided sound career advice once upon a time. This dissertation would be radically different without his timely candour. Gerry George did an excellent job as the discussant at my final seminar. His useful comments helped me improve the quality of my dissertation. Shaker Zahra also provided useful comments on my work on different occasions. Both Gerry and Shaker have been, and remain, extremely influential on my thinking via their excellent scholarly work. I hope that I one day can reciprocate their help.

Robert Picard and the Media Management and Transformation Centre provided financial support for my research. Robert also made sure that I was able to present my work at the leading media management conferences,
introduced me to a number of media scholars, and provided a platform to build my research skills. Robert has unselfishly shown me much generosity.

I owe a great amount of thanks to Per Davidsson. He was responsible for first recruiting me to do research at JIBS and for providing me with many of the necessary tools to conduct Entrepreneurship research. He also taught me a very valuable lesson – “research is a human endeavour”. It is this advice, and the style of his excellent book *Researching Entrepreneurship*, that prompted me to write my dissertation in a more personal style, showing my own journey and thoughts during all stages of the research process. Per is an excellent scholar and role model.

Gaylen Chandler has helped me in many ways. He took me under his wing during the early years of my Ph.D. education and allowed me to work with him on a number of conference papers. He was always very patient, understanding, and constructive with me, even when I was very much a “rookie”. More than anything else, Gaylen always had a positive attitude towards my writing and ideas. It is very much thanks to him that I expanded my research interests beyond my dissertation project. Gaylen has been a fantastic mentor.

My main supervisor Johan Wiklund has been unnecessarily generous with his time while I worked as a research assistant and as a Ph.D. candidate. Johan provided me with frequent and timely feedback, even when my ideas were not quite refined. He showed a guiding hand in the early years, and encouragement and inspiration throughout. I have said a number of times that I could not imagine myself with any other supervisor. It still holds true. This research project would not be the same without Johan’s supervision.

My family has put up with me for, well, my whole life. Over the past few years though, they have endured me being extra self-absorbed and not very good at keeping contact. I doubt that I will ever succeed at expressing my gratitude and love for everything they have done for me during my lifetime.

The lovely and talented Lena Blomqvist has been a truly wonderful partner. She helped me with practical issues, including many hours of work on the layout, design, and language of the dissertation and the survey. She also stood by my side during all of the highs and lows that come with writing a dissertation, even when it meant cancelled weekends, lost nights, and travel for job interviews and conferences. She has consistently made sacrifices for my sake. I am delighted that she loves me just as much as I love her.

Jönköping, May 2007
Alex McKelvie
Executive Summary

Innovation is an important means of competition and growth for new firms, especially in industries where customer demands and technology are fast-changing. Surprisingly, little is known about how new firms acquire and use knowledge in the pursuit of innovation. Previous research has prioritised large, established firms, and therefore overlooked many central issues for new firms, such as their willingness to grow. In addition, the methods employed in previous research (e.g. case studies or proxy measures for key concepts) do not truly capture the in-depth behaviours underlying how firms acquire, assimilate, transform, and exploit their knowledge. This dissertation attempts to fill these research gaps by examining the role of knowledge and growth willingness on innovation using a longitudinal study of over 300 new firms in the Swedish TIME sector (Telecom, IT, Media, and Entertainment).

The results indicate that the innovation of new firms is largely explained by the firms’ knowledge-based capabilities and growth willingness. The detailed empirical findings also help to open up the “black box” relationships among different capabilities and types of knowledge (e.g. market and technological) in order to understand how these factors work together to increase innovation. Furthermore, the results show that growth willingness and the technological dynamism of the industry work as causal factors in the deployment of capabilities. This has implications as to intentionality in the development of capabilities and absorptive capacity in new firms.

In sum, this dissertation provides novel insights into the value creation activities of new firms and to research concerning knowledge, capabilities, absorptive capacity and Entrepreneurship.
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1 Introduction

1.1 A tale of two companies

Based on their negative experiences with the theft of mountain bikes and the high price of new computers at that time, two former JIBS students, Andreas and Mattias, came upon the idea of developing a lock-like device that would protect desktop computers. As neither Andreas nor Mattias had sufficient engineering or computing skills, they were introduced to a pair of German engineers. These four thus formed the firm HanzOff, whose product would prevent anyone from using a computer if it was stolen. The product consisted of a universal card (i.e. works on all computers) that sends out an electrical pulse to the PCI-operated functions (e.g. graphics card, motherboard), as well as the IDE buses upon opening of the computer chassis. The electrical pulse, often compared with the pulse sent out by pager-like technology, would destroy the functionality of these devices. The destroying of the IDE buses prevents the motherboard from transmitting information between the different units of the PC, for example the hard drive and the CD-ROM drive. By disabling these components, the computer would no longer be operational, the software and hardware could not be used and any information or proprietary knowledge would be eliminated. In addition, a smart card would be included in the package, which would allow corporate administrators to deactivate the card in case of repair, or any other occasion when the chassis would be opened.

Mattias and Andreas spent substantial time trying to devise appropriate target markets and potential customers. The prospective customers that HanzOff spoke to, primarily in knowledge-intensive industries, thought that the product idea had potential. Companies in these industries, such as management consultants, Internet companies and other high-technology firms, were on the rise. Sweden in particular saw an increase in the number of companies that had knowledge as their primary source of competitive advantage at that time. For them, the knowledge and information saved on the hard drive at work would be imperative for the company’s success and would thus need to be protected.

The German engineers were assigned responsibility for product development. Although the idea for the product was clear from the get-go, the technology and specifications were still hazy. It had been the Swedish entrepreneurs who had come up with the idea of how it would work. Although the engineers had the basic functioning taken care of, the more detailed work with the sensor and
software communication aspects needed to be prepared. This required further testing, research, writing more specifications, and then building a prototype. Finally, after developing four different functioning prototypes, they had figured out a final prototype that they felt had top-of-the-line technology. Price considerations needed to then be taken into consideration so that the potential customers’ demands could be met.

During the time it took to develop the working prototypes, Mattias and Andreas were involved in growing the company. The majority of the time they looked to attract further venture capital and arranged for more peripheral considerations for the firm, such as a new, larger office space, the hiring of lower level employees and hiring a new external CEO.

As negotiations were taking place for the product to begin mass production, Mattias and Andreas were working to sell to the potential customers whom they had previously targeted. They found substantial resistance. To begin with, any proprietary information that had traditionally been saved on the hard drive of a computer was no longer saved there. During the time it took to develop the product, companies had adopted a network system for storing files. No basic PCs would have corporate secrets saved exclusively on their hard drives, but would instead be shared with others in the company by way of the network. The only computers that potentially could be taken for information purposes were laptops. Although HanzOff had further thoughts about developing a prototype for laptops, the existing product was not yet compatible. Secondly, the price of a PC had decreased dramatically; whereas hardware was once a major investment for many firms, increased competition in the PC market had driven costs down sharply. Older computers were moreover worthless in terms of computing capacity and re-selling ability. If the PCs were going to be replaced, as HanzOff had hoped, the new computers came cheaply. In addition, component parts could be purchased extremely inexpensively from generic producers. So, there was no longer a need to protect hardware or components as valuable assets. As a whole, those companies that HanzOff had proclaimed to be their target market no longer had a need for the product, especially with such a relatively high price. This lack of need came from technological changes (i.e. advances in network memory), reduced prices, and the inability of older computers to retain their value. Only a few months after they were ready to sell to customers, the board of directors for HanzOff decided that HanzOff would be liquidated and closed down.

The second story, this time concerning Buyonet, began when Freddy stumbled across a market inefficiency concerning traditional software distribution. The physical distribution of software took a very long time from production to delivery and involved a number of logistical nightmares. His company, Buyonet, was built around the idea of delivering software electronically,
Introduction

without the hassle of waiting times or problems with shipping. At the same time, by delivering electronically via a store, Freddy’s firm could reach the whole world.

The Buyonet operating system platform, the underlying technology that permitted customers to download software, allowed payment in 34 currencies, navigation in six languages, had anti-fraud reporting, and had four options of payment, including telephone, fax, and on-line methods. The technology recognized the country from which the visitor was surfing and could set the culture parameters accordingly. Therefore, Freddy and Buyonet had learnt how to solve some of the major problems of e-retailers before they emerged. The operating system was moreover rather flexible in terms of the programming behind it. This meant that future programming developments would not render the thousands of hours of code obsolete.

At first, Buyonet sold almost exclusively to end customers. They had titles from over 170 different publishers and customers in 22 different countries. However, based on increasing demand from software publishers who wanted to have their own stores and other firms who wanted to start on-line software stores in their home countries, Buyonet branched out to those markets as well. Accordingly enough, as new types of customers emerged, increased demands for further technical support followed. In response to this, the number of programmers and designers at Buyonet was augmented. Their job was to deal with the mounting requests for small changes to websites and with further tinkering. Programmers and designers spent almost their entire time making small incremental changes to the new websites ordered by new customers. At times though, some more radical changes were demanded. The customer information and requests often came from the sales staff in the U.S., which was then transferred over to the Gothenburg office to be carried out.

Through this continuous tinkering and modification to websites, the programmers learned the operating system and web design in detail. They became able to increasingly quickly adapt the technical side to the customer’s requests. Staff were encouraged to participate in courses and attend conferences in order to learn more about how to potentially better serve customer needs. Buyonet OS, in the end, became very much an evolving technology, where there were no “new releases from scratch” of the whole system, but rather some minor and fundamental changes all the time. The advantage of this was that it was extremely well adapted to what Buyonet wanted to do. The disadvantage was that it was non-standardized technology. That meant that any new external programmer would not be able to come in and manage the system, but would rather have to learn the “Buyonet-way” first.
David Bowman, the Vice President of Corporate Development, looked at further expanding the business. He found that Buyonet could use the same technology platform to sell other products, not only software stores. For example, new markets were developing in markets such as e-books, music, film, games and the like. The technological platform was able to handle these types of transactions as well, meaning that they could build stores for those markets. So David attended a number of conferences in these areas, used his contact network to see and discuss with the leaders and publishers in these markets and basically kept informed about these new possible opportunities. One initiative that he led, based on the input from the programmers and the software publishers, was to start a subsidiary that would manage the relationships between software publishers and the plethora of re-sellers. These on-going initiatives helped Buyonet on its journey towards profitability.

1.2 Connections and implications

The two empirical tales above illustrate some of the challenges of entrepreneurship in fast-changing markets. However, at the most basic level, they both essentially revolve around one main question: Why are some new firms able to innovate while others are not? After collecting data and analysing the cases of HanzOff and Buyonet in 2001, I began to truly, deeply try to comprehend what separated these two companies. When making sense of their individual behaviours, I noticed a few things. One of the primary things that I noted was that while both firms had knowledge that led to their original opportunity and attempts to reach the market, there were some differences as to how further knowledge was acquired and used within the firm. For HanzOff, they did not acquire much knowledge from the market. The technological knowledge that the German engineers acquired was not shared with the Swedish entrepreneurs. In the case of Buyonet, there were a number of meetings between different areas of responsibility and challenges for the programmers to meet changing customer demands. For Buyonet, it seemed as though knowledge was constantly acquired, shared, and then used for something new in the future.

A second observation that I made was that the environment, and in particular the fast-changing nature of the environment, had a role in the behaviour and innovative activities of the firms. Buyonet was constantly on the lookout for other ways to apply their knowledge to new emerging markets. They were also constantly seeking new technological approaches that helped them run their business. In their world, the environment provided further opportunities for expansion. For HanzOff, the changing nature of the environment led to their product not being successful as customer tastes had changed during the time it
took to develop and get their product to market. So, for HanzOff, the changing market had a direct effect on them going out of business.

Having originally drawn these preliminary conclusions based on the empirical observations approximately five years ago, I decided to look further into the literature to refine my understanding of the situations. My intention was to find further guidance and theoretical explanations for why these two stories that had started out somewhat similarly ended very differently.

There were a few salient streams of literature that I found most compelling. The first streams, and the ones that provided what I felt were the best explanations of the firm-level behaviour of these two firms, were those of capabilities (e.g. Kogut & Zander, 1992; Henderson & Cockburn, 1994) and absorptive capacity (e.g. Cohen & Levinthal, 1990). The capabilities viewpoint fundamentally studies the resources and activities (e.g. resource deployments) of firms and argues that there is large heterogeneity between firms in these regards. My conclusion was that some firms have and use their capabilities to create further value while others did not have or did not use these capabilities. The growing literature on absorptive capacity looks at the ability of firms to use, transform, and exploit knowledge. This area of research sheds light on the fact that gaining knowledge of the market and of technology, and how it is incorporated into the firms, is vitally important. While there were and still are some differences between these streams and the on-going discussions within them, I perceived them as encompassing the most important aspects of the cases. In addition, they both focused very much on the action of firms, and primarily concerning their knowledge. These views did not simply examine the resources and experiences that firms had, but rather the flow of activity.

Another stream of research looked more closely at the nature of the external environment of firms. At that time, there was increased discussion of the pace and direction of technological development. With the advent of the Internet and growing IT-bubble, a vast amount of the literature dealt with the changing nature of the environment. From the academic world, Bettis and Hitt (1995) wrote specifically about the increasing difficulties of predicting the future, technological revolutions, and globalisation. Sampler (1998) discussed the overlapping and blurred nature of industries, the inability of firms to clearly define competitors, and the rapidly appearing and disappearing “windows of opportunity” that stemmed out of this blurring. One central conclusion from the articles in this field was that innovation was the key to success in fast-changing markets (Deeds, DeCarolis & Coombs, 1999; Schoohoven, Eisenhardt & Lyman, 1990).

Interestingly, there were some overlaps between these two fields. For instance, some authors focused their attention on the increasingly important role of
knowledge in dynamic markets (e.g. Grant, 1996a) and in particular, the augmented applicability and usefulness of knowledge as a resource in driving firm-level innovation. Other authors examined the importance of capabilities in dynamic markets. Teece, Pisano and Shuen (1997) and Eisenhardt and Martin (2000) provide important conceptual insights into how capabilities constitute the source of innovation, and in particular that capabilities affecting resource deployments of firms are the source of competitive advantage in high velocity environments. They call these dynamic capabilities.

Despite my fascination for these areas of research, I still had my doubts as to how effective they were at explaining differences between Buyonet and HanzOff due to a few reasons. One of the key qualms I had with this area of research was related to both the empirical and theoretical sides of the literature. The vast majority of the studies of capabilities and absorptive capacity dealt with large and established firms, most of whom were international in nature (e.g. Eisenhardt & Martin, 2000; Dougherty & Hardy, 1996). Both Buyonet and HanzOff were new firms and did not have the same resource or personnel bases as did large firms. They certainly did not have specially dedicated departments and subsidiaries to work on innovation either, or millions of dollars to invest in R&D, as described in some of the literature. Many authors (e.g. West & Meyer, 1997; Zahra & Bogner, 1999; Deeds, DeCarolis & Coombs, 1999; Li & Atuahene-Gima, 2001) made a point of arguing that new firms needed to constantly release new products and leverage their capabilities in order to survive and grow. Acquiring and using new knowledge were central in this regard (DeCarolis & Deeds, 1999). Zahra, Ireland and Hitt (2000) also argued that the process by which knowledge is acquired and used by new firms is not necessarily the same as for established firms. Yet, specific examination of new venture capabilities and knowledge surprisingly remained absent.

Moreover, new firms, as I had read in the Entrepreneurship literature, were often hindered from behaving as innovatively or as flexibly as they ideally might. They were adversely affected by liabilities of newness, such as a lack of funds, a lack of routines, a lack of legitimacy, and frequently a lack of knowledge (Stinchcombe, 1965). At the same time, new ventures were described as being particularly sensitive to their respective business environments compared to their more established competitors (Grant, 1995; Anderson & Tushman, 1990). This was especially true for fast-changing environments where the pace of change cannot be matched if technological capabilities are lacking (Zahra & Bogner, 1999). In addition, early work that I was involved in (e.g. McKelvie & Chandler, 2002) and that carried out by many of my colleagues (e.g. Davidsson, Wiklund, Delmar), showed that the behaviour of new firms varied greatly depending on the growth intentions of the firms. The majority of new firms do not want to grow to any major extent. For large firms with heavy shareholder demands, profitability and growth are
commonly prioritised goals. I was not certain how growth willingness in new firms played out for the use of capabilities and the intention to innovate. Previous research has shown that many new ventures and small firms are not interested in pursuing growth (Wiklund, Davidsson & Delmar, 2003). It is possible that such goal-oriented behaviour influences the capabilities and innovative behaviour of firms. In other words, further consideration of many of the internal and external conditions pertinent and relevant for new firms remained unattended to in this literature. This provided additional doubt as to how effective the theoretical arguments were for understanding and predicting the capabilities, knowledge usage and innovation of new firms and therefore analysing the cases of Buyonet and HanzOff.

Aside from the lack of consideration of new firms, I felt that there were two major gaps in the extant literature. Firstly, I felt that there was little empirical work done that truly supported the assertions laid out in the literature. For instance, at that point, the capabilities field did not have any convincing operational measurements that captured the fundamental ideas that they thought to test. This was, and to some extent still is, true for the dynamic capabilities stream of literature, where the focus is more and more on the evolutionary nature of the behaviours and the “routines to change routines” conceptualisation. The few empirical attempts that were made for both the “regular” and the “dynamic” capabilities fields were generally via the case study method. The drawback of this was that there was no clear connection between capabilities and innovative output. The same empirical weakness was true for the absorptive capacity literature. The best and most cited attempts at capturing this concept used proxy measures such as R&D spending, R&D intensity, and the number of patents as measures. Zahra and George (2002) provided more guidance as to how to look at absorptive capacity by dividing the concept into knowledge acquisition, assimilation, transformation and exploitation, but their examination was only theoretical in nature. Nevertheless, their work provides a coherent guiding light for understanding what goes on within these firms. I call the four concepts that they bring forward (i.e. Acquisition, Assimilation, Transformation and Exploitation) knowledge-based capabilities as they focus on the activities and behaviours involved in the deployment of knowledge. My conclusion based on the empirical studies was that researchers were not really getting at the key thoughts behind the theories, like the action, flow, and knowledge aspects. The result was therefore that the empirical studies were not truly testing the effectiveness of the theories.

Secondly, many of the studies only examined the direct effects of capabilities on some sort of performance outcome (e.g. Henderson & Cockburn, 1994), not the relationship between different capabilities. In general, these studies looked at singular capabilities and sought out whether they, individually, helped in improving the performance of the firm. I had noted in the case of Buyonet that
the knowledge they had acquired was first spread around to others within the same functional area. This same piece of knowledge was then used in pushing either the programmers or the sales people to think of new ways to apply this knowledge, before eventually concretely being used in a new product or service to the customer. That is, there seemed to be an underlying process behind the scenes that was not captured in the studies I examined. However, some authors in peripheral areas, such as Corporate Entrepreneurship, actually highlighted that such a process existed. Zahra, Nielsen and Bogner (1999), Zahra, Jennings and Kuratko (1999), Kazanjian, Drazin and Glynn (2002), among others, referred to this as a “black box” that was central to our understanding of innovation and sustainable advantage.

1.3 Purpose of this study

With these observations and conclusions in mind, I feel it desirable and valuable to extend the theoretical knowledge to the context of new ventures, at the same time as trying to shed light on some of the deficiencies of the existing literature. In particular, the purpose of this study is to evaluate the extent of the effects of knowledge-based capabilities and growth willingness on innovative output in new firms. Within this main research endeavour, I also intend on determining the indirect effects of knowledge-based capabilities on innovative output via their relationships amongst each other.

I attempt to answer these questions by studying a sample of new firms. I define a new firm by its age. In line with Yli-Renko, Autio and Sapienza (2001) and others, I define a new firm as a firm that is ten years of age or less. As is discussed in the method section, I primarily am interested in independent firms but my sample includes firms that are subsidiaries and/or are owned by venture capitalists. This empirical study uses a longitudinal design and is quantitative in nature. The longitudinal design is comprised of two surveys sent out one year apart, allowing me to have a more causal approach to the role of knowledge-based capabilities and innovation. The questions used to measure knowledge-based capabilities focus on the activities of the firm.

Why is this area of inquiry important? To begin with, the success and growth of new firms is important for society. New firms have long been considered a very valuable part of the economy. Studies as early as Birch (1979) presented that new firms were vital in the creation of new jobs. Davidsson, Lindmark and Olofsson (1994) find similar results for the value of new firms in Sweden. New firms are also credited with being the leaders in developing new breakthrough innovations that drive the economy and technological frontier forward (Schumpeter, 1934; Utterback, 1994), creating new industries (Acs & Audretsch, 1990), as well as generating the technologically superior products
that we now rely upon (Tushman & Anderson, 1986; Utterback, 1994). Some
new ventures in dynamic markets provide exceptional growth that more
traditional firms could not achieve (Cooper, 1986). Many of the fastest growing
firms inhabited industries or sectors that were only taking shape or created new
high-potential industries (Covin & Slevin, 1989; Eisenhardt & Schoonhoven,
1990). Their growth can closely match the fast-paced development of their
industries, including the development of dominant designs (Cooper, 1986;
Utterback, 1994; Autio, 2000). Innovation is a common means for growth
(Nerkar & Roberts, 2004; Lyon, Lumpkin & Dess, 2000), especially as returns
from original products decline and customer demands change. Considering the
value of new ventures to society and to the business world, it is in the best
interest of policy makers, as well as the entrepreneurs managing the firms, to
have the firms prosper, and for researchers to understand how to maximize the
value creation of these firms via identifying how they innovate. In fast-changing
markets especially, being able to pin-point the capabilities behind new firm
innovation is particularly urgent for new ventures as this may be their only
means of prosperity, let alone survival.

Furthermore, this area of examination responds to the call for more increased
efforts in understanding the creation of new economic activities of firms. Shane
and Venkataraman (2000), in their well-known staking out of
Entrepreneurship as a field of research, argue that further inquiry is needed
concerning why, when and how the creation of goods and services come into
existence and why, when and how some people are not others discover and
exploit opportunities (p. 128). Specifically at the firm level, Stevenson and
Jarillo (1990) argue that the how questions of entrepreneurship, which my
research essentially examines, are one of the three most valuable areas of
Entrepreneurship. Scholars studying issues such as entrepreneurial orientation
(e.g. Lumpkin & Dess, 1996) and Corporate Entrepreneurship (e.g. Zahra,
Jennings & Kuratko, 1999) maintain that addressing these issues lies at the
heart of understanding firm growth, innovation, and financial performance.
These topics are important for scholars and practitioners alike.

The focus in my research (with innovation as the dependent variable) is related
to these calls by looking at the knowledge-based capabilities and growth
willingness of firms in exploiting perceived opportunities. While studies of
“opportunity discovery” can produce some valuable knowledge, they do not
necessarily get at the value-creation to society and to the firm that only occur
once action is taken (Stevenson & Jarillo, 1990). That is, the action aspects of
these studies are not always central; this is one explanation for why cognitive
and psychology-based studies have been so influential in “discovery” work (e.g.
Baron & Ward, 2004). Davidsson (2004) argues that entrepreneurship is about
new economic activity, not opportunity discovery. The activity, in the case of
my research, is the deployment of knowledge-based capabilities and their
subsequent effect on innovation. I argue that this is at least partially prompted by the growth willingness of the firm. This outcome view corresponds to what Schumpeter (1934) describes as the entrepreneurial function. In my opinion, further research into the role of new firms in value creation and new economic activity provide a clearer picture of how these activities go about and their effect on the firm.

1.4 Intended contributions

With the purpose of the research clarified, I now turn to the specific intended contributions of my work. As for any academic research study, there should be a number of contributions made to the salient literature. In addition, for research within Business Administration, it is also important to have implications for practitioners; this provides some benefit to the managers who take their time to participate in the research, but also implies that there are lessons learned that can increase the performance of firms.

1.4.1 Contribution to theory

This dissertation contributes to the academic literature in two main ways. The first is that I investigate the role of knowledge-based capabilities, growth willingness and innovation in new firms. This is important for two reasons. To begin with, this area is generally understudied, despite the fact that the underlying issues are of prime interest to scholars from a variety of fields and to practitioners. Research has shown that innovation is a precondition for new firm growth (e.g. Brüderl & Preisendorfer, 2000). Yet there are only a few studies that examine these issues. Lynskey (2004) studied the characteristics of Japanese start-ups and their innovative activity. Heirman and Clarysse (2004) looked at intangible resources and innovation speed in new firms, while Deeds, DeCarolis and Coombs (1999) considered the geographic location and publishing records as links to innovation. Lee, Lee and Pennings (2001) remain the main study that I have found where the focus was on capabilities. However, they looked at new venture performance, not innovation. Therefore, we have limited knowledge of these issues in new firms. Trying to understand the internal factors and behaviours of new firms and their subsequent outcomes on innovation are important for comprehending new firms growth and performance.

Studying new firms also provides the opportunity to test the boundary conditions of existing theory. As I noted earlier, the vast majority of studies looking at knowledge, capabilities and innovation have focused on large, established firms. These studies subsequently exclude many of most relevant characteristics of new firms. Of prime interest is the effect of growth willingness
on capabilities and innovation. However, other internal issues, such as age, size, ownership, and perceived external task environments (i.e. market and technological dynamism), also fluctuate greatly among new firms. Covin and Covin (1990) observe that, “the simple fact that researchers study new ventures implies that age effects can be significant” (p. 39). As a whole, taking into consideration the distinctive issues of new firms, which I do, allows for increased testing of the viability of our existing theories of entrepreneurial behaviour, especially in dynamic markets.

The second contribution that I make is that I empirically unpack the appropriate concepts involved in the literature on knowledge-based capabilities and innovation. This contribution is based upon three foundational contributions. Firstly, I define and empirically measure knowledge acquisition, knowledge assimilation, knowledge transformation, and knowledge exploitation and their effects on innovation. Hereto few empirical studies capture these firm-level actions and their effect on innovation in a manner that allows for probability analysis. This study may therefore be seen as attempting to open the “black box” of capabilities and innovation with a large-scale quantitative study. This implies testing how well our existing theories work.

Secondly, I examine the inter-relationships between knowledge-based capabilities. Instead of assuming that the knowledge capabilities merely have direct impacts on innovation, I try to embrace the fact that there may be a sequential ordering to this. Zahra and George’s (2002) conceptual article provides input into the notion that there is a process involved. I test this.

Thirdly, I make a distinction between market and technological knowledge within this process. These are conceptually different. There has been a tendency to prioritise one of the approaches depending on the research traditions of researchers (e.g. Marketing researchers on market knowledge, technology management researchers on technological knowledge). By (consciously or unconsciously) looking at only one type of knowledge, the inherent differences between the two types are ignored. The few studies that do take both of these into empirical consideration are frequently qualitative in nature (e.g. Danneels, 2002) and therefore are devoid of statistical estimations.

My contribution to the literature on knowledge-based capabilities and innovation is aided by my choice of studying new firms. A number of researchers have suggested studying capabilities in new ventures as they often provide the opportunity to gather information from someone with full knowledge of the firm, and it is therefore easier to assess relationships between variables within these firms (Sorensen & Stuart, 2000; Autio, Sapienza & Almeida, 2000). For instance, the inherent size and complexity of established firms is removed; new firms are much simpler to study, relatively speaking.
(Kazanjian & Rao, 1999). This should allow for a closer understanding and observation of the capabilities at work. Spender and Grant (1996) note that the “variables which are most theoretically interesting are those which are least identifiable and measurable” (p. 8) Studying new firms simplifies part of this difficulty. Furthermore, some researchers have argued that innovation in new firms should be studied as new firms are less hindered by such restrictive issues as incumbent inertia, core rigidities, and competence-destroying innovation (e.g. Katila & Shane, 2005, Leonard-Barton, 1992). In sum, this study contributes both increased theoretical understanding of new firms but also a different lens through which to examine important but difficult to capture empirical issues.

1.4.2 Contribution to practice

There are naturally implications of this research to managers and other practitioners. The first and primary contribution is the value in clarifying the differential effects of the various knowledge-based capabilities on innovation. Of particular interest for managers is the effect of the different types of knowledge acquisition and transformation practices that take place within the firm. Often, managers are not familiar with the varying outcomes of certain firm-level activities and benefits of diverse sources of knowledge. The findings that I present provide managers with help in deciding where and how they can invest their time and effort, assuming that they want to innovate. Ethiraj, Kale, Krishnan and Singh (2005) argue that all firms must invest in the increased usage of capabilities if the firm is going to survive. Thus knowing what types of capabilities facilitate innovation is worthwhile. It is important to bring these effects to light for firms whose intention is to innovate and grow. I also tailor these implications to managers of new firms. This is an important distinction as much normative advice is dedicated to managers of large, established firms. I have already argued that new and primarily small firms may not be subject to many of the same issues as their more established counterparts.

This contribution may also be extended to venture capitalists, parent companies and others who would be interested in seeing new firms continue to flourish and be innovative. For owners, identifying factors that can lead to the increased capability of the firm to innovative may allow the firm to deliberately acquire or develop these capabilities. That is, the findings may help owners with a description of activities that the firm should engage in order to increase their internal capabilities and external output. For policy makers, the appropriate support mechanisms and opportunities can be put into place within society to help new firms refine the necessary capabilities. To note is that I am chiefly and foremost interested in the internal activities of the firm. Therefore, I do not necessarily intend or aspire to provide a contribution as to how specific policy
makers can develop legislation or regulations for how society can increase the ability of firms to innovate.

### 1.5 Outline for the dissertation

The remainder of the dissertation is laid out as shown below.

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Description</th>
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<tbody>
<tr>
<td>Chapter 2</td>
<td>Theory. I explain the main concepts I use and also present my research model and hypotheses.</td>
</tr>
<tr>
<td>Chapter 3</td>
<td>Method. Presentation of method, including the operationalisation of key variables and sample.</td>
</tr>
<tr>
<td>Chapter 4</td>
<td>Exploring and validating the key variables. I provide further descriptions of the knowledge-based capability, growth willingness and innovative output variables. I determine the reliability and validity of the different constructs that I measure.</td>
</tr>
<tr>
<td>Chapter 5</td>
<td>Relating knowledge-based capabilities to innovation. This is the main analysis chapter, where I look at the effects of the research variables on innovation and also on the other knowledge-based capabilities.</td>
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<tr>
<td>Chapter 6</td>
<td>Discussion. I interpret my findings and suggest future areas for research.</td>
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<td>Chapter 7</td>
<td>Conclusions. I describe the implications of my findings for other relevant areas and stakeholders.</td>
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2 Theory

2.1 Introduction

The purpose of this research project is to assess the direct and indirect impact of knowledge-based capabilities and growth willingness on innovation in the context of new firms. The goals of this project relate to a number of central questions in the field of Entrepreneurship. They also draw influence from important theoretical advances concerning the role of knowledge and capabilities that are commonly discussed within the field of Entrepreneurship. The emphasis of this chapter is to present the basic theoretical framework that allows me to explain the concepts that I am interested in as well as factors describing the relationship between these concepts.

In the remainder of the chapter, I first discuss knowledge as a resource and the main approaches taken to explain the connection between knowledge and innovation. I then discuss capabilities and their contribution to understanding how knowledge is generated and used in innovation. This section also contains discussion of the role of the environment and growth willingness. Finally, I present my research model, including the hypotheses that I formally test in later chapters of this dissertation.

2.2 Knowledge and innovation

2.2.1 A brief overview

Entrepreneurship is the development of new economic activity (Davidsson, 2004). One of the most salient drivers of this new economic activity is innovation. Innovation, just like many other aspects of entrepreneurship, is the result of the process of discovering an opportunity and exploiting it. In other words, the two key elements for innovation are identifying an opportunity (i.e. what the innovation would solve/satisfy) and then attempting to exploit this opportunity (i.e. by releasing a new product or service to the market that would provide a solution to the problem/need) (van de Ven, 1986; Danneels, 2002; Song & Parry, 1997; Subramaniam & Youndt, 2005). This implies that a firm can innovate either by discovering a gap in the market and trying to fill it (e.g. Kirzner) or create an opportunity and try to convince the market (e.g.
In both cases, innovation is seen at the firm level, as opposed to a geographic regional or the development of a particular set of technologies over time (Brown & Eisenhardt, 1995). Furthermore, I treat innovation as being synonymous with new product (or service) development (Camison-Zornoza, Lapiedra-Alcami, Segarra-Cipres & Boronat-Navarro, 2004; Brown & Eisenhardt, 1995). In this field of research, the crux of empirical investigations has been on large, manufacturing firms (Verhees & Muilenberg, 2004).

The role of knowledge in developing innovation can be traced back to classical work in Economics but is still present in modern day studies within Economics and Business Administration. Within this section, I attempt to identify the differing approaches to the role of knowledge in innovation. This section provides the reader with a basic understanding as to why knowledge is important for innovation and types of knowledge and how they work to aid innovation.

To begin with, defining knowledge is a task that a plethora of people spent entire careers discussing (e.g. Plato, Popper to name but two) but have not agreed upon a common definition. I therefore do not attempt to engage in a long-winded creative discourse about what the definition of knowledge is or should be. Rather, I follow the praxis and common usage within my field (Business Administration in general, Entrepreneurship in particular). This common usage takes the form of the knowledge-based view of the firm, which I see as an extension of the resource-based view. This approach treats knowledge as an intangible resource. As a resource, firms can possess knowledge and transfer it to other parts of the firm and even between firms (Grant, 1996b; Wiklund & Shepherd, 2003; Kogut & Zander, 1992). Firms can also combine knowledge resources, and therefore add newly acquired knowledge to existing knowledge. Knowledge is thus seen as additive and transferable. Spender (1996) and others provide competing views of knowledge compared to the one I presented, for the interested reader.

While I do not make a direct distinction in my present research, knowledge within this tradition is often divided into two types: tacit and explicit. Tacit knowledge can be loosely defined as personal, experiential-based that is difficult to codify, confirm or convey (Polanyi, 1975; Nonaka & Takeuchi, 1995). Kogut and Zander (1992) refer to this as know-how. Explicit knowledge, on the other hand, is roughly seen as codified and easy to transfer information and facts (Kogut & Zander, 1992).

The role of knowledge within entrepreneurship, including having opportunity identification as its starting point, has received considerable attention. This perspective on innovation suggests that knowledge about markets and technology are essential to the discovery as well as the evaluation and
exploitation of opportunities (Shane, 2000). Many of the studies within this field have generally approached this subject from one of two directions – either the market side or the technology side. That is, studies have examined innovation from a market knowledge or a technological knowledge perspective. The basic premise of both of these approaches is that firms and individuals differ in the knowledge that they possess (Hayek, 1945). Because of this idiosyncratic knowledge some individuals or firms can discover or create opportunities for profitable action that others cannot see (Kirzner, 1997) or deliver (Mises, 1966). The first approach examines the entrepreneur’s (or entrepreneurial firm’s) knowledge of the market or intended customers. This relates mainly to the Kirznerian approach to innovation/opportunity in Entrepreneurship and market pull in the Marketing literature. Firms with higher levels of market knowledge know where to look for opportunities and can more accurately assess the value of potential opportunities. The second approach relates to knowledge of how to solve customer needs or create opportunities. In the Marketing literature, this is sometimes referred to as technology push. Technological knowledge provides firms and individuals with the ability to rapidly exploit opportunities, or to be able to respond quickly when competitors make advancements (Cohen & Levinthal, 1990). In the sections that follow, I present some of the key thoughts and literature for both of these perspectives.

2.2.2 Market knowledge

This section discusses the usage of market knowledge in innovation. Market knowledge is knowledge of customer wants, needs, and processes. The section builds very much upon the ideas of Kirzner and others within the Entrepreneurship literature, such as Shane (2000), Gaglio (Gaglio & Katz, 2001), and others. Essentially, the point of this section is that these authors suggest that the more you know about your customers, the better it is for innovation. Drucker, a prominent thinker within Strategic Management, also has this as his main thesis on innovation (Drucker, 1985). Many of the studies within this stream do not directly question the technological knowledge approach to opportunities. Rather they attempt to highlight that it is reactions to shifts in customer needs and customers’ willingness to pay for things that form the basis of the opportunity and innovation.

Austrian Economics is a stream of Economics thinking which has its roots in the early twentieth century and has been extremely influential on the work in Entrepreneurship. For instance, Shane and Venkataraman’s (2000) seminal description of the field of Entrepreneurship clearly has its roots in Austrian Economics. One of the basic premises of Austrian Economics is that individuals differ in the knowledge that they possess (Hayek, 1945). The approach taken by Kirzner, as one of the leading thinkers within Austrian Economics, is that
individuals’ alertness to signals from the market concerning price misalignments is what leads to opportunity discovery. His view is that those individuals who are alert are those who discover price misalignments. These price misalignments exist in abundance in the marketplace; only those who are aware and alert to these things are those who discovery opportunities (Kirzner, 1973).

Jacobson, in his attempt to bring Austrian thoughts to the realm of Strategic Management, provides a further explanation of the role of knowledge of the firm. He writes, “Even though some profit opportunities are uncovered by pure chance, certain firms have more information than others, and this knowledge gives them an advantage in ascertaining market inefficiencies. The existence of true entrepreneurial profits depends on the possession of superior knowledge. This is the entrepreneurial role: to gather, evaluate and utilize information. Resources flow toward the firms that are most competent in using information, and the least efficient firms are forced out of business.” (1992: 787-788)

This view of being aware and alert to market wants and price misalignments has been widely adopted within Entrepreneurship literature and is extremely influential for studies within Entrepreneurship. Shane and Venkatarman’s (2000) stakeout of the field of Entrepreneurship clearly focuses on this aspect of knowledge. Shane’s empirical work (e.g. Shane, 2000) on the commercialisation of Massachusetts Institute of Technology innovations, found that prior knowledge of customer needs and ways to serve these needs greatly enhanced the ability to provide innovative solutions to customer problems. His study therefore supports the notion that familiarity with the market and needs of the market augments the discovery and evaluation of opportunities.

Some studies of entrepreneurship at the firm level have also adopted a market-first approach. Stevenson’s important definition of entrepreneurship may be interpreted as having a market-based approach. He argues that entrepreneurship is “the process by which individuals pursue opportunities without regard to resource currently controlled.” (Stevenson & Sahlman, 1990: 23). That is, the focus is on external opportunities. The literature of market orientation has its starting point in that intelligence of the market and of customers is the essence for success (Kohli, Jaworski & Kumar, 1993). Some studies within this stream have employed dependent variables such as responsiveness and innovation (e.g. Hurley & Hult, 1998; Atuahene-Gima, 1996; Kohli & Jaworski, 1990) and therefore can be seen as dealing with entrepreneurial behaviour.

A number of studies have directly examined the role of market knowledge and innovation. Cooper, Folta, and Woo (1995) discuss the methods by which entrepreneurs search for information that can help with developing venture ideas. They examine the use of numerous stakeholders, such as accountants, bankers, lawyers, friends, and other business owners and find that this usage is
positively related to finding opportunities. Fiet (2002) examines the systematic search efforts of entrepreneurs and, like Cooper, Folta and Woo (1995), finds that valuable information concerning potential opportunities comes from market contacts. Von Hippel’s (1986) results showed that an accurate understanding of the main market issues was near-essential in the successful release of new products. These studies thus support the idea that familiarity with and in-depth understanding of the market and its needs enhances the ability to innovate. Other authors argue that firms need to continuously scan their environments in search of shifting market demands and potential new market openings (Gaglio & Katz, 2001), as well as discuss market wants with potential stakeholders, such as customers and suppliers (Freel, 2003).

As a whole, market knowledge is seen as valuable for the discovery of opportunities and the subsequent innovations that are used to exploit these opportunities. Market knowledge is seen as being useful for opportunities as it: a) provides a true and more up-to-date awareness of customer problems; b) eases the determination of market value of new discoveries and other market changes; c) increases the communicability of potentially tacit knowledge between the user and the end-customer. As it is sometimes difficult to express needs for solutions to problems that are not yet explicitly formulated, being able to better communicate this helps to enhance the ability to understand potential responses (Cohen & Levinthal, 1990; Shane, 2000).

### 2.2.3 Technological knowledge

Whereas many within the field of Entrepreneurship have espoused the market knowledge approach to opportunities and innovation, other fields have focused more on technological knowledge as a source of opportunities. Technological knowledge refers to the knowledge of manufacturing, engineering, or producing methods or tools needed to serve the market. Technological knowledge incorporates the level of education of the people involved, their industry and technological experience, and the functional ability of the resources that these people possess (Amit & Shoemaker, 1993; Nerkar & Roberts, 2004). It also includes learned technological knowledge, such as that acquired from proficiency in R&D and engineering (Bierly & Chakrabarti, 1996), and scientific and related activities (Tsai, 2004). This type of knowledge is less plausible to be copied or found in competing firms because it is harder to transfer and develops based on specific investments (Nerkar & Roberts, 2004), not based on the harvesting of generally available knowledge.

The Schumpeterian approach to opportunities resonates well with this type of knowledge. Schumpeter (1934) essentially argued that firms do not “discover” opportunities per se, but rather create them via uniquely combining their resources. That is, by combining its resources in novel ways and then
convincing the market that the results are useful, a firm is able to create an opportunity. Other important thinkers within Entrepreneurship and Strategic Management have followed this approach.

Exploiting/creating opportunities in the market depends on the knowledge about how to solve the problems or to technically develop an innovation. The exploitation process involves converting knowledge into actual innovations (Kogut & Zander, 1996). Technological competence can be seen as being similar to the “production set” described by Nelson and Winter (1982), where the possible behaviours based on extant resources endowments are laid out. Technological competence is the mediator in actually developing the innovation, as this will take into consideration the actual manufacturing of the good or service to be brought to be market (Helfat, 1997). In fact, technological competence has been described as the cornerstone of innovation (Leonard-Barton, 1992), and the main source of competitive advantage in high-technology firms (Tsai, 2004; Bettis & Hitt, 1995; Tushman & Anderson, 1986).

A plethora of studies have examined the relationship between technological knowledge and opportunities. Roberts (1991) argues that opportunities arise out of technological advances rather than new market-side changes. Henderson and Cockburn (1994) find a relationship between indicators of technological experience and innovative output. These findings are supported by Katila and Ajuha (2002) with the introduction of new products, and King and Tucci (2002) with new market entry, as the respective dependent variables. Others have found direct positive relationships between research and development spending (R&D) and innovation (e.g. Capon et al., 1992; Baldwin & Johnson, 1996). Deeds, DeCarolis and Coombs (1999) is one exception however. In their study of biotechnology firms, they found that there is an inverse U-shaped relationship between scientific capabilities and innovative output. Finally, Lee, Lee, and Pennings (2001) even argue that technological competences are more central in start-up firms.

Of particular interest with this stream of research is the operationalisation of technological knowledge. A number of studies have relied on indicators such as R&D spending or R&D intensity (i.e. R&D spending divided by sales) (Tsai, 2004). Others have examined technological knowledge using the number of patents, number of scientists working at the firms, or number of scientific publications (e.g. Thornhill, 2006) as proxies. The use of single measures or constructs for technological knowledge poses some problems as they might not necessarily relate to the entirety of knowledge of the firm or be applicable to all types of industries. These approaches seem to only address tacit knowledge. As such, there is naturally a heavier reliance on technology- or science-oriented manufacturing industries. However, many industries do not have high levels of
Theory

research or scientists but still are innovative. As an exception, Sirilli and Evangelista (1998) examine technological knowledge and new service innovation and nevertheless find a positive relationship.

As a whole, possessing technological knowledge is important for opportunities and innovation for a number of reasons. Possessing knowledge can amplify the firm’s ability to evaluate an opportunity due to expertise in designing an optimal structure, manufacturing process or reliability of a new technology (McEvily & Chakravarthy, 2002). This same knowledge can also be harnessed as an economic or cost-related advantage (Dixon & Duffey, 1990). Sometimes technological knowledge can allow for understanding of competitors’ moves (Cohen & Levinthal, 1990). Finally, technological knowledge can lead to a radical or break-through technology that represents a new opportunity, despite the fact that market suitability is not yet established (Abernathy & Utterback, 1978). As such, increased levels of technological knowledge offer the ability to act quickly as opportunities modify and the competitive landscape quickly shift (Grant, 1996a; King & Tucci, 2002), thus potentially providing first-mover advantages (Lieberman & Montgomery, 1998).

There are obvious benefits to using for both the market and the technological knowledge approach to opportunities. In addition, there is a great amount of empirical evidence supporting both of these approaches. However, there is not sufficient evidence to suggest that one approach is universally superior to the other. In fact, I feel that allowing for both lines of attack is more beneficial. Firstly, the findings for the two schools of though may depend on the context of the studies. For instance, the technological approach may be more important for specific industries where high technology is employed. Deeds, DeCarolis and Coombs’ (1999) study was carried out on the biotechnology industry. King and Tucci’s (2002) study was focused on the disk drive industry. Both of these industries are technology-intensive. There may therefore be a bias towards one approach over the other depending on industry.

Secondly, the decision to proceed in the pursuit of a certain opportunity may be dependent on the person or firm involved and their prior knowledge. That is, one’s personal preferences and knowledge base concerning both the market and technology may be a mitigating factor in understanding which of the approaches the entrepreneur adopts. Therefore, deliberately excluding one approach may exclude the actual choice of the entrepreneur. With consideration to these two factors, I choose to retain both the market and technological knowledge approaches in my study.
2.2.4 Knowledge and dynamic markets

A growing body of literature discusses the relationship between knowledge and opportunities in more dynamic markets. Ilinitch, D'Aveni and Lewin (1996: 211) argue that dynamic markets means, “a fundamental shift in the rules of competition and the way the game is played.” In these high-velocity markets, changing demands and technologies is often rapid, future outcomes are unknown, and traditional static and planned approaches to business is futile (Utterback, 1994). The frequent external market changes taking place provide a number of windows of opportunity. However, these are open for shorter periods of time (i.e. that product life cycles are shorter) and that there is increased uncertainty as to the viability of certain opportunities. In other words, the pace of change in these markets causes opportunities to be elusive and therefore more difficult to perceive and apprehend (McKelvie & Wiklund, 2004). Rindova and Kotha (2001) provide two illustrative examples of how changing markets conditions affect the sources of competitive advantage in Yahoo! and Excite during their founding years.

In these fast-changing markets, knowledge as a resource is of added benefit as it has greater levels of general applicability compared with other resources in such changing conditions (Miller & Shamsie, 1996; McEvily & Chakravathy, 2002). That is, some non-knowledge resources, such as machinery, may be rendered obsolete by environmental changes. Knowledge is more likely to be applicable despite these changes (Grant, 1996a; Kogut & Zander, 1996). Empirical studies, such as Wiklund and Shepherd (2003) find that higher levels of knowledge are associated with superior performance in dynamic markets.

Despite the fact that higher-levels of knowledge produce firm-level benefits, it does not imply that firms should merely possess increased levels of knowledge. The causal reasoning behind the study of knowledge in dynamic markets is that existing stocks of knowledge become obsolete at a quicker pace. The knowledge that the firm possesses may only be relevant for a particular period of time and under certain circumstances. After that, new knowledge needs to be acquired. This implies that firms must constantly gain new knowledge about the market and about the potential ways to serve this market (i.e. its technology) if they are to be abreast of new potential opportunities that become available. Increased and updated levels of knowledge improve the ability to perceive and evaluate opportunities. To that end, it is more useful to examine knowledge in dynamic markets as a flow (Teece, Pisano & Shuen, 1997; Grant, 1996a). More traditional approaches to knowledge, and resources in general, look more at the stocks. DeCarolis and Deeds (1999) liken a stock and flow of knowledge to the water in a bathtub. The existing level of water in the tub is the stock. The flow of knowledge is like the water that comes in through the tap or out through leaks in the tub or that is no longer usable (e.g. dirty water). While the distinction between stocks and flows may seem obvious,
this distinction has consequences for how and what researchers measure in their studies of knowledge.

A number of authors have argued that new firms in particular are in need of acquiring new knowledge, and therefore controlling the flow of knowledge into the firm. One prime example is by Yli-Renko, Autio and Sapienza (2001). They discuss the need to rejuvenate the knowledge stocks of the firm when it comes to customer knowledge. Hayton and Zahra (2005) argue that new ventures must replenish their technological knowledge stocks via venturing strategies such as alliances and acquisitions. The two cases I presented earlier concerning Buyonet and HanzOff also show the usefulness of generating new flows of knowledge to the firm. While there did not appear to be a problem with their original stocks of knowledge of these firms, the fluctuating nature of the environment rendered much of their existent knowledge ineffective. Their differing ability in acquiring knowledge may be seen as a deciding factor in determining their outcomes.

2.3 The capabilities approach

The previous section describes how and why knowledge is important for innovation. At this stage, it should be apparent that there is ample evidence that knowledge, opportunities and innovation are closely related, albeit in potentially different ways. While the lessons learned in the aforementioned literature are valuable for our understanding of where innovation comes from and the role of knowledge in this process, they say little or nothing about how knowledge is generated and used in the firms. In a sense, knowledge is implicitly assumed to exist and to be readily available in any eventual decision that the entrepreneur or firm need to make. Classical works, such as Cyert and March (1963) discuss that information does not simply appear to the firm; it must be sought.

I introduce the capabilities approach in the coming section. This approach has its roots in the resource-based view of the firm that was first described by Penrose (1959) and then further refined by Wernerfelt (1984) and Barney (1986; 1991). I believe that the concept of capabilities provides a theoretical background that helps explain why and how firms differ in the ways that they go about acquiring and using knowledge in the pursuit of opportunities and innovations. This means that I suggest that there are between-firm differences in managing the flow of knowledge into the firm and the use of the existing stock within the firm. Furthermore, more recent addendums to this theory allow us to understand the processes that firms engage in, in addition to environmental and motivational considerations for this behaviour. In a later section I present how other researchers have attempted to illustrate and capture
the different manifestations of these capabilities. This leads into a direct description of my research model.

2.3.1 The fundamental ideas

Very much in the same way that Austrian economics and other knowledge-based approaches to opportunities and innovation assume that both individuals and firms differ in their knowledge, the capabilities approach presupposes that there is heterogeneity in firm behaviour. The internal perspective of firm action (and as an extension strategy) developed as a response to the strategic positioning and orthodox industrial economics perspectives. The primary intention of the theories is to explain performance differences. Simply, the orthodox industrial economics and strategic positioning views argued that those firms that find the most attractive markets (e.g. with high barriers preventing competitors from entering, where the firm has power over customers, etc.) are the ones that will perform better. The internal perspective, such as the capabilities and resource based views (RBV), argues that the resources that the firm possesses (RBV) and employs (capabilities perspective) is what differentiates firm performance. That is, the resources and capabilities of the firms provide the basis for firm action, and subsequently provide understanding of why firms differ in their performance.

The fact that heterogeneity between firms is assumed to exist may appear to be an obvious assertion within the discipline of business administration. However, while evident to many, this is an important distinction from the neo-classical economics perspective, where firms are seen merely as a production function and where the multitude of factors of production are available on the market. Included in this is also the popular industrial organisation approach (cf. Porter, 1980). Additionally, within the RBV, when firms possess resources or capabilities that are deemed valuable, rare, inimitable and non-substitutable, they can provide for sustained competitive advantage over competitors (Wernerfelt, 1984; Barney, 1991). This implies that that there is heterogeneous distribution or imperfect immobility of these resources, or that these resources are protected from competition in some way (Barney, 1991; Dierickx & Cool, 1989).

The RBV subsequently focuses on what resources the firm controls and how these are deployed. Resources, in this sense, are any assets, either tangible as in a machine or product, or intangible such as knowledge, that are tied to a firm (Wernerfelt, 1984; Amit & Shoemaker, 1993). This very much is in line with the knowledge-based approach to innovation that was discussed earlier. The RBV would acknowledge that the heterogeneous spreading of knowledge between firms is what differentiates their behaviour and performance.
One major criticism of the resource-based approach is that it concentrates too much on the possession of resources and not sufficiently on the deployment or usage of resources. Early proponents of this internal perspective noted that resources do not generate rents per se, but rather must be employed in some way in order to be useful (Grant, 1991). Penrose (1959), generally considered the founder of the resource-based view, notes this difference: “The services yielded by resources are a function of the way in which they are used – exactly the same resources when used for different purposes or in different ways and in combination with different types or amounts of other resources provides a different service or set of services” (p. 24). Hence, the capabilities approach evolved, where capabilities are seen as the ability to coordinate and deploy resources in order to achieve the firm’s goals (Amit & Shoemaker, 1993). Capabilities therefore can be seen as having their main value in the deployment of the different resources (Amit & Shoemaker, 1993; Teece, Pisano & Shuen, 1997) and implies that resources are the source of capabilities. In addition, resources can often be traded, and are therefore not unique or inimitable (Baden-Fuller, 1995). Thus, while resources seldom lead to performance differences on their own, the application of resources (i.e. capabilities) is what truly causes performance differences (Grant, 1991). This capabilities approach thus overcomes the critique of whether possession or usage of resources is the primary concern (Wiklund & Shepherd, 2003). With direct impact on my study, the capabilities perspective focuses on the application and usage of knowledge, not only the possession of knowledge.

Another area of criticism of this approach to RBV, and indeed of many studies using capabilities, is the treatment of resources and capabilities as stable over time. In dynamic markets, for instance, knowledge is seen as being of prime importance for discovering and exploiting opportunities. Knowledge should be seen as a flow, not a static stock. The same rationale is applicable for other resources and capabilities. Teece, Pisano and Shuen (1997) offer a definition of dynamic capabilities, a theoretical concept that was developed as a response to the static perspective of the RBV and capabilities perspectives. They argue that dynamic capabilities are:

“...the firm’s processes that use resources – specifically the processes to integrate, reconfigure, gain and release resources – to match and even create market change. Dynamic capabilities thus are the organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve, or die.” (Teece, Pisano & Shuen, p. 516). 

As the definition points out, there is a clear connection between the capabilities that the firm employs and the external context in which this takes place. The
attractive nature of the definition and the expected predictive ability of the concepts to understand action and competitive advantage in high velocity markets has prodded a great deal of research since the term was coined. In a well-cited conceptual article, Eisenhardt and Martin (2000) explicate the different types of dynamic capabilities that can exist. King and Tucci (2002) look at market entry capabilities as one set of dynamic capabilities. Helfat (1997) looks at a number of variables related to R&D as a dynamic capability. McKelvie and Davidsson (2006) study a number of different dynamic capabilities in new firms; they find that possession and usage of varying levels of knowledge and resources have differing effects on each of the dynamic capabilities. The general conclusion on the literature, despite the awesome interest, is that still more systematic knowledge is needed in the area.

Much of recent research developments into capabilities have taken one of two approaches. The first has adopted evolutionary theory as the theoretical lens governing the study. Based on the central tenets of that theory, the focus has primarily been on the developmental nature of capabilities. In particular the variation, selection, and retention aspects of the development of capabilities (including trial-and-error learning) have taken centre stage (e.g. Zollo & Winter, 2002). Helfat and Raubitschek (2001) provide a longitudinal co-evolutionary model of knowledge, capabilities, and products. The dynamic capabilities view has also greatly followed this frame of thinking. Later views of dynamic capabilities have changed the focus from the tangible outcomes that come out of the deployment of resources (which in my view is the original spirit of the conceptualisation) to more abstract issues such as changed routines. That is, dynamic capabilities have been painted as meta-capabilities, higher-order capabilities, or “routines to change routines” (Zahra, Sapienza & Davidsson, 2006).

The second stream of research concerning capabilities, and the one that is more closely in line with my main research questions, maintains the original connection to the resource-based view. Within this, the majority of the studies has focused on the presence of capabilities and the effects on firm-level outcomes. In my opinion, this approach also falls in line with the original discourses on dynamic capabilities (Eisenhardt & Martin, 2000; Helfat, 1997; Dosi, Nelson & Winter, 2000). As the purpose of this dissertation is to unpack the relationship between knowledge-based capabilities and innovation (as an output of the firm), this choice of direction within the capabilities is natural.

2.3.2 Capabilities and firm behaviour

Despite the aforementioned importance of capabilities in understanding differential firm performance, and especially within the stream of capabilities research to which I ascribe, there is not currently one established method to
empirically measure capabilities. Capabilities, as a rather abstract concept, have proven very difficult to capture. One stream of research that attempts to empirically measure capabilities has primarily employed longitudinal case studies, where the researcher is able to map out all of the decisions taken and actions carried out by an individual firm over time. Studies such as Rosenbloom (2000) and Verona and Ravasi (2003) have provided a large amount of theory-building empirical evidence and fascinating details as to the functioning and components of capabilities. One natural weakness of this approach is that the nature of the case studies prevents any statistical measurements to be acquired or tested. In that way, there are grave difficulties in establishing causality or generalising to other cases.

A second approach to measuring capabilities has employed proxy measures. The primary argument for this type of research is that the capabilities of the firms can be gauged by more simplistic and available data. One example of research within this stream is Henderson and Cockburn (1994) who use R&D data as a function of the technological capabilities of the firm. Yeoh and Roth (1999) use R&D and the number of FDA approvals as proxies for capabilities. The data that these researchers use frequently are germane to the industry under study and therefore applicable for explaining performance differences between firms within the same competitive setting. Where these proxies are less successful is at providing in-depth descriptive and evaluative knowledge of the actions underlying the capabilities that are being measured. Furthermore, the studies have limited relevance to other industries or contexts where the proxies used are not as vital or central. For instance, using an R&D measure for capabilities in an industrial context such as management consulting or travel is clearly not a valid measure of the most important capabilities leading to competitive advantage.

A third approach to capabilities that merits recognition is what I call the “results” approach. Here, firm level outcomes or relative performance positions are used to describe the capabilities. For example, the very important study by Chandler and Hanks (1994) asked respondents to evaluate their firm based on a list of capabilities and whether the firm was at an advantage or disadvantage based on these capabilities. Lee, Lee, and Pennings (2001) evaluate technological capabilities via the number of technologies internally developed, the number of utility models, and the number of quality assurance marks earned by the firm as a measure of technological capabilities. As with the “proxies” approach (which indeed is similar in thinking but looks at inputs not outcomes), this perspective is not as effective as capturing what the firm actually does in deploying its resources, but rather measures that these deployments actually result in something. As a whole, these streams of literature have been fundamental in providing empirical evidence as to the development, use, and effectiveness of capabilities. But they are not infallible.
These drawbacks lead me to approach capabilities from a behavioural perspective. I feel that capabilities can best be perceived via the actual deployment of resources in the firm, (i.e. by looking at the specifics of what the firms do), not necessarily in the outcomes achieved or proxy considerations. Furthermore, by focusing on what firms do, I avoid the discussions of the grey area of “what could the firm do better given its resources?” My research interest is not to speculate about the potential behaviour of the firm, but rather to examine the actual actions that the firm takes and their effect on innovation. The assumption that I therefore make by adopting a behavioural approach to capabilities is that firms do things to the best of their abilities and knowledge.

This approach to capabilities can be traced back to Nelson and Winter (1982) and Penrose (1959). The former argue that the routines and process that firms possess dictate their behaviour. The latter argues that action taken by the firm stems from the deliberate choices of the firm and its managers. That is, the activities that a firm engages in, and therefore how it uses its resources to achieve its goals, are subject to the decisions of the entrepreneurs and based on their future expectations and the outcomes and applications of these resources. As such, it is the job of managers to decide what capabilities are needed and when (Amit & Shoemaker, 1993; Ethiraj et al., 2005).

2.3.3 Problems with the capabilities view

Given the importance of understanding capabilities and firm behaviour, there are a number of theoretical issues that are hotly debated within the literature. This section briefly discusses some of the controversies that have an impact on my conceptualisation and empirical measurement of capabilities.

The first issue of discussion revolves around the role of routines within capabilities. Within the evolutionary perspective there is serious discussion as to how capabilities come about and the role of routines involved in this development. For instance, in Nelson and Winter’s (1982) definition of capabilities, they assume that a routine is something that is learned, deliberate and constant. The relevance to my research is that it questions how firms learn to carry out capabilities. This appears to be particularly germane as I study new firms, where the lack of history may have hindered them from learning how to do these things effectively. I must reiterate that I am primarily interested in what the firms do, not how they learn to do these things. As such, the events that lead up to these actions – planned or not – are not my central concern. I do argue in this text, however, that the growth willingness of the firm affects the deployment of the capabilities of the firm. I also argue that firms do things to the best of their ability. If these arguments hold true under empirical testing, then there may be support for the notion that the usage of capabilities is
deliberate, and used as a means of achieving growth. However, this would not shed any light as to whether these come about based on chance, trial-and-error action, and/or improvisation (Eisenhardt & Martin, 2000; George, Zahra, Autio & Sapienza, 2004) or if the capabilities are refined over time and after extensive learning.

Secondly, Eisenhardt and Martin (2000) note that some conceptualisations of the term capabilities are tautological, endlessly recursive, or non-operational. While Priem and Butler (2001) have cleverly discussed the tautological facet as an issue of post hoc defining, the threats of being endlessly recursive and non-operational are more serious problems for the true establishment of the concept of capabilities. Collis (1994) was one of the first to note this potential problem if researchers attempt to define higher-level capabilities ad infinitum as sources of competitive advantage. Indeed, an important discussion is taking place concerning the outcomes of capabilities (e.g. Helfat & Peteraf, 2003; Zahra, Sapienza & Davidsson, 2006) and whether these outcomes are higher or lower-order capabilities. In order to overcome these potential pitfalls, the conceptualisation that I adopt is without regard to specific differential performance outcomes. That is, the behavioural approach does not assume that certain capabilities will necessarily lead to increased performance. In fact, the purpose of this dissertation is to empirically test whether there are differential outcomes that stem from capabilities; it is not to confirm that this is the case. This allows me to overcome the problems of tautology and the outcomes of capabilities. Furthermore, the capabilities that I examine, and the empirical measures that I employ, concern low-order capabilities. That is, the focus and measurement are at the basic level of deploying knowledge resources. In that way, I specifically avoid the discussions of higher-order capabilities that I suggested has been more central to the evolutionary study of capabilities. While they are valuable at understanding process and routine changes in firms, I believe that further knowledge of the lower order capabilities is of greater necessity.

2.4 Empirical manifestations of knowledge and capabilities

The previous sections have established that knowledge is important in discovering and exploiting opportunities, especially in dynamic markets, as well as that the capabilities of firms are what fundamentally undergirds their behaviour. However, the previous discourse is without mention of the types of capabilities that exist or how they can be related to innovation. This present section alleviates this. In particular, I discuss how different empirical studies have attempted to capture knowledge acquisition and deployment as a precursor to innovation. Although I still discuss theoretical constructs that form
the basis of these ideas, the empirical parts are probably the more pertinent aspect of this section.

As a side note, one of the issues with the knowledge and opportunities section that led this chapter essentially looked at the behaviours of the individuals involved. The knowledge repositories argument is basically that all knowledge is present in the heads of individuals. This is not an unfamiliar argument from business administration. For instance, Simon (1991) argues that all knowledge and learning take place in the heads of individuals. Capabilities, on the other hand, are the coordinated deployment of resources across firms. There is perhaps a bit of a conflict of the knowledge (in individuals) and the behaviour of firms. I refer to this potential quagmire in section 3.2.2 in relation to level of analysis.

One of the most important empirical and theoretical manifestations which fits appropriately into what I am interested in, has focused primarily on the development of new knowledge and how it is spread throughout the organisation (Huber, 1991). This empirical manifestation is called absorptive capacity. The original conception of absorptive capacity is the firm’s ability to recognize and acquire external knowledge, assimilate that knowledge, and then apply that knowledge in a commercial way (Cohen & Levinthal, 1990). Firms need to rely on external sources of knowledge in the innovation process (Matusik & Heeley, 2005) because not doing so would imply that firms are completely disconnected to advances in technology and unaware of customer preferences. As such, the purpose of absorptive capacity can be seen as explaining why some firms are able to effectively leverage information while others falter in their ability to acquire, assimilate and/or apply the knowledge that exists.

Absorptive capacity has been used in a number of different contexts, such as investment in research and development (Cohen & Levinthal, 1990), strategic alliances (Mowery, Oxley & Silverman, 1996) and research productivity in the pharmaceutical industry (Cockburn & Henderson, 1998). While past research on absorptive capacity has conceptualized the phenomenon in vastly different ways, Zahra and George (2002) attempt to streamline the different views by re-conceptualising absorptive capacity as “a set of organizational routines and processes by which firms acquire, assimilate, transform, and exploit knowledge,” (Zahra & George, 2002: 186).

Their reconceptualisation clearly notes that there are four distinct dimensions of absorptive capacity according to this view: knowledge acquisition, knowledge assimilation, knowledge transformation, and knowledge exploitation. Furthermore, their focus is on the processes that lie behind these components. Acquisition is related to the firm’s ability to acquire external knowledge,
Theory

perhaps via customers, suppliers, or market intelligence. Assimilation refers to the firm’s ability to analyze and essentially make sense of the information that has been acquired. Transformation is concerned with the mixing of existing knowledge with the assimilated knowledge. Exploitation relates to the firm’s ability to actually apply this knowledge to the existing capabilities of the firm (Cohen & Levinthal, 1990). As individual components, I refer to these dimensions of absorptive capacity as knowledge-based capabilities.

I envision two main contributions from the re-conceptualisation of absorptive capacity. The first is that it views the concept as an action-based capability as opposed to a static entity. That is, in the earlier literature, the concept was described and measured as something that was existent or not, not as the activities behind the concept. This was reflected in the empirical measurements (all proxies) of the concept, including R&D spending, R&D intensity, and the number of patents a firm possessed. This can be seen as a stock of knowledge, not a flow. As was pointed out in an earlier section, these same proxies have been used for understanding technological knowledge and innovation. This is one valid explanation for the somewhat limited results that have been achieved. Additionally, it also suggests that the absorptive capacity literature has primarily focused on the technological knowledge that is being absorbed and used, not market knowledge.

The second is that the re-conceptualisation provides a cohesive framework that encapsulates a variety of sub-components. Many of the studies that follow the knowledge-based activities spirit have only examined a limited number of these aspects in their study. Smith, Collins and Clark’s (2005) excellent study of high technology firms, for instance, primarily focused on new knowledge creation in firms. Another example is Yli-Renko, Autio and Sapienza’s (2001) examination of young technology based firms in the UK prioritised knowledge acquisition. These two studies provide enormously valuable empirical evidence of the knowledge-based behaviours of firms. However, they focus on only certain activities, and therefore do not examine all aspects of absorptive capacity. The result of having a cohesive framework is that it allows for future research into the inter-relations between the concepts to be guided by the framework and not be ad hoc.

There is a mass of literature on absorptive capacity. In a recent analysis of the absorptive capacity literature, Lane, Koka and Pathak (2006) state that there are over 900 peer-reviewed articles that employ the absorptive capacity construct, including 289 articles from top-ranked management journals that cite Cohen and Levinthal’s (1990) seminal article. In the table below, I summarise some of the most important empirical studies that measure absorptive capacity in a quantitative manner. Obviously, it is not possible to provide a table covering all of the empirical studies, even if I were to adopt a more conservative definition.
than Lane, Koka and Pathak (2006) in determining studies of absorptive capacity. I have therefore attempted to present a limited number of these studies as examples of how the concept has been measured previously and the samples used. All of these studies strive to measure the entire absorptive capacity construct, not only sections of it. The articles by Zahra and George (2002) and Lane, Koka and Pathak (2006) provide substantial discussion of the findings related to absorptive capacity; I refer the curious reader to these.

Upon examination of the empirical studies in absorptive capacity, especially in the table below, a few patterns appear. The first is that some of the approaches to measuring absorptive capacity have followed the different methods of capturing capabilities that I describe in section 2.3. For the most part, proxy measures have been used to measure absorptive capacity. In this case, the most important proxy measures are related to R&D spending, R&D intensity or number of patents. Other important proxies have been the number of scientific publications and the educational backgrounds of employees. These different operationalisations can be seen in the third column in the table. Just as with the operationalisation of capabilities that use proxies, I feel that these studies (and others I have seen but not included in the table) do not capture the behavioural aspects of absorptive capacity. In other words, they do not shed new evidence as to the veracity of the behavioural approach to capabilities or the actions presented in the Zahra and George (2002) model. Furthermore, Lane, Salk and Lyles (2001) find that the proxy measure (R&D) of absorptive capacity explained only a minute part of the variance. Other knowledge-related variables explained significantly more, they find. Minbaeva and colleagues (2003) note that these approaches do little to help improve understanding of how managerial practices help increase absorptive capacity. Jansen, van den Bosch, and Volberda (2005) and Liao, Welsch, and Stoica (2003) follow a behavioural operationalisation of the variables. The former looks at the four concepts that Zahra and George (2002) put forward; the latter only examines two of these concepts.

A second pattern that I see is that there are differing approaches to where knowledge comes from. This is seen in the dependent variable and sample employed. Some studies, notably Lane and Lubatkin (1998), Jansen, van den Bosch, and Volberda (2005) and Lane, Salk and Lyles (2001) assume a dependence relationship between firms that governs their knowledge acquisition. Lane and Lubatkin (1998) look at the inter-organisational learning between firms in equity alliances, Jansen, van den Bosch, and Volberda (2005) look at branches of the same bank, and Lane, Salk and Lyles (2001) look at Hungarian joint ventures. While the high standing of the journals in which these studies are published reflects the quality of their respective contributions,

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I deliberately exclude case studies from the listing, although there are some influential studies using this method, such as van den Bosch, Volberda, and de Boer (1999).
the studies assume that some parts of the organisation or relationship are responsible for the teaching and another for the learning. In addition, and as part of the focus of these studies, the results do not directly speak to the processes involved in innovation.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Sample</th>
<th>Absorptive Capacity operationalisation</th>
<th>Dependent variable</th>
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<tbody>
<tr>
<td>Cohen &amp; Levinthal (1990)</td>
<td>318 manufacturing firms in varying industries</td>
<td>R&amp;D intensity (R&amp;D spending divided by sales)</td>
<td>R&amp;D intensity</td>
</tr>
<tr>
<td>Deeds (2001)</td>
<td>80 public pharmaceutical companies</td>
<td>Co-citation of scientific publications</td>
<td>Market value added</td>
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<tr>
<td>George, Zahra, Wheatley &amp; Khan (2001)</td>
<td>143 public firms in biopharmaceutical industry</td>
<td>R&amp;D commitment; number of patents</td>
<td>Number of products on the market; net sales-to-assets</td>
</tr>
<tr>
<td>Harrington &amp; Guimaraes (2005)</td>
<td>242 IS managers from large firms</td>
<td>15 self-report measures, varying from importance of IT, the recognition of the importance of IT, level of use of IT</td>
<td>Expert system success</td>
</tr>
<tr>
<td>Jansen, van den Bosch, &amp; Volberda (2005)</td>
<td>462 units of a European bank</td>
<td>Multi-items scales based on acquisition, assimilation, transformation, and exploitation</td>
<td>Components of AbCap</td>
</tr>
<tr>
<td>Lane &amp; Lubatkin (1998)</td>
<td>69 R&amp;D non-equity alliances between pharma and biotech firms</td>
<td>Commercialise new knowledge and understanding new knowledge by bibliometric data; knowledge-processing similarity by self-report data</td>
<td>Inter-organisational learning</td>
</tr>
<tr>
<td>Lane, Salk &amp; Lyles (2001)</td>
<td>78 Hungarian international joint ventures</td>
<td>Multiple self-report measures of cultural compatibility, relatedness, education, specialization, etc. of relationship with parent</td>
<td>Learning from foreign parent; performance</td>
</tr>
<tr>
<td>Lenox &amp; King (2004)</td>
<td>82 ICT manufacturers included in environmental programme</td>
<td>Number of employees providing information and support for pollution prevention (PP); % of facilities within industry to adopt PP; number of events per firm; ISO certification</td>
<td>Number of PP modifications made</td>
</tr>
</tbody>
</table>
A third pattern that I find is that a number of different samples have been used. The majority of these are technology-intensive firms. A few specific examples are the pharmaceutical, modem, and software industries. I note in my discussion of the technological versus market approaches to opportunities that differences may be context specific. The high-tech bias in the absorptive capacity literature may also be related to the measures that are used to capture absorptive capacity such as R&D. This perhaps can be linked back to Cohen and Levinthal’s (1990) study that was primarily interested in technological knowledge. Their operationalisation of absorptive capacity using a proxy measure may have prompted others to use a similar measure; the availability of this type of data may have steered sampling. In any case, there appears to be a paucity of literature concerning new firms and their absorptive capacity. Liao, Welsch and Stoica (2003) examined growth-oriented SMEs, although these cannot be confused with new firms. Hayton and Zahra (2005) and Deeds (2001) argue that they examine new firms, however, the practicality is that they exclusively study firms that have recently gone public (via IPO). As such, these firms have undeniably achieved a level of development and legitimacy beyond what a genuinely new firm has. George (2005) describes some of the benefits of looking at privately held firms, including the fact that the vast majority of new

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<td>Matusik &amp; Heeley (2005)</td>
<td>293 software firms, mean age 14 years, mean size 232 employees</td>
<td>Multiple self-report items concerning public knowledge, structures and routines for knowledge transfer, and individual employees’ skills</td>
<td>Knowledge creation; firm private knowledge</td>
</tr>
<tr>
<td>Minbaeva, Pedersen, Björkman, Fey &amp; Park (2003)</td>
<td>241 foreign-owned subsidiaries in Finland, Russia and USA</td>
<td>Used proxies such as employees’ ability and employees’ motivation; management report for all employees in subsidiary</td>
<td>Knowledge transfer</td>
</tr>
<tr>
<td>Nieto &amp; Quevedo (2005)</td>
<td>401 Spanish manufacturing firms</td>
<td>Index of 11 factors including awareness of competitors technology, investment in training, capacity for technological development, and efforts put into cost reduction</td>
<td>R&amp;D spending/sales</td>
</tr>
<tr>
<td>Stock, Greis &amp; Fischer (2001)</td>
<td>131 public modem manufacturers</td>
<td>R&amp;D spending as percentage of sales</td>
<td>Product technical performance (bits per second)</td>
</tr>
</tbody>
</table>
firms are private and they subsequently are the largest contributors to society and economic development.

2.5 Research model and hypotheses

In the previous sections, I discuss the role and types of knowledge, capabilities, and then how certain theoretical constructs (e.g. absorptive capacity) attempt to capture knowledge-based capabilities. In this present section, I present my research model and state the main hypotheses that I test in Chapter 5 of this study.

2.5.1 Knowledge-based capabilities

One of the criticisms that I put forward in the introduction and section 2.4 is that there is a dearth of studies that look at the complexity of the relationships between knowledge and innovation. Schulz (2001) finds this particularly worrisome as “each (knowledge-based) process conceivably depends on the other.” (p. 661). I note that there are some studies that look at the direct effects of certain knowledge-based capabilities on innovation, but not at the indirect effects.

The research model that I test has its basis in the Zahra and George (2002) model. They argue that there are four separate but interrelated capabilities that together form absorptive capacity. These capabilities “build upon each other” (Zahra & George, 2002, p. 188). Therefore, there is a sequential ordering to these capabilities, as displayed in Figure 2.1 below. As a sequence of action, the direct effect of Knowledge Exploitation is viewed, but also the indirect effects of the other capabilities that lead up to Knowledge Exploitation. While this sequence is clear from the model that Zahra and George (2002) propose, they do not offer as much discussion concerning why the sequence should follow the suggested order. There thus may be some reason to question how much this process actually follows a linear sequence. This presents a research gap that I try to fill by examining the complex relations between these components. A further noticeable difference between my model and that of Zahra and George (2002) is that my model separates market and technological knowledge. As I discuss in section 2.2, there are very important differences between types of knowledge and their effect on the process but also on the outcome of the process. My model therefore extends the earlier Zahra and George (2002) model also in this sense.
The overarching theme of the hypotheses that I present in this section indeed follows the model shown in Figure 2.1 and in support of the Zahra and George (2002) model, i.e. higher levels of one knowledge-based capability lead to higher levels of the sequentially next knowledge-based capability. I hypothesise this for three reasons. Firstly, I attempt to follow the spirit of the model laid out by Zahra and George (2002). The literature is devoid of explicit discussions concerning the conditions where having lesser capabilities in one area leads to increased levels in another. The few studies that have looked at different capabilities and their individual effects on a performance-related dependent variable have always found positive relationships between capabilities in the correlation tables. For instance, Lioa, Welsch, and Stoica (2003) find a correlation of .31 between External Information Acquisition and Information Dissemination. Keh, Nguyen and Ng (2007) report a correlation of .32 between Market Information Acquisition and Information Utilisation. In the one published study I found that examines all of the components of the Zahra and George (2002) model, Jansen, van den Bosch, and Volberda (2005) find that the correlations between the components of absorptive capacity vary from .07 to .55. These correlations increase along the steps of the process, such that the correlation between Acquisition and Assimilation is .28, between Assimilation and Transformation is .50, and between Transformation and Exploitation is .55. The inter-relationships between the different capabilities were not the central research questions of these studies and therefore the discussion of these correlations is minimal. Nevertheless, there is some literature where “necessity is the mother of invention” is the running theme and where finding a balance (e.g. Brown & Eisenhardt, 1998) between the use of existing capabilities and developing new ones is considered. However, there does not appear to be clear guidelines as to under what conditions having fewer or not possessing capabilities is better. The studies I noted above as reporting positive relationships do not provide further explanations as to why the correlations among the capabilities are as they are.

At a more serious level, there does not appear to be one specific underlying theoretical approach that explains why the sequence of action should be as presented. There do appear to be a number of similarities between the model and some research within the area of organisational learning (e.g. Huber, 1991).
While I lean upon this area of research in the development of my hypotheses, one explanation for their inconsistency is that there is not one higher-level theory that guides their development (Schulz, 2001). This perhaps explains why many studies that have observed positive relationships have not elaborated on why they come about. In sum, the literature from which I base my hypotheses does not provide any concrete reason to deviate from the model presented by Zahra and George (2002) or my extended version.

Secondly, the role of knowledge as a reducer of uncertainty is common in Entrepreneurship research (cf. McMullen & Shepherd, 2006). Many studies within this stream of research argue that knowledge is fundamental to discovering and exploiting opportunities (Shane, 2003). In terms of knowledge used before deciding to exploit an opportunity, entrepreneurs are notorious for accepting more uncertainty than others might. The study by Cooper, Folta and Woo (1995) about information search patterns shows that novices search more than expert entrepreneurs do. However, most individuals and firms prefer to reduce uncertainty (Forlani & Mullins, 2000; McKelvie & Gustafsson, 2007). This might be particularly important for new firms that are more vulnerable to external jolts or mistakes that may result from negative outcomes of uncertainty (Buckley, 1997). In the context of the new firm, the hypotheses generally argue that more capabilities help in reducing the uncertainty involved in any eventual decision to exploit an opportunity. Daft and Lengel (1986) argue that firms process and use information in order to determine the value of the information by reducing uncertainty before decisions are made. This uncertainty can come from a re-evaluation of the effectiveness of the present behaviours of the firm based on the new knowledge or from how/where the firm can exploit new opportunities. The four steps in the process (e.g. the absorptive capacity components) will help reduce uncertainty to these ends (Schulz, 2001). In addition, this process will also allow others within the firm to support/accept the fact that further resources will be invested in the launch of a new product/service. In other words, I believe following the process intimated by the model will reduce uncertainty involved in any change and increase internal support for the efforts.

Thirdly, new firms are generally resource-strapped (Aldrich, 1999; Stinchcombe, 1965). In response to the resource constraints that new firms face, they engage in behaviours in a way that maximises the potential usefulness of the resources that they possess. A number of authors have described this phenomenon using similar, although slightly different, conceptualisations. Baker and Nelson (2005) refer to this as bricolage, where entrepreneurs make use of the resources at hand. Sarasvathy (2001) discusses this in the context of effectual decision-making, and argues that entrepreneurs focus their actions on their given means. The overarching theme of these studies is that new firms in particular are more resourceful than established firms are in order to overcome.
resource constraints. For example, I argue new firms are more likely to use the
knowledge they acquire. As such, the theme of the hypotheses that I will now
bring forward assumes that firms make maximal use of their other capabilities
and knowledge. This line of argument also corresponds with my earlier
assumption that firms do their best as a reason for employing a behavioural
approach to capabilities.

From Acquisition to Assimilation

While all firms possess static knowledge stocks based on their human capital
(Nerkar & Roberts, 2004), new flows of knowledge must also be acquired to
permit learning about new market characteristics and technological
opportunities (Cohen & Levinthal, 1990; Grant 1996b). Many empirical
studies support the idea that familiarity with and in-depth understanding of the
market and its needs later enhances the ability to innovate (e.g. Shane, 2000;
Von Hippe1, 1986). The same holds true for acquiring new technological
knowledge. Acquiring technological knowledge can be achieved by internal
activities such as R&D, engineering, testing (Bierly & Chakrabarti, 1996) and
other scientific related activities (Tsai, 2004). New technological knowledge
may also be acquired through less formal activities such as partnerships,
attending conferences, or scanning trends (Lee, Lee & Pennings, 2001).

The challenge for firms is to turn knowledge that is externally available into
knowledge that is ready for the firm to use in its operations. This process is
central in the discussions upheld in the organisational learning literature and in
such related fields as market orientation. Many firms engage in activities that
attempt to capture this knowledge and internalise it – but what does the firm
do to transform knowledge available into learned organisational knowledge? In
order for the value of the newly acquired knowledge to become explicit and
salient, it must be assimilated. Assimilation involves understanding the value or
significance of the acquired knowledge. Daft and Weick (1984) describe this
process as where “information is given meaning” (p. 294). Not assimilating
knowledge implies that the firm is not able to find use for any newly acquired
knowledge or that there is no “meaning” to the knowledge that is acquired.

Kim (1997) and Szulanski (1996) find that assimilation is made up of the
analysis, processing, and interpretation of knowledge. As such, assimilation can
be seen as consisting of a number of sub-processes involved in grasping,
comprehending, and sense-making of knowledge. This process may not be
directly observable, but many of the effects and processes behind this are (Lane
& Lubatkin, 1998). At the organisational, and not merely the individual, level
this means spreading knowledge to others so that they can also comprehend
(Guetzkow, 1965). Communication is clearly important as new knowledge may
best be understood by clearly communicating this knowledge to others (Brown
& Eisenhardt, 1995). Huber (1991), in his seminal article on learning,
describes that a firm must first acquire knowledge before it can disseminate knowledge. Organisational learning is a function of the distribution of the knowledge of the firm. Huber also names a number of factors that affect how well a firm is able to assimilate its knowledge.

The benefits of assimilating knowledge are many. Galbraith (1973) argues that knowledge assimilation will lessen the gap between knowledge that is necessary for decisions and knowledge that is available. Assimilation also provides higher levels of agreement between decision makers as more people understand the main issues and implications of newly acquired knowledge (Beinhocker, 1999). A further advantage from assimilation is that more individuals within the firm possess the acquired knowledge and therefore it becomes easier to locate and reanimate (Tushman & Nadler, 1978). Verona and Ravasi (2003) moreover address the role of knowledge assimilation. They argue that articulating knowledge between organizational members lies at the heart of developing new creative solutions. The benefits of understanding the outcomes of the efforts and costs of the acquisition capabilities imply that it is in the best interest of the firm to make valiant attempts to comprehend acquired knowledge.

In relation to the two types of knowledge that were discussed previously, Market Knowledge Assimilation allows for others within the firm to become aware of and understand the main issues at play in the market, to help make sense of what this acquired knowledge truly means, and to process it into more formal understanding. Technological Knowledge Assimilation provides firms with the ability to make sense of perceived changes to technological capabilities, opportunities, and potential solutions to customer problems. Higher levels of market and technological knowledge acquisition provide the fodder for which assimilation can take place. That is, only increased knowledge levels brought into the firm will allow more knowledge to be assimilated. Sinkula (1994) argues that acquired knowledge is generally treated as precious. Firms will therefore try to maximise their use of this knowledge by distributing it to other organisational members. This may be seen as primarily important for new firms as the costs outlays involved in acquiring knowledge would only be justified if the knowledge is used (Baker & Nelson, 2005).

Thus,

\[ H1: \text{Higher levels of Market Knowledge Acquisition are positively related to Market Knowledge Assimilation.} \]
\[ H2: \text{Higher levels of Technological Knowledge Acquisition are positively related to Technological Knowledge Assimilation.} \]

**From Assimilation to Transformation**

While the knowledge brought into and understood by the firm provides one aspect of Absorptive Capacity, the actual usage and application of knowledge provides another. Knowledge transformation involves bringing together sets of
knowledge that previously were unconnected (Zahra & George, 2002) or combining elements of these in new ways (Nahapiet & Ghoshal, 1998). Intersecting different areas of knowledge, including accumulated and acquired knowledge, can “trigger” new knowledge (Garud & Nayyar, 1994), which, in turn, can provide new ideas for further application of knowledge, novel solutions to market problems (Ahuja & Lampert, 2001), or multiple uses for technological knowledge (Moorman & Miner, 1998). There are therefore a number of benefits of undergoing transforming knowledge. The case of Buyonet showed how knowledge transformation led to a number of innovative outcomes for the firm, whereas the case of HanzOff showed some of the dire consequences of not transforming knowledge.

Where does assimilation fit in? Smith and DeGregario (2002), in their discussion of bisociation, focus on the pre-existing skills or knowledge of the firm as the foundation for change. This is supported by Watson and Hewett (2006) in an empirical context. Dougherty’s (1992) study of knowledge integration and innovation finds that different departments possessed different “thought worlds” and that these in turn affected the knowledge outcomes of the firms. Her study shows that combining retained knowledge from these different groups helped innovation. Sinkula (1994) points out a number of methods for transforming knowledge; his starting point is that organisational shared information creates and guides organisational action, including combining knowledge. His conceptual arguments are heavily influenced by Argyris and Schön’s (1978) earlier work where the notion of memory and shared beliefs are found to determine future action of the firm. Moorman and Miner (1997) find a positive link between knowledge dispersion and creative outcomes by recombining knowledge. Jansen, van den Bosch, and Volberda’s (2005) study of absorptive capacity and Branzei and Vertinsky (2004) examination of the development of product innovation capabilities note that transformational capabilities are heavily dependent on the accumulated knowledge levels of the firm. Huber (1991) emphasises that in order to use knowledge effectively, the firm must first retrieve it from its “memory”. This can only be done after the firm has comprehended and internalised the knowledge. By definition, he argues, a firm cannot apply knowledge that it does not comprehend.

Together these theoretical and empirical findings imply that knowledge must be first assimilated before it can be transformed. The more assimilated knowledge that is available, the more transformation can take place. Assimilated knowledge related to the market will be used to devise creative solutions to new customer problems or needs. That is, firms investing time and resources to understanding and discussing market changes will also engage in further activity toward finding how to use this knowledge in new ways. Similarly, costly capabilities purported for assimilating technological knowledge are only fruitful if the resultant knowledge is transformed into creative outcomes, for example in how
from the knowledge may be able to satisfy new customer needs. Jansen, van den Bosch, and Volberda (2005) argue that firms that do not possess capabilities to make use of assimilated knowledge means that they are not able to enjoying the benefits of this knowledge. I liken this to throwing time and money away, which would be counter to the notions of bricolage and effectual behaviour (Baker & Nelson, 2005; Sarasvathy, 2001). For this reason, I argue that the knowledge assimilation capabilities exerted is an important precursor to transformation capabilities.

**H3**: Higher levels of Market Knowledge Assimilation are positively related to Knowledge Transformation.

**H4**: Higher levels of Technological Knowledge Acquisition are positively related to Knowledge Transformation.

### From Transformation to Exploitation

Transformation capabilities have been described as forming the “black box” that is dominant in research on organizational transformation and change. This type of capability is often the most difficult for a firm to exert but the most beneficial to the firm. Transformation involves creativity and newness (Narud & Gayyar, 1994), turning information into something genuine and useful. It inherently involves doing something that produces a novel solution or potential application of knowledge (Zahra & George, 2002; Hamel & Prahalad, 1994). Transformation may be accomplished by bringing separate entities together, such as allowing those individuals possessing market knowledge to discuss opportunities with those possessing technological knowledge, to brainstorm about the implications of the assimilated knowledge, to re-examine previous stocks of knowledge, or to recognize opportunities that stem from assimilated knowledge (Narud & Gayyar, 1994; Zahra & George, 2002). It can therefore be seen as a step where knowledge is combined so that it can provide something that can later be assessed.

Exploitation emphasizes the application of this creative new knowledge or implementation into the firm. In other words, the outcomes of the transformation process constitute the knowledge that can be exploited in the form of a new product or service (Jansen, van den Bosch, & Volberda, 2005). Innovative knowledge recombinations depend on the flow and level of previous knowledge (Galunic & Rodan, 1998). Penrose (1959) was one of the first to note that the potential services yielded by resources are a function of the way in which they are used and in concert with other types of knowledge. Grant (1996a) argues, and uses the empirical result of Clark and Fujimoto (1991) as support, that bringing these parties or integrating knowledge is relatively easy; the difficulty arises in accessing and leveraging the knowledge that comes from this. That is, new creative knowledge for the future comes from the integration of knowledge. Firms that integrate the respective areas of knowledge also
produce more initiated innovation (Glynn, 1996). Ford (1996) states that creativity is an important input into developing alternatives that can be used as innovations. In view of these arguments, I predict:

**H5:** Higher levels of Knowledge Transformation are positively related to Knowledge Exploitation.

### From Exploitation to Innovative Output

Finally, knowledge exploitation involves the actual application of knowledge to commercial ends (Cohen & Levinthal, 1990). This encompasses harvesting transformed knowledge into tangible activities such as launching prototypes, service ideas, or patent applications. From a practical perspective, it may be seen as the capabilities for developing details or ideas as to how, where, and when knowledge can be exploited in the pursuit of opportunities. Van de Ven (1986) argues that the development and implementation of new ideas is a precursor to actual innovation. March (1991: 85) writes, “The essence of exploitation is the refinement and extension of existing competencies, technologies and paradigms.” Capabilities relating to exploitation result in the development of concrete uses and extensions of existing knowledge. This also involves developing systems for further exploitation of knowledge to allow for the persistent creation of new value to the firm (Spender, 1996). Therefore, the ability of the firm to leverage its knowledge and put it to use in its operations (i.e. Exploitation) is positively linked to innovation, I argue.

**H6:** Higher levels of Knowledge Exploitation are positively related to Innovative Output.

### Summary

In figure 2.2 below, I graphically display the hypotheses that I put forward concerning knowledge-based capabilities and innovation.

![Figure 2.2 Display of hypotheses related to knowledge-based capabilities](image)

#### 2.5.2 Growth willingness

As discussed in the introduction chapter, the motivation and aspirations of the managers of the firm are important factors when considering the behaviour and
innovative actions of the firm. A recurring theme in the Entrepreneurship literature, and in particular the growth branch, is the desires of the firm and the individuals running them. It has been reported in empirical studies in the new firm context that many individuals start and manage their companies for reasons other than profit maximisation or for large growth (e.g. Davidsson, 1989; Storey, 1994).

As a consequence, the behaviours of the firms differ depending on the growth orientation of the firm. In other words, motivation to achieve growth is a substantial predictor of the direction, persistence and intensity of action (Wiklund, Davidsson & Delmar, 2003). Motivation as a driving force behind behaviour is not necessarily a novel argument within the literature. Penrose (1959) discusses the attempts to grow and commitment of resources towards this endeavour. Stevenson and Jarillo (1990) also make the connection between desire to pursue opportunity, entrepreneurial management and subsequent pursuit. The underlying logic of these arguments is that the individuals’ motivation to achieve a certain end state will shape the time and energy devoted to achieving this.

The dimensions of absorptive capacity are not carried out on their own. Many of the capabilities consist of time- and resource-consuming actions and investments. The literature concerning absorptive capacity inherently assumes that firms want to engage in this behaviour. However, considering the empirical contexts in which the studies have been conducted (large established firms, recently IPO’d firms, etc.) it is a legitimate assumption to make. On the other hand, the literature on growth has observed the diverging nature of the growth aspirations of entrepreneurs. Furthermore, the literature on organisational learning suggests that intentionality is paramount in this process (Huber, 1991). I therefore suggest that the growth aspirations of the firm will influence the behaviour of the firm in such a way that the higher the motivation to grow the firm has, the greater the firm will exert its knowledge acquisition, assimilation, transformation, and exploitation capabilities.

H7: Higher levels of Growth Willingness are positively related to Market Knowledge Acquisition.

H8: Higher levels of Growth Willingness are positively related to Technological Knowledge Acquisition.

H9: Higher levels of Growth Willingness are positively related to Market Knowledge Assimilation.

H10: Higher levels of Growth Willingness are positively related to Technological Knowledge Assimilation.

H11: Higher levels of Growth Willingness are positively related to Knowledge Transformation.
H12: Higher levels of Growth Willingness are positively related to Knowledge Exploitation.

A positive decision to innovate may depend on a number of things. I have argued previously that Knowledge Exploitation is the most important predictor among the knowledge-based capabilities. However, the growth aspirations of the firm also come into play. Innovation involves the further investment of resources and of taking risk. Wiklund, Delmar and Davidsson (2003) find that financial returns are not the most important aspect of determining growth orientation. In fact, the well-being of employees and the survival of crises seem to be more significant determinants. In other words, if the perceived risks are seen as too large or the resource outlay too substantial, firms will not innovate. Stevenson and Jarillo (1990) also note this and argue that desires of the firm and its perceived capabilities to successfully pursue opportunities are central, even if these perceptions are only “loosely connected to reality” (1990; p. 23). Studies looking at the Entrepreneurial Orientation of the firm, where risk-taking, innovativeness, and proactiveness are the principal concepts, have noted that growth willingness is one of the key predictors (e.g. Wiklund, 1999). In other words, firms who are highly motivated to grow are also more likely to innovate in order to achieve that end.

H13: Higher levels of Growth Willingness are positively related to Innovative Output.

In Figure 2.3 below, I provide a visual display of how growth willingness relates to knowledge-based capabilities and innovative output.

Figure 2.3 Display of hypotheses related to growth willingness

2.5.3 Interaction effects

The first set of hypotheses (H1-H5) I presented in section 2.5.1 link the varying knowledge-based capabilities with each other, while Hypothesis 6 looks
Theory

at the direct effect of Knowledge Exploitation on innovative output. Implicitly, the hypotheses suggest that there are indirect effects of all of the knowledge-based capabilities on innovation via Knowledge Exploitation. These indirect effects are explicit in Figure 2.1. Although not as obvious from the figure, perhaps the most notable set of knowledge-based capabilities is that relating to knowledge acquisition. Acquisition is the starting point from which new knowledge begins its journey towards innovation. The importance of acquisition as an input into this process has been noted elsewhere (e.g. Cohen & Levinthal, 1990; Grant 1996a). Kogut and Zander (1992) further emphasise the role of new knowledge and Hargadon and Fanelli (2002) specifically argue that new knowledge forms the basis of all innovative behaviour of firms. It is for these reasons that I will focus on the Market and Technological Knowledge Acquisition, respectively, and their impact on both Knowledge Exploitation and Innovative Output.

The interaction effects that I am interested in are based on the dynamism of the market in which the firms operate, the dynamism of the technology employed by the firm, and the growth willingness of the firm. I begin with the effects of dynamism of the task environment (e.g. customer markets and underlying technology). Shifts in the market and in the underlying technology are likely to generate opportunities of which ventures can take advantage and to which they will be forced to respond (Drucker, 1985). Increased levels of dynamism provide for a greater set of opportunities available (Thornhill, 2006; Glazer & Weiss, 1993). Miller and Friesen (1983) and Thornhill (2005) find that industry dynamism is positively related to higher levels of firm innovation. There is therefore reason to believe that operating in a fast-changing environment provides firms with a multitude of opportunities. However, in order to take advantage of these opportunities firms must first be able to learn about/spot these opportunities via knowledge acquisition before being able to exploit them. Consequently, the relationship between the knowledge acquisition capabilities that a firm displays and its exploitation of the acquired knowledge depends on the task environment. When dynamism is higher, the resultant knowledge acquired will be of greater use as a source of new innovative ideas and innovative output. That is, knowledge acquisition capabilities will more concretely help firms to keep pace with external dynamism, to reduce the uncertainty of acquired knowledge, and as a source of innovation in dynamic markets.

H14: The greater the Market Dynamism, the larger the impact of Market Knowledge Acquisition on Knowledge Exploitation.
H15: The greater the Technological Dynamism, the larger the impact of Technological Knowledge Acquisition on Knowledge Exploitation.
H16: The greater the Market Dynamism, the larger the impact of Market Knowledge Acquisition on Innovative Output.
In section 2.5.2 I argue that Growth Willingness has a significant impact on the knowledge-based capabilities and innovative output of the firm. The premise behind this reasoning is that growth-oriented firms purposefully engage in the behaviour and innovation as a path to achieving growth. However, I believe that the aspirations of the firm will also affect the use of knowledge that the firm possesses. For instance, Wiklund and Shepherd (2003) find that there is a moderating effect of the knowledge of the entrepreneur between growth aspirations and growth. The literature on bricolage (e.g. Baker & Nelson, 2005) also suggests that individuals possessing more desire to achieve an entrepreneurial outcome are better able to use their existing resources. In other words, I believe that growth-oriented firms will pay more attention to the knowledge that they acquire and will attempt to do more with it. That is, growth willingness will moderate the relationship between knowledge acquisition and knowledge exploitation and between knowledge acquisition and innovative output.

H17: The greater the Technological Dynamism, the larger the impact of Technological Knowledge Acquisition on Innovative Output.

H18: The greater the Growth Willingness of the firm, the larger the impact of Market Knowledge Acquisition on Knowledge Exploitation.

H19: The greater the Growth Willingness of the firm, the larger the impact of Technological Knowledge Acquisition on Knowledge Exploitation.

H20: The greater the Growth Willingness of the firm, the larger the impact of Market Knowledge Acquisition on Innovative Output.

H21: The greater the Growth Willingness of the firm, the larger the impact of Technological Knowledge Acquisition on Innovative Output.
Figure 2.4 and Figure 2.5 display the interaction effects that I put forward in the text above. Figure 2.4 shows the hypotheses concerning the task environment (market and technological dynamism), whereas Figure 2.5 shows those related to growth willingness.

Figure 2.4 Interaction effects concerning market and technological dynamism

Figure 2.5 Interaction effects concerning growth willingness
3 Method

3.1 Introduction

When conducting Entrepreneurship research that is based on theory testing via hypothesis, as I do, the chapter concerning the methodological choices is central. Indeed, a large component of the criticism I put forward towards the extant literature revolves around what I perceived as the lack of adequate empirical operationalisation of knowledge-based capabilities and in the context of new ventures. In order to provide a reasonable alternate solution that overcomes this critique, the empirical component of this project should clearly explicate how these issues are dealt with. I do that in this present chapter. I discuss my epistemological and ontological stances as a precursor to the explication of my specific methodological choices. Firstly though, a clear and definite research question needs to be established beforehand (Yin, 1984). Yin (1984: 19) even writes “defining the research questions is probably the most important step to be taken in a research study.” So, the big picture is this: the intention of my research is to better understand the firm-level activities that lie behind the development of new economic activity in new firms. To be more specific, the main question of this research is “to what extent do knowledge-based capabilities affect innovative output in new ventures?”

The manner in which my research question is stated directly and indirectly implies a number of things related to my epistemology and ontology. The first observation is that, in order to answer this question, I must be able to define, measure, and observe variance in knowledge-based capabilities. Inability to do this means that I cannot observe how these capabilities affect the dependent variable. The nature of the question also implies that one can define, measure, and see differences in innovative output. That is, the dependent variable must be comprehensible and have some variation so that any eventual effects are visible. Finally, the research question implies that there is a causal relationship between knowledge-based capabilities and innovative output. That is, differing levels of knowledge affect differing levels of innovation. In other words, innovative output is dependent upon knowledge-based capabilities.

2 The main data collection of this project was very generously supported by the Media Business and Economics Research Stipend, in collaboration with the Media Management and Transformation Centre, Jönköping International Business School.
Arguing that the method should match the question at least partially assumes that there is one sufficiently correct method that provides the appropriate understanding of the certain circumstances and relations and that the researcher is familiar with and capable of employing this method (Kuhn, 1996). It also seems that the best way of answering a question depends on the question itself.

The research question that I earlier put forward makes a few assumptions about science and knowledge generation. The first assumption is that researchers are able to predict behaviour, or more relevant for my question, variance in behaviour and output. In this case, the use of established theoretical frameworks, like the theories I presented in Chapter 2 concerning knowledge-based capabilities and innovative output, simplifies this predictive ability. However, it is not reasonable to assume 100% predictive ability. There are too many possible things that can play in, including idiosyncratic behaviour and a possible inability to fully capture the ideal concepts of theory (McKelvey, 1997). The use of probabilities helps us to evaluate the predictive power of our hypotheses by taking into consideration uncertainty (Haavelmo, 1944). 100% predictive ability would exclude that one can have a parsimonious model, but rather mean that one takes all imaginable factors into account, including the price of tea in China and the magnitude of the gusts of wind emanating from the derrieres of individual elephants on the savannah. Although this type of “kitchen sink” knowledge is useful for some complexity theory enthusiasts and Hollywood films, they do not really fit into hypothesis testing research that I intend on conducting. That is of course unless there is a theory that predicts the effects of the elephants. I therefore see the role of theory as determining which factors should be included and which should be excluded in an explanatory model. That is, the choice of a specific theory, or lens if you prefer, determines which factors to include and which remain on the side. Theory provides the focus and simplification of the real world. Einstein once wrote that “It is the theory which decides what we can observe.” Generally these factors that are going to be measured are pre-defined and the relationships hypothesised about. Once again this is the role of theory to establish how these subjects are defined and how they are related. Morse (1994: 25) argues, “A theory provides the best comprehensive, coherent and simplest model for linking diverse and unrelated facts in a useful and pragmatic way. It is a way of revealing the obvious, the implicit, the unrecognised and the unknown.” They highlight the fact that theory is imperative in hypothesis testing. If the success of a scientific theory is determined by if the predictions and structures in the theory actually exist (McMullin, 1984), then it is important to carefully only test those instances that the theory should apply. I do, in other words, understand the trade-off between satisfactory theoretical testing and parsimony, compared to added complexity with potential higher explanatory power.
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My research question indirectly entails that there is a ‘truth’ beyond the world of the researcher. There are matters independent of our knowledge about them (Searle, 1995). Far-reaching planets probably do exist, even if we as humans will never get the opportunity to view them. A tree probably does make a sound when it falls in the woods, even if we cannot always be there to hear it. That being said, there is no one objective truth for everything and everyone. There is not only one correct story to tell about how the world works (Denzin & Lincoln, 2000). The chosen theory and comparison with the results of competing theories show which theory is the best one. ‘Truth’ seems to exist if theory makes predictions that are in line with the observable facts, and if the results are better than competing ‘truths’ (Boyd, 1984). The choice of theory and method depends on the researcher’s background, training, and “research community” (Rosenberg, 2000) and might shift depending on language and culture (Weiss, 2000). In sum, there cannot be one objective truth out there, but rather approximate truth based on a number of things. The truth that is the ‘best’ truth depends on theory.

My role as a researcher is to acquire data that allows me to test my hypotheses. In this case, the respondents who report their truths are the conduits for my research. Finding an appropriate group of people to provide their individual truths is a matter of determining a sample, which by the way is also a matter for theory to decide. The role of the researcher is to ask questions that accurately measure the issues at hand and acquire data that can be codified and compared. The implication is that the researcher is somewhat of a passive data recorder (Glaser & Strauss, 1967). This is not a simple task as researchers can easily provide subjective or symbol-based explanations and interpretations of the results or ask questions in different ways. For instance, face-to-face interviews and participant observation allow me to reflect upon what I see and hear, but probably do not allow me to effectively and objectively answer the research question that was stated earlier. I noted a potential drawback earlier when discussing the approach to capabilities using longitudinal case studies. Additionally, while another method might afford me with additional information, it does provide difficulty in comparability.

Comparability and the use of previous theories and cumulative knowledge are important to building existing theories, finding their boundary constraints, and testing competing theories (Blaug, 1992). Indeed, the questions that are asked and the results that they eventually provide connect to certain theories or paradigms. Contrasting studies allows one to draw broader conclusions and find the boundary limitations of theory (McKelvey, 1997). This also involves further hypothesis testing which can allow one to generate knowledge and abduct conclusions (Hunt, 1991). I feel that genuine scientific knowledge stems from drawing conclusions and building upon others ideas (cf. Hubbard, Vetter & Little, 1998).
If one were to try to categorise the entirety of the assumptions that I put forward in this text and pigeon-hole them into one established epistemological or ontological paradigm, then this would most likely fit within the realm of scientific realism. Scientific realism views the role of science as "developing genuine knowledge about the world, [although] such knowledge will never be known with certainty – there is no God’s eye view" (Hunt, 2005, p. 131). This inability to establish one objective universal truth and acceptance of the approximate truth are two of the main differentiating characteristics between scientific realism and positivism. Scientific realism builds upon a few basic elements including the purpose of theory being to increase our scientific understanding by explaining and predicting phenomena, the necessity of empirically testing these theories, self-correction of theories when necessary, and importance of cumulative knowledge (Hunt, 1991; McKelvey, 1997; Rudner, 1966; Holton, 1993). This approach has been adopted in studies of organisational science (McKelvey, 1997) and Entrepreneurship (Wiklund, 1998; Samuelsson, 2004).

### 3.2 Research design

The key words from above “measure”, “compare”, and “causality” give rise to a preference for a certain type of method. In order to accurately measure the variables, there need to be objective definitions and operationalisations. While this objectivity is far from problematic, being able to determine what one perceives and communicate this with others is a step in the right direction. Comparing further implies having data in a form that allows it to be easily compared. This is simplified if the data are on the same scale or in the same language, for example. For the most part, categories or numbers are much easier to compare than long text or perceived body language. Finally, causality means that one can determine that one factor causes the other (i.e. that the process can be viewed and captured). The method that allows for all these things to happen can loosely be determined as quantitative methods, where the quantitative component generally relates to many cases, formal measurement, and the use of statistical techniques (Davidsson, 2004).

The choices that I have made are inspired by the calls for improvements to the methodological choices in Entrepreneurship research. As Rosenberg (2000) writes, researchers are highly influenced by their research community and the praxis that exists there. I belong to the Entrepreneurship research community. Low and MacMillan (1988), followed up by a special issue of *Entrepreneurship Theory and Practice* in 2001, a few articles in different journals (e.g. Busenitz et al., 2003), and diverse “handbooks”, provide suggestions as to how
Entrepreneurship researchers can move the field forward by having more rigorous methods in their studies.

The texts make a number of recommendations concerning research design. I intend to meet these challenges to the extent possible. One of the most specific challenges that Low and MacMillan put forth is that Entrepreneurship research needs to expand beyond the simple descriptive studies into theory-building and testing studies of causal inference. Up to that point, much of the Entrepreneurship research was based on exploratory case studies or cross-sectional data. Little work had employed a prior hypothesis testing and theory development (Low & MacMillan, 1988), and although this aspect appears to be much improved, further progress is needed (Davidsson, Low & Wright, 2001). I deal with this issue with the design and hypotheses set out in my research. A second challenge of these authors was to employ more longitudinal methods so that causality and process can be determined. I discuss this in more depth in section 3.2.1 below. A third challenge is to understand the role of environmental factors in forming the behaviours of entrepreneurship (Davidsson, Low & Wright, 2001) and a fourth is the use of alternative data sources (Chandler & Lyon, 2001). These two issues are also dealt with in this research. I discuss the latter issue in section 3.2.4. The former issue has already briefly been dealt with in the theoretical framework and will also be mentioned when the control variables employed are discussed in section 3.4.6. The texts also raise concerns with the use of level of analysis in Entrepreneurship research. I discuss this issue in section 3.2.2 below.

In sum, while the popularity of Entrepreneurship as a subject has increased, (cf. Katz, 2003), some of the same difficulties that Low and MacMillan (1988) mentioned linger. Davidsson, Low and Wright (2001) and Chandler and Lyon (2001) in the aforementioned special issue provide further evidence and offer advice as to how to deal with some of these issues. This present study attempts to further their suggestions and resolve some of the challenges that they state.

### 3.2.1 A longitudinal study

As mentioned above, some of the earlier problems of Entrepreneurship research remain. One of the early calls (e.g. Low & MacMillan, 1988) was for more longitudinal studies of the creation of new economic value so that: 1) the process involved can be better defined, 2) causality can be established, and 3) the specific value-creating outcomes can be viewed.

Longitudinal studies refer to studies that collect data during at least two distinct periods of time, the cases used are the same (or comparable) for the different time periods, and the analysis includes some comparison or usage of the different time periods (Menard, 2000). Cross-sectional studies, in comparison,
measure variables at one static period of time. Longitudinal studies are therefore more suitable for studies dealing with certain questions that cross-sectional studies cannot address (Ucbasaran, Westhead, & Wright, 2001).

There are of course a number of benefits of using a longitudinal design. The largest, at least for this study, is that the temporal sequencing of actions can be viewed (Miller & Friesen, 1982). That is, if one is to argue that there is a cause-and-effect relationship, one must be able to view that the cause happens before the effect. This includes Granger causality (e.g. Delmar & Wiklund, 2003). Otherwise, the veracity of the results is a bit dubious. For cross-sectional designs, as both the cause and effect are measured at the same time, one must rely upon theory to argue that the direction of the relationship is there. There is generally little empirical substantiation for this though.

A longitudinal design can look at what processes take place and the later outcomes of these actions (Aldrich & Martinez, 2001). The advantage here is that longitudinal designs take into consideration that some outcomes actually take time to occur. For example, when a firm makes a strategic move or investment, the financial performance returns do not instantaneously appear. Rather, these effects take time to come about. This is important for this study as innovation is not something that happens overnight. In some industries, developing a tangible product takes many years (e.g. in biotech), whereas in other industries this time span is compressed. For this type of method then, the cause-and-effect begins, not ends, when the data are collected (Wiklund, 1998).

Some argue that it is possible to use longitudinal retrospective accounts in order to evaluate causality (i.e. they ask the respondents about their past behaviours and the present outcomes). This is possible but comes with a very large caveat – it relies upon subjects’ ability to correctly assess their past behaviour and attribute those assessments to present outcomes. This is neither simple nor reliable as individuals may not have entirely accurate recall, may be subject to hindsight bias, or may have some issues with the social desirability of their past actions (Golden, 1992). One empirical test of this was Golden (1992) who carried out a study of manager’s generic strategies over a two-year period. When he asked about the generic strategy that he had collected data about two years earlier, he found that 44% of the respondents reported incorrect strategies. Based on this finding, Golden suggests that despite the fact that retrospective accounts are common, they are not always valid empirically, and should thus be restricted.

Despite the obvious fact that in-depth knowledge of how value creation and its effects actually come about is beneficial, few longitudinal studies are in fact performed. Chandler and Lyon (2001) in their review of empirical studies within Entrepreneurship, find that only 7% of studies used a design with data
collection at two or more points in time. Aldrich and Baker (1997) point out that the lack of longitudinal studies is a major impediment to the development of the field.

There are a number of reasons why this type of method has not been carried out. The pragmatic side of things is that longitudinal studies take more time and effort. In many countries, the demands of publishing and tenure would prevent these prolonged studies from taking place (Davidsson, Low, & Wright, 2001). The empirical side, especially when dealing with studies of new and small firms, is that there will most likely be high attrition within the sample (Menard, 2002); partly due to firms simply refusing to participate, but also due to firms going bankrupt, moving, or going through substantial internal changes, including mergers and acquisitions. Davidsson and Wiklund (2000) even question whether it is actually the same firm that is being evaluated at a later temporal period or if the business idea, customer, and organisational changes that go on in new and small firms might mean that it is a new firm altogether.

The length of time between waves is not a simple matter to decide. Miller and Friesen (1982) allude to there not being one true answer to this question but lean towards it being a function of the research question at hand. McKelvie and Davidsson (2006) used a three-year time span between waves in a survey on the development of capabilities in new firms. They point out that this might be too much time given the fact that new firms experience many changes and that three years of out, say ten, is a large percentage. Storey (1994) notes that the changes viewed vary greatly depending on the time span. He recommends one decade. Other research, such as Wiklund (1998), took a one-year time span to see the effect of firm behaviour on growth. This present research also uses a one-year time span. The reasoning for choosing this time span is three-fold. Firstly, a one-year separation follows the guidance of Davidsson and Wiklund (2000) who argue that waiting too long between waves may result in studying a very different business entity. Secondly, given the expected market dynamism and exit rates, I would expect a large attrition rate from the sample. Thirdly, and perhaps the most pragmatic of all of the issues, is that a one-year time lag is the maximum time feasible in order to complete my dissertation on time.

3.2.2 Level of analysis

Level of analysis refers to the focal point of the research. Davidsson and Wiklund (2001) discuss the numerous micro (individual, team, idea, firm) and macro (industry, region) levels that Entrepreneurship research has used. For this study, the level of analysis is the firm. This is the most common level of analysis within Entrepreneurship research (Davidsson & Wiklund, 2001). One of the most important issues to consider when discussing level of analysis is that there is correspondence between the theories used and the level of analysis employed.
(Klein, Dansereau, & Hall, 1994). That is, a theory that discusses individuals should precipitate the use of an individual level of analysis.

There are a number of potentially good arguments for adopting a different level of analysis than the firm (Rousseau, 1985; Klein & Kozlowski, 2000). For instance, one could argue that it is the behaviour of individuals who carry out the initiatives (e.g. Schumpeter, 1934) or that the knowledge bases actually reside in the heads of the individuals (Argote, 1999). One can also argue that it is the CEO or entrepreneur behind the firm that drives these changes and activities (Hambrick & Mason, 1984). However, the actions that I study take place in the context of the firm (Moran & Ghoshal, 1999). It is the collective efforts of the individuals and the combined knowledge based capabilities that make these innovations come about that I am interested, not the specific efforts of one particular individual. So, without asking each and every person within the firm what they do, getting at these is not possible.

Furthermore, if nothing else, the theory that supports the choice of factors and measures are most suitable at the firm level. The theories of knowledge-based capabilities, the resource-based view, absorptive capacity, and innovation are all firm-level theories. Thus, the theories that are being used to predict the dependent variable are at the firm level. Rousseau (1985) argues that the theories used determine the level of analysis and the target group to which one can generalise. Davidsson and Wiklund (2001) make the point that it is the dependent variable that determines the level of analysis, not the independent variables. These authors make solid arguments that lead me to focus my level of analysis on the firm.

### 3.2.3 Other sources of evidence

In response to the earlier calls (e.g. Chandler & Lyon, 2001) to include different sources of information, this study combines both primary and secondary data. 75% of studies only use primary data, of which 66% of these used surveys (Chandler & Lyon, 2001). This study used publicly available data for finding the firms, finding out their industry code, and for financial data. I primarily use these for measures of performance (like sales, profit, etc.) that allows me to better understand my sample. One issue I considered was to use the objective measures of the environment based on Dess and Beard (1984) among others to see the dynamism, complexity, and munificence of the different industries. The main drawback of this is that these measures have shown to have little effect on new firms (McKelvie & Chandler, 2007). Some explanations for this lack of effects are that new firms tend to be located in niches, they move from industry to industry, the census data which form the measures are at higher levels of abstraction, and the data are biased towards large firms. I earlier criticised the approach to measuring capabilities and
absorptive capacity that exclusively employs proxy measures. I have therefore chosen to exclusively use self-report data for the entire range of capabilities, innovative output, growth willingness and environmental factors. I do make use of secondary data for establishing my sample and measuring the size of the firm. In sum, I do employ some secondary data in this study, as recommended by Chandler and Lyon (2001). However, the main variables are primary self-report.

3.3 Generalisation

Siegel (1983, p. 82) says that, “To claim that a scientific proposition is true is not to claim that it is certain; rather, it is to claim that the world is as the proposition says it is.” If my view of science incorporates the acceptance that studies build upon previous knowledge (cf. McMullin, 1984; McKelvey, 1997), and the goal is to be able to make claims that the relationship between knowledge-based capabilities and innovation actually is as I say it is, then my study needs to be able to show that the results are generalisable to a certain population. Without this generalisation, this study will not truly contribute to the progress towards understanding what is going on. It will not provide new knowledge and will be difficult for others to build off of. The following sections discuss how the empirical research of this study is generalisable, and thus helps allow me make the claims that I do.

3.3.1 Research setting

The research setting defines where the study will take place and when. For experiments, often the research setting is provided for the respondents and they are expected to behave in a certain way given the instructions. For this study, the respondents are asked to report on the behaviours and actions of their individual firms. The firms are all located in Sweden between 2004 and 2006 and within the TIME sector. These subjects will be discussed below.
A Swedish sample
There is evidence that entrepreneurship patterns in Sweden are comparable with those of other prominent Western countries, including the United States. Studies carried out as part of the Global Entrepreneurship Monitor (see Reynolds, Camp, Bygrave, Autio, & Hay, 2001 for example), provide support that entrepreneurship in Sweden has similar characteristics, and thus comparable, to that of the UK, the Netherlands, Spain and Portugal. In general, it is similar to the European average. Wiklund, Davidsson and Delmar (2003) find no reason why their study of Swedish growth intentions and perceptions would not be generalisable to other nations. Shane and Delmar (2004) second this by arguing that they do not perceive any institutional or cultural factor that would prevent the applicability of their results to other countries. They specifically mention that this applicability is relevant to the United States as well. In terms of venture capital opportunities, which might affect a firm’s ability to innovate, Sweden ranks only after the U.S. and the U.K. (Berggren, 2001). As a whole, the evidence provides confidence that the results drawn here are informative of other Western nations and therefore generalisable to them.

Which industries and why
The firms under study are all located in the Swedish TIME sector (Telecom, Information Technology, Media, and Entertainment). Please see appendix A for a list of the industries in the study. It is important to note that I intend to study the relationship between certain variables and the choice of industries reflects the importance of those variables. One needs a research setting where there is the potential for there to be variance in both the independent and dependent variables so that the relationship can be studied. For instance, it would be quite inappropriate to study the effect of doctoral education in nuclear physics on successful moon landings by looking at a number of restaurants in the Jönköping area. There most likely would be extremely little, if any, variance in the number of people with doctoral education in nuclear physics, let alone people who have landed on the moon. I noted in my discussion of absorptive capacity and approach to opportunities that there may be a natural tendency towards technology-based industries in many empirical studies. This is one explanation for the observed measurement and importance of technology.

That being said, there were three main reasons why I chose the TIME sector in Sweden. Firstly, the sector is known for being knowledge intensive. The type of work that is carried out there is primarily done by workers with high degrees of knowledge and education. In some industries, there are a large number of people with post-graduate degrees. Other industries with similar types of knowledge workers are biotech or consulting firms, although the number of medical doctors and people with Ph.D.’s is higher in biotech firms than in the TIME sector. The biotech industry is more research based however (i.e. there is more of an established connection between research and innovation). TIME as
a knowledge sector has received less attention in the literature. In any case, these knowledge-intensive industries may be compared with labour intensive industries where manufacturing and inexpensive labour is more common, for example auto manufacturing or agriculture. I therefore expect that knowledge-based capabilities to be important in the TIME sector.

A second reason is that the industry is seen as being very dynamic and thus one where innovation is a necessary corporate action. Studies within this industry argue that dynamism and innovation are high. Picard (2003) for example finds radical transformations in the media industry based on the digitalization of printing processes. Chan-Olmstead (2006) argues that in “new media” industries such as IT and telecommunications, entrepreneurial strategies of opportunity exploitation and constant innovation are essential. Picard (2005a) argues that incumbent firms must develop broad product portfolios for risk reduction, as a means for growth, and as a necessity for survival in rapidly changing markets. Aris and Bughin (2005) cite a McKinsey study that shows that innovation is rated as the top priority for more than two thirds of media firms. Hirsch (2000) and Eisenmann and Bower (2000) further argue that market transformation and dynamic changes are commonplace here. Zahra and Bogner (1999) also find that innovation is paramount in these industries. All in all, the TIME sector appears to be especially appropriate for studies of knowledge and innovation.

A third reason is that this sector will supposedly fuel Sweden’s economic growth in the future. This sector is supposedly the main industry that has supported and is to fuel Sweden’s economic growth (Johansson, 2004; von Schultz & Thoresson, 2005; Telekom Online, 2006). The Swedish Trade Council (Exportrådet) names these industries as the strategic growth industries and there are a large number of start-up firms located there (Aronsson, 2002). Knowledge-intensive firms in the TIME sector as a whole have topped the list of growth firms in Sweden over the past few years (Rönnberg, 2005; TT, 2005; Aspelin, 2004). Thus, it is important from a firm-level but also a policy-level perspective to study firms within this sector.

All things considered, the industries that I have selected to study suggest that there are good opportunities to observe knowledge-based capabilities and innovation in these firms. I cannot think of any reason why these industries in Sweden and during this time period (2004-2006) should not be considered representative of other knowledge-intensive industries in other Western countries.
3.3.2 Sampling frame

The choice of an appropriate sample is a precursor for being able to generalise to a population. I see two main issues at play here. The first is that there is a theoretically relevant sample that allows the researcher to examine a group of firms where the theory can appropriately be tested. I have already argued for my research setting and why it should be considered generalisable. In this section, I discuss the sampling frame. This is the second issue as a sample should be considered representative of a population for it to be considered generalisable. As I discuss in this section, I essentially study a population of firms within the research setting. As such, representation and generalisability may be more relevant to discuss in connection to response rates (see section 3.3.5).

Nevertheless, when defining my population, I tried to carefully select which firms I wanted to study. I hoped to obtain a sample that was generalisable and theoretically relevant (cf. Davidsson, 2004). There were five main criteria that I used. The first, as mentioned above (section 3.3.1) was that the firms were located in certain industries. The second was that they were genuinely new firms. The third was that they were incorporated firms. The fourth criterion was that there were at least three employees listed in the firm. Finally, I removed some firms that seemed to be part of the same business group and foreign subsidiaries from extremely well known corporations such as IBM.

Identifying new firms

Identifying genuinely new firms is a daunting task as there is no established way of finding them or verifying that they are truly new (cf. Wiklund, 1998). A good example is the toil the Swedish government went through in trying to carry out a study of the role of genuinely new firms in economic development by looking at a cohort. It took numerous iterations, including requiring collaboration between different government agencies, before the population of genuinely new firms could be determined. Even then, all was not without problems. Dahlqvist (2007) discusses some of the details behind this attempt.

Despite these difficulties, new firms can be identified and studied. Indeed, there is quite a bit of research carried out on new firms. For the purpose of this study, new firms are firms that are aged ten years of less. Yli-Renko, Autio and Sapienza (2001) use a similar definition in their research on new entrepreneurial firms in the UK. Reuber and Fisher (2005) and Talaulicar, Grundeig and Werder (2005) follow this definition on Canadian and German samples respectively. The concept of “new” varies and there is yet to be one established cut-off for what constitutes a new firm. Many of the reasons for choosing age as a criterion for “newness” relate to the research that new firms are more sensitive to their environments. Singh, Tucker and House (1986) find that mortality rates decrease with age. Their longitudinal study examined a 13-year period and found that the rate continued to decrease every year as firms
age. Kazanjian (1988), in his hotly debated article on the growth stages of firms, finds that the age of the firm affects the stage of development. After a certain age, firms can be seen as having a more stability and therefore better able to overcome external jolts, among other things. This age differentiation might also vary between countries, given the institutional factors that govern these markets. However, in the discussion above, I made the argument that Sweden was representative of a number of Western nations, and therefore there should not be much variance between these countries with which I consider this study to be generalisable.

In practical terms, as the first wave of data collection took place in 2005, the definition of a new firm means that firms were started in 1995 at the earliest. This was determined by the age of the founding of the firm, which is the most frequently used determinant of “start”. In Sweden, the founding of an incorporated company is upon the submission of a certain form and proving to a government agency that certain criteria have been met. Establishing the founding day might not be as simple for other legal forms, such as sole proprietorships, as the process to start those is different. Thus, it was possible to determine the founding date of these firms and was one of the search criterion employed when establishing the population of firms to be included in the study.

Incorporated firms
This study exclusively examines incorporated firms (aktiebolag). There are a number of reasons for this. The most important reason is that all incorporated firms in Sweden are required to provide full access to corporate financial data to the tax authority. This information is public and therefore somewhat easily available from appropriate sources. This data has also been audited and should thus be considered trustworthy.

The second most important reason is that incorporated firms are considered more ‘serious’ firms, and therefore more likely to engage in growth-related behaviour, such as innovation. For instance, there is a 100,000 SEK (approximately $15,000) capital outlay simply to incorporate the firm. This hefty outlay prevents many hobby or lifestyle firms from becoming incorporated. A number of studies have found that incorporated firms are better performers than other legal forms. Dahlqvist, Davidsson, and Wiklund (2000) found that incorporated Swedish firms had higher growth rates compared to other legal forms. Their interpretation is that incorporation reflects not only higher levels of capital but also commitment on the part of the owners. For instance, the increased level of investment means larger financial risk and (they speculate) more planning and consideration before being started. This suggests that owners of incorporated firms are more committed to their firm than other legal forms. In conjunction with this, one might conceivably make an argument
that incorporating the firm provides added legitimacy to the firm. A further study governed by the Swedish Agency for Economic and Regional Growth (NUTEK, 2003) also found a positive effect on being an incorporated firm on growth, as measured by number of employees, sales, and value-added. Storey (1994), in his comprehensive study of the small business sector in the UK, notes that it is still unclear if legal form is a cause or an effect of growth.

**Size**
I purposefully chose to remove firms with fewer than three employees. The simple reason for doing this is that many of the knowledge-based capabilities imply communication and internal activities that can only take place where there are other internal actors. That is, as I mention in Chapter 2 and again in the level of analysis discussion, I am primarily interested in the capabilities of the firm. With fewer than three employees, I felt that I would more likely to be capturing the behaviour of key individuals, not the firm.

**Obvious subsidiaries**
My original intention was to only have independent firms included in this study. The reason for doing this was to isolate the actions and knowledge of the firm (i.e. to eliminate intruding knowledge obtained from parent companies). I noted that many of the absorptive capacity studies had looked at dependence relationships and I wanted to therefore capture new insights by excluding parent-subsidiary relationships. In order to accomplish this, I attempted to identify subsidiaries by looking at the ownership structure via available public information. This information was unfortunately limited. I was able to use the available information to reduce the number of subsidiaries, but I also eliminated other subsidiaries on a firm-by-firm basis based on the name of firm. For example, I was able to remove obvious subsidiaries of well-known global companies (e.g. Microsoft, IBM, etc.). As I was not able to remove all subsidiaries, I do control for this factor in my analyses.

The discussion of the type of firms included in the sample provides background for which type of other firms I hope to be able to generalise to. It suggests that I have removed some variance, like ownership and performance, based on peripheral legal form issues. I do not make claims to generalise to firms of different ages or with different legal forms.

### 3.3.3 Mail questionnaire
The specific type of method that is used in this study is mail questionnaire. Some of the reasons for this include the ease and relatively low cost of sending surveys, the ability to ask a number large of questions without respondents getting too fatigued (relative to telephone interviews at least), and without any particular bias or variability in the role of the researcher (Forsgren, 1989).
Method

Dillman (2000) recommends the use of closed-ended questions when looking for answers that can be quantified and compared. Dillman (2000) also suggests that a mail survey is the most effective method when attempting to gather data from a larger population. The questions asked in a questionnaire can also be of a standardised format and possess more complex response formats relative to telephone interviews. This is important as I aim to analyse variance across cases and test hypotheses. As I discuss in section 3.4, I employ ordinal variables. For example, the potential responses can be from “completely agree” to “completely disagree” on a five-point scale. I believe this type of variable is more appropriately captured by a mail survey. A yes-no type of question might be more efficiently captured in a phone interview. In other words, my perspective is that the type of variables used may be a more important factor in determining method than other things, such as potential fatigue. Chandler and Lyon (2001) actually find that approximately two-thirds of the published Entrepreneurship studies employ a paper survey, and employ scale type variables.

3.3.4 Respondents

In order to be able to generalise, I must be able to provide some evidence as to the reliability and validity of the data that I acquire. Reliability can be seen as the consistency of the measures; whereas validity refers to if the measures actually measure what is supposed to be measured. Acquiring information from knowledgeable individuals is important as they provide the ‘truths’ of each company. The targeted respondent for the survey is the CEO or managing director of the firm. These individuals typically have the most comprehensive understanding of the goings-on within the firm and its behaviour (Zahra, Neubaum & El-Hagrassey, 2002). This is especially true for a new and potentially small firm. In this context, the CEO conceivably has close physical and psychological relationship with the other employees within the firm. Furthermore, in new and small firms, executive decision-making authority of whether to engage in innovative behaviour is left in the hands of the top executive (Forbes, 2005; Casson, 2003). As such, using the top executive is the most common approach when surveying new and small firms (Covin & Slevin, 1989; McDougall, Covin, Robinson & Herron, 1994).

While it is clear that using the supposedly more senior and presumably most knowledgeable informant is the best way forward (Huber & Power, 1985; Jennings & Lumpkin, 1992), valid criticism has been put forward towards the validity of managers’ perceptions (Lant, Milliken, & Batra, 1992; Starbuck & Mezias, 1996; McKelvie & Chandler, 2007). Mintzberg (1979) also makes the argument that self-perceived measures are not always the most objective. As an example, Pelham and Lieb (2004) found that Presidents and Sales Managers had different perceptions of the organizational environment as well as the actions of the firms. A pluralistic approach where multiple informants provide
their views could also be used (Lewis, 2000). This means that one must then question the validity of the single-response data and find a way to manage the potential differences in reliability. As a whole, the use of key informants provides the most reliable and valid information about firm behaviour and environments (Hrebiniak & Snow, 1980).

3.3.5 Response rate and non-response

Response rate
I identified 2038 potential firms as part of my sampling frame. I felt that this significant number of firms prevented me from taking care of many of the practical issues on my own. For instance, I felt that outsourcing certain activities such as printing and packing envelopes would increase the quality of the surveys and also save me valuable time. I therefore chose to retain the services of a firm to manage the printing, packing and mailing aspects of this process. I remained responsible for coding all of the returned surveys and providing all material to be printed, including addresses to the firms.

I began data collection with the main survey in the spring of 2005. The first wave that I sent out was in May. A reminder was sent in June and a second reminder after the summer. The month of July is a time in Sweden where many firms and executives go on vacation. For this reason, and the fact that I wanted to send out a reduced survey, I chose to wait until late September to send out the second reminder. I discuss the reduction process in section 4.2.2, although in a more general context of all the answers. The first reduction was a more simplistic removal based on individual items being removed due to low internal reliability with other items intending to measure the same construct, non-fit into principle components analysis, or being deemed part of a non-core variable. In total, I removed approximately 30 items. In section 3.3.7 concerning survival bias (Table 3.8), I show the completed responses per wave.
Table 3.1 Respondents and non-respondents

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>%</th>
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</thead>
<tbody>
<tr>
<td>Responded to survey</td>
<td>403</td>
<td>19.8</td>
</tr>
<tr>
<td>Bankrupt/liquidated</td>
<td>71</td>
<td>3.5</td>
</tr>
<tr>
<td>Firm closed</td>
<td>62</td>
<td>3.0</td>
</tr>
<tr>
<td>Merger</td>
<td>13</td>
<td>0.6</td>
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<tr>
<td>Other changes</td>
<td>89</td>
<td>4.4</td>
</tr>
<tr>
<td>Non-response</td>
<td>1400</td>
<td>68.7</td>
</tr>
<tr>
<td>Total</td>
<td>2038</td>
<td>100.0</td>
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</tbody>
</table>

This study, as in almost all others, has a large proportion of the surveyed population that did not respond. Some of the firms could not be reached or expected to reply to the survey for one reason or another. For instance, 133 firms ceased operations for a number of possible reasons. I feel that this provides ample reason to exclude them from my sampling frame. The response rate, if calculated based on the number of firms that reasonably could be expected to answer, is 22.4%. Of all the firms that I identified as being part of my sample frame, this represents slightly less than 20%. Details of the respondents and non-respondents are presented in Table 3.1. This response rate is average by international standards and low by Swedish standards. In their review of 50 studies, Alpar and Spitzer (1989) find that response rates ranged from 3 to 80%. The median was a 33% response rate. Aldrich and Baker (1997) arrive at a similar result but also find that over one-third of studies had lower response rates than 25%. The work of Dennis (2003) at the National Federation of Independent Business (NFIB), a Washington DC-based research institute, shows a more negative picture. He argues (Dennis & Dunkelberg, 2000) response rates in studies of new and small firms have actually declined by over one-third over the past two decades and that response rates for studies of entrepreneurs are “notoriously low” (Dennis, 2003). The response rate from that study was similar that of my study. However, the response rate of the present study is still higher than published and well-cited others that look at entrepreneurial firms. For example, Chandler and Hanks (1994) only had a response rate of 15% and McDougall et al. (1994) were even lower at 11%. Thus, although the response rate was low, it is still acceptable given the fact that I am examining new firms in a dynamic market and contacting the top executive. Dennis (2003) also notes that the more successful surveys include both telephone and mail components, which I did not do.
Understanding non-response

One of the potential major weaknesses with using surveys is the risk of non-response. This is especially damaging if there is a pattern for non-responding that suggests that this is not random act. The result could potentially be that one of the main principles of representativeness is not met and thus that it is not possible to generalise. This was also one of the warning signals sent out concerning using longitudinal studies.

Despite the numerous different efforts to increase response rate (see next section), I was forced to settle for the number that I had received. In order to gauge why the firms did not answer, an external marketing firm was employed to call 200 non-responding companies from the sample. This firm was given a list of 300 companies that were chosen at random and the marketing firm could further choose at random which companies they were going to have contact with. They were able to speak with someone at the firms that they attempted to call (i.e. a 100% response rate). Table 3.2 below shows the results from the telephone calls.

**Table 3.2 Reasons for not responding among those firms called**

<table>
<thead>
<tr>
<th>Reason</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of time</td>
<td>47</td>
<td>23.5</td>
</tr>
<tr>
<td>Appropriate person not available</td>
<td>25</td>
<td>12.5</td>
</tr>
<tr>
<td>Never saw the survey</td>
<td>20</td>
<td>10.0</td>
</tr>
<tr>
<td>Receive too many surveys</td>
<td>12</td>
<td>6.0</td>
</tr>
<tr>
<td>Promised loosely to answer</td>
<td>28</td>
<td>14.0</td>
</tr>
<tr>
<td>Had already answered</td>
<td>5</td>
<td>2.5</td>
</tr>
<tr>
<td>Simply declined participation</td>
<td>63</td>
<td>31.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>200</td>
<td>100</td>
</tr>
</tbody>
</table>

The table above touches on some of the issues that are warned about in the literature. Firstly, lack of time is always a serious issue when dealing with executives. This may be more relevant for entrepreneurs as well, as they tend to carry out many different tasks around the company. However, I chose to contact executives despite the fact that this would potentially decrease the response rate. Almost one quarter of the respondents cited that they did not have enough time, which seems believable, although nonetheless disappointing. One issue that is connected is that the survey may have been perceived as being too long. The methodological trade-off I made at the initiation of the study was to include more questions at the expense of receiving fewer responses. The
expected time it took to fill out the survey (stated as 30 minutes) perhaps scared many away. Length of the survey has frequently been mentioned as negatively correlated with willingness to respond (e.g., Greer, Chuchinprakam & Seshardi, 2000; Baldauf, Reisinger & Moncrief, 1999; Tomaskovic-Devey, Leiter & Thompson, 1994; Yammarino, Skinner & Childers, 1991).

Secondly, one worrisome issue is the fact that so many firms (12%) stated that the appropriate person was not available. For some, this meant that the person was abroad or out travelling and physically not available to fill it out. For others, it seemed as though the actual person the questionnaire was sent to no longer worked at that company. Forty-one letters were returned with faulty addresses, further suggesting that some of the information in the database used to generate my sample is not updated. For these firms, internet searches (for individual homepages or yellow page directories) for the correct addresses (and CEO when possible) were used. I suspect that even more had faulty address but had requested from the Post Office that all letters be forwarded. The standard in Sweden is that this is done without charge for a period of one year. That means 41 addresses were more than one year out of date. This supports the notion that these new firms are in fact quite dynamic. If the sample had been taken from a different sector, say pulp and paper, non-response due to faulty addresses or the move of the top executive would probably have been lower. On the other hand, I would have completely missed the industrial dynamism that is a key aspect of my research.

Thirdly, accessibility appears to be a problem. Twenty respondents mentioned that they had never seen the survey. Assuming that they are speaking the truth, there may be a problem getting by gatekeepers. This is common in studies of top executives as secretaries first screen incoming mail before passing it along to the top executive (Brennan & Hoek, 1992). If the respondents had seen the survey but did not recall it, then there may be an issue of drawing enough attention to the survey.

A significant number of firms mentioned that they receive too many surveys and therefore choose not to participate. Groves, Cialdini and Couper (1992) find that the more surveys that are sent, the less likely that the individual will respond. The respondents feel as though they have less of an opportunity to express their beliefs. One entrepreneur exclaimed that he received three surveys a week. Another was willing to fill out the survey if he could charge me his usual hourly rate (800 SEK/ hour). New firms generally receive surveys from the government, and now other research institutions are getting involved in trying to study new firms. This is especially true for such dynamic, growth-oriented industries. As a whole, the over-surveying of entrepreneurs is problematic for future empirical studies in Sweden where, at least historically
speaking, entrepreneurs have been more willing to participate than in many other countries.

A number of participants alluded to that they would respond to the survey soon enough. Others requested that I re-send the survey once again or stated that they had already sent in the survey. Of those who had loosely promised to answer, including those who received a further copy, only a few actually did respond. This is a poor amount and perhaps is a reflection of people’s actual willingness to participate, despite further contact attempts.

Steps taken to try to increase response rate
A number of steps were taken in order to increase the response rate. Obviously, it would have been ideal to have full responses for the entire population, thus avoid having to carry out some tests to look at how representative the responding firms are. However, getting a 100% response rate is not really realistic. Nevertheless, the following steps were taken.

The first impression I tried to give the respondents was that this was a genuine and legitimate study. Dillman (2000) argued that if the respondents felt that the study was serious, then they would be more inclined to participate. Firstly, I provided the JIBS logo on the envelope, the return envelope, and the introductory letter. This is a recognisable symbol and name that gives legitimacy for the study and suggests that the data/questions will be useful and respected. We also included a supporting letter from a recognised organisation, Företagarna. This organisation works for the betterment of companies in Sweden. They operate with the promotion and development of all types of companies. The group is not politically affiliated and has offices all around Sweden. In the letter, Företagarna support the project and state that they will help spread the results to its member firms.

The second impression that I tried to give was that this was a needed study. If the respondents feel as though the questions asked deal with contemporary and important issues, then there are likely to be more answers (Heberlein & Baumgartner, 1978). In the covering letter, I attempted to link this study to the importance of the development of the Swedish economy and role of new firms, growth, and innovation in this endeavour. I argued that participating in this study would provide needed knowledge that could benefit the economic development of Sweden in the future.

In addition to making the survey appear to be vital, I also tried to appeal to different needs of the respondent. Forsgren (1989), based on Childers, Pride and Ferrell (1980) suggest that there are three different approaches to appealing to a respondent. The first is altruistic (i.e. being useful for others although perhaps not so beneficial to the individual). The second is egoistic (i.e.
appealing to the importance of that one person’s opinion). The third is social utility, where the opinions given can be seen as being important to society. In the covering letter, I used all three approaches.

Furthermore, I personalised the names and addresses on the envelopes so that the letter would most likely go to the correct person. This might make them feel more ‘selected’ and not just any other person who might receive a survey (London & Dommeyer, 1990). The names were obtained from the data base, and in retrospect, were perhaps not all that accurate.

I also tried to make the survey visually attractive. Dillman (2000) for instance argues that a booklet form makes the questionnaire appear more professional and easier to answer. The more the physical layout and design makes for ease in responding and comprehension, the more likely there will be a complete response (Dillman, 2000). There is also some debate as to the benefits of using coloured paper. The logical argument is that coloured paper is more like to draw attention and therefore decrease the likelihood that it is simply lost on someone’s desk or get thrown away immediately. At least one study (Dennis, 2003) found that green paper resulted in two percentage point higher response rate. Green paper in booklet form was therefore used in this study.

Finally, I tried to offer some sort of compensation for their participation. There is no consensus in the literature as to whether this works or not, but I offered respondents a copy of the results. I am not sure if this had an impact or not, but approximately 40 firms requested results by including their business card in the response envelope (as I had requested that they do).

I tried to follow the Dillman (2000) approach as much as possible, but with some minor exceptions such as not sending a warning of a coming survey. In order to get as many responses as possible, I sent the original survey with two reminders. Newby, Watson and Woodcliff (2003) find that it is beneficial to have two reminders as the response rate keeps rising. More than two may be construed as nagging or harassment and therefore is not recommended. This is the same suggestion that Dillman makes. The second reminder was a more concise version of the survey as I was able to carry out exploratory factor analyses and internal reliability tests. I also removed some questions that were deemed less central than others. The intention was to get more responses. As I show in Table 3.8, the second reminder resulted in a large number (n= 112) of firms responding.

Non-response bias
In order to see if non-response was stochastic or patterned, I carried out a test on a number of different variables. This consisted of a t-test comparing means of the different variables. This test checks if there are any differences between
the participating firms. If there are any significant differences, then the generalisability of the results might be questioned. I approached this analysis in two ways. The first is that I compared the responding and the non-responding firms based on the publicly available information, such as sales and profit levels and the number of employees in the firm. These are presented in Table 3.3 below.

**Table 3.3 Mean score differences between respondents and non-respondents**

<table>
<thead>
<tr>
<th></th>
<th>Responded</th>
<th>Did not respond</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td># employees 2004</td>
<td>10.33</td>
<td>10.75</td>
<td>-0.335</td>
<td>0.738</td>
</tr>
<tr>
<td>Sales 2004 (millions of SEK)</td>
<td>15.87</td>
<td>17.78</td>
<td>-0.371</td>
<td>0.711</td>
</tr>
<tr>
<td>Profit 2004 (thousands of SEK)</td>
<td>-385</td>
<td>930</td>
<td>0.579</td>
<td>0.563</td>
</tr>
</tbody>
</table>

Note: Two outliers were deliberately removed from this analysis as I felt that they unnecessarily biased the results. One firm with a large one-time loss and one firm with 600+ employees were removed. Including these did not result in any significant differences between respondents and non-respondents however. As these variables may have skewed distributions, I also conducted a Mann-Whitney U-test. There were no significant differences between respondents and non-respondents.

The second way that I approached this potential problem was to look at the early and late respondents. It is common to extrapolate that those firms who replied after the second reminder to the non-respondents. The assumption is that these late repliers would not have responded if the second request was not sent, and therefore that one can assume that the characteristics of those laggard firms would be similar as those who do not respond at all. This provides some basis for which one can interpret their answers as representative of non-response (Covin, 1991: 446). I looked at both the early and late repliers to determine if there are any potential differences in the dependent variables. Ideally I would also compare respondents to non-respondents based on the information that I have on them, however my knowledge of the non-respondents is limited to the publicly available financial data. However, comparing the late and early respondents does allow me to compare some of the dependent variables, which I feel is more important than merely comparing size or financial performance data. As there do not appear to be any differences (see Table 3.4 below) concerning size and innovation variables, then there is no reason to believe that there is any bias towards a certain type of firm responding early or late. The only potential concern is the profitability of the late repliers being much lower. This appears to be the case due to a low number of outlying firms than a patterned difference.
Table 3.4 Mean scores and differences between late and early respondents

<table>
<thead>
<tr>
<th></th>
<th>Early repliers</th>
<th>Late repliers</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td># employees 2004</td>
<td>12.57</td>
<td>13.21</td>
<td>-.123</td>
<td>.902</td>
</tr>
<tr>
<td>Sales 2004 (millions of SEK)</td>
<td>16.6</td>
<td>12.8</td>
<td>.717</td>
<td>.474</td>
</tr>
<tr>
<td>Profit 2004 (thousands of SEK)</td>
<td>-671.5</td>
<td>-2768.1</td>
<td>1.092</td>
<td>.276</td>
</tr>
<tr>
<td># incremental products/services</td>
<td>3.47</td>
<td>3.46</td>
<td>.064</td>
<td>.949</td>
</tr>
<tr>
<td># radical products/services</td>
<td>2.80</td>
<td>2.82</td>
<td>.124</td>
<td>.902</td>
</tr>
<tr>
<td>Expected Innovative Output</td>
<td>12.38</td>
<td>12.15</td>
<td>.449</td>
<td>.654</td>
</tr>
</tbody>
</table>

Note: The outlying firms with a large one-time loss and a large number of employees are included in the “late repliers” category. There were no statistically significant differences between early and late repliers based on the results of a Mann-Whitney U-test.

3.3.6 Follow-up study

A follow-up survey was sent approximately one year after the first survey. The follow-up was sent exclusively to the firms who had fully responded to the first wave of data collection. The same names as in the first wave were used (i.e. the top executives were once again the respondents). A number of changes were made in order to achieve as high as possible a response rate, taking into considerations the lessons learned from the previous survey for why some firms did not participate in the first wave. A first action was to include a brief summary of the results from the first wave. The summary was written for practitioners and with normative results. It was written in Swedish. This provided the incentive for the firms to participate and also confirmed that there was something useful that came out of the research. This also connects with the suggestion from the literature to deliver results and not just make promises to respondents. It furthermore differentiates my survey from all the others that the firm might received.

A second action was that the survey was substantially reduced so that it fit on one side of the paper only. It comprised about 30 questions that dealt with the firm’s innovative output over the past year and the firm’s performance relative to competitors. These may be seen as potential dependent variables that can be

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1 I carried out a number of checks to examine if the number of months a firm deviated from the “one year” follow-up (i.e. 10, 11, or 13 months after responding to the first wave) made a difference. There were no statistically significant results for any of these tests.
connected to the knowledge-based capabilities questions asked in the first wave. I also included one question about how the firm was presently being run compared to the year before. For example, there were response options for if the firm was put into bankruptcy, if the firm had been sold, if the firm had merged, or if the firm was running the same as previously.

**Table 3.5 Mean scores and differences between respondents and non-respondents in follow-up survey**

<table>
<thead>
<tr>
<th></th>
<th>Respondents</th>
<th>Non-respondents</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td># employees</td>
<td>10.10</td>
<td>8.58</td>
<td>-.722</td>
<td>.471</td>
</tr>
<tr>
<td>Sales 2004 (millions of SEK)</td>
<td>12.91</td>
<td>13.74</td>
<td>.211</td>
<td>.833</td>
</tr>
<tr>
<td>Profit 2004 (thousands of SEK)</td>
<td>-1420.1</td>
<td>-357.3</td>
<td>.508</td>
<td>.612</td>
</tr>
<tr>
<td># incremental products/services</td>
<td>3.35</td>
<td>3.56</td>
<td>1.363</td>
<td>.174</td>
</tr>
<tr>
<td># radical products/services</td>
<td>2.64</td>
<td>2.84</td>
<td>1.106</td>
<td>.269</td>
</tr>
<tr>
<td>Expected Innovative Output (four items)</td>
<td>11.61</td>
<td>12.26</td>
<td>1.126</td>
<td>.261</td>
</tr>
</tbody>
</table>

Note: When the outlying “one time loss” firm is removed from the analysis, the mean profit for the Respondents becomes -293 and the p score subsequently changes to 0.915. A Mann-Whitney U-test did not result in any significant differences.

There was a huge improvement in the response rate. 217 firms responded fully, providing a response rate of 68%, after one reminder. I was able to return to the database that was originally used to find the firms to see if there might be any particular reason why some firms did not respond. I bore in mind my early criticism of the database perhaps not being fully up-to-date. Among the 103 non-responding firms, only seven firms had gone out of business during that time period. Two other non-responding companies are presently undergoing mergers. Six other firms had engaged in some other kind of corporate action, such as closing and re-starting or firing all employees other than the CEO. Eleven firms had new CEO’s installed. It is thus reasonable to exclude these 26 firms who had undergone changes during the past year, thus bringing up the response rate for the follow-up to 74%. 19 firms had moreover moved without leaving a forwarding address. All of these 19 were found but six of these did not answer the survey. This perhaps suggests that there are actually not all that many firms that disappear as previously thought or argued in the literature (McGrath, 2006). Table 3.6 below summarises what is known about the non-respondents.
Method

Table 3.6 Non-respondents in the follow-up

<table>
<thead>
<tr>
<th>Reason</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changed CEO</td>
<td>11</td>
</tr>
<tr>
<td>Out of business</td>
<td>8</td>
</tr>
<tr>
<td>Merged</td>
<td>2</td>
</tr>
<tr>
<td>Some other corporate action</td>
<td>6</td>
</tr>
<tr>
<td>Changed address</td>
<td>6</td>
</tr>
<tr>
<td>Unknown reason for not responding</td>
<td>70</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>103</strong></td>
</tr>
</tbody>
</table>

There were no apparent response biases when looking at the spread of the firms between the four sectors that make up TIME. Table 3.7 below displays the number of respondents for the initial and follow-up survey. To note is that the number of respondents per sector for the follow-up is eerily close to the near 70% response rate and the differences in portion of the entire sample between first survey and the follow-up is one-half of a percentage point. This shows that there are no differences based on industry. In addition, the overall tendency of there being more IT firms than any other sector is a general representation of the overall number of new firms in Swedish society.

Table 3.7 Respondents per sector

<table>
<thead>
<tr>
<th>Sector</th>
<th>First survey</th>
<th>%</th>
<th>Follow-up</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telecom</td>
<td>25</td>
<td>7.9</td>
<td>16</td>
<td>7.5</td>
</tr>
<tr>
<td>IT</td>
<td>231</td>
<td>73.1</td>
<td>156</td>
<td>73.6</td>
</tr>
<tr>
<td>Media</td>
<td>44</td>
<td>13.9</td>
<td>29</td>
<td>13.7</td>
</tr>
<tr>
<td>Entertainment</td>
<td>29</td>
<td>5.1</td>
<td>11</td>
<td>5.2</td>
</tr>
</tbody>
</table>

3.3.7 Survival bias

In a related vein, there is a potential bias when only a certain type of firm is studied. In this study, I only looked at surviving firms. I do not attempt to contact or collect data from firms that have disappeared or gone bankrupt. However, we know that many new firms cease to exist after a few years. Storey (1994), among many others, shows that the exit rates of new firms are high. It is even higher in industries that are considered fast changing (Sarkar et al., 2006; Singh, Tucker & House, 1986). Many of the firms that were not studied could be due to a lack of capabilities or even too much innovation. This is a
potential bias with this study and for the vast majority of studies of entrepreneurship.

Table 3.8 Overall summary of surveys received per wave

<table>
<thead>
<tr>
<th>Mailing</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>First mailing – late-May 2005</td>
<td>127</td>
</tr>
<tr>
<td>First reminder – mid-June 2005</td>
<td>160</td>
</tr>
<tr>
<td>Second reminder – mid-October 2005</td>
<td>112</td>
</tr>
<tr>
<td>Follow-up survey – beginning October 2006</td>
<td>131</td>
</tr>
<tr>
<td>Follow up-reminder – mid-October 2006</td>
<td>87</td>
</tr>
</tbody>
</table>

However, assuming that survival is only for top performing firms and exit for poorly performing firms is perhaps exaggerated. McGrath (1999; 2006) and others (Davidsson & Wiklund, 2000) show that firms have not actually failed (e.g. go bankrupt) simply because they do not appear in official registers anymore. Many of the firms have been purchased, moved, changed names, or had the businesses close but have the business ideas pursued in a different context. The results from the follow-up show that many firms did not go bankrupt, although many firms changed forms and no longer appeared in the database. For the firms involved in the first wave, there were even larger numbers of changes and only a few bankruptcies. We therefore know that while many firms “disappear” off the traditional map, why they do this is not necessarily for negative reasons. Thus, survival bias does not entail an exclusion of poorly or well performing firms.

One step around this potential bias was by using incorporated firms. As they are more serious operations due to the capital outlay and reporting requirements, they may be more likely to survive based on performance. As such, they are the most likely legal form to provide information about which one can generalise.

Tests of non-response bias based on the numerous innovative output variables including both the intended plans and previous actions were carried out. They showed no significant differences once again (p>.05). The lack of significant results supports the notion that there is no reason to suspect that there is any particular bias based on the firms who responded compared to those who did not.

3.3.8 Some conclusions on generalisation

In the beginning of the chapter, I laid out my philosophical underpinnings and how they affect my main research questions. One main branch of these
underpinnings was that I use a sample that allowed me to generalise. I discussed how my research setting was appropriate for looking at my specific variables and how the industries and country are representative of other nations and sectors. I then mentioned how my enacted method (mail questionnaire) and my target respondents (top executives) allow me to have the most reliable and valid data, as well as the steps taken to increase the theoretical relevance of my sample firms. Finally, I discussed the threat to generalisation of non-response and survival bias (i.e. how the fact that many firms did not participate in the study might affect my ability to generalise). I ran tests to ensure that there was little or no bias towards non-responding firms. My conclusion is that, based on the steps that I took, I can consider my research to be reliable, valid, and generalisable to a number of other firms and situations.

3.4 Measurement of key variables

3.4.1 General approach

When deciding how to operationalise my key variables, I attempted to find a way to allow me to maximise my validity and reliability. A practical rule of thumb for maximising validity is to make use of established measures that have been used in previous research. Existing measures from high-quality published studies usually means that they have already been empirical tested and their empirical validity has been established. Using similar questions further simplifies comparison of results with other studies, which is an important stepping stone in my view of science.

As was mentioned in the introductory chapter, I make an empirical contribution to the literature via my operationalisations of the knowledge-based capabilities and how these are measured on a sample of new firms. In order to achieve this, some new measures needed to be developed and some existing measures required some modifications so that they were relevant for new, and most likely small, firms. For this, I attempted to build off of the extant literature and theoretical guidelines as much as possible in order to increase the validity of the measures.

The constructs that I study are made up of multiple-item measures. The majority of these are on a five-point Likert scales. In total, there were over 100 items. In Chapter 4 on empirical results, I present my orthogonal principle component analyses in order to determine discriminant and convergent validity. I will also present how I calculated Cronbach’s alphas in order to determine the reliability of the different items.
In the coming sections of this present chapter, I explain which measures were used and where they came from. In the cases where I developed new or modified existing measures, I explain the theoretical or empirical reason for this. In lieu of providing all measures in two separate places, I choose to present only my final set of question items in section 4.2.2. I refer the reader to that section to see the specific items that I use in this study.

3.4.2 Innovative output

Studies of innovative output in firms are not consistent as to how to measure the dependent variable. This divide can perhaps be traced back to the classical arguments of Schumpeter (1934) who stated that new combinations of resources (his term for innovation) could consist of five different outcomes, including the release of new products, entering new markets, and new methods of production. Coombs and Bierly (2006) even argue that this lack of convergence in the use of dependent variables is one of the reasons why there are few generalisations and stable results available concerning studies of innovation.

The majority of studies use some type of proxy for innovation such as R&D spending, R&D intensity, or the number of patents. These measures have questionable reliability for their ability to measure innovation (Coombs & Bierly, 2006). This is especially true for new firm innovation where getting at exact amounts of R&D spending can be difficult as many new firms do not have separate departments for this activity. The same scepticism seems to be true for patents as a measure of innovation (Arundel & Kabla, 1998). Other studies use more number counting, such as the number of products released to a market (Rosenbusch, Rausch, Krist & Unger, 2006).

For this study, I primarily use two dependent variables. Both of them build upon the same items but are posed at different time periods. The dependent variable Expected Innovative Output is measured during the first main survey. It asks about the intended behaviour over the coming 12 months. This variable is therefore based on cross-sectional data. The variable Actual Innovative Output is part of the follow-up survey carried out one year after the first survey. It specifically gets at the behaviour carried out over the 12 months prior to this round of data collection.

Four similar items make up each of the dependent variables. This approach follows in the footsteps of Li and Atuahene-Gima (2001) who argue that innovative output can be measured in many different ways. The overarching similarities between the different variables are that they are on a five-point Likert scale, ranging from “no new products or services” to “very many new products or services” and referring to the expected behaviour over the coming
12 months for Expected Innovative Output and the behaviour carried out over the past 12 months for Actual Innovative Output. This approach to innovative behaviour has been used in studies carried out by Wiklund (1998) and McMullen (2003). The four items are based on the self-report identification of radical and incremental innovation argued in Cooper (2000), Dewar and Dutton (1986), and Ettlie, Bridges and O’Keefe (1984). The differentiation between radical and incremental innovation can be viewed such that incremental innovations are modifications to existing products/services whereas radical innovations are breakthroughs that can have a large effect on the market. There is one particular item referring to the number of modifications/extensions of existing products/services to be/launched and one item tapped radical new products/services to be/launched during the same time span. The two remaining questions were similar to these two but asked about the beginning to develop these over the time period. In other words, two questions referred to launch or release and two were concerned with beginning to develop. These therefore take into consideration the fact that time may be a factor when innovating (e.g. Schoonhoven, Eisenhardt & Lyman, 1990).

A similar approach has been used in other studies concerning knowledge and innovation (e.g., Smith, Collins & Clark, 2005). While other measures may be valuable, such as percent of revenue for new products/services, percentage of sales from new customers, and expansion into new geographic and/or customer markets served, this present research follows the stream of research where innovation is considered as new product/service development. It is important to note that these will be considered "new to the firm" as opposed to completely new to the market.

It is important to note that the dependent variable was measured in both the first and second waves of the survey. For the first wave, the wording reflected the intentions to engage in that particular behaviour over the coming 12 months. In the second wave, it was the actions carried out over the previous 12 months. It will be clearly stated which variables are being used. Both waves of data have certain advantages. For the first wave there are more respondents. For the second wave, there is reliance on actual behaviour as opposed to intended behaviour.

3.4.3 Knowledge-based capabilities

The empirical operationalisation of knowledge-based capabilities, and capabilities as a whole, has been a struggle in the literature. A number of different approaches have been attempted as I discuss in Chapter 2, but there is once again little convergence upon a single method or set of items. A number of studies have used single-item measures for capabilities, including in some cases, R&D spending. Oddly, this has also been a proxy measure for innovation as
well. Other studies have inferred capabilities as extensions of performance (e.g. if the firm performs well, then it must have capabilities). This opens up for discussions of tautology. Empirical studies such as Dutta, Narasimham and Rajiv (2005) provide valuable insights as to how to measure capabilities however. As I describe in Chapter 2, my intention is to study capabilities via the actual behaviour of the firms (i.e. by the actions that they carry out).

The knowledge-based capabilities that I measure reflect the theoretical constructs set out in the four sub-dimensions of absorptive capacity proposed by Zahra and George (2002) (i.e. knowledge acquisition, knowledge assimilation, knowledge transformation and knowledge exploitation). However, one difference between this present study and previous work within knowledge-based capabilities and absorptive capacity was that I distinguish between market and technological knowledge. As this study spanned more than one industry, orientation (i.e. manufacturing, service and R&D) and size of firms, I attempted to craft generalisable measures based on extant literature. The sources below state the original items. As I explain in Chapter 4, validation of the constructs involved removing some items from the analysis. I present the final items retained in Chapter 4.

**Market Knowledge Acquisition**
Market Knowledge Acquisition examines the methods used to acquire information about the market. This construct consists of nine items and was based on the market orientation literature (cf. Kohli, Jaworski & Kumar 1993; Kohli, & Jaworski 1990). All items have been used recurrently in other studies of knowledge acquisition and even in another study of absorptive capacity (Liao, Welsch & Stoica, 2003).

**Technological Knowledge Acquisition**
This constructs looks at the methods the firm employed in order to acquire new knowledge about technology. As technological knowledge is not part of the market orientation literature, I turned to other studies of knowledge acquisition, and more specifically, Zahra, Ireland and Hitt’s (2000) study of new venture learning. The items generally mirror those used in that study, with the exception that I removed items that were not generalisable to all types of firms or were deemed unclear during the pilot study. There are 13 items as part of this construct.

**Market Knowledge Assimilation**
The items used for Market Knowledge Assimilation were based on the market orientation literature (e.g. Kohli, Jaworski & Kumar 1993) and consist of ten items. The wording of the items is adapted to reflect the fact that the focus of this study is new, and often small, firms. Jansen, van den Bosch, and Volberda (2005) in their study of the antecedents of absorptive capacity employ some of
these measures, although their study was first published after my questionnaire was sent out.

Technological Knowledge Assimilation
The Technological Knowledge Assimilation measures are based on the same literature as Market Knowledge Assimilation. However, they are modified to reflect technological knowledge as opposed to market knowledge. The scale consisted of eight items.

Knowledge Transformation
The items used to measure the construct Knowledge Transformation are more difficult to develop as a number of studies had looked at these ideas, but few had empirically measured them. I therefore scoured the literature for appropriate items to be used for measuring this. Building upon the theoretical foundations laid out by Zahra and George (2002) and Garud and Nayyar (1994), in addition to being influenced by the empirical work of Szulanski (1996), I was able to develop original measures for Knowledge Transformation. A total of fifteen items were used. To note is that Jansen, van den Bosch, and Volberda (2005) employ some similar measures in their study.

Knowledge Exploitation
Finally, the measures of Knowledge Exploitation, gauging the ability of the firm to incorporate knowledge into its operation, are developed following the guidelines set out in literature focusing on the usage of knowledge. Items were created based on the ideas of Cohen and Levinthal (1990) and Zahra and George (2002). Eleven items are used.

3.4.4 Growth willingness
As I argued in the formulation of hypotheses 8-13, if the firm is not interested in growing, then they are less likely to be innovative or even use their knowledge-based capabilities. I see firms that want to grow to be more proactive in their approach to innovation. Wiklund has conducted a number of studies on this (e.g. Wiklund & Shepherd, 2003). Arrow (2000) also observes that managers’ motivations and goals are reflected in the resource allocation and strategic decisions made. This construct is measured by six items based on Wiklund, Davidsson and Delmar (2003).

3.4.5 Control variables
There is a plethora of literature discussing other potential factors that might affect innovative output (cf. Damanpour, 1991). These fall outside the direct theoretical framework of knowledge-based capabilities but still might provide
contingency explanations for why some firms innovate while others do not. This section presents the variables and their operationalisation.

**Internal factors**

**Firm age**
This variable takes into consideration the effects of how old or young the firm is. It is calculated by taking the year of data collection and subtracting the year in which the firm was founded. Founding date is based on self-report data.

**Firm size**
Looking at the size of the firm (in terms of employees) can provide evidence as to whether innovation is a function of size or the actual capabilities of the firms. Size is measured by the number of full-time employees. The data is from the publicly available census data, which in turn come from data directly reported by the firm in their annual report.

**Venture capital ownership**
Firms with more capital (including venture and angel capital) might have a greater ability to perform more, take larger risks, and may even have other demands to be innovative. This may provide them with an innovative advantage compared to other firms who are required to support themselves with their own funds. Amounts of capital may thus be causes for knowledge-based capabilities and innovation. Studies by Schoonhoven, Eisenhardt and Lyman (1990) and Lynskey (2004) have supported this notion. This variable is a dummy-coded variable where firms with at least one percent of their firms owned by venture capitalists ownership are coded as 1; all others are coded as 0. Percentage of ownership is based on self-report data from the survey.

**Subsidiary**
Similar to the venture capitalist argument, being owned by a parent firm may provide the firm with added capital and security. This may provide the firm with an innovative advantage. Once again this is a binary dummy variable for firms who are owned by a parent company. I coded all firms with 50% or more of the firm owned by a subsidiary or parent company as 1; the remaining firms were coded as 0. This variable is also based on self-report data.

**External factors**

**Market Dynamism**
Differing environmental conditions can affect the behaviours of the firms (Dess & Beard, 1984). For instance, the more dynamic the market is, the more innovative the firm will be forced to be in order to survive. Support of this and

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*I also examine the role of sales turnover as an alternate measure for firm size. I discuss this issue at more length in section 6.5.8.*
its effect on innovation have been covered in a number of studies, not least Moorman and Miner (1998). Market Dynamism, (i.e. the fluctuating nature of customer demands), was measured using two items from Chandler and Hanks (1994).

**Technological Dynamism**
The changing nature of the technology at use in the industry may also play a large role in the behaviour and innovative output of firms. Technological Dynamism was captured using six items that originally come from Chandler and Hanks (1994) and Narver, Slater, and MacLaclan (2004).

### 3.4.6 Pilot test

Prior to sending out the survey instrument, I conducted a minor pilot study. I sat with ten individuals to go through the survey step by step. The individuals represented people with different industry backgrounds. They were asked to provide their spontaneous comments to the question items, state when certain items were unclear or inappropriate, as well as provide a measure of how many minutes it took to fill out the entire survey. The intention of the pilot study was to iron out wrinkles in the survey and subsequently make the survey more appealing to the final respondents. Based on their comments, some aspects of the questionnaire were modified before it was mailed out to the sample.

Prior to the second reminder of the first survey round, I carried out extensive factor analysis and removed those items that did not fall into the factors. I also removed entire non-core sections in order to extensively shorten the survey. Feedback from the first round of surveying had shown that the length of the questionnaire was a main reason for non-response.

### 3.5 Validity

The validity of the responses refers to the extent to which the items accurately reflect the concept that is under study (Hair et al., 2006; Bryman & Cramer, 2001). This is an important issue for all research, including this study. My earlier criticisms of the extant literature and their operationalisations of the key variables subsumes that I can provide a valuable alternative. It goes without saying that I deliberately made a number of specific efforts to increase the validity and check the reliability of the variables that I study. I discuss many of these efforts in Chapter 4. Perhaps the most important variables are the dependent variables however. As the main variables to be predicted, it is vital that these reflect the intended constructs. This is a particular challenge with my dependent variables, where the five-point scale ranged from 1 meaning “none” and 5 meaning “very many times”. The in-between scales could potentially be
construed as being open to interpretation, such as the individual views of what constitutes “many”. This type of question has been used previously however and therefore has some empirical backing (e.g. Wiklund, 1998).

In any case, I tested these same question items in another separate study. I used the “host companies” that JIBS business students visit during their first two years of study. These firms are mostly SMEs from the Jönköping region. As part of the data collection, multiple respondents from each firm were needed. One of the respondents was supposed to be the highest executive. This was the primary respondent. Further employees were also supposed to fill in the survey. The next highest respondent (based on the level in the hierarchy and the number of years in the firm) was deemed as the secondary respondent. The perceptions of firm innovative behaviour between the primary and secondary respondents were reasonably similar. T-tests showed that there were no significant differences between the two respondents; neither for the individual items nor a number of combined items (p > 0.10). The inter-rater reliabilities varied quite a bit however. One observation based on these was that the further distance (in the hierarchy) between the primary and the secondary respondents, the greater the perceptions deviated. This might be due to this secondary person having less genuine knowledge of the whole firm. Unfortunately, there were few other members of the top management team included as secondary respondents.

There is an apparent trade-off involved when it comes to validating the dependent variable. On the one hand, potential differences in responding could be found based on the position of the individual in the firm. This is a natural limitation that can only be overcome with having multiple respondents per firm. On the other hand, relying on a single informant who arguably has the most knowledge of the actions of the firm can be seen as providing the best possible information, as I discuss in section 3.3.4. Using one key respondent also simplifies the data collection process, especially when a second knowledgeable informant is desired. My view is that relying on one best informant, especially considering the size of the firms in the study, is the best approach. In sum, I acknowledge that there are potential weaknesses concerning reliability and validity when using perceptual data from a singular key informant. However, the results of empirical testing I carried out on a different sample and my understanding of the pros and cons of using multiple informants leads me to believe that the validity of the results and my choice of method are more than satisfactory.
4 Exploring and validating the key variables

4.1 Introduction

At this stage, the purpose of this research project should be clear. Moreover, the main variables that are going to be tested should also be well understood. However, the variables that are going to be examined, such as knowledge-based capabilities and growth willingness, are latent variables. That is, they are complex higher-order variables that are not possible to measure directly. Rather, they are made up of a number of sub-questions or items that together cover the contents of the variable. As such, this chapter begins by discussing what the composition of the different variables, including running principal component analysis and reliability analyses in order to determine the convergent and discriminant validity of these. In the sections following that, I confirm the factor structure of the variables using other statistical techniques. Finally, I provide some basic descriptive analyses of these variables in order to determine their measurement properties. In Chapter 5, more advanced statistical analysis are carried out in order to determine the nature and strength of the relationships among the variables included in the study and to test the hypotheses outlined in Chapter 2. The analyses are performed using multiple regression and structural equation modelling. This present chapter is a very important chapter for this dissertation. One of the main contributions of this research, and in response to one of my main criticisms of the extant literature, is the operationalisation of the research variables. I am therefore very explicit and open in the choices I make and the criteria that I use in making these decisions.

4.2 Validation of measures using principal components analysis

4.2.1 Basics

As was described in the methods section, there are a substantial number of question items included in the survey. However, many of the variables, such as technological knowledge acquisition and knowledge exploitation, are complex ideas that can scantily be captured with single item measures. It is therefore
appropriate to use multiple items (questions) to measure these constructs. This process is called operationalising a variable. Using multiple items for a single construct has a number of benefits, including the ability to capture more of the totality of a broad concept, being able to draw finer distinctions between respondents, and also providing for more accurate evaluations of variables (Hair et al., 2006). This moreover simplifies analysis, as I will be dealing with a smaller number of combined variables in each analysis. However, moving from a single item to a fully measured construct requires the help of statistics.

Principal components analysis (PCA) is the most common method for reducing the number of variables into specific groupings (Bryman & Cramer, 2001). The basic idea behind PCA is to describe the variation, or variance, that is shared by a number of question items per case. That is, it compares the variance of individuals’ responses on the same questions and tries to explain this variance in terms of common underlying dimensions. The goal, in other words, is to condense a large number of question items into a more manageable number with minimal loss of information. Furthermore, it provides an objective basis for creating summated scales that can better reflect constructs. This process is where the individual items are combined and, together, reflect the latent variables.

PCA usually involves rotation, where the factor scores are rotated so that they provide a best simple structure by spreading explanatory power. In this case, I used orthogonal rotation (varimax) which is what Hair and colleagues (2006) and Tabachnick and Fidell (2001) recommend given that reduction is the goal of the PCA and simplified interpretation of the results is important. Orthogonal rotation assumes that the extracted factors are unrelated to each other.

The next step is to decide how many factors to extract. There are a number of methods for doing this. This is very much up to the researcher and his or her particular goals with the research, and the balance between parsimony (e.g. a model with relatively few factors) and plausibility (e.g. a sufficient number of factors to account for total variance). The most common method is using Kaiser’s criterion, which is captured using eigenvalues for all factors that are greater than 1. Eigenvalues are related to the amount of variance explained per factor. In component analysis, every variable contributes one eigenvalue to the total number of eigenvalues (Hair et al., 2006). Kaiser’s criterion essentially states that those factors with eigenvalues less than one are not significant as that factor does not explain more than the variance of one variable (Yeomans & Golder, 1982; Hair et al., 2006). A second option is to use a scree test where the eigenvalues of the correlation matrix are computed and plotted in descending order. The scree test is a visual diagnostic tool, where one can graph the eigenvalues per component. Just like scree at the foot of a mountain, one
can more or less see where the steep slope of the mountain ends and the levelling off of the ground begins (Bryman & Cramer, 2001). In other words, one is able to visually inspect where the most important and least important eigenvalues (e.g. the components) are located. I used a combination of both, where I first looked at the eigenvalues and then at the scree plots.

4.2.2 Knowledge-based capabilities

As previously mentioned, I used a large number of question items in the survey. Indeed, as I pointed out in the methods chapter, the mass of questions was most likely a key reason why the response rate was lower than expected. I purposefully chose to have more items included as I was not sure of the best way to measure certain concepts. This is one of the risks when using original operationalisations of constructs and is also a reflection of the complexity of the concepts that I am trying to capture.

That said, when I started to approach the analysis of the data, I chose to have two goals with the first steps of the analysis. My primary goal was important to establish high discriminant validity between the variables. This provides me with the knowledge that my more in-depth analyses are actually (at least statistically speaking) different variables. The secondary goal was to retain a high level of internal consistency for each factor. This is valuable in that it helps provide information on how well the different variables making up the construct actually reflect the same underlying variable. Obviously, statistics cannot explain everything and so theory is used to make sure that each of the variables can be seen as measuring the same thing – theoretically and statistically.

For the first goal, and with particular impact on principal components analysis, it meant that the items only loaded on the appropriate factor and that there were not any cross-loadings above 0.32. This level is the recommended level that Tabachnick and Fidell (2001) put forward and corresponds with the levels that Hair and friends (2006) argue are statistically significant (p < .05) when looking at samples of the size that I have. I further test discriminant validity when running confirmatory factor analysis. For the latter goal, I hoped to maintain internal reliabilities (e.g. Cronbach’s alpha) above 0.70. This level is what Nunnally (1978) recommends for confirmatory analysis, although others (e.g. Robinson, Shaver & Wrightsman, 1991) argue that levels as low 0.60 are acceptable for exploratory analyses.

As there were a number of questions that were going to eventually be removed, I began a very iterative process. The first step of this process was to run PCA on the items that I felt belonged to the same construct. For example, I had the assumption that all of the technological assimilation measures would be
included into one factor and so entered all of them into the PCA. Some of these resulted in multiple factors, and not one single factor, as was the intention. It was therefore up to me to decide if the resulting factor structure represented theoretically relevant factors or simply empirical patterns. For the most part, the emerging factor structure reflected the theoretical predictions. There are two key instances where multiple factors emerged – for Market Knowledge Acquisition and Knowledge Transformation.

For Market Knowledge Acquisition, two clear factors appeared that represented working specifically with customer needs (now called Direct Market Knowledge Acquisition) and gathering knowledge from other sources such as having lunch with industry contacts and attending trade fairs (now called Indirect Market Knowledge Acquisition). I returned to the literature where I found that in terms of acquiring market knowledge, some authors (e.g. Yli-Renko, Autio and Sapienza, 2001) focus primarily on knowledge coming directly from customers, while others considered other sources of information (e.g. Cooper, Folta and Woo, 1995). Saywer, Edbrahim and Thibodeaux (2000) find that some entrepreneurs prefer the use of more informal sources of information, such as newspapers and trade magazines, as they provide balanced information of more general trends. In other words, there is clearly a theoretical explanation for the differences. I therefore decided to retain these as two separate factors, as there was theoretical support for them being separate. For the Knowledge Transformation variable, three appropriate variables appeared that resonated well with the theoretical underpinnings of the Transformation construct that Zahra and George (2002) described. The three factors that emerged reflected going through information on previous projects (called Reviewing Previous Knowledge), deliberately connecting new projects with previous projects (called Synthesising Knowledge) and purposefully bringing together different parts of the firm (called Knowledge Combination). For instance, Garud and Nayyar (1994) present a list of possible questions to be used in operationalising the construct Transformative Capacity. Although they do not test these items, they clearly can be seen as being made up of a number of sub-concepts. These sub-concepts reflect the ones that my PCA display. This theoretical support shows that these observations are more than simply statistical anomalies. In light of this empirical discovery, I revise some of my hypotheses to reflect these new knowledge-based capabilities.

5 I long considered different labels for these transformation variables. “Reviewing Previous Knowledge” and “Synthesising Knowledge” reflect re-using existing stocks of knowledge, although the latter construct is more closely related to building upon existing stocks for future work. “Knowledge Combination” involves purposefully cross-fertilising knowledge from different individuals within the firm. There are therefore different issues with each of these factors that need to be encapsulated into simple, descriptive, and understandable labels. I finally chose to use these present labels as similar terms in the literature on transforming knowledge are used. I do acknowledge that other labels could rightfully be used instead.
H1a: Higher levels of Direct Market Knowledge Acquisition are positively related to Market Knowledge Assimilation.
H1b: Higher levels of Indirect Market Knowledge Acquisition are positively related to Market Knowledge Assimilation.
H3a: Higher levels of Market Knowledge Assimilation are positively related to Reviewing Previous Knowledge.
H3b: Higher levels of Market Knowledge Assimilation are positively related to Knowledge Synthesis.
H3c: Higher levels of Market Knowledge Assimilation are positively related to Knowledge Combination.
H4a: Higher levels of Technological Knowledge Assimilation are positively related to Reviewing Previous Knowledge.
H4b: Higher levels of Technological Knowledge Assimilation are positively related to Knowledge Synthesis.
H4c: Higher levels of Technological Knowledge Assimilation are positively related to Knowledge Combination.
H5a: Higher levels of Reviewing Previous Knowledge are positively related to Knowledge Exploitation.
H5b: Higher levels of Knowledge Synthesis are positively related to Knowledge Exploitation.
H5c: Higher levels of Knowledge Combination are positively related to Knowledge Exploitation.
H7a: Higher levels of Growth Willingness are positively related to Direct Market Knowledge Acquisition.
H7b: Higher levels of Growth Willingness are positively related to Indirect Market Knowledge Acquisition.
H11a: Higher levels of Growth Willingness are positively related to Reviewing Previous Knowledge.
H11b: Higher levels of Growth Willingness are positively related to Knowledge Synthesis.
H11c: Higher levels of Growth Willingness are positively related to Knowledge Combination.
In Figure 4.1 above and 4.2 below, I graphically illustrate how the new hypotheses affect my main research models. Figure 4.1 focuses on the interrelationships among knowledge-based capabilities and innovative output. Figure 4.2 displays the effects of growth willingness on the other variables.

In addition, I have reworded H14, H16, H18 and H20 to read Direct Market Knowledge Acquisition instead of Market Knowledge Acquisition. This change reflects the empirical observation that there are two main methods of collecting information from the market.

I then checked the internal reliability of the factors to see if they met the criterion that I have previously stated in this manuscript. I made a note if the
Exploring and validating the key variables

reliability would be higher if one particular item were removed. The second step consisted of including all of the items for all of the potential constructs into a PCA. This allowed me to see how the items actually remained with their appropriate constructs when they had the opportunity to “jump” into other competing constructs. For instance, an item that was supposed to be included in Technological Knowledge Acquisition could easily be included in the Knowledge Exploitation construct instead. From a theoretical point of view, this would make some sense as many firms learn about their technology only when they release a product and are able to get feedback on it. To note at this stage is that I did not specify a particular number of factors to be extracted but instead employed the Kaiser criterion.

As there are a number of potential theoretical explanations that could conceivably provide some justification for having certain items included in multiple constructs, I needed to make an important decision about which items would remain and which would be removed. For the Technological Knowledge Acquisition construct, I purposefully removed certain items that seemed to be more fitting in the exploitation construct. As I mentioned previously, I demanded two things of the data: 1) The item have a loading of 0.50 or greater on its intended factor, and 2) The item did not have a cross-loading above 0.32 on any other construct. These numbers match the established cut-offs described in Hair and company (2006) and Tabachnick and Fidell (2001). Items that did not meet these criteria were removed and the process re-started.

After two or three iterations using this process, I was able to develop a parsimonious factor structure that was theoretically relevant, had high discriminant validity (i.e. no cross-loadings), and high internal reliability (i.e. acceptable Cronbach’s alphas using Nunnally’s recommendations). The one exception to the internal reliability criteria was the construct Indirect Market Knowledge Acquisition, where the alpha level falls slightly below 0.60. However, I feel as though this construct provides a valuable conceptual distinction that complements the focused Direct Market Knowledge Acquisition practice of discussing wants and needs with customers. One natural weakness of having removed a large number of items in the pursuit of discriminate validity and internal reliability is that I can have lost some information at the same time. However, given the fact that I intend on carrying out certain multivariate analyses later on, I felt that these priorities are important in order to achieve higher trustworthiness, interpretability, and validity of my empirical results.

The results of the PCA can be found in the Table 4.1 below. The Cronbach’s alpha for each construct is listed in bold and match the factor (or “component” really) also in bold in the same row. The individual loadings to the factor of each item are listed in the same row as the respective item question. All of the
Table 4.1 Factors and items included in them

<table>
<thead>
<tr>
<th>Factor/item</th>
<th>Alpha/Loading</th>
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<tbody>
<tr>
<td><strong>Direct Market Knowledge Acquisition</strong></td>
<td></td>
</tr>
<tr>
<td>Discussions with customers to find out what products/services they will need in the future</td>
<td>.767</td>
</tr>
<tr>
<td>Forecasting sales and customer preferences</td>
<td>.619</td>
</tr>
<tr>
<td>Frequent contact with customers to assess quality of products/services</td>
<td>.755</td>
</tr>
<tr>
<td><strong>Indirect Market Knowledge Acquisition</strong></td>
<td></td>
</tr>
<tr>
<td>Informal means (e.g. lunch with industry friends, talks with trade partners)</td>
<td>.647</td>
</tr>
<tr>
<td>Gathering of information from suppliers and other channel members</td>
<td>.613</td>
</tr>
<tr>
<td>Trade magazines, fairs, government publications, news media</td>
<td>.716</td>
</tr>
<tr>
<td><strong>Technological Knowledge Acquisition</strong></td>
<td></td>
</tr>
<tr>
<td>Taking technological-related courses from local universities or educational institutions</td>
<td>.729</td>
</tr>
<tr>
<td>Offering in-house technological training</td>
<td>.561</td>
</tr>
<tr>
<td>Attending conferences focused on technology or knowledge</td>
<td>.606</td>
</tr>
<tr>
<td>Formal R&amp;D activities</td>
<td>.671</td>
</tr>
<tr>
<td>Hiring technology specialists</td>
<td>.724</td>
</tr>
<tr>
<td><strong>Market Knowledge Assimilation</strong></td>
<td></td>
</tr>
<tr>
<td>There is a lot of informal hallway talk concerning our competitors' tactics or strategies</td>
<td>.575</td>
</tr>
<tr>
<td>We regularly have meetings with people from different functional areas to discuss market trends and developments</td>
<td>.660</td>
</tr>
<tr>
<td>Marketing personnel in our firm spend time discussing customers' future needs with people in other functional areas</td>
<td>.690</td>
</tr>
<tr>
<td>Our firm regularly circulates documents that provide information on our customers</td>
<td>.693</td>
</tr>
<tr>
<td><strong>Technological Knowledge Assimilation</strong></td>
<td></td>
</tr>
<tr>
<td>Personnel in our firm spend time discussing technological needs with others from different functional areas</td>
<td>.569</td>
</tr>
<tr>
<td>When a new technological advance occurs, the whole firm knows about it within a short period</td>
<td>.805</td>
</tr>
<tr>
<td>There are a lot of informal discussions concerning our technology</td>
<td>.734</td>
</tr>
<tr>
<td>Data on our technological capabilities are disseminated at all levels of the firm on a regular basis</td>
<td>.790</td>
</tr>
</tbody>
</table>
Exploring and validating the key variables

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>It's common that we review the descriptions of previous technological work that our firm has carried out</td>
<td>0.768</td>
</tr>
<tr>
<td>We always go through our reports concerning the potential wants of our customers</td>
<td>0.788</td>
</tr>
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<tr>
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<tbody>
<tr>
<td>We try to develop projects that have some overlapping contents with previous work</td>
<td>0.795</td>
</tr>
<tr>
<td>We try to develop projects that can be synthesised with previous work</td>
<td>0.734</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th></th>
<th>0.795</th>
</tr>
</thead>
<tbody>
<tr>
<td>All members of the firm are invited to participate in discussions of business issues whenever possible</td>
<td>0.780</td>
</tr>
<tr>
<td>People with different functional backgrounds are encouraged to work together</td>
<td>0.697</td>
</tr>
<tr>
<td>We purposefully integrate different parts of the firm to share ideas</td>
<td>0.597</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>0.840</th>
</tr>
</thead>
<tbody>
<tr>
<td>Our firm develops a number of ideas for changes to existing products/services</td>
<td>0.612</td>
</tr>
<tr>
<td>We think of new ways of using our existing skills and knowledge</td>
<td>0.755</td>
</tr>
<tr>
<td>It is usual that we get new ideas for combining existing technology with new discoveries</td>
<td>0.805</td>
</tr>
<tr>
<td>We find innovative ways of combining our existing technology and new markets</td>
<td>0.746</td>
</tr>
<tr>
<td>We generate many ideas for radically new products/services</td>
<td>0.747</td>
</tr>
<tr>
<td>We have many ideas for development that fall beyond our existing product/service line</td>
<td>0.619</td>
</tr>
<tr>
<td>Our company develops a number of new ideas for making technological alterations that could greatly affect the way we do business</td>
<td>0.731</td>
</tr>
</tbody>
</table>

### 4.2.3 Discussion of PCA

Principal components analysis is not without weaknesses. A frequent criticism of using principal components analysis is its treatment of variance. Variance can come from common variance that exists across all response scores (e.g., common variance), variance that comes from one specific variable (e.g., specific variance), or the variance that comes about when things are measured (e.g., error variance). As it is close to impossible to distinguish between specific and error variance, these are generally treated together in statistical analyses. Together, these two types of variance are called unique variance. Principal components analysis treats the variables as though they do not contain any error variance but are linear composites of the original measured variables (Johnson & Wichern, 1988). In practical terms, this means that principal components analysis looks
at all of the variance (e.g., both common and unique, including the error variance) in trying to find separate factors (Bryman & Cramer, 2001). The criticism against this method is that it does not directly account for a higher-order common variance, or a potential latent construct, that might help with interpretability.

An alternative analysis method is exploratory factor analysis, also known as common factor analysis. This type of analysis can come in the form of such extraction methods as maximum likelihood or principal axis analysis. This method looks exclusively at the common variance of the responses and ignores unique variance (Bryman & Cramer, 2001; Hair et al., 2006). However, there are also weaknesses with common factor analysis, such as factor indeterminacy (Hair et al., 2006), so the use of common factor analysis does not necessarily mean a perfect statistical method. Furthermore, the dispute between PCA and EFA has been described by experts as simply being “mumbo jumbo” (Hair et al., 2006; 119) and does not result in any de facto differences in factor structure.

As I have previously explained, I used principal components analysis to uncover the factor structure of my responses. However, I then re-ran the same analyses using principal axis and then maximum likelihood extraction. There were no differences in factor structure, but the latter two methods reduced the already miniscule cross-loadings of items to even lower levels. In other words, the overall differences were negligible. This provides further support for my choice of using principal component analysis. I will now turn my attention to confirming my factor structure using confirmatory factor analysis, right after I discuss the three other latent variables that are involved in my study.

4.2.4 Other variables in the study

In order to determine the validity and reliability of the task environment and growth willingness variables, I followed the same principal component analysis process as was undertaken for the knowledge-based capabilities. The results are presented below. These constructs also showed a high level of discriminant validity and internal reliability.
Table 4.2 PCA results for task environment and growth willingness variables

<table>
<thead>
<tr>
<th>Factor/item</th>
<th>Alpha/Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market Dynamism</td>
<td>.839</td>
</tr>
<tr>
<td>Market demand and customer tastes are unpredictable</td>
<td>.928</td>
</tr>
<tr>
<td>It is difficult for use to foresee customer needs in the near future</td>
<td>.928</td>
</tr>
<tr>
<td>Technological Dynamism</td>
<td>.825</td>
</tr>
<tr>
<td>The technology in our markets is changing rapidly</td>
<td>.813</td>
</tr>
<tr>
<td>It is very difficult to forecast where the technology in this market will be in the next few years</td>
<td>.606</td>
</tr>
<tr>
<td>Technological developments in this market are rather minor (reverse coded)</td>
<td>.746</td>
</tr>
<tr>
<td>A large number of new products/services in this market have been made possible through technological breakthroughs</td>
<td>.741</td>
</tr>
<tr>
<td>Products/services become obsolete quickly</td>
<td>.673</td>
</tr>
<tr>
<td>Technological changes provide big opportunities in this market</td>
<td>.806</td>
</tr>
<tr>
<td>Growth Willingness</td>
<td>.802</td>
</tr>
<tr>
<td>We strongly prefer stability over growth (reverse coded)</td>
<td>.758</td>
</tr>
<tr>
<td>We are willing to bring in new owners in order to grow the firm</td>
<td>.628</td>
</tr>
<tr>
<td>The firm is willing to take on new loans in order to grow the firm</td>
<td>.629</td>
</tr>
<tr>
<td>The firm is committed to achieving growth, even if it means lower profits</td>
<td>.715</td>
</tr>
<tr>
<td>We strongly prefer to keep the firm at its present size, even if there is the possibility to grow (reverse coded)</td>
<td>.734</td>
</tr>
<tr>
<td>The general attitude of the firm is to grow as big as possible, as quickly as possible</td>
<td>.767</td>
</tr>
</tbody>
</table>

4.3 Confirmatory factor analysis

Confirmatory factor analysis (CFA) is used to make sure the data actually fit the model better than competing models. In practical terms for this research, it helps me evaluate the veracity of the factor structure that was obtained in the PCA. This method is generally used when there is a strong basis to assume that there are a certain number of factors and that the items fit with them. CFA requires the researcher to specify an explicit model of how the observed items are related to the hypothesised latent factors. As a result, it is not likely that the CFA will capitalise on chance variance of the data. CFA also offers advanced statistical techniques that allow the researcher to test how well the a priori
model fits the data and permits comparative model testing to see how well the data fits other plausible models.

The evaluation of CFA is best when the preferred model is shown to possess better fit than competing models. The metric most commonly used to evaluate fit is the likelihood ratio, also known as the Chi-square goodness-of-fit (or $\chi^2$). Other alternative measures of model fit have also been developed, including incremental fit models, where the tested model is compared to a “null model” (where all measures are assumed to have variances but no relations to each other). The Tucker-Lewis Index (TLI) and Incremental Fit Index (IFI) are employed in this study. Absolute fit indices examine the absolute discrepancy between the model and the data rather than as a comparison between models. Root Means Square Error of Approximation (RMSEA) looks at the discrepancy per degree of freedom. This measure is also used in this study.

The nine-factor model that was presented in the previous PCA section was compared to ten-, eight-, seven-, six-, five-, four-, three-, two-, and one-factor models. This was only conducted for the knowledge-based capability factors. The nine-factor model was vastly superior compared to all other competing models using a number of fit indices. The table below shows the most important fit indices. For space reasons, only the nine-, eight, and one-factor model are presented.

Table 4.3 Confirmatory factor analysis results

<table>
<thead>
<tr>
<th></th>
<th>Nine-factor solution</th>
<th>Eight-factor solution</th>
<th>One-factor solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\chi^2$</td>
<td>712.13</td>
<td>915.15</td>
<td>1806.53</td>
</tr>
<tr>
<td>Df</td>
<td>459</td>
<td>467</td>
<td>495</td>
</tr>
<tr>
<td>CFI</td>
<td>.928</td>
<td>.873</td>
<td>.628</td>
</tr>
<tr>
<td>IFI</td>
<td>.932</td>
<td>.876</td>
<td>.635</td>
</tr>
<tr>
<td>TLI</td>
<td>.912</td>
<td>.847</td>
<td>.578</td>
</tr>
<tr>
<td>RMSEA</td>
<td>.042</td>
<td>.055</td>
<td>.092</td>
</tr>
</tbody>
</table>

Using the metrics described in the previous chapter, we can see that the nine-factor model is superior to all other models. In Table 4.3, I only present two competing models; this was for space purposes only. All of the other models are inferior to the nine-factor model. In addition, the nine-factor model shows excellent fit. For example, RMSEA levels less than 0.05 indicate very good fit (Byrne, 2001; Browne & Cudeck, 1992) and levels up to 0.08 indicate reasonable fit. Other metrics, such as the Comparative Fit Index (CFI), the
Incremental Fit Index (IFI) and Tucker-Lewis Index (TLI) are all above the recommended levels of 0.90 (Hu & Bentler, 1999; Hair et al., 2006).

Hair and colleagues (2006) argue that one measure of discriminant validity is to examine the variance extracted per construct and compare it with the square of the correlation estimate between the two constructs. The basic idea behind this is that the construct should better explain its underlying variables than another construct. A good starting point in this endeavour is that the average variance extracted is greater than 0.50 for each of the constructs. This means that the variance captured by the construct is greater than any measurement error (Fornell & Larcker, 1981). The inter-correlations between the latent constructs, including those for Market and Technological Dynamism and Growth Willingness, ranged from 0.00 to 0.57. The highest bivariate correlation was between Technological Assimilation and Knowledge Combination (0.57). These are displayed in the bottom left hand corner of Table 4.10. The extracted levels of variance, seen in the diagonal of the same table and displayed in parentheses, vary from 0.55 to 0.82. A potential problem could exist if the inter-correlations were greater than the variance extracted. However, the two variables that correlate highly (e.g. Knowledge Combination and Technological Knowledge Assimilation) have extracted variances of 0.76 each. The variable with somewhat low extracted variance (e.g. Indirect Market Knowledge Acquisition with 0.55) does not correlate with any other variable above 0.40. In other words, the levels of correlation are not especially problematic. In addition, the shared variance, in the top right hand corner, range from 0.00 to 0.32, are far below the average variance extracted. Overall, the tests provide evidence of convergent and divergent validity for the latent measurement model.

4.4 Internal non-response

One aspect that has yet to be discussed within the analysis is the occurrence of missing data due to internal non-response (i.e. the fact that some respondents did not answer all of the questions in the survey). The first action that I took was to remove those firms that had not responded to a large portion of the questions or that did not respond to a number of the key variables in my analyses. These problematic firms were simply excluded from the study. This was vigilantly done for firms missing data for the dependent variable, but otherwise the decision to remove a firm from the study was made on a case-by-case basis. I did not allow a firm with more than five missing answers to remain in the sample. However, as there was only a handful of firms with a small number of missing values, this was not a major problem. For these few firms with a tiny number of missing answers, a more complicated process was adapted. Hair and colleagues (2006) discuss a number of methods of dealing with missing data. I first examined the remaining firms with internal non-
response to see if there were any particular patterns to them not responding to individual items. Fortuitously, the internal non-response seemed to generally only be one question per firm and these were spread out across items. In other words, internal non-response appeared to be more random than systematic. Many items did not have any missing values; at the very most, one item had six missing values. The majority only had one or two missing values.

I imputed the missing data for the very few cases by taking into consideration two particular issues. Firstly, I looked at the other items that were included in the same factor. Secondly, I looked at other items that were not part of the same factor and how well the individual items correlated. Based on these, I could run a regression based on a few items that correlated well with the missing item. This provided a statistically relevant value to impute. Upon re-running the principal components analyses, I noted no differences.

4.5 Descriptive analysis of key variables

4.5.1 Knowledge-based capabilities

The knowledge-based capability variables play a central role in the framework for understanding how and why innovation might vary between firms. As such, there should be some variance between firms in terms of innovative output. Table 4.4 below shows some descriptive statistics of the knowledge-based capability variables. It also shows satisfactory standard deviations, showing that there is variance between firms. One observation is that the mean for most responses lies close to the mean of the range of possible values. This suggests that the scales capture the full range of variance in responses. However, for some variables, the means are relatively high. For example, for Direct Market Knowledge Acquisition the mean is slightly over 11 out of a maximum score of 15. This implies that there might be some skewing of these variables. While it is impossible to foresee if there are any potential effects of this, it might be worthwhile to bear this in mind when analysing the data.
Table 4.4 Descriptive statistics of knowledge-based capabilities

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Range</th>
<th>Mean</th>
<th>S.d.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Market Acquisition</td>
<td>316</td>
<td>3-15</td>
<td>11.08</td>
<td>2.22</td>
</tr>
<tr>
<td>Indirect Market Acquisition</td>
<td>316</td>
<td>3-15</td>
<td>9.50</td>
<td>2.33</td>
</tr>
<tr>
<td>Technological Knowledge Acquisition</td>
<td>316</td>
<td>5-25</td>
<td>12.61</td>
<td>4.24</td>
</tr>
<tr>
<td>Market Knowledge Assimilation</td>
<td>316</td>
<td>4-20</td>
<td>11.48</td>
<td>3.42</td>
</tr>
<tr>
<td>Technological Knowledge Assimilation</td>
<td>316</td>
<td>4-20</td>
<td>15.51</td>
<td>3.33</td>
</tr>
<tr>
<td>Reviewing Previous Knowledge</td>
<td>316</td>
<td>2-10</td>
<td>6.11</td>
<td>1.78</td>
</tr>
<tr>
<td>Synthesising Knowledge</td>
<td>316</td>
<td>2-10</td>
<td>7.85</td>
<td>1.71</td>
</tr>
<tr>
<td>Knowledge Combination</td>
<td>316</td>
<td>3-15</td>
<td>11.91</td>
<td>2.47</td>
</tr>
<tr>
<td>Knowledge Exploitation</td>
<td>316</td>
<td>8-35</td>
<td>24.20</td>
<td>5.10</td>
</tr>
</tbody>
</table>

4.5.2 Innovative output

There are two Innovative Output variables used in this study, as was explained in Chapter 3. Expected Innovative Output is based on the cross-sectional data and reports on the expected number of innovations to be launch/developed over the coming year. This variable is made up of four different items with a Cronbach’s alpha of 0.901, as shown in Table 4.5 below. This variable runs the risk of being subject to common method bias. The Actual Innovative Output is based on the longitudinal data and is made up of the same four questions as the Expected Innovative Output variable. As this was the follow-up survey, there are fewer respondents. More details on the respondents and non-respondents are available in Chapter 3. I also sometimes use a dependent variable only looking at radical innovation. However, these are only used as tests of robustness, and not part of the main analyses. Often, radical and incremental innovation are treated as vastly diverging. By only examining the radical innovation variables, I am able to confirm that the findings are applicable to innovative output in general and not applicable to one particular type of innovation only.
Table 4.5  Cronbach's alpha and correlations for the different dependent variables

<table>
<thead>
<tr>
<th></th>
<th>Alpha</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Expected Innovative Output</td>
<td>.901</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Actual Innovative Output</td>
<td>.794</td>
<td>.431**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Expected Radical Innovation</td>
<td>.920</td>
<td>.934**</td>
<td>.410**</td>
<td></td>
</tr>
<tr>
<td>4. Actual Radical Innovation</td>
<td>.732</td>
<td>.398**</td>
<td>.908**</td>
<td>.440**</td>
</tr>
</tbody>
</table>

Note: * = p < .05, ** = p < .01, *** = p < .001

As can be seen in Table 4.6 below, the mean scores for Actual Innovative Output are also a bit lower than the Expected Innovative Output variables and the correlations are only moderately high (Table 4.5 above). What this shows is that the Expected and Actual Innovative Output variables may be considered to represent different concepts and should therefore not be considered as synonymous.

Table 4.6  Descriptive statistics of innovative output variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Range</th>
<th>Mean</th>
<th>S.d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected Innovative Output</td>
<td>316</td>
<td>4-20</td>
<td>11.82</td>
<td>4.28</td>
</tr>
<tr>
<td>Actual Innovative Output</td>
<td>213</td>
<td>4-20</td>
<td>9.96</td>
<td>3.84</td>
</tr>
<tr>
<td>Expected Radical Innovation</td>
<td>316</td>
<td>2-10</td>
<td>5.23</td>
<td>2.47</td>
</tr>
<tr>
<td>Actual Radical Innovation</td>
<td>213</td>
<td>2-10</td>
<td>4.18</td>
<td>2.20</td>
</tr>
</tbody>
</table>

The fact that these variables are highly correlated relates to the nature of the variables. One can argue that Expected Innovative Output is a variable measuring intentions, and therefore is not the same thing as action. If this is the case, then a number of studies within psychology can at least partially explain differences between intentions and enacted behaviour. In a recent meta-analysis, the correlation between intentions and behaviour were found to be slightly less than 0.3 (Armitage & Conner, 2001). This number is substantially lower than the correlation I find here. There are also studies within Entrepreneurship that have looked at the intentions of individuals to engage in entrepreneurial action (e.g. Choi & Shepherd, 2004). I return to this subject in the Discussion chapter.

Why the mean values are different can be due to a number of reasons. One potential reason is that there is a response bias where the most innovative firms did not respond to the follow-up survey. The Expected Innovative Output measure was collected in the first wave of data collection. The Actual Innovative
Output data was collected in the follow-up one year later. However, I presented a test of non-response bias in section 3.3.6 and did not find any statistically significant differences between respondents and non-respondents. There was nevertheless a tendency for the less innovative firms to answer \( p > .261 \), which would explain why the main levels are somewhat lower for Actual Innovative Output.

Another reason for the differences between variables may be common method bias. Common method bias is an over-inflation of the relationships between variables as they are all collected at the same time and using the same survey instrument. It can also be the case that the same response scale is used. This type of problem is especially common to cross-sectional data. One test of this is Harmon’s one factor test (Podsakoff & Organ, 1986). This test has been used in other studies examining knowledge-based capabilities (e.g. Jansen, van den Bosch, and Volberda, 2005). As I collected data on the dependent variable one year later, common method variance is not a huge problem for the Actual Innovative Output data. However, as I intend on carrying out some cross-sectional analyses using Expected Innovative Output as the dependent variable, I felt it necessary to examine the possibility of common method bias. This is done by entering both the independent and dependent variables into one exploratory factor analysis. A large number of variables were produced and they explained a total of 62% of all variance. The largest factor accounted for 29% of the variance. As one single factor did not emerge and one factor did not account for the majority of the variance, common method bias does not appear to pose a grave problem for the cross-sectional data. Other issues dealing with common method bias, such as common source bias are dealt with in other parts of this dissertation.

Although I cannot completely discard the notion that common method bias is the root of the higher scores for Expected Innovative Output, a more plausible scenario for why there are lower scores for Actual Innovative Output is that people over-estimated their ability to innovate during the year. They simply might have had too high expectations about what they were going to achieve, and it may be that they did not have the time or resources to innovate. It may also be that the expected viability of the opportunities they believe they had spotted diminished during the year, or even that the innovation used to satisfy the opportunity took longer to develop than expected. This is of course speculation, but what is an empirical certainty is that there is an average reduction per firm of 14-18% from expectation to actual innovation. This means that there may be lower effects when examining the Actual Innovative Output data compared to the Expected Innovative Output.
4.5.3 Other variables

There are a number of other variables employed in this study. The age and size variables are used as control variables, as are the ownership and market and technological dynamism variables. The growth willingness variable was also included here, although it is an important research variable. The descriptive statistics of these variables are presented below. There are two major outliers for the size variable. Those particular firms have a very large number of employees. The mean and standard deviation are therefore skewed by these firms.

Table 4.7 Descriptive statistics of other variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Range</th>
<th>Mean</th>
<th>S.d.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>316</td>
<td>2-10</td>
<td>5.60</td>
<td>2.27</td>
</tr>
<tr>
<td>Size</td>
<td>316</td>
<td>3-636</td>
<td>12.75</td>
<td>41.92</td>
</tr>
<tr>
<td>Market Dynamism</td>
<td>310</td>
<td>2-10</td>
<td>5.78</td>
<td>1.89</td>
</tr>
<tr>
<td>Technological Dynamism</td>
<td>311</td>
<td>9-30</td>
<td>22.32</td>
<td>4.33</td>
</tr>
<tr>
<td>Growth Willingness</td>
<td>316</td>
<td>6-30</td>
<td>18.12</td>
<td>5.31</td>
</tr>
</tbody>
</table>

The size variable, as it was skewed, warranted further attention and description. In the table below, I have presented further information about the size levels of the firms in the sample. One half of the firms have five employees or fewer, and thus are quite small firms. Almost another 25% of the firms had between five and ten employees. The conclusion is that the majority of the firms in this sample are very small. Only 8 firms (2.6% of the sample) had more than 50 employees. These firms unnaturally warp the mean and standard deviations of the size variable.

Table 4.8 Number of firms in sample based on size

<table>
<thead>
<tr>
<th>Size</th>
<th>Number of firms</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5 employees</td>
<td>158</td>
<td>50.0</td>
</tr>
<tr>
<td>6-10 employees</td>
<td>77</td>
<td>24.4</td>
</tr>
<tr>
<td>11-20 employees</td>
<td>51</td>
<td>16.1</td>
</tr>
<tr>
<td>21-50 employees</td>
<td>22</td>
<td>7.0</td>
</tr>
<tr>
<td>51-100 employees</td>
<td>4</td>
<td>1.3</td>
</tr>
<tr>
<td>Over 100 employees</td>
<td>4</td>
<td>1.3</td>
</tr>
<tr>
<td>Total</td>
<td>316</td>
<td>100</td>
</tr>
</tbody>
</table>
I am also interested in the ownership of the firms. In the method chapter, I noted that firms that are have venture capital or were subsidiaries of other firms might affect the capabilities and innovative output of the firms. A firm was dummy-coded as having venture capital (VC) if over 1% of the firm was owned by a venture capitalist. Forty-eight firms had VC. Furthermore, a firm was considered a subsidiary if 50% or more of the firm was owned by a parent company or holding company. 50% was used as the cut-off as this would represent a controlling ownership relationship. Thirty-five firms were coded as being subsidiaries, 24 of which were entirely owned by a parent company or holding company. Two firms were treated as being both subsidiaries and venture-capital backed firms. Further examination of these two cases resulted in discovering that they both had spread out ownership between internal (e.g. employees, CEO) and external owners.

In Table 4.9, I present a comparison of the VC-backed and non VC-backed firms. I also present a comparison of subsidiaries and independent firms. I used t-tests to examine the differences based on ownership. The statistically significant variables are marked with asterisks. Only the means for each variable are presented. Of note is that both the VC-backed firms and subsidiaries are larger than the average firm. In the case of subsidiaries, this can be connected to having larger resource bases, established products, and perhaps even existing customer bases via the parent company. The largest firms in the sample (including the recently mentioned size outliers) are subsidiaries. For the VC-backed firms, this is more likely connected to the added resources that are injected into the firm so that it can grow and earn returns for the venture capitalist. It is therefore not surprising that the VC-backed firms have higher levels of growth willingness than the rest of the firms, considering the goals of venture capitalists. Perhaps surprisingly, task environment dynamism is not significantly greater for VC firms. Venture capital firms are well-known for investing in firms who are in fast-changing markets at the global knowledge frontier; it is often these types of industries that have the highest growth potential and therefore prospective financial returns.
Table 4.9 Relationship between ownership and other variables

<table>
<thead>
<tr>
<th>Mean</th>
<th>VC</th>
<th>Non-VC</th>
<th>Subsidiary</th>
<th>Independent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>5.44</td>
<td>5.62</td>
<td>5.54</td>
<td>5.60</td>
</tr>
<tr>
<td>Size</td>
<td>14.23*</td>
<td>12.49</td>
<td>42.91***</td>
<td>9.00</td>
</tr>
<tr>
<td>Growth Willingness</td>
<td>22.17***</td>
<td>17.40</td>
<td>19.03</td>
<td>18.01</td>
</tr>
<tr>
<td>Market Dynamism</td>
<td>5.60</td>
<td>5.82</td>
<td>6.49</td>
<td>5.69</td>
</tr>
<tr>
<td>Tech Dynamism</td>
<td>22.50</td>
<td>22.28</td>
<td>22.17</td>
<td>22.33</td>
</tr>
</tbody>
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Note: * = p < .05, ** = p < .01, *** = p < .001

4.6 Correlations

The main variables in the study have now been described. However, aside from a few relationships and groupings for the control variables, I have said little about how these variables are related to each other. In order to do this, I present the bivariate correlations in the Table 4.10 and 4.11 below. Table 4.10 shows the relationships for the control and independent variables. Table 4.11 shows the moderators and dependent variables. I split these exclusively for space reasons. Please note that in Table 4.11 the format is different from that of Table 4.10. The bottom left corner of Table 4.10 is where the bivariate correlations are presented. It is the upper right corner in Table 4.11. The numbers in parentheses in Table 4.10 show the level of extraction for each construct. In the upper right corner of that same table, I display the squared inter-correlations between constructs. These issues have been discussed in section 4.3 concerning confirmatory factor analysis. These statistics are not shown in Table 4.11.

There are a number of interesting relationships. Firstly and most importantly for the study, all of the knowledge-based capability variables have significant positive relationships with each other. This is interesting for a number of reasons. To begin with, this might show that firms who possess one of these capabilities generally possess the others. In other words, some firms are good at all of the things whereas others are not. Similarly, this finding might be a reflection of that these variables are parts of a process, and not independently standing variables, i.e. firms do all or most of these things. This finding could also mean that there is some overlap between these variables, although much of this overlap may have been reduced and accounted for in the PCA and confirmatory factor analysis. This can mean that there is the risk of multicollinearity between the variables, which can have negative consequences.
for certain more advanced analyses. I will explain this in more depth later within this dissertation, and in particular section 5.2.

Relating to the other variables that are not directly related to the knowledge-based capabilities, there are other interesting findings. Growth willingness is negatively related to age. This might be interpreted as younger firms are more interested in growing, whereas as when they get older, firms might prefer stability. Technological dynamism is positively related to market dynamism. This is natural and expected. It can be interpreted as the more technology changes, the more demands on how to use this technology also change. The flip side could also be true, where new technology needs to be developed in order to satisfy changing customer demands.

A few surprising non-relationships were also found. Most obviously, there does not appear to be a statistically significant linear relationship between age and size. I expected that as firms got older, they also tended to grow in terms of the number of employees. There is quite a bit of research, including the life-cycle stream of research, which suggests that new firms start small and then grow as they age. This may be heavily influenced by the large size of some subsidiaries however. Also surprising was the VC–backed firms did not have higher correlations with the knowledge-based capabilities. I had expected that as they were generally more interested in growth, they would be heavily engaged in using their capabilities.
Table 4.10 Bivariate correlations among control and research variables in this study

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Note: * = p < .05; ** = p < .01; the bottom left corner shows the variance extracted per construct. The top right corner shows the shared variance between variables.
### Table 4.11 Bivariate correlations between moderating and dependent variables

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Note: * = p < .05, ** = p < .01
5 Relating knowledge-based capabilities to innovation

5.1 Introduction

After much discussion of the sample and method that I use and characteristics of the main variables that I study, I now finally start to look at testing my hypotheses and therefore answer my main research questions. However, in order to do this, I must employ more sophisticated statistical techniques than I used in the previous chapter.

I first carry out two exploratory analyses in order to gauge the direct effects of the knowledge-based capabilities on innovation and to get an overview of the relationship between the different knowledge-based capabilities. These are undeniably central to the main research questions, although they do not necessarily provide true answers to the hypotheses that were laid out at the end of Chapter 2.

In this chapter, the first analysis (the direct effects) will employ multiple regression analysis. The function and assumptions of this analysis is explained in section 2.2.1. The second analysis, providing the exploratory overview of the relationship among knowledge-based capabilities, is done via path analysis, a type of structural equation modelling (SEM). In the later parts of this chapter, I return to multiple regression and focus on testing my main hypotheses. The empirical results are discussed at length and connected to theory in Chapter 6.

5.2 Exploratory analyses

5.2.1 Direct effects

As previously mentioned, the first analysis that I undertake is multiple linear least-squares regression analysis. I sometimes refer to this as simply “regression”. This method works such that an imaginary line of best fit is established that minimises the sum of the squared distances between the data points and the line. The line therefore tries to best explain the variance that appears between different variables. Take the example of trying to explain the relationship
between age and height in small children. Obviously, not all children grow at
the exact rate such that all five year-olds are the same height. There is obviously
some variation in this variable (i.e. some children of the same age are tall, some
short, and some average height). The imaginary regression line attempts to take
into account the variance and produce one line that works quite well. The line
is calculated by the simple equation

\[ Y = a + b_1x_1 + b_2x_2 + \ldots + b_nx_n + e \]

where \( y \) is the dependent variable. The \( x \)'s are represented by the different
control and independent variables. For this study, these are represented by the
age, size, etc. variables as well as growth willingness and knowledge-based
capabilities. Some variables are more influential than others. These differences
are represented in the equation by the fact that the \( b_1, b_2, \ldots \) will have varying
values, where the higher the \( b \), the more this factor influences the outcome. The
\( a \) in the equation is the intercept of the line and the \( e \) is the error term. It is not
possible to have a perfectly fitting line - just like it is impossible to exactly
predict the height of a child on the basis of age - and so the \( e \) fills the remaining
unexplained variance from the rest of the equation. Astute readers or people
with knowledge of statistics will note that this method implies a linear
relationship between the independent and control variables on the one hand
and the dependent variable on the other (Bryman & Cramer, 2001). What is
less obvious is that multiple regression builds upon the least squares method,
where the residuals (errors) from fitting the line are squared and minimised
(Hair et al., 2006).

There are a few main statistics that I will examine when using multiple
regression analysis. The first is the overall fit of the regression analysis, or how
much the variance of \( Y \) is explained by the other variables. This is represented
by a statistic (\( R^2 \)). I sometimes refer to this as the variance explained or
explanatory power. The adjusted \( R^2 \) is the score when one takes into
consideration the number of variables included. Naturally, the more variables
that are entered into the regression, the higher the \( R^2 \). This potentially false
inflation is corrected for in the Adjusted \( R^2 \) statistic. The second main statistic I
focus on is the regression coefficients of the individual variables (the \( b \)'s in the
equation).

The type of multiple regression analysis that I use is known as hierarchical
regression analysis. This, in practical terms, means that I enter the variables at
different stages of the regression and am then able to see the differing effects on
\( R^2 \) of having entered additional variables. The change in \( R^2 \) statistic shows how
much the explanatory power has changed by entering that one block of
variables. For the most part, I first enter the entire block of control variables
Relating knowledge-based capabilities to innovation

(age, size, the two ownership variables, and the two environment variables) and then one or more knowledge-based capabilities or growth willingness.

For the direct effects model that I present below in Table 5.1, I first enter the control variables and then one knowledge-based capability at a time. The purpose of this is that I am able to examine the effect of each and every capability without seeing how the other capabilities might affect the relationship with innovative output. I do not include growth willingness in this as I formally hypothesise that this variable affects knowledge-based capabilities.

The control variables explained a significant amount of variance of the Expected Innovative Output variable. Over 11% of the entire variance is predicted by only the control variables. There were two particular variables that seemed to have the largest impact – Venture Capital and Technological Dynamism. Both of these had large, positive relations with the dependent variable. These significant positive effects were also maintained even when the knowledge-based capabilities were entered one at a time (except Technological Dynamism once Exploitation is entered). The other control variables did not seem to have any significant impact worth mentioning, with the exception of the subsidiary ownership variable. This variable becomes statistically significant once the Exploitation variable is entered.

The knowledge-based capabilities each explain a significant portion of Expected Innovative Output. Each of the capabilities also had a positive effect on the dependent variable. The largest effect comes from Exploitation, where the change in $R^2$ was a substantial 30.5% above and beyond the 11% explained by the base model. This represents a very large amount for a singular construct. Many published articles have approximately 30% explained variance for the entire model. Following Exploitation, the next capability to show large power was Technological Knowledge Acquisition (12% more explanatory power), Indirect Market Knowledge Acquisition (7%), and then the Assimilation variables (approximately 6% each). The individual explanatory power coming from Direct Market Knowledge Acquisition is relatively low (almost 5%), but still slightly larger than the effects of the Transformation variables (slightly less than 4% each).

For Actual Innovative Output, where the levels of innovation were observed as lower (see 4.5.2), the results were not as large as those from Expected Innovative Output. Firstly, the control variables “only” explained 6.5% (compared to 11% for the Expected Innovative Output). The positive significant impact of venture capital vanished, but the effect of Technological Dynamism, though less significant than in the first regression, remained.
Table 5.1 Regression with Expected Innovative Output as dependent variable

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Note: Standardized regression coefficients are displayed in the table.  
*= p < 0.10, *= p < .05, **= p < .01, ***= p < .001
Table 5.2 Regression with Actual Innovative Output as dependent variable

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Note: Standardized regression coefficients are displayed in the table.
+ = p < 0.10, * = p < .05, ** = p <.01, *** = p < .001
All the knowledge-based capabilities still had positive impacts on innovative output, but not all were statistically significant. For example, the capabilities Reviewing Previous Knowledge and Knowledge Combination were no longer significant and added less than 0.5% each to the explanatory power. The two assimilation variables were only marginally significant and added approximately 1.5% explained variance each. Exploitation was still the most major predictor, with 12% added explanatory power. This is noticeably less than the 30% for Expected Innovative Output. Indirect Market Knowledge Acquisition (5.4%) and Direct Market Knowledge Acquisition (2.7%) become slightly more important than Technological Knowledge Acquisition (2.5%).

On the whole, the direct effects models are able to explain substantial portions of the two Innovative Output variables. The relative importance of the majority of the factors stayed the same for both analyses. This provides support for that these variables are the most important of the absorptive capacity components for explaining innovation. However, as expected and predicted when discussing the two Innovative Output variables in Chapter 4, there were significant differences in the total explanatory power between the two dependent variables.

5.2.2 Indirect effects

The multiple regressions that I carried out in the past section directly showed that the individual effects of the respective knowledge-based capabilities. This, in essence, shows that there is a positive correlation between all of these elements. This means that innovating firms carry out these activities. However, the results from the previous tables truly say little about how firms go about executing their knowledge acquisition, assimilation, transformation, and exploitation capabilities in combination with each other. Rather they show that each and every one of them is helpful in some way when carried out individually.

The Zahra and George (2002) exposition on absorptive capacity presented an illustration of how absorptive capacity and its sub-components might be considered as processual. They argue, as I display in a model (see Figure 2.1) that knowledge begins by first being acquired and assimilated. They call this potential absorptive capacity. Subsequently, the potential absorptive capacity provides the foundation for transformation and exploitation capabilities of the firm. These latter two capabilities make up realised absorptive capacity in Zahra and George’s (2002) article. Thus, although it is not entirely explicitly laid out in this way, it is in no means a stretch to make the argument that knowledge must be acquired before it can be assimilated, and then assimilated before it can be transformed, and transformed before it can be exploited. This is as I describe and hypothesise in Chapter 2.
The direct effects model therefore reveals neither the temporal nature nor the processual ordering of the capabilities. It does not show that knowledge should be acquired before it is assimilated, for instance. In this present section, I explore the relationship between the knowledge-based capabilities. Only then can one begin to understand the extent of the effects knowledge-based capabilities as a whole have on innovation.

In order to do this, I carry out a number of tests. Firstly, I carry out a path analysis, also known as structural equation modelling (SEM). The goal of SEM is similar to that of multiple regression analysis (i.e. to examine the strength and effect of certain relationships; Shook et al., 2004). SEM takes more of a confirmatory approach as it demands that the researcher enters a specific model (Byrne, 2001). It therefore looks at the structure of the relationships (Hair et al., 2006). Also in contrast to hierarchical multiple regression analysis, the method used to determine the best fit is maximum likelihood, not least squares. Moreover, there is no magic $R^2$ to tell us of how well the regression line best fits the data as there is in hierarchical regression analyses. Using SEM implies making use of a number of different fit statistics, which are described in this section. This analysis is primarily exploratory in nature and only examines the statistically significant relationships between the variables. Secondly, I look deeper into how each capability comes about by looking at the control variables and the other sub-capabilities effect. This is done via hierarchical regression, as I did for the direct effects above. Thirdly, I examine the ability of all of the capabilities together predict innovative output. Hierarchical regression is used once again to do this. One difference between the tests that I ran in confirmatory factor analysis and now is that I am only using summated scales. They can therefore be seen as treating the constructs as single-item measures. This can result in some problems as the constructs are viewed as error free. What this does, however, is saves degrees of freedom. This allows me to test my model with the number of firms in my sample.

One reason to separate the usage of SEM and hierarchical regression analysis is due to mediating and moderating factors. For instance, the theoretical model that I test implies that there are mediating effects of some variables (e.g. Assimilation mediates the relationship between Acquisition and Transformation). Moderating effects, such as those which I brought forward in Hypotheses 14-21, assume a different relationship between variables. Testing both moderations and mediations is a very complicated statistical matter. SEM is excellent at evaluating the mediating variables, but not as effective at examining moderations. I have therefore chosen to use path analysis for exploratory evaluation of the entire mediating model (i.e. as seen in Figure 2.1), but hierarchical regression analysis for the moderations and individual knowledge-based capabilities.
As I previously mentioned, I first carry out path analysis in order to explore the relationships between the different variables and also their effect on Innovative Output. I started by entering the saturated model. This means that all possible relationships are included in the model. I removed the relationships that were not significant, using $p > .01$ as the cut-off criteria. This represented a standardised score of 0.140 for the relationship. In other words, I let the data speak for themselves and did not take theory into consideration when deciding which relationships to keep and which to remove. As a result, the construct Reviewing Previous Knowledge did not have a significant relationship with Exploitation or Innovative Output; it was therefore removed. I call the model where all of the non-significant relationships are removed the Reduced Model. I repeated the same process using the longitudinal data (i.e. with Actual Innovative Output as the dependent variable). The same criteria were used for removal from the model. Table 5.3 below shows the model fit for the saturated model, the reduced model, and the model using Actual Innovative Output as the dependent variable (named Longitudinal data in the table). There was only one noticeable difference between the reduced (i.e. cross-sectional) and longitudinal model - the Technological Knowledge Acquisition variable’s direct effect on innovation disappeared and was replaced by a direct effect from informal market knowledge acquisition. This empirical observation is basically the same as when the direct effects regressions were run, where Technological Knowledge Acquisition is very significant for Expected Innovative Output but not as much so for Actual Innovative Output. The diagnostics that are presented in Table 5.3 are the same ones that were presented when discussing confirmatory factor analysis in Chapter 4.

What Table 5.3 shows is that, if one were to employ the Chi-square/degrees of freedom method ($\chi^2$/df) for evaluating the overall model fit, the reduced and longitudinal models are superior to the saturated model. Interestingly, two of the metrics (CFI and IFI) are greater for the saturated model than for the reduced and longitudinal data. However, the TLI and RMSEA are vastly inferior and well beyond what might be considered acceptable for the saturated model. According to Hair and colleagues (2006), RMSEA’s around or below 0.10 represent the most desirable levels. The TLI should approach levels of 1 for good fit. The significance of the Chi-square test is the most common fit measure but is subject to variations based on sample size; Tabachnick and Fidell (1996) argue that trivial differences become significant once sample sizes exceed 200. One therefore does not need to specifically examine this statistic. Another matter to take into consideration is the parsimony of the model. Parsimony fit indices are only useful to compare model fit, not to use as an absolute fit measure. Higher levels of Parsimony Normed Fit Index (PNFI) are better than lower levels. The PNFI for the saturated model was 0.084. For the Reduced model, it was 0.485 and 0.388 for the longitudinal model. These latter two models thus show much greater parsimony.
Unfortunately, the reduced and longitudinal models do not show excellent fit. The TLI, for instance, is still below the ideal levels. The other fit indices are also not at the most optimal levels, although they are still at acceptable levels. What is apparent is that the proposed reduced and longitudinal models seem to be better than other models, but are perhaps not the absolute best fitting empirical model. However, achieving optimal fit is not the primary goal of this test given the fact that I used summated scales as the observed variables. I mentioned earlier that this may cause some problems. Hair and company (2006) argue that the Chi-squared measurement is the best tool for comparing these models. This score is undeniably better for the reduced and longitudinal models. Nevertheless, as a test of robustness, I re-ran the analyses using radical innovation as the dependent variable. The results were essentially the same as presented in Table 5.3.

Table 5.3 Fit results of the models

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<th>Reduced model</th>
<th>Longitudinal data</th>
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<tr>
<td>RMSEA</td>
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<td>.096</td>
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Table 5.4 below shows the strength of the relationships of capabilities that remained included in the structural models. While these results shed light onto the nature of these relationships, further research in this endeavour is clearly needed. Indeed, in the next section of this chapter, I carry out further analyses in order to examine the factual relationship among the different knowledge-based capabilities. This, in turn, should help in understanding the complex set of relationships that exist between these capabilities.
Table 5.4 Significant regression weights between constructs

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Note: *** = p < .001

Figure 5.1 below shows the resulting significant relationships between the different capabilities and innovation. There are three notable differences compared to my model (Figure 2.1, based on Zahra and George, 2002). The first is that Direct Market Knowledge Acquisition was related to Technological Assimilation. In accordance with the model I put forward in Figure 2.1, one could expect that Direct Market Knowledge Acquisition would only be related to Market Assimilation. However, from a theoretical perspective this can make sense. For new and small firms, a great deal of the knowledge about technological advances can be acquired from customers, not only from methods that deal directly with technology. In other words, this finding may be a result of the size and age of the firms, where customer power and specific demands may drive the technological progress of the firm (i.e. the firm becomes more conscious of technological changes via customers and so must try to respond to that).
The second variation actually consists of two parts. Technological knowledge acquisition had a direct effect on Exploitation and on Innovative Output. Once again, this might be an artefact of the sample involved. For a new and small firm, all investments in technological knowledge acquisition are costly. In many cases, the technological acquisition capabilities may be deliberately carried out in order to solve a particular problem. Furthermore, they may be expected to result in clear and immediate dividends, and not necessarily need to go through the assimilation and transformation processes before leading to Exploitation and Innovative Output. Hence, that the specific investments made in technological knowledge acquisition lead directly to exploitation has some logic to it.

The third difference was that the construct Reviewing Previous Knowledge did not have a significant impact on Innovative Output or Exploitation. In other words, while there were effects of the Acquisition and Assimilation variables on Reviewing Previous Knowledge, it did not appear to create any further value in the absorptive capacity process as it did not provide any statistically significant explanatory power to either Exploitation or Innovative Output. This finding supports the faint results that were obtained in the direct effects regression models.

5.3 Hypothesis testing

The findings in the previous section demonstrate that there is a positive relationship between all of the knowledge-based capabilities and innovative output. The findings also show that there is a complex relationship among the knowledge-based capability variables, not only a direct effect of each of the capabilities. In this section, I further examine the complex relationship. In
particular, I inspect the factors that predict the existence/usage of the capability, including bringing in the effects of growth willingness on these relationships. This helps provide a direct test of the Zahra and George (2002) model but also provides understanding how the different capabilities work together. The coming analyses directly test my hypotheses. Within every sub-section, I graphically show which relationships I am testing, highlighted in bold heavy text and lines. It should therefore be clear which questions I answer in every sub-section.

5.3.1 Explaining Knowledge Acquisition

As was suggested in the Zahra and George (2002) model, the entire absorptive capacity process begins with the acquisition of knowledge. To begin with, I look at the factors that help predict the three knowledge acquisition variables (see Figure 5.2). As I earlier explained for hierarchical regression, I first enter the control variables – age, size, ownership, and environmental factors. I then enter growth willingness and am able to observe the differences in explanatory power. This process is repeated for all three of the knowledge acquisition variables.

![Figure 5.2 Relationships analysed in this sub-section](image)
Table 5.5 Predicting Knowledge Acquisition Capabilities

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Note: Standardized regression coefficients are displayed in the table. + = p < 0.10, * = p < .05, ** = p < .01, *** = p < .001

Table 5.5 above shows that the individual effects of age and size have very little effect, with the exception for size on Technological Knowledge Acquisition. For this variable, size has a substantial, statistically significant, and positive effect. Venture capital ownership also had a statistically significant effect on technological knowledge acquisition. Subsidiary ownership did not have any significant effect. Market dynamism did not have any effect either. Technological dynamism was significant for all three of the acquisition capabilities, although its effect was lesser for direct market knowledge acquisition. Growth willingness, as was suggested in Hypotheses 7a, 7b, and 8, was important in predicting knowledge acquisition. However, this was only the case for Indirect Market Knowledge Acquisition (H7b) and Technological Knowledge Acquisition (H8).

As a whole, the factors only explained a very limited amount of the variance within the variables. The control variables explained 6.8% at its peak, and as low as 3%. Growth willingness added at most 2%, although this was significant for both Indirect Market Knowledge Acquisition and Technological Knowledge Acquisition. These limited effects suggest that there could be other, more important, factors at play here. The fact that Direct Market Knowledge Acquisition was so poorly explained by the factors involved (3% total) can be
interpreted as that it must be explained by other issues. The fact that there is some variation for this construct (based on the standard deviation presented in Table 4.4) implies that it is not a constant that firms of all ages, sizes and industries engage in this type of activity. This was a skewed variable however, which might be one explanation for the weak results.

5.3.2 Explaining Knowledge Assimilation

I now turn my attention to the two knowledge assimilation variables (Market Knowledge Assimilation and Technological Knowledge Assimilation, respectively), as shown in Figure 5.3. The analysis process is essentially the same as was carried out with the Knowledge Acquisition variables. However, I enter the other Knowledge Acquisition variables as controls before entering the research variables. In other words, for the Market Assimilation variables, I first enter the control variables model before then entering Technological Knowledge Acquisition. I then enter the research variables of Growth Willingness and Direct Market Knowledge Acquisition and Indirect Market Knowledge Acquisition, although in different blocks. For the variable Technological Assimilation, I enter the base, the controls of Direct and Indirect Market Knowledge Acquisition, followed by Growth Willingness and Technological Knowledge Acquisition.

Figure 5.3 Relationships analysed in this sub-section
Table 5.6 Predicting Market Knowledge Assimilation

<table>
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<td>-.154**</td>
<td>-.131*</td>
<td>-.122*</td>
</tr>
<tr>
<td><strong>Size</strong></td>
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<td>.010</td>
<td>.026</td>
<td>.032</td>
</tr>
<tr>
<td><strong>VC</strong></td>
<td>.138*</td>
<td>.105+</td>
<td>.043</td>
<td>.031</td>
</tr>
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<td><strong>Subsidiary</strong></td>
<td>.033</td>
<td>.031</td>
<td>.010</td>
<td>.012</td>
</tr>
<tr>
<td><strong>Market Dynamism</strong></td>
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<td>-.103+</td>
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<td><strong>Tech Dynamism</strong></td>
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<td>.069***</td>
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<td>.076</td>
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<td><strong>Growth Willingness</strong></td>
<td>.199***</td>
<td>.193***</td>
<td></td>
<td></td>
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<td><strong>Direct Acquisition</strong></td>
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<td><strong>Indirect Acquisition</strong></td>
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<td></td>
</tr>
<tr>
<td><strong>R2</strong></td>
<td>.069**</td>
<td>.134***</td>
<td>.168**</td>
<td>.273***</td>
</tr>
<tr>
<td><strong>Adj R2</strong></td>
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<td>.114***</td>
<td>.145**</td>
<td>.248***</td>
</tr>
<tr>
<td><strong>Change R2</strong></td>
<td>.069**</td>
<td>.065***</td>
<td>.034**</td>
<td>.105***</td>
</tr>
</tbody>
</table>

Note: Standardized regression coefficients are displayed in the table. + = p < 0.10, * = p < .05, ** = p <.01, *** = p < .001

The overall effects and level of explanatory power were greater for this regression. The control variables explained approximately 7% of the entire variance. Among these variables, age had a significant negative effect. This finding remained even when the research variables were entered. This shows that younger firms actively engage in more assimilation than do older firms. Furthermore, Market Dynamism had a statistically significant negative effect on Assimilation, at least until the Market Knowledge Acquisition variables were entered. This suggests that discussing and spreading knowledge to others in the organisation is done less the more the market is changing.

Growth willingness had a significant positive effect on Market Knowledge Assimilation, as Hypothesis 9 suggested. Its overall effect was an added 3.4%. Furthermore, the effects of Direct and Indirect Market Knowledge Acquisition were greater than that of Technological Knowledge Acquisition. Indeed, there was little overall impact of Technological Knowledge Acquisition variable on Market Knowledge Assimilation once the other acquisition variables were entered. One interesting finding is that Direct Market Knowledge Acquisition had a larger effect than Informal Market Knowledge did, as seen by the standardised Beta values presented in Table 5.6. As a whole, the three predicted
variables (Growth Willingness, Indirect Market Knowledge Acquisition and Direct Market Knowledge Acquisition) explained over half of the entire variance explained.

There was a different outcome for Technological Knowledge Assimilation, as seen in Table 5.7. For instance, both age and size had significant negative effects. Market dynamism was once again negative but was not significant. Technological dynamism was highly significant. The overall explanatory power of the control variables was almost 12%. Additionally, as was predicted in the hypotheses, Technological Knowledge Acquisition was a larger predictor than the other knowledge-based capabilities. Its individual impact was an added 5% of variance explained. More surprising was that Direct Market Knowledge Acquisition was also highly significant even once the Technological Knowledge Acquisition variable was entered. This supports Hypothesis 2. Growth willingness was not significant and did not contribute anything to \( R^2 \); thus Hypothesis 10 was not supported.

For both Assimilation variables, the overall explanatory power of the models was quite high. For Technological Knowledge Assimilation, 31% of the variance was explained while for Market Knowledge Assimilation, 27% was explained. This offers support for that the absorptive capacity "process" as was modelled previously provides a sound base to begin understanding how these capabilities work together. However, the fact that the amount of variance not explained remains large shows that there may be other issues at play.
Table 5.7 Predicting Technological Knowledge Assimilation

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<th>Tech Acq.</th>
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<td>-.089+</td>
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<td>.029</td>
<td>.026</td>
<td>.028</td>
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<td>.145*</td>
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<td>.000</td>
<td>.052***</td>
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</table>

Note: Standardized regression coefficients are displayed in the table.  
+ = p < 0.10, * = p < .05, ** = p < .01, *** = p < .001

5.3.3 Explaining Knowledge Transformation

The same process was followed as before for the three knowledge transformation variables – Reviewing Previous Knowledge, Synthesising Knowledge, and Knowledge Combination. First, the base model with control variables was entered, followed by all three Knowledge Acquisition variables. I then entered the Growth Willingness and then the Knowledge Assimilation variables into subsequent blocks. The relationships examined in this sub-section are shown in Figure 5.4.

For Reviewing Previous Knowledge, there were some surprising and some expected results (Table 5.8). As a surprise, venture capital ownership had a significant positive effect. Only Technological Dynamism was significant among the control variables aside from VC. The entire block of controls explained 4.3%. Another surprise was that Direct Market Knowledge Acquisition had a greater total effect than the individual assimilation variables. The assimilation variables were still significant and in the correct direction, thus
providing support for Hypotheses 3a and 4a. Together, these variables added almost 4% to the entire variance explained. On the other hand, Growth willingness had a significant negative effect, which in practical terms means reversing the hypothesis (H11a). Overall, the model explained over one quarter of all the variance. This is less than for the Assimilation variables, but still certainly acceptable.

Figure 5.4 The relationships under study in this sub-section
Table 5.8 Predicting Reviewing Previous Knowledge

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<td>.048*</td>
<td>.069</td>
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<td>-.118*</td>
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</table>

Note: Standardized regression coefficients are displayed in the table.
+ = p < 0.10, * = p < .05, ** = p < .01, *** = p < .001
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<td>0.073***</td>
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</table>

Note: Standardized regression coefficients are displayed in the table. 
+ = p < 0.10, * = p < .05, ** = p <.01, *** = p < .001

For Knowledge Synthesis (Table 5.9) there are once again some surprisingly significant effects. The two most unexpected of these are that the significant effect of Direct Market Knowledge Acquisition and Technological Knowledge Acquisition are maintained even when the other capabilities were entered. The control variables together explained 5%, but the individual variables’ impacts that were significant in the first block dissipated once other variables were entered. As predicted though, there were significant positive effects from the Assimilation variables on Knowledge Synthesis. However, in contrast to Reviewing Previous Knowledge, the assimilation variables were more important than the Acquisition variables. This provides support for Hypotheses H3b and H4b. Growth willingness provided little added extra variance explained (0.7%) and was not statistically significant once the assimilation variables were entered into the regression model. Thus Hypothesis 11b was not supported.
Relating knowledge-based capabilities to innovation

Table 5.10 Predicting Knowledge Combination

<table>
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<td>.001</td>
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<td>.145*</td>
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<td>.024</td>
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</table>

Note: Standardized regression coefficients are displayed in the table.
+ = p < 0.10, * = p < .05, ** = p <.01, *** = p < .001

For the Transformation variable Knowledge Combination, as displayed in Table 5.10, the control variables had a larger coefficient than the other Transformation variables. The entire group provided for almost 9% of the variance. The significant and negative effects of Market Dynamism remained even once the capability and growth willingness variables were entered into the regression. At the same time, Technological Dynamism was primarily positive and statistically significant; at least until the Assimilation variables were entered.

As was argued in the hypotheses, the two Assimilation variables were significant and in the hypothesised direction. This provides support for Hypotheses 3c and 4c. In fact, these variables explained an added 16% of the variance, which I consider substantial. However, Direct Market Knowledge Acquisition was once again important, and in this case, had a larger impact than Market Assimilation did. The fact that it had a significant impact was seen earlier on in Figure 5.1. Growth willingness did not provide any additional explanatory power and
Hypothesis 11c was therefore not supported. The entire model explained over 40% of the variance. This is a large amount, and can primarily be attributed to the large effects of the Assimilation variables. One (perhaps destructive) explanation for this higher explanatory power than before is the definitional similarity between the assimilation variables and Knowledge Combination, as seen in Table 4.1 where the individual question items are presented.

5.3.4 Explaining Knowledge Exploitation

Once again, I test the effects of the other variables on Exploitation (see Figure 5.5). This essentially is the same process as before, where the control variables are entered first, followed by the Acquisition and Assimilation variables, and finally the Growth Willingness and Transformation variables. However, as compared to the first regression analyses, I enter a number of interaction terms as the final blocks. The interaction terms are entered one at a time. The first interaction is the moderating effect of Market Dynamism on the relationship between Direct Market Knowledge Acquisition and Exploitation. The second interaction is the impact of Growth Willingness on the relationship between Direct Market Knowledge Acquisition and Exploitation. The third and fourth interactions examine the effects of Technological Dynamism and Growth Willingness, respectively, on the relationship between Technological Knowledge Acquisition and Exploitation.

Figure 5.5. The focal relationships of this sub-section

Note: The interactions tested here are displayed in Figure 2.5.3

---

Including all of the interaction terms at the same time would result in high levels of multicollinearity. This would make interpretation of the interactions difficult. I discuss this issue in more length in section 5.5.
The results are shown in Table 5.11. Once again, the base model had a high level of explanatory power. The primary source of this is Technological Dynamism. The highly significant findings remained even when the other variables competed for the same explanatory power. In fact, it seemed to have the second highest explanatory of the whole model except for Technological Knowledge Acquisition. The two other control variables that were significant in the beginning (age and VC) disappeared once other variables were entered.
### Table 5.11 Predicting Knowledge Exploitation

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<td>-.079</td>
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</tbody>
</table>

Note: Standardized regression coefficients are displayed in the table.
+ = p < 0.10, * = p < .05, ** = p < .01, *** = p < .001

Two of the transformation variables (Synthesising Knowledge and Knowledge Combination) had significant positive effects on Exploitation. However, the
third Transformation variable (Reviewing Previous Knowledge) was not significant. This non-relationship was observed in the SEM model. In any case, Hypotheses 5b and 5c were supported and Hypothesis 5a was not fully supported. Growth willingness was only slightly significant and thus the hypothesis was only marginally supported.

The interactions provided mixed results. The effect of Market dynamism on Direct Market Knowledge Acquisition had very little effect and Hypothesis 14 was therefore not supported. The same non-effects held true for the effect of Growth Willingness on Technological Knowledge (H19). Both the individual effects of Growth Willingness on Direct Market Knowledge Acquisition (H18) and Technological Dynamism on Technological Knowledge Acquisition (H15) were statistically significant. These two relationships are graphically displayed in Figure 5.6 and 5.7 below.

It is common practice that the interaction terms are plotted. This allows the researcher to more clearly see how the relationship between two variables is moderated by the third (Tabachnick & Fidell, 2001). The independent variable (in this case Direct Market Knowledge Acquisition) is on the x-axis and the dependent variable is on the y-axis. I followed the recommendations of Cohen and Cohen (1983) where the plotted values reflect plus and minus one standard deviation from the mean.
For the moderating effect of growth willingness on the relationship between Direct Market Knowledge Acquisition and Exploitation (Hypothesis 18), we can see that the impact of motivation decreases the more direct market knowledge capabilities the firm deploys. In other words, growth willingness is more important for innovation when there is less direct market knowledge. The hypothesis is stated such that increased levels of growth willingness would have increased positive influence on the Direct Market Knowledge Acquisition. As the impact of motivation decreases, this hypothesis is essentially reversed.

Figure 5.7 below shows what was predicted – that the higher the Technological Dynamism, the larger the effect of Technological Knowledge Acquisition. This means that as there are increased levels of technological dynamism, technological knowledge acquisition becomes more important knowledge for exploitation. This provides support for Hypothesis 15. Interestingly, even when dynamism is low, technological knowledge is still important for exploitation.
5.3.5 Some thoughts on the results

The purpose of this past section was to provide more in-depth understanding of the factors that lead to the usage of the absorptive capacity components. This was also in conjunction with testing Hypotheses 1a-5c. In sum, there is overall positive support for the idea that there is a process ordering to the components of absorptive capacity. The components that were expected to be immediately prior to the focal capability were statistically significant – the lone exception being Reviewing Previous Knowledge on Exploitation. However, this finding was also unearthed in the path analysis, providing some further support that this capability is not effective in predicting Exploitation. There were also some surprising effects of the Acquisition variables on later capabilities; some of these were spotted in the path analysis as well. Possible theoretical explanations for why this might be are brought up in the discussion chapter.

In general, the results are quite strong and satisfactory compared to the levels of explanatory power in manuscripts published in international journals. The levels of explanation ranged from 25% to about 40%. This is not including the Acquisition variables, where the levels of explanatory power were much lower. This clearly shows that a substantial part of sequence of the absorptive capacity components is in line with theory. That is, the knowledge-based capabilities that occur sequentially later in the process are quite well explained by the variables that occur earlier.
5.4 Innovative output

This section deals with the fundamental question, “what are the effects of knowledge-based capabilities and growth willingness on innovation?” As the final set of statistical analyses, I aspire to shed light on this important question and test the remaining hypotheses. In order to do this, I run two hierarchical regression analyses – one using Expected Innovative Output and one using Actual Innovative Output. The process is similar to the previous section where I first entered the control variables, and then some knowledge-based capabilities before entering the research variables. For this particular analysis, the main research variables are Growth Willingness, Exploitation, and then four different interaction terms. This is shown in Figure 5.8 below.

![Figure 5.8 The key relationships under study in this sub-section](image)

Note: The interactions tested here are displayed in Figure 2.5.3

Table 5.12 below shows the regression results using the Expected Innovative Output dependent variable. The control variables explained quite a bit of the variance involved in the regression (11%). The two ownership variables had statistically significant positive effects, although at different times. The subsidiary dummy variable was only marginally significant once other variables were entered, but not significant when alone. Venture capital ownership was significant in the first block as well as in the remaining blocks. Technological Dynamism had a significant positive effect on innovation until the Exploitation variable was entered; this effect then vanished.

The other knowledge-based capability variables also accounted for a large chunk of variance (17%). The two main culprits are Indirect Market Knowledge Acquisition and Technological Knowledge Acquisition. Even when the Exploitation variable was entered, these two capabilities remained statistically significant. Exploitation was the most important predictor of Innovative
Relating knowledge-based capabilities to innovation

Output, accounting for 18% on its own. This is natural and expected given the Zahra and George (2002) model and also is in line with Hypothesis 6. Growth willingness has a large and positive impact on innovation, and thus provides support for Hypothesis 13.

Among the interaction effects, only one was significant - the effect of Market Dynamism on the relationship between Direct Market Knowledge Acquisition and Innovative Output. I hypothesised that higher levels of knowledge acquisition would be more important for innovation in more dynamic markets. However, as is displayed in Figure 5.9 below, the opposite appears to be true. Namely, in more dynamic markets, direct market knowledge is negatively related to innovation. This might signal that when there is high market dynamism, direct market knowledge does not really help in innovation. However, in markets with lower dynamism, direct market knowledge is increasingly important. While this may seem odd, I present my theoretical interpretation in the Discussion chapter.
Table 5.12 Predicting Expected Innovative Output

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Note: Standardized regression coefficients are displayed in the table.
* = p < 0.10, * = p < .05, ** = p < .01, *** = p < .001
The regression results in Table 5.12 are for the cross-sectional data (i.e. using Expected Innovative Output as the dependent variable). The results for a similarly conducted analysis using Actual Innovative Output as the dependent variable are below in Table 5.13. For the most part, the results were comparable, although there are a few noticeable differences. The first is that the effects from different ownership (e.g. VC or subsidiary) vanished. There was a positive and marginally statistically significant effect from the size of the firm instead. The effect of the entire set of control variables was almost cut in half, down to 6.5%.

For the knowledge-based capabilities, Indirect Market Knowledge Acquisition maintained its positive and significant effect on innovation, but the impact of Technological Knowledge Acquisition was non-significant. As was predicted in Hypothesis 6 and was shown in Table 5.13, Exploitation retained its positive and significant impact. It also remained the single factor with the highest impact. Growth willingness still was positive and significant, and therefore provided support for Hypothesis 13.
### Table 5.13 Predicting Actual Innovative Output

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</table>

Note: Standardized regression coefficients are displayed in the table.

+ = p < .10, * = p < .05, ** = p < .01, *** = p < .001
Three of the four interactions were significant. Firstly, as is presented in Figure 5.10 below, there is an effect of growth willingness on the relationship between Direct Market Knowledge Acquisition and innovation. In this case, firms with high motivation and high levels of knowledge have much higher innovation than those with low motivation. This supports H20. However, the difference between firms with high and low growth willingness is greatest when levels of direct market knowledge acquisition are lowest. That is, as levels of knowledge increase, motivation matters less for innovation.

Figure 5.10  The moderating effect of growth willingness on the relationship between Direct Market Knowledge Acquisition and Actual Innovative Output.

Figure 5.11 below displays the impact of Technological Dynamism on the relationship between Technological Knowledge Acquisition and Innovation. This supports Hypothesis 17, where Technological Knowledge increases in importance in fast-changing technological regimes. In non-dynamic markets, technological knowledge did not assist in innovation. In fact, the graphic shows a slightly decreasing effect. This may be interpreted as that the technological knowledge acquired is used for other things than product or service innovation, such as process innovation or in the on-going efficiency work of the firm. There is substantial evidence from the Economics and Strategic Management literatures that this is the case for non-dynamic markets.
The final significant interaction effect was the impact of growth willingness on the relationship between Technological Knowledge Acquisition and innovation (see Figure 5.12). In opposition to what was hypothesised, the returns of growth willingness decrease as levels of knowledge acquisition increase. Knowledge acquisition still maintains its positive trend and seems to be more important than motivation when it comes to innovation. Oddly, firms with lots of motivation but little technological knowledge seem to be more innovative than firms with high motivation and high levels of technological knowledge. As this seemed illogical, I chose to delve further into why this may be the case. It appears that this relationship is primarily valid for service firms, where technological knowledge may be less important. The relationship was non-existent for product-oriented firms.
5.5 Mean centring

There is generally a recommendation to mean centre the values that will be included in the interactions. This means that the values are transformed so that the mean levels are equal to zero and the values that fall below the mean thus become negative. The reason that this is recommended is to reduce multicollinearity with the other variables included in the regression. For instance, if one were to examine the interacting effect of Direct Market Knowledge Acquisition and Growth Willingness, both of these variables would be included in the regression before the interaction term (Direct Market Knowledge Acquisition x Growth Willingness) is included. Naturally, there is a high level of correlation between the two individual predictor variables and the interaction term. This could unnaturally warp the results. However, there is some discussion of how important mean centring is, especially when hierarchical regression is used (such as I have used) and one can interpret the overall changes in $R^2$ and not only the beta coefficients.

The results in the tables and figures above represent the mean centred results. However, I also tested the interactions using non-mean centred variables. The results are essentially the same, with the exception that the magnitude of the effects increases. To be specific, the effects of the interactions of Expected Innovative Output remain non-significant, statistically speaking. However, for
the Actual Innovative Output dependent variable, the directions of the interactions remained the same, but the standardised Betas and statistical significance became stronger. The impact of Market Dynamism on the relationship between Direct Market Knowledge Acquisition and Actual Innovative Output becomes marginally significant. With this one minor exception, not mean centring does little except provide further support for the finding that these interactions are important. This includes that the results of the graphical displays of the interactions are identical. In other words, the de facto differences between the mean centred and non-mean centred interactions were marginal, as Kromrey and Foster-Johnson (1998) suggest.

5.6 Outliers and influential cases

The hunt for outliers is important as some individual cases (i.e. firms in this study) are far from expected and have large enough influence to affect the results. There are three specific diagnostic statistics to determine outliers and how much they influence the findings – Cook’s distances, leveraged centres and the Mahalobis D measure. I looked at these based on regression results for both Expected and Actual innovative output. Based on the visual overview of the plotted levels, I determined that there were six potential outliers, four primarily for Expected Innovation and two for Actual Innovation. As suggested by Hair and friends (2006), I re-examined the answers to see if there was a pattern or common reason for the outliers. For two of the six total outliers, they had the highest number of employees among all the firms in the sample. Two other firms had reported close to zero innovation and the lowest possible answers for each of the capabilities. One firm had full innovation (i.e. maximum potential score) but did not have excessively high reported capabilities. The final outlier was an R&D only firm, and therefore reported that they did not have any customers per se. They did suggest that they have extremely high levels of innovative output but little or no direct market knowledge acquisition or market knowledge assimilation.

I attempted to deal with these outliers in two ways. The first was that I entered a dummy variable that I called “Outlier” coded one for these six firms. This could be seen as potentially erroneous as there is not one specific underlying factor that can account for the outlying relationship. The result of this was a marginal increase in the explanatory power of the regressions ($R^2$), but a slightly diminished Adjusted $R^2$ (i.e. taking into consideration degrees of freedom). The second method, which Hair and colleagues (2006) suggest is probably the more effective method, is to simply remove the cases from the analyses. When I did this, the $R^2$ and Adjusted $R^2$ increased, but there were no statistically significant changes to the effects of the knowledge-based capabilities, growth willingness, and the control variables, with the exception that Knowledge Combination
Relating knowledge-based capabilities to innovation

becomes significant and negative for the Actual Innovative Output and the marginally significant positive effect of size disappears. However, the variance inflator index is the highest for Knowledge Combination once the outliers are removed. This suggests that collinearity may be a more probable cause of the statistically significant finding of Knowledge Combination than a genuine negative relationship. In light of the minor changes to the outputs, and the fact that there is not an underlying cause behind outlying and influential cases, I have chosen to retain my original analyses with the outliers included.
Table 5.14 Changes to outcomes after removing outliers

<table>
<thead>
<tr>
<th></th>
<th>Expected Innovative Output</th>
<th>Actual Innovative Output</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Base</td>
<td>Acq., Assim. &amp; Trans</td>
</tr>
<tr>
<td>Age</td>
<td>-0.056</td>
<td>-0.026</td>
</tr>
<tr>
<td>Size</td>
<td>0.068</td>
<td>-0.016</td>
</tr>
<tr>
<td>VC</td>
<td>0.211***</td>
<td>0.154**</td>
</tr>
<tr>
<td>Subsidiary</td>
<td>0.063</td>
<td>0.069</td>
</tr>
<tr>
<td>Market Dynamism</td>
<td>0.003</td>
<td>0.029</td>
</tr>
<tr>
<td>Tech Dynamism</td>
<td>0.258***</td>
<td>0.130*</td>
</tr>
<tr>
<td>Direct Acquisition</td>
<td>0.000</td>
<td>0.001</td>
</tr>
<tr>
<td>Indirect Acquisition</td>
<td>0.116*</td>
<td>0.112+</td>
</tr>
<tr>
<td>Tech Acquisition</td>
<td>0.224***</td>
<td>0.203**</td>
</tr>
<tr>
<td>Market Assimilation</td>
<td>0.118+</td>
<td>0.072</td>
</tr>
<tr>
<td>Tech Assimilation</td>
<td>0.065</td>
<td>0.074</td>
</tr>
<tr>
<td>Review</td>
<td>0.059</td>
<td>0.081</td>
</tr>
<tr>
<td>Synthesis</td>
<td>0.020</td>
<td>0.003</td>
</tr>
<tr>
<td>Combination</td>
<td>-0.003</td>
<td>-0.008</td>
</tr>
<tr>
<td>Growth Willingness</td>
<td>0.185***</td>
<td>0.149**</td>
</tr>
<tr>
<td>Exploit</td>
<td>0.569***</td>
<td>0.569***</td>
</tr>
<tr>
<td>R2</td>
<td>0.125***</td>
<td>0.271***</td>
</tr>
<tr>
<td>Adj R2</td>
<td>0.107***</td>
<td>0.236***</td>
</tr>
<tr>
<td>Change R2</td>
<td>0.125***</td>
<td>0.146***</td>
</tr>
</tbody>
</table>

Note: Standardized regression coefficients are displayed in the table. + = p < 0.10, *= p < .05, **= p < .01, ***= p < .001
Relating knowledge-based capabilities to innovation

5.7 Summary of hypothesis testing

The table below summarises the outcomes of the hypotheses that have been presented in the past chapter. Support is given when the tested hypothesis has the correct direction and is statistically significant at the p < .05 level or lower. Marginal support is given if the direction of the coefficient is in the correct direction and is statistically significant at the p < .10 level. A hypothesis is reversed when the coefficient is statistically significant but in the opposite direction to that which is hypothesised. I primarily examined the dependent variable Actual Innovative Output for the interactions. One interaction term was statistically significant (and in the opposite direction than hypothesised) for the Expected Innovative Output but not Actual Innovative Output. As the coefficient was in the hypothesised direct for Actual Innovative Output, my conclusions was that this hypothesis was not supported.

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Decision</th>
<th>Hypothesis</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge-based capabilities</td>
<td></td>
<td>Growth willingness</td>
<td></td>
</tr>
<tr>
<td>H1a</td>
<td>Supported</td>
<td>H7a</td>
<td>Not supported</td>
</tr>
<tr>
<td>H1b</td>
<td>Supported</td>
<td>H7b</td>
<td>Supported</td>
</tr>
<tr>
<td>H2</td>
<td>Supported</td>
<td>H8</td>
<td>Supported</td>
</tr>
<tr>
<td>H3a</td>
<td>Supported</td>
<td>H9</td>
<td>Supported</td>
</tr>
<tr>
<td>H3b</td>
<td>Supported</td>
<td>H10</td>
<td>Not supported</td>
</tr>
<tr>
<td>H3c</td>
<td>Supported</td>
<td>H11a</td>
<td>Reversed</td>
</tr>
<tr>
<td>H4a</td>
<td>Supported</td>
<td>H11b</td>
<td>Not supported</td>
</tr>
<tr>
<td>H4b</td>
<td>Supported</td>
<td>H11c</td>
<td>Not supported</td>
</tr>
<tr>
<td>H4c</td>
<td>Supported</td>
<td>H12</td>
<td>Marginally supported</td>
</tr>
<tr>
<td>H5a</td>
<td>Not supported</td>
<td>H13</td>
<td>Supported</td>
</tr>
<tr>
<td>H5b</td>
<td>Supported</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H5c</td>
<td>Supported</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H6</td>
<td>Supported</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interactions</th>
</tr>
</thead>
<tbody>
<tr>
<td>H14</td>
</tr>
<tr>
<td>H15</td>
</tr>
<tr>
<td>H16</td>
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<td>H17</td>
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<td>H18</td>
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<td>H19</td>
</tr>
<tr>
<td>H20</td>
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<tr>
<td>H21</td>
</tr>
</tbody>
</table>
6 Discussion

I have now presented a large number of tables and briefly described whether or not my hypotheses were supported. But what do my findings really mean and what opportunities do they provide for future research? These two questions are answered in this section. The discussion is presented based on the different dependent variables used and following the order of the absorptive capacity process. That is, I first discuss the Acquisition variables, continue by discussing the Assimilation variables, the Transformation and Exploitation variables before I finish with the Innovative Output variables.

6.1 Knowledge Acquisition

Knowledge Acquisition is an important cog in the absorptive capacity process, as it is at this point where new knowledge is brought into the firm. This new knowledge may be seen as forming the basis for future innovative behaviour and affecting the other knowledge-based capabilities. The results from the regression models explaining how and why firms use their resources towards this end are presented in section 5.4.1. There are three different modes of Knowledge Acquisition – Direct Market Knowledge Acquisition, Indirect Market Knowledge Acquisition, and Technological Knowledge Acquisition. The three are explained to different extents and in diverging magnitudes by the control variables.

Technological Dynamism had an important role for all three Knowledge Acquisition capabilities. This suggests that the more dynamic the external technological regimes and environments of the firms, the more the different mechanisms for acquiring knowledge are used. What is notable about this is that all types of new knowledge acquisition are affected (i.e. direct, indirect, and technological), not only levels of technological knowledge acquisition, which might be the natural assumption. The unexpectedly large impact of Technological Dynamism on Indirect Market Knowledge Acquisition suggests that firms prefer to keep abreast of market changes via informal methods when there is external dynamism, not by speaking directly with customers. This can be interpreted to mean that firms trust their own instincts and abilities to prognosticate the future based on information they receive from other sources rather than the information they get from customers, at least when there are high levels of technological change. This may also sense that customers have
difficulty in concretely expressing their future demand. This observation has been made in other studies, including Christensen and Bower (1996). Relying on existing customer demands may be an issue if substantial time is needed to exploit an opportunity (e.g. Mises, 1966).

Conversely, levels of Market Dynamism did not have any significant impact on any of the acquisition variables. It is a commonly found argument and normative advice, at least in the marketing literature (e.g. Jaworski & Kohli, 1993) that firms should work harder to learn about customer wants when these have a tendency to fluctuate frequently. This does not seem to be the case, at least for this sample of new and primarily small Swedish firms. The finding that technological dynamism is an important predictor of knowledge acquisition provides support for the stream of literature, such as dynamic capabilities, that has an underlying assumption that knowledge is more important in dynamic markets. However, the finding in this present study extends this literature by pointing out that it is the level of technological dynamism that is imperative for new knowledge acquisition, not fluctuations in levels of market dynamism.

The variable Growth Willingness was a significant predictor of Indirect Market Knowledge Acquisition and Technological Knowledge Acquisition, but not Direct Market Knowledge Acquisition. Acquiring knowledge via informal methods and through investments in technology may be seen as more costly than “simply” speaking with customers. For instance, gathering indirect knowledge is done by attending trade fairs or using network contacts while technological knowledge comes from R&D, specialised courses, and specific training. These two types of knowledge require active investments and conscious decisions to engage in this type of activity. Gathering knowledge from customers (cf. Shane, 2000) may be seen as given for firms, regardless of growth aspirations. Not acquiring knowledge from customers will also be noticed by the customers themselves. The relatively high mean level for this variable (11 out of a maximum of 15) may be attributable to this. Any company that has customer contact will, to some extent, gain their knowledge in this way.

Firm size was also an important factor for Technological Knowledge Acquisition. As I recently mentioned, acquiring this type of knowledge may be seen as an expensive activity, regardless of how the knowledge is acquired. Saemundsson (2005) argues that there is tension in new firms between the potential benefits of acquiring new technological knowledge and the costs involved in doing so. For this reason, having a larger critical mass of employees (and the other size benefits that come with increased size) may help with financing the costs of technological knowledge acquisition. Support for this can also be seen from the significant role that VC has on technological knowledge acquisition. For instance, Lee, Lee and Pennings (2001) find a positive
relationship between technological capabilities and financial resources and venture capital in their study of Korean start-ups. Likewise, Lysnkey (2004) find a positive and significant relationship between these variables in Japanese technology start-ups. There is a wealth of research that discusses the importance of other resources for acquiring technological knowledge (e.g. Brush, Greene & Hart, 2001).

As a whole, the three Knowledge Acquisition variables were quite poorly explained by the control variables. The variable that was best explained was Technological Knowledge Acquisition, where the control variables and growth willingness explained a total of 12% of the variance. For Direct Market Knowledge Acquisition only 3% of was variance was explained. However, it should be noted that explaining variance in these variables is not a key consideration in this study. What is obvious is that the variance within these variables can better be explained when one takes into consideration other factors – either internal firm-based factors or external environmental factors. Yli-Renko, Autio and Sapienza (2001) look at knowledge acquisition in a sample of young British high-tech firms. They find positive relationships between knowledge acquisition and a number of factors such as social interaction, customer network ties and the technological distinctiveness of the product offerings. Similarly, Smith, Collins, and Clark (2005) observe that network issues, such as the strength of ties and level of education are strong predictors of knowledge acquisition. Aldrich and Zimmer (1986) point out that networks are imperative for the discovery of new opportunities via information gathering, but also in acquiring vital resources to exploit these. These studies reveal that there are other internal issues that predict knowledge acquisition – with a focus on knowledge from customers – that are not included in this study but may provide increased understanding of how and where new firms go about acquiring their knowledge. There are also a multitude of studies that argue that technological knowledge is primarily acquired via alliances and partnerships with other firms (e.g. Saxenian, 1994). There are studies that examine the role of the combination of external sources and internal factors used in acquiring knowledge (e.g. Lee, Lee & Pennings, 2001; Smith, Collins & Clark, 2005). From an external perspective, notions such as knowledge spillovers (e.g. Nieto & Quevedo, 2005) based on industry and firm clusters, in addition to the power of customers in business relationships that can shed further light into Knowledge Acquisition practices.

6.2 Knowledge Assimilation

The Assimilation variables as dependent variables appear in both the path analysis and the regressions presented in section 2.4.2. The variance explained for both Market Knowledge Assimilation and Technological Knowledge
Assimilation was much greater than for the Acquisition variables. The overall explained variance for Market Assimilation was slightly more than 27% and 31% for Technological Assimilation.

There was little effect of the environmental variables on Market Assimilation. Market Dynamism had a significant negative impact on assimilation where Technological Dynamism had a significant positive effect. However, both of these effects disappeared once other variables were entered. In other words, the external environment seems to have very little impact on the market knowledge assimilation behaviour of the firm. This is not the case for Technological Knowledge Assimilation, where there is an important positive impact of Technological Dynamism. This once again provides support for the idea that technological dynamism forms the basis for firm behaviour within these industries. At the very least, the pace of change of technology is central in the decision to acquire and assimilate knowledge.

There were significant negative effects of age on both of the Assimilation variables. The conclusion is that younger firms are more inclined to discuss their market and technological knowledge than are older firms. My instinctive reaction to this observation was to conclude that this is actually a spurious relationship that more closely reflects the size of the firm; the point being that younger/smaller firms would have a simpler time in engaging in discussions based on the ease of sharing knowledge where there are only a limited number of employees. I based this on the fact that the vast majority of the firms in my sample are both young and small. However, firm size was marginally significant and positively related to Technological Knowledge Assimilation and in the positive direction (although not significant) for Market Knowledge Assimilation. The negative effects of age seem to be more closely related to the fact that new firms must first establish their place within the market and therefore be more attentive to on-going external happenings. Liabilities of newness and vulnerability to external fluctuations may be the biggest threat that new firms face and assimilating knowledge may be one method in overcoming these. It may be the case that individuals in new firms discuss more in order to better grasp and manage the uncertainty of their markets. That is, assimilating the knowledge allows them to improve their understanding of external factors and the relevance/importance of their newly acquired knowledge, and thereby reduce uncertainty. It may also be that new firms prefer to discuss as part of the development of the top management team. For instance, discussing important issues may help with team bonding and dynamics. As the firm becomes older, top management team members may have more established roles and develop a culture of their own. As such, discussion may not be as necessary. Arrow and colleagues (2004) discuss temporal aspects of teams and note that established team member roles and routines develop over time. Chandler, Honig and Wiklund (2005) examine turnover in new venture teams and the functions that
Discussion

change in connection to this. Ensley, Pearson and Pearce (2003) look at the shared leadership and group processes in new venture teams. There is clearly interest in this area, although we still have limited knowledge as to how firm age may affect the actions and functions of top management team members. In addition, at the present time, there are still only a limited number of studies that provide compelling theoretical and empirical explanations for new firms and overcoming liabilities of newness (cf. Delmar & Shane, 2004) even though there are many more so for explaining differences between small versus large firms.

As shown in Figure 5.1 and Table 5.6, Market Assimilation was best predicted by Direct Market Knowledge Acquisition and Indirect Market Knowledge Acquisition. As anticipated in Chapter 2 and shown in Figure 5.1, Technological Knowledge Acquisition did not have a significant effect once the other two Acquisition capabilities were entered into the regression. The theoretical explanation for this is that firms primarily discuss market knowledge acquired via one of two market-related modes as part of Market Assimilation.

In terms of Technological Knowledge Assimilation, the main predictor was Technological Knowledge Acquisition. This falls very much in line with the theoretical predictions made. More unexpectedly, Direct Market Knowledge Acquisition also was significant in explaining this variable. What this intimates is that firms begin to discuss specific customer wants and characteristics in connection with assimilating the knowledge. This may be a reflection of the fact that many of the firms are very young and small and therefore many of the employees may have responsibility for both customer contact and technological aspects. The theoretical explanation was that firms would primarily begin to integrate the different areas of knowledge in the Transformation stage of Absorptive Capacity. The notion that this is an artefact of the types of firms included in the sample is partially supported by the marginally significant negative impact of age on this relationship, but also partially rejected by the marginal positive impact of size on this relationship. Another interpretation is that young firms may be more attuned to discussing technological trends as they may be more sensitive to environmental jolts when compared to older firms (e.g. Buckley, 1997). That is, the same factors that were discussed in connection to Market Knowledge Assimilation may come into place.

Growth willingness had different effects on the two Assimilation variables. For Market Assimilation, there was a positive and statistically significant effect. This was in line with the expectations put forward in Hypothesis 9. Growth willingness did not have an effect on Technological Assimilation though. This might once again be a reflection of the vulnerability of the firm to technological changes. In the case of Market Assimilation, the fact that growth willingness had a positive impact might suggest that firms discuss market changes and
knowledge as a specific source of planning for the future and being able to satisfy customer demands. For technology, discussions may take place as a matter of livelihood and being able to understand what is going on in the marketplace; not particularly as a function of attempting to be innovative. The external technological regimes have been shown to be a major factor in explaining the demise of many start-up firms (Sarkar, Echambadi, Agarwal & Sen, 2006). After re-examining the items capturing Technological Assimilation, one may see that one potential outcome of Assimilation is to have an agenda for where new technological knowledge needs to be acquired.

6.3 Knowledge Transformation

The three constructs that make up Knowledge Transformation (Reviewing Previous Knowledge, Knowledge Synthesis, and Knowledge Combination) were all well explained on the whole. The amount of variance explained ranged from 25% for Reviewing Previous Knowledge and Knowledge Synthesis to almost 42% for Knowledge Combination.

The Assimilation variables were significant predictors for all three of the Transformation capabilities. It supports the model that I present (Figure 2.1) and the theory behind it, as hypothesised. What is more surprising is the prominent role of the Acquisition variables in explaining Transformation. For Reviewing Previous Knowledge and Knowledge Combination, Direct Market Knowledge Acquisition is significant and positive. The same holds true for Knowledge Synthesis, although this relationship is only marginally significant. There are a number of potential explanations for this occurrence. One explanation is that there may be fewer “rules” for what state of knowledge is used in cross-pollination, which Transformation refers to by definition. For instance, as a creative step in the process during Combination, Synthesis, and Reviewing activities, firms may be more prone to bring up newly acquired knowledge that has not yet been assimilated. Non-assimilated new knowledge may be due to the fact that the newly acquired knowledge is more current than that which has been assimilated, it was not considered important enough to be assimilated earlier on, or because some knowledge is likely to “slip through the cracks” of assimilation (i.e. due to lack of time, memory, satisficing, etc.). These explanations may further be reflected by the fact that much new knowledge, especially acquired “orally” such as from having lunch with partners, chats at trade fairs, or during meetings with customers, is stored in the heads of the individuals that acquire this knowledge, not necessarily in more formal ways, such as in binders or databases. As more informally stored knowledge, this newly acquired knowledge may be more easily “brought up” or reactivated (Garud & Nayyar, 1994) during transformation activities. These explanations do not imply that firms neglect assimilation before transformation; the positive
significant effects of both Assimilation capabilities show that most knowledge used in transformation goes through assimilation. Nevertheless, what is apparent from these findings is that acquired knowledge from customers is used directly in transforming knowledge. This is in contrast to Indirect Market Knowledge that did not have any significant effects on any of the Transformation capabilities.

Technological Knowledge Acquisition was only significant for one Transformation variable – Knowledge Synthesis. The potential to use other existing projects and capabilities may very much depend on the most current technological knowledge that the firm possesses. There was also a stronger impact of Technological Assimilation than Market Assimilation for all of the three Transformation variables. This may be interpreted as that the assimilated knowledge that is most important for the creative, transformative behaviour of the firms is technology-related. It appears as though the natural starting point of knowledge transformation is the technological capabilities of the firm. Garud and Nayyar (1994), for instance, argue that the transformative capacity of the firm is dependent on stocks of technology and memory of technological developments. In other words, this finding is perhaps not so surprising.

One explanatory factor in the argument that knowledge may be stored in more or less formal ways is size. Large firms may have a tendency to store this assimilated knowledge in more formal ways than smaller firms such as in written documents or databases. While not central in the literature, I found this argument appealing. In order to substantiate this claim, I looked post hoc at the moderating effect of size on the relationship between the two Assimilation variables and the three Transformation variables. I found statistically significant positive effects of size on the relationship between Market Assimilation and two of the three Transformation variables (Synthesis and Combination). There were not any statistically significant effects on the relationships among Technological Assimilation and Transformation variables.

The role of growth willingness was surprisingly low for all three Transformation variables. Two of the three hypotheses concerning growth willingness did not receive support. Most surprising is the negative and statistically significant effect of growth willingness in explaining Reviewing Previous Knowledge (i.e. a reversal of the growth willingness hypothesis). This implies that growth-oriented firms invest less effort into going through their past stocks of knowledge. Based on the results presented concerning knowledge acquisition practices, it seems as though firms with high levels of growth willingness invest in knowledge acquisition at the global knowledge frontier (via indirect methods and technological investments). Reviewing prior knowledge may not result in what they consider “new enough knowledge” that can help their growth and therefore do not engage in this activity. They therefore do not spend time
reviewing details of past projects. They look forward (e.g. West & Meyer, 1997). This can also be interpreted as that new firms primarily look externally, not internally, for future opportunities. This resonates quite well with Stevenson’s perspective of entrepreneurship (i.e. the pursuit of opportunities regardless of resources currently controlled), where present stocks of knowledge are not as important as perceived external opportunities.

There were also two significant relationships concerning non-hypothesised factors. Venture capital has a positive and significant effect on Reviewing Prior Knowledge. This is surprising considering the relationship between VC and growth willingness and that growth willingness was negatively related to Reviewing Prior Knowledge. The positive effect may be more related to the economics of the creative work; for VC, there may be better perceived potential economic pay-offs from leveraging existing competencies and making use of existing knowledge. Investors may suggest that new firms behave this way and not abandon existing knowledge right away. There may also be a larger number of “checks and balances” for VC-backed firms to attain. These benefits may not be seen by growth-oriented firms that are primarily concerned with new knowledge.

Market Dynamism was negatively related with Knowledge Combination. This suggests that firms operating in task environments that have higher levels of change in customer demands do not actively invest as much in Knowledge Combination. The reason for this is that, at least when customers’ wants and needs are perceived as changing quickly, new firms simply cannot keep up. It may also be the case that it does not make sense to invest in activities in these markets. Firms therefore avoid these situations instead. That is, when market change is high, firms do not bring together their employees and their knowledge in order to discuss these market-related issues. There are some empirical examples where Combination is examined in connection to external uncertainty. Branzei and Vertinsky (2004) did not find a relationship between transformation and dynamism; however, they used a proxy for transformation as the number of patents released and focused more on technological dynamism than market dynamism. Song and Montoya-Weiss (2001) find diverging effects of cross-functional integration in low versus high levels of technological uncertainty. Van den Bosch, Volberda and DeBoer (1999) suggest that combinative behaviour is different depending on in which type of industry the firm is operating.

The negative results of dynamism on combination may also be due to the linear, logical nature of the Knowledge Combination concept. For instance, combining people with different functions or integrating different departments requires planning and organisation. Once firms move away from markets where it is possible to plan ahead and think logically, the ability to engage in these
types of activities becomes more difficult. Therefore, in more dynamic markets where there are higher levels of chaos, firms must think outside of their “linear” behaviour (Ilinitch, D’Aveni & Lewin, 1996). This can be connected to the literature that questions whether planning is possible in an unpredictable world (cf. Grant, 2003). One suggestion is that firms become forced to improvise more (e.g. Hmieleski & Ensley, 2004) or become more flexible in their approaches to combining knowledge (e.g. Moorman & Miner, 1998). For the other Transformation capabilities, there is still the ability to carry out these activities despite external dynamism. However, for Knowledge Combination, it is much more difficult.

### 6.4 Knowledge Exploitation

Exploitation was the most important predictor of Innovative Output, and therefore might be considered the most important of the capabilities. Exploitation also marks the final step of absorptive capacity, where the activities lead to tangible products or service launches. Two of the three hypotheses about the effect of Transformation on Exploitation were supported, where Reviewing Previous Knowledge did not result in any significant changes in Exploitation. As was argued when discussing that higher levels of growth willingness were negatively correlated with Reviewing Prior Knowledge, this activity does not seem to provide any absorptive capacity “value added”. The argument when the hypothesis was laid out was that this transformation activity would lead to more serendipitous bisociation or knowledge retrieval sparks that would lead to something new. There is an inherent tendency in the operationalisation of the Exploitation construct to place an emphasis on newness. The lack of impact from Reviewing Previous Knowledge may once again be based on the age and experience of the firms involved in this sample. The “previous knowledge” that is to be reviewed may not be “old” and lead to new levels of recollection. Instead, the “previous knowledge” may in fact be quite recent and therefore fresh in people’s memories. As such, there is no natural creative spark that comes from Reviewing Previous Knowledge. This, however, does not preclude that there are absolutely no benefits from carrying out this type of activity however.

As was shown in Figure 5.1 and again in Table 5.11, Technological Knowledge Acquisition had a direct effect on Exploitation. Another tech-oriented variable, Technological Dynamism, also had a direct effect on Exploitation. These are both important as they suggest that knowledge and change provide

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7 From a purely definitional perspective, Exploitation and Innovation could be considered tautological. However, the operationalisations of these two sets of variables show clear conceptual differences between the two, where Exploitation can be seen as a precursor to Innovative Output. The empirical results also support that there are differences between these variables.
opportunities for doing new things and also the ideas for how to exploit these. However, this is only the case for technology not market knowledge. Cooper (1986) and Anderson and Tushman (1990) argued that high-growth firms generally operate in dynamic industries, where the dynamism leads to the opening of new opportunities. The empirical results here support that the more dynamism there is, the more the firm is able to exploit its knowledge. The results also support the fact that firms that engage in expensive technological knowledge acquisition generally do see some concrete output from these investments. This may once again be the case that the newness and smallness of the firms denotes that the costly investments made are for specific purpose and therefore provide specific outcomes. Larger firms, perhaps with increased levels of slack resources and greater ability to absorb external shocks, may have more larger-scale flexibility and experimentation as part of R&D.

Growth willingness was only slightly statistically significant in predicting Exploitation. Of all of the capabilities, my expectation was that growth-oriented firms would make specific and substantial efforts into Exploitation as this would have direct pay-offs. I return to this subject in the section on Innovative Output.

There were two significant interaction terms in predicting Knowledge Exploitation. One of them was the moderating impact of growth willingness on the relationship between Direct Market Knowledge Acquisition and Exploitation. This showed that the returns from motivation decreased as direct market knowledge acquisition increased. What this implies is that growth willingness becomes less important in explaining Exploitation as knowledge acquisition increases. The other interaction term concerned the moderating role of Technological Dynamism on the relationship between Technological Knowledge Acquisition and Exploitation. Figure 5.7 shows that Exploitation is highest in dynamic markets and when technological knowledge acquisition is high. In addition, it is when knowledge acquisition is at its highest that the largest differences in Exploitation occur (e.g. based on differing levels of dynamism). This empirical finding provides further support for the argument that knowledge is most important in fast-changing industries (e.g. Grant, 1996a) but more closely pinpoints this to technological knowledge and dynamism.

6.5 Knowledge and innovation

The starting point for the discussion in this section underscores one of the most central of questions in my research – what are the effects of knowledge and capabilities on innovation? As the results from the examination of the direct effects model, the path analysis and the regressions investigating the full model
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generally support each other, I have chosen to treat each of the control and research variables on their own and in the same order as before instead of discussing these analysis by analysis. As such, I shuffle the discussion between different analyses and dependent variables during this section. Nevertheless, it is important to note that the more important of the two dependent variables is Actual Innovative Output. As I discuss in section 4.5.2, Expected Innovative Output can be interpreted as an intentions variable. While it is still important in understanding firm-level differences, it is not the main aspect of my study. To this end, I attempt primarily to discuss the results using that dependent variable.

6.5.1 Knowledge Acquisition

The three knowledge acquisition variables have varying levels of importance in affecting the innovative output of the new firms in this study. The direct effects of Direct Market Knowledge Acquisition on innovation are positive and significant. However, this impact disappears once the other knowledge-based capability variables are entered. In other words, there is no longer any significant effect of this capability on innovation when other firm-level knowledge-based capabilities are taken into consideration. This is not to say that there are no benefits that come from acquiring direct market knowledge. This may break away from the Kirznerian argument where newly acquired knowledge about potential customers is the optimal source of opportunities. However, it does not argue that direct market knowledge acquisition does not have any value. For instance, knowledge received directly from customers may very well be closely related to the market success and adoption of the innovation or for promoting and maintaining existing relationships with customers.

Indirect Market Knowledge Acquisition had a significant effect on both Expected and Actual Innovative Output. This empirical observation shows that the market knowledge acquisition that provide the most gains for innovation comes from dealing with other industry experts and in informal ways. This may relate back to the firm trying to predict the future based on the info they get. In other words, the internal knowledge generation based on perceived trends and insider information seems to be more important for innovation. Other empirical studies such as Fiet (2002) and Cooper, Folta, and Woo (1995) suggest that information search processes take place via individuals other than customers and still provide valuable information. This finding could also mean that customers do not necessarily know or are able to explain what they want; they are more passive recipients of the innovations that firms provide. Hamel and Prahalad (1994) argue that customers notoriously lack foresight (p. 99). Christensen and Bower (1996), in their study of the disk-drive industry, note that the leading firms may lose their market positions by listening too carefully
to customer demands. In any case, it does not seem like the firms in this sample are merely responsive to the demands of customers as the source of innovation. Indeed, given the positive effect of Technological Dynamism on the knowledge acquisition capabilities, this finding may very much be industry-specific.

Technological Knowledge Acquisition is one of the strongest predictors of Expected Innovative Output and had a statistically significant direct effect on Actual Innovative Output (from the direct effects model, e.g. before the other capabilities are entered into the equation). This could signify that the industries are technology-driven, that firms are attempting to create demand or “push” products onto consumers rather than respond to market demands, or that the firms focus primarily on getting more out of their technological sunk costs. As developing a resource base in new ventures requires time and money (Brush, Greene, & Hart, 2001), strategic flexibility and responsiveness may be based on exploiting current technological bases. That is, while new firms engage in the process of finding their niche in the market, success might stem from being better able to exploit opportunities or drive new unproven innovations to market. For example, Raff (2000) finds that firms who show increased levels of flexibility in using their resource base are better able to take advantage of emerging opportunities. The literature dealing with the technological foundation of innovation is bountiful, even if there is less attention paid to new firms. Kelly and Rice (2001; 2002) find that the technological knowledge bases of new firms form the basis of all of the future strategic actions. It is perhaps the sunk costs involved in building and maintaining a technological resource base that really decide if and what the firm can do innovatively. It may also simply be a reflection of the fact that IT firms are predominant in this sample.

One drawback to this argument is that the effect of technological knowledge acquisition is severely reduced for Actual Innovative Output, which is the more important of the dependent variables. In fact, the relationship between technological knowledge acquisition and innovation is not statistically significant. While surprising and in direct challenge to a great deal of literature, this empirical finding suggests that the outcomes of acquiring technological knowledge are not guaranteed to increase innovation. Rather these investments might very well be a crap-shoot. That is, some investments provide immediate returns and dividends while others provide little tangible that can be launched to market. This may also be a time-lagged effect, where the benefits of investments in technology only pay off over the long term, or at least later than one year. What might also be relevant in the case of Actual Innovative Output is that the investments in technological knowledge allow firms to understand and manage the firm in rampant technological dynamism, although not result in concrete innovations. As these are surviving firms, one may not discount this performance outcome.
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Nevertheless, the direct effects tests and regressions using the full model show that Technological Knowledge Acquisition is superior to Direct Market Knowledge Acquisition in explaining innovation. As mentioned previously in this section, this may be seen as challenging the very influential Kirznerian arguments that have been so widely adopted in the entrepreneurship literature (e.g. Shane, 2000; Shane & Venkatamaran, 2000). It also runs against the findings that the majority of small technology firms focus on market not technological knowledge (Berry & Taggart, 1998). While the results do not show unanimous universal support that innovation is a direct product of investments in acquiring technological knowledge, the results do suggest that not taking the acquisition of technological knowledge into account in studies of innovation could lead to biased results. This result also offers an explanation for why there have generally been inconsistent findings in innovation studies (e.g. Wolfe, 1994), namely that there is a complex relationship between market and technological knowledge. This also suggests that future research consider the complex relationship between these two realms of knowledge.

While I have critically assessed the low to moderate direct effects of the acquisition capabilities on innovation, the Zahra and George (2002) model would suggest that there should not be a direct effect at all. Acquired knowledge should be assimilated, transformed and exploited before being incorporated into innovative output. As I showed in the earlier parts of the discussion section concerning the predictions of the other knowledge-based capabilities, knowledge acquisition is important for understanding these. In other words, the theoretical model supports that these acquisition practices are key for innovation in an indirect manner, and therefore any direct impact, however limited, is only a bonus.

Moreover, the direct relationships of the Acquisition variables on innovation seem to be context specific. To be more precise, there are a four moderating variables that change the effects of the Acquisition variables on innovative output. All four of these are statistically significant and provide increased explanatory power over and above the Knowledge Exploitation variable.

Three of the interaction terms are related to Actual Innovative Output. The fact that these are statistically significant despite the fact that the sample size is smaller (due to the longitudinal nature of the data) provides support that they are very important. Lack of statistical power due to having too few cases is a common concern for interactions. Two of these interactions have to do with the moderating role of growth willingness, and in particular its role in moderating the relationship between Direct Market Knowledge Acquisition (Figure 5.10) and Technological Knowledge Acquisition (Figure 5.12) respectively, with Innovative Output. Both of these figures show the returns from motivation on innovation decrease as knowledge acquisition increases.
practices. The overall trend for both types of knowledge acquisition is positive (i.e. the effect on innovative output is positive). However, the two go in different directions once growth willingness is entered into the equation. For instance, the effect of knowledge acquisition on innovative output decreases for highly motivated firms when it comes to technological knowledge acquisition. However, the effect of acquisition increases for firms with low growth aspirations. That is, the higher the level of technological knowledge capabilities, the smaller the gap between highly and lowly motivated firms. The surprising aspect out of this is not the fact that there are such large differences between growth oriented and non-growth oriented firms in innovative output when knowledge acquisition is low; what is unexpected is the minute differences when knowledge acquisition is high. This might simply be the case that highly motivated but not as knowledgeable firms mass exploit their existing competencies in the form of marginally new innovations. However, when firms invest in higher levels of technological knowledge acquisition, the levels of knowledge acquisition become more important than growth orientation. Firms may chose to invest in fewer more high potential innovations than many, low return ones. The work of Christensen (1997) and others (e.g. Leonard-Barton, 1992; Mosakowski, 2002; Cliff, Jennings & Greenwood, 2006) have provided valuable empirical insights that the more knowledgeable incumbent firms become myopic about new trends or potentially blockbuster innovations. This is one plausible alternate explanation.

For Direct Market Knowledge Acquisition, the expected relationship is seen, where the highly motivated and knowledgeable firm is more innovative than the unmotivated knowledgeable firm is. The differences are at their largest when knowledge is at its least. This shows that growth willingness becomes less important for innovation as knowledge acquisition capabilities increase.

The third interaction concerns the interaction effect of Technological Dynamism on the relationship between Technological Knowledge Acquisition and Actual Innovative Output, as displayed in Figure 5.11. As hypothesised, the value for innovation of technological knowledge acquisition is greatest in highly dynamic markets. This shows that the effect of Technological Knowledge Acquisition is greatest in fast-changing technological markets. One fascinating finding is that when knowledge acquisition is lowest, levels of innovative output are higher for lowly dynamic markets. This offers valuable support to the knowledge-based and dynamic capabilities views of the firm (e.g. Eisenhardt & Martin, 2000). For non-dynamic markets, investments in technological knowledge do not appear to pay off in the form of innovation. However, it may be that these investments may help for other types of innovation, such as process innovation and decreasing costs of production. For instance, in stable markets, competitive advantage may better be earned via low
cost or efficiency strategies. For example, Utterback (1994) finds that firms in more stable markets use process innovation as a main tool for competition.

The fourth moderator is the effect of Market Dynamism on the relationship between Direct Market Knowledge Acquisition and Expected Innovative Output. As shown in Figure 5.9, it appears that acquiring knowledge about customers is more important in less dynamic markets than in highly dynamic markets. In fact, the effect of knowledge on innovation in fast-changing customer markets is negative. This is counter to the hypothesis that I put forward, but does make some theoretical sense. In markets where it is possible to predict and understand customer behaviour, increased direct market knowledge acquisition appears to be the key to innovation. In other words, this very much falls in line with Stevenson’s arguments about pursuing external opportunities without regard to internal resources. In addition, Kirzner’s suggestions (although he focuses on the system level, not the firm level) that individuals are alert to new information about market gaps seem to hold true, at least in the context of certain stable and predictable markets. However, when it comes to industries where it is much more difficult to predict customer wants, direct market knowledge becomes less relevant. This, as mentioned earlier, challenges the Kirznerian approach. Part of this disagreement may be due to firms learning more about how instable customer wants are, and therefore more consciously avoiding these. This could be due to risk avoidance strategies of the firms, where the firm wants to avoid taking major risks in markets where there is less certainty to succeed, or also the realisation that firms cannot survive in the long-term by delivering to extremely finicky and temperamental customers. McKelvie and Gustafsson (2007) find that new firms in the software industry have a tendency to avoid launching products when external uncertainty is high. In any case, this finding shows that Direct Market Knowledge Acquisition is important for innovation, but points that this is the case for non-dynamic customer markets only.

These four interactions essentially show that the environment and motivation change the role of the acquired knowledge on innovative output. Theory assuming that knowledge acquisition is paramount in dynamic environments (e.g. Grant, 1996a) receives support from my study. However, this is only for technological knowledge, not direct market knowledge. For direct market knowledge, the opposite appeared to be true, (i.e. that higher levels of knowledge acquisition were not helpful). This may be the case that in very dynamic customer markets, the ability of firms to predict and meet the changes that take place are based more upon the technological abilities of the firms to solve this problems than simply “discovering” external opportunities.
6.5.2 Knowledge Assimilation

There was generally little individual contribution of the Assimilation variables to innovation. In the direct effects model, the Assimilation capabilities only explained more variance than the Transformation variables. There was not a significant relationship from either of the Assimilation variables on Expected or Actual Innovation when the full models were compared. While a large effect was not expected, the lack of significant effect was slightly surprising. For example, Liao, Welsch, and Stoica (2003) find that the largest predictor of market responsiveness was knowledge assimilation. The only other capability included was external knowledge acquisition and the sample was SMEs. Their interpretation of why assimilation was superior was that knowledge acquisition was so costly and that assimilation essentially only costs work time. They find support in Pelham (2000) and Oviatt and McDougall (1994).

Other studies have found performance benefits from assimilating knowledge, such as improved decision-making, accelerated learning, and minimized reinvention (e.g. Chua & Lam, 2005; Liao, Welsch, and Stoica, 2003). What this present study shows is that Assimilation has an inferior effect when compared to other knowledge-based capabilities, not that it is detrimental to innovation. I have attributed this lack of findings to such things as organisational knowledge storage, the “newness” of knowledge, and the formal aspects involved in assimilation. I also discuss these in relation to Knowledge Transformation in the section following. Perhaps the primary value of these capabilities is their indirect effects on the other absorptive capacity components.

6.5.3 Knowledge Transformation

The three Transformation capabilities also show diverging impact on innovative output. The direct effects regressions show that these three provide the least amount of direct impact on innovation of all of the knowledge-based capabilities. There are also non-effects across the board when it comes to testing the Transformation variables on innovation as part of the full model. When some of the outliers are removed, there is actually a statistically significant negative effect of Knowledge Combination on Actual Innovative Output.

The size and age of the firms in this sample may explain the mediocre results for these three variables, and also at least partially explain the non-results for the Assimilation capabilities. Freel (2005), in his study of the innovation processes of small firms (regardless of age) found that Transformation involved integrating knowledge from different departments. Garud and Nayyar (1994) find that such appropriate knowledge is stored and accumulated in robust systems and structures. It is likely that new and small firms can assimilate and transform new knowledge without having elaborate processes for doing so. The
lack of history of the firms may mean little previous knowledge or organizational memory from which to combine acquired knowledge as well (cf. Moorman & Miner, 1998). Additionally, the lack of effects of knowledge assimilation and transformation may be due to knowledge concentration in individuals within the firm. Individuals within the firm are frequently viewed as knowledge repositories (Argote, 1999). In the case of new and small firms, imperative knowledge about technology and the market may be concentrated within the founder who may pursue multiple tasks. While this potentially diverges from previous findings that the internal activities, such as cross-functional teamwork, are important for innovation, new firms often do not have organizational structures that would facilitate such knowledge transformation. It may also be that these activities help the individuals within the firm to be active in innovation decisions, although the direct effects of these activities might not be recognised.

6.5.4 Knowledge Exploitation

Knowledge Exploitation is the most important variable for explaining innovation. The numerous analyses consistently display this fact, supporting the theoretical assertions laid out in Zahra and George (2002) and by me in this study. Knowledge exploitation has been described as the application, harvesting, and incorporation of knowledge, the outcomes of which can be seen as the persistent creation of goods or services (Spender, 1996). Therefore, its role can be seen as the final and definitive step in providing innovations to market. Indeed, when looking at the actual items used to measure this construct, it seems natural that this factor is one of the final concrete steps that lead to innovative output. For instance, the capabilities involved in developing and incorporating new ideas into the operations of the firm are clearly a precursor to innovation (Conway & McGuiness, 1986; Koc & Ceylan, 2007).

6.5.5 Growth Willingness

Growth willingness has a positive and significant direct effect on both Expected and Actual Innovative Output; these relationships were hypothesised. What this shows is that firms that are highly motivated to grow will engage in more innovative behaviour than less motivated firms. In a practical sense, this may be due to growth-oriented firms having a higher propensity to take risks, tolerance of uncertainty, or a “no pain, no gain” attitude. Whatever the causes behind these differences, the evidence clearly points to growth-oriented new firms being more innovative. Other studies of this kind have found correlations between entrepreneurial behaviour and willingness to grow. For instance, Wiklund (1998) found a positive connection between entrepreneurial orientation and attitudes towards growth. Innovativeness is one of the central aspects of the entrepreneurial orientation construct. Brown, Davidsson and
Wiklund (2001) also find that willingness to grow is heavily associated with entrepreneurial management.

There is also a significant moderating impact of growth willingness on the relationship between Direct Market Knowledge Acquisition, Technological Knowledge Acquisition and the two Innovative Output variables. These showed that when knowledge acquisition was low, the differences in innovative output between high and low growth willing firms was quite large. If nothing else, this shows that motivated firms find ways of innovating when they do not have new knowledge to rely upon. They simply do more with less. On the other hand, motivation mattered less once knowledge acquisition was higher. Perhaps this can be connected to two different types of innovation – from firms that work extremely hard despite lesser means and from firms that possess superior knowledge and capabilities. These questions are essential to key entrepreneurship discussions, such as the relationship between resources and entrepreneurial management (Stevenson & Jarillo, 1990; Bradley, Shepherd & Wiklund, 2007), and making use of existing resources (e.g. bricolage; Baker & Nelson, 2005).

6.5.6 Task environment

The role of the external environment is sometimes given prime attention in the literature. However, this has more closely been related to contingency approaches to strategy and behaviour (e.g. Wiklund & Shepherd, 2005). Included in this configuration approach is the stream of research dealing with the importance of knowledge and dynamic capabilities. These areas of research have as one of their starting points in that competitive advantage and role of capabilities are different in markets that are more dynamic. Authors within this tradition argue that continuous innovation is the key to competitive advantage and that superior knowledge-based capabilities promote this innovation. The direct effects model shows that Technological Dynamism is a very important factor in explaining innovation, at least until Knowledge Exploitation is entered into the equation. Market Dynamism does not have any significant direct impact on innovation.

In other words, the findings of this study do not contradict the arguments that have previously been brought forward in the literature concerning the importance of innovation in dynamic markets and function of capabilities in innovating. This study does not look at one of the other central assumptions of this literature, (i.e. that the performance of innovation is greater in dynamic markets; see section 3.7.1). What is clear from this study is that external change per se does not bring about innovation in firms. Rather, the regressions concerning the knowledge-based capabilities show that the external environment encourages the proliferation of the different capabilities. These
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capabilities, in turn, lead to innovation, as displayed in Figure 6.1. The novelty of the finding here is that it is Technological Dynamism that appears to be the driving force behind the capabilities, not Market Dynamism.

Figure 6.1 Relationship between dynamism, capabilities, and innovation

In addition, this study has also established that levels of external dynamism affect the relationship between acquired knowledge and innovation. As was discussed in section 2.5, higher levels of technological dynamism emphasised the importance of technological knowledge acquisition on Actual Innovative Output. The converse was true for Market Dynamism on Direct Market Knowledge Acquisition, i.e. the more dynamic the market, the less important knowledge is for innovation. This provides a more detailed understanding of the true causes of capabilities and innovation.

I chose to measure the task environment using self-report data on the changing nature of customer wants and technology. However, some other studies have relied upon the use of industry codes for controlling for the behaviour and growth of new firms. I critically compare methods for controlling for industry (McKelvie & Chandler, 2007) and note that industry codes do not necessarily represent the actual competitive industry of new firms (i.e. more appropriate codes do not exist, new firms tend to change product offerings, etc.). However, I chose to provide a post hoc control of the task environment based on industry. I entered a binary dummy variable coded for firms in the IT-sector as this sector was home to the majority of the firms in my study. I coded all firms in the IT-sector with a 1 and all others with a 0. I then re-ran all of the regression analyses. There was only one statistically significant result. Firms in the IT-sector tend to display higher levels of Technological Knowledge Acquisition than the other three sectors. Furthermore, the effects of this control on the main dependent variables (i.e. Actual Innovative Output and Expected Innovated Output) were minimal. The entire amount of variance explained was slightly higher, but the Adjusted R² levels, taking into account degrees of freedom, were lower. The fact that there was de facto no change implies that the model I put forward is robust and applicable to firms from different industries, not only to one singular industry.

6.5.7 Ownership

The two ownership variables, Venture capital and Subsidiary, were statistically significant in predicting Expected Innovative Output. Venture capital was
significant and positive and being a subsidiary was marginally significant and positive. The two ownership variables represent more than simply having external owners. VC brings increased expectations and demands for growth and financial return, as well as the capital and potential advice to help achieve this. Subsidiaries are able to build off the resource bases of the parent company, sometimes including existing product offerings and customers.

These two ownership variables did not have any statistically significant effect on Actual Innovative Output however. It appears that the lofty expectations placed on the intended behaviour of the firms were not actually met. Although not hypothesised, I personally expected that there would be differences in innovation based on ownership. The literature is replete with anecdotes about how venture capital-backed firms are able to do so much more than non-VC backed firms. However, as Katila and Shane (2005) and Baker and Nelson (2005) show in their respective studies, more resources are not always better for innovative behaviour. Bradley, Shepherd and Wiklund (2007) find that access to resources is negatively related to entrepreneurial management but positively related to firm growth. The non-results in my study do not show that either one of the approaches is necessarily better however but rather suggest that there is large divergence in the effects between ownership and innovation.

Similar arguments concerning resources and roles are on-going concerning subsidiaries. Birkinshaw’s (e.g. Birkinshaw, Hood & Jonsson, 1998; Birkinshaw, 1997) work provides evidence that there are many important subsidiary initiatives that occur, but that many parent companies cannot or choose not to leverage the individual competencies of their subsidiaries. Other studies within international management show that there are a multitude of roles that subsidiaries can be assigned or adopt themselves (e.g. Gupta & Govindarajan, 1991; Ghoshal & Bartlett, 1990). This heterogeneity in functions is perhaps reflected in this study so that the positive and negative effects of being a subsidiary are cancelled out.

6.5.8 Size and age

The size of the firm had a marginally statistically significant positive effect on actual innovative output. Size was also important in predicting technological knowledge acquisition and technological knowledge assimilation. The notion of size represents more than simply the number of employees that work at the firm; it also represents level of development and access to resources. For instance, Hanks and colleagues (1993) find that 95% of the variance between different stages of development is accounted for by the number of employees and business age. That these factors are more closely related to technological aspects – including innovation – has a large amount of support in the literature.
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The stream of research focusing primarily on SMEs may have some guidance here.

I chose to measure size using the number of employees of the firm. Another operationalisation of size that is commonly used is sales turnover. This type of operationalisation might be especially telling for a new firm as sales turnover implies that the firm has a ready product/service to sell, and that they have overcome the important “hump” of achieving first sales. Schoonhoven, Eisenhardt and Lyman (1990) argue that achieving first sales has a significant impact on growth and survival. As a post hoc test, I chose to replace the measure I used for size (number of employees) with sales turnover from 2004. This data was obtained from the Swedish tax authority. I chose to replace, rather than supplement, the existing size variable due to the very high correlation between these two variables (0.819). Using both simultaneously would have resulted in a high level of multicollinearity. There were three significant differences on the knowledge-based capabilities when using sales instead of number of employees. There were not any different results on innovative output. The first difference was that there is a marginally significant negative effect (p < 0.10) of sales turnover on Knowledge Exploitation. The second was that the effect of sales turnover was stronger in explaining Technological Knowledge Assimilation than when using number of employees. The statistical effect for sales is (p < 0.05) instead of the previous (p< 0.10) level obtained for number of employees. Thirdly, the effect of sales on Indirect Market Knowledge Acquisition is statistically significant (p< 0.01). This implies that sales turnover increases the capabilities of acquiring knowledge via informal methods. These findings open for further discussion of the role of achieving sales in the capabilities of the firm and innovation.

Age did not have any impact on innovation. This is a bit surprising considering Nicholls-Nixon, Cooper, and Woo (2000), among others argue that younger firms might engage in more innovation and experimentation. Schoonhoven, Eisenhardt and Lyman (1990) also argue that new firms are quick to build portfolios of products in order to develop a quick stream of income, among other benefits. One consideration for the lack of observed effects of age is that I measure age as though there would be a linear relationship with innovation. There may be a reason to believe that there is an inverted U-shaped curve to this relationship. This would mean that very young firms are innovative in order to find their “niche” and then quite older firms become more innovative as they have acquired extensive resources, knowledge, and industry contacts. I re-ran the analyses using a squared age term, which would be able to take into account a U-shaped relationship. There were no differences in the effects of age on innovation, or on the differing knowledge-based capabilities. This clearly suggests that the age of the firm has little total effect on the innovative behaviour or output of the firm.
6.6 Summary comments

This next section provides a number of summary comments about the effects of the various knowledge-based capabilities and innovative output. For the most part, these comments combine thoughts that were brought up earlier in the discussion section. Others provide new insights that did not necessarily fit into any one particular of the themes above.

6.6.1 Knowledge-based capabilities

Researchers with different research backgrounds have shown a profound research interest in the development and usage of capabilities. Many of the attempts to explain capabilities have been through an evolutionary lens (Zollo & Winter, 2000). For the most part, the empirical attempts at capturing these have been via longitudinal case studies (e.g. Salvato, 2006; George et al., 2004). In other words, there are still limited generalisable findings based on probability analysis in this area. One exception is McKelvie and Davidsson (2006) who look at access to resources and the development of dynamic capabilities in new firms. The findings brought forward in this dissertation provide greater levels of understanding. For the most part, over 25% of the variance for each capability was explained using the model I put forward in Figure 2.1. While this is satisfactory and offers insights that some capabilities are brought about based on the other activities of the firm, the variance that is not explained remains considerable. The remaining variance might be explained by other variables. Jansen, van den Bosch, and Volberda (2005) discuss a number of these including cultural aspects of the firm. Other factors, such as resource slack and bricolage could be useful factors in explaining the remaining variance.

Nevertheless, as a whole, the analysis that I conducted to ascertain the relationship between the different variables provides ample evidence that there are strong relationships between the capabilities.

Interestingly, the effect of age on the use of the capabilities was minimal. In fact, the only capabilities that seemed to be affected by age were the Assimilation variables. Oddly, age had a negative impact on these. The fact that I chose to study new firms implies that there may be some age effects on capabilities and innovation. Nevertheless, the non-findings presented here bring into question the evolutionary nature of development of capabilities, where some authors have suggested that capabilities develop as a function of time (i.e. the age of the firm). As I recently mentioned, it appears that capabilities develop based on other factors. To note is that I do not necessarily suggest or provide empirical evidence that large, established firms have the same capabilities as new, emerging firms. In fact, many of the evolutionary arguments may indeed hold true, such that the routines or capabilities of the firm become more refined over time, such as they become more effective, efficient, and with improved
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results. In other words, even if a new firm were to report the same capabilities as an older firm, the end result of carrying out the capabilities may be improved with age.

I find that the influential arguments about the role capabilities of firms in dynamic markets (e.g. Eisenhardt & Martin, 2000; Grant, 1996a) appear to be true. For instance, the importance of keeping up with market trends, and emphasis on communication and knowledge transfer, are imperative in dynamic markets. However, what appears to be the case is that there is a greater impact on innovation from technological aspects (i.e. assimilating technological knowledge, using technological knowledge in transformation, getting insights into exploitation via new technological knowledge and change) than market aspects. In other words, this implies that following and heeding customer needs, demands, and fluctuations does not appear to be as important. While this does not counteract the “knowledge is important” arguments from the literature, it does specify that technological knowledge appears to be more important than market knowledge.

6.6.2 Growth willingness

Growth Willingness has a significant effect on both the behaviour of the firm and innovative output. The significant impacts of Growth Willingness are displayed in Figure 6.2. Where the effect of Growth Willingness might be seen as being most important is its direct effect on innovative output. The factor was significant for both Actual and Expected Innovative Output. What this suggests is that firms that want to grow are the ones that innovate. It also suggests that the aspirations of top managers have utmost effect on the decisions and behaviour taken on by the firm. This finding is similar to those put forward in other studies of entrepreneurship (e.g. Wiklund, 1998; Wiklund & Shepherd, 2003; Wiklund, Davidsson, & Delmar, 2003).
The effects of growth willingness, however, are inferior to the effects of the capabilities on each other and on innovation. There were also cases where growth willingness had a negative impact on knowledge acquisition capabilities and their relationship with Exploitation and Innovative Output. Together, these show that the aspirations and intentions of top management of the firm are important for understanding the behaviour and innovative output of new firms, but that knowledge-based capabilities are superior tools in these relationships.

Nevertheless, the role of growth willingness is important for theory as it provides a boundary limitation and clarity into what contexts and why certain firms are able to discover and exploit opportunities while others are not. This suggests that perhaps more active search of opportunities and increased knowledge, rather than passive search, seems to prevail most in these types of firms. While the data presented in this dissertation do not speak directly to this question, the role of growth motivation is shown to affect knowledge acquisition, exploitation, and innovation.

At the most basic level, the fact that there is a significant and positive relationship between growth willingness and many of the capabilities, and with innovative output, shows that intentions matter. Arrow (2000) observes that managers’ motivations and goals are reflected in their strategic decisions and resource allocation practices. Future tests can tease out if growth willingness of the firms more closely reflects a proclivity for risk-taking or that motivated firms simply try harder. Presently, this study clearly shows that it has empirical importance.
6.6.3 Task environment

The control variables had varying effects on both the capabilities and innovative output. The largest effects seem to come from the external environment, and for the most part, Technological Dynamism (see Figure 6.3). The role of the environment in the knowledge-innovation relationship has been extensively discussed in the literature, stemming all the way back to Burns and Stalker (1961). The fundamental notion of many of the theoretical and empirical studies that I cited earlier in the text was that knowledge is more important in more dynamic markets, due to its flexibility and applicability over changing environments. This research supports this in general but provides further empirical evidence of the detail considering the type of knowledge and dynamism involved. Figures 6.3 and 6.4 show the overall impacts of the two types of external dynamism.

The opposing effects of Market and Technological Dynamism provide more clarity into the true relationship between environment, knowledge and innovation. For instance, in Figure 5.7 and Figure 5.11, where the interaction of technological dynamism on the relation between Knowledge Exploitation and Actual Innovative Output respectively is shown, one can clearly see that in more dynamic markets, technological knowledge becomes more important. There was also a direct effect of Technological Dynamism on Exploitation. Conversely, firms in more stable customer markets had better use of direct market knowledge acquisition than when in more dynamic customer markets. As has been discussed before, the implications of these two findings support and clash with existing theory.

![Figure 6.3 Effect of Technological Dynamism on capabilities and innovation](image-url)
6.6.4 Examining the knowledge – innovation relationship

As was discussed already in the Chapter 1, I intend to shed light on the in-depth details of the relationship between knowledge and innovation. What this study displays is that there is a complex relationship among the different knowledge-based capabilities. Attempting to study and capture much of this complexity is not necessarily a new idea, but few have examined the complexity within a united theoretical frame of reference or using more than only a few different knowledge-based capabilities. For the most part, studies have examined one or two of these capabilities with different measures of innovation. Two examples are Lioa, Welsch, and Stoica (2003) who chose to examine knowledge acquisition and knowledge dissemination and Matusik and Heeley (2005) who inspect internal knowledge generation capabilities. The results of the direct effects model that I present are more comparable with these studies and show that, as individual activities, all of the knowledge-based capabilities have positive effects on innovation and can explain a respectable amount of variance of innovation. What this does not do is “unpack” the complexity between the variables however.

In order to achieve increased understanding of the exhaustive details behind these relationships, I look at the effects of the gauntlet of knowledge-based capabilities. I specifically examine nine different capabilities. When the capabilities begin to compete for explanatory power, fascinating details appear. The first is that Knowledge Exploitation is the most significant explanatory factor for innovation. Different types of knowledge acquisition are next in line
in terms of importance. As a whole, the full model that Zahra and George (2002) put forward and that I expand and operationalise, explains almost 50% of the variance in Expected Innovative Output and 26% of the Actual Innovative Output. These results are comparable to other published studies within this field (e.g. Stock, Greis & Fischer, 2001; Hayton & Zahra, 2005; Tsai, 2001). This shows that the model I presented based on Zahra and George (2002) is at least an equivalent match in terms of explaining firm-level innovative output. It also suggests the knowledge and capabilities approaches to innovation have some empirical value. I argued earlier that the use of proxies and outcomes as measures of absorptive capacity misses out on the in-depth actions of the firms.

This is not the entire picture though; in order to understand, and truly examine the relationship, I also look at the effects of the different capabilities in explaining each other. That is, I examine what other factors explain Exploitation (e.g. the most important variable for explaining innovation). The results show that Exploitation is greatly explained by other knowledge-based capabilities, such as two forms of Knowledge Transformation. These two capabilities are, in turn, explained by Assimilation variables, which are in turn explained by Acquisition variables. In fact, only one of the identified knowledge-based capabilities did not provide any innovative value added (e.g. Reviewing Previous Knowledge). The complex relationship among different knowledge activities shows that the simple direct effects relationship that many of the other studies have assumed is not as valuable as the more complex model that is presented here. The nested effects illustrate that basically all of these capabilities provide value in the big picture.

As a whole, the results contribute to the field of inquiry that examines the role of knowledge in new value creation in the firm. This has been a central quest within the field of Entrepreneurship and is growing in importance in other fields as well (cf. Hitt et al., 2001). This study provides further details as to how new flows of knowledge enter the firm and how these are subsequently managed internally to lead to concrete outcomes. This provides insights into the “black box” nature of how new firms create value in the form of innovation, and also considers issues of the task environment. Sirmon, Hitt and Ireland (2007) maintain that there is little theory or empirical evidence that truly explains the complex set of actions behind value creation and including varying environmental effects. I do this, and also do so without trying to evaluate the capabilities of the firms post hoc. This overcomes some of the main criticisms of other capabilities studies (cf. Zahra, Sapienza & Davidsson, 2006). In sum, the key results of this study address crucial issues in many research conversations.
6.7 Future avenues

After all the empirical observations and theoretical interpretations, I now suggest a number of different areas and avenues that can be fruitful to investigate.

6.7.1 Performance

It goes without saying that much research conducted within Business Administration has focused on financial performance as the dependent variable. There are a number of potential reasons for this. However, the one that is probably most compelling is that managers are primarily concerned with the performance of their firm. They are not necessarily interested in theoretical developments, taxonomies, or other “empirical findings” that do not provide them with information about how they can earn increased returns to their firm.

That said, this study is not about financial performance. The dependent variable is innovative output, not sales growth, profitability, return on investment, or even employee growth. There are a number of studies that have looked at the relationship between innovation and performance (e.g. Rosenbusch et al., 2005). The main finding of these studies is that innovation and performance are not synonymous, although there is commonly a positive relationship. Indeed, innovation may be a perilous path for many new firms, as it involves taking on further costs and risks. This is particularly relevant for new ventures that frequently are subject to limited managerial time and resources (Eisenhardt & Schoonhoven, 1990). Although innovation has been connected to new venture growth (Brüderl & Preisendorfer, 2000), further examination of the relationship between innovation and performance is needed (see Li & Atuhene-Gima, 2001).

I speculated in the discussion section that Direct Market Knowledge Acquisition may in fact provide benefits that I did not capture in my study. I particularly noted that increased levels of Direct Market Knowledge Acquisition may improve the performance of innovation once launched. Yli-Renko, Autio, and Sapienza (2001) and others (e.g. Jaworski & Kohli, 1993) do find that higher levels of customer contact and knowledge help with sales and sales growth. In other words, while I by and large argued that other modes of knowledge acquisition (indirect and technological) were superior for innovation, it does not exclude the fact that market knowledge is important. Within the Kirznerian approach to innovation that I was generally critical of, the argument has been that individuals who “discover” profitable opportunities begin to exploit them instantaneously. These individuals are almost guaranteed profit once the opportunity is found. Kirzner actually describes the roles of
discovery and exploitation as the following: “Once this price difference is noticed, once someone knows it, a profit opportunity has been discovered. It is probably of dubious value to separate the discovery of such an opportunity from its exploitation… Entrepreneurship does not consist of grasping a ten-dollar bill which one has already discovered to be resting in one’s hand; it consists in realizing that it is in one’s hand and that it is available for the grasping” (Kirzner, 1973, p. 38, 47). The findings in this dissertation may provide support for the idea that market knowledge helps the successful exploitation aspect of this relationship, but not necessarily the “discovery” aspect.

Furthermore, there is a competing area of research that examines the negative performance aspects of possessing and using knowledge. Many researchers have tried to explain why successful, existing firms are out beat by new firms. Terms such as “incumbent inertia”, “myopia”, and “core rigidities” have been coined to describe this phenomena. Christensen’s work (e.g. Christensen & Bower, 1996) has shown that relying exclusively on market knowledge may lead to missing out on frame-breaking opportunities. Some have argued that the lack of sunk costs and core rigidities are the enabling factors that allow new firms to succeed in innovating. Yet there is little research that examines the transition from when knowledge-based capabilities provide a positive impact to the firm to when they result in negative outcomes.

6.7.2 Evaluation of opportunities

Many firms, just as individuals, may frequently come up with a number of potential business ideas or spot market gaps. However, not all of the firms necessarily make the choice to begin exploiting these potential opportunities. This might be due to things like a lack of funds or that the perceived opportunity was not as fruitful as one might have thought. The choice of dependent variable assumes that the choice of developing or launching a new product is the most important aspect. Growth Willingness is an important predictor of innovative output and I argued that this may reflect increased tolerance of ambiguity or risk-taking. In other words, firms with higher levels of growth willingness are more prone to see “positive” evaluations of opportunities and therefore innovate.

An underlying assumption of this approach is that it is better to innovate than not. From a societal level, Davidsson (2004) argues that all entrepreneurial activity is good. At the firm level, innovation involves resource outlays and increased levels of risk. It may therefore actually be a healthier decision for the firm to not innovate or to wait to invest in one major innovation instead of multiple minor innovations. This may be a case of superior entrepreneurial savvy. Subramamiam and Youndt (2005) in their fascinating study of
intellectual capabilities and innovation investigate the ability of the firm to innovate, not the actual innovative outcome. I recommend that further research examines both the actual output and the potential abilities of the firm to carry out these innovations. By doing so, the decisions to not innovate despite the perceived opportunity may be seized.

In a related sense, the relationship between Expected and Actual Innovative Output may be a source of added insight into the decision making processes of firms. In this study, I have treated these two dependent variables by and large as equal. However, as I discussed in Chapter 4, they are not identical despite the high correlation between them. One empirical observation that I made but have hitherto not discussed is that Expected Innovative Output alone explained 19% of the variance in Actual Innovative Output. Upon further variables being entered into the hierarchical regression, I noted that being a subsidiary had a negative and statistically significant impact on Actual Innovative Output. In addition, size of the firm had a positive effect. Growth willingness had a positive effect as well. For subsidiaries, the final decision for innovation may be left up to people outside of the firm. In other words, even if the subsidiary manager wants to launch a new innovation, managers from higher up in the corporate hierarchy have the final say and therefore may restrict innovation. The effect of size may signal that firms have the stability and resources to carry out as planned without the imminent threat of bankruptcy.

The empirical observation concerning growth willingness warrants further discussion. In addition to the direct effect of growth willingness, there was also a significant interaction effect on the relationship between Expected and Actual Innovative Output. It seems that firms that are highly motivated to grow carry out their intentions as planned regardless of their Expected Innovative Output. However, firms with lower motivation do not engage in as much actual innovation as planned. The difference between expected and actual decreases at higher levels of expected innovation output however. While examining this relationship falls beyond the scope of this dissertation, the intriguing empirical observation shows that more knowledge into the decision criteria involved in making innovate-not innovate decisions may be useful.

6.7.3 Other measures of innovation

This study used a measure of innovation that was based on the number of new products and services that were released or developed by the firm. There is some precedence for employing this type of variable in the literature. This may be because the number of new products constitutes a tangible output that is generally easy to measure and can have direct effects on firm performance. However, the majority of studies within this stream of research have employed different variables to measure innovation, such as R&D spending and number
of patents. I earlier criticised these as being too limited and not valid for some types of firms. I still feel this way, but believe that complementary measures of innovation would have been useful in my study. Other potential measures such as the specific number of innovations released or the number of innovations compared to the main competitors of the firm might have helped. While my measures may be seen as superior for a number of reasons, they are not without their limitations.

The same is true for the definitions of radical and incremental innovation. These two types of innovation are conceptually very different, but in this study, they are treated as empirically similar. This is based on my choice as a researcher to combine the total innovation of the firm, but also the fact that the types of innovation statistically appeared together. This may be due to the fact that they are based on self-report data. For instance, what one firm views as radical does not necessarily mean that others agree that an innovation is in fact radical. Some studies (e.g. Zahra & Nielsen, 2002) make use of MBA students to evaluate magnitude of innovation. One other option is to study at length the webpages of each of the firms in order to evaluate whether the information presented there offers such corroboration for the self-reports. While I do not necessarily advocate either of these methods, I think further ways of differentiating between types of innovation could be useful.

Similarly, other forms of innovation exist and can be studied. When discussing the importance of technological knowledge in lowly dynamic markets, I noted that the lower levels of product/service innovation did not imply that acquiring new knowledge was useless. I instead noted that knowledge may be helpful for process innovation. Process and routine innovation is fundamental in one branch of the dynamic capabilities literature and in other aspects of entrepreneurship and strategic management studies. As such, employing knowledge-based capabilities to help comprehend process innovation and changes to routines is a natural extension.

Studying innovation in the form of market expansion is also a valuable next step. Boter and Holmquist (1996) and Zahra, Ireland and Hitt (2000) have shown that entering new markets is an important tool for growth in new ventures. George and colleagues (2004) and King and Tucci (2002) have also shown that capabilities are useful and applicable in understanding new market entry. Extending research to these domains using the model that I developed is also encouraged for the future.

There is some literature concerning the development and release of innovation as a process. Often referred to as the new product development process, the innovation process covers the basic phases that are involved in getting from point A (the idea behind the development of some product/service concept) to
point B (the commercialisation of the final good/service to be sold) (Allen, 2003; Narayanan, 2001; Urban & Hauser, 1993). In my empirical operationalisation of the innovative output dependent variables, I deliberately asked about the number of releases/launches and the number of new products/services that have begun to be developed. This distinction was made in order to accommodate the beginning and end process aspects of innovation. The two stages were also found to be empirically connected (via Cronbach’s alpha). This dual conceptualisation does not account for all different stages of this process however, and so researchers primarily interested in the process of innovation may find use in examining the role of the different knowledge-based capabilities in the varying steps of the process.

6.7.4 Types of knowledge

During the introduction to the presentation of the knowledge-based view, I mentioned that researchers generally are in agreement that there are different types of knowledge. The two types that are most recurrent in the literature are tacit and explicit knowledge. Explicit was explained as being information or “know what” and easy to transfer to others. Tacit was more experiential, “know how” that is more difficult to communicate or transmit to others. Nonaka and Takeuchi (1995) present a now well-known 2x2 matrix that shows the types of knowledge and the process of transmitting that knowledge to others. Within my study, I have treated knowledge as a generic term without true differentiation between tacit and explicit. However, some of the results that I present may be at least partially based on the type of knowledge involved, including market and technological knowledge. For instance, more tacit knowledge might be more difficult to incorporate into transformation than explicit knowledge. Transferring tacit knowledge between individuals is difficult and as such requires more complicated methods and socialisation (Nonaka & Takeuchi, 1995). Tacit versus explicit types of knowledge may also be connected to whether it is market or technological knowledge. Other studies (e.g. Perez-Luñio, Valle & Wiklund, 2005) show that type of knowledge is important for understanding innovation. They argue that that tacit knowledge is better for radical innovation whereas explicit is better for incremental innovation. In any case, further differentiation between these two types of knowledge is needed.

In a related vein, I argued that the age and size of the firms may have had an effect on how knowledge is stored and used in the firm. In particular, I mentioned that the lack of effects from assimilation and transformation could be due to these factors, including that certain individuals take on more than one function within the firm. Individuals are knowledge repositories and may possess different amounts, types and functions of knowledge. The result is that the organisational memory of the firm may be different depending on the size
and age of the firm (Moorman & Miner, 1998). I noted that my post hoc analysis found a moderating effect of size on the relationship between assimilation and transformation. This provides a potential area of research examining when, where, and how knowledge is stored and utilised within types of firms. These effects may be essential in understanding important issues such as core rigidities and incumbent inertia.

Furthermore, recent empirical evidence as to the source of knowledge may provide additional insights into the type of knowledge that a firm possesses. Smith, Collins and Clark (2005) argue that there is a difference between knowledge acquired from outside sources and knowledge generated internally. The “not invented here” syndrome may be seen as connected to this. Shan, Walker and Kogut (1994) find that innovation in the biotech industry is affected by inter-firm cooperation. One avenue of future research that may be pertinent is to examine these two different types of knowledge acquisition – internal creation and external acquisition. Once again, this may result in further understanding as to why some firms innovate successfully and how some established firms may miss out on potential opportunities despite lack knowledge stocks.

6.7.5 Prior knowledge

This study captures certain firm-level activities and their effect on a tangible output. Arguments of path dependence and prior knowledge of firm development state that the past behaviour of firms greatly affects their present behaviour. Thus, one would argue that the past knowledge-based capabilities, innovation, and other factors would affect the present capabilities and innovative output. There are some potential issues as to causality if for example, the firm has always been innovating, and because of this, developing knowledge-based capabilities. For example, van den Ven and Polley (1992) study the amount of learning that a firm carries out while innovating. This knowledge, in turn, leads to further innovations. Other studies have pointed out that entrepreneurs very much learn while doing (e.g. Politis, 2005) and that this learning can lead to further opportunity discovery or improve exploitation (e.g. Corbett, 2005). Shane (2000) argued that entrepreneurs’ prior knowledge affected their perceived methods and markets to exploit an opportunity. Saemundsson and Dahlstrand (2005) find that the founding opportunity of the firm may constrain the firm’s subsequent growth. Autio, Sapienza, and Almeida (2001) also observe that the earlier temporal pursuit of opportunities may promote future entrepreneurial behaviour. I made a conscious choice to remove the questions related to “learning by doing” from the Technological Knowledge Acquisition construct as they would very much be related to the Exploitation questions as well. I therefore believe that more in-depth study of the mechanisms by which firms use their existing knowledge bases (including the
education and backgrounds of founders and knowledge acquired via innovating) and capabilities to mould and direct their future activities is in great need. I firmly believe that there is an iterative relationship between innovating and later knowledge acquisition activities.

Similarly, the role of knowledge and education of the founder is a recurring theme in the literature on capabilities (e.g. McKelvie & Davidsson, 2006; King & Tucci, 2002). This resonates well within the early absorptive capacity literature (e.g. Cohen & Levinthal, 1990) where there was a heavy emphasis on how starting levels of knowledge affect subsequent levels of new knowledge acquisition, assimilation, and transformation. The logic behind these arguments is quite compelling and can be illustrated by a simple example – someone with a Ph.D. in physical chemistry can much better understand and absorb the latest research in chemistry than someone with a high-school education in the arts. That is, one’s ability to acquire, make sense of and exploit new knowledge is a function of their starting knowledge.

6.7.6 Speed of action

Upon noting the negative effect of Market Dynamism on Knowledge Combination, I argued that the chaotic nature of the external environment may precipitate firms to abandon activities that might be seen as linear, planned, and logical and adopt more fluid, improvisational activities. Other studies have shown that quick action is of more benefit in fast-changing markets (e.g. Baker, Miner & Eeesely, 2003) and that more organic organisational structures are put into place (e.g. Burns & Stalker, 1961). The temporal pace of action is an important issue for exploiting opportunities, due to the elusive nature of windows of opportunity in fast-changing markets and the fact that multiple competitors may be vying for the same opportunity. There is hitherto still a lack of knowledge as to the speed of action of executing knowledge-based capabilities and their effect on the speed of innovation. I believe that insights here would be very valuable from a number of perspectives.

There are a number of extant studies that may be helpful in future research concerning these issues. Heirman and Clarysse (2005) look at the speed of innovation at start-up and Forbes (2005) studies the speed of decision-making in start-up firms. Schoonhoven, Eisenhardt and Lyman (1990) also offer a number of insights into the nature of the technology behind the opportunity and show that the technological complexity of the product slowed down development time, whereas possessing marketing and manufacturing personnel, lower monthly costs, and having competition help speed up launch times. None of these genuinely examine the firm-level knowledge-based activities, thus leaving a valuable gap in the literature.
6.7.7 Context-specific knowledge

How does a firm know that the knowledge it acquired is valuable before it is used? How does a firm know that the knowledge it acquired is pertinent to the question at hand? How can a firm measure how effective it is at transforming knowledge? How does a firm know that an opportunity will result in profit for the firm? These are not simple questions and trying to find answers has killed many a tree during the on-going discussions surrounding the resource-based view and the Kirznerian approach to opportunities. My overall personal perspective on this is that it is not possible to determine the value or accuracy of these things a priori – it implies knowing the unknowable future. In other words, the firm cannot know the quality of the knowledge it has acquired, assimilated, transformed and exploited. Rather, the firm makes any decisions based on its own perceptions of the accuracy and quality of its knowledge and capabilities. The empirical considerations of trying to measure objective “knowledge quality” aspects are extraordinarily complicated if at all possible. More importantly, it is not something that I have endeavoured to do in this research. I do nonetheless acknowledge that these are important questions that have implications for the study of knowledge-based capabilities and innovation. Fiet (2002) provides a valuable self-evaluation of the perceived best sources of knowledge for the entrepreneur. McKeelve, Wiklund and McMullen (2007) also provide a model for an iterative approach of using existing and acquired knowledge in the discovery, evaluation, and exploitation of opportunities. There are therefore some pushes into comprehending these complex issues but they remain, for the very most part, strictly conceptual attempts. However, being able to develop a method to effectively capture the appropriateness and context specific nature of knowledge and capabilities (other than via retrospective speculative studies) remains a valuable but distant area of future research.

6.7.8 Strategy of the firm

Unlocking the complex relationship between knowledge and innovation in the context of the new firm would be aided by including some discussion of the strategy of the firm. In section 3.5.1 I conjecture that some firms may choose to employ a “low returns but high number of innovations” strategy while others may have “one big innovative hit” strategy. I do this in connection with the observation that firms with high levels of growth willingness but low levels of knowledge acquisition have quite high innovation. This is clearly a question of strategic approach to their firm.

At the present time, the only factors included in my study that might be connected to strategy are Growth Willingness and the dependent variable. Motivation to grow and innovation are related to risk-taking, action, and
entrepreneurial behaviour. These can be planned and/or enacted strategy or strategic orientation of the firm, as the literature on Entrepreneurial Orientation clearly points out. In addition, Liao, Welsch, and Stoica (2003) find a significant relationship between SME strategy and responsiveness. The work of McDougall (e.g. McDougall & Robinson, 1990; McDougall et al., 1994) has offered a number of insights into the different strategies that new firms engage in. Miles and Snow (1978) also offer a classification of strategies that are relevant to this study. In particular, the organisational types of Prospectors and Reactors, where firms are the driving force behind industry change or responding laggards respectively, appear to be particularly germane. I think that including effects of strategy when dealing with the knowledge-innovation relationship is a deserving issue for future research, given it is possible to include another large set of variables in a study or if secondary is available that can adequately capture strategy.
7 Conclusions

I began this thesis with two empirical illustrations of new firms operating in dynamic markets. Following my analysis of the cases of HanzOff and Buyonet, I openly wondered how knowledge and knowledge-based capabilities affected innovation in these firms. I noted that what I perceived to be the main issues in the cases were not adequately dealt with in the literature. One major reason for this was that the studies I examined primarily dealt with large, established firms. There was little consideration in this literature of the particular characteristics of new firms, such as the fact that not all new firms want to grow. Another reason was that I felt the empirical literature did not adequately measure some of the main variables or the indirect effects of the capabilities. I also asked how the dynamism of the task environment affected knowledge-based capabilities and innovation. My intention was to examine and evaluate the extent of the relationships among growth willingness, knowledge-based capabilities and innovation in a sample of new firms.

At this stage, it is appropriate to look back and take stock of what has been achieved in my study and what my findings really mean for the different people that might have an interest in this type of research. This chapter is not the traditional “this work has its limitations” bit - I think that I have been quite explicit about my assumptions and the potential limitations of these and of my method. I have also explained how I overcome these limitations and potential weaknesses throughout the text. I also have provided an agenda for future research in connection to my discussion section. I now choose to look towards the future and what others can learn from this study, as opposed to further apologising for actions and decisions I have made in the past.

7.1 Implications for absorptive capacity and knowledge capabilities scholars

As mentioned earlier, there are two main contributions of this study: examining the issues of absorptive capacity and innovation in new firms, and empirically unpacking the relationships among knowledge-based capabilities. Both of these contributions imply implications for scholars interested in these issues.

To begin with, studying new firms constitutes an important extension of the absorptive capacity and capabilities literature as the majority of studies hitherto
have focused on large, established firms. This is, to my knowledge, the first study to look at genuinely new firms. Hayton and Zahra (2005) and Deeds (2001) purport to look at new firms, but their samples were made up of recently IPO’d firms. As such, I argue that the firms they examine have already overcome some of the very important challenges of “newness” and are therefore more homogeneous than most new firms are.

One key characteristic of new firms that I noted may be different relative to established or IPO’d firms is that there may be greater divergence in growth willingness. In my study, I find that the growth willingness of the firm has a significant impact on a number of knowledge-based capabilities and on innovative output. This implies that the growth intentions of the firm may be a causal factor in the development and deployment of firm-level resources, such that firms more interested in growth strategically invest more in the absorptive capacity of the firm. In addition, there is a significant role of technological dynamism on many capabilities. The effect of the environment on capabilities is not always clear in the literature. This means that new firms may deliberately invest in certain capabilities as a way of managing external technological fluctuations that might undermine the effectiveness of the firm. Together, these imply that there is intentionality to the development of knowledge-based capabilities and absorptive capacity in new firms. Explicating both the role of growth willingness and the task environment are novel contributions to the literature.

Furthermore, I found that age, size, and ownership had little impact on knowledge-based capabilities or actual innovative output. This implies that firms do not develop absorptive capacity by merely being older, bigger, or having external owners. This result challenges the arguments that new and young firms do not possess capabilities and that new firms require external capital in order to be innovative. Rather, this study provides further support that the action and behaviour of new firms determine their capabilities and innovation. Discriminating against new firms on the basis of age or size in the study of capabilities and absorptive capacity is not appropriate.

More generally speaking, my study provides empirical support for the role of the dynamic flow perspective of knowledge in new firms. The knowledge-based approach and organisational learning approaches have been common in the fields of Entrepreneurship and Strategic Management over the past few years. However, there is generally a dearth of literature that effectively examines the dynamic flows of knowledge into the firm, and even less that examines new firms. The results of my study show that knowledge and capabilities provide the basis for growth and innovation in new firms. This suggests that capabilities provide flexibility and opportunity for new firms. Studies of established firms have sometimes articulated that capabilities and routines may be restrictive and
actually hinder innovation and change. This does not appear to be the case with new firms.

Turning my attention toward the second main contribution (i.e. unpacking the concepts), I examine knowledge-based capabilities by adopting a framework based on Zahra and George (2002). I first extended their model by including both market and technological knowledge. This extension was most apparent in separating Knowledge Acquisition and Knowledge Assimilation into two components each. I then argued that there was a linear sequence to the entire set of variables, and that new firms in particular would follow this sequence in order to reduce uncertainty and maximise the usefulness of their other capabilities. I then operationalised the entire set of knowledge-based capabilities. During the process of validating the key variables, I discovered that there were further capabilities at play than had earlier been articulated. In particular, I noted that Market Knowledge Acquisition actually consists of Direct Market Knowledge Acquisition and Indirect Market Knowledge Acquisition. I also discovered that Knowledge Transformation was made up of Reviewing Previous Knowledge, Knowledge Synthesis, and Knowledge Combination. These discoveries resonate well with the literature (e.g. Garud & Nayar, 1994), suggesting that they are more than empirical observations. Zahra and George (2002) earlier treated these variables as uni-dimensional constructs. Together, the model that I present of the detailed set of knowledge-based capabilities is an unexpected contribution but nonetheless still valuable to absorptive capacity researchers. This elucidation also implies a group of conceptually different capabilities can exist under a united theoretical rubric. The result of this is a clear and empirically validated set of knowledge-based capabilities upon which others can research or use as a guiding light when structuring studies.

Furthermore, I examine the relationships among these capabilities. The empirical results show a complicated set of relationships that include full and partial mediations. The results do by and large support the pattern of action that was laid out by Zahra and George (2002) in their seminal paper and then extended by me. By examining in greater detail the complexity of the relationships, I provide a more clear view of the direct and indirect effects of capabilities on innovation. There were a few unexpected findings concerning the relationships among knowledge-based capabilities. One example of this is the direct effects of Direct Market Knowledge Acquisition on two Transformation variables. I argue that some of these unexpected findings may be due to the fact that I study new firms.

The direct effects analyses show a different story about the importance of certain capabilities. It is the direct effects approach that most empirical studies on capabilities and absorptive capacity adopt. The implication of my study is
that only examining the direct effects of the capabilities on innovation limits the de facto total effects. There appears to be a deeper well of knowledge to be ascertained by studying the full set of relations and inter-relations among these variables.

As a related implication, many studies have adopted a market or a technology approach to knowledge. That is, they have primarily investigated the relationship using an either/or approach. Within the absorptive capacity literature, some studies have primarily viewed knowledge that is acquired from parent companies or joint ventures. This has, perhaps intentionally, assumed a dependence relationship between firms. One implication of my study is that there is some value in separating the types of knowledge used (i.e. both market and technology) and without regard to the dependence relationships. The different modes of knowledge acquisition (i.e. Customer, Informal, and Technological) had varying direct effects on innovation and on the other capabilities. Understanding the heterogeneity in knowledge acquisition capabilities appears to be valuable.

In addition, the fact that the task environment affects the importance of the relationship knowledge acquisition on the other capabilities (e.g. Knowledge Exploitation) and innovation provides a more detailed account of frequently discussed issues in the literature. My particular finding that Technological Knowledge Acquisition is more important in highly dynamic technological regimes but that Direct Market Knowledge Acquisition is less important in fast-changing markets provides a valuable clarification of the true nature of the relationship between knowledge, the external environment, and innovation. I have yet to see this clarification elsewhere. In fact, the running theme in the literature that I have examined is that more knowledge acquisition is universally better for innovation regardless of the type of dynamism. This provides a more fine-grained view of the role of knowledge-based capabilities and innovation.

### 7.2 Implications for the study of opportunities and innovation

The overarching theme of this research is to understand why some new firms are able to spot or create opportunities and innovate while others are not. This directly addresses the challenges set out in Shane and Venkataraman (2000) and by others. By focusing on the imperative how aspects of Entrepreneurship, this question touches on many of the central discussions taking place in the Entrepreneurship literature and at the most prolific Entrepreneurship conferences. That is, this research provides an explanation for differences in how and why firms discover and exploit opportunities. The most apparent answer to these questions is that firms possessing and using their knowledge-
Conclusions

based capabilities better than others and possessing a serious willingness to grow are more innovative. This finding lies close to Shane’s (2003) notion that opportunity exploitation is a human act; the main differences in opportunity exploitation between people are due to knowledge and motivation. I provide empirical evidence to support that claim and also provide a fine-grained assessment of the modes of knowledge acquisition and management that are most important.

The most relevant observations of this study are related to opportunity exploitation, encapsulated by innovative output. However, the results I present also indirectly contribute to further understanding of how opportunities are discovered or created. Studies of the search processes of individuals can generally be divided into systematic search or serendipitous discovery (cf. Chandler, DeTienne & Lyon, 2003). My research shows that certain activities lead to the spotting of more opportunities. As such, it appears as though frequently and purposefully engaging in these activities helps, and thus provides support for the active search perspective. What it does not show is if the knowledge acquired resulted in serendipitous discovery or not. For example, it is not clear if an opportunity was immediately “discovered” upon knowledge acquisition or if it really only became evident once the new knowledge was transformed and integrated with existing stocks. The magnitude of the effect of growth willingness on two of the knowledge acquisition capabilities and the other knowledge-based capabilities suggests that the search processes of these new firms are conscious. Regardless, the acquisition of knowledge appears to be imperative for the discovery of opportunities. This research subsequently provides further insight into the study of entrepreneurial learning. Lumpkin and Lichtenstein (2005) argue that knowledge and learning are important components of the opportunity recognition processes; this study contributes empirical support for that notion.

7.3 Methodological implications

Finding an appropriate sample to study is never a simple task; this is especially true when hoping to examine genuinely new firms (cf. Davidsson, 2004). As I attempted to communicate in Chapter 3, I met a number of challenges when developing a database of appropriate firms to study. Many of the central hurdles were overcome by purposefully selecting what I felt was a better sample to test the theoretical arguments. In particular, I looked at incorporated firms. Based on the legal requirements in Sweden, I hoped that having only incorporated firms would provide me with access to more serious (as opposed to hobby) firms, would increase my access to secondary data and the financial history of the firms, but also provide me with further knowledge of the contact information for the firm and the chief executive. While this may have helped
me overcome some issues, not all of the pitfalls were eliminated. Some information (address, contact name) was erroneous. Founding dates were also not always correct, and so I chose to rely on self-reported founding year. Chandler and Lyon (2001) put forth that more Entrepreneurship studies should include secondary data. The implication from my study is that a warning flag should be raised. While much of this public information may help, it should not be assumed to be infallible.

A further implication is that there is a large amount of heterogeneity among new firms. At a most basic level, there are large differences in starting positions of firms, in terms of size and resource base. This of course is connected to ownership and intentions of the firm. This observation is nothing new to Entrepreneurship research however and does not truly merit much attention here. One observation that I feel does warrant more discussion is generating a sample based on public data and industry classifications. I chose this method as it was convenient and the Swedish government has been credited as being reliable when classifying firms into appropriate industries. Alternative classification methods would have involved large resource outlays or greater amounts of time than what I felt reasonable. What is potentially a more fascinating observation was the diversity of perceived market and technological dynamism of the firms in what was expected to be a limited number of industries. Indeed, as I have pointed in different forums (McKelvie & Chandler, 2007; McKelvie & Wiklund, 2007), there is a large variance in the perceptions of the environment even within narrowly defined sub-sectors. This heterogeneity, especially when it came to perceived technological dynamism, provided further explanatory power for firm behaviour. While the most simplistic efforts to account for industry differences is to enter dummy variables or only focus on one particular sub-sector, truly trying to capture task environments is necessary to really understand the activities of the firm and their innovative behaviour. The implication is that task environments differ greatly, even among firms in the same industry. But they help explain firm behaviour. Decision-makers appear to make use of their own perceptions of the environment in making decisions. Not controlling for heterogeneity among new firms, including both internal and external issues, leaves a substantial hole in truly comprehending the nature of capabilities and innovation.

One more negative implication was that the response rate was lower than has traditionally been achieved in Swedish studies over the past few years. I took a number of steps to increase this rate, and generally followed the recommendations in the literature, including the work of Dillman (2000). However, when the firms were contacted via telephone to try to find out why they did not respond, a troubling pattern emerged – Swedish firms are growing more negative to surveys. Many researchers, including myself, have perhaps taken respondents in Sweden for granted. The result is that there appear to be
more and more studies taking place, disturbing the same group of firms many times over. This may be a reflection of the “attractiveness” of the industries that I studied. However, the choice I made provided me with what I considered to be a superior and novel theoretically relevant research setting and sample. The implication of this is to be aware of the demands of other researchers – what appears to be an ideal research setting for one researcher may be the same for others. Response rates can be dampened by overuse of the same respondents. One contribution to the lower response rate was that the survey was made up of a large number of questions, which many have decreased the attractiveness of the survey. The implication is that researchers should be more discerning in the surveys they send and the length of the survey. The future of Entrepreneurship research in Sweden might be threatened if firms continue to be inundated with surveys.

Finally, using a longitudinal design to capture capabilities and innovation appears to be fruitful for the study of new firms. This choice of design responds to the demands of other Entrepreneurship researchers (e.g. Low & MacMillan, 1988). Although the regression results of using the Actual Innovative Output variable were less powerful than when using Expected Innovative Output variable, the longitudinal method afforded me a few benefits. Firstly, I was able to overcome some of the methodological limitations inherent in cross-sectional studies, such as causality and issues dealing with common method bias. Secondly, this allowed me to acquire more data concerning the on-going dynamism that is present in new firms, including the temporal outcomes of the capabilities – innovation relationship. For instance, the de facto effects of certain capabilities would not have been observed without the follow-up study. This method was also important in circumventing the potential criticisms of tautology that are present in studies of capabilities. One of the main concerns of using longitudinal studies for new firms is a high level of attrition. This was not a problem for this study. In sum, this study would have further limitations and fewer contributions if a longitudinal approach was not adopted.

7.4 Implications for executives

Providing sound normative advice to executives is (at least indirectly) one of the important litmus tests of most research in business administration. My intention is that this study will not be an exception to this. The most central implication for executives from this study is that firms can purposefully affect their innovative output via their behaviour. This means that innovation is not necessarily an arbitrary activity endowed only to those with a lot of luck, those being at the right place at the right time, those operating in fast-paced markets, those with certain odd personality traits, or only those with bountiful resource
bases. In the table below, I try to summarise some of the most important concrete actions that firms can engage in that will help innovation.

<table>
<thead>
<tr>
<th>Actions</th>
<th>Specific activities</th>
</tr>
</thead>
</table>
| **Acquire knowledge about technology and markets**     | - Make sure the most relevant newspapers and industry journals are available at the firm  
- Allow employees to surf the Internet for pertinent information  
- Provide employees the time and freedom to discuss with other people within the industry, such as at lunch or at more formal arenas as conferences or trade fairs  
- Keep contact with knowledgeable technological institutions and specialists |
| **Spread knowledge throughout the firm**               | - Provide a place for informal chats, such as at a communal coffee machine or space for “hallway talk”  
- Create an open culture where individuals do not feel as though they should hold back on important information  
- Communicate trends with all employees. This increases understanding of main issues the firm is facing, may reduce friction, and promotes a united effort towards the common goals of the firm  
- This is especially important for very young firms as misjudging an external jolt may have dire consequences for the firm |
| **Encourage the integration of people with different functional backgrounds** | - Cross-pollinate the knowledge of individuals from different functional areas, who have different backgrounds, or who work with different tasks  
- Provide space and opportunity for more informal meetings between these people  
- Brief written “update” memos may also work in communicating with others  
- Have social events where employees are strongly encouraged to mingle with others they normally do not work with |
| **Spend time on generating new ideas**                  | - Focus on ideas as to how to expand the existing technological capabilities of the firm, how to make changes to the existing customer offerings, potential new products/services, and how to expand upon existing projects of the firm  
- Can be achieved by such things as brainstorming sessions and playing “what if” or “why not” games  
- Use input from others within the firm |
While many of the activities mentioned above may be difficult and time-consuming, they all appear to be helpful in the final outcome of innovation. If nothing else, the final point about developing creative or novel ideas for innovations has the most significant impact on the innovative output of the firm. However, much of the input of this capability comes from the outcomes of the other actions, so only focusing on this one capability may not be as worthwhile.

One other implication is the role of intentions in the carrying out of the activities and in innovation. There is clear evidence that growth willingness has a significant impact on the behaviour of the firm and on innovation. This suggests that firms who indeed want to grow will engage in certain activities in order to achieve their growth intentions. The implication for executives is that desire means a lot, although perhaps less than knowledge. Truly wanting to grow the firm will increase the odds that the firm will find a way to innovate. This suggests that executives should:

- Decide if growth and innovation is the best way forward for the firm. Make sure that all others within the firm can understand the intentions of top management
- Share the specific goals and visions of the firm with both internal and external stakeholders. This helps create a corporate culture and common aim that is conducive for innovation

The main caveat that executives should take into consideration is that I do not examine the financial performance outcomes of the actions or the success of the new products or services that are released to market. What this means, bluntly, is that the behaviours that lead to innovation may not necessarily lead to improved profit, return on investment or sales growth. Engaging in innovation can be a risky endeavour and may be at the expense of serving and improving the relationships with existing customers.

7.5 Implications for media scholars

Research on the media sector is mounting, perhaps due to the exponential growth and influence of media firms on our everyday lives. Companies like Youtube, Metro, and Skype fundamentally affect the activities that we carry out on a daily basis. They have also created new industry segments and garnered massive attention in the news. More traditional media sectors, such as publishing and printing, have been in a stage of transformation as new technologies come to the fore and alternative solutions appear. Innovation as a means of competing has long been central theme in media studies (e.g. Picard,
However, the empirical evidence of the activities that form the basis of this innovation has been scarce, especially when it comes to new firms. In fact, the majority of studies that could potentially be considered as part of this research stream have been more focused on established majors, such as Bertelsmann, Time-Warner, BBC, and Microsoft and have frequently been in the form of case studies.

This study is one of the very few that has explicitly looked at new firms in the media sector (cf. Hang & van Weezel, 2007). One main implication of my study is that media scholars now have a better understanding of the specific dynamics and actions of new, growing firms. This provides needed insight into the particulars of how and why new media firms are able to innovate and change, the result of which is that we have more understanding of the activities behind how young media firms challenge large, incumbent firms. This is obviously related to how young media firms adapt to external market and technological fluctuations but also cause market change for others. While the development of new media firms has been a driving force for industry transformations over the past decade, specifically examining new and young media firms has not been prioritised. I feel media researchers now have more concrete evidence on how this goes about, despite the fact that start-up rates vary among industry sub-sectors.

In addition, I used a rather broad definition of media, and thus included both "new media", such as IT and telecom, and more traditional media. The results show that there are a number of generalisable “best innovative practices” relevant for firms from a variety of industries. Indeed, only technological knowledge acquisition seemed to be primarily pertinent for one industry sub-sector (IT). The dependent variable used (innovative output based on the number of innovations released or developed) likewise overcomes a potential limitation of using a variable (such as creative content innovation) that might only reflect the output of certain industries. This study thus moves beyond the limitations of many media studies that only examine one narrowly defined industry sub-sector, and subsequently employ small samples. My research therefore provides generalisable knowledge for firms in a number of industries, which many other studies do not.

There is still a need for more concrete discussion of definitions of innovation within Media Management research. In particular, there should be greater distinction between types of new innovations (e.g. a new product), new media (e.g. Internet), and media firms. Industry convergence has blurred some of these differences. Picard (2005b) discusses types of innovation in media products.
7.6 Final thoughts

Innovation, opportunities and knowledge are important concepts used for understanding new value creation at the firm and societal levels. Policy makers are attracted by increased employment, tax revenues from increased levels of sales, and the spin-off effects of success on other nascent entrepreneurs and the entrepreneurial behaviours of existing companies. Entrepreneurs, very generally, are motivated by the potential of financial pay-offs and the attractiveness of media recognition and societal fame. Academics are becoming more and more attracted by the novelty of the field of entrepreneurship and the uncertainty involved in the behaviour of individuals and firms in the discovery and exploitation of opportunities.

I feel that this dissertation provides needed insights into the antecedents, causes, and environmental conditions of new firm innovation. In doing so, the research provides new knowledge that benefits academics and practitioners alike.
References


References


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Jönköping International Business School


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Appendix

Below is a list of the industries included in the study.

<table>
<thead>
<tr>
<th>Industry number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>22110</td>
<td>Book publishing</td>
</tr>
<tr>
<td>22121</td>
<td>Daily newspaper publishing</td>
</tr>
<tr>
<td>22122</td>
<td>Newspaper advertisement publishing</td>
</tr>
<tr>
<td>22130</td>
<td>Publishing of journals/periodicals</td>
</tr>
<tr>
<td>22140</td>
<td>Sound recording publishing</td>
</tr>
<tr>
<td>22150</td>
<td>Other publication operation</td>
</tr>
<tr>
<td>22210</td>
<td>Printing of dailies</td>
</tr>
<tr>
<td>22221</td>
<td>Printing of journals/periodicals</td>
</tr>
<tr>
<td>22222</td>
<td>Printing of books and other printing</td>
</tr>
<tr>
<td>22230</td>
<td>Book binding and printed matter handling</td>
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<tr>
<td>22240</td>
<td>Setting and other pre-press activities</td>
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<tr>
<td>22250</td>
<td>Other graphic production</td>
</tr>
<tr>
<td>22310</td>
<td>Reproduction of sound recordings</td>
</tr>
<tr>
<td>22320</td>
<td>Reproduction of video recordings</td>
</tr>
<tr>
<td>22330</td>
<td>Reproduction of computer media</td>
</tr>
<tr>
<td>24650</td>
<td>Manufacturing of recording material</td>
</tr>
<tr>
<td>30010</td>
<td>Manufacturing of electronic office equipment</td>
</tr>
<tr>
<td>30020</td>
<td>Manufacturing of computers and other information processing instruments</td>
</tr>
<tr>
<td>32100</td>
<td>Electronic components</td>
</tr>
<tr>
<td>32200</td>
<td>Manufacturing of radio and TV senders</td>
</tr>
<tr>
<td>32300</td>
<td>Manufacturing of radio and TV receivers, sound/video recording or reproducing apparatus</td>
</tr>
<tr>
<td>64201</td>
<td>Network operation</td>
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<tr>
<td>64202</td>
<td>Radio and TV broadcasting</td>
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<td>64203</td>
<td>Cable TV operation</td>
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<td>72100</td>
<td>Hardware consultancy</td>
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<td>Computer consultancy</td>
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<td>Software production</td>
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<td>Data processing</td>
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<td>Database operations</td>
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<tr>
<td>72500</td>
<td>Support and reparation of data processing equipment</td>
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<td>72600</td>
<td>Other computed related operation</td>
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<td>74841</td>
<td>Graphic design and service</td>
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<tr>
<td>92110</td>
<td>Film and video reproduction</td>
</tr>
<tr>
<td>92200</td>
<td>Radio and TV operation</td>
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</tbody>
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